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NATURAL SCIENCE

GRADE 9 LESSON PLANS 2019



Together, Moving Gauteng City Region Forward

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FOREWORD

Dear Natural Sciences teachers,

Welcome to the GDE Natural Sciences Lesson Plan Development Program. These lesson plans were designed as per the CAPS document, and covers all strands in Natural Sciences. Each lesson plan is based on a 30-minute time frame and where practical activities are necessary for concept development the lesson plan will extend over more periods. The lesson plans come with:

- Images and videos for easy access to content and support material.
- Informal activities for learners to engage with, based on the content covered for that lesson.

It is of importance to note that each lesson plan is developed at a basic level to serve as a generic structure that can be built upon according to context and resource availability. Reference has been made to the Sasol Inzalo learner books as these were made available to schools in either hard copy or as a soft copy that could be downloaded free of charge from the web. All lesson plans allow for supplementary resources to be used e.g. textbooks, developed content manuals etc.

It is off importance to remember that much of the work done in future grades has to be firmly developed in the senior phase, with a sound foundation in Natural Sciences, specialist subjects like Life Sciences and Physics will be able to flourish in the FET band.

Please take note that Natural Sciences is a subject that needs to be taught in an investigative and exploratory manner for various scientific phenomena to be understood. This will be the basis for future development in STEM (Science; Technology; Engineering and Maths) subjects. Where necessary the principle of "Science on a shoe string" must be applied. Resources must be used with care and respect, such that it can be optimized for each lesson and for years to follow.

We hope that the lesson plan resource being made available will be of benefit to you and that its implementation will benefit your learners extensively. We envisage that the lesson plans provided will be of great assistance to you, the teacher and that all efforts will made to enhance the quality of teaching and learning. It must also be mentioned that the developed lesson plans will greatly reduce the administrative workload that teachers are faced with on a daily basis. However, these lesson plans must be engaged with prior to the lesson being delivered for its true potential and impact to be determined.

GDE Natural Sciences Team

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The Importance of Lesson Planning

Lesson planning is the most essential element of being an effective and resourceful teacher. The lesson planning process has to consider the learner; the school or classroom context and whether the essence of the content found within the curriculum can be addressed effectively. Integral to this process is the pedagogical knowledge the teacher possesses and how it will be used to elicit the content that needs to be taught. The time allocated to the subject must be effectively utilized and optimized such that a suitable learning environment can be created for the learner to engage with the learning process. It should be an experience that would articulate the content in a manner that the learner will be able to imbibe and reflect its worth and value in context of the real world. Each lesson provides an opportunity for the teacher to reflect and improve and scaffold the content for the next lesson. Lesson planning proposes and intention for the lesson, while preparation emphasizes the execution of the lesson plan.

Why plan?

Lesson planning is a vital component of the teaching-learning process. Proper classroom planning will keep teachers organized and on track while teaching, thus allowing them to teach more, help students reach objectives more easily and manage less. The better prepared the teacher is, the more likely she/he will be able to handle whatever unexpectedly happens in the lesson.

Lesson planning:

- provides a coherent framework for smooth efficient teaching.
- helps the teacher to be more organized.
- gives a sense of direction in relation to the syllabus.
- helps the teacher to be more confident when delivering the lesson.
- provides a useful basis for future planning.
- helps the teacher to plan lessons which cater for different students.
- Is a proof that the teacher has taken a considerable amount of effort in his/her teaching.

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Decisions involved in planning lessons:

Planning is imagining the lesson before it happens. This involves prediction, anticipation, sequencing, organizing and simplifying. When teachers plan a lesson, they have to make different types of decisions which are related to the following items:

- the aims to be achieved;
- the content to be taught;
- the group to be taught: their background, previous knowledge, age, interests, etc.
- the lessons in the book to be included or skipped;
- the tasks to be presented;
- the resources needed, etc.

The decisions and final results depend on the teaching situation, the learners level, needs, interests and the teacher's understanding of how learners learn best, the time and resources available.

Hints for effective lesson planning:

- When planning, think about your students and your teaching context first.
- Prepare more than you may need: It is advisable to have an easily presented, light "reserve" activity ready in case of extra time. Similarly, it is important to think in advance which component(s) of the lesson may be skipped. if you find yourself with too little time to do everything you have planned.
- Keep an eye on your time. Include timing in the plan itself. The smooth running of your lesson depends to some extent on proper timing.
- Think about transitions (from speaking to writing or from a slow task to a more active one).
- Include variety if things are not working the way you have planned.
- Pull the class together at the beginning and at the end.
- End your lessons on a positive note.

Planning enables you to think about your teaching in a systematic way before you enter the classroom. The outcome of your planning is a coherent framework which contains a logical sequence of tasks to prepare the field for more effective teaching and learning.

Plans only express your intentions. Plans are projects which need to be implemented in a real classroom with real students. Many things may happen which you had not anticipated. In the end you need to adapt your plans in order to respond to your pupils´ actual needs. It is important to bear in mind Jim Scrivener's words:

"Prepare thoroughly. But in class, teach the learners not the plan."

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BIBLIOGRAPHY

- Moon, J. (2005) Children Learning English. Macmillan.
- Scrivener, J. (2011) Learning Teaching. Macmillan
- Ur, P. (1996) A Course in Language Teaching. Cambridge: CUP

Use of the developed lesson plans

The developed lesson plans were designed with the intention of providing teachers with an exemplar that could be used as is or customized to suite the context of each individual class situation. As is the case in most instances, when it comes to lesson plan development, it is very difficult to establish a plan that will satisfy everyone and every situation and context, thus the lesson plans provided here are merely a base document that can be contextualized as per each teachers own liking, as lesson plans are a personal document that also expresses the teachers own creativity and professionalism.

Lesson plans were developed for all strands, namely:

- Life & Living
- Matter & Material
- Energy & Change
- Planet Earth & Beyond

Each lesson plan was developed according to the notional times as prescribed within the CAPS document, that is 30 minute periods with six periods a week for a 5-day cycle. In some instances, to cater for practical activities the lesson plan will be indicated as components and not as one lesson plan.

The lesson plans are accompanied with informal class activities to assist in reinforcing the content and concepts expressed in the lesson. The developed lesson plans also make use of PowerPoint presentations, videos and other ICT related resources to help facilitate the learning process in the digital age, these are optional and can be used as is or the teacher can contextualize it according to resources and infrastructure available at school.

We envisage that the lesson plans provided will be of great assistance to you, the teacher and that all efforts will made to enhance the quality of teaching and learning. It must also be mentioned that the developed lesson plans will greatly reduce the administrative workload that teachers are faced with on a daily basis. However, these lesson plans must be engaged with prior to the lesson being delivered for its true potential and impact to be determined.

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Acknowledgement

The following colleagues from the various district offices within Gauteng played an integral role in the development of the lesson plans being presented. Their unwavering dedication and high degree of professionalism and discipline is greatly appreciated and acknowledged.

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CONTENTS

GRADE 9

LIFE AND LIVING 1

- CELLS AS THE BASIC UNITS OF LIFE
- SYSTEMS IN THE HUMAN BODY
- HUMAN REPRODUCTION
- CIRCULATORY & RESPIRATORY SYSTEMS
- DIGESTIVE SYSTEM

MATTER AND MATERIAL 169

- COMPOUNDS
- CHEMICAL REACTIONS
- REACTIONS OF METALS WITH OXYGEN
- REACTIONS OF NON-METALS WITH OXYGEN
- ACIDS AND BASES, AND pH VALUE
- REACTIONS OF ACIDS WITH BASES PART I
- REACTIONS OF ACIDS WITH BASES PART II
- REACTIONS OF ACIDS WITH BASES PART III
- REACTIONS OF ACIDS WITH METALS

ENERGY AND CHANGE 325

- FORCES
- ELECTRIC CELLS AS ENERGY SYSTEMS
- RESISTANCE
- SERIES & PARALLEL CIRCUITS
- SAFETY WITH ELECTRICITY
- ENERGY & THE NATIONAL ELECTRICITY GRID
- COST OF ELECTRICAL POWER

PLANET EARTH AND BEYOND 565

- THE EARTH AS A SYSTEM
- LITHOSPHERE
- MINING OF MINERAL RESOURCES
- ATMOSPHERE
- BIRTH, LIFE & DEATH OF STARS

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NATURAL SCIENCES: LESSON PLAN 1 **GRADE 9**
PERIOD/DURATION: 30 MINUTES **STRAND: LIFE & LIVING**
CAPS SENIOR PHASE **TERM 1**

DURATION: Week One Lesson One **TOPIC:** Cells as the basic units of life **SUBTOPIC:** Cell structure	**OBJECTIVES: LEARNERS MUST BE ABLE TO:** • **Draw, label and describe** the structure of plant and animal cells
TERMINOLOGY	Plant cell, Animal cell, organelles, cell wall, cell membrane, nucleus, mitochondrion, chloroplast, vacuole and cytoplasm.
SPECIFIC AIMS	1. DOING SCIENCE ✓ 2. KNOWING THE SUBJECT CONTENT & MAKING CONNECTIONS ✓ 3. UNDERSTANDING THE USES OF SCIENCES & INDIGENOUS KNOWLEDGE

PROCESS SKILLS

Accessing & recalling Information	✓	Identifying problems & issues		Doing Investigations	
Observing	✓	Raising Questions		Recording Information	✓
Comparing	✓	Predicting	✓	Interpreting Information	✓
Measuring		Hypothesizing	✓	Communicating	✓
Sorting & Classifying		Planning Investigations			

CONTENT AND CONTEXT	TEACHING & LEARNING ACTIVITIES	RESOURCES
Cell as a basic unit of life.	1. Teacher introduces the lesson through baseline assessment: • What makes living organisms different from non-living components? • How can we differentiate between plants and animals? • Which common characteristics do both plants and animals have? • What do you understand by the word cell? 2. Teacher explains the concept cell, as the basic unit of life 3. Both plants and animals are made up of cells. 4. Cells differ in size and shape. 5. Teacher displays Charts showing both plant and animal cells, discuss different parts and their functions. 6. Teacher distributes learner material that contains information about organelles of a cell and their functions. 7. Teacher instructs the learners to watch a video clip, based on the structure of plant and animal cells.	Worksheets Video Clips Data Projector Laptop Chart paper Chalkboard or whiteboard Textbooks PowerPoint Internet Siyavula (Sasol Inzalo), Pg.24-42 CAPS Subject Policy.

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	 Introduction to Cells.mp4	
ASSESSMENT	Group work, presentations, worksheets and Observation from video clips.	
TEACHER REFLECTION	**Activity 1**: Learners tabulate the differences between plant and animal cells. **Activity 2:** Learners do activity 2 on the next page.	

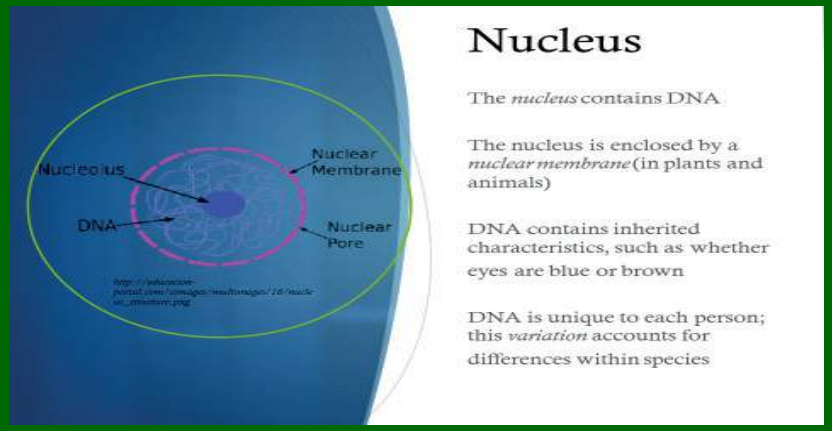
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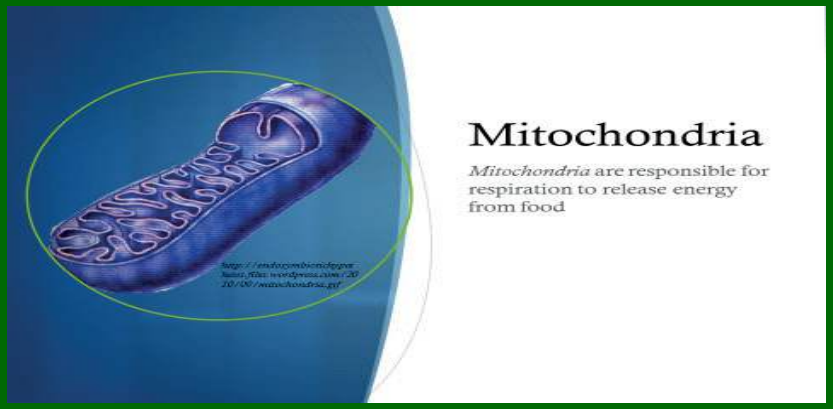
NATURAL SCIENCES: LESSON PLAN 1
PERIOD/DURATION: 30 MINUTES
CAPS SENIOR PHASE
LEARNER RESOURCE MATERIAL

GRADE 9
STRAND: LIFE & LIVING
TERM 1

a)



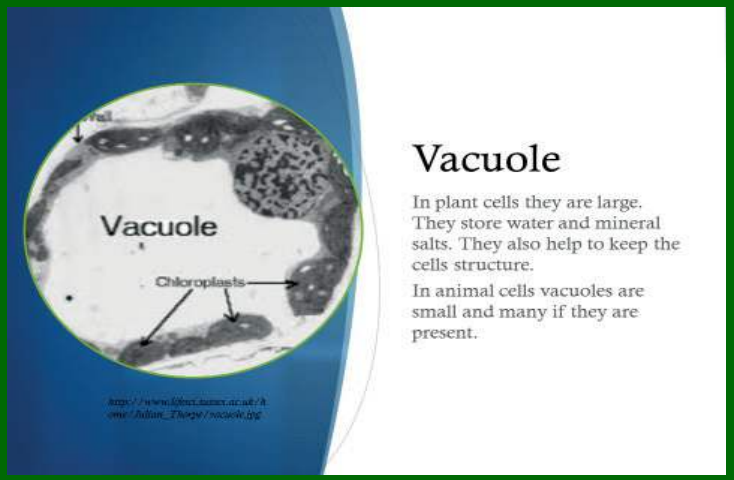
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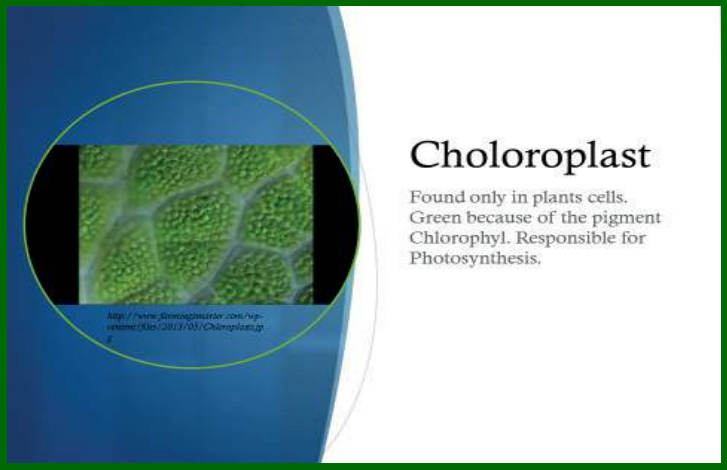
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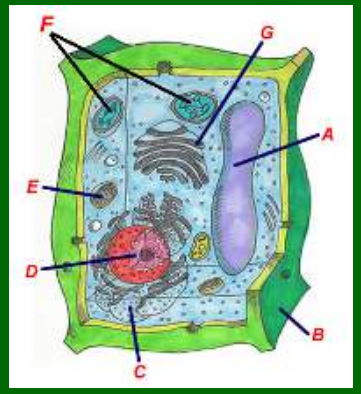


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ACTIVITY 2

1. Identify the cells represented below.





A) _____ B) _____

2. Draw a sketch of the following and state their functions next to it.

a) Nucleus

_ _____
_____
_____
_____
_____

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b) Mitochondria



c) Chloroplast



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MEMORANDUM

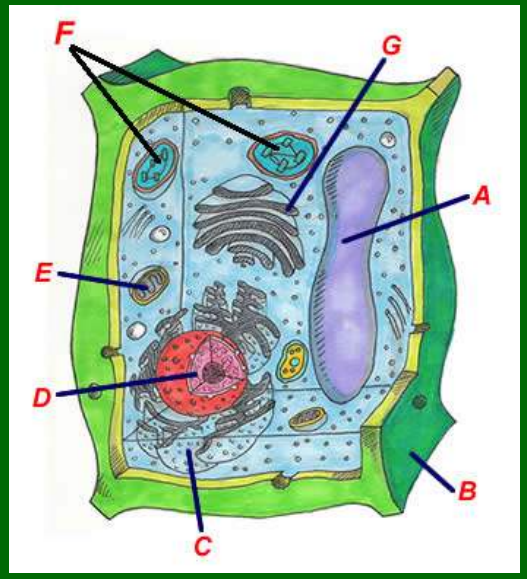
ACTIVITY 1

Characteristic	Animal cell	Plant cell
Shape	Have an irregular shape.	Have a rigid, regular shape.
Cell wall	Do not have a cell wall, only a cell membrane.	Have both a cell membrane and a cell wall.
Vacuoles	Have small vacuoles, which are often temporary or absent.	Have large vacuoles.
Chloroplasts	Do not have chloroplasts.	Have chloroplasts to photosynthesise.

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ACTIVITY 2

1. Identify the cells represented below.



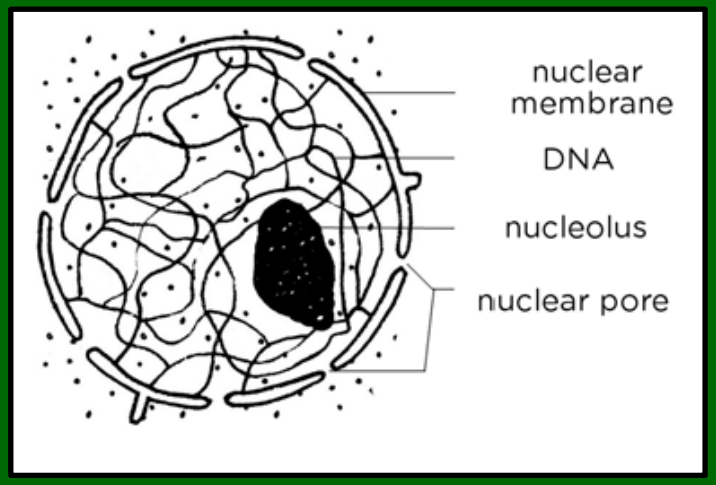


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A) Plant Cell B) Animal Cell

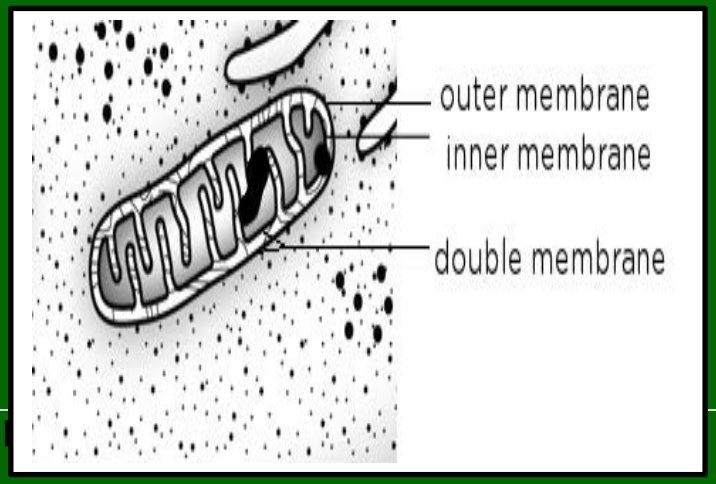
2. Draw a sketch of the following and state their functions next to it.

a) Nucleus



- The Nucleus contains DNA (hereditary material) of the cell.
- Controls the cell's activity.

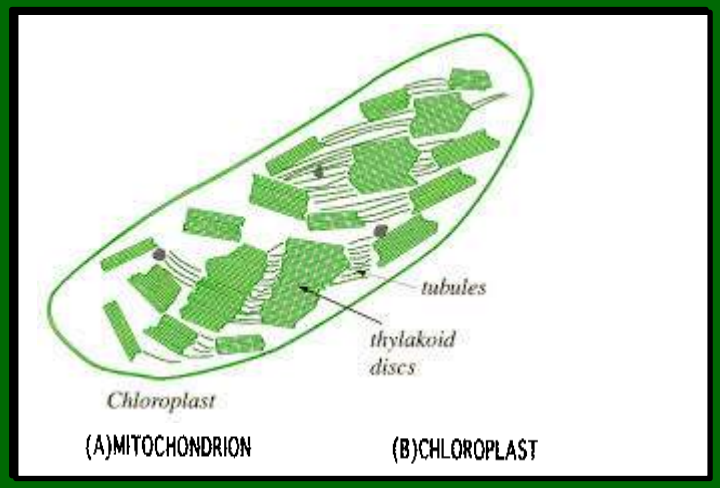
b) Mitochondria



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- Release energy from food for the cell

c) Chloroplast



- Contains the green pigment called chlorophyll, which is responsible for photosynthesis.

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NATURAL SCIENCES: LESSON PLAN 2
PERIOD/DURATION: 30 MINUTES
CAPS SENIOR PHASE

GRADE 9
STRAND: LIFE & LIVING
TERM 1

DURATION: Week One Lesson Two	**OBJECTIVES: LEARNERS MUST BE ABLE TO:**
TOPIC: Cells as the basic units of life	• **Draw, label and describe** the structure of plant and animal cells with reference to vacuoles; mitochondria; nucleus and chloroplast.
SUBTOPIC: Cell structure	

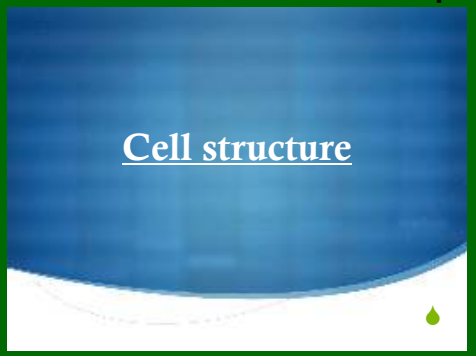
Terminology	Plant cell, Animal cell, organelles, cell wall, cell membrane, vacuole, nucleus, mitochondria, and chloroplast.	
SPECIFIC AIMS	**1. DOING SCIENCE**	✓
	2. KNOWING THE SUBJECT CONTENT & MAKING CONNECTIONS	✓
	3. UNDERSTANDING THE USES OF SCIENCES & INDIGENOUS KNOWLEDGE	

PROCESS SKILLS

Accessing & recalling Information	✓	**Identifying problems & issues**		**Doing Investigations**	
Observing	✓	**Raising Questions**		**Recording Information**	✓
Comparing	✓	**Predicting**	✓	**Interpreting Information**	✓
Measuring		**Hypothesizing**	✓	**Communicating**	✓
Sorting & Classifying		**Planning Investigations**			

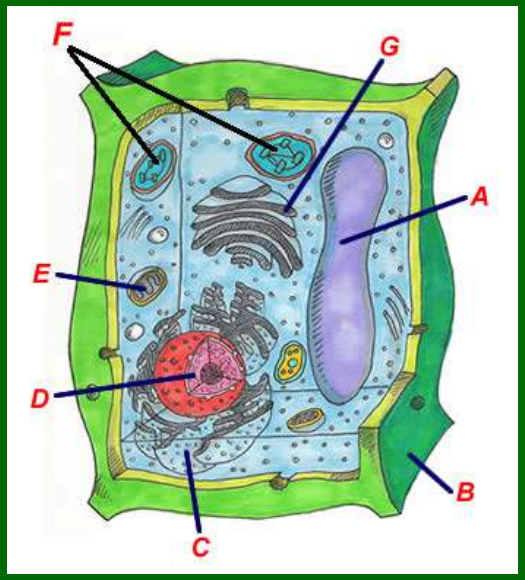
CONTENT	TEACHING & LEARNING ACTIVITIES	Resources
• The cell is the basic structural and functional unit of all living organisms. Cells can be seen under a microscope (they are microscopic). • Plant and animal cells have a cell membrane, cytoplasm, nucleus, and organelles such as mitochondria, vacuoles and chloroplasts.	Learners answer questions posed to them by the teacher. Teacher will record answers of learners on the board to reflect on the correctness of their responses. **Presentation/Lecture Method** Teacher uses a PowerPoint presentation to show how cells look and the different organelles that are found in cells.	Worksheets Video Clips Data Projector Laptop Chart paper Chalkboard or whiteboard Textbooks PowerPoint Internet

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CONTENT	TEACHING & LEARNING ACTIVITIES	Resources
-- the *nucleus* contains DNA ➢ the nucleus is enclosed by a *nuclear membrane* (in plants and animals) ➢ DNA contains inherited characteristics, such as whether eyes are blue or brown ➢ DNA is unique to each person; this *variation* accounts for differences within species -- *Mitochondria* are responsible for respiration to release energy from food.	**Activity 2** Learners pay attention and observe the plant and animal cells and answer an observational worksheet as the teacher explains. Teacher hands out Activity 2 after the PowerPoint presentation. Teacher reads through Activity 2 with learners to outline the expectations. **Double click on slide below to play presentation**  The teacher plays the presentation again, but this time learners are to complete Activity 2 while watching the presentation the second time. Only slides relevant to the organelles being discussed will be utilised for this lesson.	Siyavula (Sasol Inzalo), Pg.24-42 CAPS Subject Policy.
ASSESSMENT	Group work, presentations, worksheets and observation from video clips.	
TEACHER REFLECTION		

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1. Identify the cells represented below.





A) _____ B) _____

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2. Draw a sketch of the following and state their functions next to it.

a) Nucleus



b) Mitochondria



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c) Chloroplast



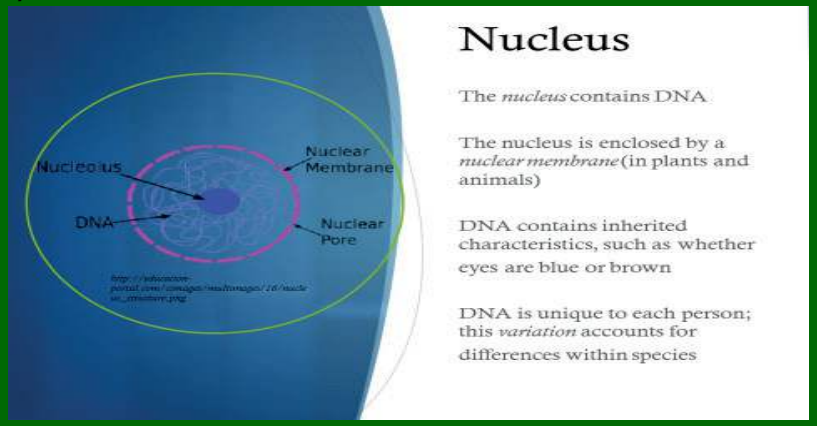
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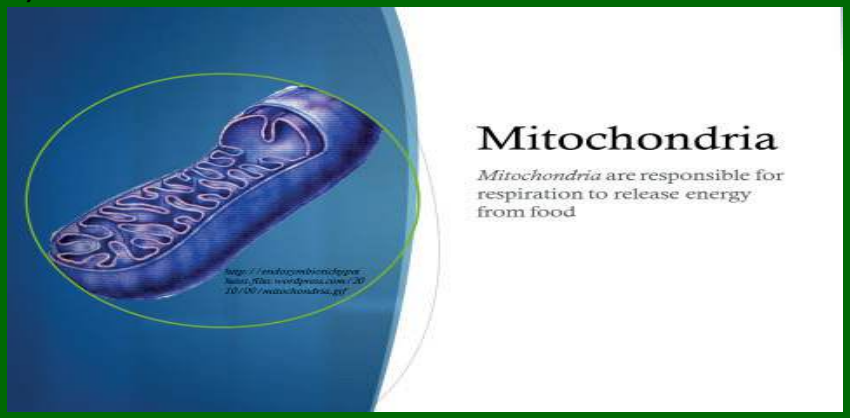
Activity 2 – Memo (Acknowledge sketches presented by learners with as much detail as possible)

1 A) Plant Cell **B) Animal Cell**

2a)

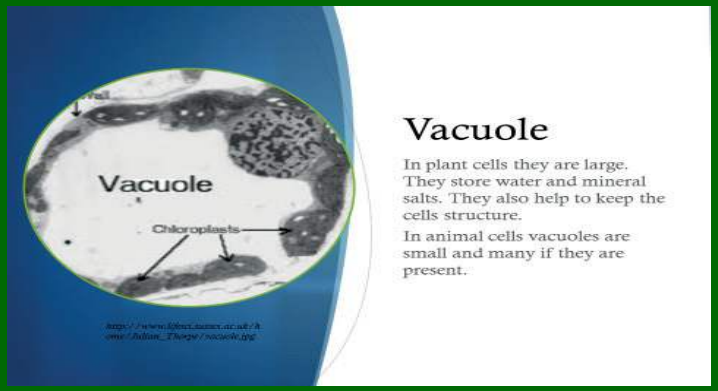


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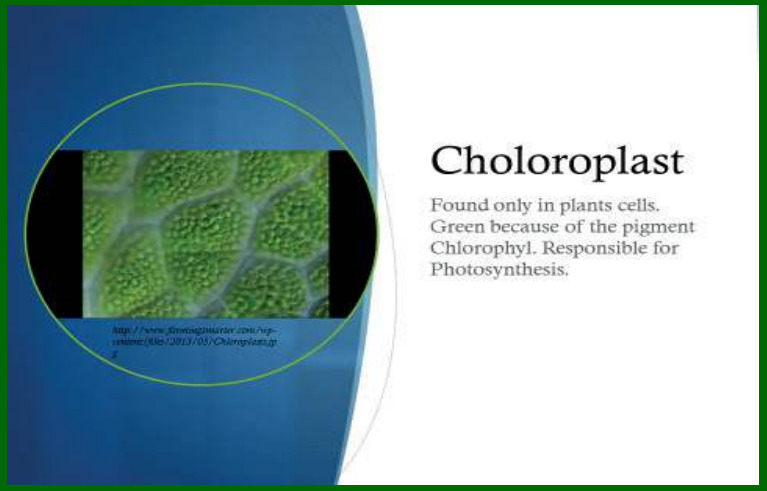


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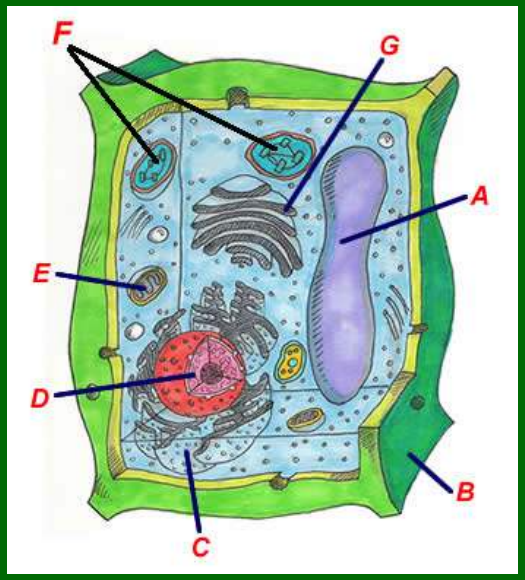
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ACTIVITY 2

1. Identify the cells represented below.

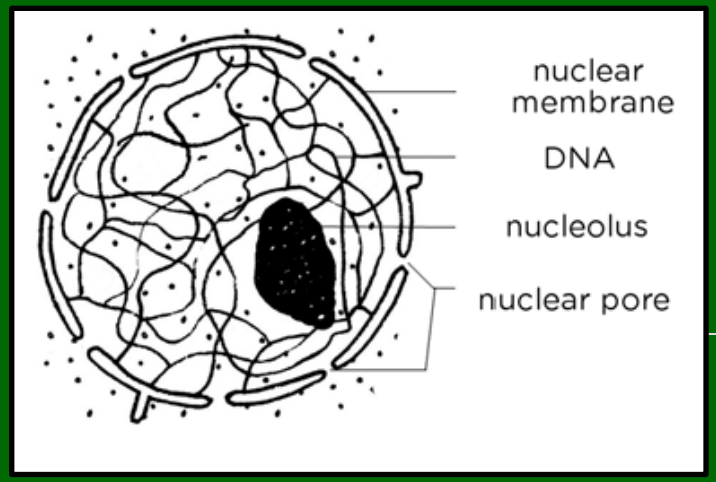


A) Plant Cell



B) Animal Cell

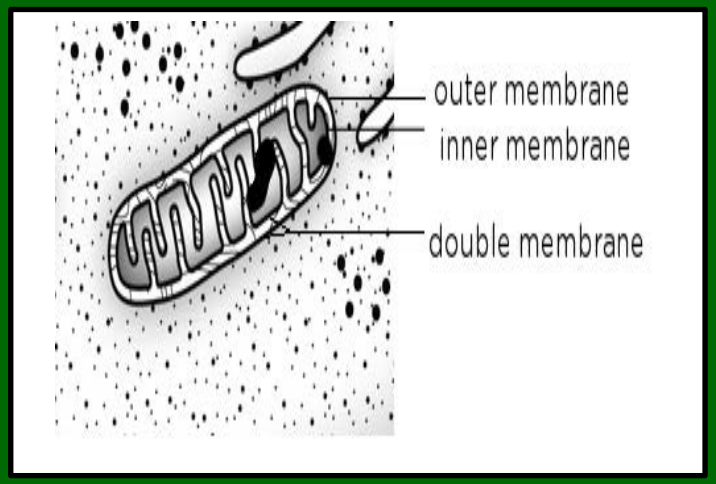
2. Draw a sketch of the following and state their functions next to it.



- The Nucleus contains DNA (hereditary material) of the cell.
- Controls the cell's activity

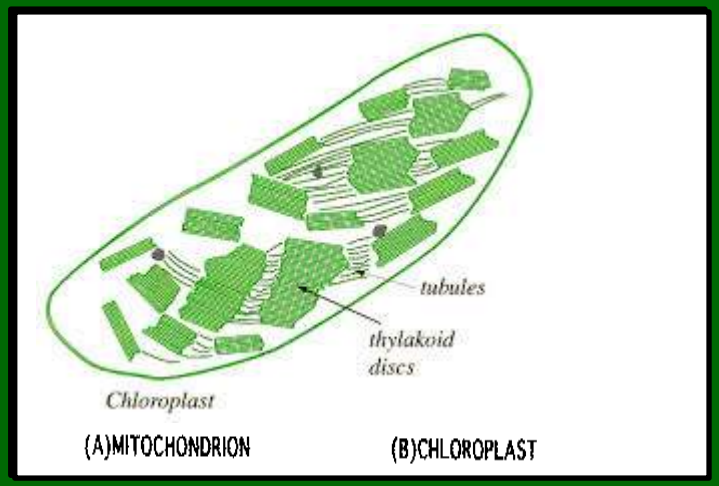
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b) Mitochondria



- Release energy from food for the cell

c) Chloroplast



- Contains the green pigment called chlorophyll, which is responsible for photosynthesis.

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DURATION: Week One Lesson Three	**OBJECTIVES: LEARNERS MUST BE ABLE TO:**
TOPIC: Cells as the basic units of life	• **Identify and explain** main differences between plant and animal cells.
SUBTOPIC: Differences between plant and animal cells	

Terminology	Cell Wall; Cell Membrane; Nucleus, Organelles; Mitochondria; Vacuoles; Cytoplasm; Microscopic; Cells; Nucleolus	
SPECIFIC AIMS	**1. DOING SCIENCE**	✓
	2. KNOWING THE SUBJECT CONTENT & MAKING CONNECTIONS	✓
	3. UNDERSTANDING THE USES OF SCIENCES & INDIGENOUS KNOWLEDGE	

PROCESS SKILLS

Accessing & recalling Information	✓	Identifying problems & issues		Doing Investigations	
Observing	✓	Raising Questions		Recording Information	✓
Comparing	✓	Predicting	✓	Interpreting Information	✓
Measuring		Hypothesizing	✓	Communicating	✓
Sorting & Classifying		Planning Investigations			

CONTENT	TEACHING & LEARNING ACTIVITIES	Resources
Differences between plant and animal cells • Plant cells differ from animal cells -- plant and animal cells are enclosed by a cell membrane, and plant cells also have rigid cellulose *cell walls* to provide support for the plant -- Plant cells also contain organelles such as large vacuoles and chloroplasts.	The teacher will play a video clip regarding the main differences between plant and animal cells. DOUBLE CLICK TO PLAY CLIP Differences Plant & Animal Cells.mp4 Ref: https://www.youtube.com/watch?v=aFE1Gcy21iA	Worksheets Video Clips Data Projector Laptop Chart paper Chalkboard or whiteboard Textbooks PowerPoint Internet

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NATURAL SCIENCES: LESSON PLAN 3
PERIOD/DURATION: 30 MINUTES
CAPS SENIOR PHASE

GRADE 9
STRAND: LIFE & LIVING
TERM 1

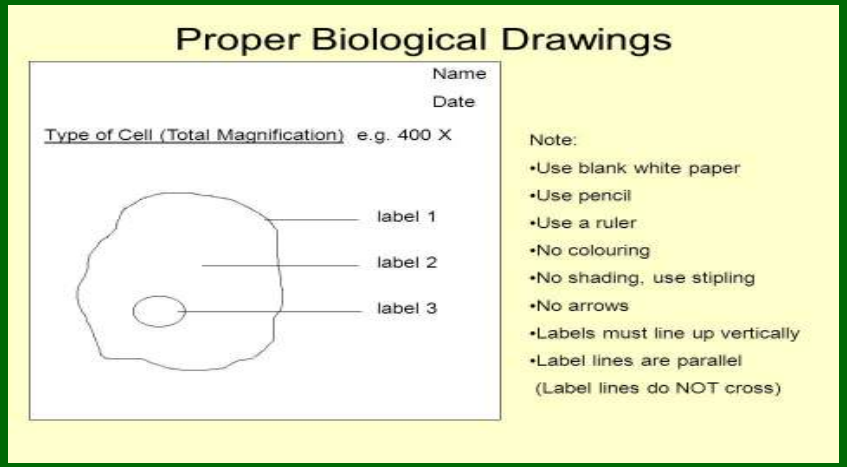
CONTENT	TEACHING & LEARNING ACTIVITIES	Resources
Chloroplasts contain chlorophyll to absorb light energy for photosynthesis *(refer to Grade 8 Life & Living)*. Vacuoles in plant cells have several functions including support and storage (Vacuoles in animal cells are small and temporary or absent).	Learners will engage teacher with regard to differences of plant and animal cells. After screening the video clip the teacher will use diagrams of the plant and animal cells to elaborate the main differences, after which learners will complete activity 3 based on the plant and animal cell differences. Learners will now complete activity 3. Learners interact with teacher to consolidate facts by answering questions posed to them over the lesson presented. Teacher consolidates important facts by reflecting on what has been done during the lesson. Questions may be asked to determine the degree of understanding by the learners. Teacher will give learners a homework task to complete (Making of a 3D model of a cell. Learners will complete Activity 4 whereby they are to show their understanding of a cell structure and its organelles.	
ASSESSMENT	Observation from video clip; worksheets, class discussions.	
TEACHER REFLECTION		

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Activity 3

3. Complete the following questions by answering on the worksheet provided.

3.1 Draw a sketch of both the plant and animal cells. Include all labels and apply the scientific drawing rules to this sketch when drawing.
(Hint: The drawing rules are outlined below)
Example of scientific drawing rules



PLANT CELL	LABELS

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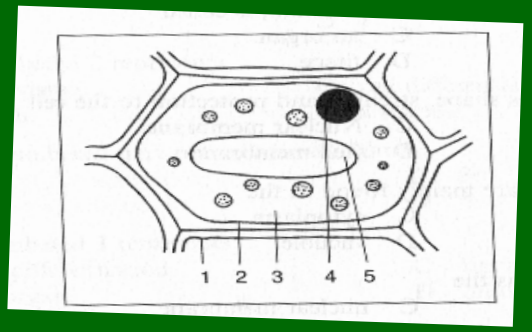
ANIMAL CELL	LABELS

3.2 Complete the table below by outlining the main differences between plant and animal cells.

No.	Cell Structure/Features	Plant Cell	Animal Cell
1.	Cell Wall		
2.	Shape of Cell		
3.	Vacuole		
4.	Chloroplast		

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3.3 Cells are the building blocks of life. Study the cell below and answer the following questions.



3.3.1 Identify the cell type above. Give a reason for your answer.

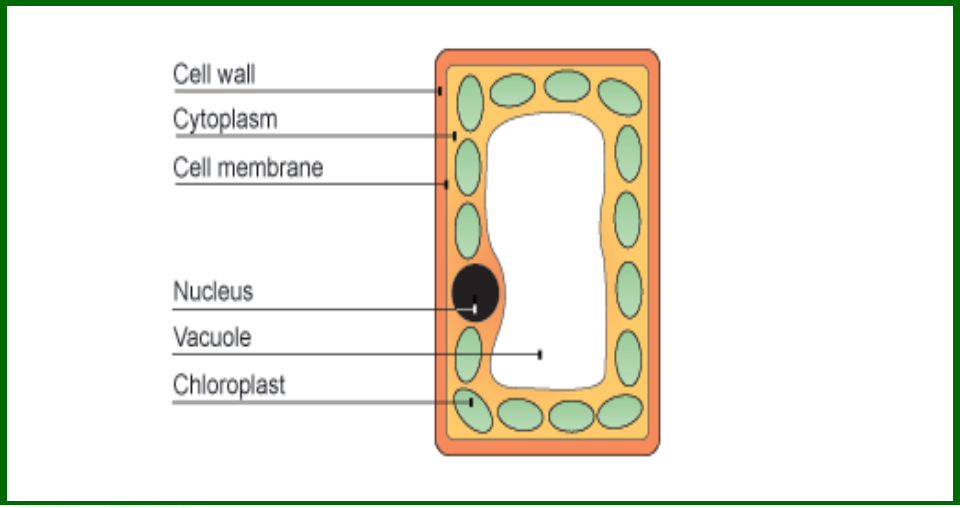
3.3.2 Give the name of label 4 and its function/s.

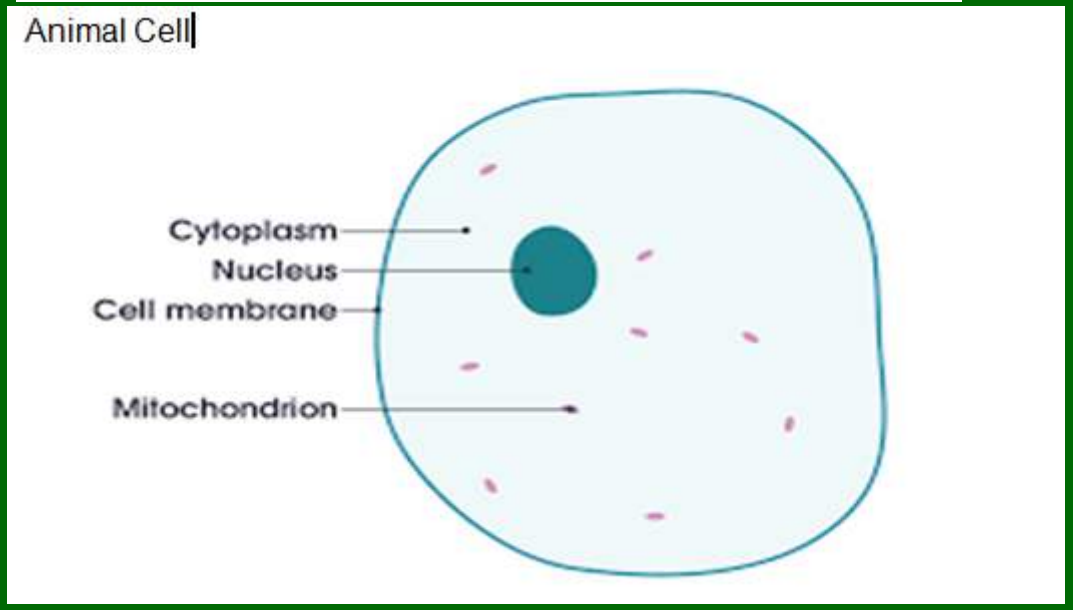
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Activity 3 – Memo

3.1 Plant Cell





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3.2

No.	Cell Structure/Features	Plant Cell	Animal Cell
1.	Cell Wall	Present in plant cells Cell wall is rigid and gives shape and protection to the cell.	Not found in animal cells
2.	Shape of Cell	Firm and rigid, keeps shape easily	No static shape or form. Irregular shape
3.	Vacuole	Large and gives cell shape support and makes it turgid. Contains nutrients and water.	Smaller in size, short life span. Temporary or absent in most animal cells.
4.	Chloroplast	Green chloroplast present for photosynthesis.	Not present in animal cells.

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3.3.1 It is a Plant Cell, has a large vacuole and a cell wall.

3.3.2 Label 4 – Nucleus

Functions are:

- Controls all the processes and chemical reactions inside the cell.
- Contains the cells genetic material.
- Nuclear membrane allows for substances to pass through and it encloses the DNA.
- DNA in the nucleus has information about inherited characteristics.

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Activity 4 - Project

Build a 3D model of a plant cell. You may consult various resources to complete the activity given e.g. Internet, books, encyclopedias etc. You are at liberty to use any material you deem necessary to complete your project. No items used should be dangerous to yourself or any other person.

NB: Safety in any scientific process is always necessary.

Requirements for your model:

- Your model should be larger than and A4 paper.
- All organelles must be the correct shape and size in relation to other organelles.
- Your model must be sturdy.
- Organelles must be labeled.
- The model must show that the plant cell is a 3 dimensional object.
- A presentation on all organelles and functions must be accompanying the model.

A portfolio showing how the model was designed and eventually fully made must be kept as part of the presentation process. Pictures at each stage should also be included.

Some examples of how your model should look like on completion

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These are mere examples, follow the rubric as well.

The following rubric will be used to assess your model: Activity 4

3-D Cell Model Rubric (Score Sheet)
Scoring out of 50

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NAME OF LEARNER: _____

Model Criteria	Excellent (5)	Great (4)	Good (3)	Fair (2)	Poor (1)
Creativity & Design	Model is 3-D. Uses different objects for each organelle. Cell proper shape. Imaginative.	Model is 3-D. Uses different objects for each organelle. Cell proper shape.	Model is 3D. Uses different objects for each organelle. Cell not properly shape.	Model is 3-D. Organelles are all made out of the same material.	Model is not 3-D. Poster, paper or puffy paint only.
Labels	Cell type present. All organelles labeled neatly and legible on model.	Missing one element: cell type, organelle label Legible and neat	Missing two elements: cell type, organelle labels Neatly labeled.	Missing more than two elements: cell type, organelle labels. Not neat.	Organelles not labeled on model. Difficult to read and understand.
Organelles	All required organelles shown. Proper size, shape and placement in the cell.	Missing, misplacement, improper size or shape of one organelle in cell. Including an extra organelle.	Missing two organelles from cell. Most organelles proper shape, size and placement.	Missing three or more organelles. Most organelles proper shape, size and placement.	Missing three or more organelles. Most organelles not proper shape, size or placement in the cell.
Stability Model	Model strong and sturdy & can stand on a base or platform.	Model strong and sturdy	All organelles in model are in place & attached	Some parts in the model are loose.	Model falls apart when handled.
Size	Model larger than A4, & organelles are in proportion relative to the cell.	Model larger than A4 and some parts are in proportion.	Model smaller than A4 but organelles are in proportion.	Model smaller than A4 and some organelles are in proportion.	Model smaller than A4 specifications & all organelles are not in proportion
Key Criteria	**Excellent (5)**	**Great (4)**	**Good (3)**	**Fair (2)**	**Poor (1)**
Functions	All organelle functions are correct for cell model. Neat and legible.	One organelle function missing or incorrect. Extra organelle function added	Missing two organelle functions. Neatly written.	Missing three organelle functions. Not neatly written.	Missing four or more organelle functions. Key is difficult to read.
Identification	All organelles are correctly labeled. Sample organelle on key. Match model.	All organelles are correctly labeled. Pictures drawn to represent organelles.	Most organelles are correctly labeled and match model.	Most organelles are NOT correctly labeled and do NOT match model.	Organelles are not labeled on key.
Presentation	**Excellent (5)**	**Great (4)**	**Good (3)**	**Fair (2)**	**Poor (1)**
Part & Function	Discusses all cell parts and functions. Explains what was used for each organelle.	Does not explain one organelle or its function.	Does not explain two organelles or their functions.	Does not explain three organelles or their functions	Does not explain four or more organelles or their functions. Does not present project.
Tone and voice modulation	Expressive and clear. Highlight functionality of organelles.	Expressive and clear for most organelles.	Expressive and clear for some organelles	Expressive and clear for two organelle.	Expressive and clear for one organelle
Additional Resources Used	Enhancing resources used for presentation, more than 3 used.	Enhancing Resources used for presentation, only 3 used	Enhancing resources used for presentation, Only 2 used.	Enhancing resources used for presentation. Only 1 used	No additional resources used except for model itself.

PUPIL MARK: ____ /50

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NATURAL SCIENCES: LESSON PLAN 4 **GRADE 9**
PERIOD/DURATION: 30 MINUTES **STRAND: LIFE & LIVING**
CAPS SENIOR PHASE **TERM 1**

DURATION: Week One Lesson Four	**OBJECTIVES: LEARNERS MUST BE ABLE TO:**
TOPIC: Cells as basic units of life	• **Explain** why cells are different in shape and size.
SUBTOPIC: Cells in tissues, organs & Systems	• **Draw** simple representations of specialised cells found in plants and animals.

TERMINOLOGY	Specialised; differentiated; muscle cells; nerve cells; epithelial cells; red blood cells; unicellular; multi-cellular	
SPECIFIC AIMS	1. DOING SCIENCE	
	2. KNOWING THE SUBJECT CONTENT & MAKING CONNECTIONS	✓
	3. UNDERSTANDING THE USES OF SCIENCES & INDIGENOUS KNOWLEDGE	

SCIENCE PROCESS SKILLS

Accessing & recalling Information	✓	Identifying problems & issues		Doing Investigations	
Observing	✓	Raising Questions		Recording Information	✓
Comparing	✓	Predicting	✓	Interpreting Information	✓
Measuring		Hypothesizing		Communicating	✓
Sorting & Classifying		**Planning Investigations**			

CONTENT	TEACHING & LEARNING ACTIVITIES	Resources
Cells come in many different shapes and sizes. Cells are adapted to perform specific functions, such as muscle cells which are specialised to contract and enable movement.	Teacher will re-cap on what was learnt about plant and animal cells by asking prompting questions. During discussions learners are asked: 1) Are all cells the same? 2) Do all cells perform the same function? With the use of a chalkboard or ICT media, teachers explore the answers.	Sasol Inzalo Workbook Video Clips Laptop Data projector

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CONTENT	TEACHING & LEARNING ACTIVITIES	Resources

Specialised cell	Structure	Function
Epithelial cells - they are mostly flat		They cover the surface of the body for protection.
Muscle cells - some are long and spindle shaped		Muscle cells can contract and relax allowing for movement within your body
Nerve cells - the are very long and have branched ends		Nerve cells are specialised to carry messages that coordinate the functions of the body.
Red blood cells - Round and biconcave shape		Red blood cells carry carry oxygen and carbon dioxide throughout the body.

Teacher asks learners to refer to the above table while the teacher explains the table represented.

Learners copy the table down in their work books.

Learners watch a video clip on cell specialisation.

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CONTENT	TEACHING & LEARNING ACTIVITIES	Resources
	 Specialized Cells- Significance and Examples.mp4 Reference: http://www.youtube.com/watch?v=wNe6RuK0FfA	
ASSESSMENT	Class discussions; Observations done by viewing video clip; Practice drawing skills by copying different cell types.	
TEACHER REFLECTION		

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DURATION: Week One Lesson 5	**OBJECTIVES: LEARNERS MUST BE ABLE TO:**
TOPIC: Cells as the basic units of life	• **Define and state** the differences between concepts 'macro' and 'micro'.
SUBTOPIC: Cells in tissues, organs and systems	• **Research and write** about the history of the discovery of the light and electron microscopes

Terminology	Multi-cellular, microscope, slide, fine & course adjustment screw, stage, light source, objective, eye piece (ocular lens), diaphragm, condenser, frame.	
SPECIFIC AIMS	1. DOING SCIENCE	✓
	2. KNOWING THE SUBJECT CONTENT & MAKING CONNECTIONS	✓
	3. UNDERSTANDING THE USES OF SCIENCES & INDIGENOUS KNOWLEDGE	

SCIENCE PROCESS SKILLS

Accessing & recalling Information	✓	Identifying problems & issues		Doing Investigations	
Observing	✓	Raising Questions	✓	Recording Information	✓
Comparing	✓	Predicting	✓	Interpreting Information	✓
Measuring		Hypothesizing	✓	Communicating	✓
Sorting & Classifying		Planning Investigations			

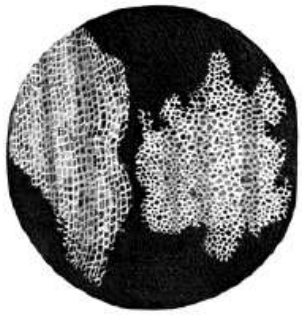
CONTENT	TEACHING & LEARNING ACTIVITIES	Resources
Microscopic organisms such as bacteria consist of a single cell. Macroscopic organisms such as humans, consist of large numbers of cells Cells are small; you need a microscope to see them. This means that large organisms are made up of millions of cells.	Lecture/Presentation mode: Teacher explains the concept "micro". Further discussions around the concepts bacteria and their size and "macro" organisms. The term "multi-cellular" is also alluded to. Teacher provides learners with different objects of varying sizes to concretise the concept of "macro" and "micro" . Learners inter-act with objects that are large in size and other objects that are tiny in size. Learners must consider which object is easier to see, exposed to the use of a magnifying glass (e.g. use fine printed document). Teacher now allows learners to watch a video clip to consolidate the concepts of micro and macro.	Video clips Internet Worksheets Magnifying glass Varying sized objects. Sasol Inzalo Book

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	 Microorganisms - The Dr. Binocs Show - Educational Videos For Kids.mp4 **Reference:** http://www.youtube.com/watch?v=JZjzQhFG6Ec Teacher introduces the concept “microscope”, briefly gives the history of the microscope. Learners are asked to read content below and answer the mini worksheet presented.	
ASSESSMENT	Discussions; Comparing activity; Read & record information (mini worksheet)	
TEACHER REFLECTION		

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Robert Hooke was the first to use the term 'cell' when he studied thin slices of cork with a microscope.



Robert Hooke's microscope that he used to first view cells.

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Mini Activity on the History of Microscopes





Image Obtained from:
https://www.google.co.za/search?q=image+of+light+microscope&espv=2&biw=1366&bih=662&source=lnms&tbm=isch&sa=X&ved=0ahUKEwis25LHq93RAhVKB8AKHZJVBzEQ_AUIBigB#imgrc=e7a3inPpZ_fZIM%3A

1. Name the item represented above?

_____

2. What do we use the item above for?

_____

_____

3. Who was the first person to use the term “cell” and the item represented above?

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4. How has the item above developed until today?





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MEMORANDUM:

1. Name the item represented above?

Microscope

2. What do we use the item above for?

To enlarge an object

3. Who was the first person to use the term “cell” and the item represented above?

Robert Hooke

4. How has the item above developed until today?

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DURATION: Week One Lesson Plan Six	**OBJECTIVES: LEARNERS MUST BE ABLE TO:**
TOPIC: Cells as the basic units of life	• **Identify & Tabulate** the functions of the different parts of a basic light microscope
SUBTOPIC: Cells in tissues, organs and systems	

Terminology	slide; fine & course adjustment screw; stage; light source; objective; eye piece (ocular lens); diaphragm; condenser; frame.	
SPECIFIC AIMS	**1. DOING SCIENCE**	✓
	2. KNOWING THE SUBJECT CONTENT & MAKING CONNECTIONS	✓
	3. UNDERSTANDING THE USES OF SCIENCES & INDIGENOUS KNOWLEDGE	✓

SCIENCE PROCESS SKILLS

Accessing & recalling Information	✓	Identifying problems & issues		Doing Investigations	
Observing	✓	Raising Questions		Recording Information	✓
Comparing	✓	Predicting	✓	Interpreting Information	
Measuring		Hypothesizing	✓	Communicating	✓
Sorting & Classifying		Planning Investigations			

CONTENT	TEACHING & LEARNING ACTIVITIES	Resources
The kind of microscope used in most school laboratories is called a **light microscope**, as it shines light through the piece of animal or plant you are looking at. The microscope has glass lenses which are used to magnify the image.	Teacher prepares by having microscopes placed at each work station for learners. Teacher presents a video clip on the use of the light microscope. Learners watch the video clip and then interact with the microscopes presented for them. How To Use a Compound Light Microscope- Biology Lab Tutorial.mp4	Video clips Internet Worksheets Microscopes Chalkboard/Whiteboard Sasol Inzalo Book

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NATURAL SCIENCES: LESSON PLAN 6
PERIOD/DURATION: 30 MINUTES
CAPS SENIOR PHASE

GRADE 9
STRAND: LIFE & LIVING
TERM 1

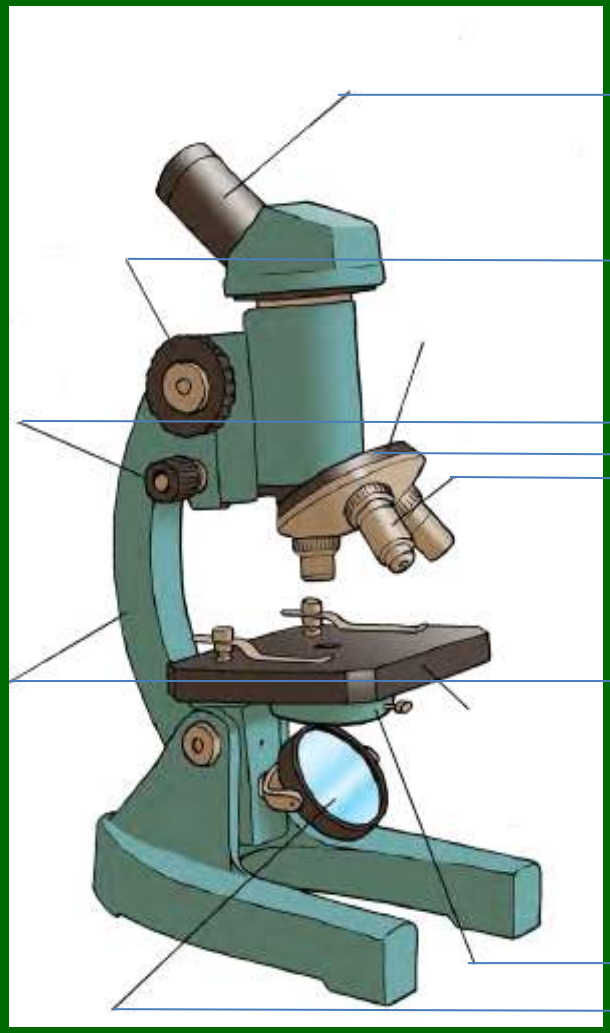
CONTENT	TEACHING & LEARNING ACTIVITIES	Resources
All parts of the microscope is shown and discussed.	**Reference:** http://www.youtube.com/watch?v=lo2aC_m2vyo Teacher now identifies each part of the microscope and discusses its functions with the learners. Learners have a prepared worksheet which they are to complete as the teacher explains. This is a re-cap of what was presented on the video clip. Learners are asked to reference the Sasol Inzalo book Pg.16 if they need assistance completing the worksheet.	
ASSESSMENT	Discussions; Watch video clip; complete worksheet.	
TEACHER REFLECTION		

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Activity worksheet

1. Label the following diagram of a light microscope.



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2. State the functions of the following labels from the diagram of the Microscope (Q1)

Label number	Function
3	
4	
8	

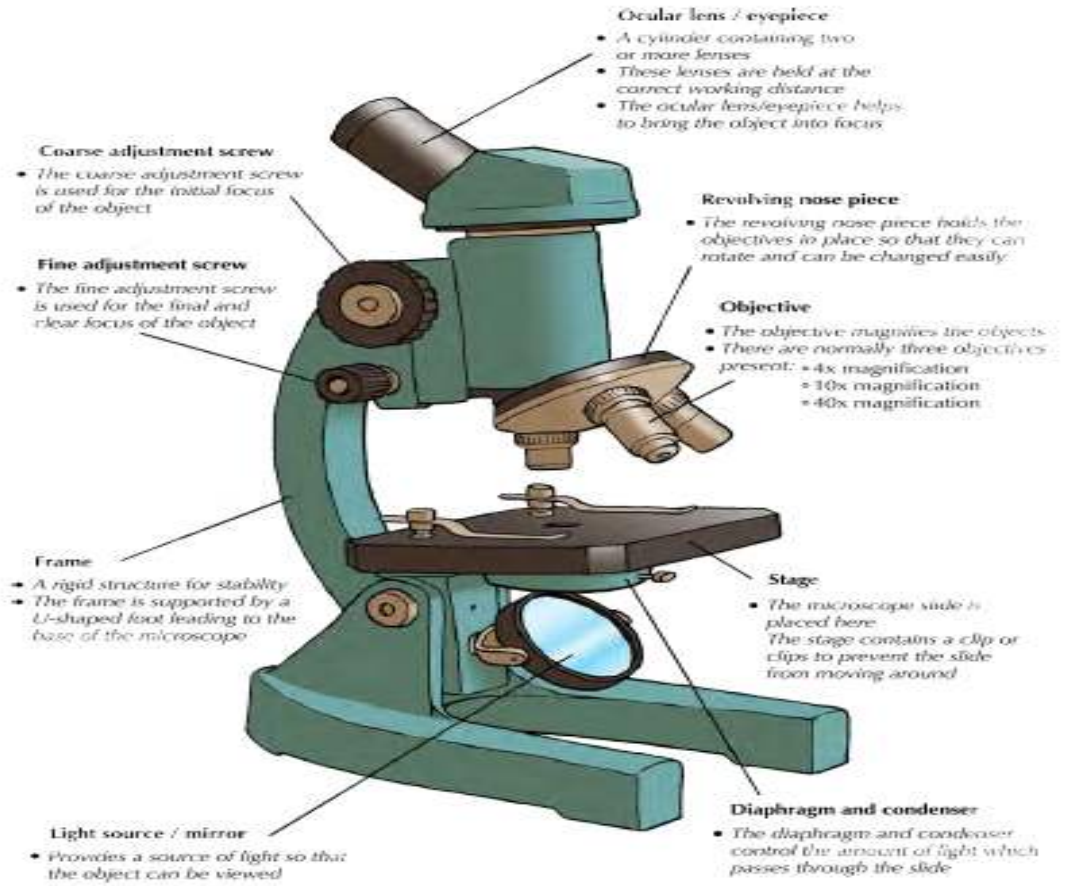
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MEMORANDUM

1.

The next image explains the different parts of a light microscope and what they are used for.



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Number	Label
1	Ocular Lens/ eyepiece
2	Coarse adjustment screw
3	Fine adjustment screw
4	Revolving nose piece
5	Objective
6	Frame/ arm
7	Diaphragm/ condenser
8	Light Source/ mirror

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2. State the functions of the following labels from the diagram of the Microscope (Q1)

Label number	Function
3	The fine adjustment screw is used for the final and clear focus of the object.
4	The revolving nose piece holds the objectives in place so that they can rotate and can be changed easily.
8	Provides a source of light so that the object can be viewed.

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NATURAL SCIENCES: LESSON PLAN 7
PERIOD/DURATION: 60 MINUTES
CAPS SENIOR PHASE

GRADE 9
STRAND: LIFE & LIVING
TERM 1

DURATION: Week Two Lesson One and Two **TOPIC:** Cells as the basic units of life **SUBTOPIC:** Cells in tissues, organs and systems	**OBJECTIVES: LEARNERS MUST BE ABLE TO:** • **Prepare and examine** slides of plant cells such as onion cells. • **Draw and label** a few cells from each observation.

Terminology	slide; wet and dry mounts; smear; stains	
SPECIFIC AIMS	**1. DOING SCIENCE**	✓
	2. KNOWING THE SUBJECT CONTENT & MAKING CONNECTIONS	✓
	3. UNDERSTANDING THE USES OF SCIENCES & INDIGENOUS KNOWLEDGE	

SCIENCE PROCESS SKILLS

Accessing & recalling Information	✓	Identifying problems & issues		Doing Investigations	
Observing	✓	Raising Questions		Recording Information	✓
Comparing	✓	Predicting	✓	Interpreting Information	
Measuring	✓	Hypothesizing	✓	Communicating	✓
Sorting & Classifying		Planning Investigations			

CONTENT	TEACHING & LEARNING ACTIVITIES	Resources
Practical skills are to be explored as learners prepare a slide of a plant cell (onion cells) and use the microscope to observe and draw what they see on the slides prepared.	Teacher prepares each work station with a microscope, slides, cover slips, stains (iodine), dissecting needles and plastic catering knives and pair of scissors, blotting paper/tissue, and onion. A page for drawing what they see will also be made available. The teacher will outline the process that will follow throughout the lesson. Safety pre-cautions are to be emphasised at each work station. Try to keep each workstation small and uncluttered *(refer to CAPS policy document Pg.12 paragraph 3)*. A practical activity sheet will be discussed with the learners, such that they know the expectations of the practical. Learners will firstly watch a video clip on how to prepare a slide of an onion cell	Video clips Internet Worksheets Microscopes Chalkboard/Whiteboard Sasol Inzalo Book Slides Cover slips Watch glass Forceps Dropper Blotting paper/Tissue

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CONTENT	TEACHING & LEARNING ACTIVITIES	Resources
	and later follow instructions given by teacher.  To prepare stained temporary mount of onion peel.mp4 OR  Onion Skin Epidermal Cells- How to Prepare a Wet Mount Microscope Slide.mp4 **Reference:** http://www.youtube.com/watch?v=cmnhBJKfvNw ScienceProfOnline.com Teacher must emphasise that there are different ways of preparing a slide and that will outline which process to follow. This will be based on the activity sheet provided. Refer to Sasol Inzalo Book pg.19-21 Each item at the work station will be identified and discussed by the teacher. Learners will now follow the activity sheet prepared and prepare their own onion cell slide. Learners can also reference Sasol Inzalo Book pg.19-21 if they need further clarity. It is always advisable to allow +/- 5 minutes for learners to discuss and prepare themselves before starting the process.	Brush Onion Distilled water Glycerine Safrorine Solution/iodine
ASSESSMENT	Discussions; Watch video clip; Conduct practical slide preparation	
TEACHER REFLECTION		

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Practical Activity Sheet: Complete after teacher explains & after watching the video clip.

- The preparation of a slide of onion cells.

1. State the apparatus required conducting this practical?

2. Prepare a procedure you will follow when you prepare an onion cell slide to be observed under a microscope?

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3. Draw and label what you observed under the microscope.

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MEMORANDAUM

Practical Activity Sheet: Complete after teacher explains & after watching the video clip.

- The preparation of a slide of onion cells.

1. State the apparatus required conducting this practical?

Onion
Scalpel or knife
Dissecting needle
Forceps
Microscope slides
Coverslips
Dropper
Tissue paper or filter paper
Distilled water
Iodine solution
Light microscope

2. Prepare a procedure you will follow when you prepare an onion cell slide to be observed under a microscope?

Risk assessment: Some people are allergic to iodine and/or shellfish. If any learners are allergic to iodine or shellfish DO NOT use the iodine solution to stain your specimens. Methylene blue and crystal violet are harmful and can be irritants. Avoid contact with the skin.

Step 1: Prepare your microscope and slides as discussed in the safety methods above.
Step 2: Cut the onion into blocks of about 1 cm square with a sharp knife or scalpel.
Step 3: Use forceps to pull or peel a small piece of the very thin membrane-like epidermis lining off one of the **inner** layers of the onion.
Step 4: Place a drop of iodine solution onto the slide.

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Step 5: Place the membrane directly in the drop on the slide.
Step 6: Gently lower a coverslip at an angle onto the onion cells. Hold the coverslip up with a dissection needle and gently lower the slip. This prevents air bubbles from getting trapped under the cover slip.
Step 7: Wipe off excess fluid around the edge of the coverslip with tissue paper or filter paper.
Step 8: Make sure the lowest power objective lens (this is the shortest lens) is in line with the eyepiece. Switch on the lamp or use the mirror to reflect the light onto your stage. Place the prepared slide onto the stage and secure it with the stage clips.
Step 9: While on the low power, look from the side and lower the objective lens to just above the coverslip. Then look through the eyepiece and use the fine focus to focus your image.
Step 10: Magnify your cells by swapping the objective lens to a higher powered lens. Only use the fine focus adjustment to focus clearly.
Step 11: Make careful drawings of your observations in the space below and remember to label what you see. Add a heading including the specimen, the stain used and the magnification

3. Draw and label what you observed under the microscope.



Onion cells.

Learner's drawings of what they observe.

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DURATION: Week Two lesson Three and Four	**OBJECTIVES: LEARNERS MUST BE ABLE TO:**	
TOPIC: Cells as the basic units of life	• **Prepare and examine** slides of an animal cell such as cheek epithelial cells.	
SUBTOPIC: Cells in tissues, organs and systems	• **Draw and label** a few cells from each observation.	
Terminology	slide; wet and dry mounts; smear; stains	
SPECIFIC AIMS	**1. DOING SCIENCE**	✓
	2. KNOWING THE SUBJECT CONTENT & MAKING CONNECTIONS	✓
	3. UNDERSTANDING THE USES OF SCIENCES & INDIGENOUS KNOWLEDGE	

SCIENCE PROCESS SKILLS

Accessing & recalling Information	✓	Identifying problems & issues		Doing Investigations	
Observing	✓	Raising Questions		Recording Information	✓
Comparing	✓	Predicting	✓	Interpreting Information	
Measuring	✓	Hypothesizing	✓	Communicating	✓
Sorting & Classifying		Planning Investigations			

CONTENT	TEACHING & LEARNING ACTIVITIES	Resources
Practical skills are to be explored as learners prepare a slide of an animal cell (Cheek epithelial) and use the microscope to observe and draw what they see on the slides prepared.	Teacher prepares each work station with a microscope, slides, cover slips, stains (methylene blue), dissecting needles, and blotting paper/tissue; tooth pick/cotton bud; methylated spirits; forceps. A page for drawing what they see will also be made available. The teacher will outline the process that will follow throughout the lesson. Safety pre-cautions are to be emphasised at each work station. Try to keep each workstation small and uncluttered *(refer to CAPS policy document Pg.12 paragraph 3).* A practical activity sheet will be discussed with the learners, such that they know the expectations of the practical. Learners will firstly watch a video clip on how to prepare a slide of a cheek epithelial cell and later follow instructions given by teacher.	Video clips Internet Worksheets Microscopes Chalkboard/Whiteboard Slides Cover slips Forceps Dropper Toothpick/Cotton bud Blotting paper/Tissue

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NATURAL SCIENCES: LESSON PLAN 8
PERIOD/DURATION: 60 MINUTES
CAPS SENIOR PHASE

GRADE 9
STRAND: LIFE & LIVING
TERM 1

CONTENT	TEACHING & LEARNING ACTIVITIES	Resources
	 Cheek Epithelial Cells- How to Prepare a Wet Mount Microscope Slide.mp4 **Reference:** ScienceProfOnline.com Teacher must emphasise that there are different ways of preparing a slide and that he will outline which process to follow. Each item at the work station will be identified and discussed by the teacher. Learners will now follow the activity sheet prepared and prepare their own cheek epithelial cell slide. Learners can also reference the resource sheet provided if they need further clarity. It is always advisable to allow +/- 5 minutes for learners to discuss and prepare themselves before starting the process.	Methylene blue
ASSESSMENT	Discussions; Watch video clip; Conduct practical slide preparation	
TEACHER REFLECTION		

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Practical Activity Sheet: Complete after teacher explains & after watching the video clip.

The preparation of a slide of cheek epithelial cells.

1. State the apparatus required to conduct this practical?

2. Explain the procedure that you will follow to collect and prepare cheek epithelial cells to be observed under a microscope?

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3. Draw and label what you observed under the microscope.

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MEMORANDUM

Resource Sheet for the preparation of cheek epithelial cells.

1. Using a clean new toothpick or clean new cotton bud gently scrape the inside of your cheek.



2. Put the scrapings onto the surface of a microscope slide.



3. Place the used cotton bud in sterilising liquid e.g. methylated spirits.



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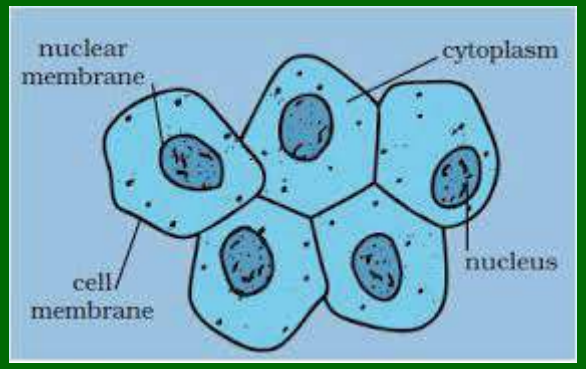
4. Add a drop of methylene blue to the scrapings on the slide. This will stain the cells and help you to see the cells.



5. Using a pair of forceps gently lower a coverslip at 45º over the scrapings.

6. Examine the slide under the microscope. First use the low power to find some of the scrapings, then the medium power and finally the high power.

7. Draw and label a diagram of a cheek cell you have observed.



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NATURAL SCIENCES: LESSON PLAN 9 **GRADE 9**
PERIOD/DURATION: 30 MINUTES **STRAND: LIFE & LIVING**
CAPS SENIOR PHASE **TERM 1**

DURATION: Week Two Lesson Five	**OBJECTIVES: LEARNERS MUST BE ABLE TO:**
TOPIC: Cells as the basic units of life	• **Explain** the relationship between cells, tissues, organs and systems.
SUBTOPIC: Cells in tissues, organs and systems	

Terminology	Specialised cells; tissues; organs; systems	
SPECIFIC AIMS	1. DOING SCIENCE	
	2. KNOWING THE SUBJECT CONTENT & MAKING CONNECTIONS	✓
	3. UNDERSTANDING THE USES OF SCIENCES & INDIGENOUS KNOWLEDGE	

SCIENCE PROCESS SKILLS

Accessing & recalling Information	✓	Identifying problems & issues		Doing Investigations	
Observing		Raising Questions		Recording Information	
Comparing	✓	Predicting	✓	Interpreting Information	
Measuring		Hypothesizing	✓	Communicating	✓
Sorting & Classifying		Planning Investigations			

CONTENT	TEACHING & LEARNING ACTIVITIES	Resources
Organization of cells in macroscopic organisms In microscopic single-celled organisms, the individual cell has to perform all the life processes for that microscopic organism. So what about the cells in macroscopic organisms that consist of many cells? We have already learnt about specialized cells in macroscopic organisms, so we know that not all cells perform all the processes - they are specialized to perform a specific function. Specialized cells that perform a specific function, group together to form a tissue.	Lecture mode/Presentation Teacher discusses the role of cells and how they inter-act collectively to form tissue and tissues collectively form an organ and an organs work collectively to form a system. At each stage the teacher will highlight the collective functionality. Teacher presents a video clip to further elaborate on his discussions. Learners watch the video clip and then answer the worksheet provided. Worksheet will emphasise the relationship between cells, tissues, organs and systems.	Internet Video clips Chalkboard White board worksheets

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NATURAL SCIENCES: LESSON PLAN 9
PERIOD/DURATION: 30 MINUTES
CAPS SENIOR PHASE

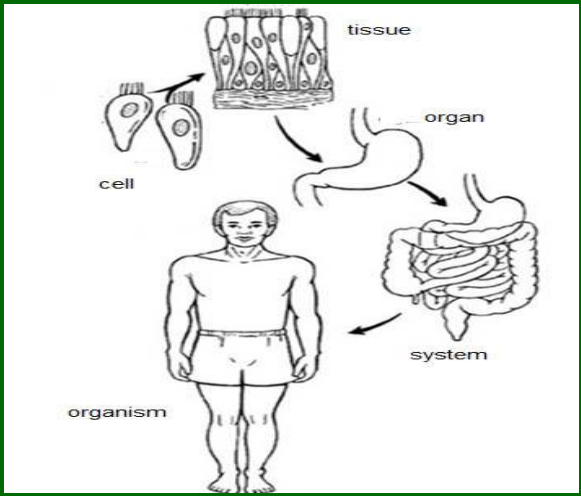
GRADE 9
STRAND: LIFE & LIVING
TERM 1

CONTENT	TEACHING & LEARNING ACTIVITIES	Resources
Groups of tissues that work together form organs. When organs work together we say they form systems or organ systems. There are many different systems in your body where specific organs work closely together to make your body function.	 Cells, Tissues, Organs, Organ Systems - Biology - Science - Get That C In Your GCSE.mp4 **Reference:** http://www.youtube.com/watch?v=gDSsQnU_q2E	
ASSESSMENT	Discussions; Watch video clip; Conduct practical slide preparation	
TEACHER REFLECTION		

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Worksheet: Cells, tissues, organs and systems

1.



1.1 By referring to the diagram above explain the relationship between cells, tissues, organs and systems.

_____

_____

_____

_____

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1.2 Draw and explain how the digestive system works.

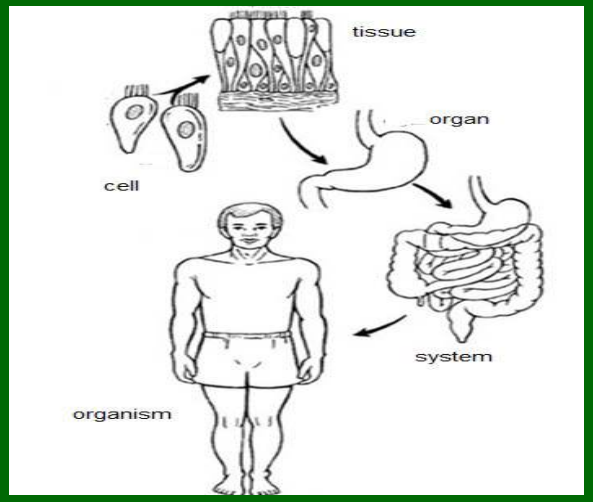
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MEMORANDUM

Worksheet: Cells, tissues, organs and systems

1.



1.1 By referring the diagram above explain the relationship between cells, tissues, organs and systems.

Cell – basic unit of life.

Tissues – group of cells performing a specific function.

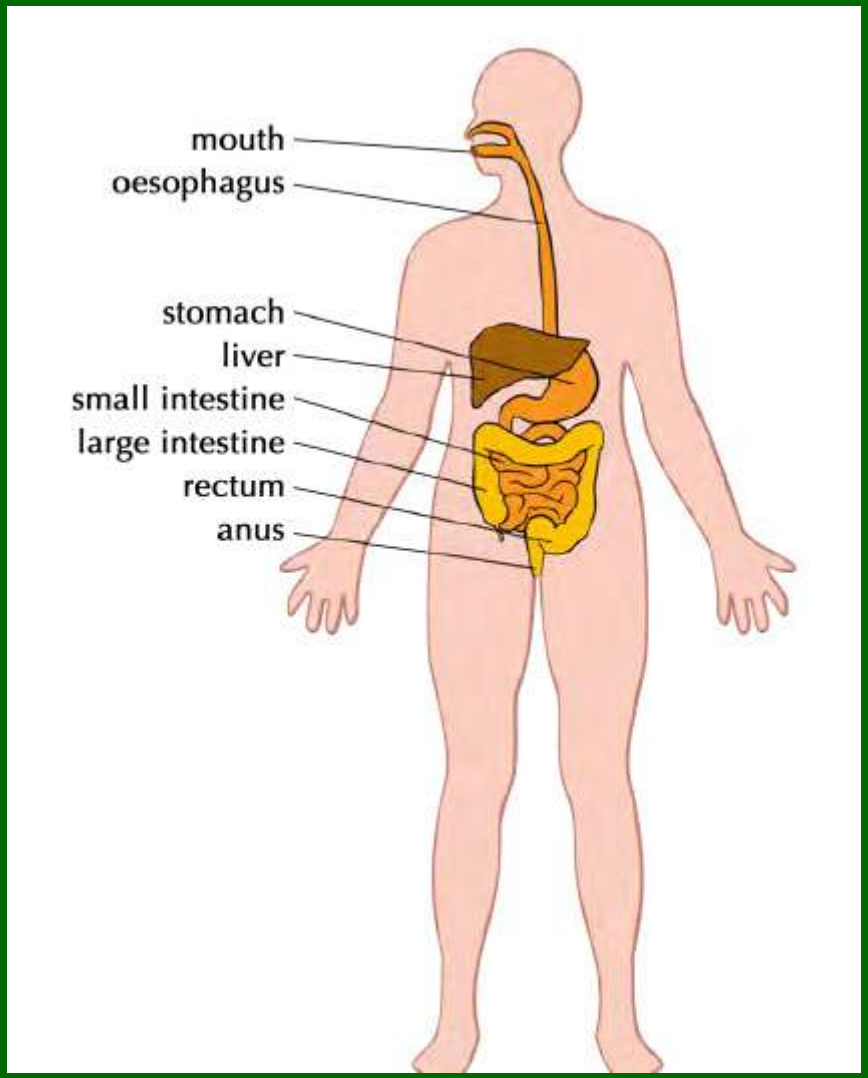
Organs – group of tissues performing the specific function.

Systems – organs working together.

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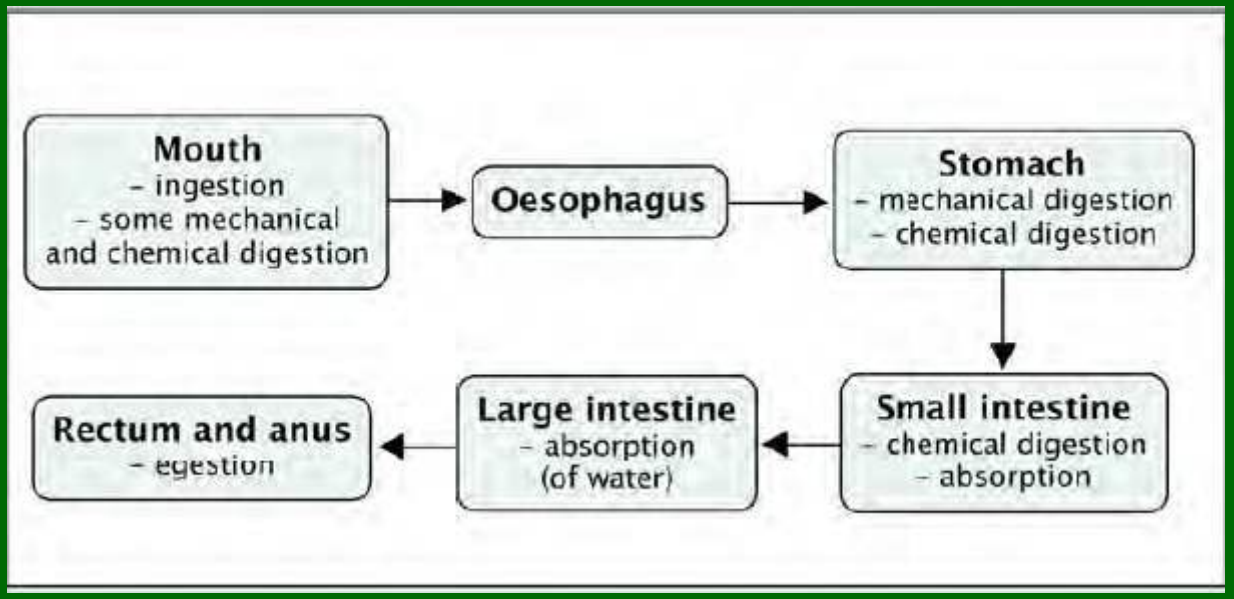
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1.2 Draw and explain how the digestive system works.



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NATURAL SCIENCES: LESSON PLAN 10 **GRADE 9**
PERIOD/DURATION: 30 MINUTES **STRAND: LIFE & LIVING**
CAPS SENIOR PHASE **TERM 1**

DURATION: Week Two Lesson Six	**OBJECTIVES: LEARNERS MUST BE ABLE TO:**
TOPIC: Cells as the basic units of life	• **Explain** what is "stem cells" and what the pro and cons of its use.
SUBTOPIC: Cells in tissues, organs and systems	
Terminology	Specialised cells; tissues; organs; systems
SPECIFIC AIMS	1. DOING SCIENCE
	2. KNOWING THE SUBJECT CONTENT & MAKING CONNECTIONS ✓
	3. UNDERSTANDING THE USES OF SCIENCES & INDIGENOUS KNOWLEDGE

SCIENCE PROCESS SKILLS

Accessing & recalling Information	✓	Identifying problems & issues		Doing Investigations	
Observing		Raising Questions		Recording Information	
Comparing	✓	Predicting	✓	Interpreting Information	
Measuring		Hypothesizing	✓	Communicating	✓
Sorting & Classifying		**Planning Investigations**			

CONTENT	TEACHING & LEARNING ACTIVITIES	Resources
Stem Cells Stem cells are unspecialized cells which can divide and develop into many different types of specialized cells. Stem cells are quite amazing as they can divide and multiply while at the same time keeping their ability to develop into any other type of cell. Embryonic stem cells are the little ball of 50 -150 cells that forms 4-5 days after conception. Embryonic stem cells are very special as they can become absolutely any cell in the body, for	Teacher will present the lesson by giving a case study which contains information about stem cell research. Teacher will use a video clip to explain what stem cells are in a simplified manner.	Internet Video clips Chalkboard White board worksheets

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CONTENT	TEACHING & LEARNING ACTIVITIES	Resources
example, blood cells, nerve cells, muscle cells or brain cells. For this reason, scientists are using stem cells to conduct research. There are many benefits in doing this, but there are also many controversial and ethical issues surrounding stem cell research.	Learners will watch a video clip and answer a worksheet based on stem cells.  Stem Cell Basics- Educational cartoon for young learners.mp4 **Reference:** http://www.youtube.com/watch?v=tPulEAryPO0 Teacher will also state why some people believe that stem cell research is unethical.	
ASSESSMENT	Discussions; Watch video clip; Conduct practical slide preparation	
TEACHER REFLECTION		

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Why do we need stem cells? Answer this worksheet in your note books.

CASE STUDY ON STEM CELL RESEARCH

Stem cells in the news

1. Read the article and answer in your notebooks.

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AUGUST 2, 2009
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Award-winning researcher's stem cell study offers hope for Parkinson's cure

Lyndsay Moss
Health Correspondent

A GROUND-BREAKING stem cell study being carried out in Scotland could finally lead to a cure for Parkinson's disease.

A researcher at Edinburgh University has been awarded £380,000 to create a special type of stem cell from patients with Parkinson's and their relatives.

It is hoped that cell lines created from just three families will help researchers around the world test new treatments for the disease.

And eventually the research could lead to patients receiving transplants of their own specially-treated cells to cure the condition.

Dr Tilo Kunath has been awarded a senior research fellowship by the Parkinson's Disease Society to push forward with his stem cell work.

In patients with Parkinson's, nerve cells in a particular part of the brain involved in co-ordinating movement die, leading to symptoms like tremors and problems walking.

In a UK first, Kunath and colleagues will create induced pluripotent stem cells (iPS cells) from people with Parkinson's to help understand why nerve cells die.

IPS cells are created by taking adult cells, such as from the skin, and reprogramming them in the lab to become cells which behave like embryonic stem cells – with the ability to transform into any type of cell, including nerve cells.

Glossary:

- cell line: cells that all originate from the same cell; they are grown and kept in the lab.
- condition: disease
- tremors: shaking
- reprogramming: change

In South Africa it is thought that around 18 000 people have Parkinson's disease. Most patients get the disease when they are over 50, but sometimes young people also get it.

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1. What happens to patients with Parkinson's? Give two symptoms.
2. What's so special about stem cells? Give two reasons

Dr Tilo Kunath is going to use patients' cells to make stem cells.

3. What can he do with these stem cells to understand the disease better?

4. Scientists hope that in the future stem cells can be used to help the patients. How?

5. What are these special types of stem cells called?

6. In your opinion do you think that "stem cell" research should continue, why?

7. If you had a specific disease that could be cured by stem cells would you use it and why?

8. What do you think are the reasons for people opposing stem cell usage?

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MEMORANDUM

1. The nerve cells involve in coordination in a particular part of the brain dies. Symptoms: tremors and problems with walking.
2. Stem cells can transform into any cell. Replace dead cells.
3. He will conduct research on patients with Parkinson's disease to better understand the disease.
4. In 2006, scientists discovered a new technique. They can now take a cell from a body, for example a skin cell, and turn it into a cell that behaves like stem cells from an embryo.
5. Induced pluripotent cells(IPS)
6. Yes, it will help to cure chronic diseases
   No, It is expensive.
   (Learner must justify their answer)
7. Yes, it will cure me, which will improve my quality of life.
   No, I cannot afford it because it is very expensive.
   (Learner must justify their answer)
8. Religious beliefs, we should not interfere with God's creation.
   (Learner must justify their answer)

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NATURAL SCIENCES Grade 9: LESSON PLAN 1
PERIOD/DURATION: 60 MINUTES
CAPS SENIOR PHASE

GRADE 9
STRAND: LIFE & LIVING
TERM 1

DURATION: Week Three Lesson One and Two **TOPIC:** Systems in the human body **Content & Concepts:** Body systems	**OBJECTIVES: LEARNERS MUST BE ABLE TO:** • **List and identify** the body systems dealt with, namely digestive; circulatory, respiratory; musculoskeletal; excretory; nervous and reproductive systems.

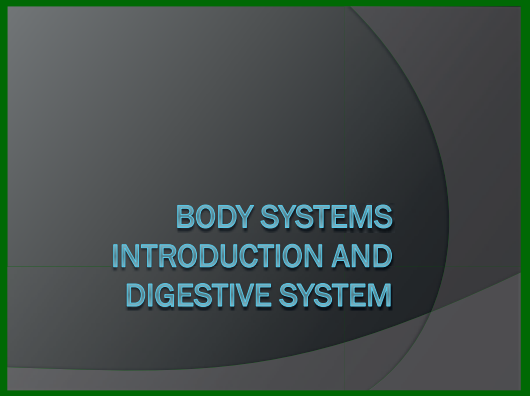
Terminology	Body systems, digestive, circulatory, respiratory, musculoskeletal, excretory, nervous, reproductive systems	
SPECIFIC AIMS	1. DOING SCIENCE	
	2. KNOWING THE SUBJECT CONTENT & MAKING CONNECTIONS	✓
	3. UNDERSTANDING THE USES OF SCIENCES & INDIGENOUS KNOWLEDGE	

PROCESS SKILLS

Accessing & recalling Information	✓	Identifying problems & issues		Doing Investigations	
Observing	✓	Raising Questions		Recording Information	✓
Comparing	✓	Predicting		Interpreting Information	
Measuring		Hypothesizing		Communicating	
Sorting & Classifying		Planning Investigations			✓

CONTENT	TEACHING & LEARNING ACTIVITIES	Resources
The human body consists of several integrated systems working together including the following: Digestive, Circulatory, respiratory, musculoskeletal, excretory, nervous and reproductive systems.	Teacher uses the Human Torso model to show to the learners the how the human body is made up of several integrated systems.  A teacher may use a large chart of the torso if needed. Teacher uses a video clip to further enhance what he explained when using the torso.	Video clips Internet Worksheets Chalkboard/Whiteboard Sasol Inzalo Book Torso Chart of Torso

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CONTENT	TEACHING & LEARNING ACTIVITIES	Resources
	Each individual system will be shown to learners. PowerPoint presentation can also be used. CLICK on slide below  Learners watch the video clip and make notes of each system discussed. The learners will complete an activity sheet as they complete each system in the human body. This can also be given as a homework activity.	
ASSESSMENT	Discussions; Watch video clip; Complete activity sheet.	
TEACHER REFLECTION		

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Activity Sheet: Human Body Systems

Building a Torso

1. Draw up a key for 36 structures.
2. Lightly shade all the bones on page 1 in grey pencil.
3. Fill in the key, shoulder blade (1), humerus (2), radius (3), ulna (4), floating rib (5), backbone (6), hip (7), femur (8).

4. Shade the following structures in yellow and fill in the key: gullet (9), stomach (10), duodenum (11), ileum (16), appendix (17), large intestine (18), rectum (19), and anus (20).
5. Shade the liver (12) in purple and fill in the key.
6. Shade the gall bladder (13) and bile duct (14) in green and fill in the key.
7. Do not shade the pancreas (15), but fill it in on the key.
8. Shade the following structures in brown and fill in the key: kidney (21), ureter (22), and bladder (23).

9. Shade the following structures in blue and fill in the key: urethra (24), sperm duct (26) and testis (27).
10. Do not shade the penis (25), but fill it in on the key.

11. Cut out tab AB and CD on the dotted lines.
12. Fold the tabs and glue them to the respective boxes on page 1. CD should lie below AB.
13. Fill in the following on in the key, leave them un shaded: voice box (28), windpipe (29), and bronchus (30).

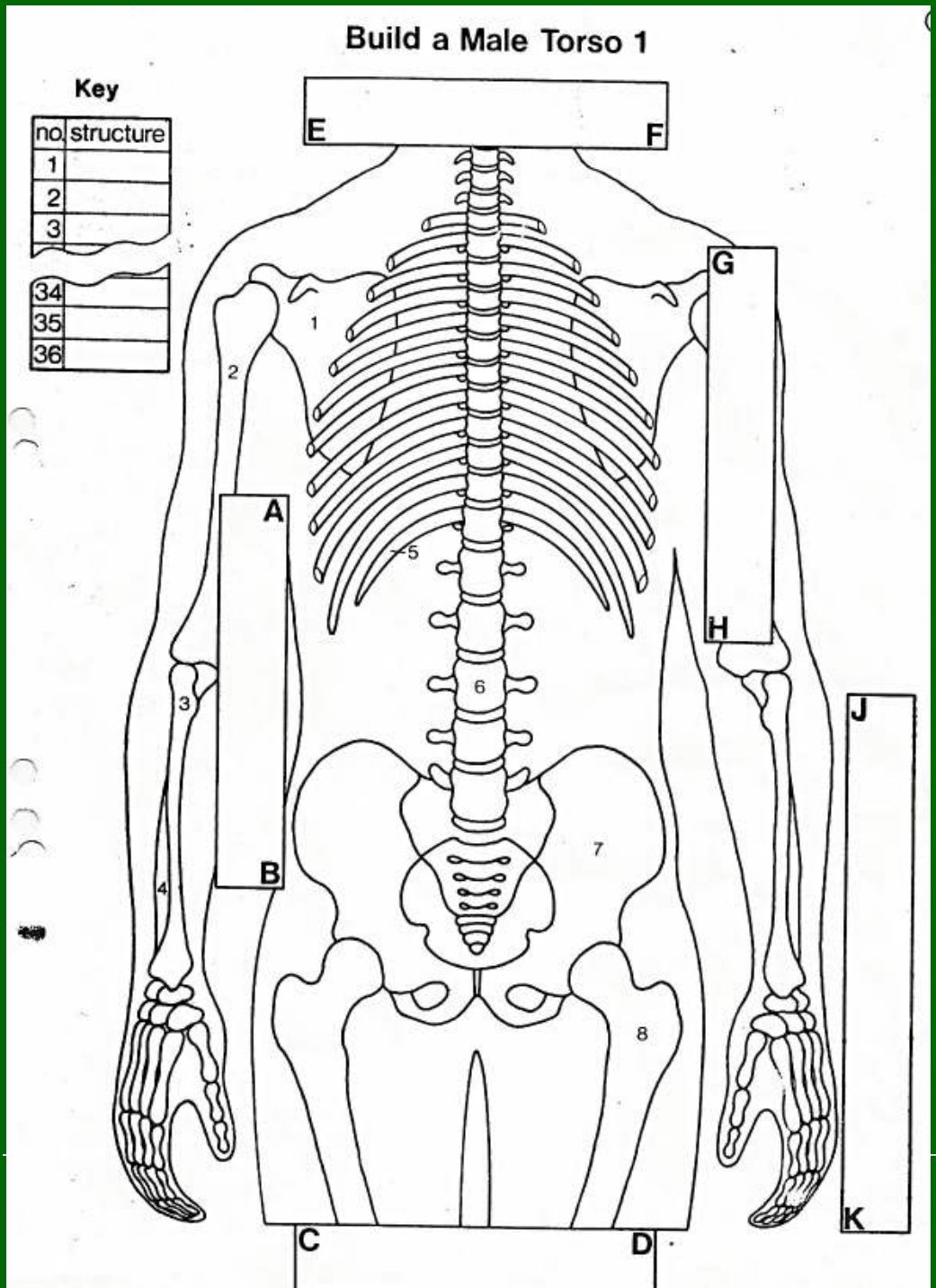
14. Shade the lungs (31) in pink and fill in the key.
15. Shade the following structures in red and fill in the key: heart (32) and diaphragm (33).

16. Use purple again to shade the outside of the liver (12).
17. Shade the following structures in grey and fill in the key: collar bone (34), breast bone (35) and rib cage (36).
18. Cut out tab EF and GH on the dotted lines.

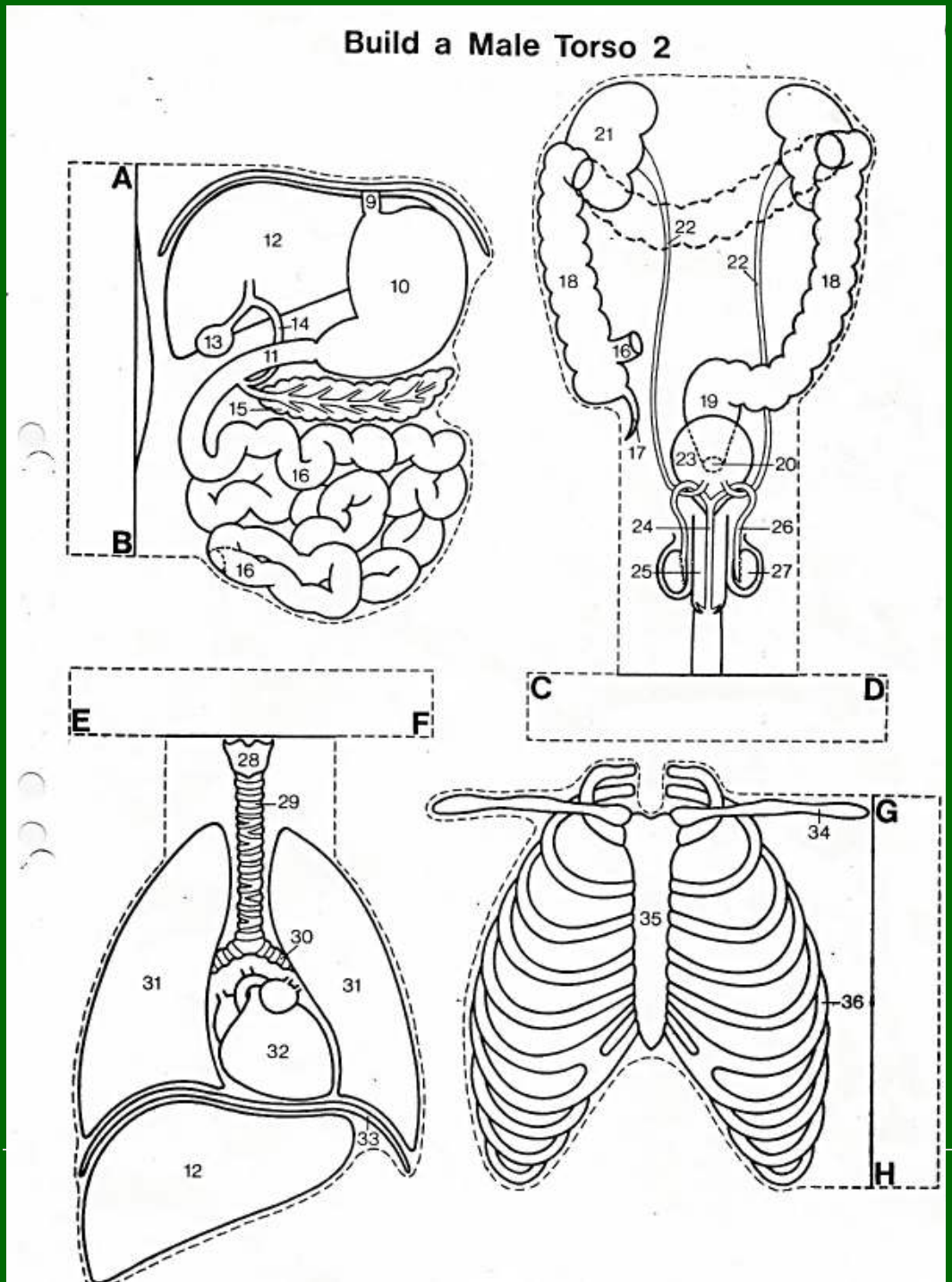
19. Fold the tabs and glue them to the respective boxes on page 1. EF should lie below GH.
20. Shade the muscles on JK in pink.
21. Cut out tab JK on the dotted lines, fold the tab and glue to the respective boxes on page 1.

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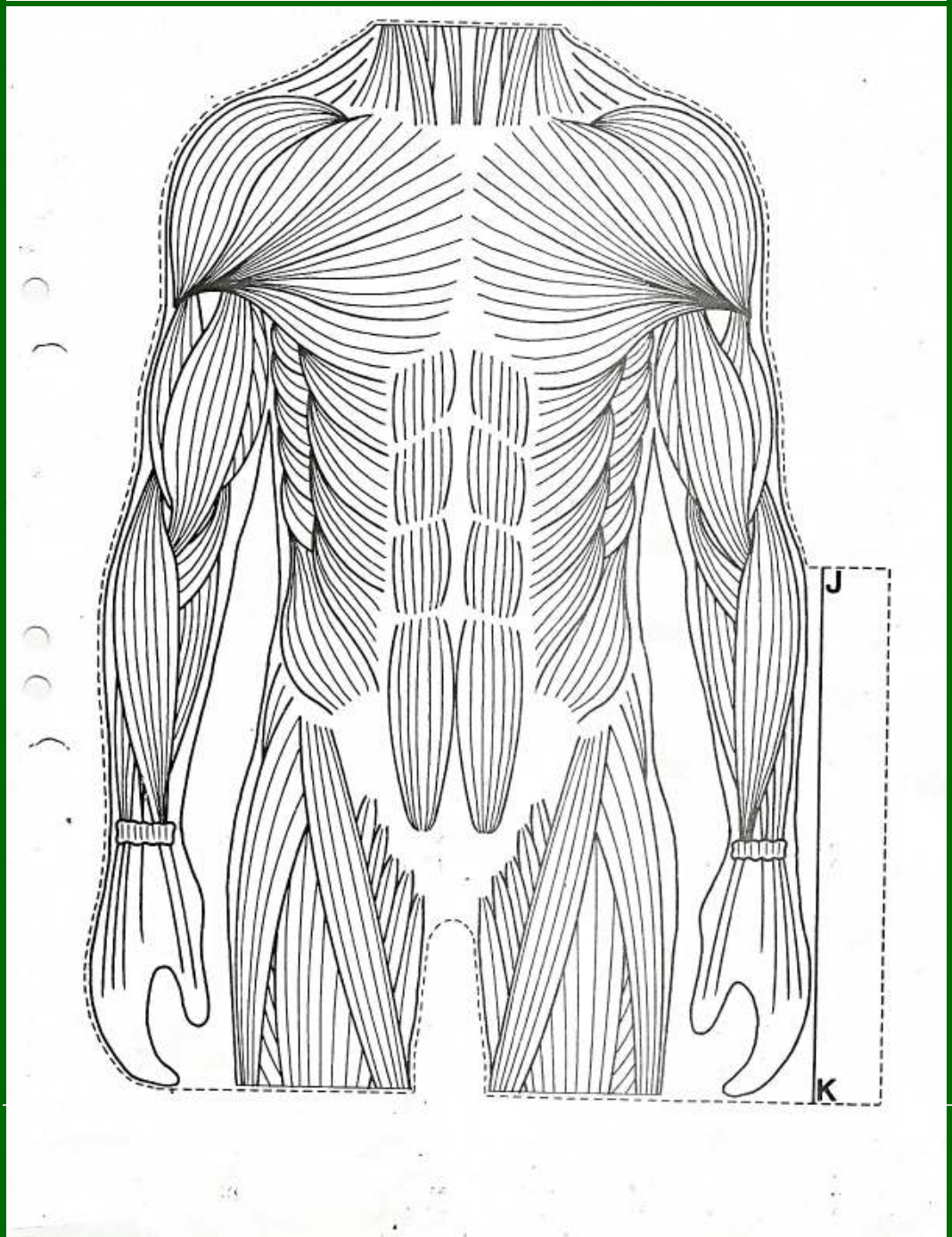


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Build a Male Torso 3



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MEMORANDUM
Teacher will print and copy for learners. The teacher can make a model for the learners.

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NATURAL SCIENCES: LESSON PLAN 2 **GRADE 9**
PERIOD/DURATION: 120 MINUTES **STRAND: LIFE & LIVING**
CAPS SENIOR PHASE **TERM 1**

DURATION: Week Three Lesson Three, Four, Five and Six **TOPIC:** Systems in the human body **SUBTOPIC:** Body systems – Digestive System	**OBJECTIVES: LEARNERS MUST BE ABLE TO:** • **State** the main purpose of the digestive system, namely ingestion, digestion, absorption and egestion. • **Identify** the main components of the digestive system.

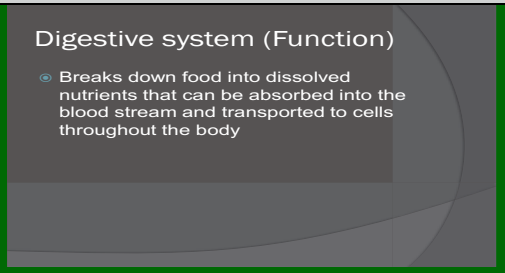
Terminology	Body systems, digestion; oesophagus, bolus, mastication, gastric juices, mechanical and chemical digestion, ingestion, absorption, elimination (egestion)	
SPECIFIC AIMS	1. DOING SCIENCE	
	2. KNOWING THE SUBJECT CONTENT & MAKING CONNECTIONS	✓
	3. UNDERSTANDING THE USES OF SCIENCES & INDIGENOUS KNOWLEDGE	✓

PROCESS SKILLS

Accessing & recalling Information	✓	Identifying problems & issues	✓	Doing Investigations	
Observing	✓	Raising Questions	✓	Recording Information	✓
Comparing	✓	Predicting	✓	Interpreting Information	✓
Measuring		Hypothesizing	✓	Communicating	✓
Sorting & Classifying		Planning Investigations			

CONTENT	TEACHING & LEARNING ACTIVITIES	Resources
• **Digestive system** • Breaks down food into dissolved nutrients that can be absorbed into the blood stream and transported to cells throughout the body. • the main processes include ingestion, digestion absorption • and egestion	Teacher uses the model of the torso or a chart of the digestive system and explains the parts that make up the digestive system. He also engages discussions around the main purpose of the digestive system. The following PowerPoint slides can be used during discussions. CLICK on slide below	Video clips Internet Worksheets Chalkboard/Whiteboard Sasol Inzalo Book Torso Chart of Torso

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CONTENT	TEACHING & LEARNING ACTIVITIES	Resources
• the main components include the mouth, oesophagus, stomach, intestines, liver **The alimentary canal and digestion** • the alimentary canal is composed of the mouth, oesophagus, stomach, small intestine, large intestine, rectum and anus. • digestion is the breakdown of food into a usable dissolved form There are two types of digestion: ○ mechanical digestion involves the physical breaking, crushing and mashing of food ○ chemical digestion involves the mixing food with digestive enzymes and hydrochloric acid *[no detail of the enzymes required]* • the structure of each part of the alimentary canal is adapted to its function *[no detail required]*	 Learners watch a video clip that explores the concepts of ingestion, digestion, absorption and egestion. Reference: http://www.youtube.com/watch?v=dGC_WIGPiMo Ingestion, digestion, absorption and elimination.mp4 An alternative video can also be used. The Digestive System.mp4 **Reference:** http://www.youtube.com/watch?v=P0zIzJVkxzA Learners are to complete the activity sheet provided. This can be a homework activity.	
ASSESSMENT	Discussions; Watch video clip; Complete activity sheet.	
TEACHER REFLECTION		

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ACTIVITY WORKSHEET: THE DIGESTIVE SYSTEM

1. Draw and label an annotated diagram of the human digestive system. Use a full page for this diagram.

2. List one function of the following structures of the digestive system:
   a) Oesophagus
   b) Pancreas
   c) Colon
   d) Small intestine

3. Outline the process of ingestion, digestion, absorption and elimination (egestion)

4. Complete the following table.

Component of Digestive System	Structure	Function	Common Conditions Associated with Component
Mouth			
Oesophagus			
Stomach			
Small Intestines			
Large Intestines (Colon)			
Anus			

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MEMORANDUM

THE DIGESTIVE SYSTEM

1. Most of the internal organs of the human body are situated in the torso (body cavity). The torso is hollow. The diaphragm divides the torso into a thoracic cavity (above the diaphragm) and an abdominal cavity (below the diaphragm). The digestive system forms a continuous canal from the mouth to the anus. This canal is called the **alimentary canal**.

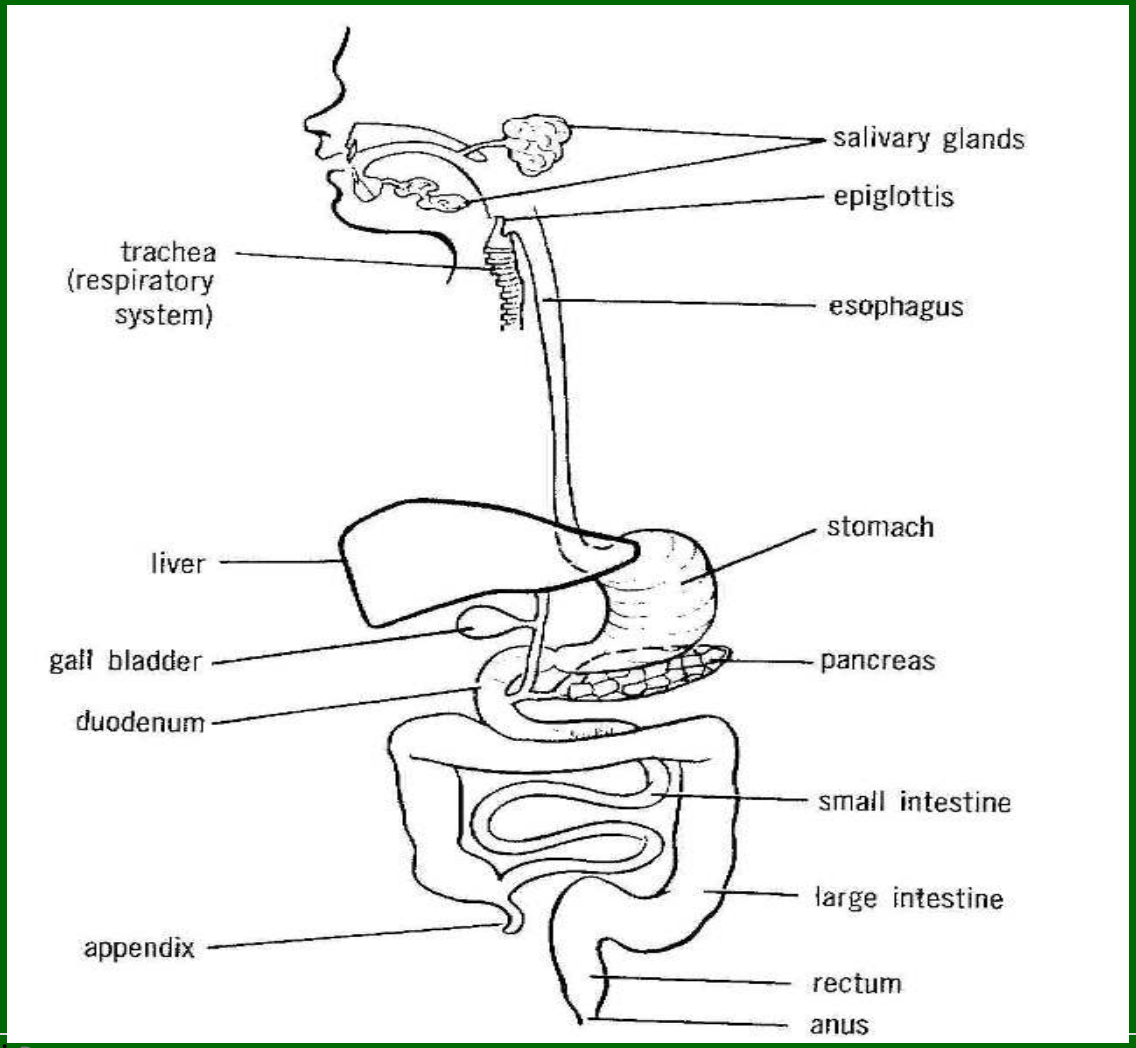


Diagram showing the human digestive system

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2.

a) Oesophagus - Muscle movements (peristalsis) moves bolus from mouth to stomach.
b) Pancreas - Produces insulin that helps regulate blood sugar levels.
c) Colon - Re-absorption of water, vitamins and minerals.
d) Small intestine - Chemical digestion.

3. The following processes take place in the alimentary canal:

Ingestion: the act of eating, putting food into your body.
Digestion: breaking the food down into smaller parts, so that it is small enough to be absorbed and transported by the blood. Mechanical digestion involves the physical breaking, crushing and mashing of food. Chemical digestions involves mixing food with digestive enzymes and hydrochloric acid.
Absorption: the uptake of food from the alimentary canal into the blood stream.
Elimination : the removal of undigested waste from the body through the anus.

4. The table below summarises the structures and functions of the various parts of the digestive system:

Component of Digestive System	Structure	Function	Common Conditions Associated with Component
Mouth	Teeth situated in upper and lower jaws.	Mechanical digestion (bite and chew food).	
	Salivary glands	Secretes saliva that contains enzymes that assists with chemical digestion of starch.	
	Tongue	• Helps to mix food with saliva to form bolus. • Assists with swallowing.	
Oesophagus	Long, muscular tube.	Muscle movements (peristalsis) moves bolus from mouth to stomach.	Heart burn
Stomach	A muscular, sac-like organ.	• Constant peristalsis to mix bolus with gastric juice. • Secretes gastric juice. • Chemical and mechanical digestion.	Heart burn Ulcers Gastro-enteritis (could lead to dehydration)
Liver	Beneath the diaphragm and partly overlaps the stomach.	• Detoxifies poisonous substances such as caffeine and alcohol from blood. • Produces bile.	Cirrhosis
Gall Bladder		Stores bile that neutralises gastric juice and breaks down fats.	
Pancreas		Produces insulin that helps regulate blood sugar levels.	Diabetes
Small Intestines	Muscular tube (±6m), coiled in abdominal cavity	• Chemical digestion. • Absorption of nutrients.	Ulcers Malnutrition (due to poor absorption)
Large Intestines (Colon)		• Re-absorption of water, vitamins and minerals. • Stores undigested waste (faeces) until egestion.	Constipation
Appendix		No function.	Appendicitis
Anus	Muscular valve at external opening of colon.	Egestion, elimination of undigested waste out of the body.	Haemorrhoids

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DURATION: Week Four Lesson One and Two **TOPIC: Systems in the human body** **Sub Topic:** Body systems Digestive System	**OBJECTIVES: LEARNERS MUST BE ABLE TO** • **List and describe** the health conditions associated to the digestive system.
TERMINOLOGY	Body systems, digestion; oesophagus, bolus, mastication, gastric juices, mechanical and chemical digestion, ingestion, absorption, elimination (egestion)
SPECIFIC AIMS	1. DOING SCIENCE
	2. KNOWING THE SUBJECT CONTENT & MAKING CONNECTIONS ✓
	3. UNDERSTANDING THE USES OF SCIENCES & INDIGENOUS KNOWLEDGE ✓

SCIENCE PROCESS SKILLS

Accessing & recalling Information	✓	Identifying problems & issues	✓	Doing Investigations	
Observing		Raising Questions		Recording Information	✓
Comparing	✓	Predicting	✓	Interpreting Information	✓
Measuring		Hypothesizing	✓	Communicating	✓
Sorting & Classifying		Planning Investigations			

CONTENT	TEACHING AND LEARNING ACTIVITY	Resources
Digestive system Health issues include ulcers, *anorexia nervosa*, diarrhoea, liver cirrhosis	The teacher will discuss how different health issues (ulcers, anorexia nervosa, diarrhoea and liver cirrhosis) are caused in the digestive system. The teacher will play a video that will assist with the understanding of how an ulcer will affect the digestive system and the human being in general. Reference: http://www.youtube.com/watch?v=lnVjXuyM6xk Stomach Ulcer - Nucleus Health.mp4 The teacher asks learners to refer to the hand out and read about ulcers, anorexia nervosa, diarrhoea and liver cirrhosis. Learners are to prepare a short presentation on each of these diseases and present to	Video clips Internet Chalkboard/Whiteboard Sasol Inzalo Book

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CONTENT	TEACHING AND LEARNING ACTIVITY	Resources
	their class mates.	
ASSESSMENT	Discussions; Watch video clip; Presentation by learners, read information.	
TEACHER REFLECTION	Progress / Challenges	

Hand out for learners

Health issues involving the digestive system
Common diseases of the digestive system include :

Ulcers: Sometimes open sores or ulcers develop on the lining of the mouth, oesophagus, stomach or upper portions of the small intestine. Ulcers can be very painful. They are generally caused by bacterial infections and some medications.

Anorexia nervosa: This is one of many eating disorders. People who suffer from this eating disorder have an abnormal fear of gaining weight and therefore starve themselves on purpose. This can lead to many health issues such as bone thinning, kidney damage, heart problems and even death.

Diarrhoea: Someone who passes very frequent, loose, watery stools has diarrhoea. Many diseases cause undigested food to pass through the large intestines too quickly for water to be absorbed and cause diarrhoea.

Liver cirrhosis: This disease slowly replaces healthy liver tissue with scar tissue and eventually prevents the liver from functioning properly. Alcohol abuse and fatty liver caused by obesity and diabetes are the most common causes of liver cirrhosis.

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DURATION: Week Four Lesson Three and Four	**OBJECTIVES: LEARNERS MUST BE ABLE TO**
TOPIC: Systems in the human body **Sub Topic:** Body systems Digestive System	• **List and describe** the health conditions associated to the digestive system.

TERMINOLOGY	Body systems, digestion; oesophagus, bolus, mastication, gastric juices, mechanical and chemical digestion, ingestion, absorption, elimination (egestion)	
SPECIFIC AIMS	1. DOING SCIENCE	
	2. KNOWING THE SUBJECT CONTENT & MAKING CONNECTIONS	✓
	3. UNDERSTANDING THE USES OF SCIENCES & INDIGENOUS KNOWLEDGE	✓

SCIENCE PROCESS SKILLS

Accessing & recalling Information	✓	Identifying problems & issues	✓	Doing Investigations	
Observing		Raising Questions		Recording Information	✓
Comparing	✓	Predicting	✓	Interpreting Information	✓
Measuring		Hypothesizing	✓	Communicating	✓
Sorting & Classifying		Planning Investigations			

CONTENT	TEACHING AND LEARNING ACTIVITY	Resources
Digestive system **Healthy diet** • a healthy diet (eating plan) requires different components including proteins, carbohydrates, fats and oils, vitamins and minerals, fibre and water • disorders of the digestive system can be related to inappropriate eating plans	The teacher will introduce the lesson with the seven building blocks of a healthy diet, which are proteins, carbohydrates, fats and oils, vitamins, minerals, fibre(non-digestive carbohydrates) and water. The teacher will explain each of the groups and learners will provide examples for each group. The teacher continues the lesson by discussing the disorders associated with inappropriate eating habits. Learners will complete worksheet on disorders as homework.(homework Activity) The teacher will demonstrate the practical to test which foods contain starch while the learners complete the worksheet.	Worksheets Chalkboard/Whiteboard Sasol Inzalo Book Iodine solution Food samples White paper
ASSESSMENT	Discussions, read information.	

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CONTENT	TEACHING AND LEARNING ACTIVITY	Resources
TEACHER REFLECTION	Progress	Challenges

HOMEWORK ACTIVITY: How does your diet affect your health in the short and long term?

INSTRUCTIONS:
1. Below is a table with descriptions of several health issues relating to a poor diet.
2. You need to read the descriptions and use your knowledge of the food groups to then classify what the diet of the person is deficient in, or else has a surplus of in their diet.
3. For some conditions, there may be a variety of causes, but this activity is focusing on the causes related to diet.

Name of health issue	Description	What does this person have a deficiency or surplus of in their diet?
Osteoporosis	Osteoporosis is a disease, most common in older women, where the bones become fragile and are more likely to break. Usually the bones lose density and become porous.	
Anaemia	Anaemia is a condition of the blood when there are not enough healthy red blood cells. A patient feels tired and weak as the tissues and organs in the body are not able to get enough oxygen so respiration slows down.	
Marasmus	This is a severe form of malnutrition due to starvation. The person becomes extremely thin (emaciated).	

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Name of health issue	Description	What does this person have a deficiency or surplus of in their diet?
Constipation	A person has constipation when they have a bowel movement less than 3 times per week. The person may have hard stools and difficulty and pain when passing stools.	

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Learners worksheet on the practical to test for starch.

INVESTIGATION: Which foods contain starch?

This investigation, will be demonstrated by the teacher and learners will complete the worksheet provided.

The materials required are:
• various food items to test for starch: for example, pieces of bread, apple, tomato, boiled egg, cheese, cucumber, potato, yoghurt, ham (some substances must contain starch and some not)
• various food items to test for fats and oil: for example, the above food items can be used, and in addition, you could also provide peanut butter and butter
• petri dish
• bottle of iodine solution and dropper
• forceps

AIM:
1. What is the aim of your investigation?
_____

HYPOTHESIS:
1. What is your hypothesis for this investigation?
_____

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MATERIALS AND APPARATUS:

1. List the materials and apparatus you used in this investigation.

_____

METHOD:

1. Write down the method which you followed in this investigation.

_____

RESULTS AND OBSERVATIONS:

1. Use the following space to record your results and observations from this investigation.

_____

Food substances	Result of iodine test	Contains starch

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DISCUSSION:

1. Discuss and evaluate your results and findings and the importance of food tests.

_____

_____

CONCLUSION:

1. What do you conclude from this investigation?

_____

_____

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MEMORANDUM

Name of health issue	Description	What does this person have a deficiency or surplus of in their diet?
Osteoporosis	Osteoporosis is a disease, most common in older women, where the bones become fragile and are more likely to break. Usually the bones lose density and become porous.	The main contributing factor is not enough calcium or Vitamin D in the diet. This can also be a genetic, inherited trait.
Anemia	Anemia is a condition of the blood when there are not enough healthy red blood cells. A patient feels tired and weak as the tissues and organs in the body are not able to get enough oxygen.	Too little iron in the diet. Iron is needed for healthy red blood cells to deliver oxygen to the tissues. Blood loss can also result in anemia, but this does not refer to diet.
Marasmus	This is a severe form of malnutrition due to starvation. The person becomes extremely thin (emaciated).	A severe deficiency of nearly all nutrients, especially protein and carbohydrates.
Constipation	A person has constipation when they have a bowel movement less than 3 times per week. The person may have hard stools and difficulty and pain when passing stools.	A diet lacking fibre. Fibre helps to produce stools and stimulate the digestive system. Not drinking enough fluids (water) can also cause constipation.

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INVESTIGATION: Which foods contain starch?

This investigation, will be demonstrated by the teacher and learners will complete the worksheet provided.

The materials required are:
• various food items to test for starch: for example, pieces of bread, apple, tomato, boiled egg, cheese, cucumber, potato, yoghurt, ham (some substances must contain starch and some not)
• various food items to test for fats and oil: for example, the above food items can be used, and in addition, you could also provide peanut butter and butter
• petri dish
• bottle of iodine solution and dropper
• forceps

INSTRUCTIONS TO TEACHER:
1. You need to conduct an investigation to test whether the food substances you have been provided with contain starch.
2. A summary of each test is given below. You will need to design your investigation and conduct it.

Starch iodine test:
Iodine solution is an orange-brown colour. When iodine is added to a substance which has starch in it, the iodine reacts with the starch to produce a blue-black colour. The blue-black colour indicates the presence of starch.

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TEACHER'S NOTE
Learners will need to use the dropper to add a couple drops of the iodine solution to the food substance to be tested in a petri dish. Let them practise on a small piece of white paper, so they see the colour change before trying it on the food. Starch hold the fibres in paper together.

AIM:
1. What is the aim of your investigation?
To find out whether starch or fats and oils, or both are present in certain foods.

HYPOTHESIS:
1. What is your hypothesis for this investigation?
Learner-dependent answer

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TEACHER'S NOTE
This will vary depending on what food substances you provide to learners. An example of a hypothesis for this investigation is: "The iodine solution will turn blue-black when added to the potato, bread and apple, indicating these foods contain starch. The emulsion from the cheese, yoghurt, butter and peanut butter will turn milky white, indicating the presence of fats".

MATERIALS AND APPARATUS:
1. List the materials and apparatus you used in this investigation.
Learner-dependent answer

TEACHER'S NOTE
An example that learners could provide:
• samples (small) of the following foods - learners identify which foods they are testing for starch and fats.
• iodine solution with dropper
• petri dish
• forceps
• test tubes
• paper

METHOD:
1. Write down the method which you followed in this investigation.
Learner-dependent answer

TEACHER'S NOTE
Learners need to write the method in a list of numbered steps. Learners need to indicate that they collected the food samples and placed them in different petri dishes (bowls if these were not available). They then dropped iodine solution in turn on each of these samples observing and recording the results. They must then indicate how they did the fat emulsion test, by placing small pieces of the food substances in a test tube, adding ethanol and crushing and stirring with the rod or another rounded, hard object. They should then pour the mixture onto paper and allowed the ethanol to evaporate and record the result.

RESULTS AND OBSERVATIONS:
1. Use the following space to record your results and observations from this investigation.
Learner-dependent answer

TEACHER'S NOTE
Learners could draw a table to record their results and observations, or just list the foods which tested positive or negative for each substance. An example of the layout for a learners table could be:

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Table to indicate the presence of starch or fats and oils in various food Substances (The teacher can use any foods available)

Food substances	Result of iodine test	Contains starch

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DISCUSSION:

1. Discuss and evaluate your results and findings and the importance of food tests.

Learner-dependent answer

TEACHER'S NOTE

Learners should discuss which types of foods contained starch. They could note that plant material in particular contains starch because the plants photosynthesize specifically to produce glucose that are the building blocks for carbohydrates. Animal products (such as the ham and boiled egg) do not contain starch. Learners should also discuss any unusual findings which they did not expect and whether this could be a result of inaccuracy or contamination. Learners should also evaluate their results and whether they could have done anything to improve the investigation, such as possibly repeating the tests.

CONCLUSION:

1. What do you conclude from this investigation?

Learner-dependent answer

TEACHER'S NOTE

Learners must refer back to their hypothesis in the conclusion and either reject or accept it.

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DURATION: Week Four Lesson Five and Six	**OBJECTIVES: LEARNERS MUST BE ABLE TO** • **Explain** the purpose of the circulatory system. • **List** the main components of the circulatory system. • **Describe** some health issues related to the circulatory system, namely high blood pressure, heart attacks and strokes.
TOPIC: Systems in the human body **SUB TOPIC:** Body systems: Circulatory system	

TERMINOLOGY	Pulmonary system, veins, arteries, capillaries, circulation of blood, stroke, heart attacks, high blood pressure	
SPECIFIC AIMS	1. DOING SCIENCE	
	2. KNOWING THE SUBJECT CONTENT & MAKING CONNECTIONS	✓
	3. UNDERSTANDING THE USES OF SCIENCES & INDIGENOUS KNOWLEDGE	✓

SCIENCE PROCESS SKILLS

Accessing & recalling Information	✓	Identifying problems & issues	✓	Doing Investigations	
Observing	✓	Raising Questions		Recording Information	✓
Comparing	✓	Predicting	✓	Interpreting Information	✓
Measuring		Hypothesizing		Communicating	✓
Sorting & Classifying		Planning Investigations			

CONTENT	TEACHING AND LEARNING ACTIVITY	Resources
Circulatory system Brings nutrients and oxygen to cells and removes waste products. The main processes include circulating blood between heart and lungs, and circulating blood between the heart and the rest of the body	Teacher has a class discussion on the human circulatory system. He will define the term circulatory system on the board and then ask learners questions to prompt them into the discussions. Using a chart or Torso or PowerPoint presentation, the teacher will show the main components of the circulatory system and what is the function of the circulatory system and the disease that affects it. Click the slide below	Video clips Internet Chalkboard/Whiteboard Sasol Inzalo Book Charts

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NATURAL SCIENCES : LESSON PLAN 4 **GRADE 9**
PERIOD/DURATION: 60 MINUTES **STRAND: LIFE & LIVING**
CAPS SENIOR PHASE **TERM 1**

CONTENT	TEACHING AND LEARNING ACTIVITY	Resources
The main components include the heart, blood vessels (arteries, veins, and capillaries), blood. Health issues include high blood pressure, heart attacks, and strokes.	 Learners must answer the following questions in their note books. 1. What is the purpose of the circulatory system? 2. What are the main components of the circulatory system? 3. What are some of the diseases that affect the circulatory system? Teacher must discuss some diseases that affect the circulatory system, like heart attacks, strokes and high blood pressure. Learners must refer to the Sasol Inzalo Workbook Pg.41 for information on diseases of the circulatory system.	
ASSESSMENT	Discussions; Watch video clip; Presentation by learners, read information.	
TEACHER REFLECTION		Challenges

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MEMORANDUM

1. Transportation of nutrients and oxygen to cells and removal of waste products.
2. Heart, blood vessels and blood.
3. Common diseases of the circulatory system include:

High Blood Pressure: This occurs when the force with which the blood pushes against the walls of the blood vessels is too high and can cause damage to the capillaries and several organs.

Heart Attacks: Occur when a narrowing or blood clot develops in one of the blood vessels that supplies the heart muscle with blood. If the narrowing or blood clot is big enough it can stop the blood flow to the heart muscle and can stop the heart from pumping which is called a heart attack. The person can die.

Strokes: Occur when cells in your brain are deprived of oxygen. This often occurs as a result of a blockage in the blood vessels leading to the brain, or when one of these vessels rupture (break or burst open).

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DAURATION: Week Five Lesson One and Two	**OBJECTIVES: LEARNERS MUST BE ABLE TO:**
TOPIC: Systems in the human body **SUBTOPIC:** Body systems: Circulatory and Respiratory system	• **Explain** the purpose of the respiratory system. • **List** the main components of the respiratory system. • **Describe** some health issues related to the respiratory system, namely asthma, lung cancer, bronchitis and asbestosis

TERMINOLOGY		
SPECIFIC AIMS	Respiratory system, breathing, inhalation, exhalation, gaseous exchange, trachea, lungs, air passage ways, bronchitis, asbestosis, asthma.	
	2. KNOWING THE SUBJECT CONTENT & MAKING CONNECTIONS	✓
	3. UNDERSTANDING THE USES OF SCIENCES & INDIGENOUS KNOWLEDGE	✓

SCIENCE PROCESS SKILLS

Accessing & recalling Information	✓	Identifying problems & issues	✓	Doing Investigations	
Observing	✓	Raising Questions		Recording Information	
Comparing		Predicting	✓	Interpreting Information	✓
Measuring		Hypothesizing		Communicating	
Sorting & Classifying		Planning Investigations			

CONTENT	TEACHING AND LEARNING ACTIVITY	Resources
Respiratory system Is responsible for supplying oxygen to the body and for removing carbon dioxide.	The teacher will represent the respiratory system by using a torso, charts and the chalkboard. The purpose of the respiratory system will be brought to the fore of the discussion in class. Activity 1. Some learners are used to demonstrate the intake of air into the lungs.	Video clips Internet Worksheets

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NATURAL SCIENCES Grade 9: LESSON PLAN 5
PERIOD/DURATION: 60 MINUTES
CAPS SENIOR PHASE

GRADE 9
STRAND: LIFE & LIVING
Term 1

CONTENT	TEACHING AND LEARNING ACTIVITY	Resources
The main processes include breathing (inhalation and exhalation), gaseous exchange (diffusion) and respiration. The main components include the nose and mouth, trachea and other air passageways, lungs, blood. Health issues include asthma, lung cancer, bronchitis, asbestosis	Learners are to place their hands on the side of their rib cage and take a deep breath and then to breathe out. Through discussions allow them to explain what took place. Let the learners also present their reasoning as to where the air they breathed in goes. Learners now watch a video clip on the respiratory system and answer an activity sheet given. The Sasol Inzalo (Siyavula) Pg. 41-43 workbook can be used for more information. Reference: http://www.youtube.com/watch?v=zRv5tNCMpyY  Respiration 3D Medical Animation.wmv.mp4 The teacher will briefly explain some health issues related to the respiratory system, learners directed to the Sasol Inzalo (Siyavula Book) for further research. This will be done to encourage reading and researching skills.	Chalkboard/Whiteboard Sasol Inzalo Book Charts
ASSESSMENT	Discussions; Watch video clip; Presentation by learners, read information.	
TEACHER REFLECTION		Challenges

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The respiratory system activity sheet

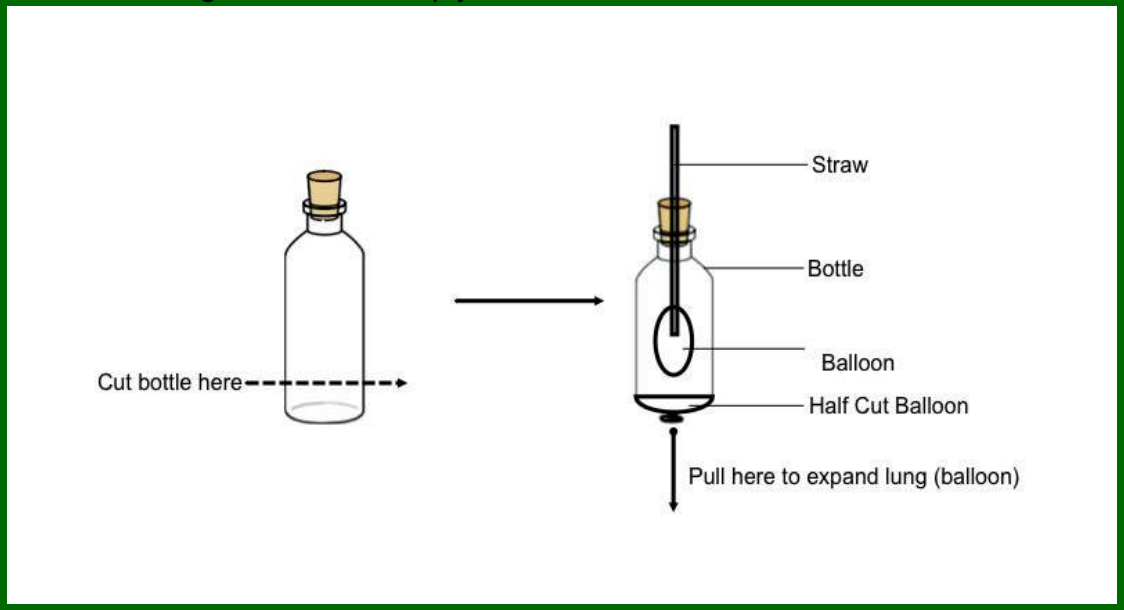
1. Name 2 air passageways in the human respiratory system.
2. Draw a table that will summarise the following diseases associated with the respiratory system: Refer to Sasol Inzalo workbook Pg. 43 for more information.

- asthma,
- lung cancer,
- bronchitis,
- asbestosis

4. Name the main components in the respiratory system. Refer to Pg. 42 of Sasol Inzalo Book.
5. State and explain the main processes that occur in the respiratory system.

Homework

Make a model of the respiratory system using a plastic coke bottle, two balloons and a straw.
Look at the diagram below to help you with the model.



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MEMORANDUM

1. Mouth, nose, trachea and bronchus.

2. Some common health issues of the respiratory system are:

Disease	Causes
Asthma	caused by allergies that inflame and narrow the airways
Lung cancer	a disease that mostly results from smoking or severe air pollution
Bronchitis	swelling of the lining of the bronchi due to infection which causes coughing and makes it difficult to get air into their lungs
Pneumonia	an infection in the lungs where the alveoli fill with fluid
TB (Tuberculosis)	an infectious disease caused by the bacteria,
Asbestosis	Caused by inhalation of asbestos fibres which get caught in the lungs and causes the lung tissue to thicken.

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DURATION: Week Five Lesson Three and Four	**OBJECTIVES: LEARNERS MUST BE ABLE TO** • **Explain** the purpose of the circulatory system. • **List** the main components of the circulatory system. • **Describe** some health issues related to the circulatory system, namely high blood pressure, heart attacks and strokes.
TOPIC: Systems in the human body **SUB TOPIC:** Body systems: Circulatory system and Respiratory System	

TERMINOLOGY	Pulmonary system, veins, arteries, capillaries, circulation of blood, stroke, heart attacks, high blood pressure	
SPECIFIC AIMS	1. DOING SCIENCE	
	2. KNOWING THE SUBJECT CONTENT & MAKING CONNECTIONS	✓
	3. UNDERSTANDING THE USES OF SCIENCES & INDIGENOUS KNOWLEDGE	✓

SCIENCE PROCESS SKILLS

Accessing & recalling Information	✓	Identifying problems & issues	✓	Doing Investigations	
Observing	✓	Raising Questions		Recording Information	✓
Comparing	✓	Predicting	✓	Interpreting Information	✓
Measuring		Hypothesizing		Communicating	✓
Sorting & Classifying		Planning Investigations			

CONTENT	TEACHING AND LEARNING ACTIVITY	Resources
Breathing, gaseous exchange, circulation and respiration • oxygen is *inhaled* in a process called breathing • in the lungs gases are exchanged (*gaseous exchange*) between the alveoli and the surrounding capillaries by the process of *diffusion* • oxygenated blood is transported (*circulation*) from the lungs to the left side of the heart	Teacher has a class discussion on the human circulatory and respiratory systems. The learners will watch the videos and complete the worksheet. Reference: http://www.youtube.com/watch?v=oiqfNHC0lG0  How The Heart Works Animation Video - How Does the Circulatory System Work- Cardiovascular Anatomy.mp4 OR	Video clips Internet Worksheets Chalkboard/Whiteboard Sasol Inzalo Book Charts

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CONTENT	TEACHING AND LEARNING ACTIVITY	Resources



Circulatory system - Function, Definition & Anatomy - Human Anatomy - Kenhub.mp4



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CONTENT	TEACHING AND LEARNING ACTIVITY	Resources
ASSESSMENT	Discussions; Watch video clip; Presentation by learners, read information.	
TEACHER REFLECTION		Challenges

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Worksheet

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1. Match the word on the left to its correct meaning on the right. Write only the letter next to the word to indicate the correct meaning. Use each letter only once.

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	breathing	a	arteries, veins and capillaries
	diaphragm	b	the type of tissue that keeps keeps the trachea open
	alveoli	c	small grape-like bunches at the ends of the bronchiole
	trachea	d	the movement of particles through a permeable membrane from a high to a low concentration
	heart	e	the tube that carries air to and from the mouth to the bronchi
	veins	f	blood vessels that transport blood away from the heart
	respiration	h	blood vessels that carry blood towards the heart
	cartilage	i	tubes leading from the trachea into the lungs
	bronchi	j	the process takes place in mitochondria to release energy for the cell to use
	capillaries	k	the organ responsible for pumping blood throughout the body
	types of blood vessels	l	inhaling and exhaling
	diffusion	m	these blood vessels surround alveoli to allow for gaseous exchange
	arteries	n	a large dome shaped muscle across the bottom of the rib cage

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l	breathing	a	arteries, veins and capillaries
n	diaphragm	b	the type of tissue that keeps keeps the trachea open
i	alveoli	c	tubes leading from the trachea into the lungs
e	trachea	d	the movement of particles from a high to a low concentration through a semi-permeable membrane
k	heart	e	the tube that carries air to and from the mouth to the bronchi
h	veins	f	blood vessels that transport blood away from the heart
j	respiration	h	blood vessels that carry blood towards the heart
b	cartilage	i	small grape-like bunches at the ends of the bronchiole
c	bronchi	j	the process takes place in mitochondria to release energy for cells to use
m	capillaries	k	the organ responsible for pumping blood throughout the body
a	types of blood vessels	l	inhaling and exhaling
d	diffusion	m	blood vessels surround cells to allow for diffusion
f	arteries	n	a large dome shaped muscle across the bottom of the rib cage

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DURATION: Week Five Lesson Five and Six	**OBJECTIVES: LEARNERS MUST BE ABLE TO:** • **Explain** the purpose/processes of the musculoskeletal system. • **List** the main components of the musculoskeletal system. • **Describe** some health issues related to the musculoskeletal system, namely rickets, arthritis and osteoporosis
TOPIC: Systems in the human body **SUB-TOPIC:** Musculoskeletal system	
REFERENCES: Sasol Inzalo workbook	

TERMINOLOGY:	Musculoskeletal system, contraction, relaxation, locomotion, bones, cartilage, tendons, ligaments, rickets, arthritis and osteoporosis.	
SPECIFIC AIMS	1. DOING SCIENCE	
	2. KNOWING THE SUBJECT CONTENT & MAKING CONNECTIONS	✓
	3. UNDERSTANDING THE USES OF SCIENCES & INDIGENOUS KNOWLEDGE	✓

SCIENCE PROCESS SKILLS

Accessing & recalling Information	✓	Identifying problems & issues	✓	Doing Investigations	
Observing	✓	Raising Questions		Recording Information	
Comparing		Predicting	✓	Interpreting Information	✓
Measuring		Hypothesizing		Communicating	
Sorting & Classifying		Planning Investigations			

CONTENT AND CONCEPTS	TEACHING AND LEARNING ACTIVITIES	RESOURCES
Musculoskeletal system Muscles produce body movement. The skeleton protects the body, provides support and enables movement The main processes include contraction and relaxation of muscles, locomotion and movement.	The teacher will use the PowerPoint presentation to explain and create discussion around the musculoskeletal system. The use of the torso and skeleton model is essential. CLICK the slide below to start presentation. 	Video clips Torso Internet Worksheets Chalkboard/Whiteboard Charts PowerPoint

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CONTENT AND CONCEPTS	TEACHING AND LEARNING ACTIVITIES	RESOURCES
The main components include the muscles, bones, cartilage, tendons and ligaments. Health issues include rickets, arthritis, osteoporosis	Learners will make notes during the presentation based on the worksheet provided. The teacher will show a video clip on the musculoskeletal system. Reference: www.makemegenius.com  The Muscular System - Human Body Video for Kids by www.makemegenius.com.mp4	
ASSESSMENT	Discussions; Watch video clip; Complete Activity 1 underneath and read information.	
TEACHER REFLECTION		

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WORKSHEET & CONTENT SHEET: MUSCULO-SKELETAL SYSTEM AND MOVEMENT

Try to fill in the blank spaces as you interact with the presentation.

Locomotion is the process in which organisms move from one place to another.
The _____**system** gives humans the ability to move. Locomotion and movement rely primarily on three systems:

- Muscular system
- Skeletal system
- Nervous system

The musculoskeletal system is an interaction of both the **skeleton** (bones) and the **muscles** of the body. The musculoskeletal system provides form, stability and movement.

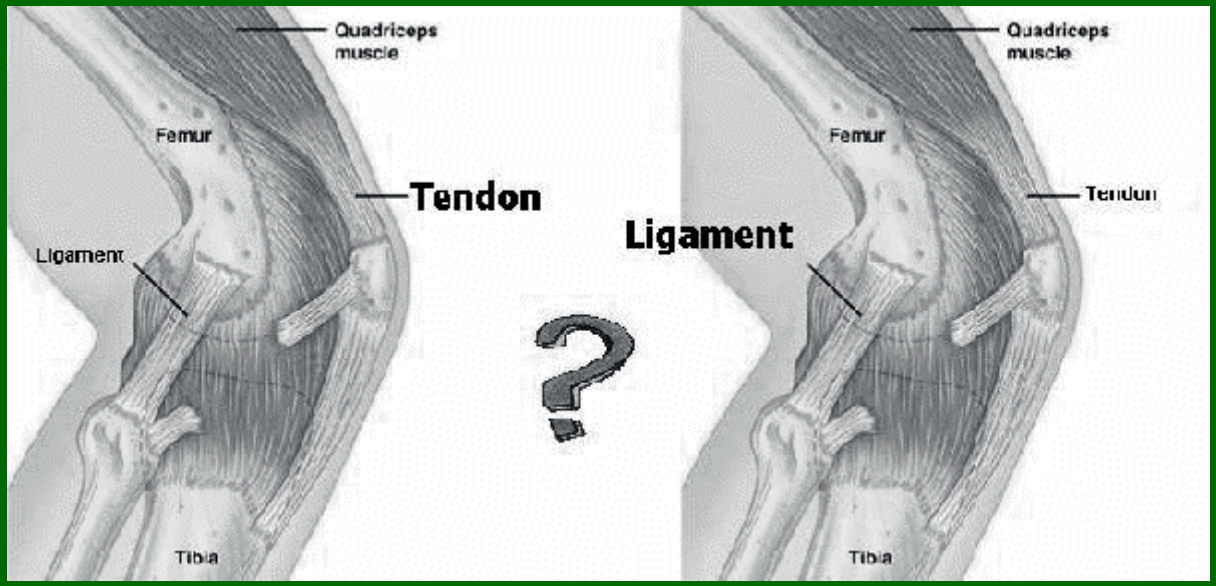
The components of the muscular skeletal systems include:

- The_____, bones provide structure to the body.
- _____ connect bones to bones.
- _____ connect muscle to bones.
- _____ contract and expand to move bones.
- Movement is controlled by “messages” sent from the brain to the muscles resulting in an action. These messages or impulses are conducted by **nerves**.

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Diagram showing tendons and ligaments in the knee.



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1. THE SKELETAL SYSTEM

Humans possess an **endoskeleton**, which forms an internal framework. The functions of the skeletal system include:

- It supports the body giving the body _____and form.
- It _____ the soft organs of the body such as the brain, lungs and heart.
- It makes _____ in the bone marrow.
- It brings about _____in conjunction with the muscles.
- **Storage of minerals** such as calcium and phosphorus.

The skeleton is made of **bone** and **cartilage.** The bone is hard because it contains minerals, the main mineral is calcium. Bone is a living **tissue**, containing blood vessels and nerves, allowing for the body to grow. Bones are held together by **ligaments**.

Cartilage is a softer material found between the bones. Cartilage acts as a shock absorber, preventing bones from jarring, and makes the back bone more flexible.

2. THE MUSCULAR SYSTEM

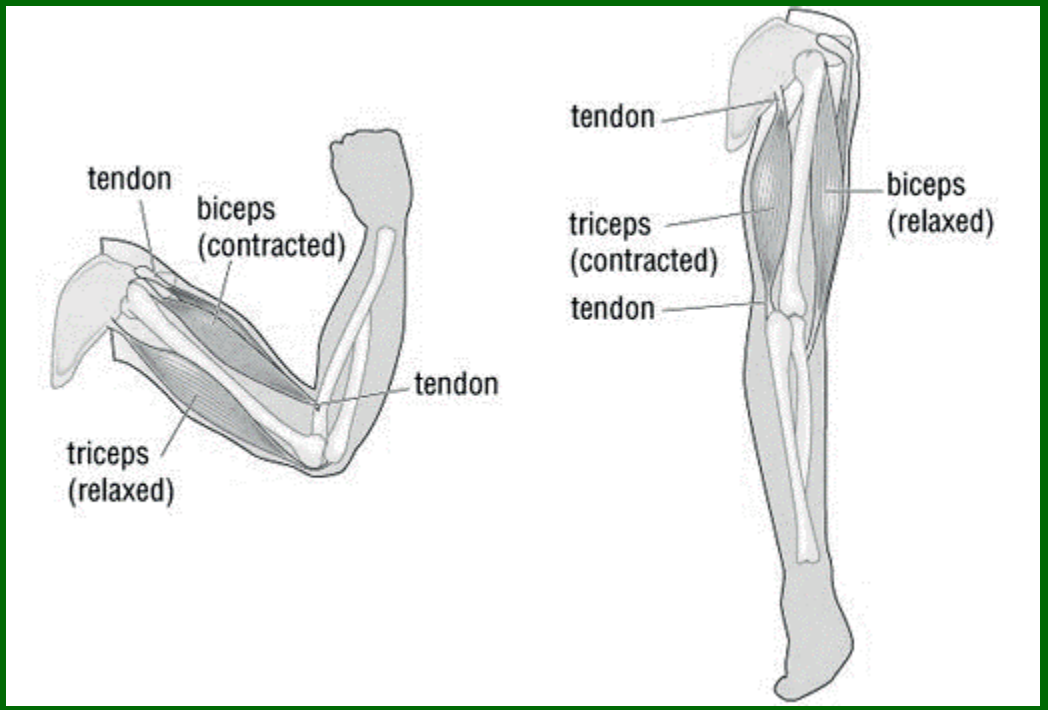
The skeleton is covered with muscles; these muscles are attached to the bones of the skeleton at both ends by **tendons**. Each muscle is made up of hundreds of muscle fibres able to contract and shorten the muscle as a whole. Every muscle has a **nerve**. When a message (**impulse**) from the brain reaches the end of the nerve it spreads along the muscle fibres causing them to contract. Because muscles can only contract (pull) and not push, a double set of muscles are needed for every movement (antagonistic pairs). When one muscle in the pair contracts the other relaxes and vice versa. This can be seen in the diagrams below.
To bend the arm the biceps contract whilst the triceps relax. When you straighten the arm the triceps contract and the biceps relax.



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Diagram showing how the biceps and triceps work antagonistically to straighten and bend an arm.



Certain drugs can cause a blockage of the barrier over which the message must cross, this results in paralysis. Most conditions of the musculoskeletal system are the result of **malnutrition**. **Drug and alcohol abuse** however also interfere with the absorption of vitamins and minerals, resulting in musculoskeletal conditions. Certain conditions associated with the musculoskeletal system are:

Health issues related to the musculoskeletal system.

1. OSTEOPOROSIS
   Osteoporosis is a condition caused by **low levels of calcium** in bones. The bones become soft, weak and fragile. It is common under older women and causes bones to fracture easily and heal slowly.

2. RICKETS
   Rickets is also a condition characterised by soft bones, but is found mostly in children. Because children are still growing, the soft bones often result in deformities (bending) of the arms and legs. Rickets is caused by a **vitamin D deficiency**.

3. ARTHRITIS

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Arthritis is a condition that affects the joints of people over the age of 55. Arthritis covers over 100 medical conditions; it is not a single disease. If you have arthritis something goes wrong with the joint(s). What goes wrong depends on what type of arthritis you have. It could be that the cartilage is wearing away, a lack of fluid, autoimmunity (your body attacking itself), infection, or a combination of many factors.

ACTIVITY 1: Musculoskeletal system.

1. State FOUR functions of the skeleton.

2. Define the terms:
   (a) Tendon
   (b) Ligament

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MEMORANDUM
WORKSHEET & CONTENT SHEET: MUSCULO-SKELETAL SYSTEM AND MOVEMENT

Try to fill in the blank spaces as you interact with the presentation.

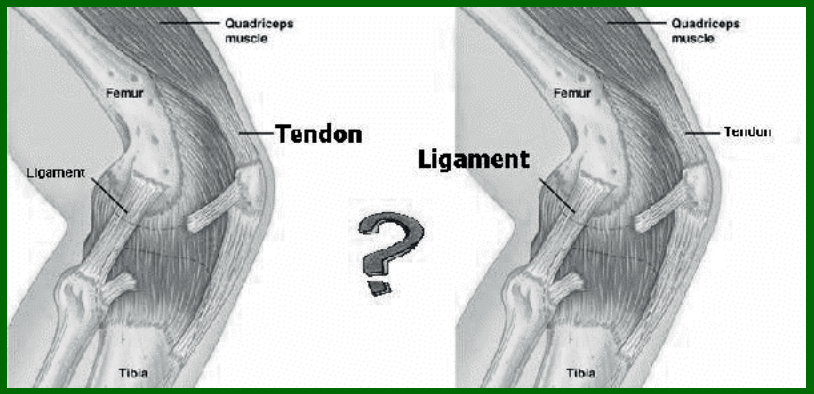
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- Nervous system

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- Cartilage connect bones to bones.
- Tendon connect muscle to bones.
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3. THE SKELETAL SYSTEM

Humans possess an **endoskeleton**, which forms an internal framework. The functions of the skeletal system include:

- It supports the body giving the body support and form.
- It protects the soft organs of the body such as the brain, lungs and heart.
- It makes blood cells in the bone marrow.
- It brings about movement in conjunction with the muscles.
- **Storage of minerals** such as calcium and phosphorus.

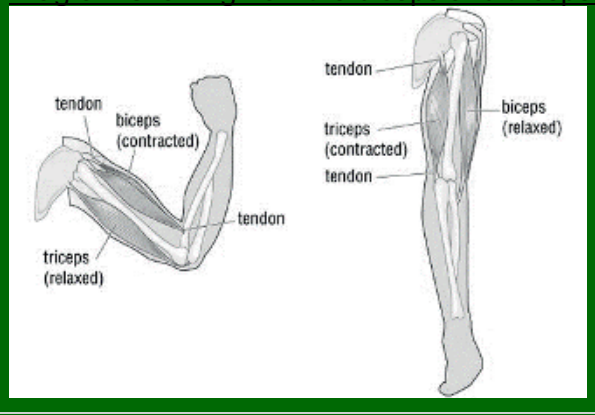
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Diagram showing how the biceps and triceps work antagonistically to straighten and bend an arm.



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Health issues related to the musculoskeletal system.

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6. ARTHRITIS
   Arthritis is a condition that affects the joints of people over the age of 55. Arthritis covers over 100 medical conditions; it is not a single disease. If you have arthritis something goes wrong with the joint(s). What goes wrong depends on what type of arthritis you have. It could be that the cartilage is wearing away, a lack of fluid, autoimmunity (your body attacking itself), infection, or a combination of many factors.

ACTIVITY 1: Musculoskeletal system.

1.
- muscles produce body movement
- The skeleton protects the body,
- provides support
– production of blood cells

2.
(a) Tendon – bands of strong, fibrous connective tissue that connect muscle to bones.
(b) Ligament – bands of tough, fibrous and slightly stretchy tissue that hold bones or cartilage together.

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NATURAL SCIENCES: EXCRETORY SYSTEM LESSON PLAN 7 **GRADE 9**

PERIOD/DURATION: 60 MINUTES **STRAND: LIFE & LIVING**

CAPS SENIOR PHASE **TERM 1**

DURATION: Wee k Six Lesson One and Two **TOPIC:** Systems in the human body **SUB-TOPIC:** Excretory System. **REFERENCES:** Sasol Inzalo workbook	**OBJECTIVES: LEARNERS MUST BE ABLE TO:** • **Draw and label** excretory system. • **List** the main components of the excretory system. • **Describe** some health issues related to the excretory system, namely kidney failure, bladder infection, kidney stones.

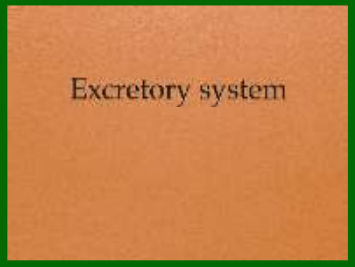
TERMINOLOGY:	Excretory system, filtration, absorption, diffusion, excretion, kidneys, bladder, ureters, kidney failure, bladder infection, kidney stones	
SPECIFIC AIMS	1. DOING SCIENCE	
	2. KNOWING THE SUBJECT CONTENT & MAKING CONNECTIONS	✓
	3. UNDERSTANDING THE USES OF SCIENCES & INDIGENOUS KNOWLEDGE	✓

SCIENCE PROCESS SKILLS

Accessing & recalling Information	✓	Identifying problems & issues	✓	Doing Investigations	
Observing	✓	Raising Questions		Recording Information	✓
Comparing		Predicting	✓	Interpreting Information	✓
Measuring		Hypothesizing		Communicating	✓
Sorting & Classifying		Planning Investigations			

CONTENT AND CONCEPTS	TEACHING AND LEARNING ACTIVITIES	RESOURCES
Excretory system Removes waste from the blood and regulates the body's fluids. The main processes include filtration, absorption, diffusion, excretion. The main components include the kidneys, bladder, and	Teacher introduces the lesson by showing a video clip on the excretory system. Reference: www.makemegenius.com  Excretory System Parts and Functions Animation video for kids.mp4 Learners will watch the video and then pay attention to the PowerPoint presentation made by the teacher.	Video clips Internet Worksheets Chalkboard/Whiteboard Charts

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CONTENT AND CONCEPTS	TEACHING AND LEARNING ACTIVITIES	RESOURCES
ureters. Health issues include kidney failure, bladder infection, kidney stones	CLICK the slide to start presentation  The teacher will use the excretory system from the torso model or a chart which will clearly address the excretory system. Learners will answer the activity sheet provided as they watch the video clip and listen to the presentation made by the teacher. Some questions from the activity sheet can be used for homework task.	PowerPoint
ASSESSMENT	Discussions; Watch video clip; Complete Activity Sheet underneath and read information.	
TEACHER REFLECTION		

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NATURAL SCIENCES: EXCRETORY SYSTEM LESSON PLAN 7
GRADE 9
PERIOD/DURATION: 60 MINUTES
CAPS SENIOR PHASE
TERM 1

STRAND: LIFE & LIVING

ACTIVITY SHEET: EXCRETION

1. Redraw and label the diagram of the urinary system using the rules for drawing a scientific diagram. Show the movement of urine using a specific colour.

2. The table below compares the quantities of five different substances in blood and urine of a human. Use the information in the table to draw a bar graph.

Substance	Quantity (parts per hundred)	
	Blood	Urine
Water	92	95
Proteins	7	0
Glucose	0.1	0
Salt	0.4	0.6
Urea	0.03	2

3. Research the various diseases of the excretory system and their symptoms and treatments. Choose ONE disease and do research on traditional/homeopathic remedies to treat your chosen disease. Prepare an oral presentation on your results, no longer than 1 minute. The rubric below will be used to assess you.

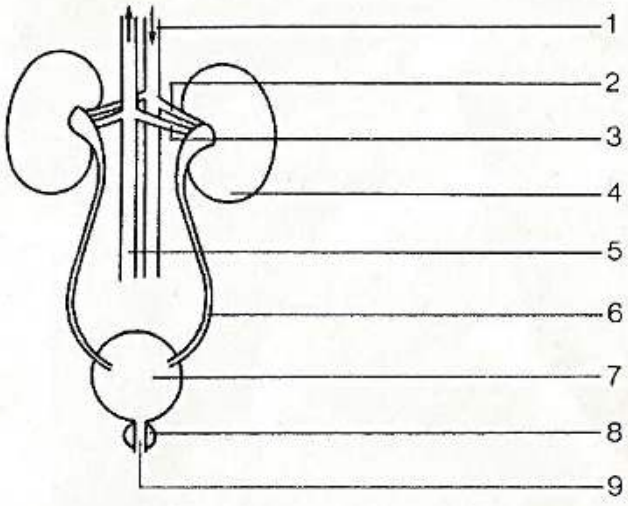
Rubric for Oral: Kidney/Bladder Ailments

Assessment Criteria	**Performance Indicators**			
	1	**2**	**3**	**4**
Introduction	No introduction	No links to content	Links to content	Stimulating with clear links to content
Body of Presentation	No body	Muddled	Coherent, but not always to the point	Coherent, clear and to the point
Summary	No summary	No links to content	Links to content	Effective, highlighted all key points
Use of Time	Too long or too short	Effective use of time		
Enthusiasm and Effort	Little enthusiasm	Good effort		
Creativity	Little creativity	Good effort		
Audience Interest	Little interest stimulated	Fun, stimulated lots of interest		
TOTAL				**20**

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4. Complete the puzzle below:



Find the names of the above 9 structures hidden in the puzzle below. Words may be in any direction but always in straight lines.

		S	O	B	A	N	J		
	J	A	T	L	E	R	I	R	I
I	A	V	A	C	A	N	E	V	T
	E	S	D	H	R	U	T	V	O	S
I	W	D	O	T	E	C	U	L	W	
T	E	K	I	D	N	E	Y	A	I	
R	U	S	T	I	A	D	G	N		
O	D	A	H	S	L	O	H	E		
P	E	P	R	O	A	S	R	R	T	
	S	G	H	E	R	F	O	T	S	
	T	U	R	E	T	H	R	A	A	M
		M	U	V	E	E	N	U	Q	O
			S	T	R	O	R	T	H	P
				V	Y	H	K	U	J	

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NATURAL SCIENCES: EXCRETORY SYSTEM LESSON PLAN 7
GRADE 9
PERIOD/DURATION: 60 MINUTES **STRAND: LIFE & LIVING**
CAPS SENIOR PHASE
TERM 1

Answers

No	Answers
1	Aorta
2	Renal artery
3	Renal vein
4	Kidney
5	Inferior vena cava
6	Ureter
7	Bladder
8	Sphincter muscle
9	urethra

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TURAL SCIENCES: LESSON PLAN 8
PERIOD/DURATION: 60 MINUTES
CAPS SENIOR PHASE

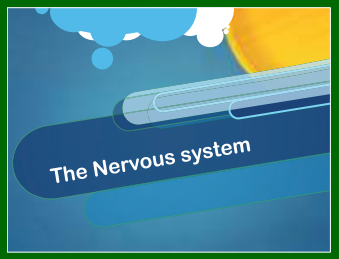
GRADE 9
STRAND: LIFE & LIVING
TERM 1

DURATION: Week Six Lesson Three and Four **TOPIC:** Systems in the human body **SUBTOPIC:** Body systems – Nervous System	**OBJECTIVES: LEARNERS MUST BE ABLE TO:** • **Explain** the processes of the nervous system. • **List** the main components of the nervous system. • **Describe** some health issues related to the nervous system, namely deafness, blindness, short sightedness, effects of drugs and alcohol on the brain.

Terminology	Nervous system, impulses, regulating temperature, brain, spinal cord, nerves, short sightedness	
SPECIFIC AIMS	1. DOING SCIENCE	
	2. KNOWING THE SUBJECT CONTENT & MAKING CONNECTIONS	✓
	3. UNDERSTANDING THE USES OF SCIENCES & INDIGENOUS KNOWLEDGE	✓

SCIENCE PROCESS SKILLS

Accessing & recalling Information	✓	Identifying problems & issues	✓	Doing Investigations	
Observing	✓	Raising Questions		Recording Information	✓
Comparing		Predicting	✓	Interpreting Information	✓
Measuring		Hypothesizing		Communicating	✓
Sorting & Classifying		Planning Investigations			

CONTENT AND CONCEPTS	TEACHING & LEARNING ACTIVITIES	Resources
Nervous system Receives and helps the body respond to stimuli. The main processes include hearing, seeing, feeling, tasting, smelling, sending and receiving impulses, regulating temperature. The main components include the brain, spinal cord, nerves, ears, nose, eyes,	Teacher will use the PowerPoint presentation and charts to explain the key content of the nervous system. CLICK the slide below. 	Video clips Internet Worksheets Chalkboard/White board Charts PowerPoint

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TURAL SCIENCES: LESSON PLAN 8
PERIOD/DURATION: 60 MINUTES
CAPS SENIOR PHASE

GRADE 9
STRAND: LIFE & LIVING
TERM 1

CONTENT AND CONCEPTS	TEACHING & LEARNING ACTIVITIES	Resources
skin, and tongue. Health issues include deafness, blindness, short sightedness, effects of drugs and alcohol on the brain.	After listening to the presentation learners are to engage with the activity sheet provided. They will also watch a video clip to get clarity of some concepts related to the nervous system. Reference: www.makemegenius.com  The Nervous System- Animation-Video for Kids -from www.makemegenius.com.mp4	
ASSESSMENT	Discussions; Watch video clip; Presentation by learners, complete activity sheet.	
TEACHER REFLECTION		

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ACTIVITY SHEET: NERVOUS SYSTEM

1. Define the following terms:
    a) Stimuli
    b) Neuron
    c) Receptor
    d) Short sightedness
2. Design a poster that can be used by the department of health warning teenagers on the dangers of smoking dagga.

3. Complete the table below by filling in the location of the receptors in each case.

Description of stimulus	Location of receptor
The smell of tasty food.	
The sound of your favourite music.	
The taste of your favourite food.	
The feel of your cell phone.	
The image on your computer screen	
The heat from a stove top.	

4. List the main components in the nervous system.

5. Distinguish between the central nervous system and the peripheral nervous system?

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MEMORANDUM

1a) Stimuli: changes in the environment(internal or external).
b) Neuron: structures that connect the central nervous system(brain 7 spinal cord) to other parts of the body.
c) Receptor: group of cells that are sensitive to stimuli.
d) Short sightedness: the focus is on things close by.
2. Use rubric to mark.
3.

Description of stimulus	Location of receptor
The smell of tasty food.	Linning of the nose
The sound of your favourite music.	Ear
The taste of your favourite food.	Tongue
The feel of your cell phone.	Skin
The image on your computer screen	Eye
The heat from a stove top.	Skin

,
4. Nerves, brain, spinal cord, sensory organs.
5. Central nervous system is consists of the brain and spinal cord. Peripheral nervous system consists of nerves connect to muscles and organs.

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TURAL SCIENCES: LESSON PLAN 9 **GRADE 9**
PERIOD/DURATION: 60 MINUTES **STRAND: LIFE & LIVING**
CAPS SENIOR PHASE **TERM 1**

DURATION: Week Six Lesson Five and Six **TOPIC:** Systems in the human body **Content & Concepts:** Body systems Reproductive System	**OBJECTIVES: LEARNERS MUST BE ABLE TO:** • **Explain** the purpose and processes of the reproductive system. • **List** the main components of the reproductive system. • **Describe** some health issues related to the reproductive system, namely infertility, foetal alcohol syndrome, and STD's.
Terminology	Reproductive system, sex cells, species, cell division, maturation, copulation, ejaculation, ovulation, menstruation, fertilisation, implantation.

SPECIFIC AIMS	**1. DOING SCIENCE**	
	2. KNOWING THE SUBJECT CONTENT & MAKING CONNECTIONS	✓
	3. UNDERSTANDING THE USES OF SCIENCES & INDIGENOUS KNOWLEDGE	✓

SCIENCE PROCESS SKILLS

Accessing & recalling Information	✓	Identifying problems & issues	✓	Doing Investigations	
Observing	✓	Raising Questions		Recording Information	
Comparing	✓	Predicting	✓	Interpreting Information	✓
Measuring		Hypothesizing		Communicating	✓
Sorting & Classifying		Planning Investigations			

CONTENT	TEACHING & LEARNING ACTIVITIES	Resources
Reproductive system Produces sex cells for the purpose of continuation of the species. The main processes include growth, cell division, maturation, copulation, ejaculation, ovulation, menstruation, fertilization, and implantation. The main components include testes, ovaries, and uterus.	Teacher will introduce this topic by using the torso or specific charts that highlights the reproductive system. The use of a guest speaker e.g. community nurse or local medical doctor could be appropriate. Allocate a maximum of 5-8 minutes for their brief interaction with the learners. A video will be played to outline the reproductive process in humans. Learners watch and conceptualise the concepts and components in the human reproductive system. Reference: http://www.youtube.com/watch?v=vOdoO7LHNJs	Video clips Internet Worksheets Chalkboard/Whiteboard Charts PowerPoint

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Health issues include infertility, foetal alcohol syndrome, STDs.	 Reproduction system in human beings ANIMATION VIDEO-must watch for students,teens and adul Learners are given an activity from Siyavula Workbook on the reproductive system (Pg.52-54)	
ASSESSMENT	Discussions; Watch video clip; Presentation by learners, complete activity sheet.	
TEACHER REFLECTION		

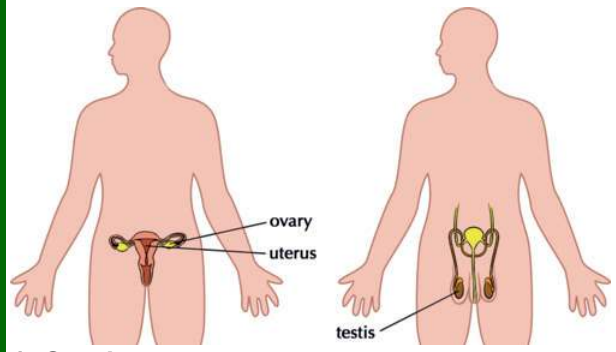
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Components of the reproductive system

We will be looking at the reproductive organs in more detail in the next chapter. For now, let's get an overview of the main components in the reproductive system.

The female (left) and male (right) reproductive organs differ:



1. Ovaries

The ovaries are located inside the female's body in the lower abdomen and produce mature egg cells (ova).

The largest cell in the human body is the ovum (egg cell) and the smallest cell is the sperm cell.

2. Uterus

The uterus (also known as the womb) is present in females. It has a thick lining and muscular wall. This is where a fertilized egg will implant and develop during pregnancy.

Some of the strongest muscles in the female body are found in the uterus! Can you think of reasons why this is?

3. Testes

The sex organs in males are located in the scrotum, a pouch of skin that hangs between the legs. During puberty the testes start to produce sperm cells.

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Main processes in the reproductive system

- ejaculation
- fertilization
- gamete cells
- ovulation
- puberty
- sexual intercourse

During sexual reproduction, the egg and sperm have to combine to form a new individual. Let's do an activity to find out about the main processes in the reproductive system.

Health issues involving the reproductive system

Infertility: About 10% of heterosexual couples have problems falling pregnant and may even be completely unable to sexually reproduce. This is infertility and it affects both men and women.

Foetal Alcohol Syndrome: When a pregnant mother drinks alcohol during her pregnancy, the alcohol may cause serious birth defects in the unborn baby. This will affect the child throughout their entire life and in most cases cannot be reversed.

South Africa has the highest percentage of Foetal Alcohol Syndrome cases in the world, especially in the Western Cape. This is very tragic and programmes are being implemented to educate people on the dangers of drinking during pregnancy.

Sexually STDs): Many life-threatening diseases such as HIV/AIDS, syphilis and gonorrhoea can be transferred during sexual intercourse

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ACTIVITY: Defining the main processes involved in reproduction

INSTRUCTIONS :

- Below is a list of the main processes involved in the reproductive system.
- Look up each term, either in your dictionary or on the internet and write a brief description on the lines provided.
- The first three have been done for you.
- Growth

Growth is the increase in size and mass of an organism as it develops over time.

- Cell division

Cell division is the process when a parent cell divides into two daughter cells. In the reproductive system, cell division occurs within the ovaries and testes to produce gametes (sperm and egg cells)

- Maturation

Maturation is the process of becoming mature. In humans, this refers to puberty where sexual organs mature so that they are able to reproduce.

1. Copulation

_____

_____

2. Ejaculation

_____

_____

3. Ovulation

_____

_____

4. Menstruation

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5. Fertilisation

6. Implantation

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MEMORANDUM

1. Copulation
Copulation is the act of sexual intercourse (procreation) when a man inserts his penis into a woman's vagina.
2. Ejaculation
This is the release of the sperm into the woman's cervix during sexual intercourse.
3. Ovulation
This is when a mature ovum (female egg cell) is released from the ovary once a month.
4. Menstruation
If the ovum is not fertilised, the lining of the uterus is shed during menstruation.
5. Fertilisation
When a male (sperm cell) and female (egg cell) gamete fuse (come together) during copulation.
6. Implantation
In the reproductive system, this refers to the process when the fertilised egg implants (attaches firmly into) the uterus lining.

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DURATION: Week Seven Lesson One and Two **TOPIC: Human Reproduction** **SUBTOPIC:** Purpose of Reproduction	**OBJECTIVES: LEARNERS MUST BE ABLE TO:** • **Explain** the purpose of reproduction • **Identify** the sex cells(gametes) needed for continuation of life
TERMINOLOGY	**Gametes, Species, Testosterone, Oestrogen, Pituitary gland, Hormones,**

SPECIFIC AIMS	1. DOING SCIENCE	
	2. KNOWING THE SUBJECT CONTENT & MAKING CONNECTIONS	✓
	3. UNDERSTANDING THE USES OF SCIENCES & INDIGENOUS KNOWLEDGE	

SCIENCE PROCESS SKILLS

Accessing & recalling Information	✓	Identifying problems & issues	✓	Doing Investigations	
Observing	✓	Raising Questions	✓	Recording Information	
Comparing		Predicting	✓	Interpreting Information	✓
Measuring		Hypothesizing		Communicating	✓
Sorting & Classifying		Planning Investigations			

CONTENT	TEACHING AND LEARNING ACTIVITY	Resources
•The main purpose of reproduction is for the gametes (male and female sex cells) to combine for the continuation of the species	Direct teaching: The teacher will discuss reasons why humans must reproduce. 1. During discussions the following questions will be asked: - Why do people reproduce? - Is it necessary for our species to reproduce? 2. Learners will watch a video on importance of reproduction of species https://vimeo.com/81524749 4. Activity: 1 Learners answer worksheets prepared by the teacher	• Models or charts of the reproductive system. • Sasol Inzalo • English dictionary • Science dictionary • Video clip
ASSESSMENT	Informal assessment activity 2.	
TEACHER REFLECTION		Challenges

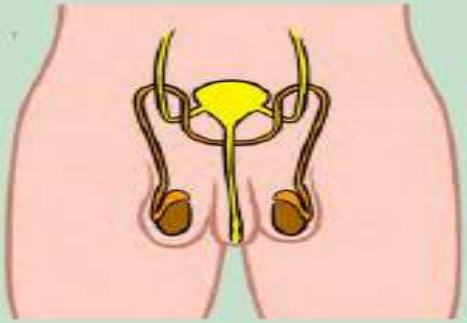
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ACTIVITY: Identify structure and function

1. Study the diagram of the male reproductive system. Label each part using its correct scientific name.
2. In the table, identify the function(s) of the male reproductive organs mentioned.
3. In the last column, suggest how you think the structure of the organ is adapted to perform the function most effectively.

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Reproductive Organ	Function	Adaptation
Penis		
Testes and scrotum		

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ACTIVITY: Comparing the reproductive organs

1. Explain how the structures of the vagina, cervix and uterus are specially adapted to fulfil their functions.

2. Provide at least 2 reasons why the uterus needs to have strong muscular walls.

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3. Compare the position and functions of the ovaries with that of the testes. Create a table to show these differences.

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MEMORANDAUM

Reproductive Organ	Function	Adaptation
Penis	During sexual intercourse, the penis becomes erect and delivers the sperm into the cervix of the vagina.	The penis is on the outside of the male body, and it is elongated so that it can insert into the vagina and deliver the sperm into cervix. The penis contains the urethra and becomes erect so that it can insert into the vagina.
Testes and scrotum	The testes produce the sperm and the scrotum hold the testes outside of the body.	The testes need to be at 35 °C, which is lower than body temperature, in order to produce sperm. The testes are therefore outside of the male body and hang in the scrotum, which can adjust the temperature of the testes so that the right temperature is maintained in order to produce sperm.

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1. Explain how the structures of the vagina, cervix and uterus are specially adapted to fulfil their functions.
   The vagina is elastic and muscular so it can contain the penis during intercourse to prevent the sperm from running out. The cervix is situated at the top of the vagina approximately where the penis' ejaculated sperm will be. It is tightly closed to protect the uterus. It carries the sperm into the uterus which has a thick, blood-rich lining, ready for the implantation of the fertilised egg.

2. Provide at least 2 reasons why the uterus needs to have strong muscular walls.
   The uterus needs to protect and carry the unborn child during pregnancy and it needs to contract and push out the baby during childbirth.
3. Compare the position and functions of the ovaries with that of the testes. Create a table to show these differences.
   A possible table that learners might produce:

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Differences between the female ovaries and the male testes

Characteristic	Ovaries	Testes
Position	Inside the body	Outside the body
Hormones produced	Oestrogen	Testosterone
When gametes are produced	Females are born with ova in their ovaries which mature once puberty is reached	Males only start to produce sperm once they reach puberty
Number of gametes released/produced	Release one ovum per month	Produce thousands of sperm daily
Hormone influence	Hormones in the ovaries stimulate the ovum which are already present so that they mature	Only start to produce sperm under the influence of the hormones

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NATURAL SCIENCE Grade 9: LESSON PLAN 2
PERIOD/DURATION: 60 MINUTES
CAPS SENIOR PHASE

GRADE 9
STRAND: LIFE & LIVING
TERM 1

DURATION: Week Seven Lesson Three and Four **TOPIC: Human Reproduction** **SUB TOPIC:** Purpose and Puberty	**OBJECTIVES: LEARNERS MUST BE ABLE TO:** • Explain the purpose of puberty and how it start • Identify the changes during puberty in males and females

TERMINOLOGY	Puberty, Mature, Testosterone, Oestrogen, Pituitary gland, Hormones, Ovaries, Testicle, Menstruation, Pubic hair, Facial hair	
SPECIFIC AIMS	1. DOING SCIENCE	
	2. KNOWING THE SUBJECT CONTENT & MAKING CONNECTIONS	✓
	3. UNDERSTANDING THE USES OF SCIENCES & INDIGENOUS KNOWLEDGE	

SCIENCE PROCESS SKILLS

Accessing & recalling Information	✓	Identifying problems & issues	✓	Doing Investigations	✓
Observing	✓	Raising Questions	✓	Recording Information	
Comparing		Predicting	✓	Interpreting Information	✓
Measuring		Hypothesizing		Communicating	✓
Sorting & Classifying		Planning Investigations			

CONTENT	TEACHING AND LEARNING ACTIVITY	Resources
•Puberty is the stage in the human life cycle when sexual organs mature for reproduction. This process is initiated when the pituitary gland releases hormones into the blood stream, triggering the testes and ovaries to release sex hormones (testosterone and oestrogen) • testosterone (from the testes) and oestrogen (from the ovaries) cause secondary sexual characteristics such as menstruation, breast development, pubic hair, facial hair, deepening of the male voice	1. Direct teaching: The teacher discusses the purpose of puberty, how it starts and changes that occur during that process in males and females. 2. The teacher uses models and charts while discussing and learners watch a video afterwards. http://www.youtube.com/watch?v=_1wIPgdNFPk  Signs You've Hit Puberty.mp4 3. ACTIVITY: Learners answer the worksheet provided after watching video	• Models and charts of the reproductive system. • Science dictionary, English dictionary. • Siyavula Gr9A • Video clip
ASSESSMENT	Informal assessment by means of the activities below.	

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NATURAL SCIENCE Grade 9: LESSON PLAN 2
PERIOD/DURATION: 60 MINUTES
CAPS SENIOR PHASE

GRADE 9
STRAND: LIFE & LIVING
TERM 1

CONTENT	TEACHING AND LEARNING ACTIVITY	Resources
TEACHER REFLECTION	Challenges	

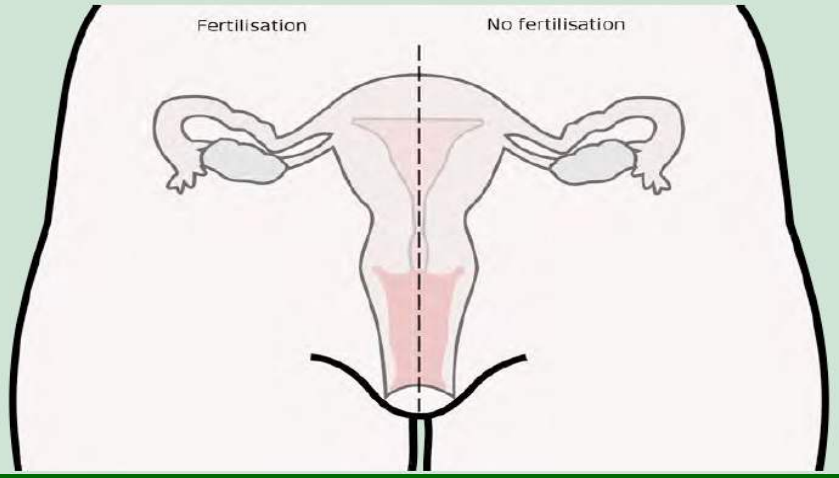
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ACTIVITY: Comparing fertilisation and menstruation

INSTRUCTIONS:

1. Use the following diagram to compare what happens when an egg is fertilised compared to when it is not fertilised. You can even use coloured pens if you have.
2. Use labels and arrows to illustrate on the left hand side what happens to the ovum if it is fertilised by a sperm cell.
3. Use arrows and labels to illustrate on the right hand side what happens if the ovum is not fertilised and the woman subsequently menstruates.



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ACTIVITY: Flow diagram of the pathway of sperm

INSTRUCTIONS:

1. Use a flow chart to track the progress of a sperm cell from the testes in the male body to the ovum in the female body.
2. Use the space below to draw your flow diagram. Remember to draw arrows.
3. Use the following terms in your flow chart, in the correct order.

a) Cervix
b) Uterus
c) Urethra
d) Penis
e) Testes
f) Sperm duct
g) Oviduct/Fallopian Tube
h) Vagina

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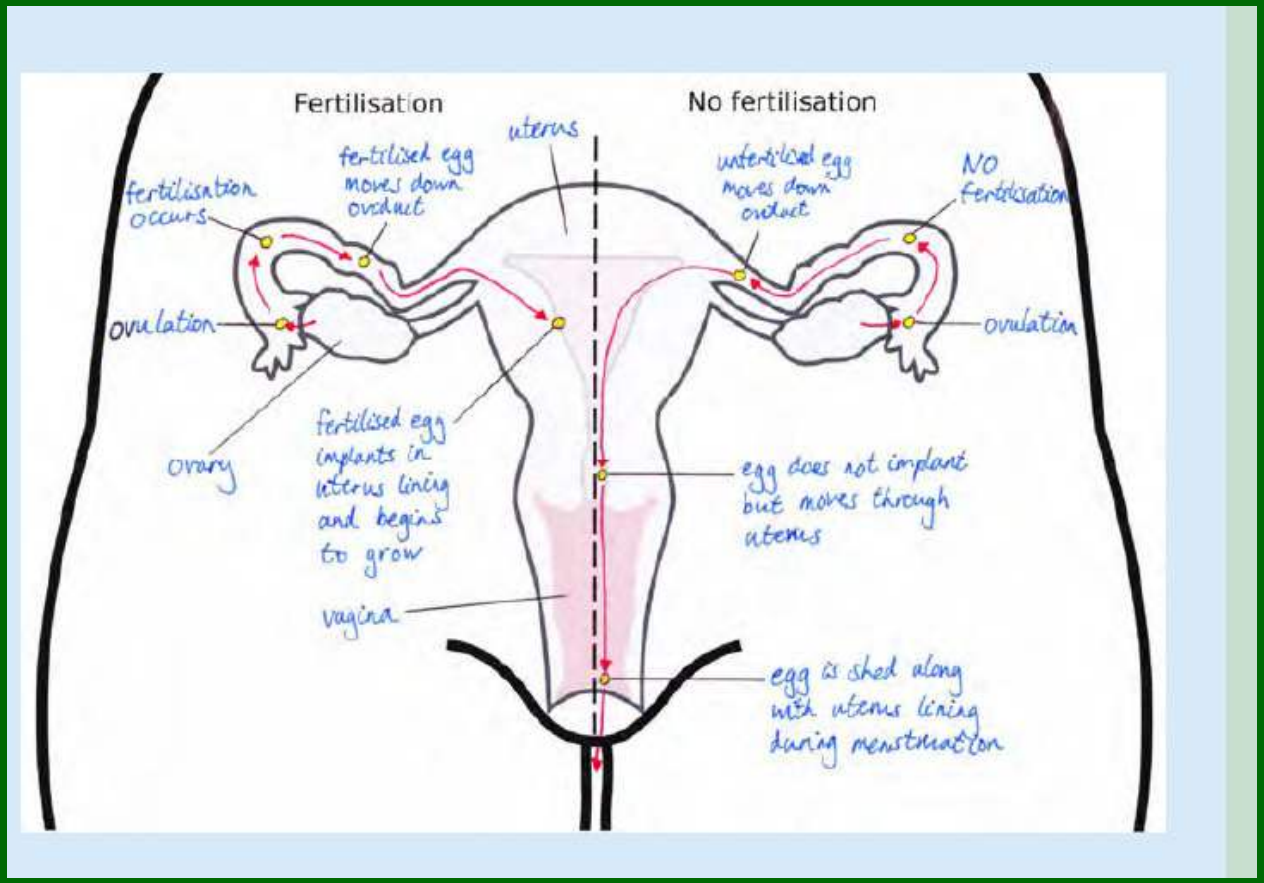
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MEMORANDUM

Activity – Comparing fertilisation and menstruation

TEACHER'S NOTE

The following diagram shows an example of something that the learners might produce. Learners might battle to do this. A suggestion is to produce a sketch on the board and go through it with them, filling in the annotations. Do not simply draw it up and get learners to copy down the answers. Ask for their input and possibly get different learners to come up to the board to draw in different stages.



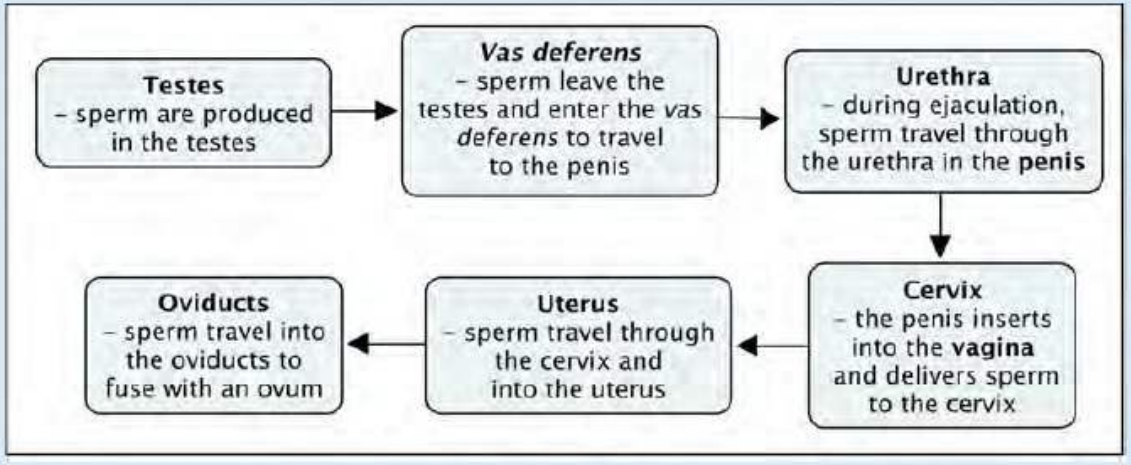
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Activity – Flow diagram of pathway of sperm

TEACHER'S NOTE

The following flow chart can be used as a reference for learners' flow charts:



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NATURAL SCIENCES: HUMAN REPRODUCTION LESSON PLAN 3 **GRADE 9**
PERIOD/DURATION: 60 MINUTES **STRAND: LIFE & LIVING**
CAPS SENIOR PHASE **TERM 1**

DURATION: Week Seven Lesson Five and Six	**OBJECTIVES: LEARNERS MUST BE ABLE TO:** • Label diagrams of male and female reproductive organs • Identify structures of reproductive organs and their functions
TOPIC: HUMAN REPRODUCTION **SUB-TOPIC:** Reproductive organs	

TERMINOLOGY:	Sperm duct, Testes, Scrotum, Uterus, Ovaries, Oviducts,	
SPECIFIC AIMS	1. DOING SCIENCE	
	2. KNOWING THE SUBJECT CONTENT & MAKING CONNECTIONS	✓
	3. UNDERSTANDING THE USES OF SCIENCES & INDIGENOUS KNOWLEDGE	

SCIENCE PROCESS SKILLS

Accessing & recalling Information	✓	Identifying problems & issues	✓	Doing Investigations	
Observing	✓	Raising Questions		Recording Information	✓
Comparing		Predicting	✓	Interpreting Information	
Measuring		Hypothesizing		Communicating	✓
Sorting & Classifying		Planning Investigations			

CONTENT AND CONCEPTS	TEACHING AND LEARNING ACTIVITIES	RESOURCES
the male reproductive organs include the penis, sperm duct (*vas deferens*), testes (produces sperm cells), scrotum, urethra • the female reproductive organs include the vagina, uterus, ovaries (contain egg cells/ ova), oviducts (Fallopian tubes)	1. Group work: Learners write new words in their exercise books as the lesson unlocks. (e.g. Sperm ducts, Testes, Scrotum, Uterus, Ovaries and Oviducts) 2. Learners must use dictionary to find meaning of the new words and write them in their exercise books. 3. Learners will be given pictures of male and female reproductive organs in their groups 4. ACTIVITY: Learners do activity 1.	• Dictionary • Science dictionary • Models and charts of the reproductive system. • Siyavula Gr9A
ASSESSMENT	Informal assessment by means of activity 1 for consolidation	
TEACHER REFLECTION	progress	Challenges

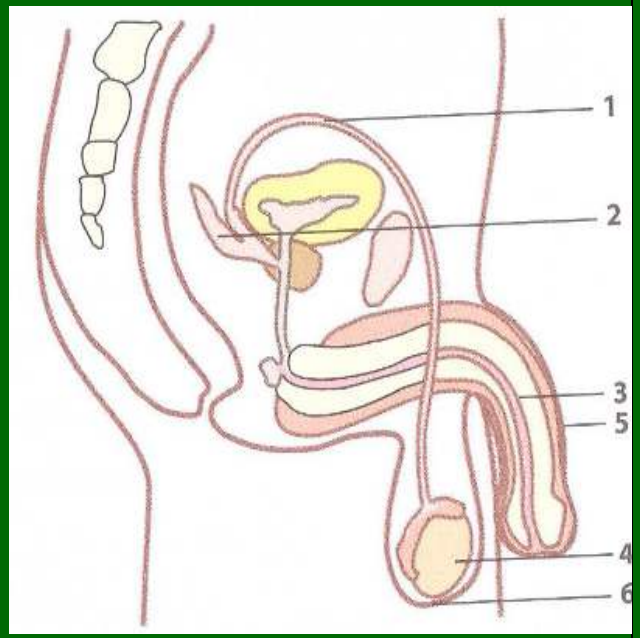
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NATURAL SCIENCES: HUMAN REPRODUCTION LESSON PLAN 3
PERIOD/DURATION: 60 MINUTES
CAPS SENIOR PHASE
ACTIVITY 1

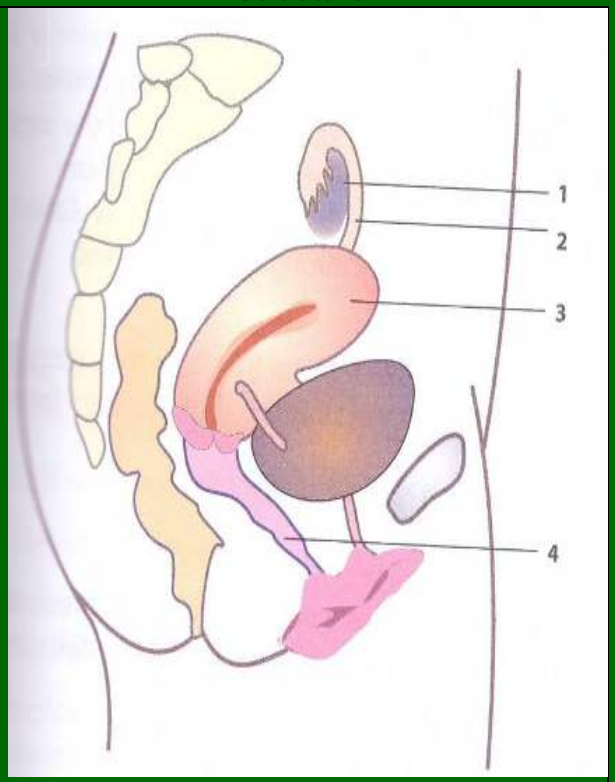
GRADE 9
STRAND: LIFE & LIVING
TERM 1

Study the following structures and answer the questions that follow.

Structure A



Structure B



1 Identify Structure A and Structure B.
2 Label the part marked 5 in the Structure A.
3 Give a reason why the testes in humans are kept outside the body.
4 The part labeled 3 in the Structure B is the uterus. What is its function?
5 Label the part marked 1 in Structure B.
6 Write down the number of the part in Structure B, where fertilization takes place.
7 A method of contraception where the part you mentioned in 5.6 is cut to prevent pregnancy.
8 Give one (1) reason why condoms are popular method of contraception.

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MEMORANDUM

1 Structure A –The male reproductive system. Structure B – The female reproductive system
2 Penis
3 The testes need to be at 53ºC, which is lower than the body temperature, in order to produce sperm.(sperms forms better at a temperature which is lower than the body temperature)
4 To carry and protect the unborn baby
5 Ovary
6 Structure B – 2
7 Fallopian tube / Oviduct
8 Condoms are reliable or cheap or always available or to avoid pregnancy.

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DURATION: Week Eight Lesson One and Two	**OBJECTIVES: LEARNERS MUST BE ABLE TO:** • **Identify and describe** the stages of reproduction
TOPIC: HUMAN REPRODUCTION **SUB-TOPIC:** Stages of reproduction	
REFERENCES: Sasol Inzalo workbook	

TERMINOLOGY:	Ovulation, Menstruation, Zygote, Fertilization	
SPECIFIC AIMS	1. DOING SCIENCE	
	2. KNOWING THE SUBJECT CONTENT & MAKING CONNECTIONS	✓
	3. UNDERSTANDING THE USES OF SCIENCES & INDIGENOUS KNOWLEDGE	

SCIENCE PROCESS SKILLS

Accessing & recalling Information	✓	Identifying problems & issues	✓	Doing Investigations	✓
Observing	✓	Raising Questions		Recording Information	
Comparing	✓	Predicting	✓	Interpreting Information	✓
Measuring		Hypothesizing		Communicating	✓
Sorting & Classifying		Planning Investigations			

CONTENT AND CONCEPTS	TEACHING AND LEARNING ACTIVITIES	RESOURCES
• once a month, one of the ovaries releases a ripe egg in a process called *ovulation* • in preparation for a fertilised egg, the uterus develops a thick layer of blood • if fertilisation does not take place, *menstruation* occurs • menstruation is the breakdown of the thick layer of blood in the uterus, which is released through the vagina • the menstrual cycle is usually a 28 day cycle during *copulation*, the erect penis is inserted into the vagina and semen is released (*ejaculation*) • *fertilisation* is the fusion of the sperm and egg, producing a zygote	1. The stages of reproductions are explained by the teacher 2. New words (e.g. Ovulation, Menstruation zygote and Fertilization) and their explanations are written on the board as the lesson unlocks. 3. Learners must write those words in their note book. 4. ACTIVITY: Learners complete the worksheet provided.	• Models and charts of the reproductive system. • Siyavula Gr9A • Video clip

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CONTENT AND CONCEPTS	TEACHING AND LEARNING ACTIVITIES	RESOURCES
• if fertilisation takes place, the fertilised egg is implanted in the blood layer in the uterus, and pregnancy results		
ASSESSMENT	Learners complete the worksheet underneath.	
TEACHER REFLECTION	progress / Challenges	

3.3 Stages of reproduction

We have already mentioned most of the processes that take place during reproduction. These processes occur in stages. Let's first have a look at the female reproductive cycle.

The reproductive cycle

The female reproductive cycle repeats every 28-30 days to release an egg cell to be fertilised if sperm are present. This cycle will repeat for many years from puberty to **menopause** (when the reproductive cycle comes to an end). The processes that occur will differ depending on whether the ovum is fertilised or not. After ovulation, if fertilisation does not occur, the reproductive organs 'reset' through menstruation to start the process again.

Ovulation

Once a month, one of the ovaries releases one mature ovum into the oviduct. This process is called ovulation. At the same time the uterus wall thickens and develops extra blood vessels. This is in preparation for the *possible* implantation of a fertilised egg.

Menstruation

When there is no fertilised egg cell (**zygote**) to implant in the uterus, the thick layer of blood and tissue is no longer needed. It is passed out through the vagina during menstruation. The entire process is called the menstrual cycle and it normally repeats every 28-30 days.

Fertilisation

During sexual intercourse the erect male penis enters the female vagina. This is called **copulation**. The male penis deposits sperm into the female vagina through **ejaculation**. There can be millions of sperm cells in one ejaculation, but only one will be able to penetrate the outer membrane of the ovum. After ejaculation into the vagina, the sperm swim into the cervix and through the uterus to the oviducts. Once inside the oviducts, the sperm swim to meet the mature egg that was released from the ovaries and is now travelling towards the uterus. One sperm cell burrows into the surface of the ovum. Only the sperm's head enters, the tail stays outside. As soon as one has penetrated the outer layer, the surface of the ovum changes and no more sperm will be allowed to enter. This process is called **fertilisation** and it takes place in the outer part of the oviduct, and not in the uterus or vagina.

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REVISION:

1. Explain the changes that occur to the male and female body during puberty. [10 marks]

2. Describe the hormonal control of the start of puberty. Name the organs involved and the hormones. [5 marks]

3. At what stage of the reproductive cycle can one say that a woman is pregnant? [1 mark]

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4. There is a urban legend or myth that says that a girl cannot fall pregnant the first time she has sexual intercourse. Think carefully about everything you have learnt about conception and fertilisation, and discuss whether this myth is true or false. [2 marks]

_____

_____

_____

5. Explain why you think it is important for someone who considers becoming sexually active to know how reproduction occurs in humans. [1 mark]

_____

_____

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6. Imagine someone who has many sexual partners asks you for advice on which contraceptive to use. What advice would you give them? [3 marks]

7. Some people have religious reasons for not using contraceptives. Decide whether you agree with them or not and why. Write a short letter to the editor of local newspaper expressing your concerns about contraceptives from this specific point of view. [6 marks]

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8. Do you think schools should teach learners about different contraceptives? Why do you say so? [3 marks]

_____

_____

_____

9. During pregnancy the pregnant mother needs to take care of herself in order to provide a healthy and safe environment for the unborn child. Your local clinic has asked you to produce a brochure that they can display in their waiting room for first-time mothers. Write a detailed list of instructions for a pregnant woman explaining what she needs to do to keep herself and her unborn baby healthy. You can chose how you want to do this - perhaps a list of "Do's" and "Dont's", or else provide some headings under which you can list some instructions such as "Diet" , "Lifestyle", etc. [6 marks]

_____

_____

_____

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MEMORANDUM

Revision activity

1. For females, these include: breasts develop, pubic hair starts to grow, underarm hair grows, body shape changes, ovaries mature, acne develops in some individuals. For males, these include: penis grows and becomes larger, testes mature, pubic hair starts to grow, facial hair grows, underarm, chest and back hair grows, voice deepens, acne develops in some individuals.

2. At the onset of puberty, hormones are released into the blood (these hormones were not specifically named at this level). These hormones travel in the blood and stimulate the reproductive organs. In females, the ovaries are stimulated to produce oestrogen and in males, the testes are stimulated to produce testosterone.

3.When the egg has been fertilised by a sperm (ie fertilisation), the woman is now pregnant.

4.It can be true if the girl has sex before her reproductive organs have matured and therefore before she is able to ovulate. In this instance she will not be able to fall pregnant. If the woman's reproductive organs have matured and she has started to menstruate and ovulate, then she can fall pregnant after sexual intercourse, even if it is the first time. Thus in this instance the myth is not true.

5.Learner's need to indicate that once someone knows the facts about conception they will be able to take (realistic) precautions to avoid unwanted pregnancies and disease. The will also not believe all the myths and make sensible decisions.

6. Someone who has many sexual partners stands a high risk of contracting an STD. To prevent this and to prevent an unwanted pregnancy learners should be able to say that they should use a condom during intercourse. They could also possibly suggest that the person limits the number of sexual partners that they have, and if they are in a relationship, then both of them should remain faithful to one partner. Alternatively, if they do continue with many partners, the person should try establish the status of these partners before intercourse, and still use a condom. The person should also be advised to have regular check ups to know their status.

7. Learner-dependent answer

TEACHER'S NOTE

Learners should be able to see the different points of view regarding this issue and reference the debate on this topic that was held earlier in this chapter. There is no right answer, rather the focus should be on the fact that learners can justify their opinions and express themselves. They should draw on this and write their letter in this frame of reference. NB: Learners are not criticising anyone's religion or culture in this activity.

8. Learner-dependent answer. Check that learners are able to justify their answer and provide a reason for what they think.

9. During pregnancy the pregnant mother needs to take care of herself in order to provide a healthy and safe environment for the unborn child. Your local clinic has asked you to produce a brochure that they can display in their waiting room for first-time mothers. Write a detailed list of instructions for a pregnant woman explaining what she needs to do to keep herself and her unborn baby healthy. You can chose how you want to do this - perhaps a list of "Do's" and "Don'ts", or else provide some headings under which you can list some instructions such as "Diet" ,"Lifestyle", etc. [6 marks]

Learners should refer to the diet and lifestyle choices of the pregnant mother, specifically noting that pregnant mothers who consume drugs and alcohol, also pass these on to the unborn baby through the placenta, resulting in irreversible damage to the unborn child. The mother should therefore avoid these during pregnancy.

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NATURAL SCIENCES: LESSON PLAN 5
PERIOD/DURATION: 90 MINUTES
CAPS SENIOR PHASE

GRADE 9
STRAND: LIFE & LIVING
TERM 1

DURATION: Week Eight Lesson Three and Four	**OBJECTIVES: LEARNERS MUST BE ABLE TO:** • **Identify and describe** the development of embryo/foetus and the stages of pregnancy in humans
TOPIC: HUMAN REPRODUCTION	
SUBTOPIC: STAGES OF REPRODUCTION	
TERMINOLOGIES:	**Embryo, Foetus, Placenta**

SPECIFIC AIMS	1. DOING SCIENCE	
	2. KNOWING THE SUBJECT CONTENT & MAKING CONNECTIONS	✓
	3. UNDERSTANDING THE USES OF SCIENCES & INDIGENOUS KNOWLEDGE	

SCIENCE PROCESS SKILLS

Accessing & recalling Information	✓	Identifying problems & issues		Doing Investigations	
Observing	✓	Raising Questions		Recording Information	
Comparing	✓	Predicting	✓	Interpreting Information	
Measuring		Hypothesizing		Communicating	✓
Sorting & Classifying		Planning Investigations			

CONTENT	TEACHING AND LEARNING ACTIVITIES	RESOURCES
• the developing embryo/foetus is attached to the uterus wall by the placenta which plays a vital role in feeding and removing waste from the foetus • the stage of pregnancy in humans (gestation) is about 40 weeks	1. Direct teaching – The development of embryo/foetus and the stages of pregnancy in humans is explained. 2. The meaning of new words is given as the lesson unfolds and learners write those meaning in their exercise books. ACTIVITY: Learners answer the worksheet provided.	• Models and charts. • Siyavula Gr 9A • Video clip

ASSESSMENT	Informal assessment by means of activity 1 for consolidation	
TEACHER REFLECTION	progress	Challenges

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ACTIVITY 1

Read the statements below and choose the correct answer:

1) As the embryo divides, it continues its journey along:

a) The fallopian tubes

b) The ovary

c) The cervix

2) The embryo reaches the uterus:

a) 1 week after fertilization

b) 2 days after fertilization

c) 2 weeks after fertilization

3) When the embryo arrives at the uterus:

a) The uterus is covered with a lining to receive the embryo

b) The lining has disappeared

c) The embryo goes towards the vagina

4) The embryo consists of:

a) 2 cells

b) 1000 cells

c) 100 cells

5) The embryo gets attached to:

a) The uterus

b) The ovary

c) The vagina

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6) At two months:

a) The embryo is called a pea

b) The embryo is called a foetus

c) The embryo has not changed

7) The placenta is:

a) The name of the embryo after 3 months

b) The union of the ovum and the sperm

c) A group of vessels and cells

8) The umbilical cord: ***(2 correct answers)***

a) Joins the foetus to the placenta

b) Joins the ovum and the sperm

c) Will become the belly button

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MEMORANDUM

1	A
2	B
3	A
4	A
5	A
6	A
7	C
8	A & C

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NATURAL SCIENCES: LESSON PLAN 6
PERIOD/DURATION: 90 MINUTES
CAPS SENIOR PHASE

GRADE 9
STRAND: LIFE & LIVING
TERM 1

DURATION: Week Eight Five and Six **TOPIC: HUMAN REPRODUCTION** **SUBTOPIC**: STAGES OF REPRODUCTION	**OBJECTIVES: LEARNERS MUST BE ABLE TO:** • **Identify and describe** the different contraceptives that can prevent pregnancy and the transmission of sexually transmitted diseases • **Debate and discuss** issues such as contraception and abortion

TERMINOLOGIES:	Contraceptive, HIV/AIDS, STDs	
SPECIFIC AIMS	1. DOING SCIENCE	
	2. KNOWING THE SUBJECT CONTENT & MAKING CONNECTIONS	✓
	3. UNDERSTANDING THE USES OF SCIENCES & INDIGENOUS KNOWLEDGE	

SCIENCE PROCESS SKILLS

Accessing & recalling Information	✓	Identifying problems & issues		Doing Investigations	
Observing	✓	Raising Questions		Recording Information	✓
Comparing	✓	Predicting	✓	Interpreting Information	✓
Measuring		Hypothesizing		Communicating	✓
Sorting & Classifying		Planning Investigations			

CONTENT	TEACHING AND LEARNING ACTIVITIES	RESOURCES
• pregnancy can be prevented by using contraceptives such as condoms to prevent the sperm reaching the egg • condoms also prevent the transmission of HIV/AIDS and other STDs (sexually transmitted diseases), if used effectively	1. Group work and discovery leaning: Learners will use dictionaries to look for the meaning of new words and write them in their exercise books. They will be given different contraceptives in their groups to examine and answer prompting questions. 2. The teacher will write learners' answers on the chalkboard/whiteboard. 3. ACTIVITY: Learners will answer activity on contraceptives. 4. After the teacher has summarised learner's answers. Learners will watch a video. 5. ACTIVITY: Afterwards learners will engage in debating and discussing issues such as contraception and abortion,	• Models and charts. • English dictionary • Science dictionary • Siyavula Gr 9A • Specimen of different contraceptives • Chalk board/white board • Video clip
ASSESSMENT	Informal assessment by means of activity 1 for consolidation	
TEACHER REFLECTION	progress	Challenges

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ACTIVITY: Describing different contraceptives

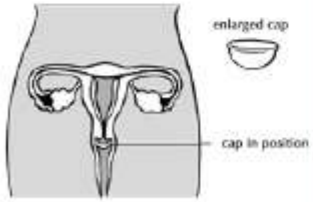
INSTRUCTIONS:

1. In the following table, several different types of contraceptives have been listed, along with a picture and description.
2. You need to read the information, look at the images and classify the types of contraceptive as one of the following:

   a) barrier
   b) hormonal
   c) intra-uterine device
   d) sterilisation

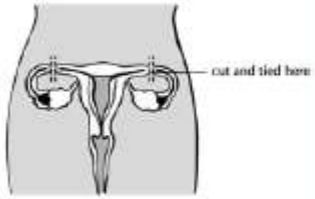
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Contraceptive	Description	Classification
Male condoms 	These thin sheaths of rubber are placed over the erect penis before inserting it into the vagina. When the male ejaculates the sperm and seminal fluid is caught in the condom and cannot enter the cervix.	
Diaphragm 	The diaphragm is a small rubber cap that is placed at the entrance to the uterus before sexual intercourse to create a seal and prevent sperm from entering the uterus.	

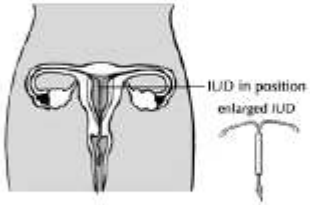
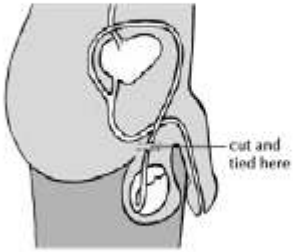
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Tubal ligation in women 	A surgical procedure in women in which the the oviducts are cut and tied which prevents mature eggs from reaching the uterus for fertilisation.	
Oral contraceptive pill 	Often referred to as "the Pill", it is taken every day by mouth. It contains a combination of female hormones which prevents ovulation each month.	

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Female intra-uterine device (IUD) 	A small 'T'-shaped device is inserted into the uterus and prevent fertilisation. It is a long-acting, reversible contraception as the device may be removed again. It is not suitable for women who have not yet had a baby and must be inserted by a doctor.	
Vasectomy 	A surgical procedure in males in which the vas deferens is cut and tied. Sperm are therefore prevented from becoming part of the ejaculate.	

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ACTIVITY: Forum discussion

Hold a forum discussion regarding the choices women have when they do not want to be pregnant or raise a child. Before the discussion, do research and interviews with your parents or caregivers, with health professionals or ask your Life Orientation teacher.

How to hold a forum discussion:

In a forum discussion, experts are asked to sit on a panel and give their opinion about a particular topic. There are specific roles in a forum discussion:

- **Moderator**: This person keeps the discussion focused and on track.
- **Participants**: The experts. This will be you, the learners, after you have conducted your research.

1. Work in groups of 6.
2. Choose a moderator.
3. Discuss the different choices that women have regarding unwanted pregnancies using the information you obtained from the interviews you conducted.

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Rules for a forum discussion:

1. The speakers need to take turns to give their opinions.
2. Treat everyone with dignity and respect. Speak politely.
3. Use the correct scientific terminology.

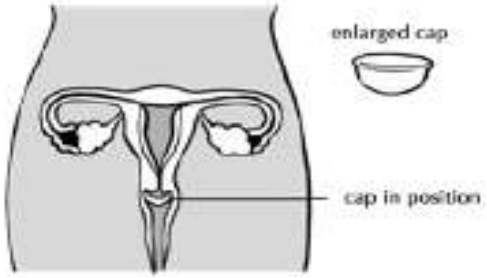
Record your findings:

Use the space below to record the findings from the forum discussion explaining what choices women have when faced with an unwanted pregnancy.

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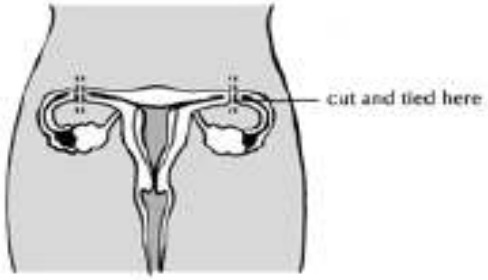
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TEACHER'S NOTE

Contraceptive	Description	Classification
Male condoms 	These thin sheaths of rubber are placed over the erect penis before inserting it into the vagina. When the male ejaculates the sperm and seminal fluid is caught in the condom and cannot enter the cervix.	Barrier
Diaphragm 	The diaphragm is a small rubber cap that is placed at the entrance to the uterus before sexual intercourse to create a seal and prevent sperm from entering the uterus.	Barrier

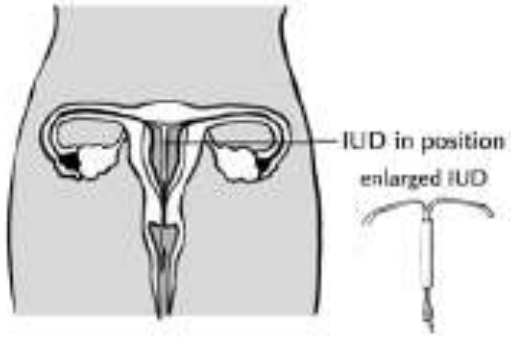
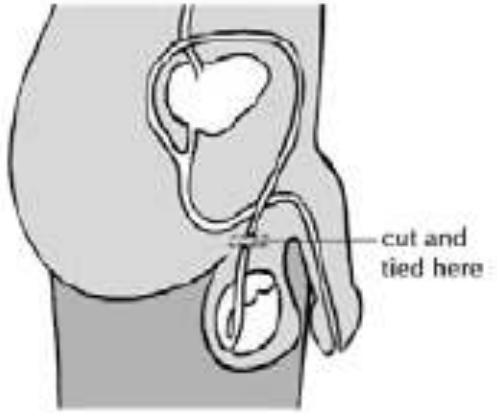
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Contraceptive	Description	Classification
Tubal ligation in women 	A surgical procedure in women in which the the oviducts are cut and tied which prevents mature eggs from reaching the uterus for fertilisation.	Sterilisation
Oral contraceptive pill 	Often referred to as "the Pill", it is taken every day by mouth. It contains a combination of female hormones which prevents ovulation each month.	Hormonal

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Female intra-uterine device (IUD)  	A small 'T'-shaped device is inserted into the uterus and prevent fertilisation. It is a long-acting, reversible contraception as the device may be removed again. It is not suitable for women who have not yet had a baby and must be inserted by a doctor.	Intra-uterine device
Vasectomy  	A surgical procedure in males in which the vas deferens is cut and tied. Sperm are therefore prevented from becoming part of the ejaculate.	Sterilisation

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ACTIVITY: Forum discussion

TEACHER'S NOTE

This activity relates to Life Orientation. This activity was specifically included at the end of the section to allow for research to occur before the forum discussion. Break the class up into groups of 6 and allow them to move into different areas of the classroom, or perhaps even move outside if space permits. Each group must then conduct their forum discussion according to the instructions and guidelines below.

You, the teacher, can spend a little time with each group to make sure they are on track and discussing the topic. Use the notes provided on the different options for an unwanted pregnancy if you need to provide a group with some background information or some guidelines about what to discuss. Encourage learners to express their points of view and why they believe something.

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TEACHER'S NOTE

An alternative is to have one discussion forum in the front of the class and give different learners the chance to sit up front on the panel, and you can be the moderator.

This activity does not need to be assessed and is more for personal education, and a chance for learners to practise debating.

Hold a forum discussion regarding the choices women have when they do not want to be pregnant or raise a child. Before the discussion, do research and interviews with your parents or caregivers, with health professionals or ask your Life Orientation teacher.

How to hold a forum discussion:

In a forum discussion, experts are asked to sit on a panel and give their opinion about a particular topic. There are specific roles in a forum discussion:

- **Moderator**: This person keeps the discussion focused and on track.
- **Participants**: The experts. This will be you, the learners, after you have conducted your research.

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1. Work in groups of 6.
2. Choose a moderator.
3. Discuss the different choices that women have regarding unwanted pregnancies using the information you obtained from the interviews you conducted.

Rules for a forum discussion:

1. The speakers need to take turns to give their opinions.
2. Treat everyone with dignity and respect. Speak politely.
3. Use the correct scientific terminology.

Record your findings:

Use the space below to record the findings from the forum discussion explaining what choices women have when faced with an unwanted pregnancy.

TEACHER'S NOTE

Learner-dependent answer

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NATURAL SCIENCES: LESSON PLAN 1 **GRADE: 9**
DURATION: 30 Minutes **STRAND: MATTER AND MATERIALS**
CAPS SENIOR PHASE **TERM : TWO**

DURATION: Week One Lesson One	**OBJECTIVES: LEARNERS MUST BE ABLE TO:** Demonstrate an understanding of the Periodic Table by answering the baseline questions orally. Identify where Metals, Non Metals and Semi Metals are found on the Periodic Table
TOPIC: COMPOUNDS	
SUB TOPIC: The Periodic Table	
REFERENCES	**Sasol Inzalo workbooks- Natural Sciences Grade 9A**
TERMINOLOGY:	Metals, Non Metals, Mass Number, Atomic Number, Semi Metals(Metalloids)
SPECIFIC AIMS	1. DOING SCIENCE
	2. KNOWING THE SUBJECT CONTENT & MAKING CONNECTIONS x
	3. UNDERSTANDING THE USES OF SCIENCES & INDIGENOUS KNOWLEDGE

SCIENCE PROCESS SKILLS					
Accessing & recalling Information	x	Identifying problems & issues		Doing Investigations	
Observing		Raising Questions		Recording Information	
Comparing		Predicting		Interpreting Information	
Measuring		Hypothesizing		Communicating	
Sorting & Classifying		Planning Investigations			

CONTENT AND CONCEPTS	ACTIVITIES	RESOURCES
the elements can be classified into metals, non-metals and semi metals • the elements found in groups (vertical columns) have similar chemical properties • Textbooks and reference materials • each element on the Periodic Table (in its own block) has an atomic number (smaller number), mass number (larger	**Introduction** The teacher will introduce the topic with baseline questions. **Baseline Questions**: 1. What is the periodic table? – **Answer**: Learners must demonstrate an understanding of the Periodic Table 2. How are elements arranged on the Periodic Table? – Answer: Learners must demonstrate an understanding of the Periodic Table 3. What does the position of the element tell us about the element? – **Answer**: An element's position on the Periodic Table tells us whether it is a metal, a non-	Periodic Table Poster

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NATURAL SCIENCES: LESSON PLAN 1 **GRADE: 9**
DURATION: 30 Minutes **STRAND: MATTER AND MATERIALS**
CAPS SENIOR PHASE **TERM : TWO**

CONTENT AND CONCEPTS	ACTIVITIES	RESOURCES
number), name and symbol • a formula/e is ratio of the symbols of the elements and number of atoms for each symbol in a compound	metal or a semi-metal. 4. Where do we find metals, non-metal and semi-metals on the periodic table? **Answer**: a) metals are found on the left hand side of the table; b) non-metals are found on the far right hand side of the table; and c) semi-metals are found in the region between the metals and non-metals. 5. List three ways to identify elements on the periodic table. – **Answer**: An element can be identified in 3 different ways: a) each element has a unique name; b) each element has a unique chemical symbol; and c) each element has a unique atomic number.	
ASSESSMENT		
TEACHER REFLECTION		

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CONTENT AND CONCEPTS	ACTIVITIES	RESOURCES

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NATURAL SCIENCES: LESSON PLAN 2 **GRADE: 9**
DURATION: 30 Minutes **STRAND: MATTER AND MATERIALS**
CAPS SENIOR PHASE **TERM : TWO**

CONTENT AND CONCEPTS	ACTIVITIES	RESOURCES
similar chemical properties • Textbooks and reference materials • each element on the Periodic Table (in its own block) has an atomic number (smaller number), mass number (larger number), name and symbol • a formula/e is ratio of the symbols of the elements and number of atoms for each symbol in a compound **Names of compounds** • many compounds are named according to their elements, such as sodium chloride (table salt) which is made of the elements sodium and chlorine. But others have common names such as water and ammonia • some compounds have names such as carbon monoxide CO, carbon dioxide CO2, sulfur trioxide SO_3. In these compounds: -- ***mono***xide- tells us that ***one*** oxygen atom has combined with the carbon atom -- ***di***oxide- tells us that ***two*** oxygen atoms have combined with the carbon atom -- ***tri***oxide- tells us that ***three*** oxygen atoms have combined with the sulfur atom	Table (Sasol Inzalo Gr.9A p.156 – 158). Students interact with “Live” periodic table web link.	board/screen. **Web links**: • The Periodic Table (Live) - http://www.chemeddl.org/resources/ptl/index.html **Video links**: The Periodic Table (Explained) - https://youtu.be/72vwtrJxUTY
ASSESSMENT		
TEACHER REFLECTION		

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NATURAL SCIENCES: LESSON PLAN 2 **GRADE: 9**
DURATION: 30 Minutes **STRAND: MATTER AND MATERIALS**
CAPS SENIOR PHASE **TERM : TWO**

ACTIVITY 1: Elements on the Periodic Table

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INSTRUCTIONS:

1. Use your Periodic Table to complete the following table.
2. Write the chemical symbol and element name for each of the first 20 elements, identified by their atomic numbers.

Atomic number	Chemical name	Element name
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		
11		
12		
13		
14		
15		
16		
17		
18		
19		
20		

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NATURAL SCIENCES: LESSON PLAN 2 **GRADE: 9**
DURATION: 30 Minutes **STRAND: MATTER AND MATERIALS**
CAPS SENIOR PHASE **TERM : TWO**

1. There are three important industrial metals of which you need to know the names and formulae. Their atomic numbers have been written in the table below. Complete the table by filling in the chemical symbols and element names.

Atomic number	Chemical name	Element name
26		
29		
30		

QUESTIONS:

1. What does the atomic number tell us about the atoms of an element?

_____

2. How many protons are there in oxygen atoms?

_____

3. In most oxygen atoms, how many neutrons are there?

_____

4. In a neutral oxygen atom, how many electrons will there be?

_____

5. What is the charge on protons and electrons?

_____

6. How are the protons, neutrons and electrons (the sub-atomic particles) arranged in an atom?

_____

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NATURAL SCIENCES: LESSON PLAN 2
DURATION: 30 Minutes
CAPS SENIOR PHASE

GRADE: 9
STRAND: MATTER AND MATERIALS
TERM : TWO

7. Draw a model of an oxygen atom in the space provided. Label your diagram.

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NATURAL SCIENCES: LESSON PLAN 2
DURATION: 30 Minutes
CAPS SENIOR PHASE

GRADE: 9
STRAND: MATTER AND MATERIALS
TERM : TWO

MEMORANDUM

Atomic number	Chemical symbol	Element name
1	H	Hydrogen
2	He	Helium
3	Li	Lithium
4	Be	Beryllium
5	B	Boron
6	C	Carbon
7	N	Nitrogen
8	O	Oxygen
9	F	Fluorine
10	Ne	Neon
11	Na	Sodium
12	Mg	Magnesium
13	Al	Aluminium
14	Si	Silicon
15	P	Phosphorus
16	S	Sulfur
17	Cl	Chlorine
18	Ar	Argon
19	K	Potassium
20	Ca	Calcium

QUESTIONS:

TEACHER'S NOTE
This also serves as a revision of what learners covered in Gr. 8 about the atom.

1. *It tells us how many protons are in the atoms.*

2. *There are 8 protons (atomic number is 8).*

3. *There are also 8 neutrons.*

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NATURAL SCIENCES: LESSON PLAN 2 **GRADE: 9**
DURATION: 30 Minutes **STRAND: MATTER AND MATERIALS**
CAPS SENIOR PHASE **TERM : TWO**

TEACHER'S NOTE
Learners will only learn about isotopes in later grades, for now it is enough to know that the atomic mass gives an indication of the number of nucleons (protons and neutrons), so for oxygen, the atomic mass is 15.999 (rounded to the nearest integer it is 16), so the number of neutrons = 16 - 8,
which is 8.

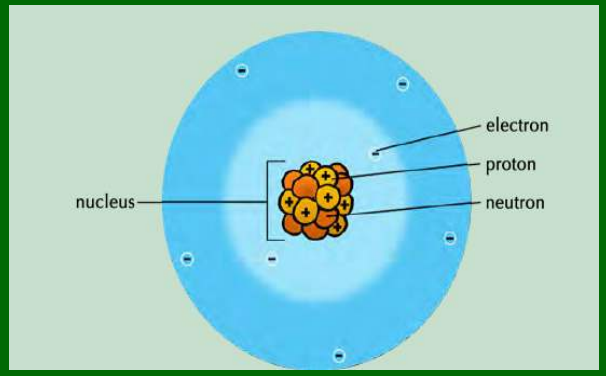
4. *There will be 8 electrons.*

TEACHER'S NOTE
At this stage, learners have not yet learned about ions, and so we only consider neutral atoms in which the number of electrons equals the number of protons.

5. *Electrons are negatively charged and protons are positively charged.*

6. *The protons and neutrons are clustered together in the centre, forming the nucleus, and the electrons occupy a much large space/cloud/area around the nucleus.*

7.
Learners must draw a central nucleus with 8 protons and 8 neutrons, with 8 electrons forming a cloud around the nucleus. An example model of a nitrogen atom is given below as a reference:



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NATURAL SCIENCES: LESSON PLAN 3 **GRADE: 9**
DURATION: 30 Minutes **STRAND: MATTER AND MATERIALS**
CAPS SENIOR PHASE **TERM : TWO**

DURATION: week One Lesson Three	**OBJECTIVES: LEARNERS MUST BE ABLE TO:** Write the names of different compounds.
TOPIC: COMPOUNDS	
SUB TOPIC: Names of Compounds	
REFERENCES	**Sasol Inzalo workbooks- Natural Sciences Grade 9A**
TERMINOLOGY:	Element, Compound

SPECIFIC AIMS	1. DOING SCIENCE	
	2. KNOWING THE SUBJECT CONTENT & MAKING CONNECTIONS	x
	3. UNDERSTANDING THE USES OF SCIENCES & INDIGENOUS KNOWLEDGE	

SCIENCE PROCESS SKILLS					
Accessing & recalling Information	x	Identifying problems & issues		Doing Investigations	
Observing		Raising Questions		Recording Information	
Comparing	x	Predicting		Interpreting Information	
Measuring		Hypothesizing		Communicating	
Sorting & Classifying		Planning Investigations			

CONTENT AND CONCEPTS	ACTIVITIES	RESOURCES
Names of compounds •Many compounds are named according to their elements, such as sodium chloride (table salt) which is made of the elements sodium and chlorine. But others have common names such as water and ammonia • some compounds have names such as carbon monoxide CO, carbon dioxide CO_2, sulfur trioxide SO_3. In	**Introduction** Each element has a unique name. It is just as important for a compound to have a unique name. If one or more elements combine chemically, a compound is formed. Example two Hydrogen atoms (2H) and one Oxygen atom (O) combine chemically to form the compound Water (H_2O). The teacher	• Periodic Table Poster

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NATURAL SCIENCES: LESSON PLAN 3 **GRADE: 9**
DURATION: 30 Minutes **STRAND: MATTER AND MATERIALS**
CAPS SENIOR PHASE **TERM : TWO**

CONTENT AND CONCEPTS	ACTIVITIES	RESOURCES
these compounds: -- ***mono***xide- tells us that ***one*** oxygen atom has combined with the carbon atom -- ***di***oxide- tells us that ***two*** oxygen atoms have combined with the carbon atom -- ***tri***oxide- tells us that ***three*** oxygen atoms have combined with the sulfur atom **ASSESSMENT**	will show different examples of compound formation to the learners. **Activities**: Teacher presents content as prescribed in the CAPS Document page 63(Example: Sasol Inzalo Gr.9A pg. 160-161.	
ASSESSMENT		
TEACHER REFLECTION	Progress:	Challenges:

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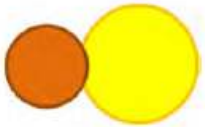
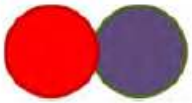
Names of. Compounds
Perhaps there are two or more people in your class with the same name? Then you will know how confusing it can be when two people have the same name!
We have learnt that each element has a unique name. This is important, so that we do not end up confusing elements with each other.

Each compound has a unique name
It is just as important for each compound to have a unique name. The following example will help you see why: The two compounds CO and CO2 consist of the same two elements, carbon and oxygen. If we named them both 'carbon oxide' (since they are both made of carbon and oxygen), we could easily confuse them. Under certain circumstances that could create problems, because CO is much more poisonous to humans and animals than CO2. So it is easy to see why each compound needs a unique name. When we write the chemical formulae for compounds, they are always a combination of the symbols of the elements in the compound. For example,
when we see the formula NaCl, we know that this compound consists of Na and Cl. When we name compounds, the names of the elements in the compound are combined and sometimes changed slightly, to make a name for the compound. When we hear the name *sodium chloride*, for instance, it is quite obvious that the compound being described must consist of *sodium* and *chlorine*. But, why is it *chloride* and not *chlorine*? Well, as you will see shortly, when we join up the names of the elements, the one that is named last is changed. All the above may sound very complicated and for this reason a system has
been developed for naming compounds. The system was developed by the **International Union of Pure and Applied Chemistry (IUPAC)**. The system is
designed in such a way that the name of a compound describes the elements it
contains and how they are combined. The IUPAC system for naming compounds is very complex, but we do not need to learn all its rules. At this point we only need to learn how to name compounds consisting of two elements. At this level we have to distinguish between two types of compounds, because
the type of compound determines how it should be named.

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NATURAL SCIENCES: LESSON PLAN 3 **GRADE: 9**
DURATION: 30 Minutes **STRAND: MATTER AND MATERIALS**
CAPS SENIOR PHASE **TERM : TWO**

Type 1: Compounds that contain a metal and a non-metal
For compounds of this type, the rule is simple. The metal comes first and the non-metal second. The name of the non-metal changes slightly: the suffix *–ide* replaces the ending of the name.

Formula	Consists of	Name	Picture of one formula unit of the compound
NaCl	Sodium and chlorine	Sodium chloride	
FeS	Iron and sulfur	Iron sulfide	
MgO	Magnesium and oxygen	Magnesium oxide	
LiF	Lithium and fluorine	Lithium fluoride	

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NATURAL SCIENCES: LESSON PLAN 4 **GRADE: 9**
DURATION: 30 Minutes **STRAND: MATTER AND MATERIALS**
CAPS SENIOR PHASE **TERM : TWO**

DURATION: Week One Lesson Five	**OBJECTIVES: LEARNERS MUST BE ABLE TO:**
TOPIC: COMPOUNDS	Write down the formulae of different compounds.
SUB TOPIC: Names of Compounds	
REFERENCES	**Sasol Inzalo workbooks- Natural Sciences Grade 9A**
TERMINOLOGY:	Element, Compound, Valency, Valence electrons

SPECIFIC AIMS	1. DOING SCIENCE	x
	2. KNOWING THE SUBJECT CONTENT & MAKING CONNECTIONS	x
	3. UNDERSTANDING THE USES OF SCIENCES & INDIGENOUS KNOWLEDGE	

SCIENCE PROCESS SKILLS					
Accessing & recalling Information	x	Identifying problems & issues		Doing Investigations	
Observing		Raising Questions		Recording Information	
Comparing	x	Predicting		Interpreting Information	
Measuring		Hypothesizing		Communicating	
Sorting & Classifying	x	Planning Investigations			

CONTENT AND CONCEPTS	ACTIVITIES	RESOURCES
Names of compounds • many compounds are named according to their elements, such as sodium chloride (table salt) which is made of the elements, sodium and chlorine. But others have common names such as water and ammonia • some compounds have names such as carbon monoxide CO, carbon dioxide CO_2, sulfur trioxide SO_3. In these compounds: -- ***mono***xide- tells us that ***one*** oxygen atom has combined with	Learners to complete the activity for consolidation of content. **Activities**: 1. Complete activity 1 on pg. 161 Sasol Inzalo Gr. 9A.	• Periodic Table Poster • English Dictionary • Textbooks: eg. Sasol Inzalo Explore Gr. 9A Projector, laptop and white board/screen

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NATURAL SCIENCES: LESSON PLAN 4 **GRADE: 9**
DURATION: 30 Minutes **STRAND: MATTER AND MATERIALS**
CAPS SENIOR PHASE **TERM : TWO**

CONTENT AND CONCEPTS	ACTIVITIES	RESOURCES
the carbon atom -- ***di***oxide- tells us that ***two*** oxygen atoms have combined with the carbon atom -- ***tri***oxide- tells us that ***three*** oxygen atoms have combined with the sulfur atom		
ASSESSMENT		
TEACHER REFLECTION		

ACTIVITY 1: Naming compounds of metals and non-metals

INSTRUCTIONS:
1. Refer to the Periodic Table and complete the following table.
2. You need to identify the elements which make up the compound and give the name of the compound.

Formula	Which elements does it consist of?	Name
Li_2O		
KCl		
CuO		
NaBr		

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NATURAL SCIENCES: LESSON PLAN 4 **GRADE: 9**
DURATION: 30 Minutes **STRAND: MATTER AND MATERIALS**
CAPS SENIOR PHASE **TERM : TWO**

MEMORANDUM

Formula	Which elements does it consist of?	Name
Li_2O	2 Lithium and 1 oxygen	Lithium oxide
KCl	1 Potassium and 1 Chlorine	Potassium chloride
CuO	1 Copper and 1 Oxygen	Copper oxide
NaBr	1 Sodium and 1 Bromine	Sodium bromide

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NATURAL SCIENCES: LESSON PLAN 5 **GRADE: 9**
DURATION: 30 Minutes **STRAND: MATTER AND MATERIALS**
CAPS SENIOR PHASE **TERM : TWO**

DURATION: Week One Lesson Six	**OBJECTIVES: LEARNERS MUST BE ABLE TO:** Draw picture models of compounds as indicated on page 63 of the CAPS Document.
TOPIC: COMPOUNDS	
SUB TOPIC: Names of Compounds	
REFERENCES	**Sasol Inzalo workbooks- Natural Sciences Grade 9A**
TERMINOLOGY:	1. Naming of compounds depending on the number of oxygen atoms present, which include the following: • ***mono***xide- tells us that ***one*** oxygen atom has combined with the carbon atom • ***di***oxide- tells us that ***two*** oxygen atoms have combined with the carbon atom ***tri***oxide- tells us that ***three*** oxygen atoms have combined
SPECIFIC AIMS	1. DOING SCIENCE x 2. KNOWING THE SUBJECT CONTENT & MAKING CONNECTIONS x 3. UNDERSTANDING THE USES OF SCIENCES & INDIGENOUS KNOWLEDGE

SCIENCE PROCESS SKILLS					
Accessing & recalling Information	x	Identifying problems & issues		Doing Investigations	
Observing		Raising Questions		Recording Information	
Comparing		Predicting		Interpreting Information	
Measuring		Hypothesizing		Communicating	
Sorting & Classifying		Planning Investigations			

CONTENT AND CONCEPTS	ACTIVITIES	RESOURCES
Names of compounds • many compounds are named according to their elements, such as sodium chloride (table salt) which is made of the ements sodium and chlorine. But others have common names such as water and ammonia	Compounds that contain only non-metals. This type of compound is slightly more complicated to name. There are three rules that you have to follow. The teacher will discuss and explain each rule.	• Periodic Table Poster • Textbooks: eg. Sasol Inzalo Explore Gr. 9A • Projector, laptop and white board/screen.

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NATURAL SCIENCES: LESSON PLAN 5 **GRADE: 9**
DURATION: 30 Minutes **STRAND: MATTER AND MATERIALS**
CAPS SENIOR PHASE **TERM : TWO**

CONTENT AND CONCEPTS	ACTIVITIES	RESOURCES
• some compounds have names such as carbon monoxide CO, carbon dioxide CO_2, sulfur trioxide SO_3. In these compounds: -- ***mono***xide- tells us that ***one*** oxygen atom has combined with the carbon atom -- ***di***oxide- tells us that ***two*** oxygen atoms have combined with the carbon atom -- ***tri***oxide- tells us that ***three*** oxygen atoms have combined with the sulfur atom	Teacher presents content as prescribed in the CAPS Document page 63(Example: Sasol Inzalo Gr.9A pg. 162-165). Complete activity 2 on pg. 164 Sasol Inzalo Gr. 9A. (NB: precise angles between the atoms is not prescribed in the CAPS Gr 9.)	
ASSESSMENT		
TEACHER REFLECTION	Progress:	Challenges:

ACTIVITY: Writing formulae from the names of Compounds

Instructions:

1. What formulae would you give the following compounds? Write the formula next to each name in the table below.
2. Draw a picture of one molecule of each compound in the last column of the table.

Formula of the Compound	Name of the Compound	Picture of one molecule of the compound
	Hydrogen Fluoride	
	Dihydrogen sulfide	

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NATURAL SCIENCES: LESSON PLAN 5 **GRADE: 9**
DURATION: 30 Minutes **STRAND: MATTER AND MATERIALS**
CAPS SENIOR PHASE **TERM : TWO**

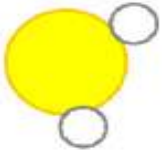
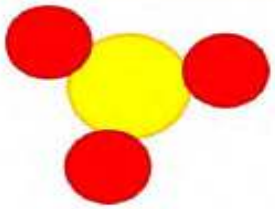
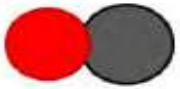
	Sulfur trioxide	
	Carbon monoxide	

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NATURAL SCIENCES: LESSON PLAN 5 **GRADE: 9**
DURATION: 30 Minutes **STRAND: MATTER AND MATERIALS**
CAPS SENIOR PHASE **TERM : TWO**

MEMORANDUM

Formula of the compound	Name of the compound	Picture of one molecule of the compound
HF	hydrogen fluoride	
H_2S	dihydrogen sulfide	
SO_3	sulfur trioxide	
CO	carbon monoxide	

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NATURAL SCIENCES: LESSON PLAN 6 **GRADE: 9**
DURATION: 30 Minutes **STRAND: MATTER AND MATERIALS**
CAPS SENIOR PHASE **TERM : TWO**

DURATION: Week Two Lesson One and Two	**OBJECTIVES: LEARNERS MUST BE ABLE TO:** Build models of several elements and compounds using beads, beans, playdough etc.
TOPIC: COMPOUNDS	
SUB TOPIC: Names of Compounds	
REFERENCES	**Sasol Inzalo workbooks- Natural Sciences Grade 9A**
TERMINOLOGY:	Naming of compounds depending on the number of oxygen atoms present, which include the following: • ***mono***xide- tells us that ***one*** oxygen atom has combined with the carbon atom • ***di***oxide- tells us that ***two*** oxygen atoms have combined with the carbon atom ***tri***oxide- tells us that ***three*** oxygen atoms have combined
SPECIFIC AIMS	1. DOING SCIENCE x 2. KNOWING THE SUBJECT CONTENT & MAKING CONNECTIONS x 3. UNDERSTANDING THE USES OF SCIENCES & INDIGENOUS KNOWLEDGE

SCIENCE PROCESS SKILLS					
Accessing & recalling Information	x	Identifying problems & issues		Doing Investigations	
Observing		Raising Questions		Recording Information	
Comparing		Predicting		Interpreting Information	
Measuring		Hypothesizing		Communicating	
Sorting & Classifying		Planning Investigations			

CONTENT AND CONCEPTS	ACTIVITIES	RESOURCES
Names of compounds • many compounds are named according to their elements, such as sodium chloride (table salt) which is made of the elements sodium and chlorine. But others have common names such as water and ammonia • some compounds have names such as carbon monoxide CO,	The teacher will demonstrate the formation of one water molecule with beads/ plasticine/ play dough etc. for learners. Complete activity 3 on pg. 163 Sasol Inzalo Gr. 9A. (NB: precise angles between the atoms is not	• Periodic Table Poster • Beads, beans, plasticine or play dough. • English Dictionary • Textbooks: eg. Sasol Inzalo Explore Gr. 9A

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NATURAL SCIENCES: LESSON PLAN 6 **GRADE: 9**
DURATION: 30 Minutes **STRAND: MATTER AND MATERIALS**
CAPS SENIOR PHASE **TERM : TWO**

CONTENT AND CONCEPTS	ACTIVITIES	RESOURCES
carbon dioxide CO_2, sulfur trioxide SO_3. In these compounds: -- ***mono***xide- tells us that ***one*** oxygen atom has combined with the carbon atom -- ***di***oxide- tells us that ***two*** oxygen atoms have combined with the carbon atom -- ***tri***oxide- tells us that ***three*** oxygen atoms have combined with the sulfur atom	prescribed in the CAPS Gr 9).	• Projector, laptop and white board/screen.
ASSESSMENT		
TEACHER REFLECTION		

ACTIVITY : Writing names from the formulae of compounds

.

MATERIALS:

• play dough, beans or beads

INSTRUCTIONS:

1. How would you name the following compounds? Write the name next to each formula in the table below.
2. Build one molecule of each compound with play dough, beans or beads. If you are not sure how to arrange the atoms, here is an important tip: the atom that comes first in the name (it will usually also be the first atom in the formula) must be placed at the centre of the molecule. All the other atoms must be placed around it. They will be bonded to the atom at the centre, but not to each other.
3. Draw a picture of your molecule in the final column of the table.

Formula of the compound	Name of the compound	Picture of one molecule of the compound
CO_2		
H_2O		

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PF_3		
SF_4		
CCl_4		

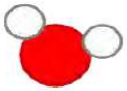
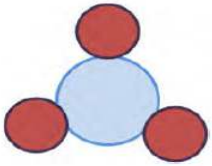
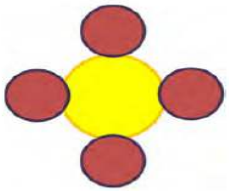
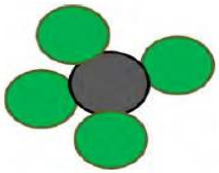
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NATURAL SCIENCES: LESSON PLAN 6
DURATION: 30 Minutes
CAPS SENIOR PHASE

GRADE: 9
STRAND: MATTER AND MATERIALS
TERM : TWO

MEMORANDUM

Formula of the compound	*Name of the compound*	*Picture of one molecule of the compound*
CO_2	carbon dioxide	
H_2O	hydrogen dioxide (water)	
PF_3	phosphorous trifluoride	
SF_4	sulfur tetrafluoride	
CCl_4	carbon tetrachloride	

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NATURAL SCIENCES: LESSON PLAN 7 **GRADE: 9**
DURATION: 30 Minutes **STRAND: MATTER AND MATERIALS**
CAPS SENIOR PHASE **TERM : TWO**

DAURATION: Week Two Lesson Three, Four and Five **TOPIC:** CHEMICAL REACTIONS **SUB TOPIC:** Chemical Equations	**OBJECTIVES: LEARNERS MUST BE ABLE TO:** Explain what a chemical reaction is. Represent chemical equations as: A) Models B) Symbols

REFERENCES	**Sasol Inzalo workbooks- Natural Sciences Grade 9A**	
TERMINOLOGY:	Chemical reactions can be represented with: Models Symbols	
SPECIFIC AIMS	1. DOING SCIENCE	
	2. KNOWING THE SUBJECT CONTENT & MAKING CONNECTIONS	x
	3. UNDERSTANDING THE USES OF SCIENCES & INDIGENOUS KNOWLEDGE	

SCIENCE PROCESS SKILLS					
Accessing & recalling Information	x	Identifying problems & issues		Doing Investigations	
Observing		Raising Questions		Recording Information	
Comparing	x	Predicting		Interpreting Information	
Measuring		Hypothesizing		Communicating	
Sorting & Classifying	x	Planning Investigations			

CONTENT AND CONCEPTS	ACTIVITIES	RESOURCES
Chemical equations to represent reactions • chemical reactions can be represented with models • chemical reactions are usually represented with symbols such as in chemical equations: For example:	**Introduction** In grade 8 Matter and Materials we learnt about the chemical reactions for the first time. Can you remember the main ideas about chemical reactions? Teacher will ask learners probing	• English Dictionary • Textbooks: eg. Sasol Inzalo Explore Gr. 9A

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NATURAL SCIENCES: LESSON PLAN 7 **GRADE: 9**
DURATION: 30 Minutes **STRAND: MATTER AND MATERIALS**
CAPS SENIOR PHASE **TERM : TWO**

CONTENT AND CONCEPTS	ACTIVITIES	RESOURCES
-- $C+O_2$ CO_2 -- $2H_2+O_2$ $2H_2O$ • the subscript number indicates the number of atoms of an element found in the formula • the numbers in front of the compounds indicate the ratio in which the molecules react. For example two molecules of hydrogen react with one molecule of oxygen to form water, therefore the ratio is 2:1 (H:O) • no atoms are lost or gained in the reaction, they are simply arranged **Balanced equations** •chemical equations must be written as balanced chemical equations. The total number and type of atoms of the reactants is the same as in the products. The above equations are therefore balanced in the following way: -- $4Fe + 3O_2 \rightarrow 2Fe_2O_3$ (brown rusty coating) -- $2Mg+ O_2 \rightarrow 2MgO$ (white powder) •another example is copper reacting with oxygen to form copper oxide. This is a very slow reaction -- word equation: copper + oxygen copper oxide chemical equation: $2Cu + O_2 \rightarrow 2CuO$ *[Learners are not required to write the formulae/symbols for* *other word equations]*	questions such as: • What is a chemical reaction? Answer It is the rearrangement of atoms, • What is the difference between reactants and products? Answer The reactants are substances used at the beginning of the reaction and products are substances formed after the reaction. • What is the meaning of the arrow when writing a chemical equation? *(Please inform learners to refrain from using an equal sign when expressing a chemical equation in writing).* Answers It shows the direction of the reaction. **Activities**: 1. Teacher presents content as prescribed in the CAPS Document page 64(Example: Sasol Inzalo Gr.9A pg. 172-178). (Teachers must ensure that the reactions are taught in words, symbols and pictures.) 2. Complete Activity 1	

ASSESSMENT		
TEACHER REFLECTION	Progress:	Challenges:

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NATURAL SCIENCES: LESSON PLAN 7 **GRADE: 9**
DURATION: 30 Minutes **STRAND: MATTER AND MATERIALS**
CAPS SENIOR PHASE **TERM : TWO**

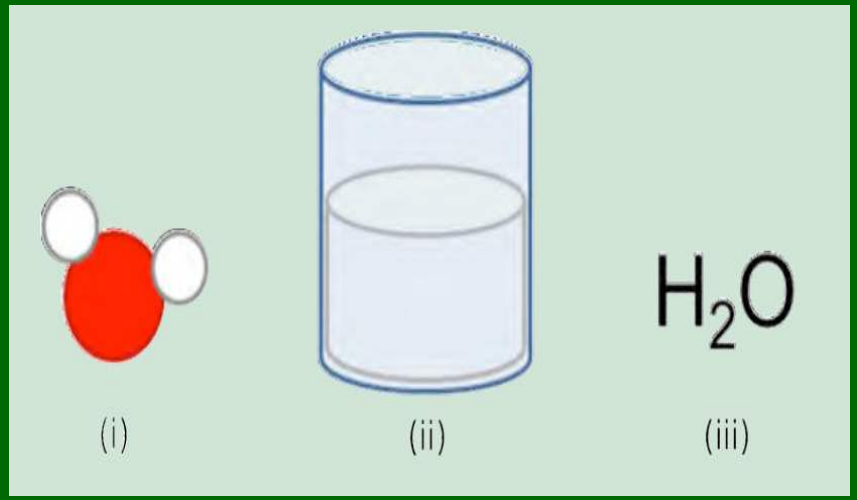
ACTIVITY: Drawing water

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INSTRUCTIONS:

The instruction for this activity is really simple: Draw a picture of water. You may use the space below for your drawing.

Your drawing may look like one of the diagrams below. They all represent water. But which one is correct?



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NATURAL SCIENCES: LESSON PLAN 7 **GRADE: 9**
DURATION: 30 Minutes **STRAND: MATTER AND MATERIALS**
CAPS SENIOR PHASE **TERM : TWO**

MEMORANDUM

They are all correct!
The three diagrams above all represent water, but they are very different from each other. We say that they are three different **representations** of the same thing, namely water.

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NATURAL SCIENCES: LESSON PLAN 8 **GRADE: 9**
DURATION: 30 Minutes **STRAND: MATTER AND MATERIALS**
CAPS SENIOR PHASE **TERM : TWO**

DURATION: Week two Lesson Six **TOPIC:** CHEMICAL REACTIONS **SUB TOPIC:** Chemical Equations	**OBJECTIVES: LEARNERS MUST BE ABLE TO:** Explain the purpose of the subscript in a compound. Identify the ratio in which molecules react.

REFERENCES	**Sasol Inzalo workbooks- Natural Sciences Grade 9A**	
TERMINOLOGY:	The subscript number indicates the number of atoms of an element. The numbers in front of the compounds indicate the ratio in which the molecules react. No atoms are lost or gained in the reaction, they are simply rearranged	
SPECIFIC AIMS	1. DOING SCIENCE	
	2. KNOWING THE SUBJECT CONTENT & MAKING CONNECTIONS	x
	3. UNDERSTANDING THE USES OF SCIENCES & INDIGENOUS KNOWLEDGE	

SCIENCE PROCESS SKILLS								
Accessing & recalling Information	x		Identifying problems & issues			Doing Investigations		
Observing			Raising Questions			Recording Information		
Comparing			Predicting			Interpreting Information		
Measuring			Hypothesizing			Communicating		
Sorting & Classifying	x		Planning Investigations					

CONTENT AND CONCEPTS	ACTIVITIES	RESOURCES
Chemical equations to represent reactions • chemical reactions can be represented with models • chemical reactions are usually represented with symbols such as in chemical equations: For example: - $C+O_2 \rightarrow CO_2$ - $2H_2+O_2 \rightarrow 2H_2O$	The teacher will use the diagram below to recap the three ways a compound can appear, that is, as a model, symbol or picture. Complete activity 2 on pg. 177 Sasol Inzalo 9A.	• English Dictionary • Textbooks: eg. Sasol Inzalo Explore Gr. 9A

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NATURAL SCIENCES: LESSON PLAN 8 **GRADE: 9**
DURATION: 30 Minutes **STRAND: MATTER AND MATERIALS**
CAPS SENIOR PHASE **TERM : TWO**

CONTENT AND CONCEPTS	ACTIVITIES	RESOURCES
• the subscript number indicates the number of atoms of an element found in the formula •the numbers in front of the compounds indicate the ratio in which the molecules react. For example two molecules of hydrogen react with one molecule of oxygen to form water, therefore the ratio is 2:1 (H: O) • no atoms are lost or gained in the reaction, they are simply rearranged **Balanced equations** •chemical equations must be written as balanced chemical equations. The total number and type of atoms of the reactants is the same as in the products. The above equations are therefore balanced in the following way: -- $4Fe + 3O_2 \rightarrow 2Fe_2O_3$ (brown rusty coating) -- $2Mg + O_2 \rightarrow 2MgO$ (white powder) •another example is copper reacting with oxygen to form copper oxide. This is a very slow reaction -- word equation: copper + oxygen copper oxide chemical equation: $2Cu + O_2 \rightarrow 2CuO$ *[Learners are not required to write the formulae/symbols for other word equations]*		

ASSESSMENT		
TEACHER REFLECTION	Progress:	Challenges:

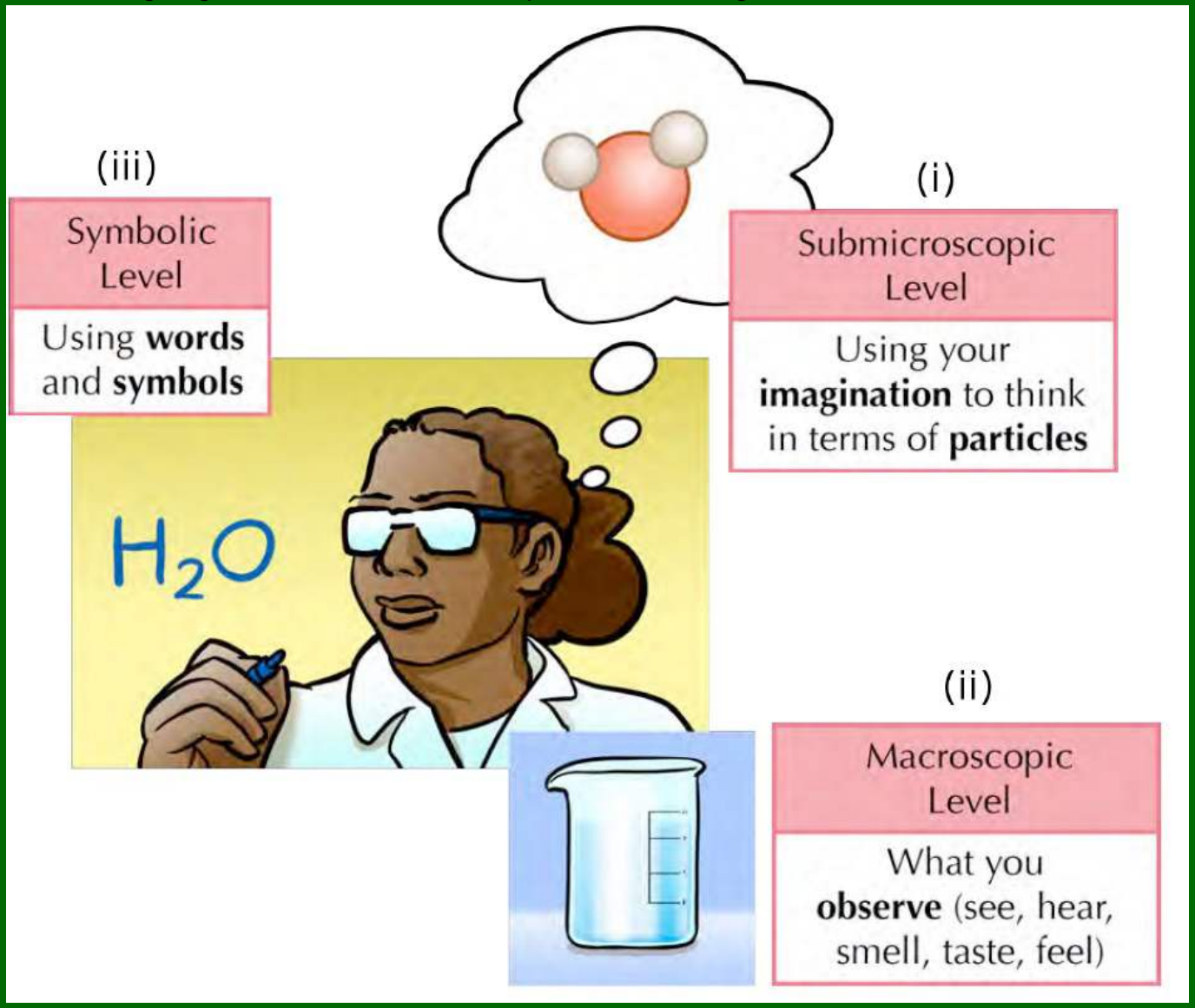
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NATURAL SCIENCES: LESSON PLAN 8
DURATION: 30 Minutes
CAPS SENIOR PHASE

GRADE: 9
STRAND: MATTER AND MATERIALS
TERM : TWO

The following diagram shows how the three representations fit together.



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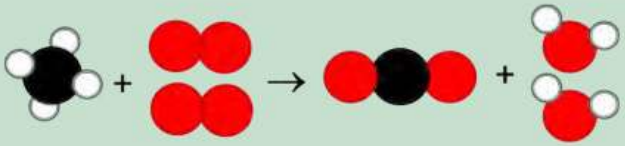
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DURATION: 30 Minutes **STRAND: MATTER AND MATERIALS**
CAPS SENIOR PHASE **TERM : TWO**

ACTIVITY : Identifying the different types of equations

.

INSTRUCTIONS:

1. Complete the following table by identifying the different types of equations which have been shown, namely word, picture or chemical equations.

Equation	Type of equation
	
carbon dioxide + water → glucose + oxygen	
$Fe + O_2 \rightarrow Fe_2O_3$	
	
$C_6H_{12}O_6 + 6O_2 \rightarrow 6CO_2 + 6H_2O$	

QUESTIONS:

1. What process does the equation, carbon dioxide + water → glucose +oxygen, represent?

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NATURAL SCIENCES: LESSON PLAN 8
DURATION: 30 Minutes
CAPS SENIOR PHASE

GRADE: 9
STRAND: MATTER AND MATERIALS
TERM : TWO

2. What process does the equation, C6H12O6 + 6O2 → 6CO2 + 6H2O, represent?

3. In the following equation: Fe + O_2 → Fe_2O_3, explain what the number 2 and 3 attached to the 'O' mean?

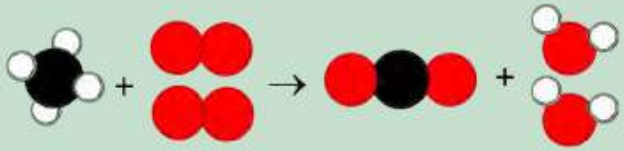
4. In the equation 2 Mg + O_2 → 2MgO, what does the number 2 in front of Mg tell us?

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NATURAL SCIENCES: LESSON PLAN 8
DURATION: 30 Minutes
CAPS SENIOR PHASE

GRADE: 9
STRAND: MATTER AND MATERIALS
TERM : TWO

MEMORANDUM

Equation	Type of equation
	Picture equation
carbon dioxide + water → glucose + oxygen	Word equation
$Fe + O_2 \rightarrow Fe_2O_3$	Symbolic/chemical equation
	Picture equation
$C_6H_{12}O_6 + 6O_2 \rightarrow 6CO_2 + 6H_2O$	Symbolic/chemical equation

1. Photosynthesis
2. Cellular respiration
3. The 2 indicates that there are two iron atoms in the compound and the 3 indicates that there are three oxygen atoms in the compound.
4. The 2 indicates that there are two molecules of the compound.

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NATURAL SCIENCES: LESSON PLAN 9 **GRADE: 9**
DURATION: 30 Minutes **STRAND: MATTER AND MATERIALS**
CAPS SENIOR PHASE **TERM : TWO**

DAURATION: Week Three Lesson One and Two	**OBJECTIVES: LEARNERS MUST BE ABLE TO:** Write out word equations for chemical reactions.
TOPIC: CHEMICAL REACTIONS	
SUB TOPIC: Balanced Equations	
REFERENCES	**Sasol Inzalo workbooks- Natural Sciences Grade 9A**
TERMINOLOGY:	Chemical equations must be written as balanced chemical equations. The total number and type of atoms of the reactants is the same as in the products.(In words)
SPECIFIC AIMS	1. DOING SCIENCE
	2. KNOWING THE SUBJECT CONTENT & MAKING CONNECTIONS x
	3. UNDERSTANDING THE USES OF SCIENCES & INDIGENOUS KNOWLEDGE

SCIENCE PROCESS SKILLS								
Accessing & recalling Information	x		Identifying problems & issues			Doing Investigations		
Observing			Raising Questions			Recording Information		
Comparing			Predicting			Interpreting Information		
Measuring			Hypothesizing			Communicating		
Sorting & Classifying			Planning Investigations					

CONTENT AND CONCEPTS	ACTIVITIES	RESOURCES
Chemical equations to represent reactions • chemical reactions can be represented with models • chemical reactions are usually represented with symbols such as in chemical equations: For example: -- $C+O_2 \rightarrow CO_2$	To introduce the lesson the teacher will show learners how to write equations in word form, for example: Hydrogen + Oxygen →Water.	• Textbooks: eg. Sasol Inzalo Explore Gr. 9A Projector, laptop and white board/screen.

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NATURAL SCIENCES: LESSON PLAN 9 **GRADE: 9**
DURATION: 30 Minutes **STRAND: MATTER AND MATERIALS**
CAPS SENIOR PHASE **TERM : TWO**

CONTENT AND CONCEPTS	ACTIVITIES	RESOURCES
-- $2H_2+O_2 \rightarrow 2H_2O$ • the subscript number indicates the number of atoms of an element found in the formula • the numbers in front of the compounds indicate the ratio in which the molecules react. For example two molecules of hydrogen react with one molecule of oxygen to form water, therefore the ratio is 2:1 (H:O) • no atoms are lost or gained in the reaction, they are simply rearranged **Balanced equations** • chemical equations must be written as balanced chemical equations. The total number and type of atoms of the reactants is the same as in the products. The above equations are therefore balanced in the following way: -- $4Fe + 3O_2 \rightarrow 2Fe2O_3$ (brown rusty coating) -- $2Mg+ O_2 \rightarrow 2MgO$ (white powder) • another example is copper reacting with oxygen to form copper oxide. This is a very slow reaction -- word equation: copper + oxygen copper oxide chemical equation: $2Cu + O_2 \rightarrow 2CuO$ *[Learners are not required to write the formulae/symbols for other word equations]*	The teacher will thereafter give further examples to learners to reinforce the concept. The nature of the examples given will depend on the learners grasp and understanding of the concept. Learners will complete the activity.	

ASSESSMENT		
TEACHER REFLECTION	Progress:	Challenges:

Activity

Turn the following chemical equations into word equations:

1) $2CO + O_2 \rightarrow 2 CO_2$
2) $2 Mg + O_2 \rightarrow 2 MgO$
3) $S + O_2 \rightarrow SO_2$
4) $4Fe + O_2 \rightarrow 2Fe_2O_3$

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NATURAL SCIENCES: LESSON PLAN 9
DURATION: 30 Minutes
CAPS SENIOR PHASE

GRADE: 9
STRAND: MATTER AND MATERIALS
TERM : TWO

MEMORANDUM

1) Carbon monoxide + oxygen → Carbon dioxide
2) Magnesium + oxygen → Magnesium oxide
3) Sulfur + oxygen → Sulfur dioxide
4) Iron + oxygen → Iron oxide

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NATURAL SCIENCES: LESSON PLAN 10
DURATION: 60 Minutes
CAPS SENIOR PHASE

GRADE: 9
STRAND: MATTER AND MATERIALS
TERM : TWO

DURATION: Week Three Lesson Four and Five	**OBJECTIVES: LEARNERS MUST BE ABLE TO:** Write out balanced equations in symbol form.
TOPIC: CHEMICAL REACTIONS	
SUB TOPIC: Balanced Equations	
REFERENCES	**Sasol Inzalo workbooks- Natural Sciences Grade 9A**
TERMINOLOGY:	Chemical equations must be written as balanced chemical equations. The total number and type of atoms of the reactants is the same as in the products.(In Symbols)
SPECIFIC AIMS	1. DOING SCIENCE
	2. KNOWING THE SUBJECT CONTENT & MAKING CONNECTIONS x
	3. UNDERSTANDING THE USES OF SCIENCES & INDIGENOUS KNOWLEDGE

SCIENCE PROCESS SKILLS								
Accessing & recalling Information	x		Identifying problems & issues			Doing Investigations		
Observing			Raising Questions			Recording Information		
Comparing			Predicting			Interpreting Information		
Measuring			Hypothesizing			Communicating		
Sorting & Classifying			Planning Investigations					

CONTENT AND CONCEPTS	ACTIVITIES	RESOURCES
Balanced equations • chemical equations must be written as balanced chemical equations. The total number and type of atoms of the reactants is the same as in the products. The above equations are therefore balanced in the following way: -- $4Fe + 3O_2 \rightarrow 2Fe_2O_3$	To introduce the lesson the teacher will show learners how to write equations in words, for example: Hydrogen + Oxygen →Water. The teacher will thereafter give further examples to learners to reinforce the concept. The nature of the examples given will depend on the learners grasp and	• Textbooks: eg. Sasol Inzalo Explore Gr. 9A • Projector, laptop and white board/screen.

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NATURAL SCIENCES: LESSON PLAN 10
DURATION: 60 Minutes
CAPS SENIOR PHASE

GRADE: 9
STRAND: MATTER AND MATERIALS
TERM : TWO

CONTENT AND CONCEPTS	ACTIVITIES	RESOURCES
(brown rusty coating) -- 2Mg+ O_2→ 2MgO (white powder) • another example is copper reacting with oxygen to form copper oxide. This is a very slow reaction -- word equation: copper + oxygen copper oxide chemical equation: 2Cu + O_2→ 2CuO *[Learners are not required to write the formulae/symbols for other word equations]*	understanding of the concept. Learners will complete the activity below.	

ASSESSMENT		
TEACHER REFLECTION	Progress:	Challenges:

Activity

Balance the following equations:

1) Na + I_2 → NaI
2) Cu + O_2 → CuO
3) Zn + HCl → $ZnCl_2$ + H_2
4) Fe + O_2 → Fe_2O_3

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NATURAL SCIENCES: LESSON PLAN 10
DURATION: 60 Minutes
CAPS SENIOR PHASE

GRADE: 9
STRAND: MATTER AND MATERIALS
TERM : TWO

MEMORANDUM

Activity

1) $2Na + I_2 \rightarrow 2NaI$
2) $2Cu + O_2 \rightarrow 2CuO$
3) $Zn + 2HCl \rightarrow ZnCl_2 + H_2$
4) $4Fe + 3O_2 \rightarrow 2Fe_2O_3$

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NATURAL SCIENCES: LESSON PLAN 11
DURATION: 60 Minutes
CAPS SENIOR PHASE

GRADE: 9
STRAND: MATTER AND MATERIALS
TERM : TWO

DAURATION: Week Three Lesson Five and Six	**OBJECTIVES: LEARNERS MUST BE ABLE TO:** Answer and analyse different types of questions based on chemical reactions
TOPIC: CHEMICAL REACTIONS	
SUB TOPIC: Balanced Equations	
REFERENCES	**Sasol Inzalo workbooks- Natural Sciences Grade 9A**
TERMINOLOGY:	Consolidation of chemical reactions.

SPECIFIC AIMS	1. DOING SCIENCE	
	2. KNOWING THE SUBJECT CONTENT & MAKING CONNECTIONS	x
	3. UNDERSTANDING THE USES OF SCIENCES & INDIGENOUS KNOWLEDGE	

SCIENCE PROCESS SKILLS								
Accessing & recalling Information	x		Identifying problems & issues			Doing Investigations		
Observing			Raising Questions			Recording Information		
Comparing			Predicting			Interpreting Information		
Measuring			Hypothesizing			Communicating		
Sorting & Classifying	x		Planning Investigations					

CONTENT AND CONCEPTS	ACTIVITIES	RESOURCES
Balanced equations • chemical equations must be written as balanced chemical equations. The total number and type of atoms of the reactants is the same as in the products. The above equations are therefore balanced in the following way: -- $4Fe + 3O_2 \rightarrow 2Fe_2O_3$ (brown rusty coating)	Teacher will give learners an informal test to write. **Activities**: Informal test to be written by learners.	• Copies of test

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NATURAL SCIENCES: LESSON PLAN 11 **GRADE: 9**
DURATION: 60 Minutes **STRAND: MATTER AND MATERIALS**
CAPS SENIOR PHASE **TERM : TWO**

CONTENT AND CONCEPTS	ACTIVITIES	RESOURCES
-- 2Mg+ O_2→ 2MgO (white powder) • another example is copper reacting with oxygen to form copper oxide. This is a very slow reaction -- word equation: copper + oxygen copper oxide chemical equation: 2Cu + O_2→ 2CuO *[Learners are not required to write the formulae/symbols for other word equations]*		

ASSESSMENT		
TEACHER REFLECTION	Progress:	Challenges:

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NATURAL SCIENCES: LESSON PLAN 11 **GRADE: 9**
DURATION: 60 Minutes **STRAND: MATTER AND MATERIALS**
CAPS SENIOR PHASE **TERM : TWO**

Name Of Learner:_____ **Grade:_____**

Natural Sciences Test

Consolidation of Chemical equations

1. Why can we not change the subscripts in the formulas of reactants and products when we want to balance an equation? [2]

2. Write the balanced chemical equation between carbon and oxygen to form carbon dioxide. [1]

3. Write the balanced chemical equation between hydrogen and oxygen to form water. [1]

4. Here is a balanced chemical equation: $C + H_2O \rightarrow CO + H_2$

   Answer the four questions below that relate to this equation: [8]
   a) Write the formulae of the reactants of this reaction.
   b) Write the names of the reactants of this reaction.
   c) Write the formulae of the products of this reaction.
   d) Write the names of the products of this reaction.

5. The balanced equation below represents the reaction between nitrogen monoxide (NO) and bromine (Br_2): $2\ NO + Br_2 \rightarrow 2\ NOBr$

Complete the table by counting how much of each atom is on each side of the reaction equation. [6

Elements present:	Number of atoms of reactants:	Number of atoms in products:
Nitrogen (N)		
Oxygen (O)		
Bromine (Br)		

6. Turn the following chemical equations into word equations: [2 x 3 = 6]

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a) $2\ CO + O_2 \rightarrow 2\ CO_2$

b) $2\ Mg + O_2 \rightarrow 2\ MgO$

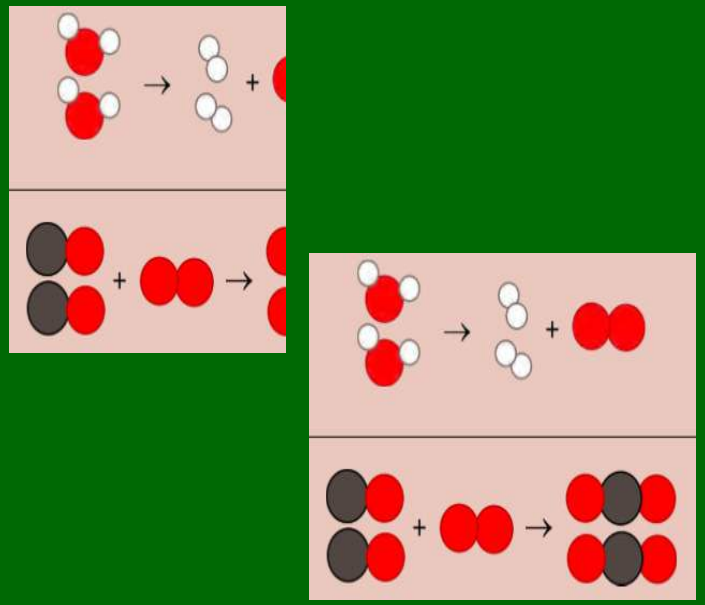
7. Turn the following word equations into chemical equations: [2 x 3 = 6]

a) sulfur + oxygen → sulfur dioxide

b) carbon monoxide + water → carbon dioxide + hydrogen

8. Turn the following picture equations into chemical equations. [2 x 3 = 6]

- The red circles represent oxygen (O) atoms.
- The white circles represent hydrogen (H) atoms.
- The grey circles represent carbon (C) atoms.
- The yellow circles represent sulfur (S) atoms.



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NATURAL SCIENCES: LESSON PLAN 11 **GRADE: 9**
DURATION: 60 Minutes **STRAND: MATTER AND MATERIALS**
CAPS SENIOR PHASE **TERM : TWO**

9. Write the following chemical equations as word equations: [4 x 1 = 4]

a) 4 Fe + 3 O_2 → 2 Fe_2O_3

b) What does this product look like?

c) 2 Mg + O_2 → 2 MgO

d) What does the product look like?

10. Turn the following chemical equations into picture equations: [2 x 4 = 8]

a) CH_4 + 2 O_2 → CO_2 + 2 H_2O

b) CS_2 + 3 O_2 → CO_2 + 2 SO_2

Total = 48 marks

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NATURAL SCIENCES: LESSON PLAN 11 **GRADE: 9**
DURATION: 60 Minutes **STRAND: MATTER AND MATERIALS**
CAPS SENIOR PHASE **TERM : TWO**

Memorandum

1. This is because it will change the formula of the compound which then represents a different compound, and not the one involved in the reaction.

2. $C + O_2 \rightarrow CO_2$

3. $2H_2 + O_2 \rightarrow 2H_2O$.

4. Answer the four questions below that relate to this equation: [8 marks]
a) Write the formulae of the reactants of this reaction.
b) Write the names of the reactants of this reaction.
c) Write the formulae of the products of this reaction.
d) Write the names of the products of this reaction.
a) C and H_2O.
NOTE: Learners do not need to know this equation; it is just to practice balancing equations.
b) carbon and water
c) CO and H_2
d) carbon monoxide and hydrogen

5. **NOTE:** Learners do not need to know this equation; it is just to practice balancing equations.

Number of atoms	*In the reactants*	*In the product*
Nitrogen (N)	*2*	*2*
Oxygen (O)	*2*	*2*
Bromine (Br)	*2*	*2*

6.
a) carbon monoxide + oxygen → carbon dioxide
b) magnesium + oxygen →magnesium oxide
7.
a) $S + O_2 \rightarrow SO_2$

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213
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b) $CO + H_2O \rightarrow CO_2 + H_2$

8.
a) $2\ H_2O \rightarrow 2\ H_2 + O_2$
b) $2\ CO + O_2 \rightarrow 2\ CO_2$

9.
a) iron + oxygen → iron oxide
b) It is a brown rusty coating (rust).
c) magnesium + oxygen→ magnesium oxide
d) It is a white powder.

10.
a) $CH_4 + 2\ O_2 \rightarrow CO_2 + 2\ H_2O$
b) $CS_2 + 3\ O_2 \rightarrow CO2 + 2\ SO_2$

Total [48 marks]
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NATURAL SCIENCES: LESSON PLAN 12 **GRADE: 9**
DURATION: 60 Minutes **STRAND: MATTER AND MATERIALS**
CAPS SENIOR PHASE **TERM : TWO**

DURATION: Week four Lesson One and Two	**OBJECTIVES: LEARNERS MUST BE ABLE TO:** Identify and rectify their misconceptions and gaps in the content relating to chemical equations.
TOPIC: CHEMICAL REACTIONS	
SUB TOPIC: Balanced Equations	
REFERENCES	**Sasol Inzalo workbooks- Natural Sciences Grade 9A**
TERMINOLOGY:	Reactants, Products
SPECIFIC AIMS	1. DOING SCIENCE
	2. KNOWING THE SUBJECT CONTENT & MAKING CONNECTIONS x
	3. UNDERSTANDING THE USES OF SCIENCES & INDIGENOUS KNOWLEDGE

SCIENCE PROCESS SKILLS								
Accessing & recalling Information	x		Identifying problems & issues	x		Doing Investigations		
Observing			Raising Questions			Recording Information		
Comparing			Predicting			Interpreting Information		
Measuring			Hypothesizing			Communicating		
Sorting & Classifying			Planning Investigations					

CONTENT AND CONCEPTS	ACTIVITIES	RESOURCES
Balanced equations • chemical equations must be written as balanced chemical equations. The total number and type of atoms of the reactants is the same as in the products. The above equations are therefore balanced in the following way: -- $4Fe + 3O_2 \rightarrow 2Fe_2O_3$ (brown rusty coating)	The teacher will eradicate gaps and misconceptions in the content from the results of the informal test.	• Copies of test

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NATURAL SCIENCES: LESSON PLAN 11 **GRADE: 9**
DURATION: 60 Minutes **STRAND: MATTER AND MATERIALS**
CAPS SENIOR PHASE **TERM : TWO**

CONTENT AND CONCEPTS	ACTIVITIES	RESOURCES
-- $2Mg + O_2 \rightarrow 2MgO$ (white powder) • another example is copper reacting with oxygen to form copper oxide. This is a very slow reaction -- word equation: copper + oxygen copper oxide chemical equation: $2Cu + O_2 \rightarrow 2CuO$ *[Learners are not required to write the formulae/symbols for other word equations]*		

ASSESSMENT		
TEACHER REFLECTION	Progress:	Challenges:

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NATURAL SCIENCES: LESSON PLAN 13 **GRADE: 9**
DURATION: 60 Minutes **STRAND: MATTER AND MATERIALS**
CAPS SENIOR PHASE **TERM : TWO**

DURATION: Week Four Lesson Three and Four **TOPIC:** REACTIONS OF METALS WITH OXYGEN **SUB TOPIC:** The General Reactions of Metals with Oxygen	**OBJECTIVES: LEARNERS MUST BE ABLE TO:** Explain that burning/ combustion requires oxygen. Write out balanced equations for metal oxides.
REFERENCES	**Sasol Inzalo workbooks- Natural Sciences Grade 9A**
TERMINOLOGY:	**The general reaction of metals with oxygen** Some metals react with oxygen during burning (combustion) When a metal reacts with oxygen, a metal oxide is formed as a product.

SPECIFIC AIMS	1. DOING SCIENCE	
	2. KNOWING THE SUBJECT CONTENT & MAKING CONNECTIONS	x
	3. UNDERSTANDING THE USES OF SCIENCES & INDIGENOUS KNOWLEDGE	

SCIENCE PROCESS SKILLS								
Accessing & recalling Information			Identifying problems & issues			Doing Investigations	x	
Observing	x		Raising Questions			Recording Information	x	
Comparing	x		Predicting			Interpreting Information	x	
Measuring			Hypothesizing			Communicating		
Sorting & Classifying			Planning Investigations					

CONTENT AND CONCEPTS	ACTIVITIES	RESOURCES
The general reaction of metals with oxygen • some metals react with oxygen during	When a substance burns in air, the reaction is called a combustion reaction. This reaction is always in the presence of oxygen (from the air). The products formed when metals react	• Textbooks: eg. Sasol Inzalo Explore Gr. 9A • English dictionary

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NATURAL SCIENCES: LESSON PLAN 13 **GRADE: 9**
DURATION: 60 Minutes **STRAND: MATTER AND MATERIALS**
CAPS SENIOR PHASE **TERM : TWO**

CONTENT AND CONCEPTS	ACTIVITIES	RESOURCES
burning (combustion) • when a metal reacts with oxygen, a metal oxide is formed as a product. The general equation for this type of reaction is always: metal + oxygen→ metal oxide	with oxygen are called metal oxides. 1. Teacher presents content as prescribed in the CAPS Document page 65(Example: Sasol Inzalo Gr.9A pg. 194) 2. Learners will complete activity 1.	

ASSESSMENT		
TEACHER REFLECTION	Progress:	Challenges:

Activity 1

1) What happens when a metal reacts with oxygen?

2) What is the product called?

3) How can we represent the general reaction between a metal and oxygen?

4) What is a combustion reaction?

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NATURAL SCIENCES: LESSON PLAN 13 **GRADE: 9**
DURATION: 60 Minutes **STRAND: MATTER AND MATERIALS**
CAPS SENIOR PHASE **TERM : TWO**

MEMORANDUM

1) When a metal reacts with oxygen, a metal oxide forms.
2) Metal oxide
3) The general equation for this reaction is: metal + oxygen → metal oxide.
4) A reaction where a metal reacts with oxygen and burns.

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NATURAL SCIENCES: LESSON PLAN 14 **GRADE: 9**
DURATION: 60 Minutes **STRAND: MATTER AND MATERIALS**
CAPS SENIOR PHASE **TERM : TWO**

DURATION: Week Four Lesson Five and Six **TOPIC:** REACTIONS OF METALS WITH OXYGEN **SUB TOPIC:** Reaction of Magnesium with Oxygen	**OBJECTIVES: LEARNERS MUST BE ABLE TO:** Write out the word equation and chemical equation for the reaction between magnesium and oxygen.

REFERENCES	**Sasol Inzalo workbooks- Natural Sciences Grade 9A**	
TERMINOLOGY:	Reaction of magnesium with oxygen The metal magnesium burns in air (which contains oxygen), to form magnesium oxide.	
SPECIFIC AIMS	1. DOING SCIENCE	x
	2. KNOWING THE SUBJECT CONTENT & MAKING CONNECTIONS	x
	3. UNDERSTANDING THE USES OF SCIENCES & INDIGENOUS KNOWLEDGE	

SCIENCE PROCESS SKILLS								
Accessing & recalling Information			Identifying problems & issues			Doing Investigations	x	
Observing	x		Raising Questions			Recording Information		
Comparing			Predicting			Interpreting Information	x	
Measuring			Hypothesizing			Communicating		
Sorting & Classifying			Planning Investigations					

CONTENT AND CONCEPTS	ACTIVITIES	RESOURCES
Reaction of magnesium with oxygen • when the metal magnesium is burnt in air (which contains oxygen), the reaction forms magnesium oxide as a product -- word equation: magnesium + oxygen →magnesium oxide -- chemical equation: $Mg + O_2 \rightarrow MgO$	When a substance burns in air, the reaction is called a combustion reaction. This reaction is always in the presence of oxygen (from the air). The products formed when metals react with oxygen are called metal oxides. 1. The teacher will discuss the balancing of the equation of	• Textbooks: eg. Sasol Inzalo Explore Gr. 9A • English dictionary • Magnesium Ribbon/ filings Iron filings

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NATURAL SCIENCES: LESSON PLAN 14 **GRADE: 9**
DURATION: 60 Minutes **STRAND: MATTER AND MATERIALS**
CAPS SENIOR PHASE **TERM : TWO**

CONTENT AND CONCEPTS	ACTIVITIES	RESOURCES
[unbalanced]	magnesium and oxygen. 2. Learners will complete activity 2	
ASSESSMENT		
TEACHER REFLECTION	Progress:	Challenges:

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Activity : Reaction concerned with magnesium burning in oxygen.

When magnesium metal burns in oxygen, we can write the following word equation for the reaction that occurs between these two elements:
magnesium + oxygen → magnesium oxide



Magnesium flakes burning in oxygen in a sparkler.

QUESTIONS:

1. What are the reactants of the reaction?

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NATURAL SCIENCES: LESSON PLAN 14 **GRADE: 9**
DURATION: 60 Minutes **STRAND: MATTER AND MATERIALS**
CAPS SENIOR PHASE **TERM : TWO**

2. What is the product?

We can change the word equation into a chemical equation: $Mg + O_2 \rightarrow MgO$

3. What kind of representation is this: macroscopic, submicroscopic, or symbolic?

4. Is the equation balanced? If you are not sure, count the number of each type of atom on the left, and on the right. Perhaps it will help to look at a submicroscopic representation (a particle diagram) of the reaction:



You can write your results in the table below:

Number of atoms:	Reactants:	Products:
Mg		
O		

5. What is your conclusion: Is the equation balanced? Explain your answer.

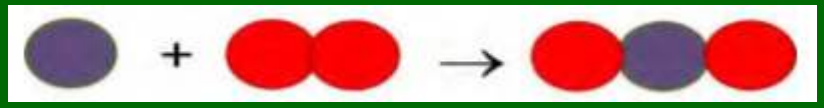
Teacher Guide

So how could we balance the equation to describe magnesium burning in oxygen? When balancing reactions, there is one simple rule:

You may only add compounds that are already in the equation. This means only coefficients may be changed, not subscripts!

Let's try a few alternative solutions. Would it help to add an O atom on the right, like this?

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Now the O atoms are balanced on both sides of the equation, but we don't have MgO on the right anymore. We have changed the formula on the right to MgO2. That means we have changed a subscript in the formula. You cannot change the formula of a compound when balancing chemical equations.

Adding single atoms to any side of the equation is also not allowed. That means the following equation is also not correct:



Remember that we may only use the chemical formulae that are already in the equation. We need two MgO's on the right to balance the two O's in O_2. We also need two Mg's on the left to balance the two MgO's on the right

Can you build this equation with play dough balls or beads? When you convert the play dough 'reactants' to 'products', are there any unused 'atoms' left behind afterwards?

Now, let us take this a step further. We are going to convert our balanced submicroscopic equation to a symbolic chemical equation. Write down a balanced equation for magnesium burning in oxygen to produce magnesium oxide.

Here are a few important rules for balancing chemical equations:

- *When we balance reaction equations we may ONLY add coefficients to the chemical formulae that are already in the equation.*
- *We may NOT change the chemical formulae of any of the reactants or products by changing the subscripts in a formula.*
- *We may NOT add other reactants or products. This includes adding single atoms of any of the elements already in the reaction equation.*
- *We may NOT remove reactants or products. We are now ready to practice balancing other reaction equations.*

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NATURAL SCIENCES: LESSON PLAN 15 **GRADE: 9**
DURATION: 60 Minutes **STRAND: MATTER AND MATERIALS**
CAPS SENIOR PHASE **TERM : TWO**

DURATION: Week Five Lesson One and Two	**OBJECTIVES: LEARNERS MUST BE ABLE TO:** Identify the oxide formed during the chemical reaction between magnesium and oxygen.
TOPIC: REACTIONS OF METALS WITH OXYGEN	
SUB TOPIC: Reaction of magnesium with oxygen	

REFERENCES	**Sasol Inzalo workbooks- Natural Sciences Grade 9A**	
TERMINOLOGY:	Reaction of magnesium with oxygen The metal magnesium burns in air (which contains oxygen), to form magnesium oxide.	
SPECIFIC AIMS	1. DOING SCIENCE	x
	2. KNOWING THE SUBJECT CONTENT & MAKING CONNECTIONS	x
	3. UNDERSTANDING THE USES OF SCIENCES & INDIGENOUS KNOWLEDGE	

SCIENCE PROCESS SKILLS								
Accessing & recalling Information			Identifying problems & issues			Doing Investigations		
Observing			Raising Questions			Recording Information		
Comparing			Predicting			Interpreting Information		
Measuring			Hypothesizing			Communicating		
Sorting & Classifying			Planning Investigations					

CONTENT AND CONCEPTS	ACTIVITIES	RESOURCES
Reaction of magnesium with oxygen • when the metal magnesium is burnt in air (which contains oxygen), the reaction forms magnesium oxide as a product -- word equation: magnesium + oxygen magnesium oxide	1. The teacher will demonstrate the burning of magnesium ribbon in the presence of oxygen. 2. Learners will complete activity 3.	• Textbooks: eg. Sasol Inzalo Explore Gr. 9A • English dictionary • Magnesium Ribbon/ filings • Projector, laptop and

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NATURAL SCIENCES: LESSON PLAN 15 **GRADE: 9**
DURATION: 60 Minutes **STRAND: MATTER AND MATERIALS**
CAPS SENIOR PHASE **TERM : TWO**

CONTENT AND CONCEPTS	ACTIVITIES	RESOURCES
-- chemical equation: $Mg + O_2 \rightarrow MgO$ [unbalanced]		white board/screen.
ASSESSMENT		
TEACHER REFLECTION	Progress:	Challenges:

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Activity:

INSTRUCTIONS:

1. The teacher will demonstrate the combustion of magnesium in oxygen.
2. You should make careful observations during the demonstration and write these down in the spaces provided below.
   VISIT Video showing calcium reacting with oxygen bit.ly/19n3u7c

QUESTIONS:

1. Describe the physical form (shape) of the metal in this experiment.
2. What do we call reactions where a substance burns in air?
3. How would you describe the physical appearance or colour of the metal before it is burned?
4. Can you see the oxygen that the metal will react with? Can you describe it?
5. What do you observe during the reaction? Describe anything you see, hear, or smell.
6. What does the product of the reaction look like? Describe it in as much detail as possible.

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NATURAL SCIENCES: LESSON PLAN 15 **GRADE: 9**
DURATION: 60 Minutes **STRAND: MATTER AND MATERIALS**
CAPS SENIOR PHASE **TERM : TWO**

MEMORANDUM

1. The magnesium is in the form of magnesium 'ribbon'.

2. Combustion reactions.

3. Learners' observations may include any of the following: The magnesium ribbon looks like a thin strip of metal. It looks like metal tape. Depending on the state of the ribbon, learners may describe it as shiny, or dark grey, black, metallic, or even tarnished. Encourage creative descriptions.

4. Oxygen gas cannot be seen or directly observed and so it cannot be described.

5.
• Learners may see the magnesium burning with a blinding white light. They may notice some smoke.
• Learners may hear crackling or hissing as the magnesium burns.
• Learners may notice a hot, metallic smell in the air.
• Learners may experience the heat from the combustion reaction.

6. The product is a soft, white, powdery solid

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NATURAL SCIENCES: LESSON PLAN 16 **GRADE: 9**
DURATION: 60 Minutes **STRAND: MATTER AND MATERIALS**
CAPS SENIOR PHASE **TERM : TWO**

DURATION: Week Five Lesson Three and Four	**OBJECTIVES: LEARNERS MUST BE ABLE TO:** Write out the word equation and chemical equation for the reaction between iron and oxygen.
TOPIC: REACTIONS OF METALS WITH OXYGEN	
SUB TOPIC: Reaction of iron with oxygen	

REFERENCES	**Sasol Inzalo workbooks- Natural Sciences Grade 9A**	
TERMINOLOGY:	Reaction of iron with oxygen The metal iron burns air (which contains oxygen), to form iron oxide.	
SPECIFIC AIMS	1. DOING SCIENCE	
	2. KNOWING THE SUBJECT CONTENT & MAKING CONNECTIONS	x
	3. UNDERSTANDING THE USES OF SCIENCES & INDIGENOUS KNOWLEDGE	

SCIENCE PROCESS SKILLS								
Accessing & recalling Information			Identifying problems & issues			Doing Investigations		
Observing			Raising Questions			Recording Information		
Comparing			Predicting			Interpreting Information		
Measuring			Hypothesizing			Communicating		
Sorting & Classifying			Planning Investigations					

CONTENT AND CONCEPTS	ACTIVITIES	RESOURCES
Reaction of iron with oxygen • when the metal iron is burnt in air (which contains oxygen), the reaction forms iron oxide as a product -- word equation: iron + oxygen iron oxide -- chemical equation: $Fe + O_2 \rightarrow Fe_2O_3$ [unbalanced]	1. The teacher will discuss the balancing of the equation dealing with iron and oxygen. 2. Learners will complete activity 4.	• Textbooks: eg. Sasol Inzalo Explore Gr. 9A English dictionary

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NATURAL SCIENCES: LESSON PLAN 16 **GRADE: 9**
DURATION: 60 Minutes **STRAND: MATTER AND MATERIALS**
CAPS SENIOR PHASE **TERM : TWO**

CONTENT AND CONCEPTS	ACTIVITIES	RESOURCES
ASSESSMENT		
TEACHER REFLECTION		

ACTIVITY : A reaction concerned with iron reacting with oxygen.

When iron rusts, it is because the iron metal reacts with oxygen in the air to form iron oxide.



An old car with rust on the bonnet.



A closeup photo of a rusted barrel.

The word equation is the following: iron + oxygen → iron oxide.

The chemical equation is the following: $Fe + O_2 \rightarrow Fe_2O_3$ is the equation balanced? Draw a sub-microscopic picture to help you decide.

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You could also use a table like the one below:

Number of atoms:	Reactants:	Products:
Fe		
O		

What is your verdict: Is the equation balanced? Explain your answer.

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NATURAL SCIENCES: LESSON PLAN 16 **GRADE: 9**
DURATION: 60 Minutes **STRAND: MATTER AND MATERIALS**
CAPS SENIOR PHASE **TERM : TWO**

MEMORANDUM

Number of atoms:	Reactants:	Products:
Fe	1	2
O	2	3

No. two oxygen atoms and one iron atom in the reactant and three oxygen atoms and two iron atoms in the products.

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NATURAL SCIENCES: LESSON PLAN 17 **GRADE: 9**
DURATION: 60 Minutes **STRAND: MATTER AND MATERIALS**
CAPS SENIOR PHASE **TERM : TWO**

DURATION: Week Five Lesson Five	**OBJECTIVES: LEARNERS MUST BE ABLE TO:** Explain that iron oxide forms during the chemical reaction between iron and oxygen.
TOPIC: REACTIONS OF METALS WITH OXYGEN	
SUB TOPIC: Reaction of iron with oxygen	
REFERENCES	**Sasol Inzalo workbooks- Natural Sciences Grade 9A**
TERMINOLOGY:	Metal Oxides
SPECIFIC AIMS	1. DOING SCIENCE x
	2. KNOWING THE SUBJECT CONTENT & MAKING CONNECTIONS x
	3. UNDERSTANDING THE USES OF SCIENCES & INDIGENOUS KNOWLEDGE

SCIENCE PROCESS SKILLS								
Accessing & recalling Information			Identifying problems & issues			Doing Investigations		
Observing			Raising Questions			Recording Information		
Comparing			Predicting			Interpreting Information		
Measuring			Hypothesizing			Communicating		
Sorting & Classifying			Planning Investigations					

CONTENT AND CONCEPTS	ACTIVITIES	RESOURCES
Reaction of iron with oxygen • when the metal iron is burnt in air (which contains oxygen), the reaction forms iron oxide as a product -- word equation: iron + oxygen iron oxide -- chemical equation: $Fe + O_2 \rightarrow Fe_2O_3$	When a substance burns in air, the reaction is called a combustion reaction. This reaction is always in the presence of oxygen (from the air). The products formed when metals react with	• Textbooks: eg. Sasol Inzalo Explore Gr. 9A • English dictionary • test tube • clamp

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NATURAL SCIENCES: LESSON PLAN 17 **GRADE: 9**
DURATION: 60 Minutes **STRAND: MATTER AND MATERIALS**
CAPS SENIOR PHASE **TERM : TWO**

CONTENT AND CONCEPTS	ACTIVITIES	RESOURCES
[unbalanced]	oxygen are called metal oxides. 1. The teacher will demonstrate the burning of iron in the presence of oxygen. 2. Learners will complete activity 5.	• retort stand • dish • iron filings • water

ASSESSMENT		
TEACHER REFLECTION	Progress:	Challenges:

Activity

The reaction between iron and oxygen in air.

MATERIALS:

• test tube

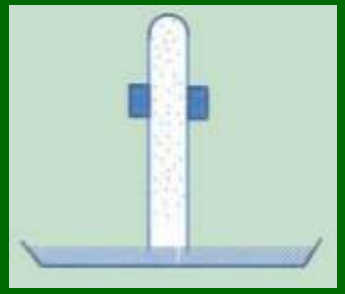
• clamp

• retort stand

• dish

• iron filings

• water



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NATURAL SCIENCES: LESSON PLAN 17 **GRADE: 9**
DURATION: 60 Minutes **STRAND: MATTER AND MATERIALS**
CAPS SENIOR PHASE **TERM : TWO**

INSTRUCTIONS:

1. Rinse a test tube with water to wet the inside.
2. Carefully sprinkle a spatula of iron filings around the sides of the test tube.
3. Invert the test tube in a dish of water. Use a clamp attached to a retort stand to hold the test tube in place.
4. Over the three days the water must remain above the lip of the test tube.

QUESTIONS:

1. What do the iron filings look like at the start of the experiment?
2. What are the reactants in this experiment?
3. Is there something present that is aiding or speeding up the reaction?
4. What does the product look like at the end of the reaction?

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NATURAL SCIENCES: LESSON PLAN 17 **GRADE: 9**
DURATION: 60 Minutes **STRAND: MATTER AND MATERIALS**
CAPS SENIOR PHASE **TERM : TWO**

MEMORANDUM

TEACHER'S NOTE
Here is a suggested activity for you to show how rust forms. This is not required by CAPS. It can be set up as a demonstration. You can then compare this reaction with the one that you did previously where iron was burned in oxygen in a combustion reaction. This experiment will require a place where it can remain undisturbed for two or three days. It may be worth setting up this experiment at the start of this section.
Take note: The test tube may be difficult to clean at the end of this experiment.

1. *They are a silvery colour.*

2. *Iron and oxygen (and water).*

3. *The water.*

4. *It is a brownish red colour.*
.

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NATURAL SCIENCES: LESSON PLAN 18 **GRADE: 9**
DURATION: 60 Minutes **STRAND: MATTER AND MATERIALS**
CAPS SENIOR PHASE **TERM : TWO**

DURATION: Week Five Lesson Six	**OBJECTIVES: LEARNERS MUST BE ABLE TO:**
TOPIC: REACTIONS OF METALS WITH OXYGEN	Discuss how rust (corrosion) forms.
SUB TOPIC: - Formation of Rust Ways to prevent rusting	Suggest ways of preventing the formation of rust.

REFERENCES	**Sasol Inzalo workbooks- Natural Sciences Grade 9A**	
TERMINOLOGY:	**Formation of rust** • Rusting is a slow chemical reaction of iron metal, with oxygen and moisture (water). **Ways to prevent rusting**	
SPECIFIC AIMS	1. DOING SCIENCE	
	2. KNOWING THE SUBJECT CONTENT & MAKING CONNECTIONS	x
	3. UNDERSTANDING THE USES OF SCIENCES & INDIGENOUS KNOWLEDGE	

SCIENCE PROCESS SKILLS								
Accessing & recalling Information	X		Identifying problems & issues	x		Doing Investigations	x	
Observing	X		Raising Questions	x		Recording Information		
Comparing			Predicting			Interpreting Information		
Measuring			Hypothesizing			Communicating		
Sorting & Classifying			Planning Investigations					

CONTENT AND CONCEPTS	ACTIVITIES	RESOURCES
Formation of rust • rusting is a slow chemical reaction of iron metal, with oxygen and moisture (water) to form a complex compound part of which is iron oxide.	1.Teacher presents content as prescribed in the CAPS Document page 66(Example:	• Textbooks: eg. Sasol Inzalo Explore Gr. 9A • English dictionary

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NATURAL SCIENCES: LESSON PLAN 18 **GRADE: 9**
DURATION: 60 Minutes **STRAND: MATTER AND MATERIALS**
CAPS SENIOR PHASE **TERM : TWO**

CONTENT AND CONCEPTS	ACTIVITIES	RESOURCES
• rust (a form of corrosion) only occurs at the surface of the iron exposed to the air • steel (which consists mostly of iron) is an essential material in modern construction. Equipment and structures can rust, and weaken **Ways to prevent rusting** • iron and steel can be painted to keep away moisture and oxygen • iron and steel can be coated with a thin layer of chromium or zinc (metals which do not rust) This is done by an electroplating technique which is a form of electrolysis	Sasol Inzalo Gr.9A pg. 202-204) 2. Complete activity 6 on Rust pg. 204 3. Teacher will ask learners to mention ways of how to prevent the formation of rust. 4. Teacher presents content as prescribed in the CAPS Document page 66(Example: Sasol Inzalo Gr.9A pg. 205-207)	• Projector, laptop and white board/screen. **Video Link** https://www.youtube.com/watch?v=TKMgUCq3npg

ASSESSMENT		
TEACHER REFLECTION	Progress:	Challenges:

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NATURAL SCIENCES: LESSON PLAN 18 **GRADE: 9**
DURATION: 60 Minutes **STRAND: MATTER AND MATERIALS**
CAPS SENIOR PHASE **TERM : TWO**

ACTIVITY: Why is rust a problem?

1. Let's imagine we have manufactured something out of iron. What properties of iron do we want to take advantage of?

2. What objects do you think we make out of iron where these properties are desirable?



A rusted chain. *A rusted door hinge.*

3. When an item is made of iron, we might want to protect it from rust, to prevent it from losing those desired properties. Do you think the rusty chain and door handle in the following photos will be as strong and flexible as when they were new? Why not?

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NATURAL SCIENCES: LESSON PLAN 18 **GRADE: 9**
DURATION: 60 Minutes **STRAND: MATTER AND MATERIALS**
CAPS SENIOR PHASE **TERM : TWO**

MEMORANDUM

Methods to prevent rust:

1. Paint provides a barrier to rust.

2. Using other metals as barriers to rust.

There are a number of other ways to stop or slow down rust. One way to protect the iron surface is to cover it with a metal that does not corrode, like chromium, for instance. Taps and bathroom fittings are often made of iron that has been 'chromed'. They have been covered with a layer of chromium to protect the iron surface from contact with the air.

ACTIVITY: Why is rust a problem?

1. Iron is a strong, so it is hard, strong and flexible.

2. Tools, hinges, screws and nails, garage doors, etc

3. No, they will not be as strong. Rust is a different compound to the element iron and so it has different properties. It start to weaken the objects.

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NATURAL SCIENCES: LESSON PLAN 19 **GRADE: 9**
DURATION: 60 Minutes **STRAND: MATTER AND MATERIALS**
CAPS SENIOR PHASE **TERM : TWO**

DURATION: Week Six Lesson One and Two	**OBJECTIVES: LEARNERS MUST BE ABLE TO:** Write out balanced equations for non-metal oxides.
TOPIC: REACTIONS OF NON-METALS WITH OXYGEN	
SUB TOPIC: The General Reaction of non-metals with Oxygen	
REFERENCES	**Sasol Inzalo workbooks- Natural Sciences Grade 9A**
TERMINOLOGY:	**Non Metal Oxides, general equations**
SPECIFIC AIMS	1. DOING SCIENCE
	2. KNOWING THE SUBJECT CONTENT & MAKING CONNECTIONS x
	3. UNDERSTANDING THE USES OF SCIENCES & INDIGENOUS KNOWLEDGE

SCIENCE PROCESS SKILLS								
Accessing & recalling Information	x		Identifying problems & issues			Doing Investigations		
Observing			Raising Questions			Recording Information		
Comparing			Predicting			Interpreting Information		
Measuring			Hypothesizing			Communicating		
Sorting & Classifying			Planning Investigations					

CONTENT AND CONCEPTS	ACTIVITIES	RESOURCES
The general reaction of non-metals with oxygen • non-metals react with oxygen to form non-metal oxides • when any non-metal is burnt in excess oxygen, the general equation is always: non-metal + oxygen non-metal oxide	Teacher starts the lesson with familiar elements that are non-metals such as carbon, sulfur and iodine. All the above non-metals share similar physical and chemical properties with the exception of carbon which can conduct electricity. All non-metals are found on the right	• Periodic Table • English Dictionary Textbooks: eg. Sasol Inzalo Explore Gr. 9A

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NATURAL SCIENCES: LESSON PLAN 19 **GRADE: 9**
DURATION: 60 Minutes **STRAND: MATTER AND MATERIALS**
CAPS SENIOR PHASE **TERM : TWO**

CONTENT AND CONCEPTS	ACTIVITIES	RESOURCES
Reaction of carbon with oxygen • when the non-metal carbon is burnt in oxygen, carbon dioxide is produced -- word equation: carbon + oxygen carbon dioxide -- chemical equation: $C + O_2 \rightarrow CO_2$ (this equation is already balanced) **Reaction of sulfur with oxygen** • another example is sulfur reacting with oxygen to form sulfur dioxide -- word equation: sulfur + oxygen sulfur dioxide -- chemical equation: $S + O_2 \rightarrow SO_2$ (this equation is already balanced)	hand side of the periodic table. **Activities**: 1. Teacher presents content as prescribed in the CAPS Document page 66(Example: Sasol Inzalo Gr.9A pg. 212). Learners will complete activity 1.	

ASSESSMENT		
TEACHER REFLECTION	Progress:	Challenges:

Activity 1

1. What happens when a non-metal and oxygen react?
2. What is the product called?
3. How should we write equations for the reactions of carbon and sulfur with oxygen?
4. Do all non-metals form dioxides with oxygen?

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NATURAL SCIENCES: LESSON PLAN 19 **GRADE: 9**
DURATION: 60 Minutes **STRAND: MATTER AND MATERIALS**
CAPS SENIOR PHASE **TERM : TWO**

MEMORANDUM : Activity 1

1. A non-metal oxide is formed.
2. Non-metal oxide
3. $C + O_2 \rightarrow CO_2$
   $S + O_2 \rightarrow SO_2$

4. No, eg. Water

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NATURAL SCIENCES: LESSON PLAN 20 **GRADE: 9**
DURATION: 60 Minutes **STRAND: MATTER AND MATERIALS**
CAPS SENIOR PHASE **TERM : TWO**

DURATION: Week Six Lesson Three and Four **TOPIC:** REACTIONS OF NON-METALS WITH OXYGEN **SUB TOPIC:** Reaction of carbon with oxygen	**OBJECTIVES: LEARNERS MUST BE ABLE TO:** Write out the word equation and chemical equation for the reaction between carbon and oxygen. State that carbon dioxide forms during the chemical reaction between carbon and oxygen.
REFERENCES	**Sasol Inzalo workbooks- Natural Sciences Grade 9A**
TERMINOLOGY:	**Reaction of carbon with oxygen** • The non-metal carbon burns in air (which contains oxygen), to form carbon dioxide.

SPECIFIC AIMS	1. DOING SCIENCE	x
	2. KNOWING THE SUBJECT CONTENT & MAKING CONNECTIONS	x
	3. UNDERSTANDING THE USES OF SCIENCES & INDIGENOUS KNOWLEDGE	

SCIENCE PROCESS SKILLS								
Accessing & recalling Information	x		Identifying problems & issues			Doing Investigations	x	
Observing	x		Raising Questions			Recording Information	x	
Comparing			Predicting	x		Interpreting Information		
Measuring			Hypothesizing	x		Communicating		
Sorting & Classifying			Planning Investigations	x				

CONTENT AND CONCEPTS	ACTIVITIES	RESOURCES
The general reaction of non-metals with oxygen • non-metals react with oxygen to form non-metal oxides • when any non-metal is burnt in excess oxygen, the general equation is always:	Teacher presents content as prescribed in the CAPS Document page 66(Example: Sasol Inzalo Gr.9A pg. 212).	• English Dictionary • Textbooks: eg. Sasol Inzalo Explore Gr. 9A • Bunsen burner

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NATURAL SCIENCES: LESSON PLAN 20 **GRADE: 9**
DURATION: 60 Minutes **STRAND: MATTER AND MATERIALS**
CAPS SENIOR PHASE **TERM : TWO**

CONTENT AND CONCEPTS	ACTIVITIES	RESOURCES
non-metal + oxygen non-metal oxide **Reaction of carbon with oxygen** • when the non-metal carbon is burnt in oxygen, carbon dioxide is produced -- word equation: carbon + oxygen carbon dioxide -- chemical equation: $C + O_2 \rightarrow CO_2$ (this equation is already balanced) **Reaction of sulfur with oxygen** • another example is sulfur reacting with oxygen to form sulfur dioxide -- word equation: sulfur + oxygen sulfur dioxide -- chemical equation: $S + O_2 \rightarrow SO_2$ (this equation is already balanced)	Teacher demonstrates the practical showing the reaction between Carbon and Oxygen.	• Matches • Safety goggles • Charcoal • Tongs • Deflagrating spoon
ASSESSMENT		
TEACHER REFLECTION	Progress:	Challenges:

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PRACTICAL DEMONSTRATION

Reaction of carbon with oxygen

Apparatus:

- Matches
- Safety goggles
- Charcoal
- Tongs
- Deflagrating spoon

Method:

1. Heat the piece of carbon (charcoal) until it is red-hot in a deflagrating spoon.
2. Lower the spoon into the jar filled with oxygen.
3. Observe what happens.

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NATURAL SCIENCES: LESSON PLAN 20
DURATION: 60 Minutes
CAPS SENIOR PHASE

GRADE: 9
STRAND: MATTER AND MATERIALS
TERM : TWO

ACTIVITY: Coal burning in air

The energy in coal comes from the energy stored in plants and other organisms that lived hundreds of millions of years ago. Over the millennia, layers of dead plants and other biological waste were covered by layers of water and soil. The heat and pressure from the top layers caused the plant remains to turn into energy-rich coal.



The energy released by burning coal is used to generate electrical energy in coal-powered power stations.

Coal is a form of carbon and when it burns in oxygen we can represent the reaction with the following word equation:

carbon + oxygen → carbon dioxide

Draw a picture equation for this reaction in the space below.

Convert the picture equation into a chemical equation. Is it balanced?

_____

_____

What group is carbon in on the Periodic Table?

_____

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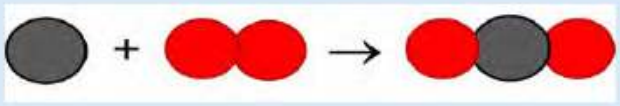
NATURAL SCIENCES: LESSON PLAN 20
DURATION: 60 Minutes
CAPS SENIOR PHASE

GRADE: 9
STRAND: MATTER AND MATERIALS
TERM : TWO

MEMORANDUM

TEACHER'S NOTE

In the picture equation here, the black atoms are carbon (C) and the red atoms are oxygen (O). If learners do not have coloured pens or pencils, they can use patterns and shading to differentiate between different atoms.



Convert the picture equation into a chemical equation. Is it balanced?

TEACHER'S NOTE

The chemical equation is $C + O_2 \rightarrow CO_2$. This equation is already balanced.

What group is carbon in on the Periodic Table?

TEACHER'S NOTE

Group 14.

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NATURAL SCIENCES: LESSON PLAN 21 **GRADE: 9**
DURATION: 30 Minutes **STRAND: MATTER AND MATERIALS**
CAPS SENIOR PHASE **TERM : TWO**

DURATION: Week Six Lesson Five	**OBJECTIVES: LEARNERS MUST BE ABLE TO:**
TOPIC: REACTIONS OF NON-METALS WITH OXYGEN	Write out the word equation and chemical equation for the reaction between carbon and oxygen.
SUB TOPIC: Reaction of carbon with oxygen	
REFERENCES	**Sasol Inzalo workbooks- Natural Sciences Grade 9A**
TERMINOLOGY:	**Reaction of carbon with oxygen** • The non-metal carbon burns in air (which contains oxygen), to form carbon dioxide.
SPECIFIC AIMS	1. DOING SCIENCE x
	2. KNOWING THE SUBJECT CONTENT & MAKING CONNECTIONS x
	3. UNDERSTANDING THE USES OF SCIENCES & INDIGENOUS KNOWLEDGE

SCIENCE PROCESS SKILLS								
Accessing & recalling Information	x		Identifying problems & issues			Doing Investigations	x	
Observing	x		Raising Questions			Recording Information	x	
Comparing			Predicting	x		Interpreting Information		
Measuring			Hypothesizing	x		Communicating		
Sorting & Classifying			Planning Investigations	x				

CONTENT AND CONCEPTS	ACTIVITIES	RESOURCES
Reaction of carbon with oxygen • when the non-metal carbon is burnt in oxygen, carbon dioxide is produced -- word equation: carbon + oxygen carbon dioxide -- chemical equation: $C + O_2 \rightarrow CO_2$ (this equation is already balanced)	Learners will complete activity 2B. Pg. 213	• English Dictionary • Textbooks: eg. Sasol Inzalo Explore Gr. 9A

ASSESSMENT		
TEACHER REFLECTION	Progress:	Challenges:

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NATURAL SCIENCES: LESSON PLAN 21 **GRADE: 9**
DURATION: 30 Minutes **STRAND: MATTER AND MATERIALS**
CAPS SENIOR PHASE **TERM : TWO**

Activity: Coal burning in air.

The energy in coal comes from the energy stored in plants and other organisms that lived hundreds of millions of years ago. Over the millennia, layers of dead plants and other biological waste were covered by layers of water and soil. The heat and pressure from the top layers caused the plant remains to turn into energy-rich coal.



The energy released by burning coal is used to generate electrical energy in coal-powered power stations.

Coal is a form of carbon and when it burns in oxygen we can represent the reaction with the following word equation: carbon + oxygen → carbon dioxide.

1. Draw a picture equation for this reaction.
2. Convert the picture equation into a chemical equation. Is it balanced?
3. What group is carbon in on the Periodic Table?
4. The other elements in the same group as carbon will react in the same way as carbon with oxygen. Since coal is a non-renewable energy source as well as one that causes pollution and other environmental problems, scientists and engineers continue to look for alternative fuels and energy sources to eventually replace coal as an energy source. Can you think of the names of some alternative, renewable energy sources?

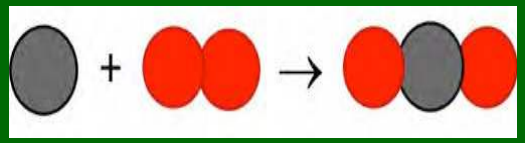
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NATURAL SCIENCES: LESSON PLAN 21 **GRADE: 9**
DURATION: 30 Minutes **STRAND: MATTER AND MATERIALS**
CAPS SENIOR PHASE **TERM : TWO**

Activity: Coal burning in air.

MEMORANDUM

1.



2. carbon + oxygen→ carbon dioxide.

3. Group 14

4. Wind energy, solar energy, biofuels, etc.

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NATURAL SCIENCES: LESSON PLAN 22 **GRADE: 9**
DURATION: 30 Minutes **STRAND: MATTER AND MATERIALS**
CAPS SENIOR PHASE **TERM : TWO**

DURATION: Week Six Lesson Six	**OBJECTIVES: LEARNERS MUST BE ABLE TO:** Write out the word equation and chemical equation for the reaction between sulfur and oxygen. State that sulfur dioxide forms during the chemical reaction between sulfur and oxygen.
TOPIC: REACTIONS OF NON-METALS WITH OXYGEN	
SUB TOPIC: Reaction of sulfur with oxygen	

REFERENCES	**Sasol Inzalo workbooks- Natural Sciences Grade 9A**	
TERMINOLOGY:	**Reaction of sulfur with oxygen** The non-metal sulfur burns air (which contains oxygen), to form sulfur dioxide.	
SPECIFIC AIMS	1. DOING SCIENCE	x
	2. KNOWING THE SUBJECT CONTENT & MAKING CONNECTIONS	x
	3. UNDERSTANDING THE USES OF SCIENCES & INDIGENOUS KNOWLEDGE	

SCIENCE PROCESS SKILLS								
Accessing & recalling Information	x		Identifying problems & issues			Doing Investigations	x	
Observing	x		Raising Questions			Recording Information		
Comparing	x		Predicting			Interpreting Information		
Measuring			Hypothesizing	x		Communicating		
Sorting & Classifying			Planning Investigations	x				

CONTENT AND CONCEPTS	ACTIVITIES	RESOURCES
Reaction of sulfur with oxygen • another example is sulfur reacting with oxygen to form sulfur dioxide -- word equation: sulfur + oxygen sulfur dioxide -- chemical equation: $S + O_2 \rightarrow SO_2$ (this equation is already balanced)	Teacher presents content as prescribed in the CAPS Document page 66(Example: Sasol Inzalo Gr.9A pg. 214-215). 1. Teacher will allow learners to watch a video of sulfur burning in oxygen. 2. Learners will complete activity 3.pg. 215	• Periodic Table Poster • Examples of various elements • English Dictionary • Textbooks: eg. Sasol Inzalo Explore Gr. 9A

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NATURAL SCIENCES: LESSON PLAN 22 **GRADE: 9**
DURATION: 30 Minutes **STRAND: MATTER AND MATERIALS**
CAPS SENIOR PHASE **TERM : TWO**

CONTENT AND CONCEPTS	ACTIVITIES	RESOURCES
	Teacher will consolidate lesson using Teacher Guide.	**Video links**: https://youtu.be/jij5JYOTtJU
ASSESSMENT		
TEACHER REFLECTION	Progress:	Challenges:

Activity : The reaction between sulfur and oxygen.

In the following activity we are going to review word equations, picture equations and chemical equations, using the reaction between sulfur and oxygen as our context.

Reaction between sulfur and oxygen: sulfur + oxygen → sulfur dioxide

QUESTIONS:

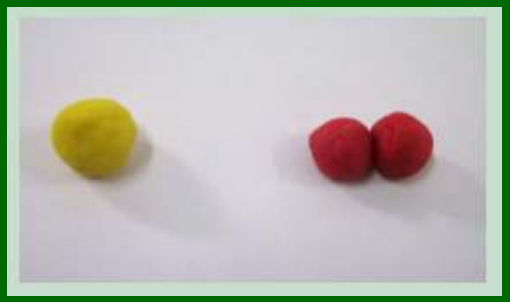
1. What group is sulfur in on the Periodic Table?
2. What are the reactants of this reaction? Write their names and formulas.
3. What is the product of the reaction? Write its name and formula.
4. Now, use the formulas of the reactants and products to write a chemical equation.
5. When is a reaction balanced?
6. Is your reaction above balanced? Why do you say so?
7. Draw a picture equation for the reaction, using the example of carbon above as guide.
8. Use play dough or clay to build models of the reactants and products of the reaction.

This is what your starting reactants could look like:

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NATURAL SCIENCES: LESSON PLAN 22 **GRADE: 9**
DURATION: 30 Minutes **STRAND: MATTER AND MATERIALS**
CAPS SENIOR PHASE **TERM : TWO**



Challenge question: How many bonds were broken and how many bonds were formed during this reaction?

Memorandum

1. Group 16

2. Sulfur(S) and Oxygen(O)

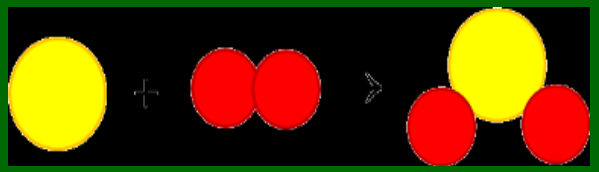
3. Sulfur dioxide -SO_2

4. $S + O_2 \rightarrow SO_2$

5. When both sides of the reaction have the same number of the same types of atoms.

6. The reaction is balanced because it has the same number of S and O atoms on either side of the equation.

7.

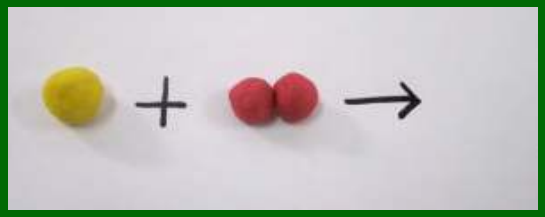


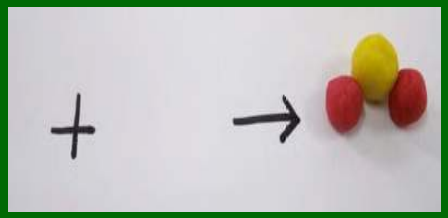
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NATURAL SCIENCES: LESSON PLAN 22 **GRADE: 9**
DURATION: 30 Minutes **STRAND: MATTER AND MATERIALS**
CAPS SENIOR PHASE **TERM : TWO**

8.





Challenge question:

1 bond was broken (between the oxygen atoms) and 2 bonds were formed (1 between each of the oxygen atoms and the sulfur atom)

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NATURAL SCIENCES: LESSON PLAN 23 **GRADE: 9**
DURATION: 60 Minutes **STRAND: MATTER AND MATERIALS**
CAPS SENIOR PHASE **TERM : TWO**

DURATION: Week Seven Lesson One and Two **TOPIC:** Acids and Bases and pH Value **SUB TOPIC:** The concept of pH value	**OBJECTIVES: LEARNERS MUST BE ABLE TO:** Identify whether substances are acids, bases or neutral using the pH scale. Differentiate the colour changes of acids, bases and neutral substances with different chemical indicators (example universal indicator, bromothymol blue, etc.) found in the Caps Document page 67.
REFERENCES	**Sasol Inzalo workbooks- Natural Sciences Grade 9A**
TERMINOLOGY:	**The concept of pH value.** The pH scale ranges from 1 to 14. pH is a measure of how acidic or basic a substance is. Acids have a pH in the range of 1 to 7. Bases have a pH in the range of 8 to 14. A neutral substance has a pH of 7.

SPECIFIC AIMS	1. DOING SCIENCE	
	2. KNOWING THE SUBJECT CONTENT & MAKING CONNECTIONS	x
	3. UNDERSTANDING THE USES OF SCIENCES & INDIGENOUS KNOWLEDGE	

SCIENCE PROCESS SKILLS								
Accessing & recalling Information	x		Identifying problems & issues	x		Doing Investigations	x	
Observing			Raising Questions			Recording Information	x	
Comparing			Predicting			Interpreting Information	x	
Measuring			Hypothesizing			Communicating		
Sorting & Classifying	x		Planning Investigations					

CONTENT AND CONCEPTS	ACTIVITIES	RESOURCES
The concept of pH value • pH is a measure of how acidic or basic a substance is. The pH scale ranges from 1 to 14	**Introduction** Teacher introduces lesson by asking learners probing questions	• English Dictionary Textbooks: eg. Sasol

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NATURAL SCIENCES: LESSON PLAN 23 **GRADE: 9**
DURATION: 60 Minutes **STRAND: MATTER AND MATERIALS**
CAPS SENIOR PHASE **TERM : TWO**

CONTENT AND CONCEPTS	ACTIVITIES	RESOURCES
• acids have a pH in the range of 1 to 7. Strong acids have very low pH values • bases have a pH in the range of 7 to 14. Strong bases have very high pH values • a neutral substance has a pH of 7 • we use chemical indicators (such as universal indicator, litmus paper, red cabbage water, red onion water, turmeric water, bromothymol blue, phenolphthalein) to tell us whether a substance is an acid, base or neutral • universal indicator has the ability to indicate the full range of pH values on the pH scale by colour changes -- acids change the colour of universal indicator towards the yellow, orange and red colours -- bases change the colour of universal indicator towards the blue and purple colours -- neutral substances (pH 7), change the colour of universal indicator to green	orally on acids and bases with reference to the work done in grade 7. After completing the oral questions the teacher will introduce the pH scale as a way of determining the strength of an acid or base. **Activities**: 1. Teacher presents content as prescribed in the CAPS Document page 67(Example: Sasol Inzalo Gr.9A p.224-230). 2. Learners will complete activity 1 on pH scale. 3. Teacher presents content as prescribed in the CAPS Document page 67(Example: Sasol Inzalo Gr.9A p.230-232).	Inzalo Explore Gr. 9A

ASSESSMENT		
TEACHER REFLECTION	Progress:	Challenges:

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NATURAL SCIENCES: LESSON PLAN 23 **GRADE: 9**
DURATION: 60 Minutes **STRAND: MATTER AND MATERIALS**
CAPS SENIOR PHASE **TERM : TWO**

Questions teacher can ask during introduction:

1. What are the unique properties of:
   A) Acids
   B) Bases
   C) Neutral Substances?
2. Which household substances are (or contain):
   A) Acids
   B) Bases
   C) Neutral Substances?
3. How can we tell if something is an acid, a base or a neutral substance?

Expected Answers
1)

Acids	Bases	Neutral substances
Taste sour Feel rough Can be corrosive Can make bases lose their basic character Turn blue litmus red	Taste bitter Feels slippery between your fingers Can be corrosive Can make acids lose their acidic character Turns red litmus blue	They have neither acidicor basic properties.

2) Learners response that correctly identifies acids, bases and neutral substances.
3) chemical indicators can be used such as litmus paper, red cabbage.

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NATURAL SCIENCES: LESSON PLAN 23 **GRADE: 9**
DURATION: 60 Minutes **STRAND: MATTER AND MATERIALS**
CAPS SENIOR PHASE **TERM : TWO**

Actvity 1: pH scale
INSTRUCTIONS:

1. In the following picture the pH values of a variety of substances are shown on the pH scale 2. Use the picture to answer the questions.



The pH scale.

QUESTIONS:

1. Circle the names of all the acids in the diagram above with a red pen or koki.
2. Write the lowest and highest pH values of these acids. This represents the pH range of the acids on our list.
3. Does this range lie below or above pH 7?
4. Circle the names of all the bases in the diagram above with a blue pen or koki on the pH scale above.
5. Write the lowest and highest pH values of these bases below. This represents the pH range of the bases on our list.

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6. Does this range lie below or above pH 7?
7. Find water on the scale and circle it with a green pen or koki. Is water an acid or a base? Or is it perhaps something else?
8. What is the pH of water?
9. Which do you think is more acidic: orange juice or lemon juice? If you are not sure, ask this question: Which one is more sour?
10. Which one has the lower pH: orange juice or lemon juice?

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NATURAL SCIENCES: LESSON PLAN 23 **GRADE: 9**
DURATION: 60 Minutes **STRAND: MATTER AND MATERIALS**
CAPS SENIOR PHASE **TERM : TWO**

MEMORANDUM

Actvity 1: pH scale

.

1. Learners should circle orange juice, lemon juice and gastric acid in red.
2. Lowest value: 1 (gastric acid); Highest value: 3 (orange juice)
3. Below 7
4. Learners should circle bicarbonate of soda, soapy water, bleach and ammonia solution in blue.
5. Lowest value: 9 (baking soda); Highest value: 13 (bleach)
6. Above 7
7. Water is neither an acid nor a base. Water is a neutral substance.
8. Water has a pH equal to 7.
9. Lemon juice is more acidic.
10. Lemon juice has a lower pH. .

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NATURAL SCIENCES: LESSON PLAN 24 **GRADE: 9**
DURATION: 60 Minutes **STRAND: MATTER AND MATERIALS**
CAPS SENIOR PHASE **TERM : TWO**

DURATION: Week Seven Lesson Three and Four	**OBJECTIVES: LEARNERS MUST BE ABLE TO:** Differentiate the colour changes of acids, bases and neutral substances with different chemical indicators (example universal indicator, bromothymol blue, etc.) found in the Caps Document page 67.
TOPIC: Acids and Bases and pH Value	
SUB TOPIC: Indicators	
REFERENCES	**Sasol Inzalo workbooks- Natural Sciences Grade 9A**
TERMINOLOGY:	**The concept of pH value** We use chemical indicators to tell us whether a substance is an acid, base or neutral.

SPECIFIC AIMS	1. DOING SCIENCE	
	2. KNOWING THE SUBJECT CONTENT & MAKING CONNECTIONS	x
	3. UNDERSTANDING THE USES OF SCIENCES & INDIGENOUS KNOWLEDGE	

SCIENCE PROCESS SKILLS								
Accessing & recalling Information	x		Identifying problems & issues			Doing Investigations	x	
Observing	x		Raising Questions			Recording Information	x	
Comparing			Predicting	x		Interpreting Information	x	
Measuring			Hypothesizing	x		Communicating		
Sorting & Classifying			Planning Investigations	x				

CONTENT AND CONCEPTS	ACTIVITIES	RESOURCES
The concept of pH value • pH is a measure of how acidic or basic a substance is. The pH scale ranges from 1 to 14 • acids have a pH in the range of 1 to 7. Strong acids have very low pH values	Teacher presents content as prescribed in the CAPS Document page 67(Example: Sasol Inzalo Gr.9A p.230-232). Learners will complete activity 1 from the worksheet	• English Dictionary • Textbooks: eg. Sasol Inzalo Explore Gr. 9A

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NATURAL SCIENCES: LESSON PLAN 24 **GRADE: 9**
DURATION: 60 Minutes **STRAND: MATTER AND MATERIALS**
CAPS SENIOR PHASE **TERM : TWO**

CONTENT AND CONCEPTS	ACTIVITIES	RESOURCES
• bases have a pH in the range of 7 to 14. Strong bases have very high pH values • a neutral substance has a pH of 7 • we use chemical indicators (such as universal indicator, litmus paper, red cabbage water, red onion water, turmeric water, bromothymol blue, phenolphthalein) to tell us whether a substance is an acid, base or neutral • universal indicator has the ability to indicate the full range of pH values on the pH scale by colour changes -- acids change the colour of universal indicator towards the yellow, orange and red colours -- bases change the colour of universal indicator towards the blue and purple colours -- neutral substances (pH 7), change the colour of universal indicator to green	below.	

ASSESSMENT		
TEACHER REFLECTION	Progress:	Challenges:

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NATURAL SCIENCES: LESSON PLAN 24 **GRADE: 9**
DURATION: 60 Minutes **STRAND: MATTER AND MATERIALS**
CAPS SENIOR PHASE **TERM : TWO**

Activity 1

A scientist is given 6 solutions labelled A to F. The scientist tests each solution with universal indicator and records her results as follows:

Solution	Colour of the universal indicator
A	Yellow
B	Blue
C	Green
D	Red
E	Purple
F	Orange



Use the results in the table and the colour guide for universal indicator underneath the table, to answer the following questions:

1. Which solutions are acidic? Write their labels below.

2. Which solutions are basic? Write their labels below.

3. Which solution is neutral? Write its label below.

4. Arrange the solutions in order from most acidic to most basic in the table below. Also write the colour and the approximate pH range of each solution in the table.

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NATURAL SCIENCES: LESSON PLAN 24
DURATION: 60 Minutes
CAPS SENIOR PHASE

GRADE: 9
STRAND: MATTER AND MATERIALS
TERM : TWO

Solution	Colour of the solution	Approximate pH range of the solution

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NATURAL SCIENCES: LESSON PLAN 24 **GRADE: 9**
DURATION: 60 Minutes **STRAND: MATTER AND MATERIALS**
CAPS SENIOR PHASE **TERM : TWO**

MEMORANDUM

1. *A, F and D*
2. *B and E*
3. *C*

4.

Solution	**Colour of the solution**	**Approximate pH range of the solution**
D	*Red*	*1 - 3*
F	*Orange*	*4 - 5*
A	Yellow	5-6
C	Green	7
B	Blue	8-10
E	Purple	1-14

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NATURAL SCIENCES: LESSON PLAN 25 **GRADE: 9**
DURATION: 60 Minutes **STRAND: MATTER AND MATERIALS**
CAPS SENIOR PHASE **TERM : TWO**

DURATION: Week Seven Lesson Five and Six	**OBJECTIVES: LEARNERS MUST BE ABLE TO:** Conduct a practical experiment using the universal indicator and red cabbage indicator to show whether one substance is more acidic or basic than the other.
TOPIC: Acids and Bases and pH Value	
SUB TOPIC: The concept of pH value	
REFERENCES	**Sasol Inzalo workbooks- Natural Sciences Grade 9A**
TERMINOLOGY:	**The concept of pH value** We use chemical indicators to tell us whether a substance is an acid, base or neutral.
SPECIFIC AIMS	1. DOING SCIENCE x
	2. KNOWING THE SUBJECT CONTENT & MAKING CONNECTIONS x
	3. UNDERSTANDING THE USES OF SCIENCES & INDIGENOUS KNOWLEDGE x

SCIENCE PROCESS SKILLS								
Accessing & recalling Information	x		Identifying problems & issues			Doing Investigations	x	
Observing	x		Raising Questions			Recording Information	x	
Comparing	x		Predicting	x		Interpreting Information	x	
Measuring	x		Hypothesizing	x		Communicating		
Sorting & Classifying			Planning Investigations	x				

CONTENT AND CONCEPTS	ACTIVITIES	RESOURCES
The concept of pH value • pH is a measure of how acidic or basic a substance is. The pH scale ranges from 1 to 14 • acids have a pH in the range of 1 to 7. Strong acids have very low pH values	**Introduction** Teacher introduces lesson by asking learners probing questions orally on acids and bases with reference to the work done in grade 7. After completing the oral	• English Dictionary • Textbooks: eg. Sasol Inzalo Explore Gr. 9A • small containers (test tubes or yoghurt tubs)

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NATURAL SCIENCES: LESSON PLAN 25 **GRADE: 9**
DURATION: 60 Minutes **STRAND: MATTER AND MATERIALS**
CAPS SENIOR PHASE **TERM : TWO**

CONTENT AND CONCEPTS	ACTIVITIES	RESOURCES
• bases have a pH in the range of 7 to 14. Strong bases have very high pH values • a neutral substance has a pH of 7 • we use chemical indicators (such as universal indicator, litmus paper, red cabbage water, red onion water, turmeric water, bromothymol blue, phenolphthalein) to tell us whether a substance is an acid, base or neutral • universal indicator has the ability to indicate the full range of pH values on the pH scale by colour changes -- acids change the colour of universal indicator towards the yellow, orange and red colours -- bases change the colour of universal indicator towards the blue and purple colours -- neutral substances (pH 7), change the colour of universal indicator to green	questions the teacher will introduce the pH scale as a way of determining the strength of an acid or base. **Activities**: 1. Teacher will group learners into manageable numbers for easy facilitation of practical. 2. Teacher will then discuss the procedure of the practical with learners. 3. Learners will complete the practical Investigation(optional formal assessment)	containing the following substances: • clean water • soda water • vinegar • lemon juice • sugar solution (1 tablespoon dissolved in a cup of water) • baking soda (bicarbonate of soda) (1 tablespoon dissolved in a cup of water) • Handy Andy (1 tablespoon dissolved in a cup of water) • aspirin (Disprin) (1 tablet in 2 tablespoons of water) • dishwashing liquid (1 teaspoon dissolved in a cup of water) • any other substances commonly used at home that are not dangerous. Do not use strong • acids or bases, or bleach. Suggestions include: tea, coffee, rooibos tea, milk, tartaric

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NATURAL SCIENCES: LESSON PLAN 25 **GRADE: 9**
DURATION: 60 Minutes **STRAND: MATTER AND MATERIALS**
CAPS SENIOR PHASE **TERM : TWO**

CONTENT AND CONCEPTS	ACTIVITIES	RESOURCES
		acid, salt • water, Sprite. • universal indicator paper • red cabbage indicator paper • glass or plastic rods (plastic teaspoons or straws will also work well). • white tile or sheet of A4 printer paper.
ASSESSMENT		
TEACHER REFLECTION	Progress:	Challenges:

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NATURAL SCIENCES: LESSON PLAN 25 **GRADE: 9**
DURATION: 60 Minutes **STRAND: MATTER AND MATERIALS**
CAPS SENIOR PHASE **TERM : TWO**

INVESTIGATION: Universal indicator paper and red cabbage indicator paper.

The purpose of this investigation is to determine whether universal indicator and red cabbage can be used to show whether one substance is more acidic or basic than another.

INVESTIGATIVE QUESTION:

What question are we trying to answer with this investigation?

HYPOTHESIS:

What do you think the answer to the investigative question is? You should try to make a prediction.

IDENTIFY VARIABLES:

What will you be changing in this investigation? What is this variable called?

MATERIALS AND APPARATUS:

- small containers (test tubes or yoghurt tubs) containing the following substances:
  - clean water
  - soda water
  - vinegar
  - lemon juice
  - sugar solution (1 tablespoon dissolved in a cup of water)
  - baking soda (bicarbonate of soda) (1 tablespoon dissolved in a cup of water)
  - Handy Andy (1 tablespoon dissolved in a cup of water)
  - aspirin (Disprin) (1 tablet in 2 tablespoons of water)
  - dishwashing liquid (1 teaspoon dissolved in a cup of water)
  - any other substances commonly used at home that are not dangerous. Do not use strong acids or bases, or bleach. Suggestions include: tea, coffee, rooibos tea, milk, tartaric acid, salt water, Sprite.
- universal indicator paper
- red cabbage indicator paper
- glass or plastic rods (plastic teaspoons or straws will also work well).
- white tile or sheet of A4 printer paper.

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NATURAL SCIENCES: LESSON PLAN 25 **GRADE: 9**
DURATION: 60 Minutes **STRAND: MATTER AND MATERIALS**
CAPS SENIOR PHASE **TERM : TWO**

METHOD:

Step 1: Use a small strip (1 cm long) of universal indicator paper for each substance that you will be testing. Place them on a sheet of printer paper or a white tile.
Step 2: Dip the glass rod or straw into the first solution and transfer a drop of it to the first piece of universal indicator paper. Does the paper change colour? Write the colour of the paper with each substance in your table, in the appropriate place.
Step 3: Compare the colour of the test strip with the colour range on the packaging of the universal indicator paper roll to find the pH of the solution. Write this in your table as well.
Step 4: Rinse the straw very thoroughly with tap water before testing the next solution. Do so every time you move from one solution to the next.
Step 5: Test all the solutions and record their colours.
Step 6: Save the solutions to now test them again with red cabbage indicator paper.
Step 7: Use a small strip (2 cm long) of red cabbage paper for each substance that you will be testing.
Step 8: Dip a fresh piece of paper into each of the test solutions and place it on the tile or white paper to dry. For each test solution, write the colour of the red cabbage paper in the table in the appropriate place

RESULTS AND OBSERVATIONS:

Record your observations in the table.

Substance	Colour with universal indicator.	pH with substance.	Colour with red cabbage indicator.
Water			
Soda water			
Vinegar			
Lemon juice			
Sugar water			
Baking soda			
Handy Andy			
Aspirin			
Dishwashing liquid			
(Any other substance)			
(Any other substance)			

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NATURAL SCIENCES: LESSON PLAN 25 **GRADE: 9**
DURATION: 60 Minutes **STRAND: MATTER AND MATERIALS**
CAPS SENIOR PHASE **TERM : TWO**

Sequence the substances that you tested according to the colour change of the universal indicator, from the most acidic (darkest red) to the most basic (purple).

QUESTIONS:

1. Which of the test substances are acids?
2. Which of the test substances are bases?
3. Which of the test substances are neutral substances?
4. Which substance is the strongest acid?
5. Which substance is the strongest base?
6. Count all the different colours that were possible with the red cabbage.
7. What colour(s) did the red cabbage paper turn in the test substances that were acids?
8. What colour(s) did the red cabbage paper turn in the test substances that were bases?
9. What colour(s) did the red cabbage paper turn in the test substances that were neutral?
10. Do you think red cabbage indicator can be used to actually measure pH? Why or why not?

CONCLUSIONS:

11. What is your conclusion(s)? (Here you should answer the investigative question.)

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NATURAL SCIENCES: LESSON PLAN 25 **GRADE: 9**
DURATION: 60 Minutes **STRAND: MATTER AND MATERIALS**
CAPS SENIOR PHASE **TERM : TWO**

MEMORANDUM
QUESTIONS:

1. *Learners should list all the substances that gave pH measurements below 7.*
2. *Learners should list all the substances that gave pH measurements above 7.*
3. *Learners should list all the substances that gave pH measurements equal to 7.*
4. *Activity-dependent answer.*
5. *Activity-dependent answer.*
6. *Activity-dependent answer.*

7. The red cabbage paper should turn a red-pink colour in an acid.

8. The red cabbage paper should turn a blue-green colour in a base.

9. The red cabbage paper should turn (or remain) purple with neutral substances.

10. Learner-dependent answer. Allow learners to express an opinion here, backed by one or two sentences as motivation.

CONCLUSIONS:
Learner-dependent answer. They should note that universal indicator allows them to measure the pH of individual substances. By arranging the substances in order of increasing pH, they can rank the substances from most acidic to most basic. They should note that red cabbage indicator does give a range of colours with varying pH, but that it is not as effective as universal indicator for measuring pH.

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NATURAL SCIENCES: LESSON PLAN 26 **GRADE: 9**
DURATION: 60 Minutes **STRAND: MATTER AND MATERIALS**
CAPS SENIOR PHASE **TERM : TWO**

DURATION: Week Eight Lesson One and Two	**OBJECTIVES: LEARNERS MUST BE ABLE TO:** Demonstrate an understanding of neutralisation by conducting an experiment.
TOPIC: REACTIONS OF ACIDS WITH BASES – PART 1	
SUB TOPIC: Neutralisation and pH	

REFERENCES	**Sasol Inzalo workbooks- Natural Sciences Grade 9A**	
TERMINOLOGY:	Neutralisation reactions • a base reacts with an acid, to make it less acidic / neutral • an acid reacts with a base, to make it less basic / neutral • acids commonly used in the laboratory include sulphuric acid (H_2SO_4) and hydrochloric acid (HCl) • after reacting an acid and a base together, the resultant pH will vary based on the strength of the acid and base reactants • non-metal oxides tend to be acidic (low pH) • bases (high pH) include metal oxides, metal hydroxides, metal carbonates	
SPECIFIC AIMS	1. DOING SCIENCE	
	2. KNOWING THE SUBJECT CONTENT & MAKING CONNECTIONS	x
	3. UNDERSTANDING THE USES OF SCIENCES & INDIGENOUS KNOWLEDGE	

SCIENCE PROCESS SKILLS								
Accessing & recalling Information	x		Identifying problems & issues			Doing Investigations		
Observing			Raising Questions			Recording Information		
Comparing	x		Predicting			Interpreting Information		
Measuring			Hypothesizing			Communicating		
Sorting & Classifying			Planning Investigations					

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NATURAL SCIENCES: LESSON PLAN 26 **GRADE: 9**
DURATION: 60 Minutes **STRAND: MATTER AND MATERIALS**
CAPS SENIOR PHASE **TERM : TWO**

CONTENT AND CONCEPTS	ACTIVITIES	RESOURCES
Neutralisation and pH • acids and bases react together, we call this a neutralisation reaction • a base reacts with an acid, to make it less acidic / neutral • an acid reacts with a base, to make it less basic / neutral • acids commonly used in the laboratory include sulphuric acid (H_2SO_4) and hydrochloric acid (HCl) • after reacting an acid and a base together, the resultant pH will vary based on the strength of the acid and base reactants • non-metal oxides tend to be acidic (low pH) • bases (high pH) include metal oxides, metal hydroxides, metal carbonates	**Introduction** Teacher will introduce the lesson by explaining what neutralisation is. The teacher will then continue with the content as per the CAPS document. **Activities**: 1. Teacher presents content as prescribed in the CAPS Document page 67(Example: Sasol Inzalo Gr.9A pg. 242-243). Learners will complete activity 1.	English Dictionary Textbooks: eg. Sasol Inzalo Explore Gr. 9A

ASSESSMENT		
TEACHER REFLECTION	Progress:	Challenges:

Activity 1

1) What do you think would happen if we mixed an acid and a base?
2) Are non-metal oxides acidic or basic?
3) Which pH range will their solution fall into?
4) Are metal-hydroxides acidic or basic?
5) Which pH range will their solution fall into?
6) What are the common acids used in the laboratory?

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NATURAL SCIENCES: LESSON PLAN 26 **GRADE: 9**
DURATION: 60 Minutes **STRAND: MATTER AND MATERIALS**
CAPS SENIOR PHASE **TERM : TWO**

MEMORANDUM

Activity 1

1) They will neutralize each other.
2) Acidic.
3) pH will range from 1-6.
4) Basic.
5) pH will range from 8-14.
6) sulphuric acid (H_2SO_4) and hydrochloric acid (HCl)

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NATURAL SCIENCES: LESSON PLAN 27 **GRADE: 9**
DURATION: 60 Minutes **STRAND: MATTER AND MATERIALS**
CAPS SENIOR PHASE **TERM : TWO**

DURATION: Week Eight Lesson Three	**OBJECTIVES: LEARNERS MUST BE ABLE TO:** Demonstrate an understanding of neutralisation by conducting an experiment.
TOPIC: REACTIONS OF ACIDS WITH BASES – PART 1	
SUB TOPIC: Neutralisation and pH	

REFERENCES	**Sasol Inzalo workbooks- Natural Sciences Grade 9A**	
TERMINOLOGY:	Neutralisation reactions • a base reacts with an acid, to make it less acidic / neutral • an acid reacts with a base, to make it less basic / neutral • acids commonly used in the laboratory include sulphuric acid (H_2SO_4) and hydrochloric acid (HCl) • after reacting an acid and a base together, the resultant pH will vary based on the strength of the acid and base reactants • non-metal oxides tend to be acidic (low pH) • bases (high pH) include metal oxides, metal hydroxides, metal carbonates	
SPECIFIC AIMS	1. DOING SCIENCE	x
	2. KNOWING THE SUBJECT CONTENT & MAKING CONNECTIONS	x
	3. UNDERSTANDING THE USES OF SCIENCES & INDIGENOUS KNOWLEDGE	

SCIENCE PROCESS SKILLS								
Accessing & recalling Information	x		Identifying problems & issues			Doing Investigations	x	
Observing	x		Raising Questions			Recording Information	x	
Comparing	x		Predicting	x		Interpreting Information	x	
Measuring	x		Hypothesizing	x		Communicating		
Sorting & Classifying			Planning Investigations	x				

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NATURAL SCIENCES: LESSON PLAN 27 **GRADE: 9**
DURATION: 60 Minutes **STRAND: MATTER AND MATERIALS**
CAPS SENIOR PHASE **TERM : TWO**

CONTENT AND CONCEPTS	ACTIVITIES	RESOURCES
Neutralisation and pH	**Introduction**	• English Dictionary
• acids and bases react together, we call this a neutralisation reaction • a base reacts with an acid, to make it less acidic / neutral • an acid reacts with a base, to make it less basic / neutral • acids commonly used in the laboratory include sulphuric acid (H_2SO4) and hydrochloric acid (HCl) • after reacting an acid and a base together, the resultant pH will vary based on the strength of the acid and base reactants • non-metal oxides tend to be acidic (low pH) • bases (high pH) include metal oxides, metal hydroxides, metal carbonates	Teacher will introduce the lesson by explaining what neutralisation is. The teacher will then continue with the content as per the CAPS document. **Activities**: 1. Teacher presents content as prescribed in the CAPS Document page 67(Example: Sasol Inzalo Gr.9A pg. 242-243). Learners will complete activity 1.	• Textbooks: eg. Sasol Inzalo Explore Gr. 9A • baking soda • vinegar • water • glass beaker or small yoghurt tub • universal indicator paper (cut into 1 cm strips) • sheet of white printer paper plastic teaspoon
ASSESSMENT		
TEACHER REFLECTION	Progress:	Challenges:

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NATURAL SCIENCES: LESSON PLAN 27 **GRADE: 9**
DURATION: 60 Minutes **STRAND: MATTER AND MATERIALS**
CAPS SENIOR PHASE **TERM : TWO**

Activity 1

INVESTIGATION: The reaction between vinegar and baking soda.

The purpose of this experiment is to investigate how the pH changes when vinegar is added to baking soda.

INVESTIGATIVE QUESTION(S):

1. What question do you hope to answer with this investigation?

OVERVIEW OF THE INVESTIGATION:

2. We will measure the pH of a solution of baking soda with universal indicator paper to confirm whether it is acidic or basic. What range do you expect the pH of this solution to fall in?
3. We will add vinegar to the baking soda solution in small portions and measure the pH after each portion has been added. What changes do you expect to observe? Will the pH increase, decrease or stay the same?

HYPOTHESIS:

4. What is your prediction? Your hypothesis should be a prediction of the finding(s) of the investigation. You should write it in the form of a possible answer to the investigative question.

MATERIALS:

• baking soda

• vinegar

• water

• glass beaker or small yoghurt tub

• universal indicator paper (cut into 1 cm strips)

• sheet of white printer paper

• plastic teaspoon

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NATURAL SCIENCES: LESSON PLAN 27 **GRADE: 9**
DURATION: 60 Minutes **STRAND: MATTER AND MATERIALS**
CAPS SENIOR PHASE **TERM : TWO**

METHOD:

Step 1: Prepare the universal indicator paper by neatly placing five 1-cm pieces underneath each other on the sheet of paper.

Step 2: Place one teaspoon of baking soda in the beaker or yoghurt tub.

Step 3: Add approximately 10 teaspoons of water to the baking soda.

Step 4: Use the teaspoon to stir the solution until all the baking soda has dissolved. We will be calling this the 'test solution' from now on.

Step 5: Transfer one drop of the test solution to the first piece of universal indicator paper using the teaspoon or a straw.

Step 6: Compare the colour of the paper with the colour guide given at the start of the chapter, to find the pH of the solution. Record this pH in your results table.

Step 7: Add 1 teaspoon of the vinegar to the test solution. Stir it gently and transfer another drop of the solution to a fresh strip of the universal indicator.

Step 8: Read the pH of the solution off the colour guide and record it in your results table.

Step 9: Repeat steps 6 and 7 until the pH of the test solution drops below 7. You may need more than 5 pieces of universal indicator paper.

RESULTS:

5. Present your results in a neat table. Use appropriate headings for your table. 'Number of teaspoons of vinegar added' and 'Colour of the universal indicator paper' and 'pH of the test solution' are suggested headings for your columns.

6. Draw a line graph to illustrate your results. What will be on the x-axis and what will be on the y-axis? Give your graph a heading.

CONCLUSIONS:

7. What conclusions can be made from the results of your investigation? Here you can rewrite your hypothesis, but change it to reflect your findings if they are different from what you predicted earlier.

8. Were you able to confirm or reject your hypothesis?

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NATURAL SCIENCES: LESSON PLAN 27 **GRADE: 9**
DURATION: 60 Minutes **STRAND: MATTER AND MATERIALS**
CAPS SENIOR PHASE **TERM : TWO**

MEMORANDUM

RESULTS:

TEACHER'S NOTE
Learners must draw a graph with the 'number of teaspoons of vinegar added' on the x-axis (independent variable) and the pH of the solution on the y-axis (dependent variable).

CONCLUSIONS:
What conclusions can be made from the results of your investigation? Here you can rewrite your hypothesis, but change it to reflect your findings if they are different from what you predicted earlier. Were you able to confirm or reject your hypothesis?

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NATURAL SCIENCES: LESSON PLAN 28 **GRADE: 9**
DURATION: 60 Minutes **STRAND: MATTER AND MATERIALS**
CAPS SENIOR PHASE **TERM : TWO**

DURATION: Week Eight Lesson Four and Five	**OBJECTIVES: LEARNERS MUST BE ABLE TO:** Understand the general equation : acid + metal oxide → salt + water. Conduct an experiment with Hydrochloric acid and Magnesium Oxide.
TOPIC: REACTIONS OF ACIDS WITH BASES - PART 2	
SUB TOPIC: The general reaction of an acid with a metal oxide (base)	

REFERENCES	**Sasol Inzalo workbooks- Natural Sciences Grade 9A**	
TERMINOLOGY:		
SPECIFIC AIMS	1. DOING SCIENCE	x
	2. KNOWING THE SUBJECT CONTENT & MAKING CONNECTIONS	x
	3. UNDERSTANDING THE USES OF SCIENCES & INDIGENOUS KNOWLEDGE	

SCIENCE PROCESS SKILLS								
Accessing & recalling Information	x		Identifying problems & issues			Doing Investigations		
Observing			Raising Questions			Recording Information		
Comparing			Predicting			Interpreting Information		
Measuring			Hypothesizing			Communicating		
Sorting & Classifying			Planning Investigations					

CONTENT AND CONCEPTS	ACTIVITIES	RESOURCES
The general reaction of an acid with a metal oxide (base) • when metals react with *oxygen*, they tend to form oxides which are bases *(see reactions of metals with oxygen)* • when any acid reacts with a metal oxide, the products formed	Introduction: 1. Metal oxides Do you remember learning about some of the	• English Dictionary • Textbooks: eg. Sasol Inzalo Explore Gr. 9A • magnesium oxide

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NATURAL SCIENCES: LESSON PLAN 28 **GRADE: 9**
DURATION: 60 Minutes **STRAND: MATTER AND MATERIALS**
CAPS SENIOR PHASE **TERM : TWO**

CONTENT AND CONCEPTS	ACTIVITIES	RESOURCES
are *a salt* and *water*. The type of salt formed will depend on the specific acid and metal oxide used in that reaction • the general equation is always: acid + metal oxide salt + water • *Example*: -- word equation: hydrochloric acid + magnesium oxide magnesium chloride + water -- balanced chemical equation: $2HCl + MgO \rightarrow MgCl_2 + H_2O$ **Applications** • burning wood and fossil fuels releases carbon dioxide and sulfur dioxide into the atmosphere. These combine with water in the atmosphere to produce acid rain • limestone (CaCO3) is used in agriculture to make soil less acidic	metal oxides in Chapter 3? We already learnt these rules to write the formulae of metal oxides. 1.1 Metal oxides from group 1 on the Periodic Table will have the formula MgO, where M stands for any metal in group 1. Can you write two examples? Look at the Periodic Table at the front of the book, pick any two metals from group 1 and write their formulae using this rule. 1.2 Metal oxides from group 2 will have the formula MO, where M stands for any metal in group 2. Can you write 2 examples? **Activities**: 1. Teacher presents content as prescribed in the CAPS Document page 68(Example: Sasol Inzalo Gr.9A pg. 247- 248). 2. Teacher will divide learners into manageable numbers for easy facilitation of practical. 3. Teacher will then discuss the procedure of the practical with learners. 4. Learners will complete the practical Investigation attached (optional formal assessment).	powder • water • universal indicator paper (cut into 1 cm strips) • white tile or sheet of white printer paper • glass rod (or plastic straw) • test tube • dropper hydrochloric acid (HCl) solution (0.1 M)

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NATURAL SCIENCES: LESSON PLAN 28 **GRADE: 9**

DURATION: 60 Minutes **STRAND: MATTER AND MATERIALS**

CAPS SENIOR PHASE **TERM : TWO**

CONTENT AND CONCEPTS	ACTIVITIES	RESOURCES
ASSESSMENT		
TEACHER REFLECTION	Progress:	Challenges:

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NATURAL SCIENCES: LESSON PLAN 28 **GRADE: 9**
DURATION: 60 Minutes **STRAND: MATTER AND MATERIALS**
CAPS SENIOR PHASE **TERM : TWO**

Activity

INVESTIGATION: The reaction between magnesium oxide and hydrochloric acid.

The purpose of this investigation is to:

• test whether a solution of magnesium oxide in water is acidic, basic or neutral; and

• determine whether the reaction between an aqueous solution of magnesium oxide and hydrochloric acid is a neutralisation reaction.

INVESTIGATIVE QUESTION(S):

What are the questions you hope to answer with this investigation? Write them in the space below. There are a few words to start you off.

1. When magnesium oxide is dissolved in water, will the resulting solution……..
2. When a solution of magnesium oxide is treated with hydrochloric acid, will the pH of the mixture …….

OVERVIEW OF THE INVESTIGATION:

3. We will measure the pH of a solution of magnesium oxide (MgO) with universal indicator paper to confirm whether it is acidic or basic. Within what range do you expect the pH of the magnesium oxide solution to fall?
4. We will add hydrochloric acid (HCl) to the magnesium oxide solution in small portions and measure the pH after each portion has been added. What changes do you expect to observe - will the pH increase, decrease or stay the same?

HYPOTHESIS:

What are your predictions? Your hypothesis should be a prediction of the finding(s) of the investigation. You should write it in the form of a possible answer to the investigative question(s). Here are a few words to start you off:

5. When magnesium oxide is dissolved in water, the resulting solution will…
6. When a solution of magnesium oxide is treated with hydrochloric acid, the pH of the mixture will…

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NATURAL SCIENCES: LESSON PLAN 28 **GRADE: 9**
DURATION: 60 Minutes **STRAND: MATTER AND MATERIALS**
CAPS SENIOR PHASE **TERM : TWO**

MATERIALS:

- magnesium oxide powder
- water
- universal indicator paper (cut into 1 cm strips)
- white tile or sheet of white printer paper
- glass rod (or plastic straw)
- test tube
- dropper
- hydrochloric acid (HCl) solution (0.1 M)

METHOD:

Step 1. Prepare the universal indicator paper by neatly placing five 1 cm pieces in a column on the white tile or sheet of printer paper.

Step 2. Place a small quantity (the size of a match head) of the magnesium oxide in a test tube.

Step 3. Add approximately 2 ml of tap water to dissolve most of the magnesium oxide.

Step 4. Use the glass rod (or plastic straw) to stir the solution until most the magnesium oxide has dissolved. We will be calling this the test solution from now on.

Step 5. Transfer one drop of the test solution to the first piece of universal indicator paper.

Step 6. Compare the colour of the paper with the colour guide to find the pH of the solution.

Step 7. Record this pH in the table you prepared beforehand.

Step 8. Add 10 drops of the hydrochloric acid solution to the test solution. Stir it gently and transfer another drop of the solution to a fresh strip of the universal indicator.

Step 9. Read the pH of the solution off the colour guide and record it in your table.

Step 10. Repeat steps 3 and 4 until the pH of the test solution drops below 7. You may need more than 5 pieces of universal indicator paper.

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NATURAL SCIENCES: LESSON PLAN 28 **GRADE: 9**
DURATION: 60 Minutes **STRAND: MATTER AND MATERIALS**
CAPS SENIOR PHASE **TERM : TWO**

RESULTS:

7. Present your results in a table. You should prepare this beforehand. Use appropriate headings for your table. 'Number of drops of HCl added' and 'Colour of the universal indicator paper' and 'pH of the test solution' are suggested headings for your columns.
8. Draw a graph of your results. Here are some hints to help you decide which variable to put on which axis:
   a) What is your independent variable? (Which variable did you change?) This goes on the x-axis.
   b) What is your dependent variable? (Which variable did you measure?) This goes on the y-axis.

CONCLUSIONS:

9. What conclusions can be made from the results of your investigation?
10. Rewrite your hypothesis, but change it to reflect your findings if they are different from what you predicted earlier.
11. Were you able to confirm or reject your hypotheses?

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NATURAL SCIENCES: LESSON PLAN 28 **GRADE: 9**
DURATION: 60 Minutes **STRAND: MATTER AND MATERIALS**
CAPS SENIOR PHASE **TERM : TWO**

MEMORANDUM

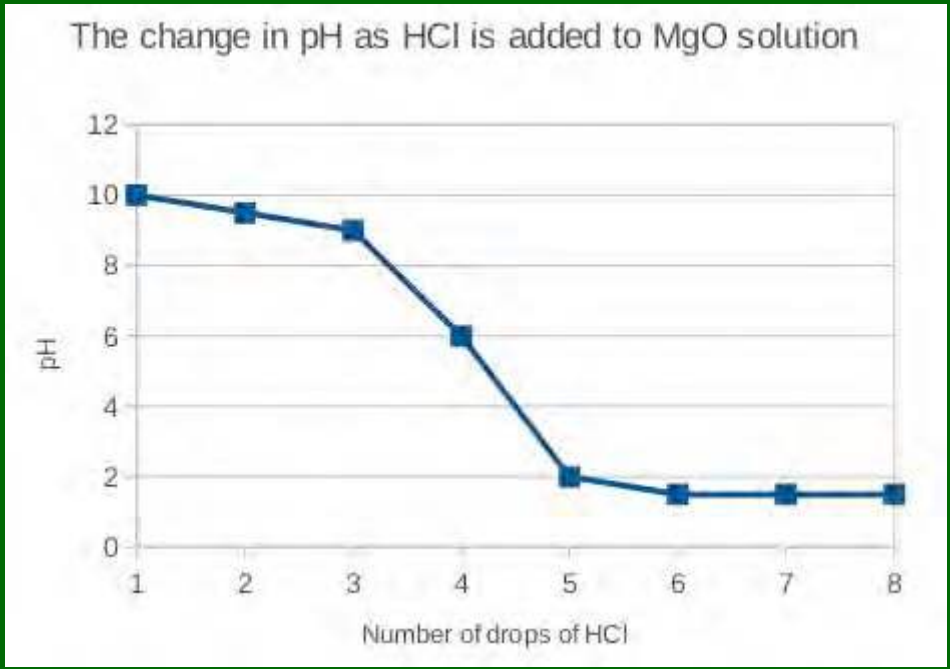
RESULTS:

1. *Learner-dependent answer*
2. a) What is your independent variable? (Which variable did you change?) This goes on the x-axis.
   Number of drops of HCl

b) What is your dependent variable? (Which variable did you measure?) This goes on the y-axis.
pH

TEACHER'S NOTE

The number of drops of HCl should be on the x-axis of the graph and pH should be on the y-axis. There should be a general trend downwards (since acid is added to a base, we can expect the pH to drop), but it should not be linear. This experiment is a very rudimentary 'titration' and an example of a titration curve from this experiment is given here: It is therefore not expected that learners' curves will be linear, but rather that there will be a gradual decline in pH at first, followed by a rapid drop when all the base has been neutralised. After this the curve levels out again.



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NATURAL SCIENCES: LESSON PLAN 29 **GRADE: 9**
DURATION: 60 Minutes **STRAND: MATTER AND MATERIALS**
CAPS SENIOR PHASE **TERM : TWO**

DURATION: Week Eight Lesson Six and Week Nine Lesson One **TOPIC:** REACTIONS OF ACIDS WITH BASES - PART 2 1. **SUB TOPIC:** The general reaction of an acid with a metal oxide (base)	**OBJECTIVES: LEARNERS MUST BE ABLE TO:** Explain how acid rain forms. Explain how limestone is used to make soil less acidic.

REFERENCES	**Sasol Inzalo workbooks- Natural Sciences Grade 9A**	
TERMINOLOGY:	**Acid rain**	
SPECIFIC AIMS	1. DOING SCIENCE	
	2. KNOWING THE SUBJECT CONTENT & MAKING CONNECTIONS	x
	3. UNDERSTANDING THE USES OF SCIENCES & INDIGENOUS KNOWLEDGE	x

SCIENCE PROCESS SKILLS								
Accessing & recalling Information	x		Identifying problems & issues			Doing Investigations		
Observing			Raising Questions			Recording Information		
Comparing			Predicting			Interpreting Information		
Measuring			Hypothesizing			Communicating		
Sorting & Classifying			Planning Investigations					

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NATURAL SCIENCES: LESSON PLAN 29 **GRADE: 9**
DURATION: 60 Minutes **STRAND: MATTER AND MATERIALS**
CAPS SENIOR PHASE **TERM : TWO**

CONTENT AND CONCEPTS	ACTIVITIES	RESOURCES
The general reaction of an acid with a metal oxide (base) • when metals react with *oxygen*, they tend to form oxides which are bases *(see reactions of metals with oxygen)* • when any acid reacts with a metal oxide, the products formed are *a salt* and *water*. The type of salt formed will depend on the specific acid and metal oxide used in that reaction • the general equation is always: acid + metal oxide salt + water • *Example*: -- word equation: hydrochloric acid + magnesium oxide magnesium chloride + water -- balanced chemical equation: $2HCl + MgO \rightarrow MgCl_2 + H_2O$ **Applications** • burning wood and fossil fuels releases carbon dioxide and sulfur dioxide into the atmosphere. These combine with water in the atmosphere to produce acid rain • limestone ($CaCO_3$) is used in agriculture to make soil less Acidic	Introduction : Burning wood and fossil fuels releases carbon dioxide and sulfur dioxide into the atmosphere. These combine with water in the atmosphere to produce acid rain. **Activities**: 1. Teacher presents content as prescribed in the CAPS Document page 68(Example: Sasol Inzalo Gr.9A pg. 249-250). 2. Learners will complete the activity attached. 3. Teacher will allow learners to watch the video on limestone as a soil neutraliser	• English Dictionary • Textbooks: eg. Sasol Inzalo Explore Gr. 9A • Projector, laptop and white board/screen. **Video links:** https://www.youtube.com/watch?v=3nehXThUWYw
ASSESSMENT		
TEACHER REFLECTION	Progress:	Challenges:

ACTIVITY : Acid rain.

For the next activity, you have to do some research on acid rain.

INSTRUCTIONS:

1. Study the diagram showing how acid rain forms.

2. Do some extra reading and research about acid rain.

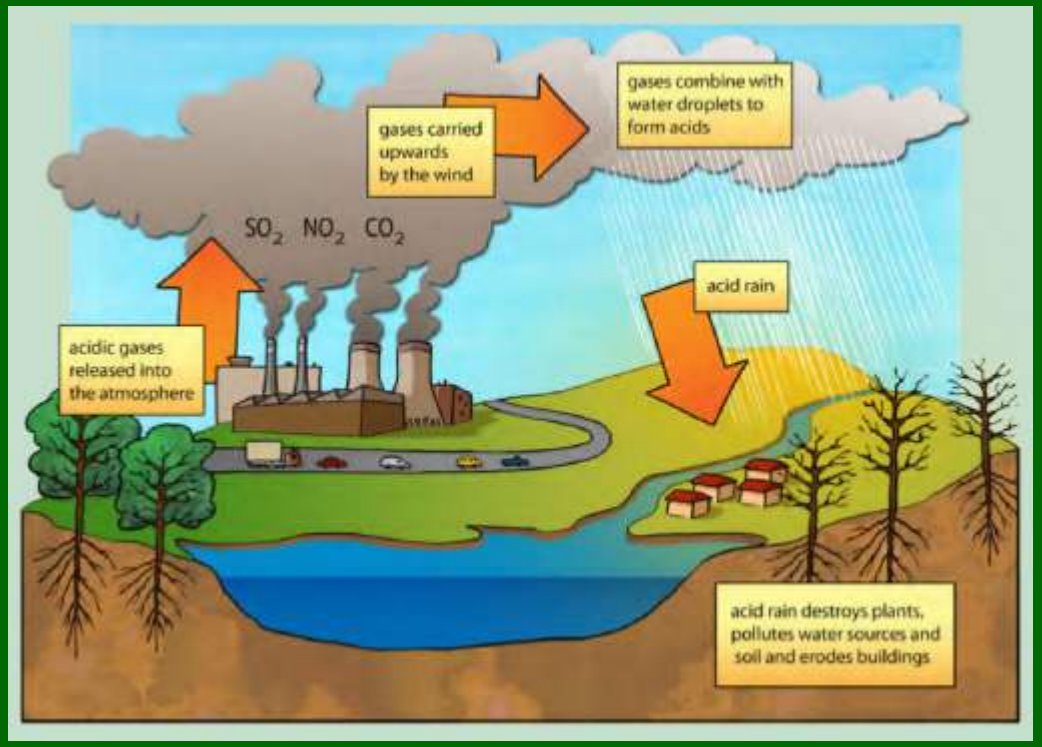
3. Answer the questions about acid rain.

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NATURAL SCIENCES: LESSON PLAN 29 **GRADE: 9**

DURATION: 60 Minutes **STRAND: MATTER AND MATERIALS**

CAPS SENIOR PHASE **TERM : TWO**



QUESTIONS:

1. Which three gases are shown in the diagram that contribute to the formation of acid rain? Write their names and formulae.
2. What are some of the sources of these gases? You can do some extra reading about this to help you answer this question.
3. Write the equations for how two of these gases which you have learnt about react with the water in the atmosphere to form acids.
4. What are the names of these two acids?
5. What are some of the environmental impacts of acid rain? Study the diagram for some clues and do some extra reading.
6. Acid rain can also damage buildings as it 'eats away' the stone. What property of acids allow it to do this?
7. Factories used to have very tall smoke funnels so that the smoke was let out high enough to be blown further away. Do you think this is an efficient way to help reduce acid rain? Explain your answer.
8. Do some research to find out about the possible ways to prevent or minimize the harmful effects of acid rain. Write a paragraph on one of these methods below.

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NATURAL SCIENCES: LESSON PLAN 29 **GRADE: 9**
DURATION: 60 Minutes **STRAND: MATTER AND MATERIALS**
CAPS SENIOR PHASE **TERM : TWO**

MEMORANDUM

1. *They are sulfur dioxide (SO2), carbon dioxide (CO2) and nitrogen dioxide (NO2).*

2. *The main sources of these gases which contribute to acid rain are from human activity, such as electricity generation in fossil fuel power plants (especially coal), factories emitting smoke and the exhaust fumes from motor vehicles. Acid rain can also occur due to natural phenomena, such as volcanoes which emit sulfur dioxide into the atmosphere. Some processes in the ocean and in wetlands also produce the gases which form acids.*

3. $SO_2 + H_2O \rightarrow H_2SO_3$
$CO_2 + H_2O \rightarrow H_2CO_3$

4. *Sulphurous acid and carbonic acid.*

5. *The impacts include:*
- *damage of plant life, both wilderness areas and also crops, depending on where the rain falls*
- *the rain leaches into soil and makes it more acidic; this kills microorganisms living in the soil, damages plants further by contaminating soil water*
- *the rain can fall into various water sources and also run off into water sources such as rivers, lakes and dams; this causes the water to become more acidic; aquatic animals and plants can die; human water sources become too acidic as well*

6. *Acids are corrosive and so they can corrode surfaces over time.*

7. *Learners need to justify their answers. They may say that it helps the local environment as the gases are carried further away and therefore do not pollute the town or city that the factory is in or near. But this does not do anything to minimize the acid rain that could potentially form as the same amounts of gases are still emitted; they are just carried further away. The acid rain therefore can still form and fall on the vegetation and areas outside of the towns and cities.*

8. *There are several solutions to minimizing the formation of acid rain. For example, coal-powered stations can use filters and other processes in their smoke towers to remove sulfur gases before the smoke is released into the atmosphere. Countries can take bigger steps by signing treaties to reduce their sulfur and other greenhouse gas emissions. The move towards using renewable energy sources will also help to reduce the reliance on coal and other fossil fuels, thereby reducing the emission of acid-producing gases into the atmosphere.*

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NATURAL SCIENCES: LESSON PLAN 30 **GRADE: 9**
DURATION: 60 Minutes **STRAND: MATTER AND MATERIALS**
CAPS SENIOR PHASE **TERM : TWO**

DURATION: Week Nine Lesson Two and Three **TOPIC:** REACTIONS OF ACIDS WITH BASES - PART 2 **SUB TOPIC:** The general reaction of an acid with a metal hydroxide (base)	**OBJECTIVES: LEARNERS MUST BE ABLE TO:** Conduct the experiment between Hydrochloric acid and Sodium hydroxide.

REFERENCES	**Sasol Inzalo workbooks- Natural Sciences Grade 9A**	
TERMINOLOGY:	Acid + Metal Hydroxide= Salt + Hydrogen	
SPECIFIC AIMS	1. DOING SCIENCE	x
	2. KNOWING THE SUBJECT CONTENT & MAKING CONNECTIONS	x
	3. UNDERSTANDING THE USES OF SCIENCES & INDIGENOUS KNOWLEDGE	

SCIENCE PROCESS SKILLS								
Accessing & recalling Information			Identifying problems & issues			Doing Investigations	x	
Observing	x		Raising Questions			Recording Information	x	
Comparing	x		Predicting	x		Interpreting Information	x	
Measuring	x		Hypothesizing	x		Communicating		
Sorting & Classifying			Planning Investigations	x				

CONTENT AND CONCEPTS	ACTIVITIES	RESOURCES
The general reaction of an acid with a metal hydroxide (base) • when metals react with *water*, they tend to form hydroxides which are bases • when any acid reacts with a metal hydroxide, the products	Introduction : Metal hydroxides A metal hydroxide forms when a metal reacts with water. A metal hydroxide has the general formula MOH or $M(OH)_2$. In the formula, M represents a metal atom, O represents	• English Dictionary • Textbooks: eg. Sasol Inzalo Explore Gr. 9A • sodium hydroxide solution (0.1 M)

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NATURAL SCIENCES: LESSON PLAN 30 **GRADE: 9**
DURATION: 60 Minutes **STRAND: MATTER AND MATERIALS**
CAPS SENIOR PHASE **TERM : TWO**

CONTENT AND CONCEPTS	ACTIVITIES	RESOURCES
formed are *a salt* and *water*. The type of salt formed will depend on the specific acid and metal oxide used in that reaction • the general equation is always: acid + metal hydroxide salt + water • *Example*: -- word equation: hydrochloric acid + sodium hydroxide sodium chloride + water -- balanced chemical equation: HCl + NaOH→ NaCl + H_2O ***[Note:** sodium chloride (NaCl) is table salt]*	an oxygen atom and H represents a hydrogen atom. To know whether the MOH or $M(OH)_2$ will be the correct formula, here are two simple rules for you to remember: 2.1 Metal hydroxides from group 1 on the Periodic Table will have the formula MOH. Can you write two examples? Look at the Periodic Table at the front of the book, pick any two metals from group 1 and write their formulae using this rule. 2.2 Metal hydroxides from group 2 will have the formula $M(OH)_2$. Can you write two examples? What do you think the pH will be of a solution of a metal hydroxide in water? The final class of compounds that forms basic solutions in water is the metal carbonates. Baking soda is a special kind of carbonate, called bicarbonate (or hydrogen carbonate). You may remember that it was one of the bases we tested with universal indicator earlier. **Activities**: 1. Teacher presents content as prescribed in the CAPS Document page 68(Example: Sasol Inzalo Gr.9A pg. 252-254). 2. Teacher will group learner to manageable numbers for easy facilitation of practical. 3. Teacher will then discuss the procedure of the practical with learners. 4. Learners will complete the practical Investigation attached (optional formal assessment).	• universal indicator paper (cut into 1 cm strips) • white tile or sheet of white printer paper • glass rod or plastic straw • test tube or small glass beaker • plastic syringe (2.5 ml capacity) • hydrochloric acid (HCl) solution (0.1 M)

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NATURAL SCIENCES: LESSON PLAN 30
DURATION: 60 Minutes
CAPS SENIOR PHASE

GRADE: 9
STRAND: MATTER AND MATERIALS
TERM : TWO

CONTENT AND CONCEPTS	ACTIVITIES	RESOURCES
ASSESSMENT		
TEACHER REFLECTION		

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NATURAL SCIENCES: LESSON PLAN 30 **GRADE: 9**
DURATION: 60 Minutes **STRAND: MATTER AND MATERIALS**
CAPS SENIOR PHASE **TERM : TWO**

Activity

INVESTIGATION: The reaction between sodium hydroxide and hydrochloric acid

The purpose of this investigation is to:

• test whether sodium hydroxide is acidic or basic; and

• determine whether the reaction between sodium hydroxide and hydrochloric acid is a neutralisation reaction.

INVESTIGATIVE QUESTION(S):

What are the questions you hope to answer with this investigation? Write them below. You may use the previous investigation (of the reaction between magnesium oxide and hydrochloric acid) as guideline.

OVERVIEW OF THE INVESTIGATION:

1. We will measure the pH of a solution of sodium hydroxide (NaOH) with universal indicator paper to confirm whether it is acidic or basic. Within what range do you expect the pH of the sodium hydroxide solution to fall?
2. We will add hydrochloric acid (HCl) to the sodium hydroxide solution in small portions and measure the pH after each portion has been added. What changes do you expect to observe? Will the pH increase, decrease or stay the same?

HYPOTHESIS:

3. What are your predictions? Your hypothesis should be a prediction of the finding(s) of the investigation. You should write it in the form of a possible answer to the investigative question(s). If you are unsure, check the previous investigation

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NATURAL SCIENCES: LESSON PLAN 30 **GRADE: 9**
DURATION: 60 Minutes **STRAND: MATTER AND MATERIALS**
CAPS SENIOR PHASE **TERM : TWO**

MATERIALS:

- sodium hydroxide solution (0.1 M)
- universal indicator paper (cut into 1 cm strips)
- white tile or sheet of white printer paper
- glass rod or plastic straw
- test tube or small glass beaker
- plastic syringe (2.5 ml capacity)
- hydrochloric acid (HCl) solution (0.1 M)

METHOD:

Step 1. Prepare the universal indicator paper by neatly placing five 1 cm pieces in a column on the white tile or sheet of printer paper.

Step 2. Use the syringe to transfer 2 ml of the sodium hydroxide solution into the test tube or small glass beaker. We will be calling this the test solution from now on.

Step 3. Rinse the syringe very thoroughly with water and dry it out with a clean tissue. Now fill it with hydrochloric acid solution and set it aside.

Step 4. Transfer one drop of the sodium hydroxide (test solution) to the first piece of universal indicator paper.

Step 5. Compare the colour of the paper with the colour guide to find the pH of the sodium hydroxide solution. Record this pH in your results table.

Step 6. Add 0.5 ml of the hydrochloric acid solution from the syringe to the test solution. Stir it gently with the glass rod or straw and transfer another drop of the test solution to a fresh strip of the universal indicator paper.

Step 7. Read the pH of the solution off the colour guide and record it in your results table.

Step 8. Repeat steps 6 and 7 until the pH of the test solution reaches approximately 7.

Step 9. How much of the hydrochloric acid solution have you used? Write the volume on the line below. If you are quite sure that all the base has been neutralised by the acid (the pH should be 7 and the universal indicator paper should have turned green), pour the test solution into a small glass beaker and leave it in the window sill for a few days. Remember to come back to it later to see what has happened to it.

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NATURAL SCIENCES: LESSON PLAN 30 **GRADE: 9**
DURATION: 60 Minutes **STRAND: MATTER AND MATERIALS**
CAPS SENIOR PHASE **TERM : TWO**

RESULTS:

4. Present your results in a neat table. Use appropriate headings for your table.

The following are suggested headings for your columns.

• Volume of HCl added

• Colour of the universal indicator paper

• pH of the test solution

5. Draw a graph of your results.

a) What is your independent variable? (Which variable did you change?)

b) What is your dependent variable? (Which variable did you measure?)

CONCLUSIONS:

6. What conclusions can be made from the results of your investigation? Here you can rewrite your hypothesis, but change it to reflect your findings if they are different from what you predicted earlier.
7. Were you able to confirm or reject your hypothesis?

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NATURAL SCIENCES: LESSON PLAN 30 **GRADE: 9**
DURATION: 60 Minutes **STRAND: MATTER AND MATERIALS**
CAPS SENIOR PHASE **TERM : TWO**

MEMORANDUM

INVESTIGATION: The reaction between sodium hydroxide and hydrochloric acid

TEACHER'S NOTE
Notes for the investigation:
• The same cautions regarding droppers and syringes apply to this activity.You will need to enforce very strict rules for handling these items or learners may find the temptation to squirt water at each other very difficult to resist.
• Remember to provide learners with a colour guide for universal indicator, if you have this.
• Remind learners to draw a results table before they start the experiment.

The purpose of this investigation is to:
• test whether sodium hydroxide is acidic or basic; and
• determine whether the reaction between sodium hydroxide and hydrochloric acid is a neutralisation reaction.

INVESTIGATIVE QUESTION(S):
1. *Here are some ideas:*
• *When sodium hydroxide is dissolved in water, will the resulting solution be acidic, basic or neutral?*
• *When a solution of sodium hydroxide is treated with hydrochloric acid, will the pH of the mixture increase, decrease or stay the same?*
• *Will it be possible to neutralise all the sodium hydroxide by adding hydrochloric acid?*

OVERVIEW OF THE INVESTIGATION :
1. *in the range pH > 7*
2.The pH will decrease

HYPOTHESIS:
1. *Some ideas:*
• *Sodium hydroxide solution will have a pH greater than 7.*
• *When a solution of sodium hydroxide is treated with hydrochloric acid, the pH of the mixture will decrease.*
• *By adding hydrochloric acid to the sodium hydroxide solution, it should be able to decrease the pH to 7 and even below 7.*

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NATURAL SCIENCES: LESSON PLAN 30 **GRADE: 9**
DURATION: 60 Minutes **STRAND: MATTER AND MATERIALS**
CAPS SENIOR PHASE **TERM : TWO**

MATERIALS:

TEACHER'S NOTE
Prepare 0.1 M NaOH solution by dissolving approximately 4 g of NaOH pellets in 1 liter of cold tap water. Wear safety goggles and gloves since there is a chance the sodium hydroxide solution could splash up.

TEACHER'S NOTE
Learner dependent answer. Should be around 2 ml.
9. If you are quite sure that all the base has been neutralised by the acid (the pH) should be 7 and the universal indicator paper should have turned (green), pour the test solution into a small glass beaker and leave it in the window sill for a few days. Remember to come back to it later to see what has happened to it.

TEACHER'S NOTE
NaCl forms in this reaction and the idea is for learners to let it dry out in the window sill and examine it later. It is probably not a good idea to let them taste it, as there is a possibility that not all of the acid or base has been neutralised.

RESULTS:
1. The following are suggested headings for your columns.
• Volume of HCl added
• Colour of the universal indicator paper
• pH of the test solution
learner-dependent answer
1.
a) *Volume of HCl*
b)*pH*

TEACHER'S NOTE
The volume of HCl added should be on the x-axis of the graph and pH should be on the y-axis. There should be a general trend downwards (since acid is added to a base, we can expect the pH to drop), but it should not be linear.

CONCLUSIONS:
Here you can rewrite your hypothesis, but change it to reflect your findings if they are different from what you predicted earlier.

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NATURAL SCIENCES: LESSON PLAN 31 **GRADE: 9**
DURATION: 30 Minutes **STRAND: MATTER AND MATERIALS**
CAPS SENIOR PHASE **TERM : TWO**

DURATION: Week Nine Lesson Four **TOPIC:** REACTIONS OF ACIDS WITH BASES: PART 3 **SUB TOPIC:** The general reaction of an acid with metal carbonate (base)	**OBJECTIVES: LEARNERS MUST BE ABLE TO:** Explain the general formula : acid + metal carbonate → salt + water + carbon dioxide

REFERENCES	**Sasol Inzalo workbooks- Natural Sciences Grade 9A**	
TERMINOLOGY:	The general reaction of an acid with a metal carbonate (base)	
SPECIFIC AIMS	1. DOING SCIENCE	
	2. KNOWING THE SUBJECT CONTENT & MAKING CONNECTIONS	x
	3. UNDERSTANDING THE USES OF SCIENCES & INDIGENOUS KNOWLEDGE	

SCIENCE PROCESS SKILLS								
Accessing & recalling Information	x		Identifying problems & issues			Doing Investigations		
Observing			Raising Questions			Recording Information		
Comparing			Predicting			Interpreting Information		
Measuring			Hypothesizing			Communicating		
Sorting & Classifying			Planning Investigations					

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NATURAL SCIENCES: LESSON PLAN 31 **GRADE: 9**
DURATION: 30 Minutes **STRAND: MATTER AND MATERIALS**
CAPS SENIOR PHASE **TERM : TWO**

CONTENT AND CONCEPTS	ACTIVITIES	RESOURCES
The general reaction of an acid with a metal carbonate (base) • metal carbonates are bases • when any acid reacts with a metal carbonate, the products formed are *a salt*, *carbon dioxide* and *water*. The type of salt formed will depend on the specific acid and metal carbonate used in that reaction • the general equation is always: acid + metal carbonate salt + carbon dioxide + water *Example*: -- word equation: hydrochloric acid + calcium carbonate calcium chloride + carbon dioxide + water -- balanced chemical equation: $2HCl + CaCO_3 \rightarrow CaCl_2 + CO_2 + H_2O$	Introduction : Metal carbonates A metal carbonate has the general formula MCO_3 or M_2CO_3. In the formula, M represents a metal atom, C represents a carbon atom and O represents an oxygen atom. To know whether the MCO_3 or M_2CO_3 will be the correct formula, there are two simple rules to remember: 1.1 Metal carbonates from group 1 on the Periodic Table will have the formula M_2CO_3.Can you write two examples? Answers: Any two of the following: Li_2CO_3, Na_2CO_3, K_2CO_3, Cs_2CO_3 1.2 Metal Hydroxides from group 2 will have the formula MCO_3. Can you write two examples? Answers: Any two of the following: $BeCO_3$, $MgCO_3$, $CaCO_3$, $SrCO_3$, $BaCO_3$. What do you think the pH will be of a solution of a metal carbonate in water? Answers: The pH will be above 7 **Activities**: 1. Teacher presents content as prescribed in the CAPS Document page 69(Example: Sasol Inzalo Gr.9A p.270). Learners will complete the activity attached	• English Dictionary • Textbooks: eg. Sasol Inzalo Explore Gr. 9A

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NATURAL SCIENCES: LESSON PLAN 31
DURATION: 30 Minutes
CAPS SENIOR PHASE

GRADE: 9
STRAND: MATTER AND MATERIALS
TERM : TWO

CONTENT AND CONCEPTS	ACTIVITIES	RESOURCES
ASSESSMENT		
TEACHER REFLECTION		

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NATURAL SCIENCES: LESSON PLAN 31 **GRADE: 9**
DURATION: 30 Minutes **STRAND: MATTER AND MATERIALS**
CAPS SENIOR PHASE **TERM : TWO**

ACTIVITY J: Writing the chemical equation

The following steps will guide you:

1. The acid of our reaction was hydrochloric acid. Can you write its chemical formula?

2. What is the name and formula of the metal carbonate we used?

3. Now, let's try to predict the products of the reaction. We know that water and carbon dioxide will be two of the products.

4. Write what remains of the base after we have taken away the CO_3 to make CO_2 and leave one O to make water.

5. Write what remains of the acid after we have taken away the H to make water. Remember we need two H to make one H_2O and $CaCO_3$ has only contributed one O.

6. Now put the two fragments together. Place the metal from the base first and the non-metal from the acid Ca and 2 Cl makes.

7. Now, let's put it all together, first the reactants, then the products:

   $2\ HCl + CaCO_3 \rightarrow CaCl_2 + H_2O + CO_2$

8. Let's check quickly if the reaction is balanced.
   a) How many H on the left and right? Are they balanced?
   b) How many Cl on the left and right? Are they balanced?
   c) How many O on the left and right? Are they balanced?
   d) How many C on the left and right? Are they balanced?

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NATURAL SCIENCES: LESSON PLAN 31 **GRADE: 9**
DURATION: 30 Minutes **STRAND: MATTER AND MATERIALS**
CAPS SENIOR PHASE **TERM : TWO**

MEMORANDUM:

1. HCl
2. Sodium hydroxide (NaOH)
3. NaCl
4. Na
5. NaCl
6. HCl + NaOH →NaCl + H2O
7. a) 2 H atoms on the left and 2 H atoms on the right. The H's are balanced.
   b) 1 Cl atom on the left and 1 Cl atom on the right. The Cl's are balanced.
   c) 1 O atom on the left and 1 O atom on the right. The O's are balanced.
   d) 1 C atom on the left and I C atom on the right. The C's are balanced.
8. You need to evaporate the water so that the salt crystallizes, either by leaving it in a sunny spot or boiling the solution.

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NATURAL SCIENCES: LESSON PLAN 32 **GRADE: 9**
DURATION: 60 Minutes **STRAND: MATTER AND MATERIALS**
CAPS SENIOR PHASE **TERM : TWO**

DURATION: Week Nine Lesson Five and Six **TOPIC:** REACTIONS OF ACIDS WITH BASES: PART 3 **SUB TOPIC:** Neutralisation of metal carbonates	**OBJECTIVES: LEARNERS MUST BE ABLE TO:** Explain the general formula : acid + metal carbonate → salt + water + carbon dioxide Conduct the experiment between Hydrochloric acid and Calcium carbonate.
REFERENCES	**Sasol Inzalo workbooks- Natural Sciences Grade 9A**
TERMINOLOGY:	Investigating neutralisation of metal carbonates by reacting chalk dust (calcium carbonate) with dilute Hydrochloric acid (HCl)
SPECIFIC AIMS	1. DOING SCIENCE: x 2. KNOWING THE SUBJECT CONTENT & MAKING CONNECTIONS: x 3. UNDERSTANDING THE USES OF SCIENCES & INDIGENOUS KNOWLEDGE:

SCIENCE PROCESS SKILLS								
Accessing & recalling Information			Identifying problems & issues			Doing Investigations	x	
Observing	x		Raising Questions			Recording Information	x	
Comparing			Predicting	x		Interpreting Information	x	
Measuring			Hypothesizing	x		Communicating		
Sorting & Classifying			Planning Investigations	x				

CONTENT AND CONCEPTS	ACTIVITIES	RESOURCES
The general reaction of an acid with a metal carbonate (base) • metal carbonates are bases • when any acid reacts with a metal carbonate, the products formed are *a salt*, *carbon dioxide* and *water*. The type of salt	1. Teacher will divide learners into manageable numbers for easy facilitation of practical. 2. Teacher will then discuss the procedure of the practical with learners.	• English Dictionary • Textbooks: eg. Sasol Inzalo Explore Gr. 9A • Projector, laptop and white board/screen.

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NATURAL SCIENCES: LESSON PLAN 32 **GRADE: 9**
DURATION: 60 Minutes **STRAND: MATTER AND MATERIALS**
CAPS SENIOR PHASE **TERM : TWO**

CONTENT AND CONCEPTS	ACTIVITIES	RESOURCES
formed will depend on the specific acid and metal carbonate used in that reaction • the general equation is always: acid + metal carbonate→ salt + carbon dioxide + water *Example*: -- word equation: hydrochloric acid + calcium carbonate calcium chloride + carbon dioxide + water -- balanced chemical equation: $2HCl + CaCO_3 \rightarrow CaCl_2 + CO_2 + H_2O$	3. Learners will complete the practical Investigation attached (optional formal assessment).	• chalk dust (calcium carbonate) suspended in a small quantity of water. • universal indicator paper (cut into 1 cm strips) • white tile or sheet of white printer paper • glass rod or plastic straw • test tube or small glass beaker • plastic syringe (2.5 cm capacity) or dropper hydrochloric acid (HCl) solution (0.1 M)

ASSESSMENT		
TEACHER REFLECTION	Progress:	Challenges:

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NATURAL SCIENCES: LESSON PLAN 32 **GRADE: 9**
DURATION: 60 Minutes **STRAND: MATTER AND MATERIALS**
CAPS SENIOR PHASE **TERM : TWO**

Activity:

INVESTIGATION: The reaction between calcium carbonate (chalk) and hydrochloric acid.

The purpose of this investigation is to:

• test whether calcium carbonate is acidic or basic;

• determine whether the reaction between calcium carbonate and hydrochloric acid is a neutralisation reaction; and

• determine the products of the reaction between calcium carbonate and hydrochloric acid.

INVESTIGATIVE QUESTIONS:

1. What are the questions you hope to answer with this investigation? Write them on the lines below. You may use your previous investigations as a guideline.

OVERVIEW OF THE INVESTIGATION

.

1. Now thatpH of a suspension of calcium carbonate ($CaCO_3$) with universal indicator paper to confirm whether it is acidic or basic. Within what range do you expect the pH of the calcium carbonate to fall?
2. We will add hydrochloric acid (HCl) to the calcium carbonate in small portions and measure the pH after each portion has been added. What changes do you expect to observe? Will the pH increase, decrease or stay the same?

HYPOTHESIS:

3. What are your predictions? Your hypothesis should be a prediction of the finding(s) of the investigation. You should write it in the form of a possible answer to the investigative question(s). If you are unsure, check the previous investigation.

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NATURAL SCIENCES: LESSON PLAN 32 **GRADE: 9**
DURATION: 60 Minutes **STRAND: MATTER AND MATERIALS**
CAPS SENIOR PHASE **TERM : TWO**

MATERIALS:

• chalk dust (calcium carbonate) suspended in a small quantity of water.

• universal indicator paper (cut into 1 cm strips)

• white tile or sheet of white printer paper

• glass rod or plastic straw

• test tube or small glass beaker

• plastic syringe (2.5 cm capacity) or dropper

• hydrochloric acid (HCl) solution (0.1 M)

METHOD:

Step 1. Prepare the universal indicator paper by neatly placing five 1 cm pieces in a column on the white tile or sheet of printer paper.

Step 2. Place approximately 2 ml of the calcium carbonate suspension into the test tube or small glass beaker. We will be calling this the test solution from now on.

Step 3. Rinse the syringe very thoroughly with water and dry it out with a clean tissue. Now fill it with hydrochloric acid solution and set it aside.

Step 4. Transfer one drop of the calcium carbonate (test solution) to the first piece of universal indicator paper.

Step 5. Compare the colour of the paper with the colour guide below, to find the pH of the calcium carbonate solution. Record this pH in your results table.

Step 6. Add 0.5 cm of the hydrochloric acid solution from the syringe to the test solution. Watch very carefully what happens. Do you see anything interesting? (Hint: Look for bubbles!) Stir the test solution gently with the glass rod and transfer another drop of it to a fresh strip of the universal indicator.

Step 7. Read the pH of the solution off the colour guide and record it in your table.

Step 8. Repeat steps 6 and 7 until the pH of the test solution reaches approximately 7. How much of the hydrochloric acid solution have you used? Write the volume in the space below.

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Step 9. Your teacher will repeat the experiment as a demonstration and will collect the gas that formed during the reaction, for testing with clear limewater.

Step 10. Can you remember which gas we are testing for with clear limewater? Write its name and formula below.

RESULTS:

4. Present your results in a neat table. Use appropriate headings for your table. Suggested headings for your columns are as follows:
   - Volume of HCl added
   - Colour of the universal indicator paper
   - pH of the test solution

6. Draw a graph of your results.

   a) What is your independent variable? (Which variable did you change?)

   b) What is your dependent variable? (Which variable did you measure?)

CONCLUSIONS:

7. What conclusions can be made from the results of your investigation? Here you can rewrite your hypothesis, but change it to reflect your findings if they are different from what you predicted earlier.

1. Were you able to confirm or reject your hypothesis?

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NATURAL SCIENCES: LESSON PLAN 32 **GRADE: 9**
DURATION: 60 Minutes **STRAND: MATTER AND MATERIALS**
CAPS SENIOR PHASE **TERM : TWO**

MEMORANDUM

INVESTIGATION: The reaction between calcium carbonate (chalk) and hydrochloric acid

TEACHER'S NOTE
Grind up a few pieces of white chalk for this experiment. The calcium carbonate will not actually dissolve well in water, but it should be possible to determine that the solution is basic, from the tiny amount of calcium carbonate that will dissolve when the chalk dust is suspended in water. Learners will need their colour charts and results tables before they start. The purpose of this investigation is to:

• test whether calcium carbonate is acidic or basic;
• determine whether the reaction between calcium carbonate and hydrochloric acid is a neutralisation reaction; and
• determine the products of the reaction between calcium carbonate and hydrochloric acid.

INVESTIGATIVE QUESTIONS:

1. Some ideas:
• When calcium carbonate is dissolved in water, will the resulting solution be acidic, basic or neutral?
• When a solution of calcium carbonate is treated with hydrochloric acid, will the pH of the mixture increase, decrease or stay the same?
• Will it be possible to neutralise all the calcium carbonate by adding hydrochloric acid? (Be careful not to introduce misconceptions here)
• What other products will form when calcium carbonate reacts with hydrochloric acid?

OVERVIEW OF THE INVESTIGATION:
1. *in the range pH > 7*
2. The pH will decrease

HYPOTHESIS:

1. Some ideas:
• Calcium carbonate solution will have a pH greater than 7
• When calcium carbonate is treated with hydrochloric acid, the pH of the mixture will decrease
• By adding hydrochloric acid to the calcium carbonate, it should be able to decrease the pH to 7 and even below 7

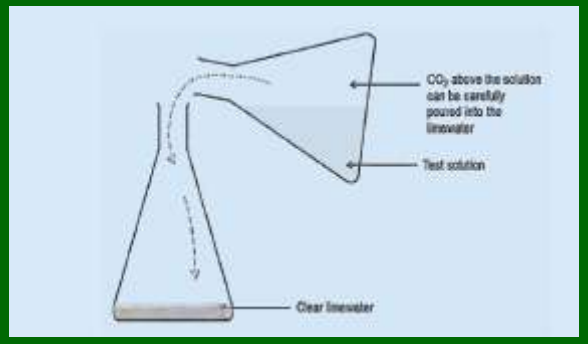
METHOD:
TEACHER'S NOTE
Perform the experiment in a conical flask, as follows:

• $_2$ into another conical flask containing lime water (see diagram below). The CO_2 gas should be poured out. Shake the conical flask containing the lime water and CO_2 to facilitate mixing. Allow the learners to make their observations.$_2$ is denser than air and will remain in the conical flask

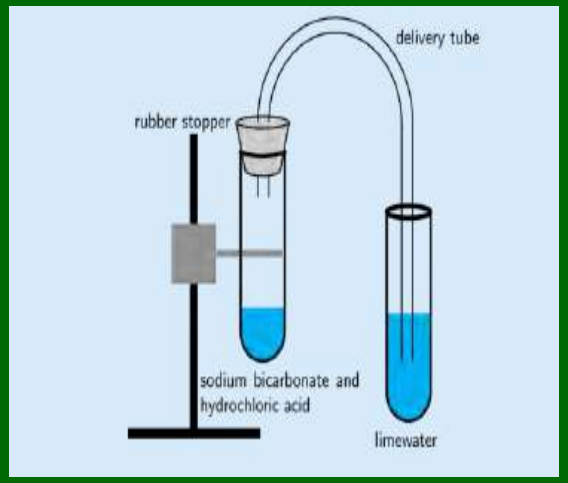
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for a few minutes before diffusing into the air. It is during this time that you should pour it over into the lime water. Be careful not to let any of the test solution flow over into the clear lime water. Only the CO



Alternatively, you could use a setup like the one shown in the diagram below:



RESULTS:

1. Present your results in a neat table.

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2. Draw a graph of your results.
a) *Volume of HCl*
b) *pH*

CONCLUSIONS:
Were you able to confirm or reject your hypothesis?

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NATURAL SCIENCES: LESSON PLAN 33 **GRADE: 9**
DURATION: 30 Minutes **STRAND: MATTER AND MATERIALS**
CAPS SENIOR PHASE **TERM : TWO**

DURATION: Week Ten Lesson One	**OBJECTIVES: LEARNERS MUST BE ABLE TO:**
TOPIC: REACTION OF ACIDS WITH METALS	Explain the general formula : acid + metal → salt + hydrogen gas Balance the chemical equation between Hydrochloric acid and Magnesium.
SUB TOPIC: The general reaction of an acid with a metal	

REFERENCES	**Sasol Inzalo workbooks- Natural Sciences Grade 9A**	
TERMINOLOGY:	The general reaction of an acid with a metal	
SPECIFIC AIMS	1. DOING SCIENCE	
	2. KNOWING THE SUBJECT CONTENT & MAKING CONNECTIONS	x
	3. UNDERSTANDING THE USES OF SCIENCES & INDIGENOUS KNOWLEDGE	

SCIENCE PROCESS SKILLS								
Accessing & recalling Information			Identifying problems & issues	x		Doing Investigations		
Observing			Raising Questions			Recording Information		
Comparing	x		Predicting			Interpreting Information		
Measuring			Hypothesizing			Communicating		
Sorting & Classifying			Planning Investigations					

CONTENT AND CONCEPTS	ACTIVITIES	RESOURCES
The general reaction of an acid with a metal • when any acid reacts with a metal, the products formed are *a salt* and *hydrogen gas*. The type of salt formed will depend on the specific acid and metal used in that reaction • the general equation is always:	Introduction : When any acid reacts with a metal, the products formed are *salt* and *hydrogen gas*. The type of salt formed will depend on the	• English Dictionary • Textbooks: eg. Sasol Inzalo Explore Gr. 9A • Projector, laptop and white board/screen.

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NATURAL SCIENCES: LESSON PLAN 33 **GRADE: 9**
DURATION: 30 Minutes **STRAND: MATTER AND MATERIALS**
CAPS SENIOR PHASE **TERM : TWO**

CONTENT AND CONCEPTS	ACTIVITIES	RESOURCES
acid + metal→ salt + hydrogen gas	specific acid and metal used in that reaction • the general equation is always: acid + metal→ salt + hydrogen gas **Activities**: 1. Teacher presents content as prescribed in the CAPS Document page 69(Example: Sasol Inzalo Gr.9A p.270-283). 2. Learners will complete the activity attached. 3. Teacher let the learner to watch the video clip before completing the attached activity.	**Video links:** https://youtu.be/9hBCLoWwcWo

ASSESSMENT		
TEACHER REFLECTION	Progress:	Challenges:

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NATURAL SCIENCES: LESSON PLAN 33 **GRADE: 9**
DURATION: 30 Minutes **STRAND: MATTER AND MATERIALS**
CAPS SENIOR PHASE **TERM : TWO**

ACTIVITY: Writing the chemical equation.

The following steps will guide you:

1. The acid of our reaction was hydrochloric acid. Can you write its chemical formula?

2. What is the name and formula of the metal we used?

3. Now, let's try to predict the products of the reaction. We know that hydrogen gas will be one of the products. Write the chemical formula for hydrogen gas.

4. Write what remains of the acid (HCl) after we have taken away the H to make H2. (Remember we need two H to make one H2).

5. The two Cl and the Mg are exactly what are needed to make magnesium chloride. Write the formula below.

6. Now, let's write the reaction; first the reactants, then the products: 2 HCl + Mg → MgCl2+ H2 Let's check quickly if the reaction is balanced. ***VISIT Cokecansmadefrom aluminium(ametal)react withanacidandabase (video) bit.ly/11YxBMO***
   a) How many H on the left and right? Are they balanced?

   b) How many Cl on the left and right? Are they balanced?

   c) How many Mg on the left and right? Are they balanced?

Since the numbers of each type of atom is the same on either side of the equation, we can confirm that it is balanced.

7. Finally, let's use the chemical equation to write a word equation for the reaction.

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NATURAL SCIENCES: LESSON PLAN 33 **GRADE: 9**
DURATION: 30 Minutes **STRAND: MATTER AND MATERIALS**
CAPS SENIOR PHASE **TERM : TWO**

MEMORANDUM

1. HCl
2. Magnesium (Mg)
3. H_2
4. 2 Cl
5. $MgCl_2$
6. a) 2 H left and 2 H right. The H's are balanced.
   b) 2 Cl left and 2 Cl right. The Cl's are balanced.
   c) 1 Mg left and 1 Mg right. The Mg's are balanced.
7. *hydrochloric acid + magnesium !magnesium chloride + hydrogen gas*

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NATURAL SCIENCES: LESSON PLAN 34 **GRADE: 9**
DURATION: 60 Minutes **STRAND: MATTER AND MATERIALS**
CAPS SENIOR PHASE **TERM : TWO**

DURATION: Week Ten Lesson Two and Three	**OBJECTIVES: LEARNERS MUST BE ABLE TO:** Conduct the experiment between Hydrochloric acid and Magnesium. Test for hydrogen gas when it is released in a chemical reaction.
TOPIC: REACTION OF ACIDS WITH METALS	
SUB TOPIC: The reaction of Hydrochloric acid with magnesium	

REFERENCES	**Sasol Inzalo workbooks- Natural Sciences Grade 9A**	
TERMINOLOGY:	The general reaction of an acid with a metal	
SPECIFIC AIMS	1. DOING SCIENCE	x
	2. KNOWING THE SUBJECT CONTENT & MAKING CONNECTIONS	x
	3. UNDERSTANDING THE USES OF SCIENCES & INDIGENOUS KNOWLEDGE	

SCIENCE PROCESS SKILLS								
Accessing & recalling Information	x		Identifying problems & issues			Doing Investigations	x	
Observing			Raising Questions			Recording Information	x	
Comparing			Predicting	x		Interpreting Information	x	
Measuring	x		Hypothesizing	x		Communicating		
Sorting & Classifying			Planning Investigations	x				

CONTENT AND CONCEPTS	ACTIVITIES	RESOURCES
The general reaction of an acid with a metal • when any acid reacts with a metal, the products formed are *a salt* and *hydrogen gas*. The type of salt formed will depend on the specific acid and metal used in that reaction	Teacher will divide learners into manageable numbers for easy facilitation of practical. 1. Teacher will then discuss the procedure of	• English Dictionary • Textbooks: eg. Sasol Inzalo Explore Gr. 9A • Projector, laptop and

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NATURAL SCIENCES: LESSON PLAN 34 **GRADE: 9**
DURATION: 60 Minutes **STRAND: MATTER AND MATERIALS**
CAPS SENIOR PHASE **TERM : TWO**

CONTENT AND CONCEPTS	ACTIVITIES	RESOURCES
• the general equation is always: acid + metal salt + hydrogen gas • *Example*: -- word equation: hydrochloric acid + magnesium magnesium chloride + hydrogen gas -- balanced chemical equation: $2HCl + Mg \rightarrow MgCl_2 + H_2$	the practical with learners. 2. Learners will complete the practical Investigation attached (optional formal assessment). 3. Learners will test for hydrogen gas.	white board/screen. • magnesium ribbon (cut into smallish pieces) • hydrochloric acid (HCl) solution (1 M) • large test tube • retort stand with clamp • rubber stopper with short length of glass tubing pushed through it • silicone or rubber tubing (or a glass delivery tube as shown in the set-up below) • shallow dish filled with soapy water (made by mixing a few teaspoons of dishwashing liquid with water) • glowing splint

ASSESSMENT		
TEACHER REFLECTION	Progress:	Challenges:

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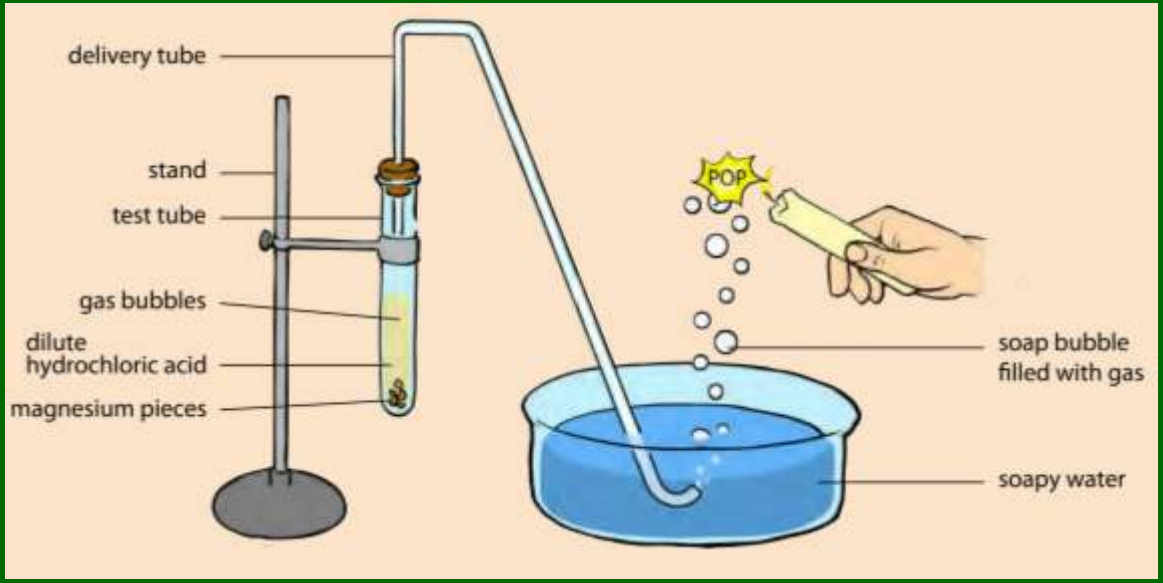
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- rubber stopper with short length of glass tubing pushed through it
- silicone or rubber tubing (or a glass delivery tube as shown in the set-up below)
- shallow dish filled with soapy water (made by mixing a few teaspoons of dishwashing liquid with water)

METHOD:

Step 1: Use a piece of universal indicator paper to test the pH of the hydrochloric acid solution. Record its pH.

Step 2: Set up the experiment as shown in the following diagram. Ensure that the end of the delivery tube is below the surface of the soap solution in the dish.



Step 3: Place approximately 1 g of the magnesium pieces in the test tube, but do not add the hydrochloric acid until everything else is ready to be assembled.

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Step 4: Add approximately 40 ml of hydrochloric acid and immediately place the stopper on the test tube. The first few bubbles of gas that are released from the end of the delivery tube will be air.

Step 5: When the soap bubbles start to float up, hold a burning candle to them and listen carefully for the sound they make when they pop. Do not hold the candle to the end of the delivery tube.

Step 6: When the magnesium stops reacting and no further hydrogen bubbles are released, extinguish the candle and set it aside.

Step 7: Disassemble the experiment and test the pH of the reaction mixture. Record the pH value.

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RESULTS AND OBSERVATIONS:

3. Record your results in the following table:

pH of the 1 M hydrochloric acid before the reaction.	
pH of the mixture before the reaction.	

4. Use the following lines to write down any observations that you make during the investigation.

CONCLUSIONS:

5. What conclusions can be made from the results of your investigation? Rewrite your hypothesis, but change it to reflect your findings if they are different from what you predicted earlier.

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NATURAL SCIENCES: LESSON PLAN 34 **GRADE: 9**
DURATION: 60 Minutes **STRAND: MATTER AND MATERIALS**
CAPS SENIOR PHASE **TERM : TWO**

6. QUESTIONS:

6.1 What did you observe in the test tube when the magnesium and hydrochloric acid were mixed?

6.2 What did you observe at the end of the gas delivery tube after the magnesium and hydrochloric acid were mixed?

6.3 Why do you think the soap bubbles floated upwards?

6.4 Which gas do you think was produced by the reaction? Write its name and formula below. What makes you think it was this gas?

6.5 What happened to the pH of the hydrochloric acid solution during the reaction?

6.6 What does the increase in pH mean?

Activity A: Testing for hydrogen gas

1. What do you know about hydrogen gas? Perhaps you know its formula? Write it below.
2. Hydrogen gas is a diatomic gas. What does this mean?
3. What do you know about the position of hydrogen in the periodic table? Write what you know below.
4. The position of hydrogen in the periodic table tells us that it is the lightest of all the elements. It has the smallest atomic mass. Because the element hydrogen is a gas (even though it is a diatomic one), it has one of the lowest densities of any substance. Can you remember what density means? Write your own definition below.

When hydrogen gas is released in a reaction it will immediately rise up, because hydrogen is less dense than air. If you filled a balloon with hydrogen, it would float up and you would need to tie a string to it to prevent it from floating away!

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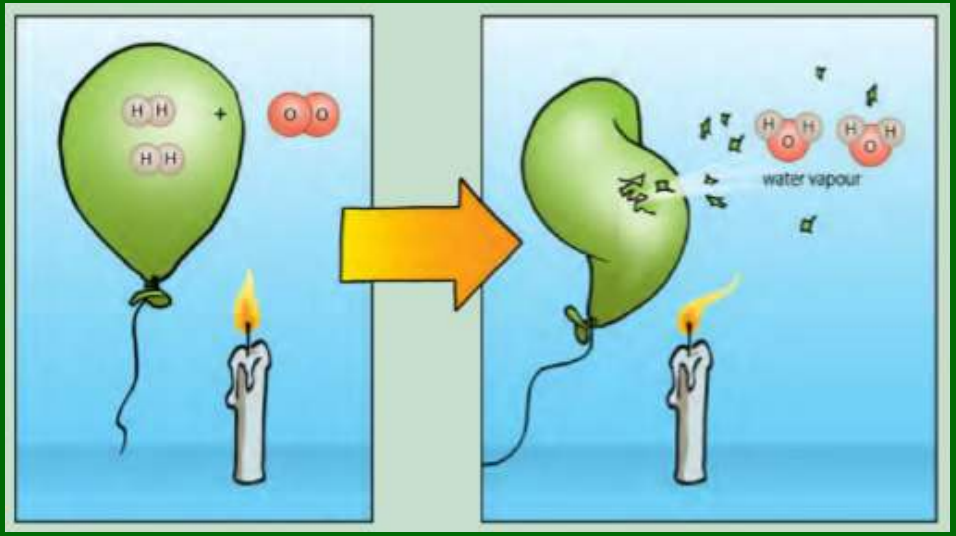
NATURAL SCIENCES: LESSON PLAN 34
DURATION: 60 Minutes
CAPS SENIOR PHASE

GRADE: 9
STRAND: MATTER AND MATERIALS
TERM : TWO



This man is about to launch a weather balloon filled with hydrogen gas. It will float upwards to collect information about the weather in Antarctica.

Another interesting thing about hydrogen is that it reacts explosively with oxygen if you bring a flame near it. You may remember learning about this in Chapter 4 about the reactions of non-metals with oxygen. The reaction between a large quantity of hydrogen and oxygen in the air produces a beautiful orange fireball and a very loud boom! Do you remember seeing the following diagram?

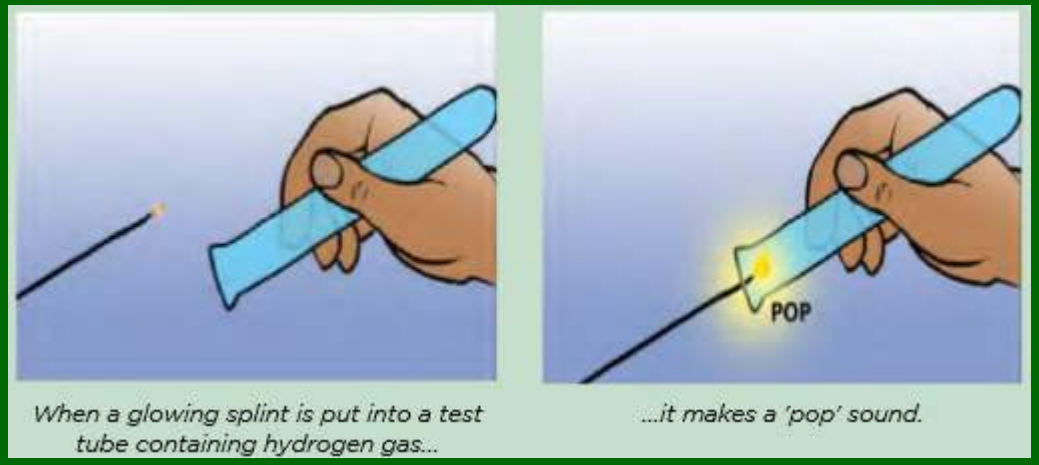


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321

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5. Write the balanced equation for the reaction between hydrogen gas and oxygen below.

The reaction between a tiny amount of hydrogen and oxygen in the air produces a characteristic 'pop' sound and this serves as test for the presence of hydrogen. You can watch the short video clip in the visit box in the margin to see this 'pop'.



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NATURAL SCIENCES: LESSON PLAN 34
DURATION: 60 Minutes
CAPS SENIOR PHASE

GRADE: 9
STRAND: MATTER AND MATERIALS
TERM : TWO



In 1937, a German airship exploded and fell to the ground in a huge fireball as the hydrogen gas which kept it floating ignited and reacted with the oxygen in the air.

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NATURAL SCIENCES: LESSON PLAN 34 **GRADE: 9**
DURATION: 60 Minutes **STRAND: MATTER AND MATERIALS**
CAPS SENIOR PHASE **TERM : TWO**

MEMORANDUM

QUESTIONS:

6.1. Bubbles formed on the surface of the magnesium pieces.

6.2. Bubbles came out of the end of the gas delivery tube.

6.3. The gas in the soap bubbles is less dense than air. ***NOTE:*** *Learners may say lighter' than air; you can use the opportunity to remind them that less dense substances will float on substances of higher density.*

6.4. Hydrogen gas (H2). Hydrogen is less dense than air so it made soap bubbles and floated upwards which made the characteristic 'pop' sound when a candle was brought near to the bubbles.

6.5. The pH increased.

6.5. When the pH increases, it means there is less acid in the solution. The hydrochloric acid was being used up in the reaction with magnesium.

Activity A: Testing for hydrogen gas

1. H_2
2. That means each molecule of hydrogen gas consists of two H atoms
3. Hydrogen can be found in the top left hand corner of the periodic table
4. Density is the mass of a substance in a given space (volume)
5. $2H_2 + O_2 \rightarrow 2H_2O$

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NATURAL SCIENCE: LESSON PLAN | **GRADE 9**

PERIOD: 60 MINUTES | **STRAND: ENERGY & CHANGE**

CAPS SENIOR PHASE 1 | **TERM 3**

DURATION: Week One Lesson One and Two **TOPIC: FORCES** **SUB – TOPIC: Types of Forces**	**OBJECTIVES: LEARNERS MUST BE ABLE TO:** • Display understanding of force as a pull or a push • Explain changes experienced by objects when force is applied • Mention that the newton is the unit of measurement for force
REFERENCES	CAPS (pg 71), Sasol Inzalo Learner's Workbook (pg4 – 8)
TERMINOLOGY:	Push, pull, force, Newton, compression
SPECIFIC AIMS	1. DOING SCIENCE ✓ 2. KNOWING THE SUBJECT CONTENT & MAKING CONNECTIONS ✓ 3. UNDERSTANDING THE USES OF SCIENCES & INDIGENOUS KNOWLEDGE

SCIENCE PROCESS SKILLS					
Accessing & recalling Information	✓	Identifying problems & issues	✓	Doing Investigations	✓
Observing	✓	Raising Questions	✓	Recording Information	✓
Comparing	✓	Predicting		Interpreting Information	✓
Measuring	✓	Hypothesizing		Communicating	✓
Sorting & Classifying		Planning Investigations			

CONTENT & CONCEPTS	ACTIVITIES	RESOURCES
• Force as a push or pull • Force can change shape, direction and speed of an object • Newton as measurement of	1. Teacher introduces the lesson by requesting 1 learner to push a desk for 1 m and then to pull the desk back to its original position. The learner is then requested to discuss his/her experience. 2. Another learner is then requested to push against the wall/chalkboard/big cupboard. The learner is then requested to discuss his/her experience. 3. The teacher then supplies all the learners with different objects such as	• Desks • Tables • Sponges • Wooden block • Balloons

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force	sponges, playing dough, wooden blocks, erasers, balloons. The learners are put into groups of 3 and then required to perform the ACTIVITY in the **Sasol Inzalo Learner's Workbook (page 5 – 6)** and to complete and discuss the changes experienced by different objects when a force is applied. 4. Learners are then required to work individually and to complete the Activity worksheet (Is it a Push or a Pull?) **Sasol Inzalo Learner's Workbook (page 7 – 8)**and to answer the questions that follow. 5. Teacher also explains Newton as a unit of measurement for force.	• Erasers • Sasol Inzalo Workbook/ or any other suitable approved resource
ASSESSMENT	1. Learners orally respond to questions based on their experiences as they carried out classroom activities 2. Informal Assessment worksheet pg 7 – 8.	
TEACHER REFLECTION	Progress:	Challenges:
	Intervention Strategies:	

Sasol Inzalo Learner's Workbook (page 5 – 6)

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NATURAL SCIENCE: LESSON PLAN

PERIOD: 60 MINUTES

CAPS SENIOR PHASE 1

GRADE 9

STRAND: ENERGY & CHANGE

TERM 3

ACTIVITY: What can forces do?

This activity is all about experimenting with different objects and seeing what happens to them when we push and pull them. Learners should see that pushing on solid objects accelerates them. Pushing or pulling on sponges, balloons and play dough distorts their shape and the ball can be made to move. Each group will need the materials listed below.

MATERIALS:

- blocks (wooden or metal)
- sponge or piece of foam
- ball
- blown up balloon
- putty or play dough

INSTRUCTIONS:

1. Work in groups of 2 or 3 as you follow the instructions and describe the effects of the forces that you are applying.

2. Start with the ball and place it on the ground. Push it towards your partner. What were you able to cause the ball to do by pushing it?

3. When one of you pushes the ball to the other, the third person must give the ball another push at an angle to the direction in which it is already moving. What were you able to do to the direction in which the ball was moving?

4. Exert a force in the opposite direction to its movement while it is already moving. What are you able to cause the ball to do?

5. Exert a force in the same direction to its movement while it is already moving. What are you able to cause the ball to do?

6. Pick up the piece of putty or play dough. Exert pulling or pushing forces on it. Try this out with the blown up balloon too. What are you doing to the shape of the putty or play dough and the blown up balloon?

7. Push and pull the wooden blocks. Are you able to change their motion? Are you able to change their shape?

8. Pick up the piece of sponge and twist it. This is also a type of force which changes the sponge's shape.

9. Press the sponge between both hands. This is called compression.

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NATURAL SCIENCE: LESSON PLAN

PERIOD: 60 MINUTES

CAPS SENIOR PHASE 1

Sasol Inzalo Learner's Workbook (page 7 – 8)

GRADE 9

STRAND: ENERGY & CHANGE

TERM 3

ACTIVITY: Is it a push or a pull?

INSTRUCTIONS:

1. Look at the pictures in the table.
2. Describe the action in each image.
3. Decide if the force being exerted is a push or a pull.
4. Describe the effect of the force.

Action	Push or pull?	Effect
 Kicking a ball.		
 Moulding clay.		
 Playing with a toy wagon.		

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NATURAL SCIENCE: LESSON PLAN

PERIOD: 60 MINUTES

CAPS SENIOR PHASE 1

GRADE 9

STRAND: ENERGY & CHANGE

TERM 3

Action	Push or pull?	Effect
 A rocket blasting off into space.		
 Exercising on a bar.		

QUESTIONS:

1. In the example of the girl kicking the ball, which is the object experiencing the force and which is the agent of the force (i.e. the body which is applying the force)?

2. When moulding clay, which object is experiencing the force and which object is the agent?

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NATURAL SCIENCE: LESSON PLAN **GRADE 9**

PERIOD: 60 MINUTES **STRAND: ENERGY & CHANGE**

CAPS SENIOR PHASE 1 **TERM 3**

MEMORANDUM

ACTIVITY: What can forces do?

2. Learners are able to cause the ball to move.

3. Pushing the ball changes its direction as it is moving.

4. Learners are able to slow the ball down or stop it.

5. Learners are able to make the ball move faster.

6. Exerting forces on the putty or play dough changes its shape and it remains deformed. Exerting forces on the balloon also changes its shape, but it resumes its shape again once you stop exerting a force on it.

7.Yes, you can change their motion by causing them to move. No, you are not able to change the shape.
8. Learners will carry out the instruction.
9. Learners will carry out the instruction.

ACTIVITY: Is it a push or a pull?

Action	**Push or pull?**	**Effect**
Kicking the ball.	**Push**	**Kicking the ball causes the direction and the speed of the ball to change.**
Moulding clay.	**Push**	**The push exerted on the clay changes the shape of the clay.**
Playing with a toy wagon.	**Pull**	**Pulling force changes the motion of the wagon.**
A rocket blasting off into space.	**Push**	**Pushing force changes the motion of the rocket(i.e. accelerating it)**
Exercising on a bar.	**Pull**	**Pulling upwards changes the motion of the boy's body**

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NATURAL SCIENCE: LESSON PLAN

PERIOD: 60 MINUTES

CAPS SENIOR PHASE 1

GRADE 9

STRAND: ENERGY & CHANGE

TERM 3

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NATURAL SCIENCE: LESSON PLAN **GRADE 9**

PERIOD: 60 MINUTES **STRAND: ENERGY & CHANGE**

CAPS SENIOR PHASE 2 **TERM 3**

DURATION: Week One Lesson Three **TOPIC:** FORCES **SUB – TOPIC:** Types of forces	**OBJECTIVES: LEARNERS MUST BE ABLE TO:** • Identify different types of forces • Explain that forces that act on two objects always act in pairs.
REFERENCES	CAPS page 71, Sasol Inzalo Learner's Workbook page 8 – 10,
TERMINOLOGY:	Contact forces, Non – Contact Forces, Field Forces, Gravitational Forces, Balanced and unbalanced forces
SPECIFIC AIMS	1. DOING SCIENCE ✓ 2. KNOWING THE SUBJECT CONTENT & MAKING CONNECTIONS ✓ 3. UNDERSTANDING THE USES OF SCIENCES & INDIGENOUS KNOWLEDGE

SCIENCE PROCESS SKILLS					
Accessing & recalling Information	✓	Identifying problems & issues	✓	Doing Investigations	✓
Observing	✓	Raising Questions	✓	Recording Information	✓
Comparing	✓	Predicting	✓	Interpreting Information	✓
Measuring		Hypothesizing	✓	Communicating	✓
Sorting & Classifying		Planning Investigations			

CONTENT & CONCEPTS	ACTIVITIES	RESOURCES
• Types of forces • Contact forces • Field forces (non – contact forces) • Forces acting in pairs	1. Example of Baseline questions posed to learners: • Explain the meaning of the word compression. • Explain some of the effects an applied force can have on an object. In your explanation, give examples of the applied force and what effect it could have. • What is the unit of force?	• Desks • Tables • Sponges • Wooden block • Balloons • Erasers

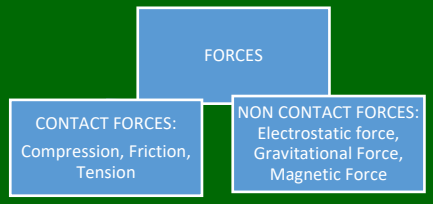
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PERIOD: 60 MINUTES **STRAND: ENERGY & CHANGE**

CAPS SENIOR PHASE 2 **TERM 3**

	2. Teacher then presents a mind map and explains different types of forces and asks learners to provide examples.  3. Learners work in pairs to conduct practical activity on how forces work in pairs **(Sasol Inzalo Learner's Workbook pages 9 – 10).**	
ASSESSMENT	Informal assessment : completion of Activity (pg. 9 – 10)	
TEACHER REFLECTION		
	Intervention Strategies:	

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PERIOD: 60 MINUTES

CAPS SENIOR PHASE 2

Sasol Inzalo Learner's Workbook pages 9 – 10

GRADE 9

STRAND: ENERGY & CHANGE

TERM 3

ACTIVITY: Pairs of forces

INSTRUCTIONS:

1. Work in groups of three for this activity.
   First, go up to your classroom wall and push against it. Describe what you feel below.

   _____

2. When you push on the wall, do you think the wall is pushing back on your hands? How does this force compare to the force you are exerting on the wall?

   _____

   _____

3. Stand in a triangle with your two partners and hold hands. Pull on each others' hands. Do you feel your partners' hands pulling back as you pull?

   _____

4. Still standing in a triangle, place your palms up against each other and push against each others' hands. Do you feel your partners' hands pushing back as you push?

   _____

5. Next, stand shoulder-to-shoulder with your two partners. The two learners on the outside must push against the shoulders of the learner in the middle.



6. What happens when you both push with the same force?

   _____

7. What happens when one of you pushes with a harder force than the other?

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8. Next, the learner in the middle must stretch out his or her arms. The learners on the outside must pull on the middle learner's hands in opposite directions.



9. What happens when you both pull with equal force?

10. What happens when one of you pulls with a stronger force than the other?

11. What happens when one of you pulls and the other pushes?

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NATURAL SCIENCE: LESSON PLAN **GRADE 9**

PERIOD: 60 MINUTES **STRAND: ENERGY & CHANGE**

CAPS SENIOR PHASE 2 **TERM 3**

MEMORANDUM

ACTIVITY: Pairs of forces

.

1. Learner-dependent answer. Learners may note that they feel the wall pushing back on their hands.

2. Yes, it is pushing back. The force experienced by the learners is equal in magnitude and opposite in direction, which will be discussed later.

3. Yes.

4. Yes

6. The learner in the middle remains stationary.

7. The middle learner will move in the direction of the stronger force.

9. The middle learner remains stationary. This is important for later. It is important to identify the forces on a specific object

10. The middle learner will move in the direction of the stronger force.

11. These forces are both acting in the same direction and so the learner moves in the direction of the push and pull.

.

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NATURAL SCIENCE: LESSON PLAN **GRADE 9**

PERIOD: 60 MINUTES **STRAND: ENERGY & CHANGE**

CAPS SENIOR PHASE 3 **TERM 3**

DURATION: Week One Lesson Four and Five **TOPIC: FORCES** **SUB – TOPIC: Types of forces**	**OBJECTIVES: LEARNERS MUST BE ABLE TO:** • Explain different types of field forces (non – contact forces) • Investigate if forces can act over a distance
REFERENCES	Sasol Inzalo Workbook
TERMINOLOGY:	Contact forces, non – contact forces, field forces, weight
SPECIFIC AIMS	1. DOING SCIENCE ✓ 2. KNOWING THE SUBJECT CONTENT & MAKING CONNECTIONS ✓ 3. UNDERSTANDING THE USES OF SCIENCES & INDIGENOUS KNOWLEDGE

SCIENCE PROCESS SKILLS					
Accessing & recalling Information	✓	Identifying problems & issues	✓	Doing Investigations	✓
Observing	✓	Raising Questions	✓	Recording Information	✓
Comparing	✓	Predicting	✓	Interpreting Information	✓
Measuring		Hypothesizing	✓	Communicating	✓
Sorting & Classifying		Planning Investigations			

CONTENT & CONCEPTS	ACTIVITIES	RESOURCES
• Types of forces • Forces acting over a distance	1. Example of baseline questions posed to learners: • Is a net (resultant) force an example of an applied force? • You apply a force on a desk. Name the “action” and ‘reaction” forces. • You are seated on a chair. Which is the object/agent that pulls you down? 2. Learners work in pairs to conduct an investigation on how forces act over a distance. **(Sasol Inzalo Learner’s Workbook page 13).**	• Bar magnets • Metal paper clips • Sasol Inzalo Workbook or any other approved resource

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PERIOD: 60 MINUTES **STRAND: ENERGY & CHANGE**

CAPS SENIOR PHASE 3 **TERM 3**

	3. Learners can be given the following site to interact with simulations on forces and motion: bit.ly/1gme5Cr	
ASSESSMENT	1. Informal assessment on types of forces. Investigation on how forces act over a distance	
TEACHER REFLECTION		
	Intervention Strategies:	

Sasol Inzalo Learner's Workbook page 13

ACTIVITY: Can forces act over a distance?

MATERIALS:

- bar magnets
- metal paper clips

INSTRUCTIONS:

1. Place one of the bar magnets on the table.
2. Bring the north end of another bar magnet close to the south end of the first bar magnet. What happens?

_____

3. Bring the north end of one bar magnet close to the north end of the other bar magnet. What happens?

_____

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4. Place the paper clips on the table.

5. Bring a bar magnet over the paper clips. What do you observe?

QUESTIONS:

1. Did you have to touch the bar magnets together before they would attract each other?

2. Did the paper clips move towards the magnet?

3. What caused the movements?

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NATURAL SCIENCE: LESSON PLAN **GRADE 9**

PERIOD: 60 MINUTES **STRAND: ENERGY & CHANGE**

CAPS SENIOR PHASE 3 **TERM 3**

MEMORANDUM

ACTIVITY: Can forces act over a distance?

2. The bar magnets move towards each other

3. The magnets try to push each other away.

5. The paper clips are attracted to the bar magnet

.

QUESTIONS:

1. No.

2. Yes

3. The magnet exerted a force on the other magnet or the paper clips

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NATURAL SCIENCE: LESSON PLAN | **GRADE 9**

PERIOD: 60 MINUTES | **STRAND: ENERGY & CHANGE**

CAPS SENIOR PHASE 4 | **TERM 3**

DURATION: Week One Lesson Six **TOPIC: FORCES** **SUB – TOPIC: Contact Forces**	**OBJECTIVES: LEARNERS MUST BE ABLE TO:** • Explain what friction is. • Explain the relationship between normal force and friction • Measure and record the weights (in newton) of different objects
REFERENCES	Sasol Inzalo Learner's Workbook
TERMINOLOGY:	Normal force, friction, mass, weight
SPECIFIC AIMS	1. DOING SCIENCE ✓ 2. KNOWING THE SUBJECT CONTENT & MAKING CONNECTIONS ✓ 3. UNDERSTANDING THE USES OF SCIENCES & INDIGENOUS KNOWLEDGE

SCIENCE PROCESS SKILLS					
Accessing & recalling Information	✓	Identifying problems & issues	✓	Doing Investigations	✓
Observing	✓	Raising Questions	✓	Recording Information	✓
Comparing	✓	Predicting	✓	Interpreting Information	✓
Measuring	✓	Hypothesizing	✓	Communicating	✓
Sorting & Classifying	✓	Planning Investigations			

CONTENT & CONCEPTS	ACTIVITIES	RESOURCES
• Friction is a constant force that a surface exerts on an object. • Difference between normal force and friction • Weight and mass • Measuring and recording	1. Example Baseline questions: • Define weight. • You are seated on a chair. Which is the object/agent that pulls you down? • Write down the name of the reaction force to your weight. 2. Teacher uses notes from any approved textbook to explain the concept of normal force and friction. 3. Learners work in groups to conduct an investigation on what is the	• Desks • Tables • Sponges • Wooden block • Balloons • Erasers

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weight of different objects	relationship between normal force and friction and record their results on the table. **(Sasol Inzalo Learner's Workbook page 14 – 20)**	
ASSESSMENT	1. Learners orally respond to questions base on their experiences as they carried out classroom activities 2. Completion of Investigation "What is the relationship between the normal force and friction (Sasol Inzalo Learner's workbook pg. 16 – 20)	
TEACHER REFLECTION	Progress:	Challenges:
	Intervention Strategies:	

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NATURAL SCIENCE: LESSON PLAN

PERIOD: 60 MINUTES

CAPS SENIOR PHASE 4

Sasol Inzalo Learner's Workbook page 16 – 20

GRADE 9

STRAND: ENERGY & CHANGE

TERM 3

INVESTIGATION: What is the relationship between the normal force and friction?

INVESTIGATIVE QUESTION: What is the relationship between the normal force and friction?

AIM: To determine the relationship between the normal force and the size of the frictional force.

In the situations that we are going to investigate, the object will be pulled along on a flat, level surface. We will increase its mass and measure the resulting frictional force. But how does this relate to the normal force?

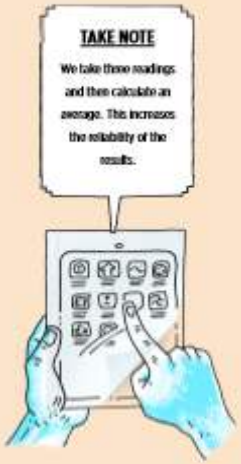
Where the object is on a flat level surface, the normal force is equal to the weight. As you learnt in Gr. 8 Planet Earth and Beyond, and will see in the next

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section, we can calculate the weight of an object. We can therefore calculate the normal force acting on the object.

For this investigation, calculate the weight using the formula W = m x g, where m is the mass of the object in kg and g is 9,8 m/s^2. We will learn more about this in the next section.

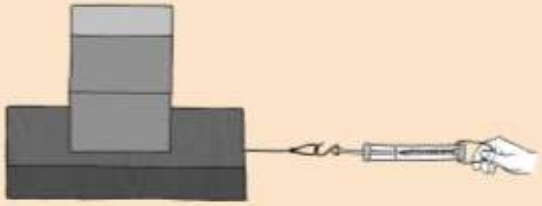


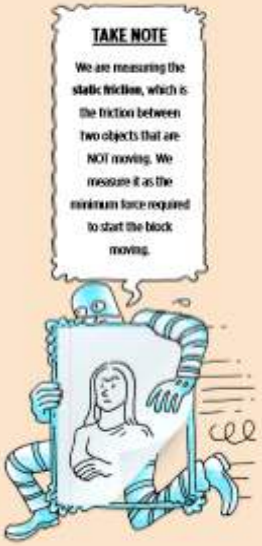
MATERIALS AND APPARATUS:

- wooden blocks with different known masses or mass pieces
- wooden block with a hook
- spring balance
- triple beam balance or electronic scale

METHOD:

1. Measure the mass of the wooden block with a hook with the triple beam balance. Record the mass in the table. Calculate and record the normal force.
2. Put the wooden block with the hook on the table. Attach the spring balance to the hook. Make a small mark on the desk from which to start pulling the block.
3. Pull sideways to the point that the block just starts moving.
4. Record the force reading in the table below. Repeat this three times for the wooden block.
5. Put a mass piece on top of the wooden block. Record the total mass. Calculate and record the normal force. Pull it sideways to the point that it starts to move. Record the force. Repeat this three times. In each case, start the block from the same position and pull gently.





6. Repeat the experiment for larger masses and complete the table.

RESULTS:

Table to record the force required to overcome the frictional force and move the block.

Mass (kg)	Normal force (N)	Reading 1 (N)	Reading 2 (N)	Reading 3 (N)	Average (N)

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STRAND: ENERGY & CHANGE

TERM 3

Plot a graph of the average force applied to the block at rest against the normal force of the block.

1. Which is the dependent variable?

_____

2. Which is the independent variable?

_____



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TERM 3

ANALYSIS:

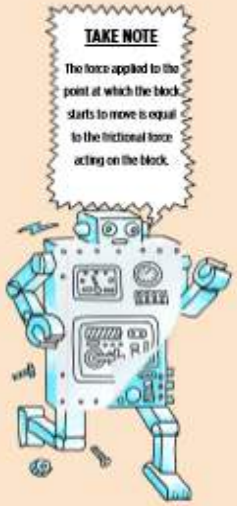
1. Draw a labelled free-body diagram of all the forces acting on the block just as it is about to start moving.

2. Why is the weight on the block being changed when the aim of the investigation is to find out how the normal force affects frictional force?

3. Why are three readings taken for each setup and an average calculated?

4. What is the shape of your graph?

5. What does the shape of the graph tell us about the relationship between the normal force of the block and the friction force?



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6. What do you think would happen if the block was not placed on the smooth desk, but rather on a rough surface, or a much smoother surface? Will this affect the results?

_____

_____

CONCLUSION:

1. Write a conclusion for this investigation.

_____

_____

2. Repeat the investigation and take some readings from the spring balance once the block is moving. How do the readings for the stationary block and a moving block compare? Is there a difference?

_____

_____

_____

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CAPS SENIOR PHASE 4 **TERM 3**

MEMORANDUM

INVESTIGATION: What is the relationship between the normal force and friction?

RESULTS:

TEACHER'S NOTE
The results obtained will depend on the mass of blocks used and the surface on which the investigation is carried out. It is important that the learners see that as the mass increases, the normal force increases and the reading on the spring balance, measured as the block begins to move, also increases.

Plot a graph of the average force applied to the block at rest against the normal force of the block.
1. The size of the frictional force.

2. The normal force as a result of the mass of the blocks.

ANALYSIS:

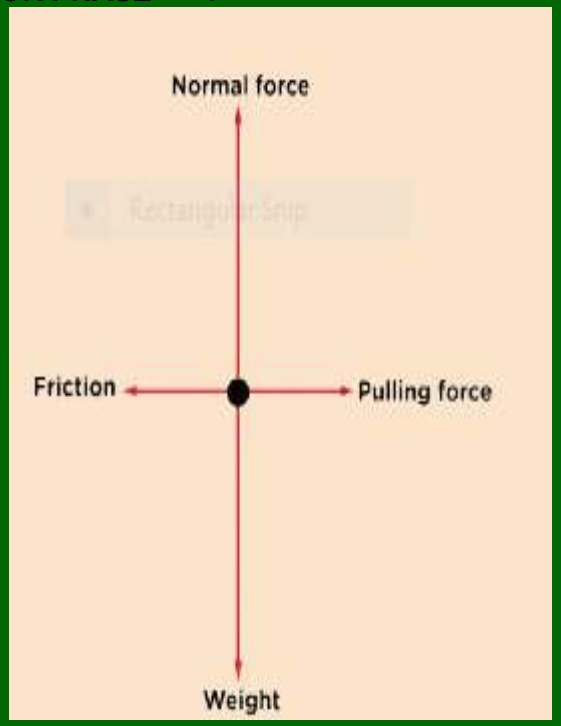
1. An example free-body diagram. The weight and normal force must have arrows of equal size. The pulling force must be equal in size to the friction as the diagram represents that object just as it is about to start moving

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CAPS SENIOR PHASE 4 **TERM 3**



2. *The object is on a flat surface so the normal force equals the weight. Increasing the mass, increases the weight as W = m x g, therefore the normal force increases.*

3. *Repeating the experiment increases the reliability of the results.*

4 *The shape should be a straight line through the origin. The actual shape will depend on the accuracy of the learners' results and plotting. It is only*
important that the graph shows an increasing trend so that the relationship between the normal force and friction can be established.

5. *The shape tells us that as the normal force increases, so does the size of the friction force.*

6. *Yes, this will affect the result as the frictional force between different kinds of surfaces is different, for example between smooth and rough surfaces.*

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CAPS SENIOR PHASE 4 **TERM 3**

CONCLUSION:

1. *The friction force increases as the normal force of the object increases.*

2. *When the block is moving at constant speed, the friction decreases, compared to the friction that has to be overcome to make the block move.*

.

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CAPS SENIOR PHASE 5 | **TERM 3**

DURATION: Week Two Lesson One and Two **TOPIC: FORCES** **SUB – TOPIC: Gravitational Force**	**OBJECTIVES: LEARNERS MUST BE ABLE TO:** • Explain the relationship between mass and weight of object as they experience gravitational force/pull • Explain the concept of gravitational force and provide examples • Identify factors on which gravitational force depends
REFERENCES	Sasol Inzalo Workbook
TERMINOLOGY:	Gravitational Force

SPECIFIC AIMS	1. DOING SCIENCE	✓
	2. KNOWING THE SUBJECT CONTENT & MAKING CONNECTIONS	✓
	3. UNDERSTANDING THE USES OF SCIENCES & INDIGENOUS KNOWLEDGE	

SCIENCE PROCESS SKILLS					
Accessing & recalling Information	✓	Identifying problems & issues	✓	Doing Investigations	✓
Observing	✓	Raising Questions	✓	Recording Information	✓
Comparing	✓	Predicting	✓	Interpreting Information	✓
Measuring	✓	Hypothesizing	✓	Communicating	✓
Sorting & Classifying		Planning Investigations			

CONTENT & CONCEPTS	ACTIVITIES	RESOURCES
• Relation between mass and weight of objects • Gravity is the force of attraction (pull) that objects have on one another due to their masses.	1. Exemplar Baseline questions: • Define “mass”, “weight”, “normal force”, • The investigation to show the relationship between Normal force and Frictional force was done yesterday. Identify the (a) independent variable (b) dependent variable. • What was the shape of the graph showing the relationship	Hammer, feather, two balls of the same mass, different volumes (one set per pair) two balls of the same volume,

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• Factors on which gravitational forces depends	between "normal force" and "friction force"? • What is the relationship between "frictional force" and "normal force"? • Give TWO examples of "contact force" and TWO examples of "non-contact forces" 2. Learners work in groups to conduct an investigation on the relationship between mass and weight of objects by dropping different objects at same time, predict and write their observations. **(Sasol Inzalo Learner's Workbook page 25 – 27).** 3. Learners conduct an investigation to establish the relationship between the mass of an object and its weight as explained by the teacher. **(Sasol Inzalo Workbook page 28 – 30)** 4. Teacher concludes the investigation by using notes from textbooks to explain the concept of gravity and its relation to mass of objects. .	different masses (one set per pair) four mass pieces in increments of 500 g (one of 500 g, one of 1 kg, one of 1,5 kg and one of 2 kg) spring balance triple beam balance
ASSESSMENT	1. Oral Assessment 2. Completion of Investigation task – relationship between mass and weight.	
TEACHER REFLECTION		
	Intervention Strategies:	

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CAPS SENIOR PHASE 5 **TERM 3**

Sasol Inzalo Workbook page 25 – 27

INVESTIGATION: Dropping objects



INVESTIGATIVE QUESTION:

Do different objects fall at the same rate?

HYPOTHESIS:

What do you think will happen?

_____

_____

MATERIALS AND APPARATUS:

- hammer
- feather
- two balls of the same mass, different volumes (one set per pair)
- two balls of the same volume, different masses (one set per pair)



METHOD:

1. Work in pairs, take turns to be the person who drops an object (experimenter) and the person who observes the objects dropping (observer).
2. Complete the "prediction" column in the table below.
3. Experimenter: stand on top of a chair or desk and take the two balls of the same mass, with one in one hand and the other in the other hand.
4. Experimenter: hold the two balls up at the same height in front of you and drop them at exactly the same time.
5. Observer: note what happens, in particular which lands first.
6. Swap positions and repeat the experiment using two balls which have the same volume but different masses.
7. Your teacher will now do a demonstration for you and drop a hammer and a feather. Before your teacher drops the hammer and feather, record the prediction column for the hammer and feather drop.
8. Record what happened with the hammer and feather and answer the questions below.

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RESULTS AND OBSERVATIONS:

1. What did you keep constant in this experiment?

_____

2. What did you change in this experiment?

_____



In the table below, record what you think will happen in the "prediction" column before you conduct your experiment. Assuming that you drop each pair of objects from the same height at the same time, what do you think will happen? Which do you think will land first?

Objects	Prediction	Observation
Balls: same mass, different volume		
Balls: different mass, same volume		
Hammer and feather		

EVALUATION:

How reliable was your experiment? How could you improve your method?

_____

_____

_____

_____

CONCLUSIONS:

Write a conclusion for this investigation.

_____

_____

_____



QUESTIONS:

1. Which landed first, the apple or the half apple?

_____

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2. Considering the balls of the same mass, which landed first, the larger one or the smaller one?

3. Considering the balls of the same volume, which landed first, the heavier one or the lighter one?

4. Why do you think the two dropped balls always landed at the same time?

5. Why do you think the hammer landed before the feather?

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CAPS SENIOR PHASE 5 **TERM 3**

Sasol Inzalo Workbook page 28 – 30



INVESTIGATION: What is the relationship between the mass of an object and its weight?

INVESTIGATIVE QUESTION: What is the relationship between the mass of an object and it's weight?

HYPOTHESIS: Write a hypothesis for this investigation.

_____

_____

MATERIALS AND APPARATUS

- four mass pieces in increments of 500 g (one of 500 g, one of 1 kg, one of 1,5 kg and one of 2 kg)
- spring balance
- triple beam balance



METHOD:

1. Measure the mass pieces on the triple beam balance.
2. Measure the weight of each mass piece with the spring balance.
3. Record the mass and matching weight in the results table.
4. Draw a graph of your results.
5. Calculate the gradient of the graph.

RESULTS:

Record your results in the following table.

Mass (kg)	Weight (N)

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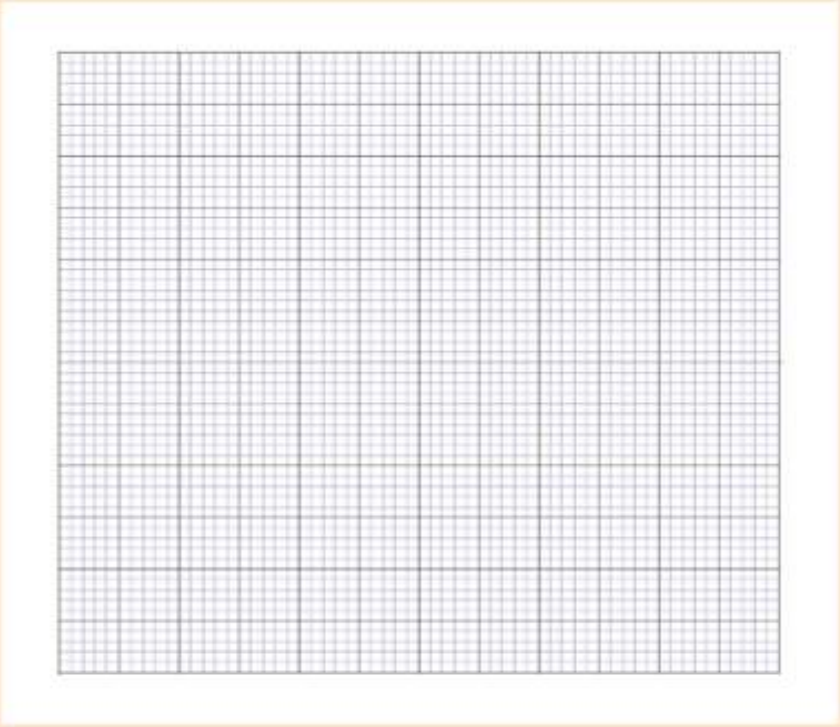
1. What is the dependent variable?

_____

2. What is the independent variable?

_____

3. Draw your graph in the space provided below.



4. Your graph should be a straight line. Use the space below to calculate the gradient of your graph.

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CONCLUSION:

Write a conclusion for this investigation.

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CAPS SENIOR PHASE 5 **TERM 3**

MEMORANDUM

INVESTIGATION: Dropping objects

HYPOTHESIS:

Learner-dependent answer.

RESULTS AND OBSERVATIONS:

1. The height at which objects are dropped.

2.The type objects that are being dropped, in particular the mass and volume of the objects.

EVALUATION:

TEACHER'S NOTE
Learner dependent answer. Example answers could include: It is difficult to drop objects at exactly the same time. It would be better to drop the objects from a greater height. Air resistance could have affected the results and it would be better to drop the objects in a vacuum.

CONCLUSIONS:

.
TEACHER'S NOTE
Learners should have found that the half apple and the whole apple hit the floor at the same time. They should also have found that the balls of the same mass hit the floor at the same time and also the balls of the same volume hit the floor at the same time. From this they should conclude that all objects dropped fall at the same rate no matter what their shape or size if air resistance can be ignored.

QUESTIONS:
1. They should have both landed at the same (or close to the same) time.

2. They should have both landed at the same time.

3. They should have both landed at the same time.

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4. In an ideal situation, all objects dropped from the same height will land at the same time. This is because the Earth's gravitational force causes each object to get faster by the same amount every second, no matter how heavy it is or what its volume is.

5. In a real situation, the air around us affects how objects fall. As an object moves through the air, and experiences air resistance. The feather is much lighter than the hammer and so the effect of air resistance is much larger on the feather. The net force acting downwards on a falling object is the gravitational force minus force due to air resistance. As the feather is much lighter than the hammer, the net force acting on it will be less and so it will experience a smaller acceleration towards the ground and fall more slowly.

INVESTIGATION: What is the relationship between the mass of an object and its weight?

RESULTS:

Mass(kg)	Weight(N)
0.5	4.8
1	9.8
1.5	14.7
2	19.6

1. Weight

2. Mass
Therefore, weight is on y-axis versus mass on the x-axis

4. The gradient should be 9,8.

TEACHER'S NOTE
You may need to remind the learners about calculating the gradient of a straight line. They should have covered this topic in Mathematics but it would be useful to remind them. They need to choose two co-ordinates on their straight line. They can choose any two coordinates which should be labelled as (x1 ; y1) and (x2 ; y2). The formula for the gradient of a straight line is gradient = rise/run = (y2 - y1)/(x2 - x1) Example calculation: gradient = (9,8 - 4,8)/(1 - 0.5) = 9,8 Learners may not get the correct answer for the gradient if they have not plotted correctly or if the spring

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balances are not calibrated properly. They may get an answer closer to 10. The gradient of the graph gives the gravitational acceleration on Earth. This will be explained in the text after the investigation.

CONCLUSION:

The weight of an object is directly proportional to the object's mass.

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NATURAL SCIENCE: LESSON PLAN | **GRADE 9**

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CAPS SENIOR PHASE 6 | **TERM 3**

DURATION: Week Two Lesson Three and Four **TOPIC: FORCES** **SUB – TOPIC: Magnetic Force**	**OBJECTIVES: LEARNERS MUST BE ABLE TO:** • Explain what is a magnetic force • Differentiate between magnetic and non-magnetic materials • Explain how magnetic force can act through substances					
REFERENCES	Sasol Inzalo Workbook					
TERMINOLOGY:	Magnetic force, attraction, repulsion, non – magnetic, magnetic					
SPECIFIC AIMS	1. DOING SCIENCE	✓				
	2. KNOWING THE SUBJECT CONTENT & MAKING CONNECTIONS	✓				
	3. UNDERSTANDING THE USES OF SCIENCES & INDIGENOUS KNOWLEDGE					
SCIENCE PROCESS SKILLS						
Accessing & recalling Information	✓	Identifying problems & issues	✓	Doing Investigations		
Observing	✓	Raising Questions	✓	Recording Information	✓	
Comparing	✓	Predicting	✓	Interpreting Information	✓	
Measuring		Hypothesizing	✓	Communicating	✓	
Sorting & Classifying		Planning Investigations				

CONTENT & CONCEPTS	ACTIVITIES	RESOURCES
• Magnetic force • Classification of substances as magnetic and non – magnetic substances • Magnetic force acting through substances	1. As part of Baseline assessment, teacher provides learners with a worksheet to classify substances as metals and non – metals based on their properties and record their observations in a table form **(Sasol Inzalo Learner Workbook page 34 – 35)** 2. Teacher instructs learners to use dictionaries and textbook to find meaning of magnetic force and write notes. Teacher consolidates learners notes	• bar magnets • paper • wood • plastic • iron • aluminium

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	through class discussion with the learners using notes from any approved textbook 3. Learners work in groups to conduct an investigation on whether magnetic force can act through substances **(Sasol Inzalo Learner Workbook page 34- 35)**	• steel • thin piece of wood • thick piece of wood • foil • paperclips
ASSESSMENT	1. Investigating which substance is magnetic and which is non-magnetic. 2. Investigation on whether magnetic force can act through substances.	
TEACHER REFLECTION	Progress:	Challenges:
	Intervention Strategies:	

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NATURAL SCIENCE: LESSON PLAN

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CAPS SENIOR PHASE 6

GRADE 9

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TERM 3

Sasol Inzalo Learner Workbook page 34 – 35

INVESTIGATION: Magnetic or non-magnetic materials

INVESTIGATIVE QUESTION: Which materials are magnetic and which are not?

HYPOTHESIS:

Write a hypothesis for this investigation.

_____

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GRADE 9

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TERM 3

MATERIALS AND APPARATUS:

- bar magnets
- paper
- wood
- plastic
- iron
- aluminium
- steel

METHOD:

1. Hold the different items close to the bar magnet (not touching) to see if they are attracted to the magnet.
2. Complete the table indicating whether or not the items are attracted to the magnet.

RESULTS:

Complete the following table.

Material	Magnetic (YES/NO)
paper	
wood	
plastic	
iron	
aluminium	
steel	
copper	



CONCLUSION:

What can you conclude from your results?

_____

_____



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TERM 3

Sasol Inzalo Learner Workbook page 36

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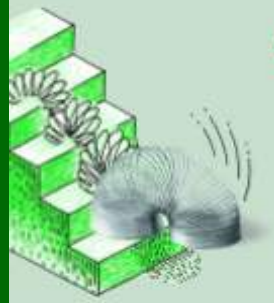
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GRADE 9

STRAND: ENERGY & CHANGE

TERM 3



ACTIVITY: Can a magnetic force act through substances?

MATERIALS:

- bar magnets
- paper
- thin piece of wood
- thick piece of wood
- foil
- paperclips

INSTRUCTIONS:

1. Hold two north poles close together. What do you notice?

_____

2. Hold two south poles close together. What do you notice?

_____

3. Hold a north pole and a south pole close together. What do you notice?

_____

4. Put the paper clips on the desk.
5. Try to pick up the paperclips with the magnet but put one of the other materials between the magnet and the paper clips. Are the paperclips still attracted to the magnet?

_____



6. Try each of the different materials between the magnet and the paper clip.

QUESTIONS:

1. Were there any materials which prevented the magnet from picking up the paper clips.

_____

_____

2. What does this activity tell us about the nature of the magnetic force?

_____

_____

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CAPS SENIOR PHASE 6 **TERM 3**

MEMORANDUM

INVESTIGATION: Magnetic or non-magnetic materials

HYPOTHESIS:

.

TEACHER'S NOTE

Learner-dependent answer. There are many different possible hypotheses for this investigation. An example would be: Only some materials are magnetic.

RESULTS:

Material	Magnetic (Yes/No)
Paper	NO
wood	NO
plastic	NO
iron	YES
aluminium	NO
steel	Yes

CONCLUSION:

TEACHER'S NOTE

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CAPS SENIOR PHASE 6 **TERM 3**

Not all materials are magnetic. Only some metals are magnetic, such as iron.

ACTIVITY: Can a magnetic force act through substances?

INSTRUCTIONS:

1. The two poles repel each other. There is a "pushing" force.

2. The two poles repel each other. There is a "pushing" force.

3. The two poles attract each other. There is a pulling force between the poles.

5. The magnet should work through any of the materials, as long as they are thin enough. It is the distance between the magnet and the paper clips that will affect the attraction. So the thin piece of wood should not prevent the attraction but the thicker wood will keep the paper clips far enough away from the magnet to make the attraction too weak to pick up the paper clips.

QUESTIONS:

1. The only material which may have prevented the magnet from picking up the paper clips is the thick piece of wood.

2. It acts over a distance. It is strongest closer to the magnet and weaker as you move further away from the magnet.

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NATURAL SCIENCE: LESSON PLAN | **GRADE 9**

PERIOD: 30 MINUTES | **STRAND: ENERGY & CHANGE**

CAPS SENIOR PHASE 7 | **TERM 3**

DURATION: Week Two Lesson Five **TOPIC: FORCES** **SUB – TOP: Magnetic Force**	**OBJECTIVES: LEARNERS MUST BE ABLE TO:** • Investigate magnetic field around a bar magnet • Investigate attraction and repulsion between magnets
REFERENCES	**Sasol Inzalo Workbook**
TERMINOLOGY:	**Magnetic force, attraction, repulsion, non – magnetic, magnetic**
SPECIFIC AIMS	1. DOING SCIENCE ✓ 2. KNOWING THE SUBJECT CONTENT & MAKING CONNECTIONS ✓ 3. UNDERSTANDING THE USES OF SCIENCES & INDIGENOUS KNOWLEDGE

SCIENCE PROCESS SKILLS

Accessing & recalling Information	✓	Identifying problems & issues	✓	Doing Investigations	
Observing	✓	Raising Questions	✓	Recording Information	✓
Comparing	✓	Predicting	✓	Interpreting Information	✓
Measuring		Hypothesizing	✓	Communicating	✓
Sorting & Classifying		Planning Investigations			

CONTENT & CONCEPTS	ACTIVITIES	RESOURCES
• Magnetic field around bar magnets • Repulsion and attraction between magnets	1. A short informal test of 10 minutes can be given on • Types of forces, • definition of mass, weight and normal forces • Action reaction pairs of forces 2. Learners then work in groups to investigate magnetic field patterns around bar magnets using iron filings, A4 white sheet paper and bar magnets **(Sasol Inzalo Learner Workbook page 37 – 38)**	• Bar Magnets • Iron Filings • Wood • Paper • Plastic • Iron • Brass

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	3. Teacher consolidates this section by allowing learners to watch a video on how field lines are formed around bar magnets https://youtu.be/j8XNHlV6Qxg and write notes. 4. Teacher provides learners with bar magnets and worksheet to complete an investigation on repulsion and attraction between magnets then consolidates this section by watching video clip with the learners. **(See attached video)** https://youtu.be/iE_rD4ECzEA	• Aluminium Foil • You Tube video clips
ASSESSMENT	1. Short Informal test on forces 2. Investigation on magnetic field around bar magnets	
TEACHER REFLECTION		

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PERIOD: 30 MINUTES

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TERM 3

Sasol Inzalo Learner Workbook page 37 – 38

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NATURAL SCIENCE: LESSON PLAN

PERIOD: 30 MINUTES

CAPS SENIOR PHASE 7

GRADE 9

STRAND: ENERGY & CHANGE

TERM 3

ACTIVITY: Visualising magnetic fields

MATERIALS:

- iron filings
- two bar magnets
- paper

INSTRUCTIONS:

1. Put the bar magnet on the table.
2. Put the paper over the magnet.
3. Shake the iron filings onto the paper.
4. Use your finger to slowly push the filings around the magnet.
5. Take note of the pattern and draw it below.

6. Lift the paper away from the magnet.
7. Place a second magnet next to the first so that different poles are facing each other.
8. Put the paper back over the magnets.
9. Move the iron filings around the two magnets, especially between the magnets.

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10. Draw the pattern in the space below.

11. Lift the paper away from the magnet.
12. Move the second magnet so that the same poles are facing each other.
13. Put the paper back over the magnets.
14. Move the iron filings around the two magnets, especially between the magnets.
15. Draw the pattern in the space below.

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NATURAL SCIENCE: LESSON PLAN

PERIOD: 30 MINUTES

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GRADE 9

STRAND: ENERGY & CHANGE

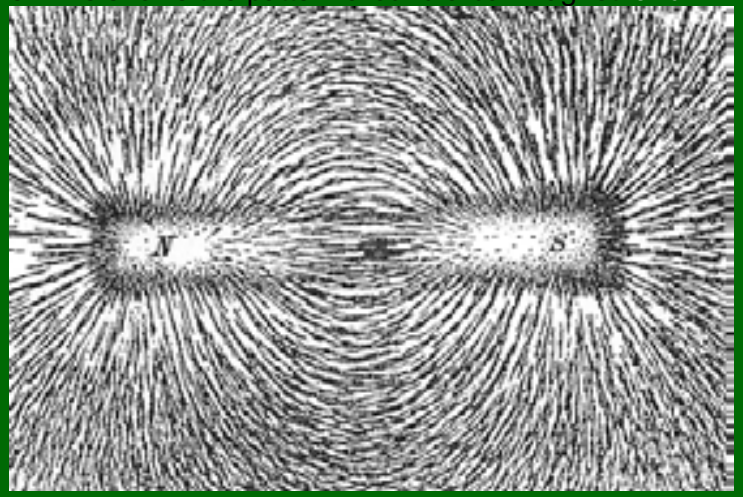
TERM 3

MEMORANDUM

ACTIVITY: Visualising magnetic fields

INSTRUCTIONS:

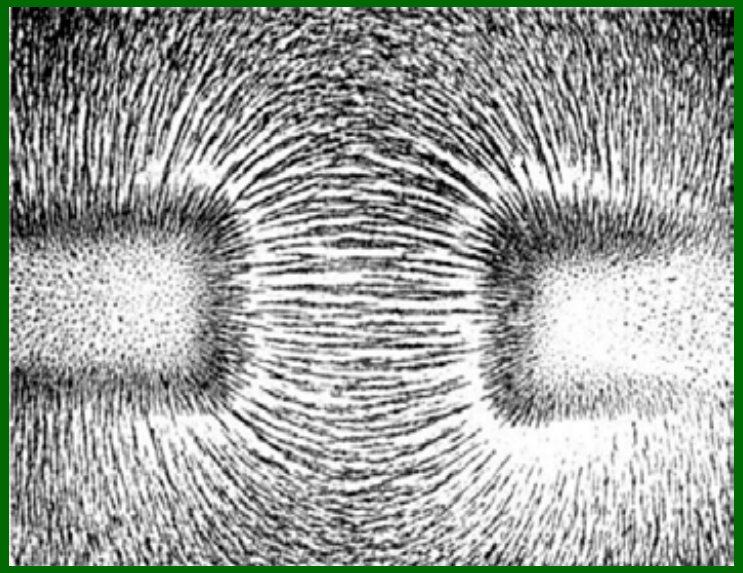
5. This shows the pattern around a bar magnet. and



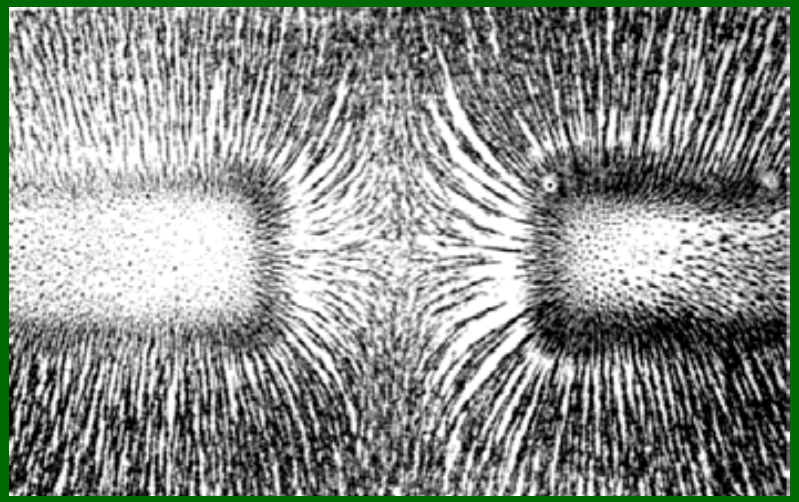
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10. The pattern between two opposite poles attracting.



15. The pattern between two like poles repelling



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NATURAL SCIENCE: LESSON PLAN | **GRADE 9**

PERIOD: 30 MINUTES | **STRAND: ENERGY & CHANGE**

CAPS SENIOR PHASE 8 | **TERM 3**

DURATION: Week Two Lesson Six **TOPIC: FORCES** **SUB – TOPIC: Electrostatic Force**	**OBJECTIVES: LEARNERS MUST BE ABLE TO:** • Explain what is electrostatic force • Explain how objects become charged • Explain how lightning occurs
REFERENCES	CAPS (pg 72), Sasol Inzalo Workbook (pg 41)
TERMINOLOGY:	neutrons, electrons, protons, electrostatic force, elec
SPECIFIC AIMS	1. DOING SCIENCE ✓ 2. KNOWING THE SUBJECT CONTENT & MAKING CONNECTIONS ✓ 3. UNDERSTANDING THE USES OF SCIENCES & INDIGENOUS KNOWLEDGE

SCIENCE PROCESS SKILLS					
Accessing & recalling Information	✓	Identifying problems & issues	✓	Doing Investigations	✓
Observing	✓	Raising Questions	✓	Recording Information	✓
Comparing	✓	Predicting	✓	Interpreting Information	✓
Measuring		Hypothesizing		Communicating	✓
Sorting & Classifying		Planning Investigations			

CONTENT & CONCEPTS	ACTIVITIES	RESOURCES
• Electrostatic force • How objects become charged • Transfer of electronics • How lightning occurs.	1. Teacher introduces the lesson by instructing learners to work in pairs and conduct an investigation to recap concepts already known from Grade 8. **(Sasol Inzalo Learner Workbook page 41 – 42).** 2. Teacher consolidates learner activity and provides learner with notes on electrostatic force.	• Wool • Plastic Comb • Ruler • Pieces of paper • Perspex Rod

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	3. Teacher uses examples to define protons, electrons and neutrons and explain how electrons are transferred from one object to another. 4. Learners work in pairs to conduct an investigation on how electrons are transferred from one object to another 5. Teacher uses notes on Sasol Inzalo Workbook to explain the concept of lightning. **(Sasol Inzalo Workbook page 47 – 48)** 6. Visit site: bit.ly/1bYvJdy (big sparks and little sparks) and bit.ly/GS5BTm (lightning)	• Balloons • Glass rod • Plastic bag • Silk cloth and other fabrics
ASSESSMENT	1. Sasol Inzalo Learner Workbook page 51 – 52 to be done as homework	
TEACHER REFLECTION		

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NATURAL SCIENCE: LESSON PLAN

PERIOD: 30 MINUTES

CAPS SENIOR PHASE 8

GRADE 9

STRAND: ENERGY & CHANGE

TERM 3

Sasol Inzalo Learner Workbook page 41 – 42 – Revision on Charging Objects

ACTIVITY: Charging objects

MATERIALS:

- balloons (or a plastic comb)
- glass rod
- piece of knitted fabric (wool)
- PVC rod
- plastic ruler
- small pieces of paper
- water tap

INSTRUCTIONS:

1. Work in pairs.
2. Blow up a balloon and tie it closed so the air does not escape.
3. Hold the balloon a short distance away from your hair. What do you notice?

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4. Rub your hair with the balloon.
5. Now hold the balloon a short distance away from your hair. What do you see?

6. Next, hold the glass rod over the small pieces of paper. What do you notice?

7. Rub the glass rod with the knitted fabric.
8. Hold the glass rod over the pieces of paper. What do you notice?

9. Rub the glass rod with the knitted fabric again.
10. Open the tap so that a thin stream of water is flowing.
11. Hold the glass rod close to the stream of water. What do you notice?

QUESTIONS:

1. What did you do to make your hair stick to the balloon?

2. What happens when you rub the glass rod with the knitted fabric?

3. Why did the glass rod attract the stream of water?

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NATURAL SCIENCE: LESSON PLAN

PERIOD: 30 MINUTES

CAPS SENIOR PHASE 8

GRADE 9

STRAND: ENERGY & CHANGE

TERM 3

The following to be done as homework

REVISION:

1. Give one term for each of the following descriptions. [5 marks]
   a) An influence that can deform a flexible object or change the motion of an object with mass.

   _____

   b) A region in space where an object with certain properties will experience a force.

   _____

   c) When the only force acting on an object is the force due to gravity.

   _____

   d) The two opposite ends of a magnet.

   _____

   e) A fundamental property of matter that comes in two types and is carried by protons and electrons.

   _____

2. Four possible answers are given for each of the following questions. There is only one correct answer. Write the letter on the line below each question. [6 x 2 = 12 marks]

   a) Which ONE of the following statements is FALSE?

   A. In order for a non-moving object to start moving, a net force must act on that object.
   B. Contact forces are strongest when the objects experiencing the force are touching.
   C. Field forces act over distances, but they can also act when objects are touching.
   D. Forces always act in pairs of equal strength, but these pairs act on different objects.

   _____

   b) Which ONE of the following is NOT a field force?

   A. Gravitational force
   B. Frictional force
   C. Electrostatic force
   D. Magnetic force

   _____

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c) The correct unit for gravitational force is:

A. the newton
B. the kilogram
C. the newton per kilogram
D. the kilogram per newton

---

d) Which ONE of the following substances is magnetic?

A. aluminium
B. copper
C. cobalt
D. tin

---

e) The electrostatic force between two charged objects is F. The distance between them is increased. How does the electrostatic force change?

A. It increases
B. It decreases
C. It remains the same
D. Not enough information has been provided.

---

f) An astronaut has a mass of 80 kg on Earth. Which ONE of the following regarding mass and weight of the astronaut on the Moon is correct?

A. The mass will be the same and the weight will also be the same.
B. The mass will be less and the weight will also be less.
C. The mass will be the same and the weight will be less.
D. The mass will be less and the weight will be the same.

---

3. Decide which of the following statements are True or False. If they are False, rewrite them to make them true. [5 x 2 = 10 marks]

a) A force cannot make a motionless object move.

---

b) A force can make a moving object change direction.

---

c) A force can change the shape of an object.

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NATURAL SCIENCE: LESSON PLAN **GRADE 9**

PERIOD: 30 MINUTES **STRAND: ENERGY & CHANGE**

CAPS SENIOR PHASE 8 **TERM 3**

MEMORANDUM

ACTIVITY: Charging objects

TEACHER'S NOTE

You can also do this activity using a plastic comb rather than balloons. Otherwise you can use pieces of paper instead of a learner's hair as not all hair
will behave in the following way.

INSTRUCTIONS:
3.Nothing happens.

5. The hair should "rise" and stick to the balloon.

6. Nothing happens.

8. The pieces of paper stick to the glass rod.

11. The stream of water bends towards the glass rod.

QUESTIONS:
1. Rubbed it vigorously with the balloon.

2. Electrons are transferred from the glass rod to the knitted fabric because of friction. The glass rod becomes positively charged and the wool becomes negatively charged.

3. The water has positive and negative charges. The negative charges were attracted to the positively charged rod.

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NATURAL SCIENCE: LESSON PLAN

PERIOD: 30 MINUTES

CAPS SENIOR PHASE 8

GRADE 9

STRAND: ENERGY & CHANGE

TERM 3

REVISION:

.

1.

a) Force.
b) Field.
c) Free-fall
d) Poles.
e) Charge.

2

a) B
b) B
c) A
d) C
e) B
f) C

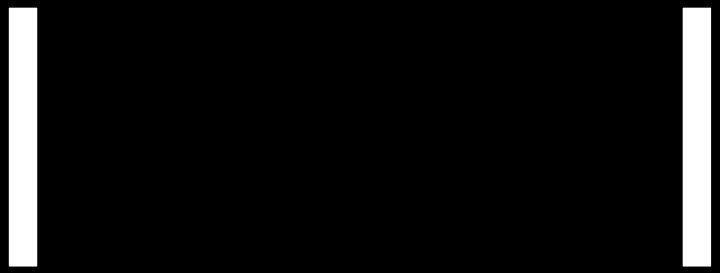
3.

a) False. A force can make a motionless object move.
b) True
c) True

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CONTENT AND CONCEPTS	ACTIVITIES	RESOURCES

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	4. Teacher opens a dry cell and show chemicals inside a dry cell to learners. In groups, use wires and connect cell terminals to LED bulb. They observe and communicate their findings.	• Conducting wires.
ASSESSMENT		
TEACHER REFLECTION		

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NATURAL SCIENCE: LESSON PLAN | **GRADE 9**

PERIOD: 30 MINUTES | **STRAND: ENERGY & CHANGE**

CAPS SENIOR PHASE 10 | **TERM 3**

DURATION: Week Three Lesson Two **TOPIC: Electric cells as energy systems** **SUB-TOPIC: Electric cells**	**OBJECTIVES: LEARNERS MUST BE ABLE TO:** • Observe how a zinc- copper/ a fruit (lemon/potato) cell can be made. • Make a zinc - copper cell or Fruit cell .
REFERENCES:	Siyavula Workbook ; NS GR. 9(Act: Pg 73-78)
TERMINOLOGY:	Multi-meter, Voltmeter, Electrode, electrolytic cell
SPECIFIC AIMS	1. DOING SCIENCE ✓ 2. KNOWING THE SUBJECT CONTENT & MAKING CONNECTIONS ✓ 3. UNDERSTANDING THE USES OF SCIENCES & INDIGENOUS KNOWLEDGE

SCIENCE PROCESS SKILLS					
Accessing & recalling Information	✓	Identifying problems & issues	✓	Doing Investigations	✓
Observing	✓	Raising Questions	✓	Recording Information	✓
Comparing		Predicting		Interpreting Information	
Measuring		Hypothesizing		Communicating	✓
Sorting & Classifying		Planning Investigations	✓	Follow Instructions	

CONTENT AND CONCEPTS	TEACHING AND LEARNING ACTIVITIES	RESOURCES
• Cells are sources of electricity	1. Teacher collects and prepares resources for making a cell. This must be done prior to learners entering the class and not wasting their time. 2. Teacher builds a zinc-Copper electrochemical cell (**Sasol Inzalo Learner Workbook pg 63 – 64**) 3. Teacher then gives instructions and, learners working in groups of	• Approved Text book(s)/ work book • LED bulbs/ sensitive multi-meter /voltmeter • Zinc and copper plates. • Zinc sulphate, copper

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	4 to make a Fruit cell. 4. Connect a LED bulb observe and keep record. 5. Learners complete a practical worksheet. (**Sasol Inzalo Learner Workbook pg 61 – 62**)	sulphate. • Conducting wires
ASSESSMENT	1. Baseline (oral questions and answers) .Informal practical worksheet. 2. Sasol Inzalo Learner Workbook pg 67 - 68	
TEACHER'S REFLECTIONS		

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NATURAL SCIENCE: LESSON PLAN

PERIOD: 30 MINUTES

CAPS SENIOR PHASE 10

GRADE 9

STRAND: ENERGY & CHANGE

TERM 3

TEACHER DEMONSTRATION: Sasol Inzalo Learner Workbook pg 63 – 64

ACTIVITY: Zinc-copper cell

MATERIALS:

- two 250 ml beakers
- copper sulphate solution
- zinc sulphate solution
- concentrated sodium sulphate or sodium chloride solution
- salt bridge made with a U tube (this can be made from a plastic tube which is bent) or filter paper soaked in the salt bridge solution
- cotton wool
- copper electrode
- zinc electrode
- insulated copper connecting wires with crocodile clips
- LED bulb
- ammeter

INSTRUCTIONS:

1. Pour about 200 ml of the zinc sulphate solution into a beaker and put the zinc electrode into the solution.
2. Pour about 200 ml of the copper sulphate solution into the second beaker and place the copper electrode into the solution.
3. Fill the U-tube with the sodium sulphate solution and seal the ends of the tubes with the cotton wool. This will stop the solution from flowing out when the U-tube is turned upside down.
4. Connect the zinc and copper electrodes to the ammeter. Does the ammeter record a reading?

---

5. Place the U-tube so that one end is in the copper sulphate solution and the other end is in the zinc sulphate solution, as shown in the diagram.

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GRADE 9

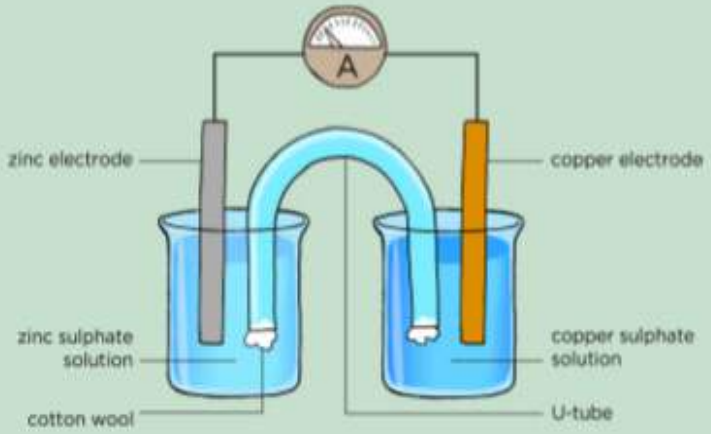
STRAND: ENERGY & CHANGE

TERM 3

DID YOU KNOW?

An ion is an atom or molecule in which the total number of electrons is not equal to the total number of protons. If there are fewer electrons than protons, this gives an atom a positive charged. If there are more electrons than protons, this this gives an atom a negative charge.





Is there a reading on the ammeter?

6. Remove the ammeter and insert the LED bulb in the circuit. Does it glow? If not, try connecting a few cells in series until the LED lights up.
7. Observe what is happening at the copper electrode and at the zinc electrode.

QUESTIONS:

1. What did you notice on the ammeter (or voltmeter) when you connected the circuit with the U-tube?

2. What does the ammeter reading tell us?

TAKE NOTE

You can also use a voltmeter to measure the potential difference across the cell. The voltmeter will replace the ammeter and LED light.

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NATURAL SCIENCE: LESSON PLAN

PERIOD: 30 MINUTES

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STRAND: ENERGY & CHANGE

TERM 3

GROUP WORK: Sasol Inzalo Learner Workbook pg 61 – 62

ACTIVITY: Fruit cell

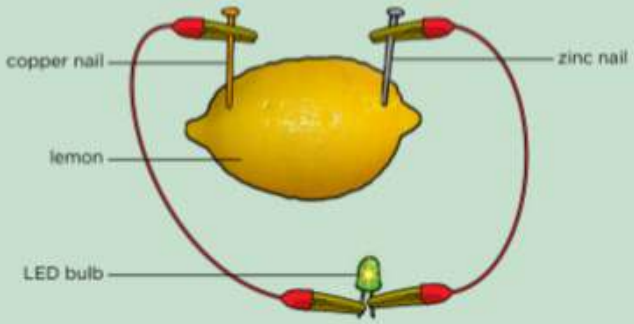


MATERIALS:

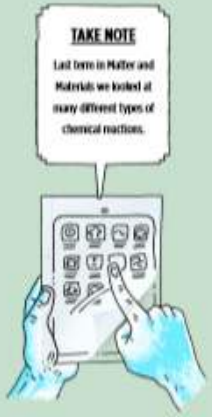
- lemon (or potato)
- zinc strip or galvanised nail
- copper strip or coin
- LED bulb
- ammeter
- insulated copper conducting wires

INSTRUCTIONS:

1. Gently squeeze the lemon to soften the fruit so that the juice is released inside. Be careful not to crush the lemon or break the peel. If you are using a potato, you do not need to squeeze it first.
2. Next, puncture the peel of the lemon with the two different nails (or strips) of **different** metals. If you are using a copper coin, then push it carefully into the lemon so that it breaks the skin.
3. Insert each nail slowly and carefully into either side of the lemon. Push the nails into the lemon so that they almost reach the centre of the lemon, but are not touching.
4. Attach one wire to the zinc (or iron) nail and the other wire to the copper nail or copper coin.
5. Connect the wires to the LED bulb and ammeter if you are using one as shown in the diagram.



What do you notice?





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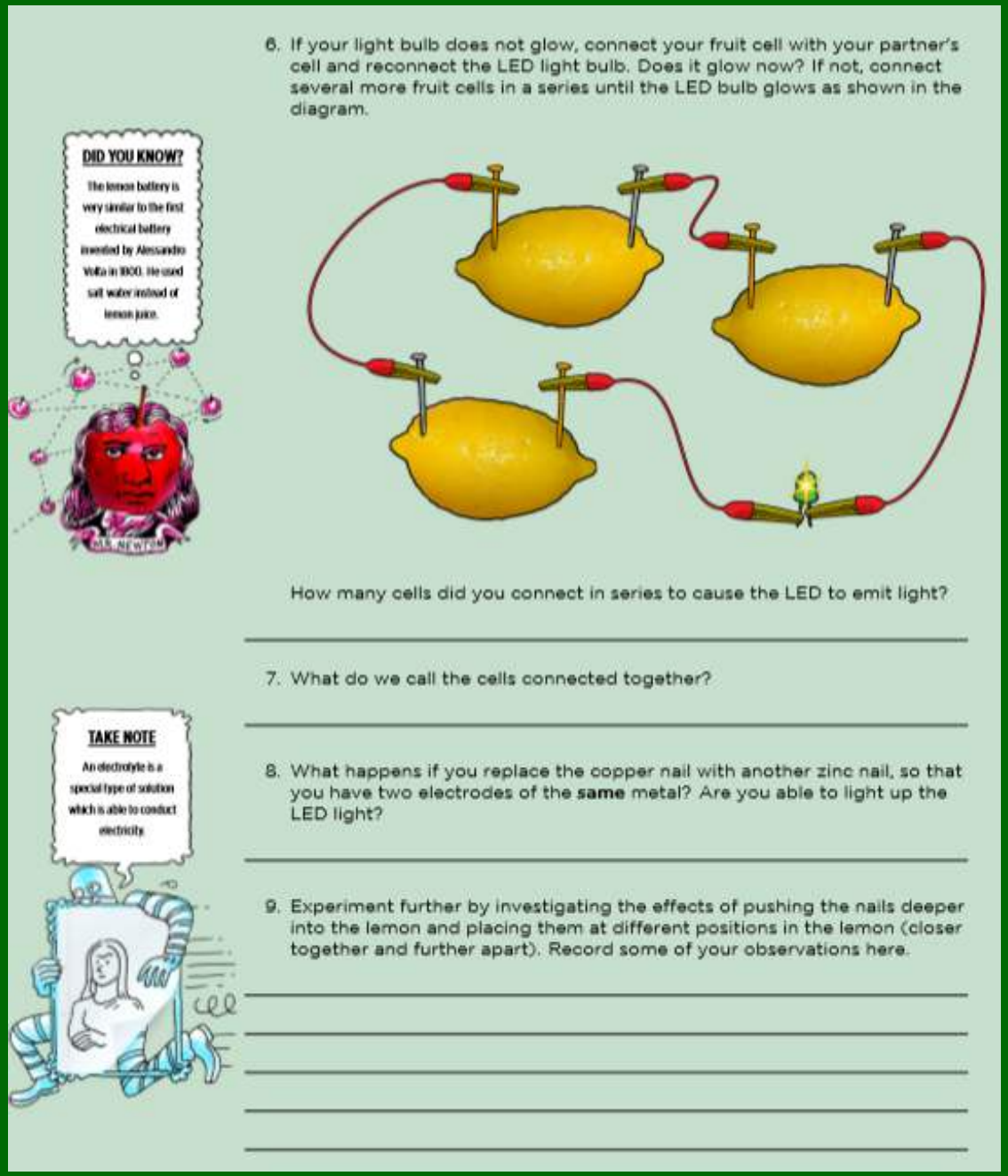
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CAPS SENIOR PHASE 10

GRADE 9

STRAND: ENERGY & CHANGE

TERM 3



6. If your light bulb does not glow, connect your fruit cell with your partner's cell and reconnect the LED light bulb. Does it glow now? If not, connect several more fruit cells in a series until the LED bulb glows as shown in the diagram.

How many cells did you connect in series to cause the LED to emit light?

7. What do we call the cells connected together?

8. What happens if you replace the copper nail with another zinc nail, so that you have two electrodes of the **same** metal? Are you able to light up the LED light?

9. Experiment further by investigating the effects of pushing the nails deeper into the lemon and placing them at different positions in the lemon (closer together and further apart). Record some of your observations here.

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NATURAL SCIENCE: LESSON PLAN

PERIOD: 30 MINUTES

CAPS SENIOR PHASE 10

GRADE 9

STRAND: ENERGY & CHANGE

TERM 3

Homework

REVISION:

1. Write a short paragraph to describe, in your own words, what an electrical cell is and how it causes a current in an external circuit. [3 marks]

2. What is the difference between a cell and a battery? [2 marks]

3. You made an electrical cell from a lemon. How could you generate enough energy from lemons in order to make a light bulb glow? [2 marks]

4. How would you test whether or not a battery or cell is producing energy? [2 marks]

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NATURAL SCIENCE: LESSON PLAN

PERIOD: 30 MINUTES

CAPS SENIOR PHASE 10

GRADE 9

STRAND: ENERGY & CHANGE

TERM 3

5. Draw a diagram to show how to set up a zinc-copper cell. Include an ammeter in the external circuit. You must use the following labels: zinc electrode, copper electrode, salt bridge/U-tube, zinc-sulphate solution, copper sulphate solution. [8 marks]

Total [17 marks]

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NATURAL SCIENCE: LESSON PLAN **GRADE 9**

PERIOD: 30 MINUTES **STRAND: ENERGY & CHANGE**

CAPS SENIOR PHASE 10 **TERM 3**

MEMORANDUM

ACTIVITY: Zinc-copper cell

.

MATERIALS:

TEACHER'S NOTE

Prepare 1 M zinc sulphate and 1 M copper sulphate solutions before hand. A 1 molar (M) solution contains 1 mole of solute dissolved in 1 litre of solution:

• To make a 1 M solution of copper sulphate, dissolve 250 g of hydrated copper sulphate ($CuSO_4.5H_2O$) in distilled water and then add more water
until you have 1 litre.

• To make a 1 M solution of zinc sulphate, dissolve 288g of hydrated zinc sulphate ($ZnSO_4.7H_2O$) in distilled water and then add more water until
you have 1 litre

The exact concentration of sodium sulphate or sodium chloride is not too important.

If you have a sensitive measuring balance, measure the mass of the electrodes before the experiment, and then again one day later, to show the change in
mass. This will highlight the fact that a chemical reaction has taken place.

If your solutions are concentrated enough, the bulb should glow, otherwise you can also connect more than one cell in series as was done with the lemons.

If you do not have enough materials for each learner to build a cell, you can do this as a demonstration or else set up a couple workstations for a group of
learners to observe.

76

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E**INSTRUCTIONS:**

TEACHER'S NOTE

If you have a sensitive measuring balance, measure the mass of the copper and zinc plates and get learners to record this.

3. Learners should fill the salt bridge with the sodium sulphate solution and then plug the ends with cotton wool. Inserting the salt bridge can be a difficult manoeuvre so make sure that they practise it a bit first and use enough cotton wool. If you do not have a U-bend tube then use strips of

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filter paper or a cloth soaked with saturated sodium sulphate solution.
4. No, there is no reading on the ammeter.
5.

TAKE NOTE
If you do not have a U-tube or plastic tubing, you can use strips of filter paper or a cloth soaked in the sodium sulfate solution with the ends dipped into each beaker.

TAKE NOTE
You can also use a voltmeter to measure the potential difference across the cell. The voltmeter will replace the ammeter and LED light.

Yes, there is a reading on the ammeter.
7.

TEACHER'S NOTE
If you measured the mass of the electrodes at the beginning of the experiment, take the ammeter away and connect the copper and zinc plates to each other directly using copper wire. Leave to stand for about one day.

After a day, remove the two plates and rinse them first with distilled water, then with alcohol and finally with ether. Dry the plates using a hair dryer.

Weigh the zinc and copper plates and get learners to record their mass again. Has the mass of the plates changed from the original measurements?

Yes, the mass should have changed. The mass of the zinc plate decreased, while the mass of the copper plate increased. Discuss this with your class. The changes in mass have occurred as chemical reactions have taken place in the solutions. This is discussed more in the text after the activity.

QUESTIONS:
1. The ammeter should measure a current in the circuit. The voltmeter should register a potential difference across the two electrodes.

3. The ammeter reading tells us that there are electrons moving through the external circuit. There is a current.

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NATURAL SCIENCE: LESSON PLAN **GRADE 9**

PERIOD: 30 MINUTES **STRAND: ENERGY & CHANGE**

CAPS SENIOR PHASE 10 **TERM 3**

ACTIVITY: Fruit cell

TEACHER'S NOTE

The citric acid in the lemon acts as an electrolyte. When two different metal electrodes are placed into the acidic lemon solution, and the circuit is closed, electrons flow from the one electrode to the other. This flow of electrons is called electric current.

This is a fun activity for the learners and easily accessible if you do not have the equipment to make the zinc/copper cell in the next activity.

The ammeter is optional. You can use the LED light instead of an ammeter to indicate that current is present. However, depending on the fruit that you use, the current might not be strong enough to make the LED light glow, and therefore an ammeter is a more sensitive measure of whether there is current. Connect several of the learner's fruit cells in series until the LED bulb lights up. Note that incandescent light bulbs from torches are not used as the lemon battery will not produce a high enough potential difference to light them up. Instead of a copper nail or copper strip, you can also use a copper coin or piece of copper wire. Instead of a zinc nail, you can also use a steel or iron nail. It is important to highlight to learners that TWO different conductors/metals must be used in the cell. If two of the same metals are used, a potential difference is not created, and the electrons will not flow. As an extension, you can also use different types of fruit to see which ones produce the best cells.

5. There should be a small reading on the ammeter and the light bulb might glow. The size of the reading will depend on the size of the lemon and the quality of the connections. Make sure that the zinc and copper are not touching each other inside the lemon.

6 Learner-dependent answer.

7. A battery.

8. No you are not able to light up the LED bulb using two nails of the same type of metal. If two of the same metals are used, a potential difference is not created, and the electrons will not flow.

.

TAKE NOTE

An electrolyte is a special type of solution which is able to conduct electricity.

9. Learners should see that the further the nails are pushed into the lemon, the greater the current. This is because the length of the electrodes exposed to the electrolyte is greater (there is increased surface area in contact with the electrolyte).

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Placing the nails in different positions also has an effect, as the closer the electrodes are to each other, the less resistance there is, and therefore a greater current.

This is a good opportunity to also discuss a fair test as learners must only change one variable at a time.

A further extension is to use different electrodes. For example, replace the zinc nail or strip with a magnesium strip. Learners can then observe and compare the ammeter readings and draw further conclusions about how the type of material of the conductor has an effect

HOMEWORK

REVISION:

1. The paragraph should mention that an electrical cell is a system in which chemical reactions occur. The chemical reactions set up a potential difference across the cell, which makes the electrons move around the circuit (electric current).

2. A cell is a system in which chemical reactions occur. A battery is a number of cells connected together.

3. If you make several lemon cells and connect them in series with a light bulb.

4. You can connect an ammeter to measure current or use a torch light bulb. If the bulb glows then there is a current flowing. Or you can use a voltmeter to measure the potential difference.

5. One mark is allocated to each of the correct labels, one mark to placing the salt bridge with the ends in each solution, one mark for including an ammeter in the correct position with the symbol A and one mark for placing the electrodes in the right solutions. A reference diagram is supplied here

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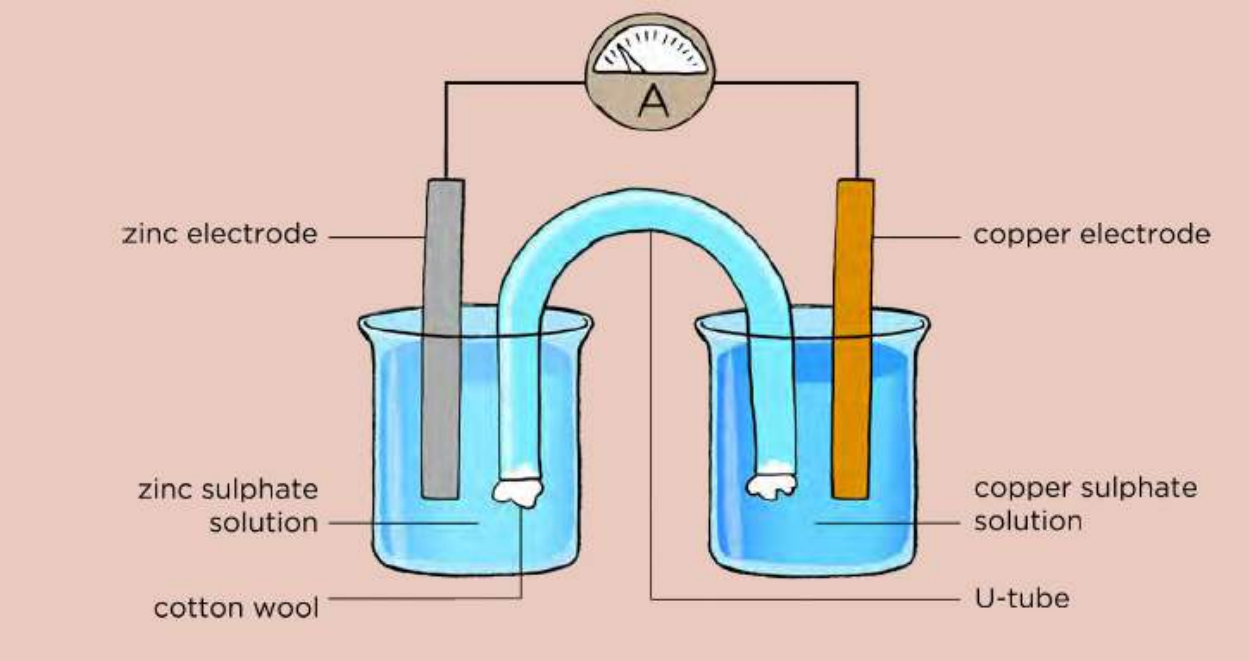
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CAPS SENIOR PHASE 10

GRADE 9

STRAND: ENERGY & CHANGE

TERM 3



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NATURAL SCIENCE: LESSON PLAN **GRADE 9**

PERIOD: 30 MINUTES **STRAND: ENERGY & CHANGE**

CAPS SENIOR PHASE 11 **TERM 3**

DURATION: Week Three Lesson Three **TOPIC: Electric cells as energy systems** **SUB-TOPIC: Electric cells**	**OBJECTIVES: LEARNERS MUST BE ABLE TO:** • Define the word "battery'. • Build or make a battery from a number of dry cells. • Draw (using) symbols diagrams of batteries made up of different number of cell
REFERENCES:	Siyavula Workbook ; NS GR. 9(Act: Pg 73-78)
TERMINOLOGY:	Battery
SPECIFIC AIMS	1. DOING SCIENCE ✓ 2. KNOWING THE SUBJECT CONTENT & MAKING CONNECTIONS ✓ 3. UNDERSTANDING THE USES OF SCIENCES & INDIGENOUS KNOWLEDGE

SCIENCE PROCESS SKILLS					
Accessing & recalling Information	✓	Identifying problems & issues		Doing Investigations	
Observing		Raising Questions		Recording Information	
Comparing		Predicting		Interpreting Information	
Measuring		Hypothesizing		Communicating	✓
Sorting & Classifying		Planning Investigations		Follow Instructions	✓

CONTENT AND CONCEPTS	TEACHING AND LEARNING ACTIVITIES	RESOURCES
	• Previous homework on Forces is marked • Homework on Electrolytic cells (Zn-Cu cell and Fruit cell) of the previous days is marked.	• Text book(s)/Worksheet,
ASSESSMENT	Baseline (oral questions and answers) .Informal practical worksheet. Siyavula GR. 9-B NS;	

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NATURAL SCIENCE: LESSON PLAN

PERIOD: 30 MINUTES

CAPS SENIOR PHASE 11

GRADE 9

STRAND: ENERGY & CHANGE

TERM 3

TEACHER'S REFLECTIONS	Progress:	Challenges:

REVISION:

1. Write a short paragraph to describe, in your own words, what an electrical cell is and how it causes a current in an external circuit. [3 marks]

2. What is the difference between a cell and a battery? [2 marks]

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3. You made an electrical cell from a lemon. How could you generate enough energy from lemons in order to make a light bulb glow? [2 marks]

4. How would you test whether or not a battery or cell is producing energy? [2 marks]

5. Draw a diagram to show how to set up a zinc-copper cell. Include an ammeter in the external circuit. You must use the following labels: zinc electrode, copper electrode, salt bridge/U-tube, zinc-sulphate solution, copper sulphate solution. [8 marks]

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NATURAL SCIENCE: LESSON PLAN **GRADE 9**

PERIOD: 30 MINUTES **STRAND: ENERGY & CHANGE**

CAPS SENIOR PHASE 11 **TERM 3**

MEMORANDUM

1.The paragraph should mention that an electrical cell is a system in which chemical reactions occur. The chemical reactions set up a potential difference across the cell, which makes the electrons move around the circuit (electric current).

2. A cell is a system in which chemical reactions occur. A battery is a number of cells connected together.

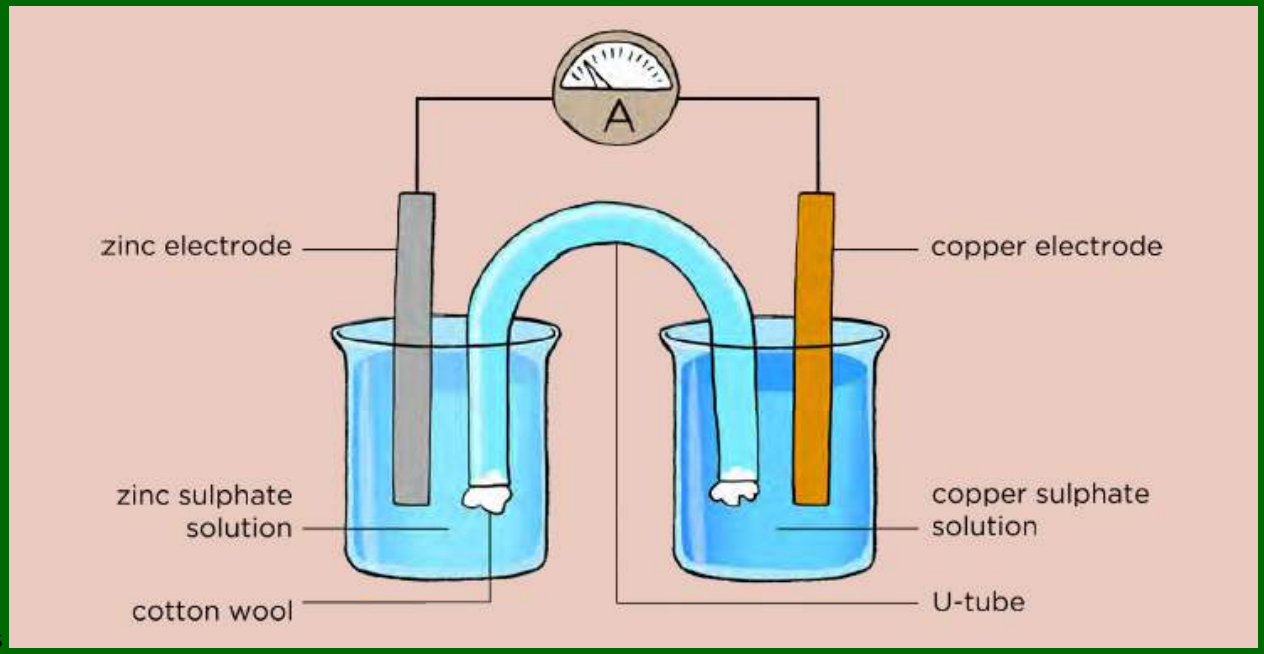
3. If you make several lemon cells and connect them in series with a light bulb.

4. You can connect an ammeter to measure current or use a torch light bulb. If the bulb glows then there is a current flowing. Or you can use a voltmeter to measure the potential difference.

5. One mark is allocated to each of the correct labels, one mark to placing the salt bridge with the ends in each solution, one mark for including an ammeter in the correct position with the symbol A and one mark for placing the electrodes in the right solutions. A reference diagram is supplied here:

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Total [17 marks

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Energy and

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NATURAL SCIENCE: LESSON PLAN **GRADE 9**

PERIOD: 60 MINUTES **STRAND: ENERGY & CHANGE**

CAPS SENIOR PHASE 12 **TERM 3**

DURATION: Week Three Lesson Four and Five **TOPIC: RESISTANCE** **SUB – TOP: Uses of resistors**	**OBJECTIVES: LEARNERS MUST BE ABLE TO:** • Differentiate between conductors, semi – conductors and insulators and provide examples • Differentiate between resistor and resistance • Explain how resistor work in terms of controlling current.
REFERENCES	Siyavula Workbook
TERMINOLOGY:	Resistor, resistance, conductor, semi – conductor, insulator, current, ohm,
SPECIFIC AIMS	1. DOING SCIENCE 2. KNOWING THE SUBJECT CONTENT & MAKING CONNECTIONS ✓ 3. UNDERSTANDING THE USES OF SCIENCES & INDIGENOUS KNOWLEDGE

SCIENCE PROCESS SKILLS					
Accessing & recalling Information	✓	Identifying problems & issues	✓	Doing Investigations	✓
Observing	✓	Raising Questions	✓	Recording Information	✓
Comparing	✓	Predicting	✓	Interpreting Information	✓
Measuring		Hypothesizing	✓	Communicating	✓
Sorting & Classifying		Planning Investigations			

CONTENT & CONCEPTS	ACTIVITIES	RESOURCES
• Examples of conductors, semi-conductors and insulators. • All conductors have some resistance • A resistor is a conducting material selected to control	1. Teacher introduces the lesson by asking question, orally, to establish what learners have already learnt from Grade 6 and 8. Sample questions: What is a conductor, semi-conductor, insulator? What is resistance? What is electric current? What is resistors used for?	• Sasol Inzalo Workbook • English dictionary

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the current.	What is the unit of resistance? Does the type of material affect the resistance of a resistor? 2. Learners work in groups to differentiate between conductors, semi – conductors and insulators. 3. Teacher uses **Sasol Inzalo Learner Workbook (page 70 -74)** to explain the difference between a resistor and resistance and provide learners with examples of resistors and their uses. 4. Learners complete a worksheet to identify resistors in everyday life. **(Sasol Inzalo Learner Workbook pg 73 - 74)**	
ASSESSMENT	Learners complete a worksheet (Sasol Inzalo Learner Workbook pg 73 – 74)	
TEACHER REFLECTION	Progress:	Challenges:

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NATURAL SCIENCE: LESSON PLAN **GRADE 9**

PERIOD: 60 MINUTES **STRAND: ENERGY & CHANGE**

CAPS SENIOR PHASE 12 **TERM 3**

TEACHER DEMONSTRATION or GROUP ACTIVITY: Sasol Inzalo Learner Workbook pg 73 – 74

ACTIVITY: Useful resistance



Why do we want to resist the movement of electrons? Resistors can be extremely useful. Think about a kettle. If you look inside you will see a large metal coil.



Looking inside a kettle.

This metal coil is the heating element. If you plug in and switch on the kettle, the element heats up and heats the water. The element is a large resistor. When the electrons move through the resistor, they release a lot of energy in overcoming the resistance. This energy is transferred to the water in the form of heat. This transfer of energy is useful to us as the thermal energy is used to boil water in the kettle.

1. What is the input energy in this system?

_____

2. What is the useful output energy?

_____



Look at the photograph of a light bulb on the left. Can you see there is a small coiled wire in the glass bulb? This is called the filament. The filament is made from tungsten wire. This is an element with high resistance.



An incandescent light bulb.



The tungsten filament glowing brightly.

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1. When the electrons move through the filament they experience high resistance. This means that they transfer a lot of their energy to the filament when they pass through. Describe the energy transfer taking place.

2. What is the useful energy output and what is the wasted energy output in this light bulb?

3. The filament is tightly coiled. Why do you think this is? Discuss this with your class and teacher.



Look at the following photo of a toaster.



An electric toaster.

4. Can you see the glowing filament inside? Why does the element glow?

5. What is the useful output energy in this system?

6. What is the wasted output energy in this system?

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NATURAL SCIENCE: LESSON PLAN **GRADE 9**

PERIOD: 60 MINUTES **STRAND: ENERGY & CHANGE**

CAPS SENIOR PHASE 12 **TERM 3**

MEMORANDUM

ACTIVITY: Useful resistance

TEACHER'S NOTE

This activity links back to the work done in Grade 8 Energy and Change. The difference between "useful" and "wasted" energy is highlighted again. The learners should see that resistors can be used to provide useful energy transfers.

1. Electrical energy.
2. Thermal energy.

TAKE NOTE

Incandescent means to emit light as a result of being heated.

1. Electrical energy is transferred to heat and light.

2. Light is the useful output energy and heat is the wasted output energy.

3. This is an extension question as learners will only cover factors affecting resistance later so discuss this as a class. This is to fit a longer length of tungsten within a small space to increase the resistance.

4. The electric current passes through the toaster and the element has a high resistance. Energy is transferred to the particles in the element so that they.

5. Heat.

6. Light. .

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NATURAL SCIENCE: LESSON PLAN **GRADE 9**

PERIOD: 60 MINUTES **STRAND: ENERGY & CHANGE**

CAPS SENIOR PHASE 13 **TERM 3**

DURATION: Week Three Lesson Six and Week Four lesson One **TOPIC: RESISTANCE** **SUB – TOP: Types of resistors**	**OBJECTIVES: LEARNERS MUST BE ABLE TO:** • Identify different types of resistors and their uses • Explain what is a rheostat • Discuss uses of different diodes.
REFERENCES	Sasol Inzalo Workbook
TERMINOLOGY:	Resistor, resistance, conductor, semi – conductor, insulator
SPECIFIC AIMS	1. DOING SCIENCE ✓ 2. KNOWING THE SUBJECT CONTENT & MAKING CONNECTIONS ✓ 3. UNDERSTANDING THE USES OF SCIENCES & INDIGENOUS KNOWLEDGE

SCIENCE PROCESS SKILLS					
Accessing & recalling Information	✓	Identifying problems & issues		Doing Investigations	✓
Observing	✓	Raising Questions		Recording Information	✓
Comparing	✓	Predicting		Interpreting Information	✓
Measuring		Hypothesizing		Communicating	✓
Sorting & Classifying		Planning Investigations			

CONTENT & CONCEPTS	ACTIVITIES	RESOURCES
• Types of resistors • Fixed and variable resistors • Rheostats • Diodes	1. Teacher introduces the lesson by asking learners to use textbooks to find terminology that best suites the statements provided. **(Sasol Inzalo Learner Workbook pg 75 – 77).** 2. Teacher leads discussion on different types of resistors and their used with reference to the worksheet completed in the previous lesson. 3. Teacher uses Sasol Inzalo workbook or any other approved textbook, to explain what a rheostat is	• Sasol Inzalo Workbook • English dictionary • graphite rod or graphite pencil • torch light bulb • battery (AA)

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	4. Provide learners with resources to build their own resistors **Sasol Inzalo Learner Workbook page 75 – 76** and answer questions based on the activity. 5. Teacher concludes discussing different types of diodes and their uses.	• insulated copper conducting wires with crocodile clips • ammeter
ASSESSMENT		
TEACHER REFLECTION		

GROUP WORK ACTIVITY: Sasol Inzalo Learner Workbook page 75 – 76

ACTIVITY: Make your own rheostat

MATERIALS:

- graphite rod or graphite pencil
- torch light bulb
- battery (AA)
- insulated copper conducting wires with crocodile clips
- ammeter

INSTRUCTIONS:

Set up a circuit as in the diagram below with the battery, ammeter, light bulb and graphite rod connected in series. Use crocodile clips to attach the wires to each end of the graphite rod.

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NATURAL SCIENCE: LESSON PLAN

PERIOD: 60 MINUTES

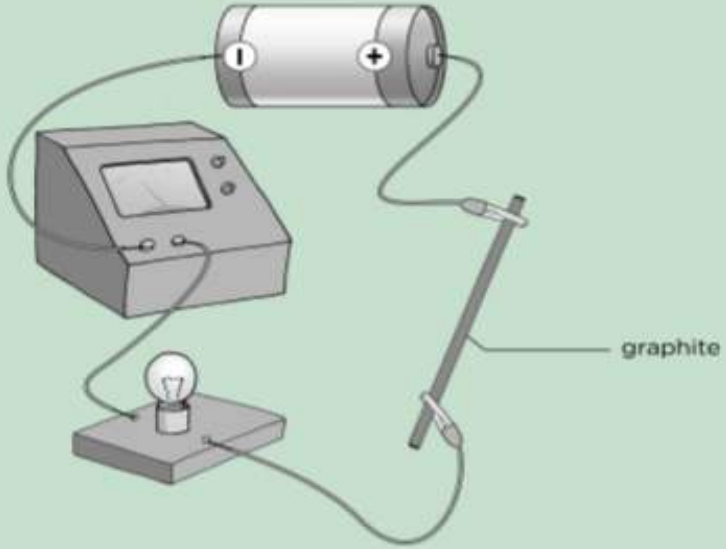
CAPS SENIOR PHASE 13

GRADE 9

STRAND: ENERGY & CHANGE

TERM 3





1. Does current flow through the circuit? How do you know?

2. The crocodile clips are connected on either end of the graphite rod. Predict what you think would happen if you moved the crocodile clips closer towards the centre of the piece of graphite.

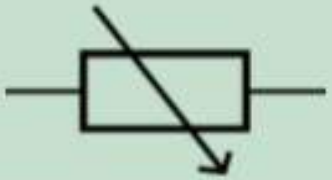
3. Move the crocodile clips closer towards the centre of the graphite rod. What do you observe?

4. How do you think the length of the graphite connected to the circuit has affected the current strength?

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5. Draw a circuit diagram to represent this set-up.



The symbol for a variable resistor.

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NATURAL SCIENCE: LESSON PLAN **GRADE 9**

PERIOD: 60 MINUTES **STRAND: ENERGY & CHANGE**

CAPS SENIOR PHASE 13 **TERM 3**

MEMORANDUM

ACTIVITY: Make your own rheostat

TEACHER'S NOTE

If you have rheostats in your laboratory then you may choose to simply demonstrate how the resistance is varied by changing the position of the slider.
The position of the slider affects the length of the resistor coil. Because length is a factor which affects resistance, the shorter the coil, the less resistance; the
longer the coil, the greater the resistance.

MATERIALS:

TEACHER'S NOTE

If you do not have a graphite rod then a graphite pencil can be used. Sharpen the pencil on both sides and carve the wood from the pencil at various points
along the length of the pencil. This is easier than trying to remove the entire graphite rod from the pencil. The graphite is soft and often breaks into pieces if
you try to remove the entire thing.

The ammeter is not strictly necessary. If you do not have one, then the learners can use the brightness of the bulb as an indication of the strength of the current.

INSTRUCTIONS:

1. Yes. The light bulb glows and the ammeter has a reading on it.

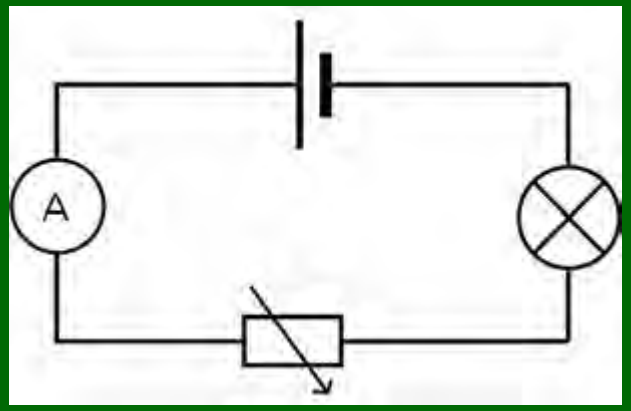
2. Learners' predictions will vary. They should refer to how they think the length of graphite will affect the current strength.

4. The shorter the length, the smaller the resistance and so the current strength is greater. By changing the length, the resistance has changed.

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5.



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NATURAL SCIENCE: LESSON PLAN **GRADE 9**

PERIOD: 60 MINUTES **STRAND: ENERGY & CHANGE**

CAPS SENIOR PHASE 14 **TERM 3**

DURATION: Week Four Lesson Two and Three	**OBJECTIVES: LEARNERS MUST BE ABLE TO:** • Compare and explain the difference between an LED and the filament of a bulb • Investigate and state the factors affecting resistance of a resistor.	
TOPIC: RESISTANCE		
SUB – TOP: Factors affecting resistance in a circuit		
REFERENCES	Siyavula Workbook, CAPS	
TERMINOLOGY:		
SPECIFIC AIMS	1. DOING SCIENCE	✓
	2. KNOWING THE SUBJECT CONTENT & MAKING CONNECTIONS	✓
	3. UNDERSTANDING THE USES OF SCIENCES & INDIGENOUS KNOWLEDGE	

SCIENCE PROCESS SKILLS					
Accessing & recalling Information	✓	Identifying problems & issues	✓	Doing Investigations	✓
Observing	✓	Raising Questions	✓	Recording Information	✓
Comparing	✓	Predicting	✓	Interpreting Information	✓
Measuring	✓	Hypothesizing		Communicating	✓
Sorting & Classifying		Planning Investigations			

CONTENT & CONCEPTS	ACTIVITIES	RESOURCES
• Type of material • Thickness of the conductor • Length of the conductor • Temperature of the conductor	1. Teacher introduces the lesson by asking questions and learners respond as well as make predictions on how some factors will affect resistance. **(Sasol Inzalo Learner Workbook pg 80 – 89)** 2. Teacher will divide learners into THREE groups and	• three 1,5 V cells • insulated conducting wires with crocodile clips • conductors of different materials to test,

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	each group will conduct an investigation on type of material, thickness and length of a conductor and record their observations. Each group will then give feedback to the other learners 3. After the experiments are done by the groups, the following sites can be shared with the learners: • bit.ly/laqYf0T; bit.ly/1c0cNvf; bit.ly/174rdsp	• ammeter • light bulb • conductors of different thickness • piece of resistance wire (110cm) long metre ruler • tape
ASSESSMENT	1. Investigation on factors affecting resistance in a conductor 2. Revision Exercises from Sasol Inzalo Learner Workbook pg 93 – 95 or any other approved textbook	
TEACHER REFLECTION		
	Intervention Strategies:	

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NATURAL SCIENCE: LESSON PLAN

PERIOD: 60 MINUTES

CAPS SENIOR PHASE 14

GRADE 9

STRAND: ENERGY & CHANGE

TERM 3

GROUP WORK ACTIVITY: Sasol Inzalo Learner Workbook pg 80 – 89

GROUP 1

INVESTIGATION: How does the material of the resistor affect the resistance?

How can we measure the resistance? Do you remember that in a series circuit, if we increase the resistance, then the strength of the current decreases? This means that we can use the strength of the current in the circuit as an indication of the amount of resistance in the circuit.

AIM: To determine whether different types of conducting materials have different resistances.

HYPOTHESIS:

1. Write a hypothesis for this investigation.

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VARIABLES

1. Which variables would we need to keep constant in an investigation such as this?

_____

_____

2. Which variable is the independent variable?

_____

3. Which variable is the dependent variable?

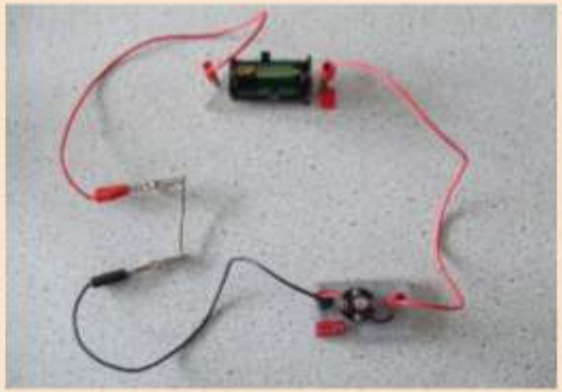
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MATERIALS AND APPARATUS:

- three 1,5 V cells
- insulated, conducting wires with crocodile clips
- conductors of different materials to test
- ammeter
- light bulb

METHOD:

1. Set up a circuit with the three cells, ammeter and light bulb connected in series.
2. Test each of the conductors by adding each to the circuit individually. Use crocodile clips to connect each conductor to the circuit, as shown below.



A similar setup showing a light bulb, one cell and a piece of copper wire connected in series.

3. Read the ammeter and record the reading for each test material.
4. Draw a bar graph to show your results.

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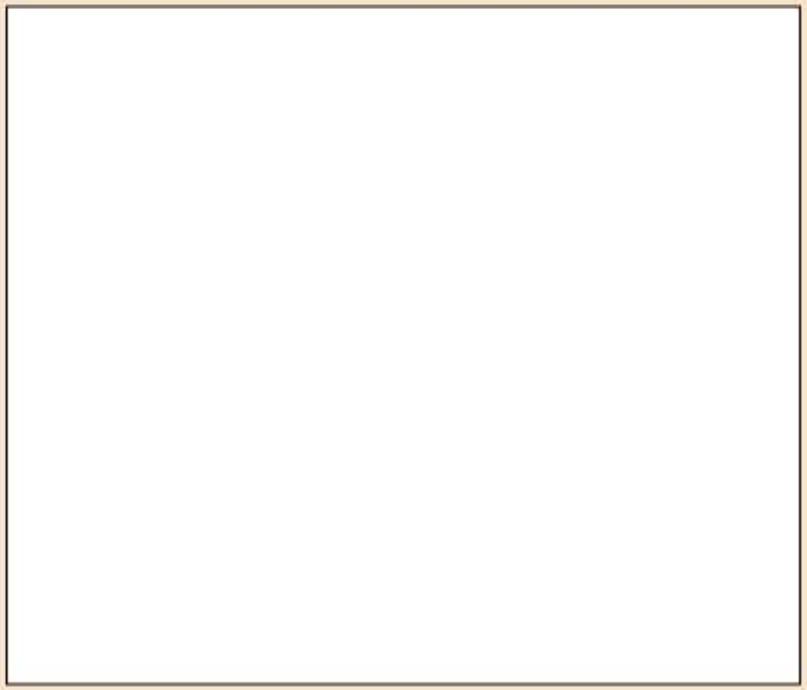
RESULTS:

1. Draw a circuit diagram of the setup.

2. Draw a table showing your results.

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3. Draw a bar graph of your results in the space provided.



ANALYSIS AND EVALUATION:

1. Which material offered the most resistance in the electric circuit? How do you know this?

2. Which material offered the least resistance in the electric circuit? How do you know this?

3. Are there any potential problems with the way in which this investigation was set up, or are there any ways in which you could have improved the design?

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CONCLUSIONS:

1. What conclusion can you reach from this investigation?

_____

_____

2. Why must the different conductors have the same length and thickness?

_____

_____

GROUP 2

INVESTIGATION: How does the thickness of the conductor affect the resistance?

AIM: To determine whether the thickness of the conductor will affect the resistance.

HYPOTHESIS: Write a hypothesis for this investigation.

_____

_____

VARIABLES:

1. Which variables would we need to keep constant in an investigation such as this?

_____

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2. Which variable is the independent variable?

3. Which variable is the dependent variable?

MATERIALS AND APPARATUS:

- three 1,5 V cells
- insulated, conducting wires with crocodile clips
- conductors of different thickness
- ammeter
- light bulb

METHOD:

1. Assess the lengths of wire that you have and arrange them in order from thickest to thinnest. Label the thickest wire as 1, the next thickest as 2, and so on, so that you can easily record the results.
2. Set up a circuit as in the previous investigation with the three cells, ammeter and light bulb connected in series.
3. Test each of the different wires by adding each to the circuit in turn. Use the conducting wires with crocodile clips attached at the ends to join each conductor to the circuit.
4. Read the ammeter and record the reading for each wire.

RESULTS:

Draw a table showing your results.

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NATURAL SCIENCE: LESSON PLAN

PERIOD: 60 MINUTES

CAPS SENIOR PHASE 14

GRADE 9

STRAND: ENERGY & CHANGE

TERM 3



ANALYSIS AND EVALUATION:

1. Which thickness of wire offered the most resistance in the electric circuit?

2. Which thickness of wire offered the least resistance in the electric circuit?

3. Are there any potential problems with the way in which this investigation was setup, or are there any ways in which you could have improved the design?

CONCLUSIONS:

1. What conclusion can you reach from this investigation?

2. Can you accept or reject your hypothesis?

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NATURAL SCIENCE: LESSON PLAN

PERIOD: 60 MINUTES

CAPS SENIOR PHASE 14

GRADE 9

STRAND: ENERGY & CHANGE

TERM 3

GROUP 3

INVESTIGATION: How does the length of a conductor affect the resistance of the conductor?



HYPOTHESIS: Write a hypothesis for this investigation.

_____

_____

MATERIALS AND APPARATUS:

- piece of resistance wire (110cm) long
- ammeter
- two 1,5 V cells
- metre ruler
- tape
- insulated copper conducting wires



VARIABLES:

1. Which variables would we need to keep constant in an investigation such as this?

_____

_____

2. Which variable is the independent variable?

_____

3. Which variable is the dependent variable?

_____

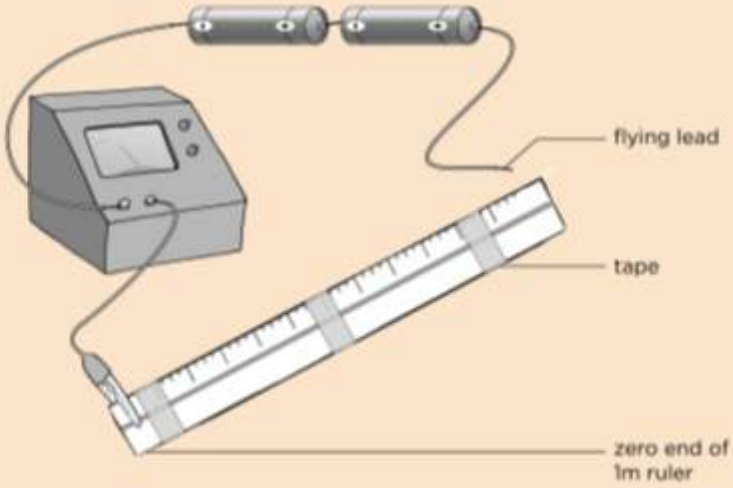
METHOD:

1. Tape the resistance wire to the metre ruler. Make sure the wire is stretched flat and that the numbers on the ruler are still visible.
2. Assemble a circuit according to the diagram on the next page.
3. Use the flying lead and touch it to the resistance wire at the 1 m mark. Record the ammeter reading.
4. Use the flying lead and touch it to the resistance wire at the 0,9 m mark. Record the ammeter reading.
5. Move the flying lead in 10 cm intervals until you have 10 readings. Record the ammeter reading each time.

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RESULTS:

Record your results in the following table.

Length of wire (m)	Ammeter reading (A)
1,0	
0,9	
0,8	
0,7	
0,6	
0,5	
0,4	
0,3	
0,2	
0,1	



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Draw a graph to show the relationship between the length of the resistor and the ammeter readings.



CONCLUSIONS:

1. Look at your table and graph. What conclusion can you draw?

2. What is causing the decrease in current strength?

3. What can you conclude about the relationship between the length of the resistor and the resistance of the resistor?

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MEMORANDUM

GROUP ONE

INVESTIGATION: How does the material of the resistor affect the resistance?
HYPOTHESIS:

1. Possible hypotheses are: Different conductors will provide different amounts of resistance in an electrical circuit.
2. The type of material will determine the amount of resistance.

VARIABLES
1. The materials we test would all need to have the same length and thickness and be kept at the same temperature. The number of batteries used to provide energy in the circuit.

2. The independent variable is the type of material.

3. The dependent variable is the amount of resistance provided by the material, as indicated by the change in current.

TEACHER'S NOTE
This experiment does not measure resistance directly, but rather uses ammeter readings. Later on in this investigation learners are required to draw a bar graph. The bar graph will have ammeter readings (current) on the y-axis.

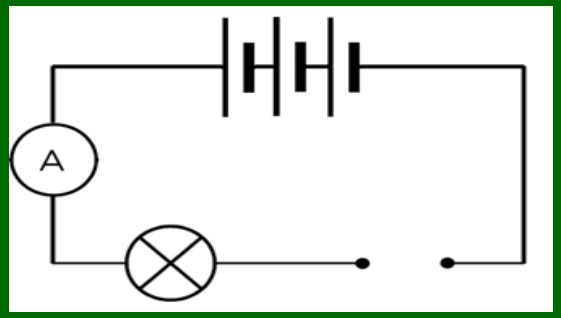
MATERIALS AND APPARATUS:

TEACHER'S NOTE
Use whichever metals you have available. Good materials to use are copper (a thicker gauge than those in the normal conducting wires), nickel, nichrome and iron.

RESULTS:
1. Here is an example circuit diagram. The way in which learners represent the connection points for the material to be tested may vary.

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3. An example table is shown here:

Table showing the ammeter readings for each type of conducting material tested

Conducting material	Ammeter reading(A)
Copper	
Nickel	
Nichrome	
Iron	

Learners must provide a heading for the table and each column, and the unit must be in the heading. You can also use Assessment Rubric 4 at the back of your Teacher's Guide for a more detailed assessment.

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3. Learners must provide a heading for the graph, such as 'Graph showing the current in an electric circuit with different types of conducting materials being tested.' The type of material must be on the x-axis and the ammeter reading on the y-axis. The bars must not be touching in this type of bar graph as the data is not continuous. For a more detailed assessment, refer to Assessment Rubric 3.

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ANALYSIS AND EVALUATION:

1. This will depend on the materials used, but the material which has the lowest ammeter reading, and therefore the lowest current, has the highest resistance.
2. This will depend on the materials used, but the material with the highest ammeter reading will have the lowest resistance.

3. Learners' responses will vary but the learners should mention that it is difficult to control the temperature of the conductors and that they should read the ammeter reading immediately upon adding their test material to the circuit.

CONCLUSIONS:
1. The type of material from which the resistor is made affects the resistance.
Different materials offer different amounts of resistance.

2. Length and thickness can also affect amount of resistance. We only want
to test one variable at a time and therefore other variables must remai

GROUP TWO

INVESTIGATION: How does the thickness of the conductor affect the resistance?

HYPOTHESIS:

TEACHER'S NOTE

Possible hypotheses are:
• The thicker the conductor, the smaller the resistance.
• The thinner the conductor, the smaller the resistance.

VARIABLES:

1. The wires used must all be of the same material (for example, copper), the same length and the same temperature. The number of batteries used to provide energy in the circuit.

2. The independent variable is the thickness of the wire.

3. The dependent variable is the amount of resistance provided by the different wires, as measured by changes in current.

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MATERIALS AND APPARATUS:

TEACHER'S NOTE
A suggestion is to use three equal lengths of copper wire with different thicknesses.

RESULTS:
An example table is shown here:

Table showing the ammeter readings for each thickness of wire used

Wire of different thickness	Ammeter reading (A)
1(Thickest)	
2	
3(thinnest)	

ANALYSIS AND EVALUATION:

1. The thinnest wire offers the most resistance.

2. The thickest wire offers the least resistance.

3. Learners' responses will vary but the learners should mention that it is difficult to control the temperature of the conductors and that they should read the ammeter reading immediately upon adding their wire to the circuit.

CONCLUSIONS:
1. The thickness of the wire does affect the resistance. The thinner the wire, the higher the resistance.

2. Learner-dependent answer.

GROUP Three

INVESTIGATION: How does the length of a conductor affect the resistance of the conductor?

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NATURAL SCIENCE: LESSON PLAN **GRADE 9**

PERIOD: 60 MINUTES **STRAND: ENERGY & CHANGE**

CAPS SENIOR PHASE 14 **TERM 3**

TEACHER'S NOTE
A possible hypothesis is: The longer the length of the conductor, the higher the resistance.

MATERIALS AND APPARATUS:

TEACHER'S NOTE

The wire must be without any insulation. Copper wire often has varnish as insulation and therefore will not work. Nichrome or constantan wire work well (between 28 and 32 SWG - the SWG rating indicates the cross-sectional area of the wire). Other wires can also be used. The length is a suggestion only. If you are only able to obtain smaller lengths, the learners will take fewer readings. If you do not have an ammeter then use a light bulb as an indicator of current strength. You want about 3 V for this circuit so any combination of cells which provide 3 V would work, or a low voltage power supply.

VARIABLES:

1The wires used must all be of the same material (for example, copper). The number of batteries used to provide energy in the circuit.

2. The independent variable is the length of the wire.

3. The dependent variable is the amount of resistance provided by the different length of the wire, as measured by changes in current.

RESULTS:

TEACHER'S NOTE
The results obtained in this investigation will depend on the type of material chosen and the SWG rating of the wire chosen.
Record your results in the following table.

Length of wire (m)	Ammeter reading (A)
1.0	
0.9	
0.8	
0.7	
0.6	
0.5	
0.4	
0.3	
0.2	
0.1	

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TEACHER'S NOTE
The graph should have the independent variable (length) on the x-axis and the dependent variable (ammeter reading) on the y-axis. The graph should show that as the length of the resistance wire increases, the ammeter reading decreases. It is unlikely to be a straight line. Learners must provide a heading, such as "Graph showing the change in current in a circuit as the length of a conducting wire is varied." As an extension, learners can rather calculate the resistance using the formula R = V/I and then plot resistance versus length directly.

CONCLUSIONS:

1. There is a relationship between the length of the resistor and the current strength. Increasing the length of the conductor decreases the current strength.

2. Current is affected by resistance. If the current has decreased, it must mean that the resistance has increased.

3. Increasing the length of the resistor increases the resistance of the resistor.

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NATURAL SCIENCE: LESSON PLAN **GRADE 9**

PERIOD: 60 MINUTES **STRAND: ENERGY & CHANGE**

CAPS SENIOR PHASE 15 **TERM 3**

DURATION: Week Four Lesson Four and Five	**OBJECTIVES: LEARNERS MUST BE ABLE TO:** • Make/build a circuit with the given components • Predict the brightness of bulbs when more cells are connected in series. • Predict the brightness of bulbs when more bulbs are connected in series. • Observe and record the brightness of light bulbs /the ammeter and voltmeter readings. • DRAW line graphs
TOPIC: SERIES AND PARALLEL CIRCUITS **SUB-TOPIC:** SERIES CIRCUITS OF CELLS	
REFERENCES	
TERMINOLOGY:	Series, Resistor, current strength, potential difference., line of best fit, voltage, ampere
SPECIFIC AIMS	1. DOING SCIENCE ✓ 2. KNOWING THE SUBJECT CONTENT & MAKING CONNECTIONS ✓ 3. UNDERSTANDING THE USES OF SCIENCES & INDIGENOUS KNOWLEDGE

SCIENCE PROCESS SKILLS

Accessing & recalling Information	✓	Identifying problems & issues	✓	Doing Investigations	✓
Observing	✓	Raising Questions	✓	Recording Information	✓
Comparing	✓	Predicting	✓	Interpreting Information	✓
Measuring	✓	Hypothesizing	✓	Communicating	✓
Sorting & Classifying		Planning Investigations		Follow Instructions	✓

CONTENT AND CONCEPTS	ACTIVITIES	RESOURCES
• Effect of connecting cells in series on the current strength and the potential difference • Effect of connecting more	1. Marking of previous day's homework (10 minutes) 2. Revision question on previous lesson • What are some of the uses of resistors? • What is a variable resistor called?	• Circuit board(s) • Cells/battery, Conducting wires • Resistors, Light

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bulbs in series on the brightness of the bulb/.	• What are the four factors affecting the resistance of a resistor? • How does each factor affect the resistance of a resistor? 3. Teacher distribute materials to groups and gives instructions. 4. Learners start to perform the experiments and complete the worksheet from Sasol Inzalo Learner Workbook pages 98 - 103 5. Teacher asks learners to make a prediction about the brightness of the bulbs when more are connected in series. 6. Learners make /build electric circuits using given components. 7. If bulbs are used instead of ammeters, connect bulbs one by one in the circuit, observe and record the brightness of the bulbs. 8. Learners DRAW TWO LINE GRAPHS then answer the question whether cells/resistors in series are voltage dividers.	bulbs Or LEDs • Voltmeters, Ammeters • Practical worksheet • Learners can visit the following sites: bit.ly/19nQOtw bit.ly/15XAKOK bit.ly/1gqqTla
ASSESSMENT	1. Baseline (oral questions and answers). 2. Informal practical worksheet. 1 from Sasol Inzalo Learner Workbook pg 98 - 101 – attached below.	
TEACHER'S REFLECTIONS	Progress:	Challenges:
	Intervention Strategies:	

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NATURAL SCIENCE: LESSON PLAN

PERIOD: 60 MINUTES

CAPS SENIOR PHASE 15

GRADE 9

STRAND: ENERGY & CHANGE

TERM 3

GROUP WORK: Sasol Inzalo Learner Workbook pages 98 – 101 – EXPERIMENT 1

INVESTIGATION: What is the effect of the number of cells connected in series on current and potential difference?

HYPOTHESIS:

Write a hypothesis for this investigation.

_____

_____

_____

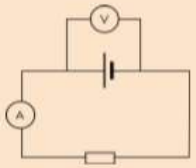
MATERIALS AND APPARATUS:

- three 1,5 V cells
- insulated copper conducting wires with crocodile clips
- ammeter
- voltmeter
- resistor or light bulb

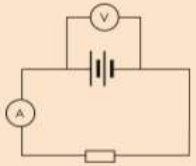


METHOD:

1. Construct a series circuit with 1 cell, a resistor and the ammeter in series.
2. Connect the voltmeter in parallel with the cell as shown in the following circuit diagram.

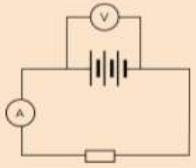


3. Record the readings on the ammeter and voltmeter in the table below.
4. Add a second cell in series with the first cell.





5. Record the new readings on the ammeter and voltmeter in the table below.
6. Add the third cell in series with the other two cells.



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7. Record the new readings on the ammeter and voltmeter in the table below.
8. Draw a graph of your results.

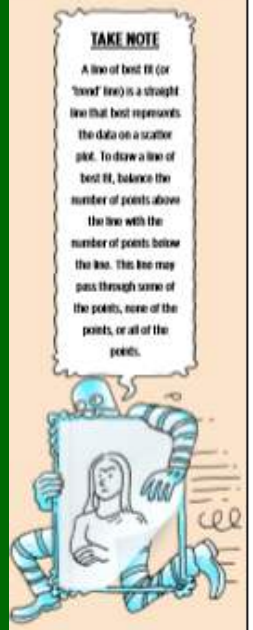
RESULTS:

Complete the following table:

Number of cells	Ammeter reading (A)	Voltmeter reading (V)
1		
2		
3		

Use your table to draw two line graphs on the same set of axes. One graph should be the number of cells against the current (ammeter reading) and the other graph should be the number of cells against the potential difference (voltmeter reading). Decide which are your independent and dependent variables in this investigation. Draw a line of best fit through the data points.





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If you used a light bulb instead of a resistor, what happened to the brightness of the bulb as you added more cells in series? If you did not do this, predict what would happen.

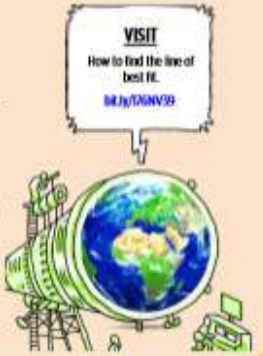
_____

CONCLUSION:

What can we conclude happens to the current strength and potential difference as more cells are added in series?

_____

_____



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NATURAL SCIENCE: LESSON PLAN **GRADE 9**

PERIOD: 60 MINUTES **STRAND: ENERGY & CHANGE**

CAPS SENIOR PHASE 15 **TERM 3**

MEMORANDUM

NVESTIGATION: What is the effect of the number of cells connected in series on current and potential difference?

.

TEACHER'S NOTE

Possible hypothesis:
Increasing the number of cells connected in series will increase the current strength and potential difference in the circuit.

Remember that a hypothesis does not have to be "correct", it only needs to mention which variables are being considered and the relationship that is expected to be observed.

.

TAKE NOTE
If you are using a light bulb and not an ammeter to see the effect, then take note of the brightness of the bulb as you add more cells in series.

MATERIALS AND APPARATUS:

TAKE NOTE
Remember that the units of measurement are noted in the heading for a column in a table and not written in each cell in the table.

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NATURAL SCIENCE: LESSON PLAN **GRADE 9**

PERIOD: 60 MINUTES **STRAND: ENERGY & CHANGE**

CAPS SENIOR PHASE 15 **TERM 3**

RESULTS:

TAKE NOTE
A line of best fit (or 'trend' line) is a straight line that best represents the data on a scatter plot. To draw a line of best fit, balance the number of points above them line with the number of points below the line. This line may pass through some of the points, none of the points, or all of the points.

Complete the following table:

Number of cells	Ammeter of reading(A)	Voltmeter reading (A)
1.		
2.		
3.		

Use your table to draw two line graphs on the same set of axes. One graph should be the number of cells against the current (ammeter reading) and the other graph should be the number of cells against the potential difference (voltmeter reading). Decide which are your independent and dependent variables in this investigation. Draw a line of best fit through the data points.

TEACHER'S NOTE
Learners should plot the number of cells along the x-axis as this is the independent variable. Learners can draw two separate graphs. The plotted points must be visible and learners must draw a line of best fit. Learners must provide a heading for their graph. If you used a light bulb instead of a resistor, what happened to the brightness of the bulb as you added more cells in series? If you did not do this, predict what would happen.

TEACHER'S NOTE

Adding more cells in series increases the brightness of the bulb.

CONCLUSION:

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TEACHER'S NOTE
Connecting more cells in series into a circuit increases the current strength in the circuit and the potential difference across the cells.

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NATURAL SCIENCE: LESSON PLAN **GRADE 9**

PERIOD: 60 MINUTES **STRAND: ENERGY & CHANGE**

CAPS SENIOR PHASE 16 **TERM 3**

DURATION: Week Four Lesson Six and Week Five lesson One	**OBJECTIVES: LEARNERS MUST BE ABLE TO:** • Read voltmeters, measure and record voltage across different resistors connected in series in a circuit. • Calculate total voltage of resistors in series and compare with the voltage across the battery. • Make a conclusion about voltage across resistors connected in series in a circuit.
TOPIC: **SERIES AND PARALLEL CIRCUITS** **SUB-TOPIC: Resistors in series (voltage)**	
REFERENCES	Sasol Inzalo Workbook pg 103 – 106
TERMINOLOGY:	Voltage (potential difference).
SPECIFIC AIMS	1. DOING SCIENCE ✓ 2. KNOWING THE SUBJECT CONTENT & MAKING CONNECTIONS ✓ 3. UNDERSTANDING THE USES OF SCIENCES & INDIGENOUS KNOWLEDGE

SCIENCE PROCESS SKILLS

Accessing & recalling Information	✓	Identifying problems & issues		Doing Investigations	✓
Observing	✓	Raising Questions		Recording Information	✓
Comparing		Predicting		Interpreting Information	
Measuring	✓	Hypothesizing		Communicating	✓
Sorting & Classifying		Planning Investigations		Follow Instructions	✓

CONTENT AND CONCEPTS	ACTIVITIES	RESOURCES
• The total voltage across a battery is the same as the sum of the voltages across each resistor	1. Teacher show learners how to connect a voltmeter in a circuit. 2. Groups build up a simple circuit with three different resistors in series.	• Circuit board(s) • Battery made up of three cells.

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when resistors are connected in series	3. Connect the voltmeters across batteries, take readings and keep records in a tabular form. Follow the procedure outlined in Sasol Inzalo Learner Workbook pg 103 – 106.See below for Experiment 1 and 2. 4. Connect the voltmeter across resistor 1, take readings and keep record, repeat with other two resistors. 5. Add the three reading from three resistors and compare with the reading from the battery.	• Conducting wires • 3x different rated Resistors • Light bulbs Or LEDs • Voltmeter • Text book(s) / work book
ASSESSMENT	1. Baseline (Question and answer). 2. Increasing the resistance in a Series Circuit LB Pg 103 – 105 – attached below 3. Measuring the potential difference across components in a Series Circuit. LB Pg 105 – 106 – attached below. 4. Homework – Sasol Inzalo Learner Workbook pg 108 – 109- attached below	
TEACHER'S REFLECTIONS	Progress:	Challenges:
	Intervention Strategies:	

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NATURAL SCIENCE: LESSON PLAN

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CAPS SENIOR PHASE 16

GRADE 9

STRAND: ENERGY & CHANGE

TERM 3

Sasol Inzalo Learner Workbook pg 103 – 106

EXPERIMENT 1

ACTIVITY: Increasing the resistance in a series circuit



MATERIALS:

- 1,5 V cell
- 3 torch bulbs
- insulated copper conducting wires
- switch
- ammeter

INSTRUCTIONS:

1. Construct the circuit with the cell, the ammeter, 1 bulb and the switch in series.
2. Close the switch.
3. Note how brightly the bulb is shining and record the ammeter reading. Draw a circuit diagram.



4. Open the switch.
5. Add another light bulb into the circuit.
6. Close the switch.
7. Note how brightly the bulbs are shining and record the ammeter reading. Draw a circuit diagram.

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8. Open the switch.
9. Add the third light bulb into the circuit.
10. Close the switch.
11. Note how brightly the bulbs are shining and record the ammeter reading. Draw a circuit diagram.

Record the ammeter readings in the following table:

Number of bulbs (resistors)	Ammeter reading (A)
1	
2	
3	

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QUESTIONS:

1. What happened to the brightness of the bulbs and the ammeter reading as more light bulbs were added to the circuit?

_____

2. Explain the observations you made in question 1.

_____

_____

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PERIOD: 60 MINUTES **STRAND: ENERGY & CHANGE**

CAPS SENIOR PHASE 16 **TERM 3**

MEMORANDUM

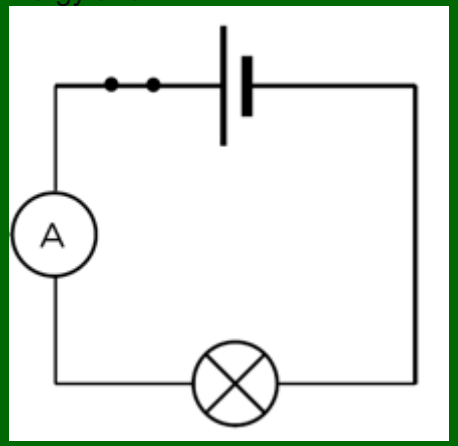
ACTIVITY: Increasing the resistance in a series circuit

TEACHER'S NOTE
This is a revision activity of what learners covered in Gr. 8. It can also be done concurrently with the following investigation to look at the effect on the potential difference.

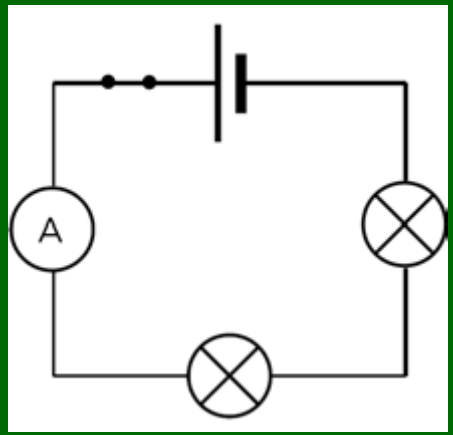
MATERIALS:

TEACHER'S NOTE
The switch is not an essential part of this investigation. It can be left out of the circuit. If you do not have an ammeter, then use the brightness of the bulbs to indicate current strength.

INSTRUCTIONS:

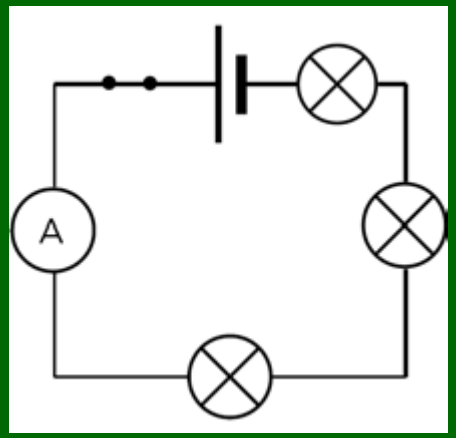


Circuit 1



Circuit 2

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Circuit 3

Record the ammeter readings in the following table:

Number of bulbs(resistors)	Ammeter reading(A)
1	
2	
3	

QUESTIONS:

1. The brightness of the bulbs decreased and so did the ammeter reading.

2. As the number of light bulbs increased, the resistance in the circuit increased. The increase in resistance caused the current to decrease.

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NATURAL SCIENCE: LESSON PLAN | **GRADE 9**

PERIOD: 60 MINUTES | **STRAND: ENERGY & CHANGE**

CAPS SENIOR PHASE 17 | **TERM 3**

DURATION: Week Five Lesson Two and Three	**OBJECTIVES: LEARNERS MUST BE ABLE TO:** • Read Ammeters, measure and record current at different points in a series circuit. • Make a conclusion about current at any point in a series circuit. • Measure and record current when resistors are added in series in a circuit. • Make a conclusion about current when resistors are connected in series in a circuit.
TOPIC: SERIES AND PARALLEL CIRCUITS	
SUB-TOPIC: Resistors in series (Current)	
REFERENCES	Sasol Inzalo Workbook or any other approved textbook
TERMINOLOGY:	Current.
SPECIFIC AIMS	1. DOING SCIENCE ✓ 2. KNOWING THE SUBJECT CONTENT & MAKING CONNECTIONS ✓ 3. UNDERSTANDING THE USES OF SCIENCES & INDIGENOUS KNOWLEDGE

SCIENCE PROCESS SKILLS					
Accessing & recalling Information	✓	Identifying problems & issues		Doing Investigations	✓
Observing	✓	Raising Questions		Recording Information	✓
Comparing	✓	Predicting	✓	Interpreting Information	✓
Measuring	✓	Hypothesizing	✓	Communicating	✓
Sorting & Classifying		Planning Investigations		Follow Instructions	✓

CONTENT AND CONCEPTS	ACTIVITIES	RESOURCES
• Current is the same when measured at any point in a series circuit. • Total current decreases	1. Teacher show learners how an Ammeter is connected in series. 2. Groups build up a circuit with three similar resistors connected in series. 3. Connect the Ammeter in front, between and at end of the resistors	• Circuit board(s) • Battery made up of three cells. • Conducting wires

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when resistors are added in a series circuit.	take readings and record in the worksheet. **Sasol Inzalo Learner Workbook pg 109 – 110.** See Below for the Activity. 4. Connect the Ammeter in the circuit, add the resistors ONE BY ONE. Take the ammeter readings and keep record. 5. Add the three reading from three resistors and compare with the reading from the battery.	• 3x similar rated Resistors • Light bulbs Or LEDs • Ammeter(s) • Text book(s) / work book • Practical worksheet.
ASSESSMENT	1. Baseline (Question and answer). 2. Work out **current flowing** in different series circuit diagrams (text books). See Activity (Current in a Series Circuit) below. 3. Homework Activity - **Sasol Inzalo Learner Workbook pg 125 – 126.** (Revision Questions attached below)	
TEACHER'S REFLECTIONS	Progress:	Challenges:
	Intervention Strategies:	

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NATURAL SCIENCE: LESSON PLAN

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GRADE 9

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TERM 3

Sasol Inzalo Learner Workbook pg 109 - 110

ACTIVITY: Current in a series circuit

MATERIALS:

- insulated copper connecting wires.
- two 1,5 V cells
- two torch light bulbs
- ammeter

INSTRUCTIONS:

1. Set up a series circuit with two cells and two torch light bulbs in series with each other.
2. Insert an ammeter in series between the positive terminal of the cells and the first torch bulb.
3. Measure the current strength using the ammeter. Draw a circuit diagram of this set-up.

4. Remove the ammeter and close the circuit again.
5. Insert the ammeter, in series, between the two torch bulbs.
6. Measure the current strength using the ammeter. Draw a circuit diagram of this set-up.

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7. Remove the ammeter and close the circuit again.
8. Insert the ammeter, in series, between the last torch bulb and the negative terminal of the battery.
9. Measure the current strength using the ammeter. Draw a circuit diagram of this set up.



Complete the following table:

Position of ammeter in circuit	Ammeter reading (A)
Between positive terminal of battery and first bulb	
Between two bulbs	
Between negative terminal of battery and last bulb	

What can you conclude from this about the current in a series circuit?

_____

_____

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NATURAL SCIENCE: LESSON PLAN

PERIOD: 60 MINUTES

CAPS SENIOR PHASE 17

GRADE 9

STRAND: ENERGY & CHANGE

TERM 3

Homework Activity

REVISION:

1. Draw the following circuit diagrams.
   a) A closed circuit with one cell, two light bulbs and a switch in series. [2 marks]

   b) An open circuit with two cells, two light bulbs and a switch in series. [2 marks]

   c) A closed circuit with 1 cell and a resistor in series, with an ammeter to measure the current and a voltmeter to measure the potential difference of the cell. [2 marks]

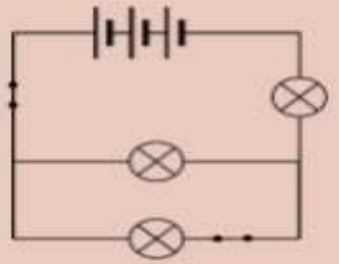
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d) A closed circuit with two cells in series and two light bulbs in parallel. [2 marks]

e) A closed circuit with an ammeter and resistor in series and three cells in parallel, with a voltmeter connected to measure the potential difference across the three cells. [2 marks]

2. Look at the following circuit diagram. Identify the number of bulbs, switches and cells in this circuit. Identify whether they are in series or parallel. [3 marks]



3. Ian has bought a string of Christmas tree lights and has hung them in the tree and plugs them in. One of the light bulbs breaks.

a) What happens to the rest of the light bulbs? [1 mark]

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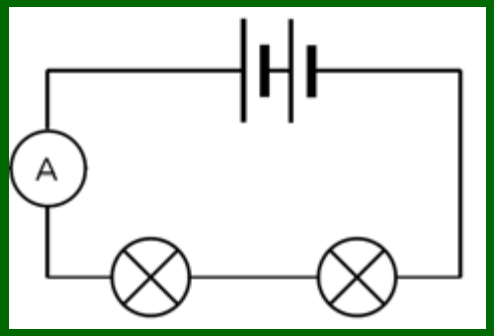
TERM 3

MEMORADUM

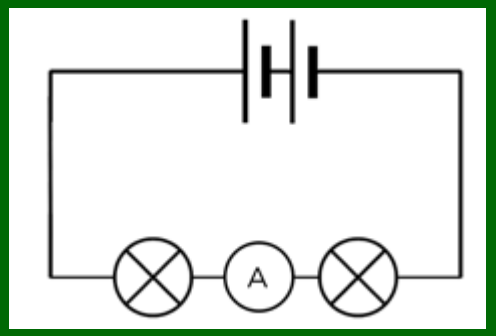
ACTIVITY: Current in a series circuit

TEACHER'S NOTE
This is a revision activity as learners would have covered this in Gr. 8.

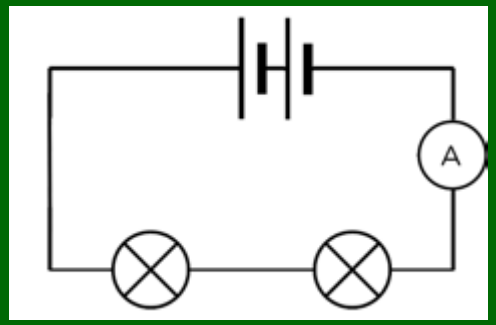
INSTRUCTIONS:
.



Circuit 1



Circuit 2



Circuit 3

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Complete the following table:

Position of ammeter in circuit	Ammeter reading (A)
Between positive terminal of the battery and the first bulb	
Between two bulbs	
Between negative terminal of the battery and the last bulb	

TEACHER'S NOTE

The ammeter readings should be the same at any point in the series circuit.

What can you conclude from this about the current in a series circuit?

TEACHER'S NOTE

The current strength is the same at any point in a series circuit.

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NATURAL SCIENCE: LESSON PLAN

PERIOD: 60 MINUTES

CAPS SENIOR PHASE 17

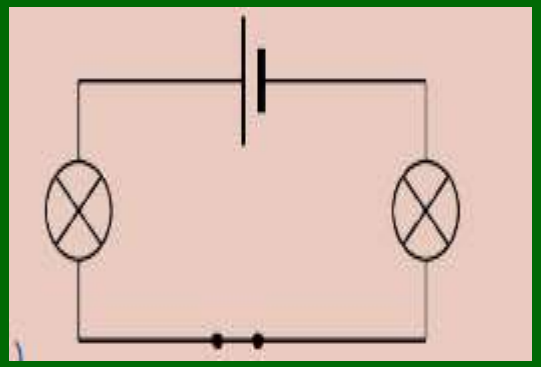
GRADE 9

STRAND: ENERGY & CHANGE

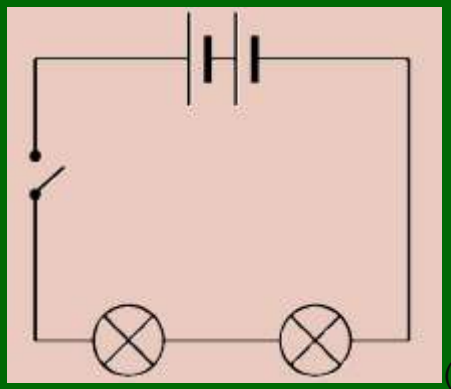
TERM 3

HOMEWORK

1.

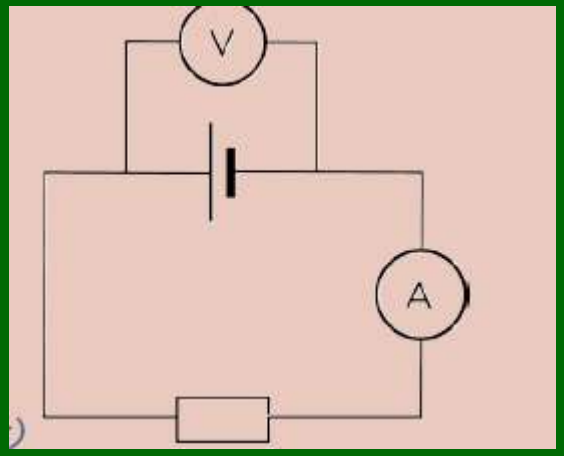


(a)

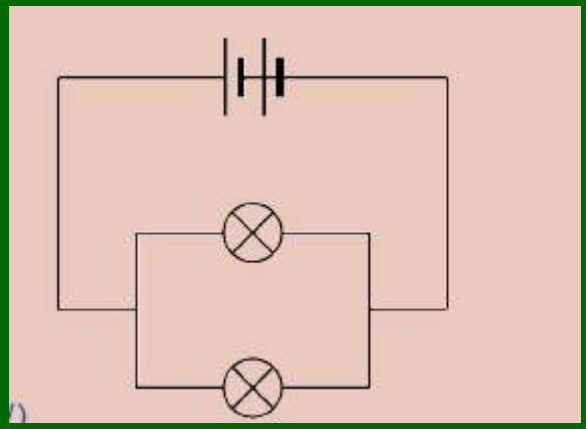


(b)

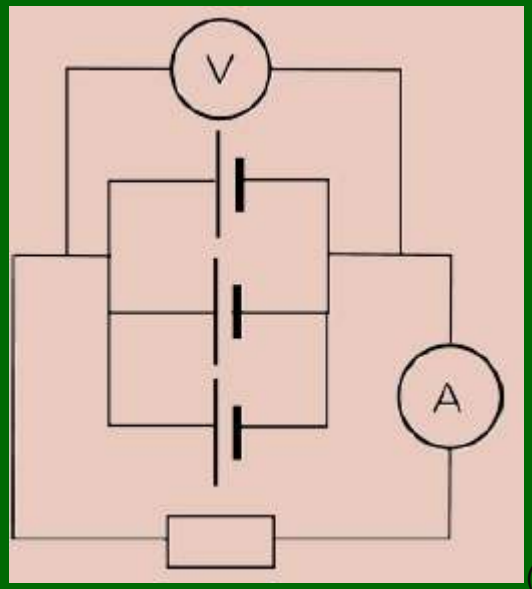
(c)



(d)



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(e)

2.There are 3 cells in series with 1 bulb and a switch, there are two bulbs in parallel and a switch in series with one bulb.

3. a) The rest of the light bulbs stop working.

b) The light bulbs are connected in series with each other. If one breaks then the circuit is broken and no current moves through the circuit.

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NATURAL SCIENCE: LESSON PLAN | **GRADE 9**

PERIOD: 60 MINUTES | **STRAND: ENERGY & CHANGE**

CAPS SENIOR PHASE 18 | **TERM 3**

DURATION: Week Five Lesson Four and Five	**OBJECTIVES: LEARNERS MUST BE ABLE TO:** • Observe and connect voltmeter in a circuit. • Read voltmeters, measure and record voltage when cells (of same voltage) are connected in parallel in a circuit. • Make a conclusion about the voltage across them (cells). • Measure and record voltage across resistors in parallel. Make a conclusion about voltage across resistors connected in parallel in a circuit.
TOPIC: SERIES AND PARALLEL CIRCUITS **SUB-TOPIC: Cells in Parallel (voltage?)**	
REFERENCES	
TERMINOLOGY:	Parallel.
SPECIFIC AIMS	1. DOING SCIENCE ✓ 2. KNOWING THE SUBJECT CONTENT & MAKING CONNECTIONS ✓ 3. UNDERSTANDING THE USES OF SCIENCES & INDIGENOUS KNOWLEDGE

SCIENCE PROCESS SKILLS					
Accessing & recalling Information	✓	Identifying problems & issues		Doing Investigations	✓
Observing	✓	Raising Questions		Recording Information	✓
Comparing	✓	Predicting	✓	Interpreting Information	✓
Measuring	✓	Hypothesizing		Communicating	✓
Sorting & Classifying		Planning Investigations		Follow Instructions	✓

CONTENT AND CONCEPTS	ACTIVITIES	RESOURCES
• When cells of the same voltage are connected in	1. Teacher builds a circuit made up of three identical cells in parallel, and connect a voltmeter.	• Circuit board(s) • Battery made up of three

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parallel, the voltage is the same as for one cell. • The voltage is the same across each resistor connected in parallel.	2. Learners observe and learn how to connect a voltmeter. 3. Learners observe the brightness of bulbs as teacher connects more cells in parallel. 4. Learners make conclusions on their findings. 5. Complete a practical worksheet. Sasol Inzalo Learner Workbook, pg 111 – 113 (What happens to the current and potential difference in a circuit when adding cells in parallel) and pg 113 – 115 (Adding resistors in parallel)..	cells. • Conducting wires • 3x Identical light bulbs Or LED • Voltmeter • Text book(s) / work book
ASSESSMENT	Baseline (Question and answer). Work out **voltages** of resistors in series in different circuit diagrams (collated from various textbooks) -	
TEACHER'S REFLECTIONS	Progress:	Challenges:
	Intervention Strategies:	

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NATURAL SCIENCE: LESSON PLAN

PERIOD: 60 MINUTES

CAPS SENIOR PHASE 18

GRADE 9

STRAND: ENERGY & CHANGE

TERM 3

Sasol Inzalo Learner Workbook pg 111 – 113.

INVESTIGATION: What happens to the current and potential difference in a circuit when adding cells in parallel?

HYPOTHESIS:

Write a hypothesis for this investigation.

MATERIALS AND APPARATUS:

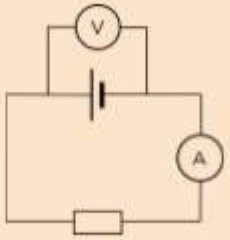
- three 1,5 V cells
- insulated copper conducting wires with crocodile clips
- ammeter
- voltmeter
- resistor

METHOD:

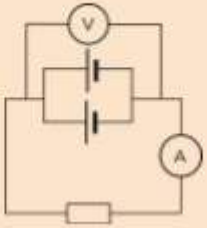
1. Construct a series circuit with 1 cell and the ammeter in series.
2. Connect the voltmeter in parallel with the cell as shown in the circuit diagram.

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3. Record the readings in the table below.
4. Add a second cell in parallel with the first cell as shown in the diagram.



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5. Record the new readings in the table below.
6. Add the third cell in parallel with the other two cells. Draw a circuit diagram for this in the space below.



7. Record the new readings in the table below.

RESULTS:

Complete the following table:

Number of cells in parallel	Ammeter reading (A)	Voltmeter reading (V)
1		
2		
3		

CONCLUSION:

What can we conclude regarding the effect of adding cells in parallel into a circuit?

_____

_____

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PERIOD: 60 MINUTES

CAPS SENIOR PHASE 18

GRADE 9

STRAND: ENERGY & CHANGE

TERM 3

Sasol Inzalo Learner Workbook pg 113 – 115.

ACTIVITY: Adding resistors in parallel

MATERIALS:

- 1,5 V cell
- 3 torch bulbs
- insulated copper conducting wires
- switch
- ammeter

INSTRUCTIONS :

1. Construct the circuit with the cell, ammeter, 1 bulb and the switch in series.
2. Close the switch.

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3. Note how brightly the bulb is shining, write down the ammeter reading. Draw a circuit diagram of your circuit.

4. Open the switch.
5. Add another light bulb, in parallel to the first, into the circuit.
6. Close the switch.
7. Note how brightly the bulbs are shining and write down the ammeter reading. Draw a circuit diagram of your circuit.

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8. Open the switch.
9. Add the third light bulb, in a parallel to the first two, into the circuit.
10. Close the switch.
11. Note how brightly the bulbs are shining and write down the ammeter reading. Draw a circuit diagram of your circuit.

QUESTIONS:

1. What happened to the brightness of the bulbs and the ammeter reading as more light bulbs were added in parallel?

_____

_____

2. Explain your observations from question 1.

_____

_____

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NATURAL SCIENCE: LESSON PLAN **GRADE 9**

PERIOD: 60 MINUTES **STRAND: ENERGY & CHANGE**

CAPS SENIOR PHASE 18 **TERM 3**

MEMORANDUM

INVESTIGATION: What happens to the current and potential difference in a circuit when adding cells in parallel?

TEACHER'S NOTE
If you do not have sufficient equipment to allow all the learners to attempt these circuits. Use the PhET simulation software which can be obtained from
bit.ly/17vBMBX

HYPOTHESIS:

TEACHER'S NOTE
A possible answer: Increasing the number of cells connected in parallel will increase the current and potential difference in the circuit.

Remember that the hypothesis does not have to be "correct", but it must just mention the variables that are to be investigated and the relationship which is expected to be observe.
Series and parallel circuits
RESULTS:

Complete the following table:

Number of cells in parallel	Ammeter reading(A)	Voltmeter reading(V)
1		
2		
3		

CONCLUSION:

TEACHER'S NOTE

Connecting more cells in parallel into a circuit does not affect the current strength and the potential difference in the circuit.

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What have we learnt? When we connect two cells in parallel with each other, the overall potential difference is the same as if we only had one cell. Therefore if both cells are 1,5 V, then the overall potential difference for the circuit is still 1,5 V. The current is the same as if there was only one cell because the electrons only travel through one of the cells.

TEACHER'S NOTE
When we connect cells in parallel we supply alternative pathways for the current to follow. This means that each of the cells last longer than if they were in a series circuit. Also if one cell fails, the circuit will still have another cell.

Resistors in parallel

Parallel circuits have more than one pathway for the current.

ACTIVITY**:** Adding resistors in parallel

TEACHER'S NOTE

This activity is a revision of the investigation completed in Gr. 8. The learners might have forgotten what happens in a parallel circuit and it is worth repeating the activity.

MATERIALS:

TEACHER'S NOTE

The switch and ammeter are not strictly necessary for this experiment. They can be left out if you do not have enough switches or ammeters.

QUESTIONS:

1. The brightness increased and so did the ammeter reading.

2. As more resistors were added in parallel, the resistance of the circuit decreased as the current is provided with alternative pathways, and the current increases with each resistor in parallel.

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NATURAL SCIENCE: LESSON PLAN | **GRADE 9**

PERIOD: 60 MINUTES | **STRAND: ENERGY & CHANGE**

CAPS SENIOR PHASE 19 | **TERM 3**

DURATION: Week Five Lesson Six and Week Six Lesson One **TOPIC:** **SERIES AND PARALLEL CIRCUITS** **SUB-TOPIC: Parallel Resistors**	**OBJECTIVES: LEARNERS MUST BE ABLE TO:** • Connect an Ammeter in a circuit. • Read Ammeters, measure and record current through a battery and resistors in parallel. • Verify that total of current through resistors in parallel is equal total current through circuit. • Find out that current increases when resistors are added in parallel
REFERENCES	Sasol Inzalo Learners Workbook pg 115 – 118)
TERMINOLOGY:	Parallel circuit, current dividers
SPECIFIC AIMS	1. DOING SCIENCE ✓ 2. KNOWING THE SUBJECT CONTENT & MAKING CONNECTIONS ✓ 3. UNDERSTANDING THE USES OF SCIENCES & INDIGENOUS KNOWLEDGE

SCIENCE PROCESS SKILLS

Accessing & recalling Information	✓	Identifying problems & issues		Doing Investigations	✓
Observing	✓	Raising Questions		Recording Information	✓
Comparing	✓	Predicting	✓	Interpreting Information	✓
Measuring		Hypothesizing		Communicating	✓
Sorting & Classifying		Planning Investigations		Follow Instructions	✓

CONTENT AND CONCEPTS	ACTIVITIES	RESOURCES
• Total current through the battery is same as the sum of currents through the resistors. • Current in a circuit increases when resistors are added in	1. Teacher builds up a circuit with three cells to make a battery. 2. Learners follow the procedure in Sasol Inzalo Learners Workbook pg 115 – 118) where they connect 3 bulbs (resistors) in parallel one after another. 3. Observe the brightness of bulbs (or ammeter reading) and record the	• Circuit board(s) • Battery made up of three cells. • Conducting wires • 3x Identical light bulbs

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parallel	results. 4. Complete practical worksheet. Practical worksheet attached below. 5. Learners make conclusion on their findings.	• Ammeter • Text book(s) / work book
ASSESSMENT	Activity: Work out and label voltages, current of circuit diagrams in the text books or work book.	
TEACHER'S REFLECTIONS	Progress:	Challenges:
	Intervention Strategies:	

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NATURAL SCIENCE: LESSON PLAN

PERIOD: 60 MINUTES

CAPS SENIOR PHASE 19

GRADE 9

STRAND: ENERGY & CHANGE

TERM 3

Sasol Inzalo Learner Workbook pg 115 - 118

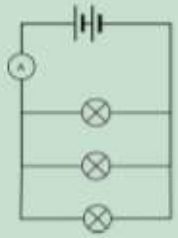
ACTIVITY: Current in a parallel circuit

MATERIALS:

- insulated copper connecting wires
- two 1,5 V cells
- three identical torch light bulbs
- ammeter

METHOD:

1. Set up a parallel circuit with two cells in series with each other and three torch light bulbs in parallel with each other.
2. Insert an ammeter in series between the cells and the first pathway as shown in the diagram.



3. Measure the current strength using the ammeter.

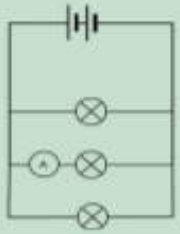
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4. Remove the ammeter and close the circuit again. Insert the ammeter, in series, in the first pathway.



5. Measure the current strength using the ammeter.
6. Insert the ammeter, in series, in the second pathway.



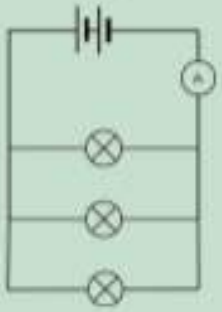
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7. Measure the current strength using the ammeter.
8. Insert the ammeter, in series, in the third pathway.



9. Measure the current strength using the ammeter.
10. Insert the ammeter, in series, between the first pathway and the batteries on the opposite side to the first reading.



11. Measure the current strength using the ammeter.

QUESTIONS:

1. What do you notice about the current in the main branch and the current in the pathways?

_____

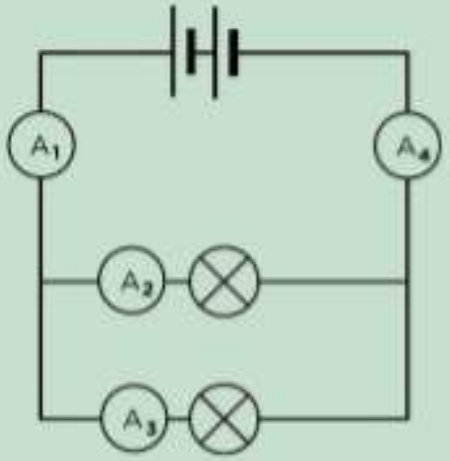
2. Add up the currents in each pathway through a bulb. What do you notice?

_____

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3. Use the following diagram and write an equation to illustrate the relationship between:



a) A1 and A4.

b) A1, A2 and A3.

c) A4, A2 and A3.

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NATURAL SCIENCE: LESSON PLAN | **GRADE 9**

PERIOD: 60 MINUTES | **STRAND: ENERGY & CHANGE**

CAPS SENIOR PHASE 19 | **TERM 3**

MEMORANDUM

ACTIVITY: Current in a parallel circuit

TEACHER'S NOTE
This is also a revision activity of what learners covered in Gr. 8.

11.
Draw a table in the following space to record your readings.

Position of ammeter in circuit	Ammeter reading (A)
Between the cells and first pathway	
In the first pathway	
In the second pathway	
In the third pathway	
Between the first pathway and the cells	

QUESTIONS:

1. *The current in the main branch is bigger than the current in each pathway.*

2. *Learners should note that the currents in each pathway through the bulbs add up to the total current.*

3. *a) A1 = A4*

   b) A1 = A2 + A3

   c) A4 = A2 + A3

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NATURAL SCIENCE: LESSON PLAN | **GRADE 9**

PERIOD: 60 MINUTES | **STRAND: ENERGY & CHANGE**

CAPS SENIOR PHASE 20 | **TERM 3**

DURATION: Week Six Lesson Two and Three **TOPIC:** **SERIES AND PARALLEL CIRCUITS** **SUB-TOPIC: ELECTRICITY IN HOMES**	**OBJECTIVES: LEARNERS MUST BE ABLE TO:** • Recognise that voltage across parallel resistors is the same • Identify electrical wiring at homes, cars and toys. • Explain the function of resistors. • Decide on the best connection of appliances in homes and wiring of cars. • Draw parallel and series circuit diagrams.
REFERENCES	Sasol Inzalo Workbook
TERMINOLOGY:	Fuses, Filament, resistance
SPECIFIC AIMS	1. DOING SCIENCE ✓ 2. KNOWING THE SUBJECT CONTENT & MAKING CONNECTIONS ✓ 3. UNDERSTANDING THE USES OF SCIENCES & INDIGENOUS KNOWLEDGE

SCIENCE PROCESS SKILLS					
Accessing & recalling Information	✓	Identifying problems & issues	✓	Doing Investigations	
Observing	✓	Raising Questions		Recording Information	✓
Comparing		Predicting		Interpreting Information	
Measuring		Hypothesizing		Communicating	✓
Sorting & Classifying		Planning Investigations		Follow Instructions	

CONTENT AND CONCEPTS	**ACTIVITIES**	**RESOURCES**
• The voltage is the same across each resistor connected in parallel. • The lighting system in	1. Teacher pose the following questions as a short informal test: • What instrument is used to measure current in an electrical circuit? • How is this device connected? In SERIES or in PARALLEL? • Do these instruments have HIGH or LOW resistance?	• Office lights • Christmas tree. • House wired diagrams/models.

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homes is always parallel. • Manufacturing of resistors to control current.	• How will the total resistance of a circuit change if more resistors are connected in (a) Parallel (b) in Series? • How will the current in a circuit change if more resistors are connected in (a) Parallel (b) in Series • How will the potential difference across a parallel combination of resistors change if more resistors are connected in parallel? • What happens to the current in a circuit if more identical cells are connected in parallel? Are there any advantages of connecting cells in parallel? • What is the advantage, if any, of connecting resistors in parallel? 2. The above short test is then marked. 3. Thereafter the teacher asks," How are electric bulbs in homes connected and give a reason? 4. Learners respond (in parallel or in series) and gives reason(s). 5. Teacher probe where necessary. 6. Learners debate among selves about connections of street lights. 7. Make conclusions on the best way to connecting bulbs/appliances in the house.	
ASSESSMENT	1. Oral question and answer. 2. What would happen if one bulb blows up in the class/house/car. 3. How the Christmas tree bulbs are connected. Why are the street lights connected in parallel? 4. Homework exercise from Sasol Inzalo Learners Workbook pg 127 – 130 (attached below)	
TEACHER'S REFLECTIONS	Progress:	Challenges:
	Intervention Strategies:	

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NATURAL SCIENCE: LESSON PLAN

PERIOD: 60 MINUTES

CAPS SENIOR PHASE 20

GRADE 9

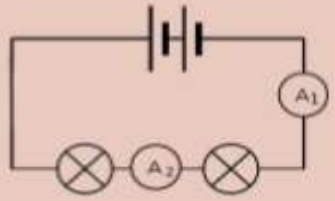
STRAND: ENERGY & CHANGE

TERM 3

HOMEWORK: Exercise from Sasol Inzalo Learners Workbook pg 127 – 128

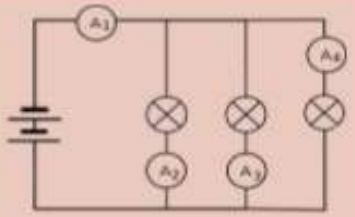
4. Household circuits are parallel circuits. Explain why it is better to use a parallel circuit in a house than a series circuit? [2 marks]

5. Answer the following questions on the circuit below.

Circuit	Values for each reading
	A_1 = 3 A A_2 =

a) Work out the missing values. [2 marks]
b) Explain your answer above. [1 mark]

6. Answer the following questions on the circuit below.

Circuit	Values for each reading [2 marks]
	A_1 = A_2 = 3 A A_3 = 3 A A_4 = 1 A

a) Work out the missing values. [2 marks]
b) Explain your answer above. [2 marks]

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NATURAL SCIENCE: LESSON PLAN

PERIOD: 60 MINUTES

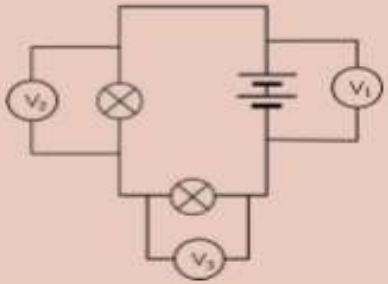
CAPS SENIOR PHASE 20

GRADE 9

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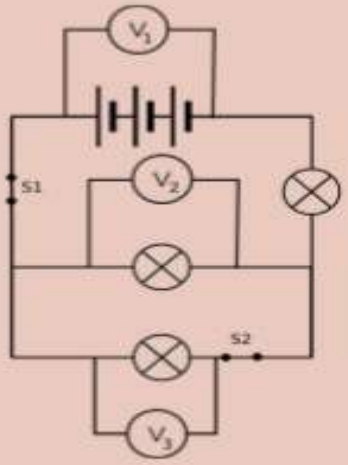
TERM 3

7. Answer the following questions about the circuit below.

Circuit	Values for each reading [2 marks]
	V_1 = 12 V V_2 = 8 V V_3 =

a) Work out the missing values. [2 marks]
b) Explain your answer above. [2 mark]

8. Answer the following questions about the circuit below.

Circuit	Values for each reading [2 marks]
	V_1 = 10 V V_2 = V_3 =

a) Work out the missing values. [2 marks]
b) Explain your answer above. [1 mark]

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MEMORANDUM

4. This enables you to switch one light on in a room without turning all the lights on. If one part of the parallel circuit breaks then the rest of the circuit can still function as the other pathways are still complete.

5. a) A2 = 3 A
NOTE: There are many different possible variations on the diagrams in this question. You can change the values or the layout of the circuits in order to give extra practice to any learners that are struggling with this concept.

b) The current is the same at all points in a series circuit.

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Energy and Change
6. a) A1 = 7 A

b) The current in a series circuits splits through each parallel branch such that the total current in the main circuit is equal to the sum of the currents in each branch.

7. a) V3 = 4 A

b) The potential differences across the battery in a series circuit is equal to the sum of the potential differences across each resistor.

8. a) V2 and V3 = 10 V.

b) The potential difference across the battery in a parallel circuit is equal to the potential difference across each resistor in parallel.

c) No bulbs will glow.

d) Two bulbs will glow.

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NATURAL SCIENCE: LESSON PLAN | **GRADE 9**

PERIOD: 30 MINUTES | **STRAND: ENERGY & CHANGE**

CAPS SENIOR PHASE 21 | **TERM 3**

CAPS SENIOR PHASE 21 **TERM 3 DURATION: Week Six Lesson Four**	**OBJECTIVES: LEARNERS MUST BE ABLE TO:** • Define a fuse/circuit breaker. • Identify fuses, circuit breakers. • Give the functions of fuses. • Explain the importance of earthing in real circuits.
TOPIC: SAFETY WITH ELECTRICITY	
SUB-TOPIC: Electricity in homes	
REFERENCES	
TERMINOLOGY:	Earthing, Fuses, Leak, leakage, short circuit.
SPECIFIC AIMS	1. DOING SCIENCE ✓ 2. KNOWING THE SUBJECT CONTENT & MAKING CONNECTIONS ✓ 3. UNDERSTANDING THE USES OF SCIENCES & INDIGENOUS KNOWLEDGE

SCIENCE PROCESS SKILLS					
Accessing & recalling Information	✓	Identifying problems & issues	✓	Doing Investigations	
Observing	✓	Raising Questions		Recording Information	
Comparing		Predicting		Interpreting Information	
Measuring		Hypothesizing		Communicating	✓
Sorting & Classifying		Planning Investigations		Follow Instructions	

CONTENT AND CONCEPTS	ACTIVITIES	RESOURCES
• Parallel connection can cause overload on mains circuit • Circuit breakers, fuses and earth leakage systems are used as safety devices	1. Part of the previous day's homework to be marked. Take approx. 15 minutes for this. 2. Learners read about electric safety practices in the approved text book. 3. Identify key words and look for meanings in the dictionaries. 4. Teacher distributes fuses, circuit breakers. Learners handle and observe how they are rated.	• Text book(s) • English dictionary. • Scientific dictionary • Different fuses/circuit breakers

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	5. Teacher lectures about "earth leakage systems in real circuits. 6. Learners are then required to complete Activity in Sasol Inzalo Learners Workbook pg 134 - 136	
ASSESSMENT	1. Activity in Sasol Inzalo Learners Workbook pg 134 – 136 (attached below) 2. Homework from Sasol Inzalo Learners Workbook pg 129 -130 (attached below)	
TEACHER'S REFLECTIONS	Progress:	Challenges:
	Intervention Strategies:	

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NATURAL SCIENCE: LESSON PLAN

PERIOD: 30 MINUTES

CAPS SENIOR PHASE 21

GRADE 9

STRAND: ENERGY & CHANGE

TERM 3

Activity in Sasol Inzalo Learners Workbook pg 134 – 136

ACTIVITY: Making your own fuse

MATERIALS:

- three 1,5 V cells (large voltage battery)
- copper conducting wires with crocodile clips
- steel wool
- heat resistant mat or piece of wood
- torch light bulb
- variable resistor
- ammeter

INSTRUCTIONS

1. Set up a circuit according to the picture on the next page.
2. Twist a few strands of steel wool into a wire. This must not be very thick. Just a few strands will do.
3. Use the steel wool to complete the circuit.
4. Set the variable resistor to its highest resistance.

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NATURAL SCIENCE: LESSON PLAN

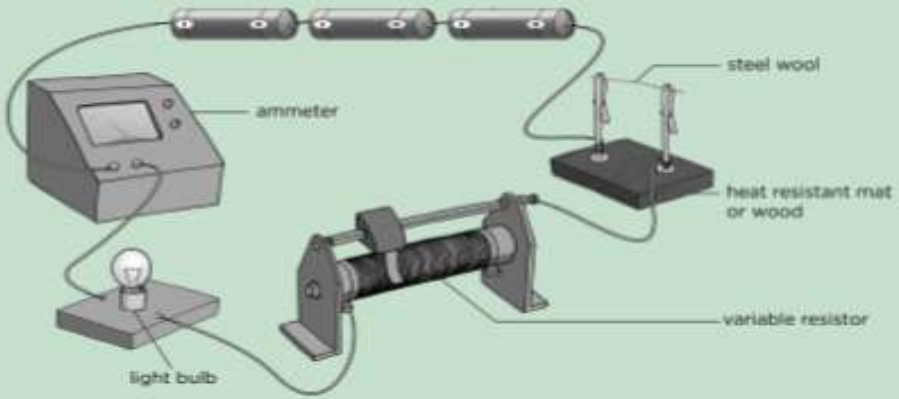
PERIOD: 30 MINUTES

CAPS SENIOR PHASE 21

GRADE 9

STRAND: ENERGY & CHANGE

TERM 3



5. Close the switch. What do you observe?

_____

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5. Close the switch. What do you observe?

_____

6. Take note of the reading on the ammeter which measures the current in the circuit.
7. Open the switch.
8. Set the variable resistance to its lowest resistance.
9. Close the switch. What do you observe?

_____

QUESTIONS:

1. Draw a circuit diagram for your circuit.

2. Why is the light bulb included in the circuit?

_____

_____

3. When you decreased the resistance, what happened to the current? In other words, what happened to the reading on the ammeter?

_____

_____

4. What do you think happens to the electric current when the steel wool has burnt? Explain your answer.

_____

_____

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NATURAL SCIENCE: LESSON PLAN

PERIOD: 30 MINUTES

CAPS SENIOR PHASE 21

GRADE 9

STRAND: ENERGY & CHANGE

TERM 3

Homework from Sasol Inzalo Learners Workbook pg 129 -130

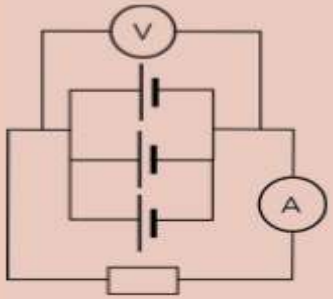
c) How many bulbs will still glow if switch S1 is opened? [1 mark]

_____

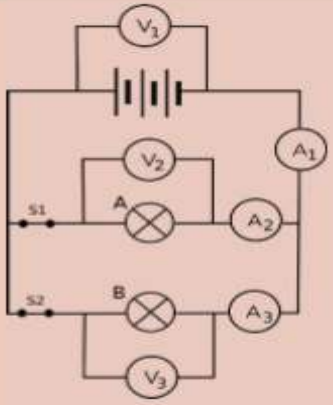
d) How many bulbs will still glow if switch S2 is opened? [1 mark]

_____

9. Work out the missing values below. [2 marks]

Circuit	Values for each reading [2 marks]
	Each cell in this circuit is 1,5 V. What is the reading on V?

10. Answer the following questions about the circuit below.

Circuit	Values for each reading [4 marks]
	V_1 = 9 V V_2 = V_3 = A_1 = 6 A A_2 = 2 A A_3 =

a) Work out the missing values.

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b) What would the reading on A2 show if switch S2 is opened? [2 marks]

c) Explain your answer to the previous question. [2 marks]

d) Which bulb, A or B, has the higher resistance? [2 marks]

e) Explain your answer to the previous question. [2 marks]

f) **Extension question:** Calculate the resistance of Bulb A and Bulb B. Show your working in the space below. [4 marks]

Total without extension [48 marks]

Total with extension [52 marks]

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NATURAL SCIENCE: LESSON PLAN **GRADE 9**

PERIOD: 30 MINUTES **STRAND: ENERGY & CHANGE**

CAPS SENIOR PHASE 21 **TERM 3**

MEMORANDUM

ACTIVITY: Making your own fuse

TEACHER'S NOTE

This is a simple way to demonstrate how a fuse works. Learners will make a small fuse from steel wool. Make sure that you use a heat resistant tile or block under the fuse because it will become hot and burn up. An old ceramic tile or piece of wood would work best.

Fuses are a practical application of the heating effect of an electric current. If you have enough equipment you could allow small groups of learners to complete this activity. Otherwise, use it as a demonstration.

MATERIALS:

TEACHER'S NOTE

The light bulb is included to show that the current is flowing while the steel wool is in place but not flowing when the steel wool melts. The variable resistor is used to show that when the resistance is high, the current is low enough that the fuse warms up but doesn't melt. When the resistance is lowered, the current speeds up until it melts the steel wool.

If you are demonstrating and you want to make the activity more exciting then you can use a small ball of steel wool instead of a wire. This should make the steel wool spark and burn. This should be done behind a screen as the sparks could land on a learner.

If you do not have a variable resistor then leave it out of the circuit and rather explain the concept. An ammeter is also not crucial in doing this activity as the light bulb can be used to indicate whether there is current or not.

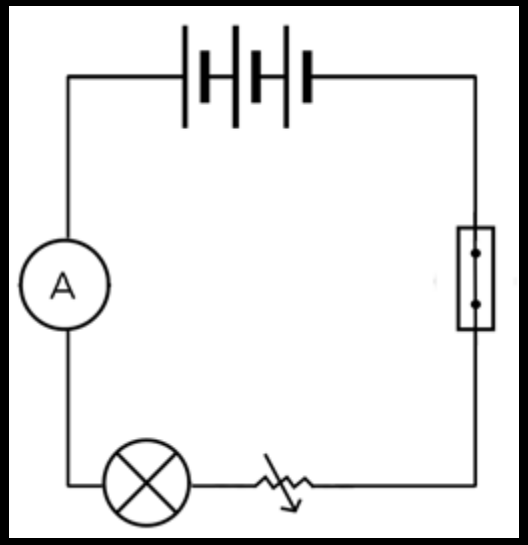
INSTRUCTIONS

5. The light bulb should glow and the steel wool should warm up but not melt.

9. The steel wool melts/burns and breaks up and the light bulb stops glowing.

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2. The light bulb is a good indicator of whether or not there is a current in the circuit. If the light bulb glows it means there is electric current. If the light does not glow it means that there is no current (or there is a very small current).

NOTE: Sometimes though there might still be a very small electric current, but it does not provide enough energy to cause the light bulb to glow. This is why the light bulb gives a good indication, but an ammeter will provide the most definitive indication of whether there is a current or not.
3. The current increases when the resistance decreased. The ammeter reading increases.

4. The current stops because the circuit has been broken. There is no longer a complete pathway for the electrons to move.

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HOMEWORK

9. The value is 1,5 V.

10. a) V2 and V3 = 9 V.
A3 = 4 A.

b) It would show 6 A.

c) When switch S2 is opened, the circuit becomes a series circuit and all the current goes through the one branch, through A2 and so A1 and A2 will show the same reading, 6 A.

d) Bulb A has the higher resistance.

e) Bulb A has the smaller current which goes through it, and therefore it must have the higher resistance as the larger the resistance, the smaller the current (they are inversely proportional).

f) This is an extension question as it is not required to be able to calculate resistance. An example was covered in the content.

Resistance in Bulb A = V/I = 9/2 = 4.5 Ω

Resistance in Bulb B = V/I = 9/4 = 2.25 Ω

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NATURAL SCIENCE: LESSON PLAN

PERIOD: 30 MINUTES

CAPS SENIOR PHASE 22

GRADE 9

STRAND: ENERGY & CHANGE

TERM 3

DURATION: Week Six Lesson Five **TOPIC:** SAFETY WITH ELECTRICITY **SUB-TOPIC:** SAFETY PRACTICES	**OBJECTIVES: LEARNERS MUST BE ABLE TO:** • Draw and label a 3-pin electric plug. • Identify/classify a 3-pin electric plug as a safety device. • State/give functions of; a live wire, a neutral wire and an earth wire. • Mention/state a few house appliances using electricity.
REFERENCES	Sasol Inzalo Workbook pg 141 – 143 or any other approved textbook
TERMINOLOGY:	Plug, "Live" wire, "neutral" wire, "Earth" wire; Device.
SPECIFIC AIMS	1. DOING SCIENCE 2. KNOWING THE SUBJECT CONTENT & MAKING CONNECTIONS 3. UNDERSTANDING THE USES OF SCIENCES & INDIGENOUS KNOWLEDGE

SCIENCE PROCESS SKILLS					
Accessing & recalling Information	✓	Identifying problems & issues		Doing Investigations	
Observing	✓	Raising Questions		Recording Information	
Comparing		Predicting		Interpreting Information	
Measuring		Hypothesizing		Communicating	
Sorting & Classifying		Planning Investigations		Follow Instructions	

CONTENT AND CONCEPTS	**ACTIVITIES**	**RESOURCES**
• Live, neutral and earth wires in a 3-pin plug. • Many household appliances have a 3-pin plug as a safety device to connect to the main	1. Part of the previous day's homework to be marked. Take approx. 15 minutes for this. 2. Teacher gives instructions. 3. Learners read about a 3-pin electric plug as a safety device and the functions of; a live wire, a neutral wire and an earth wire.	• Text book(s) • English dictionary. • Scientific dictionary • A 3-pin plug per group.

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circuit	4. Learners required to identify key words and Look for meanings in the dictionaries. 5. Learners required to identify a few household appliances using 3-pin plugs and having fuses as safety device. 6. Learners required to draw a representation of a 3-pin plug with labels and to complete Activity in Sasol Inzalo Learners Workbook pg 142 – 143 (Wiring a 3-pin plug)	
ASSESSMENT	1. Complete Activity in Sasol Inzalo Learners Workbook pg 142 - 143	
TEACHER'S REFLECTIONS	Progress:	Challenges:
	Intervention Strategies:	

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NATURAL SCIENCE: LESSON PLAN

PERIOD: 30 MINUTES

CAPS SENIOR PHASE 22

GRADE 9

STRAND: ENERGY & CHANGE

TERM 3

Activity in Sasol Inzalo Learners Workbook pg 142 – 143 (Wiring a 3-pin plug)

ACTIVITY: Wiring a 3-pin plug

MATERIALS

- piece of insulated electrical cord
- wire strippers or craft knife
- 3-pin plug
- small screwdriver

Have a look at the photo of a 3-pin plug.



A South African plug.

1. Which pin is the green-yellow cable connected to?

_____

2. Which pin is the blue neutral wire attached to?

_____

3. Which pin is the brown live wire always attached to?

_____

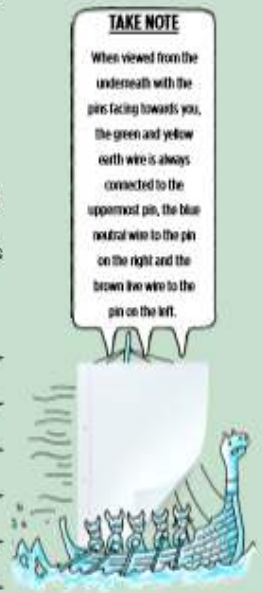
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We are now going to wire our own plugs.

INSTRUCTIONS

1. Cut about 2 cm of the white insulation off the electrical cord to expose the three wires within it. Do not slice directly into the wire as though you are cutting a loaf of bread. Move the blade carefully around the cord in a circle until you have cut through the insulation.
2. Once you have exposed the three different coloured wires, cut away about half a centimeter of insulation from each of these three smaller insulated wires to expose the copper wire inside.
3. Twist the copper wires gently with your fingers so that the strand is tight.
4. Open the plug cover.
5. Unscrew the little screws on the 3 metal pins.
6. Insert the copper wire into the metal pins. The green and yellow wire goes into the top pin (often labelled 'E' for earth, or with the symbol for earthing). The blue wire must go into the pin on the right when viewed from the bottom (often labelled 'N' for neutral). The brown wire must go into the pin on the left when viewed from the underneath of the plug (often labelled 'L' for live).
7. Tighten each of the little screws to trap the wires in place.
8. Replace the plug cover.
9. You have now correctly wired a 3-pin plug and attached it to the electrical cable.
10. When you wire a 3-pin plug of an actual appliance, what safety precautions do you think you need to follow? Discuss this with your partner or class and write down your answer here.



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NATURAL SCIENCE: LESSON PLAN **GRADE 9**

PERIOD: 30 MINUTES **STRAND: ENERGY & CHANGE**

CAPS SENIOR PHASE 22 **TERM 3**

MEMORANDUM

ACTIVITY: Wiring a 3-pin plug

TEACHER'S NOTE

It is important that the learners get to practice this themselves. You do not need a 3-pin plug for each child. Divide the class into small groups and give each group one set of apparatus. Each learner in the group can then have a turn to wire the plug and then undo the plug for the next learner to have a turn.

Stress the importance of stripping the wires carefully. If the copper wires are cut or damaged then it can lead to an unsafe plug being used.

MATERIALS

1. The green and yellow earth wire is always connected to the uppermost pin.

2. When viewed from the underneath of the plug, the blue neutral wire is always attached to the pin on the right.

3. When viewed from the underneath of the plug, the brown live wire is always connected to the pin on the left.

INSTRUCTIONS

TEACHER'S NOTE

Learners must note that here in the activity they used plugs which are not connected to an electrical appliance. So, when using an actual electrical appliance, they must make sure that the appliance is not turned on or does not have any other connection. They must also work on a dry surface.

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NATURAL SCIENCE: LESSON PLAN **GRADE 9**

PERIOD: 30 MINUTES **STRAND: ENERGY & CHANGE**

CAPS SENIOR PHASE 23 **TERM 3**

DURATION: Week Six lesson Six	**OBJECTIVES: LEARNERS MUST BE ABLE TO:** • Disassemble/dismantle and assemble a 3-pin plug. • Practice how to connect a 3-pin plug. • Draw a plan for wiring of a house
TOPIC: SAFETY WITH ELECTRICITY	
SUB-TOPIC: SAFETY PRACTICES	
REFERENCES	
TERMINOLOGY:	Cable, appliance
SPECIFIC AIMS	1. DOING SCIENCE 2. KNOWING THE SUBJECT CONTENT & MAKING CONNECTIONS 3. UNDERSTANDING THE USES OF SCIENCES & INDIGENOUS KNOWLEDGE

SCIENCE PROCESS SKILLS					
Accessing & recalling Information	✓	Identifying problems & issues		Doing Investigations	✓
Observing	✓	Raising Questions		Recording Information	✓
Comparing		Predicting		Interpreting Information	
Measuring		Hypothesizing		Communicating	✓
Sorting & Classifying		Planning Investigations		Follow Instructions	✓

CONTENT AND CONCEPTS	ACTIVITIES	RESOURCES
• Many appliances have a 3-pin plug. • Wiring in a model house	1. Teacher gives instructions. 2. Draw 3-pin plug at home and label it in class. 3. The following activity is to be done in groups of maximum 4 learners. Draw a wiring plan for their house at home and learners are required to complete Activity in Sasol Inzalo Learner Workbook pg 144 (Wiring a house) – attached below	• Conducting "blue/black; green/yellow; brown/red) wires. • Screw drivers (1 per group)

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NATURAL SCIENCE: LESSON PLAN **GRADE 9**

PERIOD: 30 MINUTES **STRAND: ENERGY & CHANGE**

CAPS SENIOR PHASE 23 **TERM 3**

ASSESSMENT	Activity in Sasol Inzalo Learner Workbook pg 144 (Wiring a house) – attached below	
TEACHER'S REFLECTIONS	Progress:	Challenges:
	Intervention Strategies:	

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NATURAL SCIENCE: LESSON PLAN

PERIOD: 30 MINUTES

CAPS SENIOR PHASE 23

GRADE 9

STRAND: ENERGY & CHANGE

TERM 3

Activity in Sasol Inzalo Learner Workbook pg 144 (Wiring a house)

ACTIVITY: Wiring a house

INSTRUCTIONS:

You have made a doll's house for a neighbour's little girl. The doll's house has 2 bedrooms, a bathroom, a lounge and a kitchen. You want to make a simple electrical circuit for the doll's house.

Start off by drawing the floor plan of the house. Once you have this, draw in the wiring system to show how you would put a light bulb in every room. Each light must be able to switch on and off without affecting the other lights in the house. There must be a mains switch located in the kitchen and a fuse to prevent overload.

You should practice this on rough paper or in the space below before drawing the final design in your workbook on the next page. Include the labels for each room.

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NATURAL SCIENCE: LESSON PLAN **GRADE 9**

PERIOD: 30 MINUTES **STRAND: ENERGY & CHANGE**

CAPS SENIOR PHASE 23 **TERM 3**

MEMORANDUM

ACTIVITY: Wiring a house

TEACHER'S NOTE

It is not necessary for the learners to build a model of this circuit. The learners need to plan how they can set up a circuit for the house which would allow each room to have a light which switches on and off without breaking the entire circuit. In other words, they will need to set up a parallel circuit with switches in each branch. The house should have a main switch capable of switching off all of the lights and a fuse, in case of overload.

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NATURAL SCIENCE: LESSON PLAN

PERIOD: 30 MINUTES

CAPS SENIOR PHASE 24

GRADE 9

STRAND: ENERGY & CHANGE

TERM 3

DURATION: Week Seven Lesson One **TOPIC:** SAFETY WITH ELECTRICITY **SUB-TOPIC:** SAFETY PRACTICES	**OBJECTIVES: LEARNERS MUST BE ABLE TO:** • Read newspapers/ magazines/approved textbooks on illegal electrical wiring. • Connect to the internet (if there is access to ITC) • Research about illegal and dangerous connections to electrical power supplies.	
REFERENCES		
TERMINOLOGY:	Mains supply, illegal, provision	
SPECIFIC AIMS	1. DOING SCIENCE	✓
	2. KNOWING THE SUBJECT CONTENT & MAKING CONNECTIONS	✓
	3. UNDERSTANDING THE USES OF SCIENCES & INDIGENOUS KNOWLEDGE	✓

SCIENCE PROCESS SKILLS					
Accessing & recalling Information	✓	Identifying problems & issues	✓	Doing Investigations	
Observing	✓	Raising Questions	✓	Recording Information	
Comparing		Predicting		Interpreting Information	
Measuring		Hypothesizing		Communicating	✓
Sorting & Classifying		Planning Investigations		Follow Instructions	✓

CONTENT AND CONCEPTS	**ACTIVITIES**	**RESOURCES**
• Illegal connections to the ESKOM mains supply can be dangerous, and are regarded as energy theft	1. Teacher gives instructions to learners to read article in approved textbooks/Sasol Inzalo Learner Workbook on Illegal connection or teacher takes learners to the computer room to do research. 2. Learners research from various media resources about illegal and dangerous connections to ESKOM. 3. Identify words and look for meanings in the dictionaries.	• News papers, magazines • Computers/ tablets for internet researches. • Text books/work books

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	4. Thereafter learners are required to do activity in Sasol Inzalo Learner Workbook pg 146 – 147 (Illegal electricity connection) or any other similar Case Study.	
ASSESSMENT	Activity in Sasol Inzalo Learner Workbook pg 146 – 147 (Illegal electricity connection) or any other similar Case Study.	
TEACHER'S REFLECTIONS		
	Intervention Strategies:	

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NATURAL SCIENCE: LESSON PLAN

PERIOD: 30 MINUTES

CAPS SENIOR PHASE 24

GRADE 9

STRAND: ENERGY & CHANGE

TERM 3

Sasol Inzalo Learner Workbook pg 146 – 147 (Illegal electricity connection)

ACTIVITY: Case study on illegal electricity connections

INSTRUCTIONS:

1. Read the following newspaper article.
2. Answer the questions that follow.

Doornbach informal settlement celebrates electricity provision
WestCapeNews, July 2012

There was much celebration in Doornbach, an informal settlement just outside of Cape Town, when the City switched on about 200 new electrical connections over the period of a few months in 2012. The illegal electricity connections had previously been the only supply of electricity to the area. Authorities often encounter fierce opposition when trying to cut down illegal electricity connections in informal settlements. But, the Doornbach residents immediately took it upon themselves to cut down the massive web of illegal wires in response to finally receiving formal, legal electricity provision.

Besides the mass of wires running through the informal settlement, many of the wires had been strung across Potsdam Road, the main road running through. This was very dangerous as the wires hung very low and would often catch on trucks passing through and snap. Fire threats and electrical shocks to passers-by and vehicles was also a safety concern. The use of legal electricity will also help to prevent shack fires as residents will rely less on candles and paraffin stoves.

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NATURAL SCIENCE: LESSON PLAN

PERIOD: 30 MINUTES

CAPS SENIOR PHASE 24

GRADE 9

STRAND: ENERGY & CHANGE

TERM 3

A fifty-two-year-old Doornbach resident, celebrating the end of illegal connections in the settlement, said that she had lived there for 18 years and never received any municipal services from the City. The reason being that they had originally settled on privately owned land, which meant that the City could not, in terms of National legislation, install services on privately owned land. However, the City bought the land in May 2011, and Eskom could therefore begin the process of providing electricity to households in Doornbach. The fifty-two-year old was very excited about being able to use an electric iron and installing a refrigerator.

As a symbolic gesture, the residents took it upon themselves to remove the illegal wires. Many of the youth climbed up the dangerous makeshift poles in order to collect the wire which they would then sell to scrap yards. Not everyone was celebrating the switching on legal electricity connections in Doornbach. Many residents in neighbouring settlements, living in formal housing, were making money by selling and supplying electricity illegally to Doornbach. Street lighting has also been installed in Doornbach and it is hoped this will help to reduce the crime rate.

Lastly, the City of Cape Town extended their sincere thanks to the community of Doornbach, as without their support, involvement and cooperation, such a project would not have been possible.



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NATURAL SCIENCE: LESSON PLAN

PERIOD: 30 MINUTES

CAPS SENIOR PHASE 24

GRADE 9

STRAND: ENERGY & CHANGE

TERM 3

QUESTIONS:

1. What is an informal settlement?

2. After reading this article, what do you think is the main reason that the people of Doornbach originally set up illegal connections?

3. Why is it dangerous for youths to climb the makeshift electricity poles?

4. What were some of the physical dangers of the illegal connections in Doornbach?



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NATURAL SCIENCE: LESSON PLAN **GRADE 9**

PERIOD: 30 MINUTES **STRAND: ENERGY & CHANGE**

CAPS SENIOR PHASE 24 **TERM 3**

MEMORANDUM

ACTIVITY: Case study on illegal electricity connections

QUESTIONS:

1. An informal settlement is a settlement that has not been planned by city planners. This means that there are no proper roads or housing developments. There are also no sanitary, water or electrical services in place before people settle on the land.

2. The residents settled on privately owned land which did not have electrical connections on site.
169
3. The wires are not always insulated and touching live electrical wire can cause electrical shock.

4. The illegal connections can electrocute passers-by, cause fires, and the wires hung very low over the main road which would then catch on trucks passing through.

5. Eskom is not being paid for the electricity used by the residents. This means that they are losing money because they are indirectly providing the electricity.

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NATURAL SCIENCE: LESSON PLAN | **GRADE 9**

PERIOD: 60 MINUTES | **STRAND: ENERGY & CHANGE**

CAPS SENIOR PHASE 25 | **TERM 3**

DURATION: Week Seven **Lesson Two and Three**	**OBJECTIVES: LEARNERS MUST BE ABLE TO:** • Explain what is primarily used for generating electricity in South Africa • Debate and discuss the use of coal powered fire stations to generate electricity
TOPIC: Energy and the national electricity grid	
SUB TOPIC: Electricity generation	
REFERENCES	Sasol Inzalo workbooks- Natural Sciences Grade 9-B
TERMINOLOGY:	turbine • generator • alternative energy • power station

SPECIFIC AIMS	1. DOING SCIENCE	
	2. KNOWING THE SUBJECT CONTENT & MAKING CONNECTIONS	√
	3. UNDERSTANDING THE USES OF SCIENCES & INDIGENOUS KNOWLEDGE	

SCIENCE PROCESS SKILLS					
Accessing & recalling Information		Identifying problems & issues	✓	Doing Investigations	✓
Observing		Raising Questions	✓	Recording Information	
Comparing		Predicting		Interpreting Information	
Measuring		Hypothesizing		Communicating	✓
Sorting & Classifying		Planning Investigations			

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NATURAL SCIENCE: LESSON PLAN **GRADE 9**

PERIOD: 60 MINUTES **STRAND: ENERGY & CHANGE**

CAPS SENIOR PHASE 25 **TERM 3**

CONTENT AND CONCEPTS	ACTIVITIES	RESOURCES
• A power station is a system used for generating electricity • Most power stations in South Africa use coal as a fuel to boil water	1. Learners must not open any textbook. Teacher will firstly revise previous knowledge of learners to determine their understanding of how electricity is produced in Coal powered stations by asking them questions orally relating to prior knowledge See notes from Teacher Guide attached below. 2. Learners put into groups of 4 and discuss how the power stations use coal to generate electricity. (5 minutes) 3. After 5 minutes, get some feedback 4. The learners are then to read from Sasol Inzalo Learner Workbook pg 154 – 155 or any approved textbook.	• Electricity generation (video) bit.ly/GY3JbX https://youtu.be/-aGzkDGlYSs
ASSESSMENT	1. Baseline (question and answer) at the beginning of the lesson **(See teacher guide)** 2. The learners are then to read from **Sasol Inzalo Learner Workbook pg 154 – 155** and to complete the questions	
TEACHER REFLECTION		
	Intervention Strategies:	

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NATURAL SCIENCE: LESSON PLAN

PERIOD: 60 MINUTES

CAPS SENIOR PHASE 25

GRADE 9

STRAND: ENERGY & CHANGE

TERM 3

TEACHER'S NOTE

Chapter overview

1 week

This chapter revises the work covered in Grades 7 and 8, with an emphasis on nuclear fuel. Try to arrange an excursion to a power plant or ask if an engineer is able to come to the school to explain how the power plant operates and to answer questions posed by the learners. This would provide an opportunity for the learners to ask questions about careers in the electrical industry. Here is a link to the Wikipedia article which lists all the power stations in South Africa.bit.ly/15vo5Vk

Here is a table summarising some of the various power stations in South Africa and which province they are located in, for your reference. The only nuclear power station is Koeberg Power Station in Cape Town.

Coal-powered stations

Power station	Province
Arnot Power Station	Mpumalanga
Bloemfontein Power Station	Free State
Camden Power Station	Mpumalanga
Duvha Power Station	Mpumalanga
Kelvin Power Station	Gauteng
Lethabo Power Station	Free State
Matimba Power Station	Limpopo
Pretoria West Power Station	Gauteng

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Hydroelectric Power Stations

Power station	Province
Drakensberg Pumped Storage Scheme	Free State
Gariep Dam	Free State-Eastern Cape border
Ingula Pumped Storage Scheme	Kwa-Zulu Natal
Kouga Dam	Eastern Cape
Palmiet Pumped Storage Scheme	Western Cape
Steenbras Pumped Storage Scheme	Western Cape
Vanderkloof Dam	Northern Cape

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NATURAL SCIENCE: LESSON PLAN

PERIOD: 30 MINUTES

CAPS SENIOR PHASE 26

GRADE 9

STRAND: ENERGY & CHANGE

TERM 3

DURATION: Week Seven **Lesson Four** **TOPIC:** Energy and the national electricity grid **SUB TOPIC:** Electricity generation	**OBJECTIVES: LEARNERS MUST BE ABLE TO:** • Explain the process of electricity production in a coal powered fire station • Write out the production of electricity process in their own words	
REFERENCES	Sasol Inzalo workbooks- Natural Sciences Grade 9-B	
TERMINOLOGY:	Turbine, generator	
SPECIFIC AIMS	1. DOING SCIENCE	
	2. KNOWING THE SUBJECT CONTENT & MAKING CONNECTIONS	✓
	3. UNDERSTANDING THE USES OF SCIENCES & INDIGENOUS KNOWLEDGE	

SCIENCE PROCESS SKILLS					
Accessing & recalling Information	✓	Identifying problems & issues		Doing Investigations	
Observing	✓	Raising Questions	✓	Recording Information	
Comparing		Predicting		Interpreting Information	
Measuring		Hypothesizing		Communicating	✓
Sorting & Classifying		Planning Investigations			

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NATURAL SCIENCE: LESSON PLAN **GRADE 9**

PERIOD: 30 MINUTES **STRAND: ENERGY & CHANGE**

CAPS SENIOR PHASE 26 **TERM 3**

CONTENT AND CONCEPTS	ACTIVITIES	RESOURCES
• Power stations in South Africa mainly use coal as a fuel to boil water for the electricity generation process • In a power station the steam from the water turns a turbine which then turns a generator which results in the production of electricity	1. The teacher will show pupils a picture of a Turbine and a generator so that they become familiar with what they look like. 2. Pupils will then watch the Electricity generation video to understand the process involved in the production of electricity.	• Pictures of power stations in Southern Africa. • Pictures of components of a power station. • Electricity generation (video). • Turbine and generation video: https://youtu.be/8JQKRl7N91w https://youtu.be/LNXTm7aHvWc
ASSESSMENT	1. Pupils will be required to write down in their own words the process involved in the production of electricity 2. Homework: Complete Activity in Sasol Inzalo Learner Workbook pg 156 – 158 (Hydroelectric Power) – attached below. Or any other suitable activity. Learners could also access the following: bit.ly/19YgYE6	
TEACHER REFLECTION	Progress:	Challenges:

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NATURAL SCIENCE: LESSON PLAN

PERIOD: 30 MINUTES

CAPS SENIOR PHASE 26

GRADE 9

STRAND: ENERGY & CHANGE

TERM 3

Activity in Sasol Inzalo Learner Workbook pg 156 – 158 (Hydroelectric Power)

ACTIVITY: Hydroelectric power

MATERIALS:

- aluminium foil plate or cooking tray
- scissors
- pencil
- adhesive tape or packaging tape
- piece of string about 45 cm long
- eraser
- nut, bolt, or other small mass piece
- source of running water, such as a tap

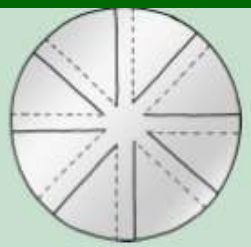
INSTRUCTIONS:

1. Cut out the circular bottom of an aluminium foil plate. If it isn't circular then use a compass to draw a circle in the base and cut it out.

2. Make eight equally spaced cuts toward the centre of the foil circle, as shown with the solid lines in the diagram. End each cut about 2 cm from the centre. You now have eight triangular sections.

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1. Fold each of the sections upwards. Use a ruler to help you get a straight edge. Use the dotted lines in the diagram as a guide.
2. Make a small hole in the centre of the plate. Push a pencil through the hole. The pencil should fit tightly into the hole. Use adhesive tape to stick the wheel to the pencil so that if you rotate the pencil, the wheel rotates.
3. Tie a piece of string around one end of the pencil. Tie the small nut or bolt to the other end of the string.
4. Hold each end of the pencil lightly between your thumbs and index fingers.
5. Hold the wheel under a slow stream of water from a running tap. Make sure to hold the wheel so that the blades are in the water, as shown in the diagram.





QUESTIONS:

1. What happens to the aluminium wheel when it is placed in the stream of water?

_____

2. What happens to the mass piece when the aluminium wheel is in the water stream?

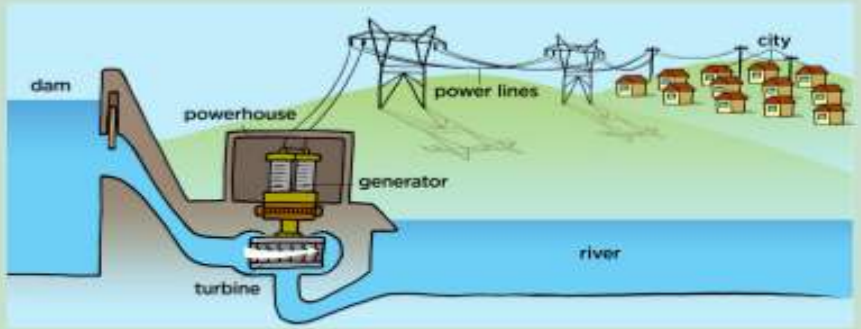
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3. Explain the energy transfers between the falling water and the mass piece lifting.

4. The following diagram shows an example of a hydroelectric power station. Answer the questions that follow.



a) The water in the dam on the left is high up. It has the ability to fall down. What kind of energy does the water have?

b) As the water flows down the outlet from the dam, describe the transfer of energy.

c) The flowing water then turns the turbine. This is a mechanical system. What energy does the turbine have?

d) The generator then transfers the energy between two systems. The kinetic energy in the mechanical system is transferred to electrical energy in the electrical system as it generates electricity. What parts make up the electrical system in the diagram?

e) What is the output from this whole system? In other words, what does the city get?

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NATURAL SCIENCE: LESSON PLAN **GRADE 9**

PERIOD: 30 MINUTES **STRAND: ENERGY & CHANGE**

CAPS SENIOR PHASE 26 **TERM 3**

MEMORANDUM

ACTIVITY: Hydroelectric power

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MATERIALS:

TEACHER'S NOTE

If you cannot get an aluminium foil plate then you could use thick cardboard. The cardboard wheel will not last long when exposed to water so you will have to take that into account. You cannot use the same wheel over again.

QUESTIONS:

1

1. The wheel turns.

2. The mass piece is pulled upwards by the turning pencil, as the string wraps around the pencil.

3. The water has gravitational potential energy which is converted to kinetic energy as it falls from the tap. The kinetic energy is transferred to the blades of the wheel. The kinetic energy of the turning blades is transferred to the pencil. The spinning pencil pulls the string upwards, which pulls the mass piece. The kinetic energy of the pencil is transferred to the gravitational potential energy of the mass piece as it moves upwards.

4.

NOTE: The following questions can be used as a revision task the next day in class or as a homework task. The water has gravitational potential energy.

a) The gravitational potential energy is transferred to kinetic energy as the water moves/flows down.

b) It has kinetic energy.

c) The electrical system is made up of the generator, the power lines and then the houses/buildings in the city.

d) The city gets electricity to run appliances, machines, equipment, lights and heating systems.

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NATURAL SCIENCE: LESSON PLAN | **GRADE 9**

PERIOD: 30 MINUTES | **STRAND: ENERGY & CHANGE**

CAPS SENIOR PHASE 27 | **TERM 3**

DURATION: Week Seven **Lesson Five**	**OBJECTIVES: LEARNERS MUST BE ABLE TO:** • State and Explain the alternative sources of energy that can be used to drive generators for the national grid. • Construct a simple model of a hydroelectric turbine
TOPIC: Energy and the national electricity grid	
SUB TOPIC: Electricity generation	
REFERENCES	Sasol Inzalo workbooks- Natural Sciences Grade 9-B
TERMINOLOGY:	Hydroelectric power, Wind turbine, falling water,Sun- heated steam, Nuclear fission, Sea waves
SPECIFIC AIMS	1. DOING SCIENCE ✓ 2. KNOWING THE SUBJECT CONTENT & MAKING CONNECTIONS ✓ 3. UNDERSTANDING THE USES OF SCIENCES & INDIGENOUS KNOWLEDGE

SCIENCE PROCESS SKILLS					
Accessing & recalling Information	✓	Identifying problems & issues		Doing Investigations	✓
Observing		Raising Questions		Recording Information	
Comparing		Predicting		Interpreting Information	
Measuring		Hypothesizing		Communicating	
Sorting & Classifying		Planning Investigations			

CONTENT AND CONCEPTS	ACTIVITIES	RESOURCES
• Apart from using coal, there are other alternative sources of energy. • These alternate sources of energy	1. Completion and discussion of previous days homework on Hydroelectric Power Stations. (not more than 12 – 15 minutes) 2. Teacher will introduce and explain the following alternative sources of energy: wind, falling water (hydroelectric), sun-heated	• Pictures of alternate sources of energy in Southern Africa Video clips from the internet

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NATURAL SCIENCE: LESSON PLAN **GRADE 9**

PERIOD: 30 MINUTES **STRAND: ENERGY & CHANGE**

CAPS SENIOR PHASE 27 **TERM 3**

CONTENT AND CONCEPTS	ACTIVITIES	RESOURCES
can be used to drive turbines and generators including wind, falling water(hydroelectric), sun – heated steam, nuclear fission, waves in the sea	steam, nuclear fission 3. Learners will then compare the different sources of energy and complete the activity worksheet (See activity Sasol Inzalo workbook page 161-162)	https://youtu.be/-1EIhowgtgA https://youtu.be/x357cFKuaf8
ASSESSMENT	Complete activity worksheet **(Activity: Sasol Inzalo Learner Workbook Page 161-162) Alternative energy Stations**	
TEACHER REFLECTION	Progress:	Challenges:

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NATURAL SCIENCE: LESSON PLAN

PERIOD: 30 MINUTES

CAPS SENIOR PHASE 27

GRADE 9

STRAND: ENERGY & CHANGE

TERM 3

Activity : Sasol Inzalo Learner Workbook Page 161-162

ACTIVITY: Alternative energy power stations

INSTRUCTIONS:

1. Research the different types of power stations in South Africa.
2. Choose one of the alternative energy sources used in South Africa.
3. Alternatively, your teacher may ask you to do this as a research project and present a poster.
4. Write a paragraph here where you discuss the alternative energy source power station you have researched. In your paragraph, include the following information:
   a) Compare the alternative energy power station to a coal-powered station in terms of sustainability and environmental impact.
   b) Discuss the advantages and disadvantages of using the alternative energy source rather than coal for generating electricity.
   c) Include your references.

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NATURAL SCIENCE: LESSON PLAN | **GRADE 9**

PERIOD: 30 MINUTES | **STRAND: ENERGY & CHANGE**

CAPS SENIOR PHASE 27 | **TERM 3**

MEMORANDUM

ACTIVITY: Alternative energy power stations

TEACHER'S NOTE

This can be used as a possible research project where learners research one of the alternative power stations in South Africa and present a poster on their findings. They must find out information about the sustainability and environmental impact of the alternative energy power station and compare this to a coal-powered power station.

INSTRUCTIONS:

TEACHER'S NOTE

Learner-dependent answer

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NATURAL SCIENCE: LESSON PLAN **GRADE 9**

PERIOD: 30 MINUTES **STRAND: ENERGY & CHANGE**

CAPS SENIOR PHASE 28 **TERM 3**

DURATION: Week Seven Lesson Six	**OBJECTIVES: LEARNERS MUST BE ABLE TO:**	
TOPIC: Energy and the national electricity grid	• Explain what nuclear power is • Debate and discuss the impact of using nuclear power on the environment	
SUB TOPIC: Nuclear power in South Africa		
REFERENCES	Sasol Inzalo workbooks- Natural Sciences Grade 9-B	
TERMINOLOGY:	Nuclear power,Nuclear fission, Nuclear waste, radioactive,	
SPECIFIC AIMS	1. DOING SCIENCE	
	2. KNOWING THE SUBJECT CONTENT & MAKING CONNECTIONS	√
	3. UNDERSTANDING THE USES OF SCIENCES & INDIGENOUS KNOWLEDGE	√

SCIENCE PROCESS SKILLS							
Accessing & recalling Information	✓		Identifying problems & issues	✓		Doing Investigations	
Observing			Raising Questions			Recording Information	
Comparing			Predicting			Interpreting Information	
Measuring			Hypothesizing			Communicating	
Sorting & Classifying			Planning Investigations				

CONTENT AND CONCEPTS	ACTIVITIES	RESOURCES
• a nuclear power station such as Koeberg in the Cape, uses radioactive fuel, the radioactivity	1. Teacher introduces the term – "Nuclear Power" to pupils and engages in a discussion about the advantages and disadvantages of this energy source. 2. Learners will then complete the activity worksheet from	• Learn more about radioactive decay by playing with this simulation. (Video link Learners

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PERIOD: 30 MINUTES

CAPS SENIOR PHASE 28

GRADE 9

STRAND: ENERGY & CHANGE

TERM 3

CONTENT AND CONCEPTS	ACTIVITIES	RESOURCES
produces heat by nuclear fission. The heat is then used to boil water to produce steam • the steam from the water turns a turbine which turns a generator, that produces electricity. The electricity is then channeled into the national electricity grid • spent nuclear fuel (nuclear waste) is still radioactive and remains so for many hundreds of years, therefore it needs to be properly disposed of so it is not a danger to life for years to come	Sasol Inzalo Learner Workbook pg 165	book Pg. 163 bit.ly/19QuXtL • How nuclear power works. Learners book Pg. 163 bit.ly/1612eLo • Learners can also access the following how nuclear bombs work: bit.ly/1aWleSR Also the following youtube videos can be accessed. https://youtu.be/HEYbgyL5n1g https://youtu.be/Cqlj4_4hcgU
ASSESSMENT	**Activity :** Sasol Inzalo Learner Workbook pg 165 – attached below	
TEACHER REFLECTION	Progress:	Challenges:

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NATURAL SCIENCE: LESSON PLAN **GRADE 9**

PERIOD: 30 MINUTES **STRAND: ENERGY & CHANGE**

CAPS SENIOR PHASE 28 **TERM 3**

Sasol Inzalo Learner Workbook pg 165

ACTIVITY: Advantages and disadvantages of nuclear power

INSTRUCTIONS:

1. Discuss and answer the questions that follow.
2. You will then be divided into groups to do some extra reading and research and host a debate for and against the advancement and development of nuclear power in South Africa.

What are some of the advantages of nuclear fuel? Discuss this with your partner and write down your answers below.

_____

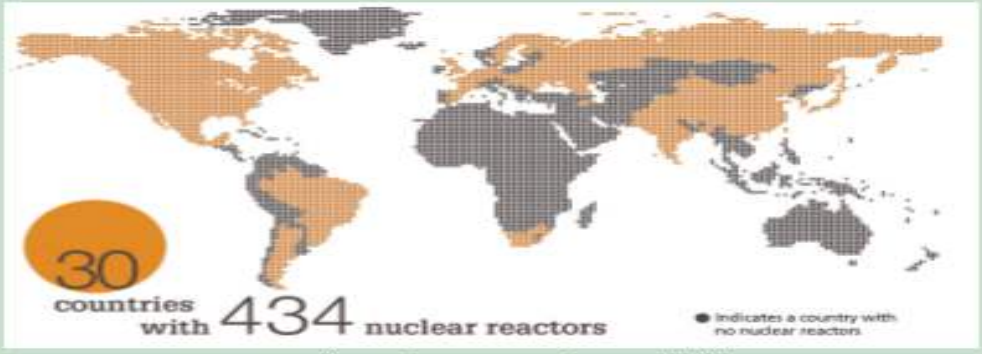
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One of the major disadvantages is that once the nuclear fuel has been used, it cannot just be thrown away in a city dump. The spent nuclear fuel is high-level radioactive waste. The radiation can also damage animals and plants. This nuclear waste needs to be disposed of carefully and correctly so that the radiation is not able to cause a lot of damage. Over time, the nuclear waste will decay to safe levels of radioactivity, but this takes thousands of years. In the meantime, it has to be stored so that it does not cause any damage or fall into the hands of nuclear arms manufacturers. This adds to the cost of using nuclear fuels. Some people also have reservations about nuclear power plants as the potential for a nuclear reactor meltdown are catastrophic.



Operating nuclear power stations worldwide.





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NATURAL SCIENCE: LESSON PLAN **GRADE 9**

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CAPS SENIOR PHASE 28 **TERM 3**

MEMORANDUM

ACTIVITY: Advantages and disadvantages of nuclear power

INSTRUCTIONS:

TEACHER'S NOTE

The biggest advantage is that nuclear power does not depend on fossil fuels. Fossil fuel power stations release huge amounts of carbon dioxide into the atmosphere which contribute to the greenhouse effect and climate change. It is therefore also not affected by the constantly changing oil and gas price. The use of nuclear fuel is also very efficient as huge amounts of electricity are generated using only a small amount of fuel. This is due to the extremely large amounts of energy released during nuclear fission. We are not about to run out of nuclear fuel.

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NATURAL SCIENCE: LESSON PLAN

PERIOD: 30 MINUTES

CAPS SENIOR PHASE 29

GRADE 9

STRAND: ENERGY & CHANGE

TERM 3

DURATION: Week Eight Lesson One	**OBJECTIVES: LEARNERS MUST BE ABLE TO:**	
TOPIC: Energy and the national electricity grid	• Explain briefly how electricity is transmitted via the National grid • Draw a simple flow diagram of the National grid	
SUB TOPIC: National electricity grid		
REFERENCES	Sasol Inzalo workbooks- Natural Sciences Grade 9-B	
TERMINOLOGY:	National electricity grid, transformer, power surge, blackout, transmission lines, pylon,	
SPECIFIC AIMS	1. DOING SCIENCE	✓
	2. KNOWING THE SUBJECT CONTENT & MAKING CONNECTIONS	✓
	3. UNDERSTANDING THE USES OF SCIENCES & INDIGENOUS KNOWLEDGE	

SCIENCE PROCESS SKILLS							
Accessing & recalling Information	✓		Identifying problems & issues			Doing Investigations	
Observing	✓		Raising Questions	✓		Recording Information	
Comparing			Predicting			Interpreting Information	
Measuring			Hypothesizing			Communicating	✓
Sorting & Classifying			Planning Investigations				

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NATURAL SCIENCE: LESSON PLAN **GRADE 9**

PERIOD: 30 MINUTES **STRAND: ENERGY & CHANGE**

CAPS SENIOR PHASE 29 **TERM 3**

CONTENT AND CONCEPTS	ACTIVITIES	RESOURCES
• The national grid is a network of interacting parts (a system): change in one part of the grid affects other parts of the grid. Power stations feed electrical energy into the national grid at high voltages Power lines carry electricity at high voltages-- transformers step down the voltage for local distributors and consumers: 15% of energy is wasted due to heating of transmission lines and transformers *[No details are required of alternating current or step-down transformers]*. Power surges and grid overload can disrupt the power supply	1. The teacher will draw a simplified diagram on the board or use a diagram of the national electricity grid to explain to pupils the process of electricity transmission from coal → power station → transformer → national transmission lines → substation → houses, shops etc. 2. Once the teacher has explained the process, pupils will now draw a simplified diagram to illustrate the process of electricity generation. 3. The teacher will then explain what a transformer is and its function- transformers are used to step up the voltage as the electricity leaves the power station and step down the voltage for local distributors and consumers. 4. Pupils will then complete a revision worksheet on energy and the national electricity supply. **(See activity : Sasol Inzalo Learner Workbook Page 170-171)**	• Diagram showing the national electricity grid with main power stations • Pictures of the National electricity grid. • Video clips or diagrams showing transformers and their uses https://youtu.be/ zB80Saglk https://youtu.be/YQQ-mgjCpn8
ASSESSMENT	1. Informal assessment: Draw a flow diagram to represent the production of electricity. 2. Complete revision worksheet on energy and the national electricity grid **(See activity : Sasol Inzalo Learner Workbook Page 170-171)**	
TEACHER REFLECTION	Progress:	Challenges:

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NATURAL SCIENCE: LESSON PLAN

PERIOD: 30 MINUTES

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GRADE 9

STRAND: ENERGY & CHANGE

TERM 3

Sasol Inzalo Learner Workbook Page 170-171

REVISION:

1. Why do you think we can refer to the national electricity supply as a **grid**? [2 marks]

2. What is the main source of energy for power stations in South Africa? [1 mark]

3. Why are renewable sources of energy referred to as alternative forms of energy? [2 marks]

4. Look at the diagram of a power station. Write a paragraph to describe the process by which electricity is produced in a coal power station. [6 marks]



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MEMORANDUM

REVISION:

1. This is because the power lines make up a grid across the country which is a closed circuit. It is a system.

2. Coal.

3. This is because the main source of energy is still coal. Any other form of energy is an alternative to the main form of coal.

4The paragraph must contain the following points:

- The coal is mined and delivered to the coal station
- The coal is pulverised to make it finer
- The coal is burned in a furnace
- The energy is used to boil water
- The steam turns the turbine
- The turbine turns a generator which produces electricity

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NATURAL SCIENCE: LESSON PLAN **GRADE 9**

PERIOD: 30 MINUTES **STRAND: ENERGY & CHANGE**

CAPS SENIOR PHASE 30 **TERM 3**

DURATION: Week Eight Lesson Two	**OBJECTIVES: LEARNERS MUST BE ABLE TO:**	
TOPIC: Cost of electrical power	• Explain the meaning of electrical power and electrical energy	
SUB TOPIC: The cost of power consumption		
REFERENCES	Sasol Inzalo workbooks- Natural Sciences Grade 9-B	
TERMINOLOGIES:	Electrical energy, electrical power	
SPECIFIC AIMS	1. DOING SCIENCE	
	2. KNOWING THE SUBJECT CONTENT & MAKING CONNECTIONS	✓
	3. UNDERSTANDING THE USES OF SCIENCES & INDIGENOUS KNOWLEDGE	

SCIENCE PROCESS SKILLS							
Accessing & recalling Information	✓		Identifying problems & issues			Doing Investigations	✓
Observing			Raising Questions			Recording Information	
Comparing	✓		Predicting			Interpreting Information	✓
Measuring			Hypothesizing			Communicating	
Sorting & Classifying			Planning Investigations				

CONTENT AND CONCEPTS	ACTIVITIES	RESOURCES
• electrical power is the rate of electrical energy supply	1. Homework from previous day must first be marked (10 minutes). 2. The teacher then begins the lesson by asking learners to answer a few baseline questions to gather the pupils level of prior knowledge (See Siyavula LB: Pg 176) such as	• Labels on electrical devices (from pictures eg. Adverts or actual

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NATURAL SCIENCE: LESSON PLAN **GRADE 9**

PERIOD: 30 MINUTES **STRAND: ENERGY & CHANGE**

CAPS SENIOR PHASE 30 **TERM 3**

CONTENT AND CONCEPTS	ACTIVITIES	RESOURCES
	• What is electrical power? • How do we measure electrical power? • Do different appliances use different amounts of energy • How do we know how much power we are using? • How do we measure our use of electrical energy • How can we work out how much our electricity cost? • How can we reduce our energy consumption? 3. teacher will then proceed to explain the concept of electrical power as being the rate of electrical energy supply. 4. Pupils will then make reference to the power labels of the electrical devices which they have brought to class. 5. Pupils are to then compare their different labels to see which appliances use the greatest amount of electrical power	electrical appliances such as iron, stove, TV, radio, refrigerator etc.)
ASSESSMENT	1. Baseline questions at the beginning of the lesson (See Siyavula LB: Pg 176) 2. Continuation of homework from Sasol Inzalo Learner Workbook pg 172 - 173	
TEACHER REFLECTION	Progress:	Challenges:

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NATURAL SCIENCE: LESSON PLAN | **GRADE 9**

PERIOD: 30 MINUTES | **STRAND: ENERGY & CHANGE**

CAPS SENIOR PHASE 30 | **TERM 3**

Continuation of homework from Sasol Inzalo Learner Workbook pg 172 - 173

10. Write a paragraph to compare how the use of coal impacts on the environment when compared to how the use of nuclear fuels impacts the environment. [4 marks]

11. Study the following diagram and answer the questions that follow.



The proportion of electricity generated using nuclear fuels in each country in 2013.

a) Which country has the highest percentage of its electricity being produced using nuclear fuels? [1 mark]

b) What is the percentage of South Africa's energy generated using nuclear fuels? [1 mark]

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529
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c) Why are all the countries in the world not shown here in this diagram? [1 mark]

d) Draw a bar graph to compare the percentage of electricity generated using nuclear fuels to compare South Africa, France, United States of America, United Kingdom, India and China. [6 marks]

12. Why can we consider the national electricity grid as a system? [2 marks]

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NATURAL SCIENCE: LESSON PLAN **GRADE 9**

PERIOD: 30 MINUTES **STRAND: ENERGY & CHANGE**

CAPS SENIOR PHASE 30 **TERM 3**

MEMORANDUM

10. Learners should discuss how the mining of coal damages the environment. They must also discuss the fact that the burning of fossil fuels generates an increase in the amount of greenhouse gases in the atmosphere which contributes to climate change. Learners can discuss the fact that nuclear fuels do not generate greenhouse gases. However, the spent nuclear fuel is still radioactive and therefore needs to be stored safely for very long periods of time so that it does not damage the environment or any organisms.

11.

a) France.

b) It is 5 %. . .
197
c) Not all countries have nuclear power stations, so only those with nuclear power are shown here.

d) Learners must draw a bar graph with the bars which do not touch [1mark]. They must provide a heading [1 mark], labels for each of the axes [2 marks], and plot the correct percentages for each country listed [3 marks].

12. The national grid is a system as it is made of different parts working together to deliver electricity. A change in one part of the grid will affect other parts.

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NATURAL SCIENCE: LESSON PLAN | **GRADE 9**

PERIOD: 60 MINUTES | **STRAND: ENERGY & CHANGE**

CAPS SENIOR PHASE 31 | **TERM 3**

DURATION: Week Eight Lesson Three and Four **TOPIC:** Cost of electrical power **SUB TOPIC:** The cost of power consumption	**OBJECTIVES: LEARNERS MUST BE ABLE TO:** • Explain what is meant by the term "Kilowatt hour" • Draw a table of electrical devices showing their different electrical power.
REFERENCES	Sasol Inzalo workbooks- Natural Sciences Grade 9-B
TERMINOLOGY:	Power; rate; appliance; watts(W); power rating; Kilowatt hour
SPECIFIC AIMS	1. DOING SCIENCE ✓ 2. KNOWING THE SUBJECT CONTENT & MAKING CONNECTIONS ✓ 3. UNDERSTANDING THE USES OF SCIENCES & INDIGENOUS KNOWLEDGE

SCIENCE PROCESS SKILLS					
Accessing & recalling Information		Identifying problems & issues		Doing Investigations	
Observing	✓	Raising Questions		Recording Information	✓
Comparing	✓	Predicting		Interpreting Information	✓
Measuring		Hypothesizing		Communicating	
Sorting & Classifying		Planning Investigations			

CONTENT AND CONCEPTS	ACTIVITIES	RESOURCES
• Electrical power is measured in units called watts (W) or kilowatts (kW) [one watt of power is equal to one joule of energy supplied in	1. Previous days homework must first be marked (10 minutes) 2. The teacher should then briefly recap the previous section on electrical power and then introduce the term "Kilowatt hour" as the unit in which electricity is sold to the consumer by Eskom.	• Examples of electricity accounts that show electricity usage and cost • Also watch the following

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NATURAL SCIENCE: LESSON PLAN **GRADE 9**

PERIOD: 60 MINUTES **STRAND: ENERGY & CHANGE**

CAPS SENIOR PHASE 31 **TERM 3**

CONTENT AND CONCEPTS	ACTIVITIES	RESOURCES
a second (I watt = 1 joule per second)]	3. Teacher is to then conduct an activity with learners to determine the power ratings of different appliances **(See activity worksheet from LB. Pg-177-179)**	video: bit.ly/18JylZc
ASSESSMENT	1. See activity worksheet from Sasol Inzalo Learner Workbook Pg-177-179 – attached below 2. Continuation of homework from Sasol Inzalo Learner Workbook pg 174 – attached below	
TEACHER REFLECTION	Progress:	Challenges:

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NATURAL SCIENCE: LESSON PLAN

PERIOD: 60 MINUTES

CAPS SENIOR PHASE 31

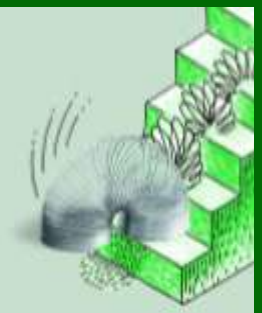
GRADE 9

STRAND: ENERGY & CHANGE

TERM 3

Sasol Inzalo Learner Workbook pg 177 - 179

ACTIVITY: Power rating of different appliances



INSTRUCTIONS:

1. Depending on your class and teacher, you might be able to walk around the school or your classroom and look at different appliances.
2. You might also have advertisements from newspapers or magazines to study.
3. Write down the power rating of each appliance that you find. Complete the table to record your findings.
4. Some photographs of the labels on various appliances have been given below. Include these power ratings in your table.
5. Answer the questions that follow.



The label on the under side of a toaster.



The box for an electric beater.



The label on the back of a television.



The label on an urn, for heating water.



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NATURAL SCIENCE: LESSON PLAN

PERIOD: 60 MINUTES

CAPS SENIOR PHASE 31

GRADE 9

STRAND: ENERGY & CHANGE

TERM 3

Fill the power ratings of the various appliances into the following table.

Appliance	Power (W)
Toaster	
Electric beater	
Television	
Urn	

TAKE NOTE

A rate is ratio where one quantity is compared to time, for example km/h which is comparing distance (in kilometers) to time (in hours).



QUESTIONS:

1. Complete the following table to convert between joules and kilojoules:

Joules (J)	Kilojoules (kJ)
120	
	34
1 230	
	24,6

TAKE NOTE

If you are given the amount of energy transferred in kilojoules, you need to convert it to joules to calculate the power in watts.



2. Complete the following table to convert between watts and kilowatts:

Watts (W)	Kilowatts (kW)
1 760	
	4,56
25	
	0,56

3. Sequence the appliances listed in your table above from those that use the most power to those that use the least power.

_____

_____

4. Did you record the power ratings of any other appliances which involve heating? What do you notice about the power for these appliances?

_____

_____

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NATURAL SCIENCE: LESSON PLAN

PERIOD: 60 MINUTES

CAPS SENIOR PHASE 31

GRADE 9

STRAND: ENERGY & CHANGE

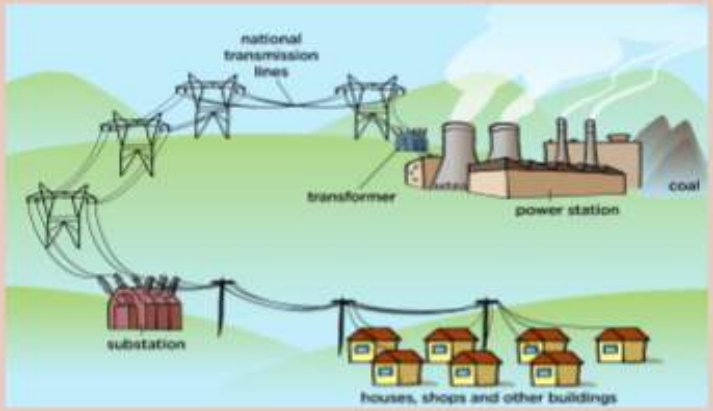
TERM 3

Continuation of homework from Sasol Inzalo Learner Workbook pg 174

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13. We can divide the national electricity grid up into 4 main stages. These are:
A: Generation (this is where electricity is generated)
B: Transmission (the electricity enters the power lines of the national grids and is transmitted)
C: Distribution (the electricity is distributed from substations to various towns and areas)
D: Consumers (this is where the electricity is transferred to useful energy outputs)
Use this information to write the letters A, B, C and D on the diagram of the national electricity grid to label these stages. [4 marks]



14. Why is electricity transmitted through the power lines at high voltages and low current strength? [3 marks]

_____

_____

15. Most household appliances need a voltage of 220 - 240 V. If the electricity in the transmission lines is very high then how are we able to use it? [2 marks]

_____

_____

16. Why should you protect your computer from power surges? [2 marks]

_____

_____

Total [50 marks]

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NATURAL SCIENCE: LESSON PLAN **GRADE 9**

PERIOD: 60 MINUTES **STRAND: ENERGY & CHANGE**

CAPS SENIOR PHASE 31 **TERM 3**

MEMORANDUM

ACTIVITY: Power rating of different appliances

TEACHER'S NOTE

If possible, bring some different appliances to class, such as a kettle, toaster or iron, to show learners the labels with the power ratings on them. You can also walk around the school and identify the different power ratings on appliances around the school. Bring newspapers to school to use the advertisements section to allow learners to also study the appliances and to identify the power ratings. Bring in different light bulbs which have different power ratings to show these to learners.

INSTRUCTIONS:
Energy and Change
TAKE NOTE

A rate is ratio where one quantity is compared to time, for example km/h which is comparing distance (in kilometres) to time (in hours).

TEACHER'S NOTE
Below are the power ratings for the appliances given here. Learners must also identify others.

Appliance	Power(W)
Toaster	700
Electric beater	175
Television	54
Urn	1500

QUESTIONS:

1. Complete the following table to convert between joules and kilojoules:

Joule(J)	Kilojoule(KJ)
120	**0.12**
34 000	34
1 230	**1.23**

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24 600	24.6

2. Complete the following table to convert between watts and kilowatts:

Watts(W)	Kilowatts(Kw)
1 760	**1.6**
4 560	4.56
25	**0.025**
560	0.56

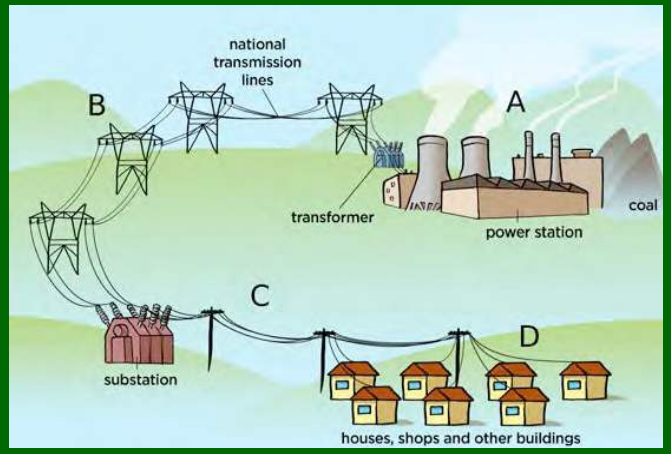
3. Learner-dependent answer, depending on the appliances listed. Learners will find that appliances which provide heat use much more energy than appliances, like a fan or radio, which supply movement and sound respectively.

4. Appliances involving heating, such as kettles, toasters, irons, heaters, use a lot of power.

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CONTINUATION OF HOMEWORK

13.



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14. There is resistance in the transmission lines. If the current is very high then a lot of energy is lost to the lines in the form of heat. It is expensive to produce electricity and we don't want to waste any. If the current is low then less energy is wasted in the lines.

15. Transformers are used to change the voltage from high to a low voltage so that the appliances in our homes are not damaged.

16. The sensitive circuits in a computer require small currents. A power surge puts a large current into the circuit. This can damage the wiring in the circuit and stop it from working.

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NATURAL SCIENCE: LESSON PLAN
PERIOD: 60 MINUTES
CAPS SENIOR PHASE 32

GRADE 9
STRAND: ENERGY & CHANGE
TERM 3

DURATION: Week Nine Lesson One and Two **TOPIC:** Cost of electrical power **SUB TOPIC:** The cost of power consumption	**OBJECTIVES: LEARNERS MUST BE ABLE TO:** • Explain and carry out the conversion of watts to kilowatts and all other units of time to hours • Calculate the cost of using electrical appliances using the given formula
REFERENCES	Sasol Inzalo workbooks- Natural Sciences Grade 9-B
TERMINOLOGY:	Kilowatt hour(kW), Eskom, power consumption, tariff, electrical appliance, survey, estimate, VAT,

SPECIFIC AIMS	1. DOING SCIENCE	
	2. KNOWING THE SUBJECT CONTENT & MAKING CONNECTIONS	✓
	3. UNDERSTANDING THE USES OF SCIENCES & INDIGENOUS KNOWLEDGE	

SCIENCE PROCESS SKILLS					
Accessing & recalling Information	✓	Identifying problems & issues		Doing Investigations	
Observing		Raising Questions		Recording Information	
Comparing	✓	Predicting		Interpreting Information	
Measuring	✓	Hypothesizing		Communicating	✓
Sorting & Classifying		Planning Investigations			

CONTENT AND CONCEPTS	ACTIVITIES	RESOURCES
• the cost to the consumer is calculated in the following way: cost = power rating of the appliance × the number of	1. Teachers will revise the concept of the kilowatt hour from the previous lesson and then proceed to explain how this is used to bill consumers for the use of electricity. 2. Conversion of watts to kilowatts will be emphasized here.	• Examples of electricity accounts that show electricity usage and cost

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NATURAL SCIENCE: LESSON PLAN **GRADE 9**

PERIOD: 60 MINUTES **STRAND: ENERGY & CHANGE**

CAPS SENIOR PHASE 32 **TERM 3**

CONTENT AND CONCEPTS	ACTIVITIES	RESOURCES
hours it was used × the unit price of electricity	3. The teacher will now introduce the formula for calculating the cost of using electricity: **cost = power rating of the appliance × the number of hours it was used × the unit price of electricity** 4. Teacher will go through a few examples with the learners to ensure that they understand how to calculate the cost of using electricity**. (Sasol Inzalo Learners Workbook pg183)** 5. Learners are then required to complete the attached worksheet from LB pg 184 – 187.	
ASSESSMENT	Complete the activity worksheet **(Sasol Inzalo Learners Workbook pg184 – 187)** – attached below	
TEACHER REFLECTION	Progress:	Challenges:

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NATURAL SCIENCE: LESSON PLAN | **GRADE 9**

PERIOD: 60 MINUTES | **STRAND: ENERGY & CHANGE**

CAPS SENIOR PHASE 32 | **TERM 3**

Sasol Inzalo Learners Workbook pg184 – 187

ACTIVITY: Calculating the cost of energy consumption

INSTRUCTIONS:

1. Use the information in the following table to answer the questions that follow.
2. Use a cost per unit of electricity of 71,65 cents/kWh in all your calculations.

Appliance	Power rating
Microwave oven	1 360 W
Conventional oven	6 000 W
Television	105 W
Geyser	4 800 W
Incandescent light bulb	100 W
Fluorescent light tube	40 W
Vacuum cleaner	1600 W
Washing machine	2200 W

QUESTIONS

1. Imagine that your family has used 320 kWh of electricity this month. Calculate the cost of the 320 kWh.
2. A potato takes about 1 hour to cook in a conventional oven. In a microwave it takes approximately 12 minutes. Calculate the cost of cooking the potato in each appliance and write which one is the cheaper option.
3. Which light bulb is cheaper to run for an hour, the incandescent light bulb or the fluorescent light bulb? Justify your answer with suitable calculations
4. If you have a prepaid electricity voucher for R15, how long could you watch TV?
5. You need to vacuum your room and it takes you 30 minutes to do this. What does this cost?
6. It take the geyser 2,5 hours to heat water from 20 ^{0}C to 65 ^{0}C. How much does it cost to heat the water?
7. What alternative appliance could a family use to heat water which would not demand such a high use of electricity?

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NATURAL SCIENCE: LESSON PLAN **GRADE 9**

PERIOD: 60 MINUTES **STRAND: ENERGY & CHANGE**

CAPS SENIOR PHASE 32 **TERM 3**

MEMORANDUM

ACTIVITY: Calculating the cost of energy consumption

QUESTIONS:

1.
cost = 320 kWh x 71,65
= 22928 cents
= R229, 28

2.
12 minutes = 0, 2 hours
1 360 W = 1, 36 kW
6 000 W = 6 kW
Microwave oven: cost = 1,36 x 0,2 x 71,65 = 19,49 cents = R0,19

Conventional oven: cost = 6 x 1 x 71,65 = 429,9 cents = R4,30

The microwave is cheaper to run than a conventional oven.

3.
100 W = 0,1 kW
40 W = 0,04 kWI
Incandescent light bulb = 0,1 x 1 x 71,65 = 7,165 cents = R0,07

Fluorescent light bulb = 0,04 x 1 x 71,65 = 2,866 cents = R0,03

The fluorescent light bulb is cheaper.

4.
R15 = 1 500 cents
105 W = 0,105 kW
Number of kWh = 1500/71, 65 = 20, 94 kWh
Number of hours = 20,94/0,105 = 199,43 hours

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5.
1600 W = 1, 6 kW
30 minutes = 0.5 hours
Cost = 1,6 x 0.5 x 71,65
= 57, 32 cents
= R0, 57

6.
4800 W = 4,8 kW
Cost = 4,8 x 2,5 x 71,65
= 537,375 cents
= R5, 37

7. A family can install a solar water heater to use to heat water instead of a geyser. This uses solar power and therefore reduces the family's energy consumption, saving electricity and money.
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NATURAL SCIENCE: LESSON PLAN **GRADE 9**

PERIOD: 60 MINUTES **STRAND: ENERGY & CHANGE**

CAPS SENIOR PHASE 33 **TERM 3**

DURATION: Week Nine Lesson Three and Four	**OBJECTIVES: LEARNERS MUST BE ABLE TO:** • Explain and carry out the conversion of watts to kilowatts and all other units of time to hours • Calculate the cost of using electrical appliances using the given formula
TOPIC: Cost of electrical power	
SUB TOPIC: The cost of power consumption	
REFERENCES	Sasol Inzalo workbooks- Natural Sciences Grade 9-B
TERMINOLOGY:	Kilowatt hour(kW), Eskom, power consumption, tariff, electrical appliance, survey, estimate, VAT,

SPECIFIC AIMS	1. DOING SCIENCE	
	2. KNOWING THE SUBJECT CONTENT & MAKING CONNECTIONS	✓
	3. UNDERSTANDING THE USES OF SCIENCES & INDIGENOUS KNOWLEDGE	

PROCESS SKILLS							
Accessing & recalling Information	✓		Identifying problems & issues			Doing Investigations	
Observing			Raising Questions			Recording Information	
Comparing	✓		Predicting			Interpreting Information	✓
Measuring	✓		Hypothesizing			Communicating	
Sorting & Classifying			Planning Investigations				

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NATURAL SCIENCE: LESSON PLAN **GRADE 9**

PERIOD: 60 MINUTES **STRAND: ENERGY & CHANGE**

CAPS SENIOR PHASE 33 **TERM 3**

CONTENT AND CONCEPTS	ACTIVITIES	RESOURCES
• the cost to the consumer is calculated in the following way: cost = power rating of the appliance × the number of hours it was used × the unit price of electricity	1. This lesson is a continuation of the preceding lesson which emphasizes the concepts explained. Teacher will give pupils another example on the board to determine whether or not they have grasped the concept of calculating the cost of electricity. Make use of other sources for examples and further exercises 2. The teacher will then give the pupils activity worksheets to further consolidate the work done in calculating the cost of electricity. **See LB pg 188-189)**	• Examples of electricity accounts that show electricity usage and cost • Other resources for more examples. • Also visit for more tips on conserving electricity: bit.ly/1gEctUP
ASSESSMENT	Activity worksheet Sasol Inzalo Learners Workbook 188-189)	
TEACHER REFLECTION	Progress:	Challenges:

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NATURAL SCIENCE: LESSON PLAN **GRADE 9**

PERIOD: 60 MINUTES **STRAND: ENERGY & CHANGE**

CAPS SENIOR PHASE 33 **TERM 3**

Activity worksheet Sasol Inzalo Learners Workbook 188-189

ACTIVITY: Home survey

INSTRUCTIONS:

1. List, in a table similar to the one above, all the electrical appliances in your home. The 4 column headings should read: Appliance, power rating, number of hours and cost.
2. Estimate the number of hours for which each appliance is used on a typical day.
3. Calculate the daily cost of each appliance, using 71,65 c/kWh as the unit price. Remember to count the number of light bulbs you have in your home and multiply that by the cost for 1 light bulb.

QUESTIONS

1. What was your total estimated electricity cost for one day?
2. If there are 30 days in an average month, what would your estimated monthly bill be?
3. Can you think of any ways that your family could reduce the amount of electricity you use?

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NATURAL SCIENCE: LESSON PLAN **GRADE 9**

PERIOD: 60 MINUTES **STRAND: ENERGY & CHANGE**

CAPS SENIOR PHASE 33 **TERM 3**

MEMORANDUM

ACTIVITY: Home survey

INSTRUCTIONS:

TEACHER'S NOT
The length of the table will depend on the number of appliances in each learner's home. Learners answers will vary. They should perform a separate calculation for each appliance in their home and then add the amounts together to get the total cost of electricity.

Here is an example of what a calculation might look like for a light bulb of 120 W which runs for 2 hours per day. You should encourage learners to follow these steps:

Step 1: Write down the formula
Cost = power rating x time x price

Step 2: List all the given values in a problem
Power rating = 120 W = 0,12 kW
Time = 2 hours
Price = 71,65 c/kWh

Step 3: Substitute the given values into the formula to find the unknown
Cost = 0,12 x 2 x 71,65
= 17,196 cents

Step 4: Write down the solution on its own line with the units.
Cost of electricity is 17 cents (R0, 17)

QUESTIONS:

TEACHER'S NOTE
All of these answers will depend of the electrical appliances used in the learner's home. It is important to check that they are using the formula correctly and that they are converting watts to kilowatts and cents into rands.

1. Learner-dependent answer.
2. Learner-dependent answer.
3. This answer is learner-dependant. Some learners might only have a few electrical appliances and would not be in a position to reduce usage. Some learners may indicate that they could be more efficient in their use of electricity. They could switch off unnecessary lighting. Use blankets

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and other forms of insulation rather than using electrical heaters in winter etc. You may find that some learners are already using geyser blankets and solar panels. Those learners may indicate that they are already doing what they can to reduce electricity use.

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NATURAL SCIENCE: LESSON PLAN | **GRADE 9**

PERIOD: 30 MINUTES | **STRAND: ENERGY & CHANGE**

CAPS SENIOR PHASE 34 | **TERM 3**

DURATION: Week Nine Lesson Five	**OBJECTIVES: LEARNERS MUST BE ABLE TO:**	
TOPIC: Cost of electrical power	• Debate/discuss and calculate the energy consumption of different light bulbs(incandescent) and compact fluorescent lamps	
SUB TOPIC: The cost of power consumption		
REFERENCES	Sasol Inzalo workbooks- Natural Sciences Grade 9-B	
TERMINOLOGY:	Incandescent, compact fluorescent lamps,	
SPECIFIC AIMS	1. DOING SCIENCE	✓
	2. KNOWING THE SUBJECT CONTENT & MAKING CONNECTIONS	✓
	3. UNDERSTANDING THE USES OF SCIENCES & INDIGENOUS KNOWLEDGE	

PROCESS SKILLS							
Accessing & recalling Information	✓		Identifying problems & issues	✓		Doing Investigations	
Observing			Raising Questions			Recording Information	
Comparing	✓		Predicting			Interpreting Information	✓
Measuring			Hypothesizing			Communicating	
Sorting & Classifying			Planning Investigations				

CONTENT AND CONCEPTS	ACTIVITIES	RESOURCES
• the energy consumption of different appliances (such as incandescent and compact fluorescent lamps) varies	1. The teacher will bring two samples of light bulbs (incandescent which is an ordinary light bulb and a compact fluorescent) and ask pupils to state the differences between them. 2. The teacher will then proceed to explain the differences between the two light bulbs and explain the energy consumption of both types of bulbs.	• Examples of electricity accounts that show electricity usage and cost

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NATURAL SCIENCE: LESSON PLAN **GRADE 9**

PERIOD: 30 MINUTES **STRAND: ENERGY & CHANGE**

CAPS SENIOR PHASE 34 **TERM 3**

CONTENT AND CONCEPTS	ACTIVITIES	RESOURCES
	3. Learners then complete the activity worksheet comparing the energy efficiency of different light bulbs. See Sasol Inzalo Learner Workbook. Pages 191-192 – attached below	
ASSESSMENT	1. Activity worksheet See (Sasol Inzalo Learner Workbook, pages 191-192) 2. Revision Exercise from Sasol Inzalo Learner Workbook pg 196 – 197 – attached below	
TEACHER REFLECTION	Progress:	Challenges:

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NATURAL SCIENCE: LESSON PLAN

PERIOD: 30 MINUTES

CAPS SENIOR PHASE 34

Sasol Inzalo Learner Workbook, pages 191-192

GRADE 9

STRAND: ENERGY & CHANGE

TERM 3

ACTIVITY: Comparing the energy efficiency of different light bulbs

INSTRUCTIONS:

Read the information in the table and use it to answer the questions.

	LED	Compact Fluorescent Light bulbs (CFLs)	Incandescent light bulbs
Example			
Average life span (in hours)	50 000	8 000	1 200
Watts	8	15	60
Lumens	800	800	800

1. Which of the three light bulbs will last the longest?

_____

2. Which of the three light bulbs has the highest power rating?

_____

3. How do the three light bulbs compare in terms of how much light they can provide?

_____

_____

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4. Calculate how much it would cost to run each light bulb in a house for 5 hours a day for an entire year (365 days). Use 71,65 cents/kWh.



5. Which light bulb would you choose to use? Explain your choice.

6. Which bulb is the best for the environment? Explain your choice.

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NATURAL SCIENCE: LESSON PLAN

PERIOD: 30 MINUTES

GRADE 9

STRAND: ENERGY & CHANGE

TERM 3

The following Revision Exercise from Sasol Inzalo LB pg 196 - 197

REVISION:

1. What is the power rating on the following two appliances? [2 marks]

a) A frying pan.



b) A fan.



2. Refer to the table of power ratings for common appliances. List the appliances in sequence from those that use the least power to those that use the most. [2 marks]

Appliance	Power rating (W)
Stove	3600
Microwave	1200
Washing machine	2200
Kettle	2200
Fridge	230
Toaster	750
Energy saver globe	40
Incandescent light bulb	120
Vacuum cleaner	1600

3. What is electrical power? Explain in your own words. [2 marks]

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MEMORANDUM

ACTIVITY: Comparing the energy efficiency of different light bulbs

TEACHER'S NOTE

More information comparing these three types of lights is available here:
bit.ly/17ytE0y

1. LED

2. Incandescent

3. These three light bulbs all emit the same number of lumens, so they can all provide the same amount of light.

4. LED: cost = 0,008 x 5 x 365 x 71, 65 = 1046, 09 cents = R10, 46

Fluorescent: cost = 0,015 x 5 x 365 x 71, 65 = 1962, 42 cents = R19, 61

Incandescent: cost = 0, 06 5 x 365 x 71, 65 = 784, 68 cents = R78, 46

5. The answer is learner-dependant. Learners should recognise that the LEDs are cheaper to run from day-to-day, although their initial cost is relatively expensive.

6. The LED light uses less electricity for the same light output. This means that less electricity is consumed. If everyone is using LED lights then the overall demand for electricity would be lower and so if less electricity is produced there would be less pollution.

REVISION:

1. a) 1400 W
   b) 120 W

2. Energy saver globe, incandescent light bulb, fridge, toaster, microwave, vacuum cleaner, washing machine, kettle, stove.

3. Learners should explain that it is the amount of electrical energy transferred per second.

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NATURAL SCIENCE: LESSON PLAN | **GRADE 9**

PERIOD: 30 MINUTES | **STRAND: ENERGY & CHANGE**

CAPS SENIOR PHASE 35 | **TERM 3**

DURATION: Week Nine Lesson Six	**OBJECTIVES: LEARNERS MUST BE ABLE TO:**	
TOPIC: Cost of electrical power	• Explain that there are alternative appliances or systems such as solar heating panels for heating water.	
SUB TOPIC: The cost of power consumption		
REFERENCES	Sasol Inzalo workbooks- Natural Sciences Grade 9-B	
TERMINOLOGY:	Infrastructure, electrical infrastructure, solar	
SPECIFIC AIMS	1. DOING SCIENCE	
	2. KNOWING THE SUBJECT CONTENT & MAKING CONNECTIONS	✓
	3. UNDERSTANDING THE USES OF SCIENCES & INDIGENOUS KNOWLEDGE	

PROCESS SKILLS					
Accessing & recalling Information		Identifying problems & issues		Doing Investigations	
Observing	✓	Raising Questions	✓	Recording Information	
Comparing	✓	Predicting		Interpreting Information	
Measuring		Hypothesizing		Communicating	✓
Sorting & Classifying		Planning Investigations			

CONTENT AND CONCEPTS	ACTIVITIES	RESOURCES
• there are also alternative appliances/systems such as solar heating panels for heating water	1. The teacher will introduce the terms infrastructure, electrical infrastructure and solar and ask pupils for their definitions thereof. A discussion of the terms will then take place. -- - Infrastructure: physical items such as roads, drains, water supply, electricity power lines and power stations that a modern country or	• Examples of electricity accounts that show electricity usage and cost • Pictures or video

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NATURAL SCIENCE: LESSON PLAN **GRADE 9**

PERIOD: 30 MINUTES **STRAND: ENERGY & CHANGE**

CAPS SENIOR PHASE 35 **TERM 3**

CONTENT AND CONCEPTS	ACTIVITIES	RESOURCES
	community needs - Electrical infrastructure: infrastructure used to generate electricity and distribute it along power lines to users. - Solar: to do with the sun 2. The teacher will then ask pupils for input regarding alternative appliances or systems which could be used to heat water for eg. 3. The learners will then complete the worksheet on the interpretation of a solar water heater diagram (See teachers guide for activity)	clips showing solar panels
ASSESSMENT	1. Activity worksheet: Interpret a solar water heater diagram **(See teachers guide for activity)** 2. Revision Exercise – Sasol Inzalo Learner Workbook Pg 198 – 201 – attached below	
TEACHER REFLECTION	Progress:	Challenges:

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8. An electric kettle is rated at 1000 W. If it is used for 1 hour every day, find the number of units of electrical energy it consumes for the month of August. [3 marks]

9. Your house's electricity meter in March was 3456 and in April it was 4566.

   a) How much electrical energy did your household use in that one month period? [2 marks]

   b) If electrical energy is charged at 71,65 c/kWh, what will your bill be for that one month period? [3 marks]

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NATURAL SCIENCE: LESSON PLAN

PERIOD: 30 MINUTES

CAPS SENIOR PHASE 35

GRADE 9

STRAND: ENERGY & CHANGE

TERM 3

10. A 120 W electric blanket is left on for 8 hours.
    a) How many kilowatt hours of electrical energy is used by the blanket? [3 marks]

    b) If the unit cost of electricity is 71,65 cents, what is the cost, in rands, of using the electric blanket for 8 hours? [3 marks]

11. A 2600 W kettle in a school staffroom is used 8 times a day for five minutes each time.
    a) What is the total time that the kettle is switched on during each 5 day school week? [2 marks]

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b) How much energy is consumed to run the kettle for this period (in kilowatt hours)? [2 marks]

c) If the cost of a unit is 71,65 cents, what is the cost of running the kettle for this period? [3 marks]

12. If you had a prepaid electricity voucher with a value of R35, calculate the following.

a) How long could you run a 230 W fridge for if electricity costs 71,65 cents per kWh. [5 marks]

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b) How long could you run six 60 W incandescent light bulbs? [5 marks]

13. Which light bulb, 15 W CFL or an 8 W LED, would you choose to use? Explain your answer. [3 marks]

14. A tumble dryer has a power rating of 4 500 W. How long did it take to dry a load of wet washing if electricity costs 71,65 cents per kWh and the cost of running the dryer was R4,84? [6 marks]

Total [62 marks]

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MEMORANDUM

8.
Power rating = 1000/1000 = 1 kW
Time = 1 x 31 = 31 hours
Energy consumption = 1 x 31 = 31 kWh

9.
a) Energy consumed = 4566 - 3456 = 1110 kWh

b) Energy = 1110 kWh
Price = 71,65 c/kWh
Cost = 1110 x 71, 65 = 79531,5 cents = R795,32

10
a) Power rating = 120 W = 0,12 kW
Time = 8 hours
Energy = power x time = 0,12 x 8 = 0,96 kWh

b) Cost = 0.96 x 71, 65 = 68,784 cents = R0,69

11.
a) Time = 8 x 5 x 5 = 200 minutes = 3,33 hours per 5 day school week.

b) Power rating = 2 600 W = 2,6 kW
Time = 3,33 hours
Energy = 2,6 x 3,33 = 8,66 kWh

c) Cost = 8,66 x 71,65 = 620,35 cents = R6,20

12.
a) Cost = R35 = 3500 cents
Power rating = 230 W = 0,23 kW
Price of electricity = 71,65 c/kWh

Number of available units (kWh) on voucher = 3500/71, 65 = 48, 85 kWh
Time = energy/power = 48,85 kWh / 0,23 kW = 212 hours

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b) Number of available units (kWh) on voucher = 3500/71, 65 = 48, 85 kWh

Power rating for one bulb = 60 W = 0,06 Kw

Power rating for six bulbs = 0,06 x 6 = 0,36 kW

Time = energy/power = 48,85 / 0,36 = 135,69 hours

13. Both light bulbs produce the same amount of light but because the power rating of the LED is lower, the cost of the electricity to run the light is less. The LED is cheaper to use. Learners may also mention that CFLs contain mercury while LEDs do not.

14.
Cost = R4,84 = 484 cents
Power rating = 4 500 W = 4,5 kW
Cost = energy consumed x price per unit
Energy consumed = cost/price per unit = 484/71,65 = 6,755 kWh
Time = energy/power = 6,755/4,5 = 1,5 hours

.

Energy and

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NATURAL SCIENCES: LESSON PLAN 1 **GRADE: 9**
DURATION: 30 Minutes **STRAND: EARTH AND BEYOND**
CAPS SENIOR PHASE **TERM : FOUR**

DURATION: Week One Lesson One, two and Three **TOPIC:** The Earth a system **SUB TOPIC:** Spheres of the Earth	**OBJECTIVES: LEARNERS MUST BE ABLE TO:** • Understand that all the spheres of the system called Earth continuously interact with one another
REFERENCES	**Sasol Inzalo workbooks- Natural Sciences Grade 9-B**
TERMINOLOGIES:	**Hydrosphere, Lithosphere, biosphere, atmoshere**
SPECIFIC AIMS	1. DOING SCIENCE 2. KNOWING THE SUBJECT CONTENT & MAKING CONNECTIONS 3. UNDERSTANDING THE USES OF SCIENCES & INDIGENOUS KNOWLEDGE

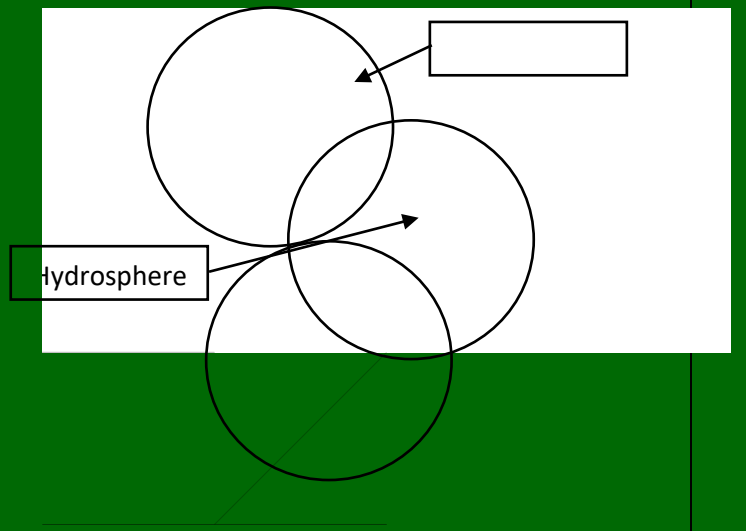
SCIENCE PROCESS SKILLS								
Accessing & recalling Information	√		Identifying problems & issues			Doing Investigations		
Observing			Raising Questions	√		Recording Information		
Comparing			Predicting			Interpreting Information	√	
Measuring			Hypothesizing			Communicating	√	
Sorting & Classifying			Planning Investigations					

CONTENT AND CONCEPTS	ACTIVITIES	RESOURCES
Spheres of the Earth • the Earth can be understood as a complex system where all the parts (called spheres) interact with each other	• Use media e.g. video clip to show the interaction which exist between the four different spheres of the Earth. • Draw a diagram (3 over lapping circles) on the black / white board • Label each of the circles with a differed sphere. The biosphere in the center where ALL circles overlap.	Video link: https://www.youtube.com/watch?v=BnpF0ndXk-8 Textbooks

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NATURAL SCIENCES: LESSON PLAN 1
DURATION: 30 Minutes
CAPS SENIOR PHASE

GRADE: 9
STRAND: EARTH AND BEYOND
TERM : FOUR



- Explain to learners that two or more spheres can interact at a time, but that all four spheres need to interact for life (biosphere) to exist. If all four spheres do not interact, then no life is possible.

- Learners will answer the question attached.

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NATURAL SCIENCES: LESSON PLAN 1 **GRADE: 9**

DURATION: 30 Minutes **STRAND: EARTH AND BEYOND**

CAPS SENIOR PHASE **TERM : FOUR**

CONTENT AND CONCEPTS	ACTIVITIES	RESOURCES

ASSESSMENT	Explain why the Atmosphere, Hydrosphere and Lithosphere are important for life on Earth?	
TEACHER REFLECTION	Progress:	Challenges:

TEACHER'S NOTE

Chapter overview

1 week

In Grade 7 the learners investigated the relationship between the Earth and the Sun, day and night, the seasons and how the Sun's energy is utilized by plants, and how fossil fuels are formed. In Grade 8 they looked at the Earth as part of a bigger system, namely the solar system. This year they will study the Earth as a system itself and the different parts that make up this system. 'Systems' is an important theme that runs through all of science and here we learn about systems in yet another application. In the first chapter the parts of the Earth's system (the spheres) and how the parts work together are examined. The hydrosphere and water cycle were studied in earlier grades and revised here. The biosphere is also studied throughout Natural Sciences. The remaining two spheres are investigated this year - the lithosphere (Chapter 2

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and 3) and the atmosphere (Chapter 4). In the lithosphere we look at how rocks are formed, the minerals found in rocks, how we extract these minerals and the impact our interactions with the lithosphere has on the other spheres. The layers of the atmosphere are studied in the last chapter. The study of the lithosphere and atmosphere links up with what learners have learnt about the atom and compounds in the Energy and Change section, as well as phases of matter and knowledge about gases, like oxygen, carbon dioxide and methane. This will prepare learners for study in Grade 10 and further, where the different branches of Natural Sciences separate into Life Sciences (Biology and Environmental Sciences), Physical Sciences (Chemistry and Physics) and Earth Sciences (Geography).

1.1 Spheres of the Earth

You have learnt about systems and cycles throughout your studies of Natural Sciences over the past 5 years. For example, you have learnt about the life cycle of a butterfly, energy systems in food webs or electric circuits, and the solar system. Much of what we observe in nature is part of one or many systems or cycles. In this chapter we are going to learn about the Earth as a closed system and the four different parts (spheres) of this system.

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Earth's four spheres

The Earth is made up of four systems, or spheres. The biosphere (life), the lithosphere (land), the hydrosphere (water) and the atmosphere (air). On Earth land, water, air and life interact with one another. As humans, we are also part of this interaction. There is a fine balance between these four systems - if the one becomes altered, it has an effect on all the others.

The Biosphere

The biosphere includes all life on Earth - plants, animals and humans. Most of what is studied in Life and Living is about the biosphere. The biosphere also includes life in the oceans, and under the soil. For example bacteria living on decaying plant material and the smallest sea creatures and plants are part of the biosphere. Almost all the life on the planet is found between 3 meters below the surface of the Earth, up to 30 meters above the ground, and in the top 200 meters of the oceans.

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NATURAL SCIENCES: LESSON PLAN 1 **GRADE: 9**
DURATION: 30 Minutes **STRAND: EARTH AND BEYOND**
CAPS SENIOR PHASE **TERM : FOUR**



Biosphere 2 is a man-made research centre in America, in the Arizona Desert, where scientists have built a large enclosed artificial biosphere.

An interesting study was done by a research team in Arizona, USA, where they built a self-contained facility called Biosphere 2 to study the relationship between living things and their environment. The facility had absolutely no contact with anything on Earth, except the Sun. The first group of people lived inside, without exiting, for 2 years. The project wasn't as successful as they planned and they realised that we do not know enough about the interactions between the systems on Earth. The project is still ongoing and used for extensive research. More information is available here (3 bit.ly/1eZtvZj). This can be given as an extension reading for your learners. All living things and their habitats form part of the biosphere. The following photographs provide examples of different organisms in their habitats, living in the biosphere.

230

The hydrosphere

The hydrosphere includes all water on the planet - the oceans, lakes, rivers, groundwater, rain, clouds, glaciers and ice caps. About 70% of the surface of the Earth is covered with water. The oceans contain most of this water, with only a small portion of it being fresh water. All the water on Earth forms part of the hydrosphere.

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NATURAL SCIENCES: LESSON PLAN 1 **GRADE: 9**
DURATION: 30 Minutes **STRAND: EARTH AND BEYOND**
CAPS SENIOR PHASE **TERM : FOUR**



An iceberg.



A river.



Clouds.



The sea.

The atmosphere

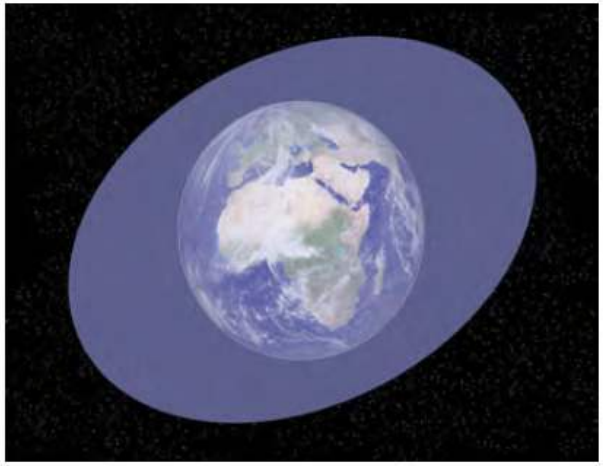
The atmosphere includes all the air above the surface of the Earth all the way to space. All the gases that are present in the air are included in the atmosphere. Most of the atmosphere is found close to the surface of the Earth where the air is most dense. The air contains 79% nitrogen,

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less than 21% oxygen, and a small amount of carbon dioxide and other gases. We will look more closely at the atmosphere later on in this chapter.



The top of Earth's atmosphere.



The region of space occupied by Earth's atmosphere.

The lithosphere

The lithosphere includes the Earth's crust and the upper part of the mantle. All mountains, rocks, soil and minerals included in the Earth's crust are part of the lithosphere. Even the seafloor is part of the lithosphere, because it is also made up of sediments of sand and rock. We will look more closely at the lithosphere in the next section. All the rocks, soil and sand on Earth form part of the lithosphere, as shown in the following photographs.

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NATURAL SCIENCES: LESSON PLAN 1
DURATION: 30 Minutes
CAPS SENIOR PHASE

GRADE: 9
STRAND: EARTH AND BEYOND
TERM : FOUR



Rock formations.



Sand dunes.



Soil.



Mountains.

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NATURAL SCIENCES: LESSON PLAN 1
DURATION: 30 Minutes
CAPS SENIOR PHASE

GRADE: 9
STRAND: EARTH AND BEYOND
TERM : FOUR



Minerals.



Seafloor.

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NATURAL SCIENCES: LESSON PLAN 1 **GRADE: 9**

DURATION: 30 Minutes **STRAND: EARTH AND BEYOND**

CAPS SENIOR PHASE **TERM : FOUR**

MEMORANDUM

The Biosphere

The biosphere includes all life on Earth - plants, animals and humans. Most of what is studied in Life and Living is about the biosphere. The biosphere also includes life in the oceans, and under the soil.

The hydrosphere

The hydrosphere includes all water on the planet - the oceans, lakes, rivers, groundwater, rain, clouds, glaciers and ice caps. About 70% of the surface of the Earth is covered with water. The oceans contain most of this water, with only a small portion of it being fresh water. All the water on Earth forms part of the hydrosphere.

The atmosphere

The atmosphere includes all the air above the surface of the Earth all the way to space. All the gases that are present in the air are included in the atmosphere. Most of the atmosphere is found close to the surface of the Earth where the air is most dense. The air contains 79% nitrogen, less than 21% oxygen, and a small amount of carbon dioxide and other gases. We will look more closely at the atmosphere later on in this chapter.

The lithosphere

The lithosphere includes the Earth's crust and the upper part of the mantle. All mountains, rocks, soil and minerals included in the Earth's crust are part of the lithosphere. Even the seafloor is part of the lithosphere, because it is also made up of sediments of sand and rock. We will look more closely at the lithosphere in the next section.

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NATURAL SCIENCES: LESSON PLAN 2 **GRADE: 9**
DURATION: 90 Minutes **STRAND: EARTH AND BEYOND**
CAPS SENIOR PHASE **TERM : FOUR**

Duration: Week One lesson Four, Five and Six **TOPIC:** The Earth a system **SUB TOPIC:** Spheres of the Earth - Continued	**OBJECTIVES: LEARNERS MUST BE ABLE TO:** • understand the concept "gravity" • know that the atmosphere consist of a mixture of gases and that, • these gases are held around the Earth by gravity • know that the word air refers to the mixture of gases found in the atmosphere • understand the concept "density of gases" • know why the density of gases decreases as the distance from the Earth increases
REFERENCES	**Sasol Inzalo workbooks- Natural Sciences Grade 9-B**
TERMINOLOGIES:	**Gravity, Atmosphere, Density of Gases**
SPECIFIC AIMS	1. DOING SCIENCE 2. KNOWING THE SUBJECT CONTENT & MAKING CONNECTIONS 3. UNDERSTANDING THE USES OF SCIENCES & INDIGENOUS KNOWLEDGE

SCIENCE PROCESS SKILLS							
Accessing & recalling Information			Identifying problems & issues			Doing Investigations	
Observing			Raising Questions			Recording Information	
Comparing			Predicting			Interpreting Information	
Measuring			Hypothesizing			Communicating	
Sorting & Classifying			Planning Investigations				

CONTENT AND CONCEPTS	ACTIVITIES	RESOURCES
Spheres of the Earth four spheres interact on or near the surface of the Earth: -- the lithosphere consists of solid rock and soil -- the hydrosphere consists of water in all its forms -- the atmosphere is a layer of gases around the Earth -- the biosphere consists of all living plants and animals and their interactions with rocks, soil, air and water	• Revise the definition gravity and explain to learners that gases, like any other object which has mass, are pulled towards the Earth by the force of gravity. • Teacher clarifies the fact that the word "air" refers to the mixture of all gases found in the atmosphere. • Teacher, with learner input, lists all the gases in the atmosphere in a two column table. • The percentage of each gas making up the gas	Textbook CAPS p. 78

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NATURAL SCIENCES: LESSON PLAN 2 **GRADE: 9**
DURATION: 90 Minutes **STRAND: EARTH AND BEYOND**
CAPS SENIOR PHASE **TERM : FOUR**

CONTENT AND CONCEPTS	ACTIVITIES	RESOURCES
	mixture (air) must also be included in the table. • Teacher explains the concept of density of gases (amount of gas per volume of gas) • Explain the decrease of air (mixture of atmospheric gases) density as the distance from the Earth increases. • Use a diagram which shows that the air gets thinner (less particles per volume) as you move higher up into the atmosphere. • Explain this phenomenon in terms of gravitational pull on the air molecules which become less effective with an increase of height from the surface of the Earth. • Explain to learners that two or more spheres can interact at a time, but that all four spheres need to interact for life (biosphere) to exist. If all four spheres do not interact, then no life is possible.	Textbooks

ASSESSMENT	**Verbal activity:** Learners identify examples (excluding the examples already mentioned in the class activity) of interactions between the following spheres **Written activity:** 1.1 Make use of the table (Activity) and draw a labelled pie chart which will clearly show the percentage of each gas making up the mixture of gases in the atmosphere.	
TEACHER REFLECTION	Progress:	Challenges:

TEACHER GUIDE

The four spheres:

- The four spheres of the Earth make a coordinated system.

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- There is interdependency between the systems.
- The biosphere is a sphere where life is and the spheres in the biosphere are also interlinked.
- The parts of the biosphere are connected

The following collage shows the four spheres of the Earth.

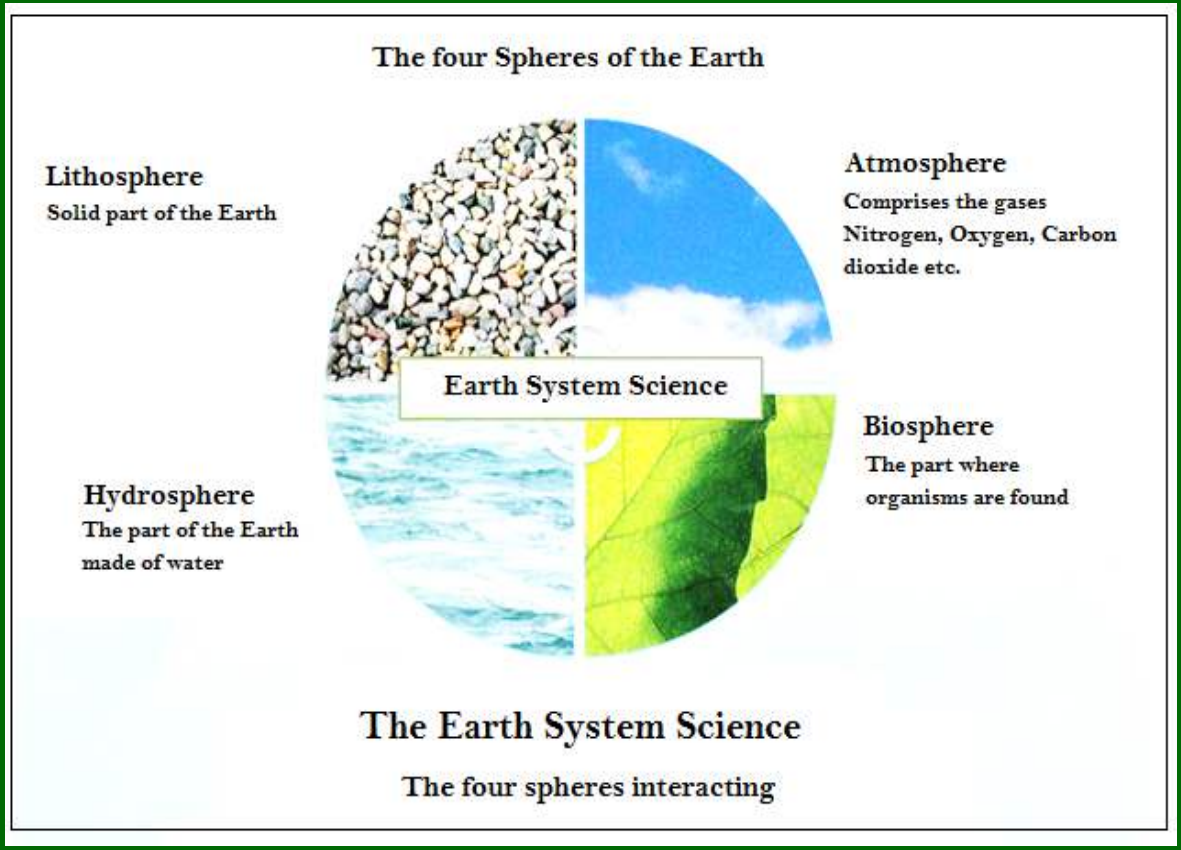


TEACHER'S NOTE
This is a very short (2:07 min) video of the four spheres of the Earth.
4 abt.cm/16Ghu5N
It summarises what was covered so far in this chapter. If you have facilities, this can be played to the class at the end of the lesson. If not, the content is covered in the text in this section.

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NATURAL SCIENCES: LESSON PLAN 2
DURATION: 90 Minutes
CAPS SENIOR PHASE

GRADE: 9
STRAND: EARTH AND BEYOND
TERM : FOUR



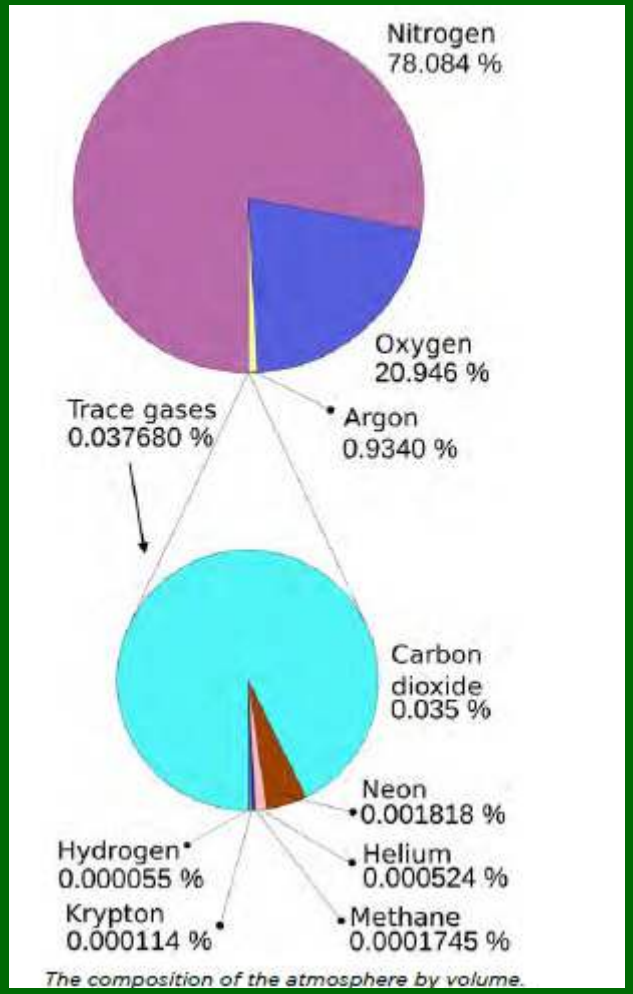
Gravity and pressure:

- Gravity pulls gas molecules (air) towards the Earth.
- The density of the gas mixture (air) decreases with the increase in altitude.
- Air pressure at sea level is at a maximum (More collisions between the higher density air molecules is responsible for the higher air pressure.
- The diagram here shows how pressure decreases with altitude.
- The average pressure at sea level as shown in the diagram is 760 mmHg and 250 mmHg at the highest point.
- Generally it is expected that there would be more oxygen at sea level than at a high altitude.

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- At high altitude people have a difficulty in breathing resulting in what is known as altitude sickness.

MEMORANDUM



The composition of the atmosphere by volume.

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NATURAL SCIENCES: LESSON PLAN 3 **GRADE: 9**
DURATION: 90 Minutes **STRAND: EARTH AND BEYOND**
CAPS SENIOR PHASE **TERM : FOUR**

DURATION: Week Two Lesson One, Two Three **TOPIC:** The Lithosphere **SUB TOPIC:** Lithosphere	**OBJECTIVES: LEARNERS MUST BE ABLE TO:** • Explain the meaning of the word Lithosphere. • Label the parts of lithosphere. • Explain each part of the Lithosphere.
REFERENCES	**Sasol Inzalo workbooks- Natural Sciences Grade 9-B**
TERMINOLOGIES:	**Lithosphere, geosphere, continental crust, oceanic crust, crust, mantle, core and composition**
SPECIFIC AIMS	1. DOING SCIENCE 2. KNOWING THE SUBJECT CONTENT & MAKING CONNECTIONS 3. UNDERSTANDING THE USES OF SCIENCES & INDIGENOUS KNOWLEDGE

SCIENCE PROCESS SKILLS							
Accessing & recalling Information			Identifying problems & issues			Doing Investigations	
Observing			Raising Questions	√		Recording Information	√
Comparing	√		Predicting			Interpreting Information	√
Measuring			Hypothesizing			Communicating	√
Sorting & Classifying	√		Planning Investigations				

CONTENT AND CONCEPTS	ACTIVITIES	RESOURCES
Lithosphere • the Earth consists of four concentric layers called the inner core, outer core, mantle and crust *(link to Grade 7 Social Sciences*) • the lithosphere ('lith' means 'rocks') has three layers: the solid outermost part of the mantle, the crust and the soil • different combinations of elements and compounds form minerals such as copper, gold and hematite (iron oxide) in the crust	The teacher will introduce the lesson, while learners listen. The teacher will use the diagram of the earth to show the different parts. The teacher will explain each part. Learners will copy the summary in their note books.	Textbook CAPS p. 84

ASSESSMENT		
TEACHER REFLECTION	Progress:	Challenges:

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NATURAL SCIENCES: LESSON PLAN 3 **GRADE: 9**
DURATION: 90 Minutes **STRAND: EARTH AND BEYOND**
CAPS SENIOR PHASE **TERM : FOUR**

Teacher's Note

The Earth is a system consisting of many parts. In the previous chapter we looked at how these parts or spheres interact. In this section we are going to look more closely at one of these spheres, namely the **lithosphere**.

2.1 What is the lithosphere?

On Earth, water, air, stone and life interact. Let's think about the stone part of this statement. Where on Earth do we find stone? What are the different forms of stone that are found on Earth? Why is it important to know about this part of the Earth? Let's investigate these questions.



Sand.



Pebbles.

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NATURAL SCIENCES: LESSON PLAN 3
DURATION: 90 Minutes
CAPS SENIOR PHASE

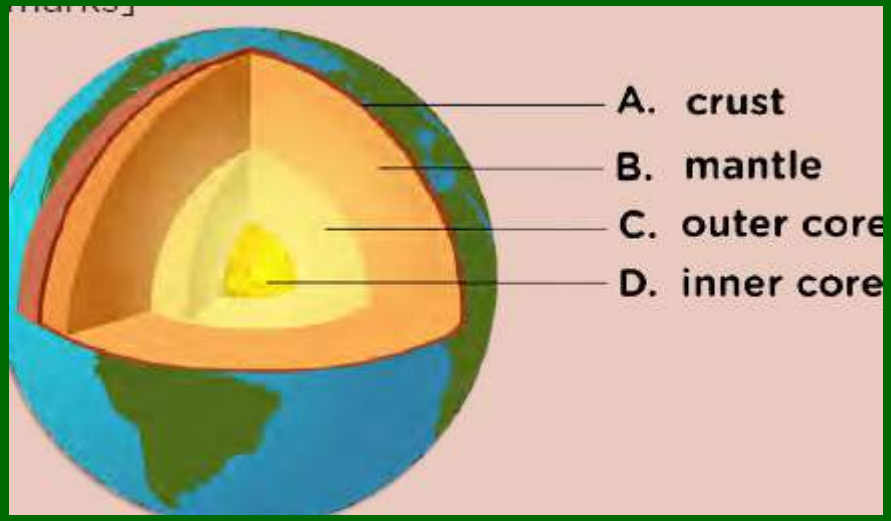
GRADE: 9
STRAND: EARTH AND BEYOND
TERM : FOUR



Stones.



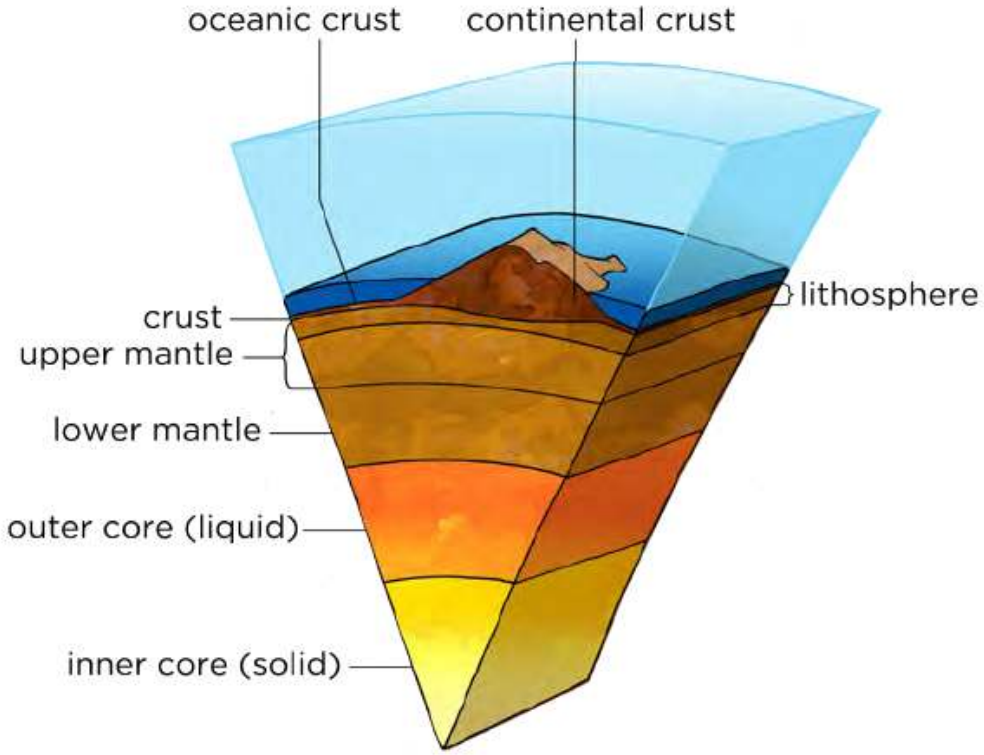
Large boulders.



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The core has two parts, the **inner core** which is solid and the **outer core** which is liquid. The mantle can also be divided into two parts, the **lower mantle** and the **upper mantle**. Some parts of the crust are found under the oceans. This is called the **oceanic crust**. Other parts of the crust form part of the continents and is called **continental crust**. The brittle upper part of the mantle and the crust form the **lithosphere**. The lithosphere, the mantle and the core are sometimes called the **geosphere**. The geosphere is also one of the parts of the Earth, just like the **hydrosphere**, **atmosphere** and **biosphere** that you learnt about in the previous chapter.



The layers inside the Earth.

- The Earth consists of four concentric layers called the inner core, the outer core, the mantle and the crust.
- The lithosphere consists of the solid outermost part of the mantle, the crust and sediments covering it.

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NATURAL SCIENCES: LESSON PLAN 3 **GRADE: 9**

DURATION: 90 Minutes **STRAND: EARTH AND BEYOND**

CAPS SENIOR PHASE **TERM : FOUR**

• The rock cycle is the natural continuous process in which rocks form, are broken down and re-form over long periods of time. The rock cycle has a number of steps.
• There are three rock types: igneous rock, sedimentary rock and metamorphic rock.
• Sedimentary rock is formed when rocks on the surface are weathered and the small particles, along with plant and animal material, are deposited in sediments at the bottom of lakes, oceans and rivers. Over time, more and more layers of sediment are deposited. The resulting increase in pressure causes compaction and the formation of hard layers of sedimentary rock.
• Fossils are often found in sedimentary rock as when some organisms die, they become incorporated into the layers of sediment..
• Hot magma is found deep below the surface of the Earth. When magma cools slowly, below the surface of the Earth, it forms intrusive igneous rock. When the magma pushes up through the crust (for example in a volcano), it cools rapidly and forms extrusive igneous rock.
• Hot magma can heat the surrounding rock and change other types of rock into metamorphic rock.
• Different combinations of elements and compounds form the minerals in the crust.

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NATURAL SCIENCES: LESSON PLAN 4 **GRADE: 9**
DURATION: 180 Minutes **STRAND: EARTH AND BEYOND**
CAPS SENIOR PHASE **TERM : FOUR**

DURATION: Week Two Lesson Four, Five and Six **Week Three Lesson One, Two and Three**	**OBJECTIVES: LEARNERS MUST BE ABLE TO:** • Explain the rock cycle. • Label each part of the rock cycle. • Explain the three types of rocks. • State the differences of three types of rocks.
TOPIC: The Lithosphere	
SUB TOPIC: The Rock Cycle	
REFERENCES	**Sasol Inzalo workbooks- Natural Sciences Grade 9-B**
TERMINOLOGIES:	**Metamorphic rock, sedimentary rock, igneous rock, magma, cycle, weathering, compaction, erosion, deposition, melting, cooling, solidify, sediment, sedimentation, cementation**
SPECIFIC AIMS	1. DOING SCIENCE
	2. KNOWING THE SUBJECT CONTENT & MAKING CONNECTIONS
	3. UNDERSTANDING THE USES OF SCIENCES & INDIGENOUS KNOWLEDGE

SCIENCE PROCESS SKILLS							
Accessing & recalling Information			Identifying problems & issues			Doing Investigations	
Observing			Raising Questions	√		Recording Information	√
Comparing	√		Predicting			Interpreting Information	√
Measuring			Hypothesizing			Communicating	√
Sorting & Classifying	√		Planning Investigations				

CONTENT AND CONCEPTS	ACTIVITIES	RESOURCES
The rock cycle • the rock cycle is the natural continuous process in which rocks form, are broken down and re-form over long periods of time • there are three rock types: igneous, sedimentary and metamorphic rocks • the rock cycle can be explained in the following steps: -- molten rock from the mantle (magma) pushes up through the crust -- pools of magma cool down slowly in the crust to form igneous rocks, like granite	Part 1 The teacher explains the rock cycle using the teacher's notes. Learners will complete the activities 1 and 2. Part 2 The teacher will continue with the explanation of the rock cycle. Learners will complete activity 3 Part 3 The teacher will use the notes and pictures to complete the last part of the rock cycle. Learners will complete activity 4 and the revision activity.	Textbook CAPS p. 84

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NATURAL SCIENCES: LESSON PLAN 4 **GRADE: 9**
DURATION: 180 Minutes **STRAND: EARTH AND BEYOND**
CAPS SENIOR PHASE **TERM : FOUR**

CONTENT AND CONCEPTS	ACTIVITIES	RESOURCES
-- some magma escapes to the surface as a volcano -- this magma cools down rapidly to form igneous rocks, like pumice stone rocks on the surface of the Earth are weathered by heat, cold, wind and water to form smaller particles -- wind and water transport these particles to flood plains and the sea by erosion -- the particles are laid down as sediments -- the sediments are covered by more layers **The rock cycle** – explained in steps • the pressure of many layers turns the lower layers into sedimentary rock like sandstone • hot magma heats the surrounding rock and changes its chemical structure to form metamorphic rock like slate from shale or marble from limestone • some rock is pushed below the crust, melts and becomes magma again		
ASSESSMENT		
TEACHER REFLECTION	Progress:	Challenges:

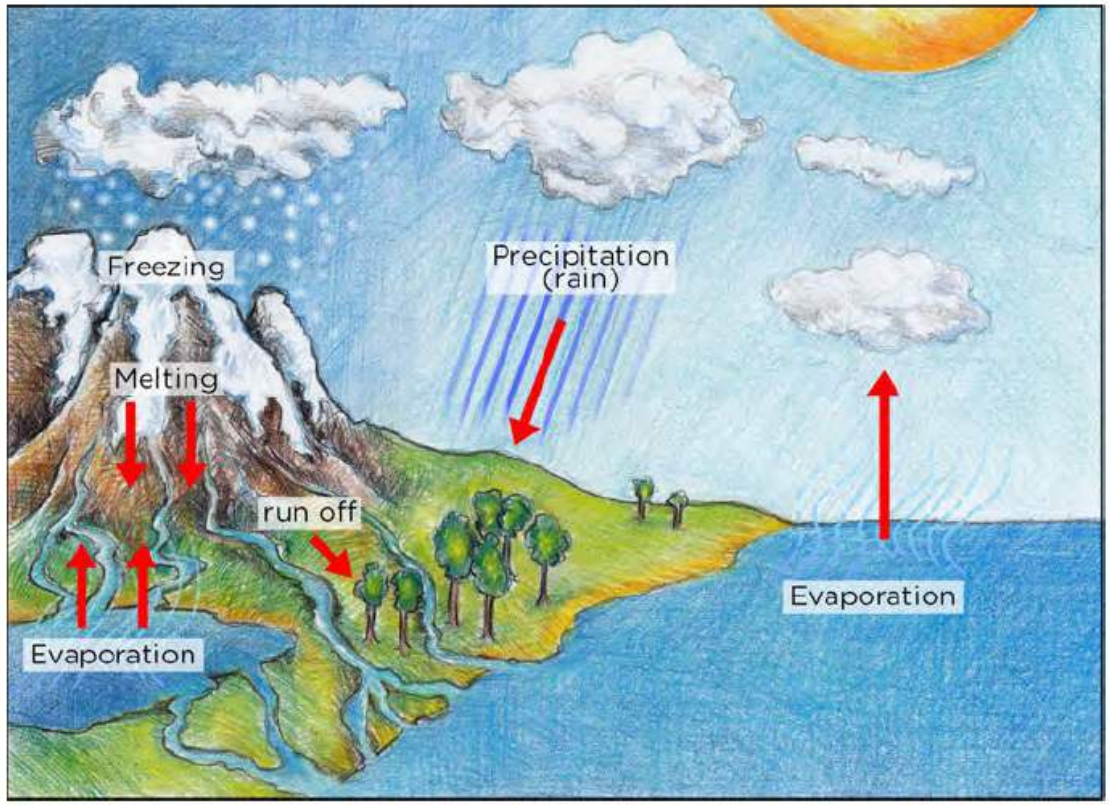
Part One
Teacher's Notes
2.2 The rock cycle

In previous grades you learnt about the water cycle. A cycle is a combination of processes that take place in a certain sequence and which repeat over and over again from the beginning. Processes in a cycle do not stop and are therefore said to be continuous. For example, the **water cycle** which is part of the biosphere describes how water forms clouds, rain, rivers and clouds again.

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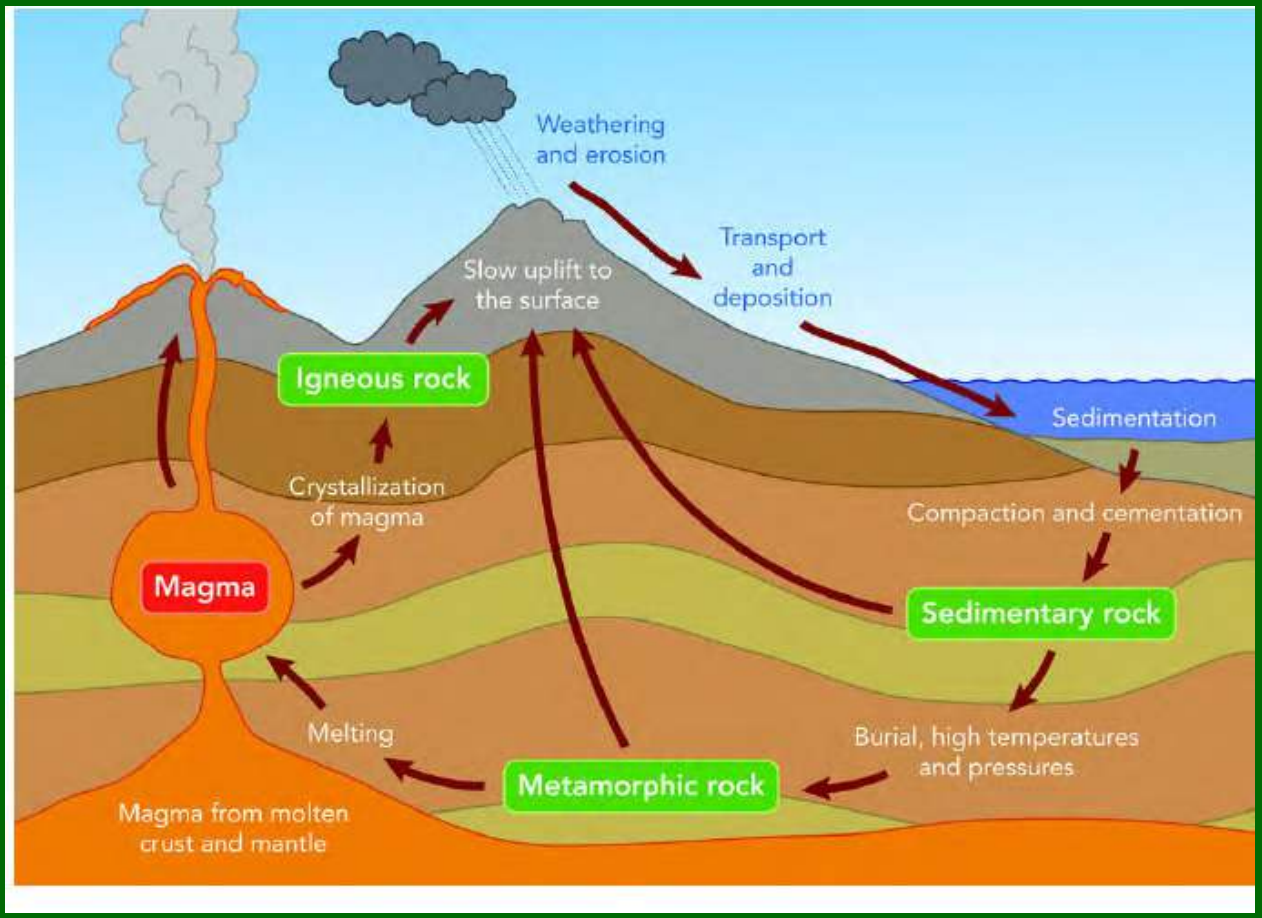
An example of a cycle, with which you are familiar, is the water cycle.

The **carbon cycle**, which takes place as part of the biosphere, describes the movement of carbon through carbon dioxide, fossil fuels and carbohydrates.
The **rock cycle** is part of the lithosphere and it describes how rocks change from one form into another and eventually back into the first form.

How does the rock cycle work?
1. **sedimentary rocks**
2. **metamorphic rock**
3. **igneous rock**

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This classification is based on where the rocks were formed. The following diagram summarizes the rock cycle.



The rock cycle is a natural continuous process in which rocks form, are broken down and re-form again over long periods of time. The process can be described as follows:

• Wind, water, heat and cold cause the weathering of rocks on the surface of the Earth. The rocks are broken up into smaller and smaller pieces and form sand.

• Wind and water wash the sand and small stones away and deposit them as **sediments** into lakes and the ocean. This process is called **deposition**.

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• The sediments settle at the bottom of the oceans, lakes and rivers. Over time they get covered with more layers of sediment. The pressure from the additional layers causes the sediments to compact and solidify to form **sedimentary rock**.
• The sedimentary rock may be buried deeper and deeper beneath the surface of the Earth through movement in the Earth's crust (where oceanic plates and continental plates meet). The rocks can also be pushed deeper (sub ducted) into the Earth. As the rocks move deeper into the Earth, temperature and pressure increase.
• Rocks become more compact as processes of compaction and cementation occur. As the chemical compounds in the rocks change, due to heat and pressure, metamorphic rock is formed.
• Over time the metamorphic rock can move deeper into the Earth, melt and become **magma**.
• Magma moves towards the surface of the Earth through volcanic pipes. The hot magma cools slowly on its way to the surface and forms **igneous rock**. Magma can also break through the surface as lava in volcanoes. In this case, the lava will solidify quickly on the surface to form igneous rocks. Igneous rock can form in the crust or on the surface.
• Igneous rocks get eroded by wind and water and the whole process starts again. Metamorphic rock is formed deeper under the surface and only becomes exposed to the surface when the layers above it are removed by erosion. Igneous rock, just like sedimentary rock, can move deeper into the Earth and form metamorphic rock due to the increase in pressure and temperatures.
As you can see in the previous diagram, rocks of all types may move down through the mantle, melt and mix with magma. The Earth's crust is continually recycled. This is why we refer to the process as the **rock cycle**.

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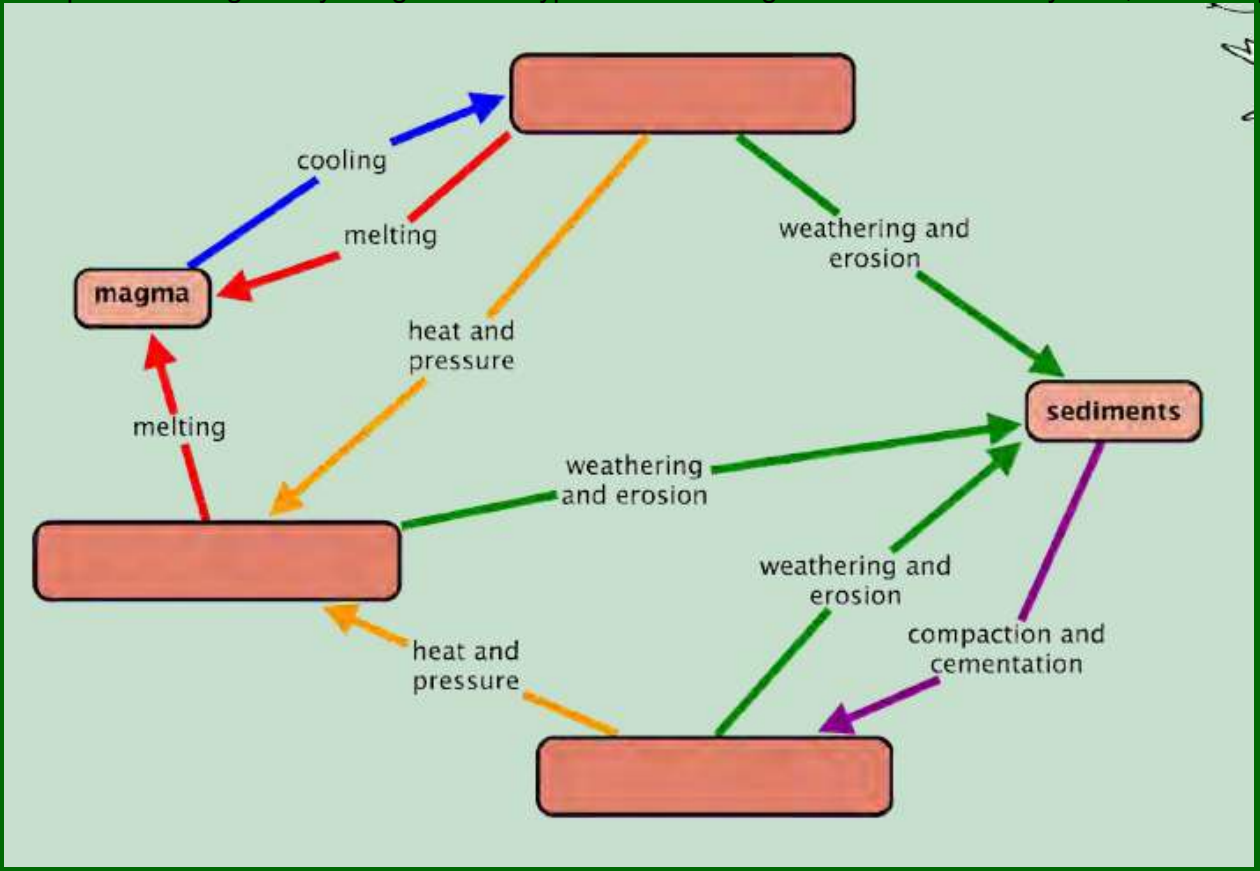
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DURATION: 180 Minutes **STRAND: EARTH AND BEYOND**
CAPS SENIOR PHASE **TERM : FOUR**

ACTIVITY 1: Summarising the rock cycle

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QUESTIONS:

1. Complete the diagram by filling in which type of rock belongs where: Sedimentary rock, Metamorphic rock, Igneous rock.



2. Name the process by which igneous rock is formed.
3. Which type(s) of rock form sediment?
4. What conditions are needed for metamorphic rock to form?
5. Explain what 'weathering and erosion' of rock mean.
6. Explain what 'compaction' means.

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7. What type of rock is formed through compaction?
8. What is magma? Explain the role of magma in the rock cycle.

ACTIVITY 2: Explaining the rock cycle

INSTRUCTIONS:
Write a paragraph to explain the rock cycle in your own words. Start the explanation with the formation of igneous rock. Use full sentences and include
the following key words in your write-up.

Key words:
• melting
• deposition
• erosion
• cooling
• compact
• temperature
• pressure
• metamorphic rock
• igneous rock
• sedimentary rock

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DURATION: 180 Minutes **STRAND: EARTH AND BEYOND**
CAPS SENIOR PHASE **TERM : FOUR**

ACTIVITY 3: Modelling the formation of sedimentary rock

MATERIALS:
• 3 slices of white bread
• 3 slices of brown bread
• heavy books or object

INSTRUCTIONS:
1. Cut off the crust from all the sides.
2. Layer the slices on top of each other, alternating the white and brown slices. Each slice represents a different layer of sediment.
3. Draw a labelled diagram of what the stack looks like.
4. Place a piece of plastic on top of the bread stack to protect the bottom book in your book stack, then place a pile of books on top of the bread stack. Observe what happens to the layers. Write your observations here.



5. Add more books to the pile and observe. What happens to the layers?

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6. Remove the books from the bread pile. Can you distinguish the different layers now?



7. Draw a labelled diagram of the bread layer.
8. Explain how this model demonstrates the formation of sedimentary rock.

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DURATION: 180 Minutes **STRAND: EARTH AND BEYOND**
CAPS SENIOR PHASE **TERM : FOUR**

ACTIVITY 4: Comparing the properties of igneous rocks

INSTRUCTIONS:
Study the following igneous rocks and compare their similarities and differences in the following table.

240
.



Sample 1. *Sample 2.*

Planet Ear

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GRADE: 9
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Sample 3.



Sample 4.

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GRADE: 9
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TERM : FOUR

Sample	Where was the sample formed? Extrusively or Intrusively	How quickly did it cool? What evidence do you have for your answer?	Was air trapped when it was formed? What evidence do you have for your answer?	Describe the colour
Sample 1				
Sample 2				
Sample 3				
Sample 4				

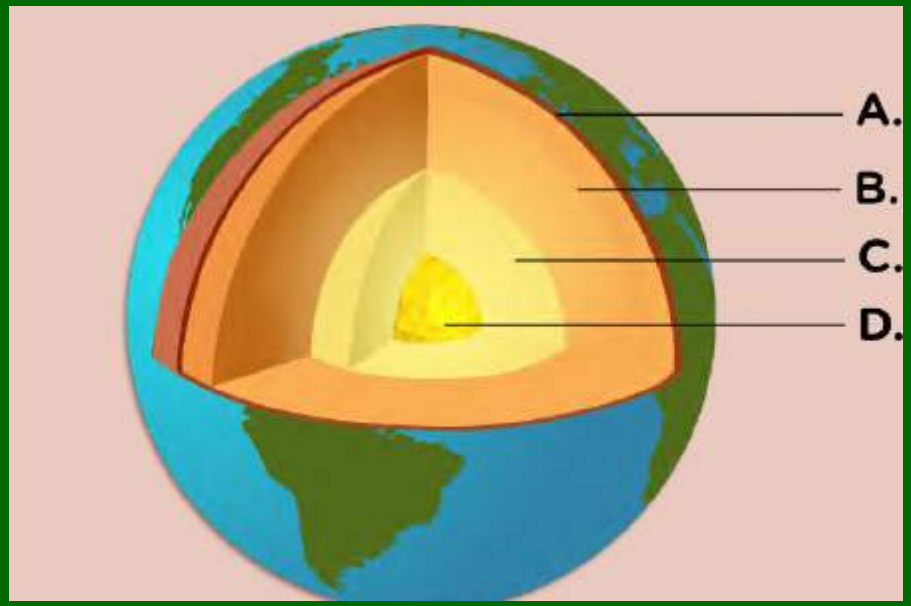
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REVISION:

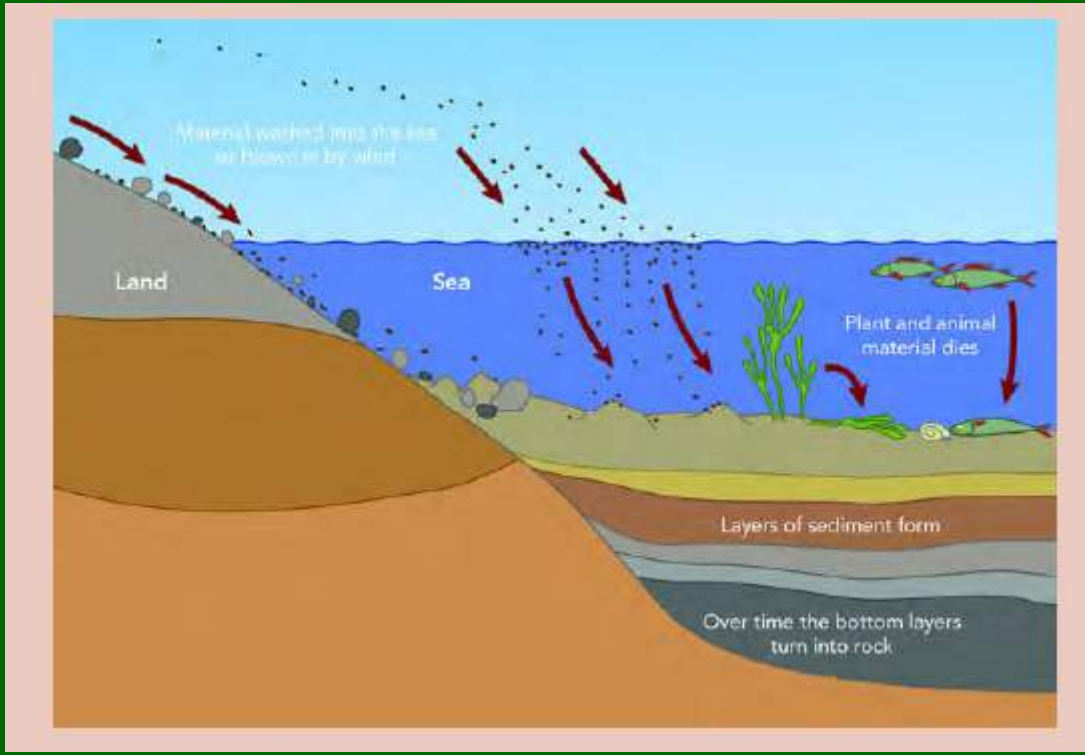
1. The Earth consists of different layers.
a) Label the following diagram: [4 marks]



b) What is the difference between parts C and D? [2 marks]
c) What does part B consist of? [1 mark]
d) Give three examples of things found around your school that form part of part A. [3 marks]
2. Why are there so many different rocks found on Earth? [2 marks]
3. The diagram below shows the formation of one of the rock types. Study the diagram and answer the question that follow.

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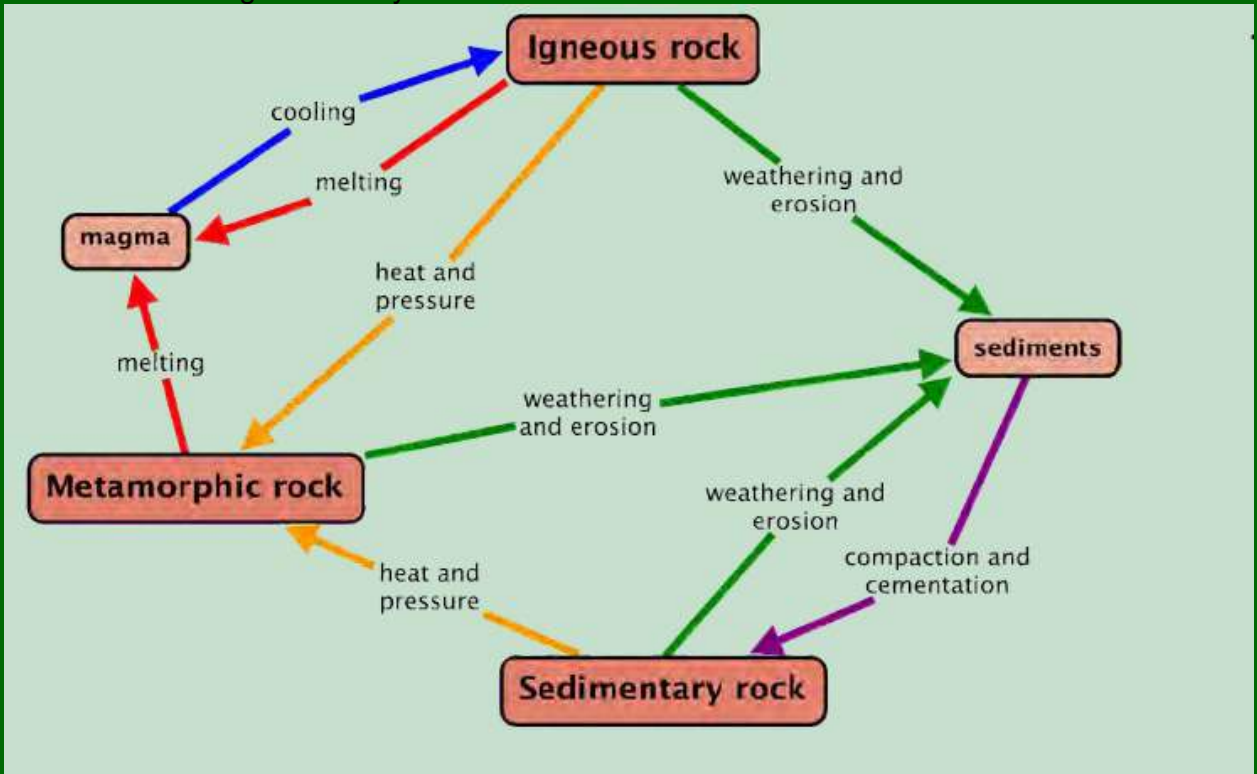


a) What type of rock formation is shown in the diagram? Give a reason for your answer. [2 marks]
b) What processes are involved in the formation of this type of rock? [2 marks]
c) What will happen if the rocks formed here move deeper into the Earth? [3 marks]
4. Fossils are often found in sedimentary rocks. Explain why this is the case. [4 marks]
5. Explain the difference between the formation of igneous rock, such as granite, and igneous rock, such as pumice. [4 marks]
6. Iron is an element found abundantly on Earth, especially in the core of the
Earth. Iron combines with oxygen to form haematite, the mineral form of iron (III) oxide. Haematite is present in sedimentary rocks, for example in the Sishen area in the Northern Cape.
a) What is the formula for iron (III) oxide? [1 mark]
b) How does iron end up in sedimentary rock? [3 marks]
c) Why is hematite an important mineral? [1 mark]

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CAPS SENIOR PHASE **TERM : FOUR**

MEMORANDUM
ACTIVITY 1: Summarising the rock cycle



2. Name the process by which igneous rock is formed.
Cooling.

3. Which type(s) of rock form sediment?
Igneous, metamorphic as well as sedimentary (all rock types).

4. What conditions are needed for metamorphic rock to form?
Increased temperature and pressure.

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5. Explain what 'weathering and erosion' of rock mean.
It is the action of wind and water which cracks and breaks up pieces of rock.

6. Explain what 'compaction' means.
It is a process where the particles are compressed closer together (for example through the action of pressure).

7. What type of rock is formed through compaction?
Sedimentary rock.

8. What is magma? Explain the role of magma in the rock cycle.
Magma is molten (melted) rock. It is called lava when it flows onto the surface of the Earth. Magma and lava form igneous rock when they cool,

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ACTIVITY 2: Explaining the rock cycle
The words can be used more than once, and you should add your own keywords as well. You should also include a labelled diagram in your write-up.

The rock cycle is the natural, continuous process in which rocks form, are broken down and re-form over long periods of time. There are three rock types: igneous, sedimentary and metamorphic rocks. The rock cycle can be explained
in the following steps:
• molten rock from the mantle (magma) pushes up through the crust
• pools of magma cool down slowly in the crust to form igneous rocks, like granite
• some magma escapes to the surface as lava in the form of a volcano
• lava cools to form igneous rocks
• the rate at which the lava cools affects the properties of the rocks formed
• rocks on the surface of the Earth are weathered by heat (expansion), cold (contraction), wind and water to form smaller particles
• wind and water transport these particles to floodplains and the sea by erosion
• the particles are laid down as sediments
• the sediments are covered by more layers of sediment
• the pressure of many layers turns the lower layers into sedimentary rock like sandstone
• magma heats the surrounding rock and changes its chemical structure to form metamorphic rock like slate from shale or marble from limestone
• some rock is pushed below the crust, melts and becomes magma again.

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DURATION: 180 Minutes **STRAND: EARTH AND BEYOND**
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Part Two
Sedimentary rock

TEACHER'S NOTE
Learners do not need to memorise the different names for all the examples of rocks in the following three sections, but they should be able to name one or two examples for each rock type. It is important to realise that rocks are used as materials in our daily lives. Many of the words will be familiar as they are referred to in everyday language (limestone, granite, etc.) so it will be good for learners to know the origins of these stones. This section links up with what is covered in the Matter and Materials strand. Stone is a natural material and resource that humans have used in the past and are still using today. The usefulness of a particular material, stone in this case, is due to its properties. Sedimentary rocks are formed when layers of sediment solidify over time.
Sediments are layers of particles from pre-existing rock or once-living organisms, for example, shells. Rocks on the surface of the Earth are weathered by expansion and contraction due to changes in temperature, wind and water, and also by erosion due to animals. Bigger rocks break up into smaller and
smaller particles through the process of erosion.



Wind and water transport the loose, smaller particles, along with debris from living organisms, and some large stones, eventually depositing them on
flood plains and in the sea. This is called erosion. The material accumulates at the bottom of oceans, rivers, lakes and swamps. The sediment settles and forms layers. These layers build up upon each other and cause the compaction of the lower layers.
Over time, the bottom layers eventually solidify and form layers of sedimentary rock, as is shown in the following diagram.

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TEACHER'S NOTE
An easy demonstration to show the concept of deposition is to mix some soil in water in a glass jar and then place it on the table in front of the class and allow the particles to settle at the bottom through the course of the class. You can then also pour in different colours of sand or soil to illustrate the different sedimentary layers.

TEACHER'S NOTE
The video link provided in the **Visit** box on the 'Formation of sedimentary rock under the sea' provides a clear and easy to understand demonstration of how sediment is deposited on the bottom of the sea in layers. You can even construct something similar to this model in your classroom to show learners.

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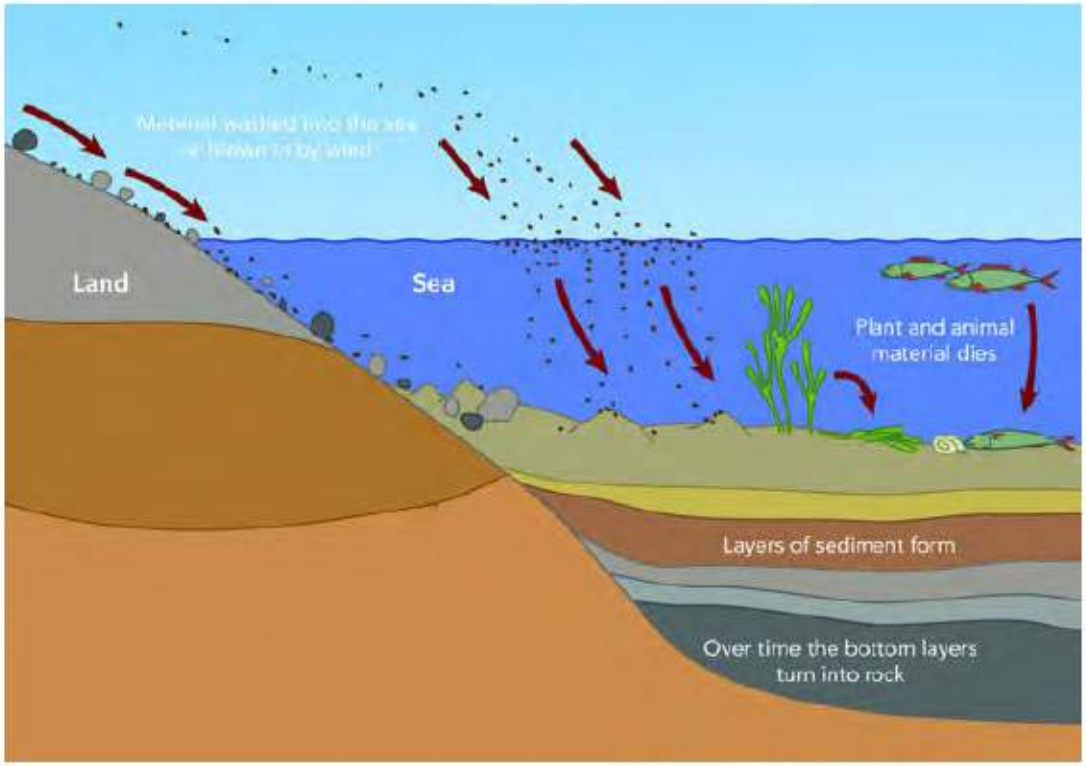


Soil erosion due to water.[3]

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CAPS SENIOR PHASE **TERM : FOUR**



The formation of sedimentary rock.

Although sedimentary rock is found in most places on Earth, these rocks make up only 8% of the Earth's crust. Different layers of sedimentary rock may be seen in the mountains and rocks around us on a daily basis. In the photograph you can clearly see the layers of sediment which have solidified over millions of years to form the sedimentary rocks of the Grand Canyon.

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The layers in the sedimentary rock in the Grand Canyon.

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You can see the layers in the sedimentary rock making up Table Mountain in Cape Town.



The sandstone layers of Table Mountain.

There are different types of sedimentary rock, including sandstone, limestone, dolomite, coal, shale and conglomerate.

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CAPS SENIOR PHASE **TERM : FOUR**



Sandstone rock in the Cederberg in the Western Cape.



Layers of limestone sedimentary rock.

Limestone is a sedimentary rock made from the mineral calcium carbonate (CaCO3), often formed from the remains of the skeletons of marine animals. We use limestone as building stone in the manufacture of lime (calcium carbonate), and cement. Dolomite is a sedimentary rock made from calcium magnesium carbonate ($CaMg(CO_3)_2$). Coal is another example of sedimentary rock formed from the solidified remains of ancient plants at the bottom of swamps. Shale is a very fine-grained sedimentary rock formed from the deposition of mud and silt. It is made up of very thin layers all stuck together. Conglomerate is a sedimentary rock made up of small stones, shells and other pieces of sediment.

Cementation is the process whereby sand and associated shells, pebbles and other sediment become cemented together to form sedimentary rock. Sedimentary rock is softer than the other types of rock. It is eroded by the actions of wind, water or ice (glaciers). Fossils, especially of sea creatures, are often found in sedimentary rocks, lying cemented in the sediments in which they fell when they died. When plants or animals die, they are often covered in sand, which later becomes rock, capturing the fossil inside.

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Dolomite mountains.



Fossils in sedimentary rock.



Limestone (creamy-brown) on top of shale (dark grey).



Conglomerate showing the layers with small pebbles embedded in the rock.

Let's take a look at how the layers of sediment are compressed and become harder over time due to pressure.

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ACTIVITY 3: Modelling the formation of sedimentary rock - MEMORANDUM

TEACHER'S NOTE

This is a good opportunity to discuss how models are used in Science to represent and explain what happens in reality. This model shows how different layers of sediment are deposited, represented by the different layers of brown and white bread. Initially the layers are quite loose, but over time as more layers are added, the bottom layers become compressed. This is represented in the model by adding on more books to increase the pressure on the layers. More books are added to represent the passing of time and more pressure. Eventually the layers of rock are squashed (cementation has taken place) and it is not as easy to recognise the different layers, as in sedimentary rock.

Part 3

Metamorphic rock

TEACHER'S NOTE

A suggestion is to get samples of slate, marble, sandstone and granite from natural stone tile shops for learners to look at and handle.

Metamorphic rock makes up a large part of the Earth's crust. Metamorphic rocks are formed when sedimentary or igneous rocks are exposed to heat and pressure. Metamorphic rocks do not form on the surface of the Earth, but rather deeper underneath the surface where the temperatures and pressures are much higher. When other types of rock experience higher pressures and temperatures the rock crystals are squashed together. They undergo changes in crystal structure to form metamorphic rock. Metamorphic rock may move deeper into the Earth where they melt, forming magma. The magma may then cool and form igneous rock. Some examples of metamorphic rocks are slate, marble, soapstone, and quartzite.

Slate is a metamorphic rock that was formed by shale (sedimentary rock) that was metamorphosed. Slate is often used for roofing or flooring. Since it can be cut into shapes and does not absorb moisture, it makes a good material for tiles. Marble is a metamorphic rock that is produced from the metamorphosis of limestone. It is used for countertops, flooring and tombstones and is a very durable building material.

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CAPS SENIOR PHASE

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Roof tiles made from slate, which was formed from shale (a sedimentary rock).



Marble blocks in a wall.



A marble arch in London.

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DURATION: 180 Minutes **STRAND: EARTH AND BEYOND**
CAPS SENIOR PHASE **TERM : FOUR**

Soapstone is a relatively soft metamorphic rock. It is often used as an alternative natural stone countertop instead of granite or marble, for example in kitchens and laboratories. In laboratories it is unaffected by acids and alkalis. In kitchens it is not stained or altered by tomatoes, wine, vinegar, grape juice and other common food items. Soapstone is unaffected by heat. That means that hotpots can be placed directly on it without fear of melting, burning or other damage. Many statues and carvings are also made from soapstone.



Soapstone carvings.



A pot made from soapstone.

Quartzite is formed through the actions of heat and temperature on sandstone. If you compare the texture of sandstone with quartzite in the pictures shown here, you will see that the process of metamorphism changes the texture from sandy to more glossy. The crystals in the quartzite are bigger and the layers have disappeared Quartzite is much harder than sandstone.

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Sandstone.



Quartzite.

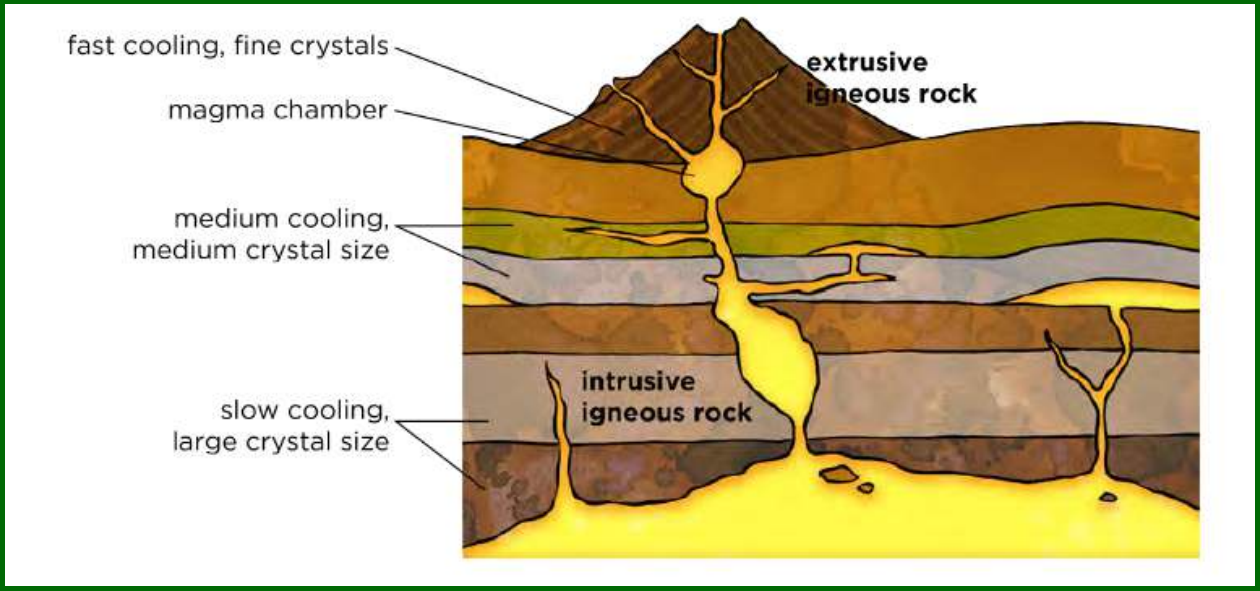
Igneous rock

Igneous rock is formed when magma cools down. Three factors play a role when igneous rocks are formed:

1. **Where it is formed:** The rocks are formed on the surface they are called **intrusive** rocks. If they are formed under the surface they are called **extrusive** rocks.
2. **How quickly it cools:** When magma cools quickly, small crystals are formed and the resulting rock has a fine-grained texture. When it cools slowly, larger crystals form, resulting in a more coarse-grained rock. Sometimes the individual crystals can be seen with the naked eye.
3. **How much gas is trapped:** Magma contains molten rock and lots of gas. The gas is under pressure deep in the Earth. When the magma breaks through the surface, the gas is released. Depending on how quickly the magma cools down, the gas has more or less time to escape. When the magma cools down very quickly, lots of gas is trapped resulting in cavities and openings forming in the rock.

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A volcano is an opening or rupture in the surface of the Earth's crust (or another planet) which allows hot lava and volcanic ash to escape in an eruption from the magma chamber below.

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The Cleveland Volcano eruption in 2006 in Alaska, photographed from the International Space Station.



An eruption from Mount Etna in Italy in 2007.

Examples of igneous rock are basalt, granite and pumice. Basalt is the most common igneous rock and makes up a large part of the rocks just under the surface of the Earth. Most of the oceanic crust is basalt rock. It is a dark-coloured rock and is used as building material, particularly in building stone walls. Basalt is not only found on Earth, but also on the Moon and Mars! The highest mountain on Mars, and also the biggest, known volcano in our solar system - Olympus Mons - was formed from basaltic lava flows.

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Basalt.



Olympus Mons, a volcano on Mars.

Granite is an igneous rock with large grains. It was formed from magma which slowly crystallised below the surface of the Earth. Granite is one of the most well-known types of rock. It is used to make numerous objects such as table tops, floor tiles and paving stone.



Various colours and patterns of granite rock.

Pumice rock is an example of extrusive igneous rock. It is formed from the lava emitted during volcanic explosions.
Because the lava cools down very quickly, a lot of gas is trapped in the rock. As a result, pumice is a very porous rock, with lots of holes in it, making it the only rock that can float on water. Pumice stones are used in lightweight concrete and as an abrasive in industries and in homes.

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Pumice stone used as an exfoliator.

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ACTIVITY 4: Comparing the properties of igneous rocks - Memorandum

TEACHER'S NOTE

Sample	Where was the sample formed? Extrusively or intrusively	How quickly did it cool? What evidence do you have for your answer?	Was air trapped when it was formed? What evidence do you have for your answer?	Describe the colour
Sample 1	Extrusively	Very fine crystals	No, no visible holes	Dark, green-grey
Sample 2	Extrusively	Fast, no visible crystals	No, no visible holes	Shiny black
Sample 3	Intrusively	Slowly, there are large interlocking crystals	No, no visible holes	Mottled with yellow-brown, white and black
Sample 4	Extrusively	Fast, there are no crystals	Yes, there are holes in the rock where gas bubbles were trapped	Grey-black

Total [32 marks]

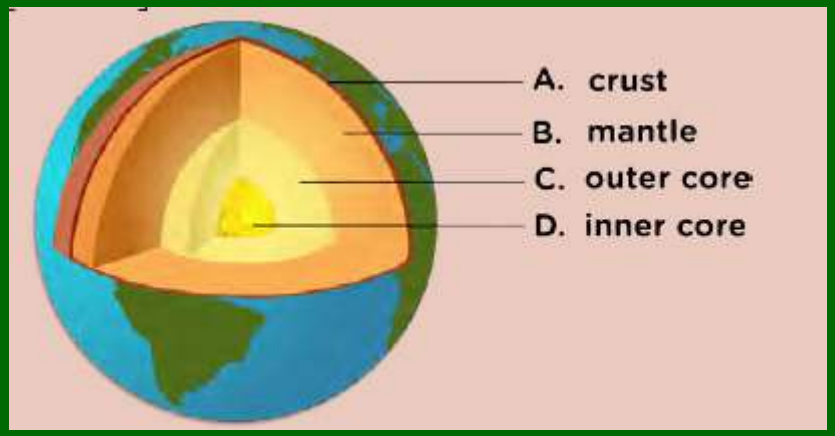
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REVISION - Memorandum:

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1. The Earth consists of different layers.
a) Label the following diagram: [4 marks]
b) What is the difference between parts C and D? [2 marks]
c) What does part B consist of? [1 mark]
d) Give three examples of things found around your school that form part of part A. [3 marks]

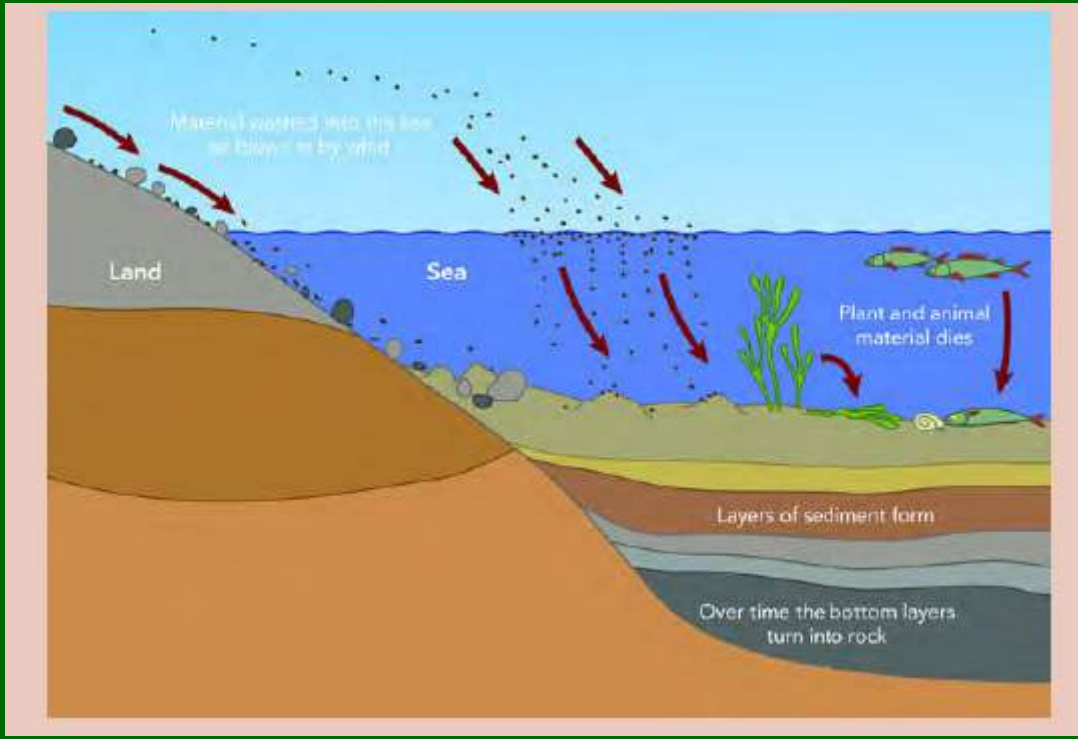


a) Diagram above

b) C (the outer core) is liquid and D (the inner core) is solid.
c) Magma or molten rock.
d) sand, stone, rocks, pebbles, clay (any three).
2. Why are there so many different rocks found on Earth? [2 marks]
Rocks are formed through many different processes resulting in a large variety of different combinations of rock minerals.
3. The diagram below shows the formation of one of the rock types. Study the diagram and answer the question that follow.

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a) What type of rock formation is shown in the diagram? Give a reason for your answer. [2 marks]
b) What processes are involved in the formation of this type of rock? [2 marks]
c) What will happen if the rocks formed here move deeper into the Earth? [3 marks]
a) Sedimentary rock. The layers of sediment can be seen forming at the bottom of the ocean.
b) Sedimentation and cementation.
c) The rocks will become hotter and more pressure will be applied. The rocks will become more compact and the chemical compounds in the rocks will change. Metamorphic rock will form.
4. Fossils are often found in sedimentary rocks. Explain why this is the case. [4 marks]
When animals or plants die, their remains often end up on the ground and are covered by sand over time. The sand gets compacted and eventually becomes sedimentary rock, with the fossilised remains of the plant or animal still inside the rock.
5. Explain the difference between the formation of igneous rock, such as granite, and igneous rock, such as pumice. [4 marks]

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Granite is intrusive igneous rock. It forms as magma beneath the surface of the Earth, cools slowly and forms large crystals. Pumice is extrusive igneous rock which forms when magma pushes out of the crust to the surface of the Earth and cools very quickly, trapping bubbles of gas.

6. Iron is an element found abundantly on Earth, especially in the core of the Earth. Iron combines with oxygen to form haematite, the mineral form of iron (III) oxide. Haematite is present in sedimentary rocks, for example in the Sishen area in the Northern Cape.

a) What is the formula for iron (III) oxide? [1 mark]

b) How does iron end up in sedimentary rock? [3 marks]

c) Why is hematite an important mineral? [1 mark]

a) (Fe_2O_3)

b) Sedimentary hematite crystals formed as evaporating oceans left deposits of iron in the sedimentary layers. The iron then combined with oxygen molecules created by the process of photosynthesis. Also accept an answer where learners explain part of the rock cycle, from magma to sedimentary rock.

c) Iron is used to make steel, stainless steel, cars [any appropriate application]

Total [32 marks]

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Planet Earth

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DATE: **TOPIC:** Mining of mineral resources **SUB TOPIC:** Extracting Ores	**OBJECTIVES: LEARNERS MUST BE ABLE TO:** • Understand how minerals are extracted from their ores • Understand the difference between physical and chemical extraction of minerals • Know that iron and copper mining has been happening over thousands of years.
REFERENCES	**Sasol Inzalo workbooks- Natural Sciences Grade 9-B**
TERMINOLOGIES:	Mineral, ore, PGM
SPECIFIC AIMS	1. DOING SCIENCE 2. KNOWING THE SUBJECT CONTENT & MAKING CONNECTIONS 3. UNDERSTANDING THE USES OF SCIENCES & INDIGENOUS KNOWLEDGE

SCIENCE PROCESS SKILLS							
Accessing & recalling Information	√		Identifying problems & issues			Doing Investigations	
Observing			Raising Questions	√		Recording Information	√
Comparing			Predicting			Interpreting Information	√
Measuring			Hypothesizing			Communicating	√
Sorting & Classifying			Planning Investigations				

CONTENT AND CONCEPTS	ACTIVITIES	RESOURCES
Extracting ores • people extract valuable minerals from the lithosphere • rock that contains high concentrations of a valuable mineral is called an ore • the ore is removed from the crust by mining • some minerals can be used in their natural form such as sand, potash, diamonds	The teacher will introduce the lesson by explaining what are minerals and how it is extracted. The teacher will also use the flow chart to explain the extraction of metals. The teacher will explain and discuss the different methods of finding minerals using the notes attached. The teacher will use the pictures attached to explain how	Textbook CAPS p. 85

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CONTENT AND CONCEPTS	ACTIVITIES	RESOURCES
	minerals are extracted. Learners will complete activity 1. The teacher will discuss gold mining in South Africa . Learners will complete activity 2. The teacher will explain using the pictures and diagrams the different methods of separating minerals from waste.	
ASSESSMENT	**Answer the following question:** 1. How are minerals extracted from their ores? 2. Discuss the difference between physical and chemical extraction of minerals? 3. Identify areas where iron and copper were used thousands of years ago.	
TEACHER REFLECTION	Progress:	Challenges:

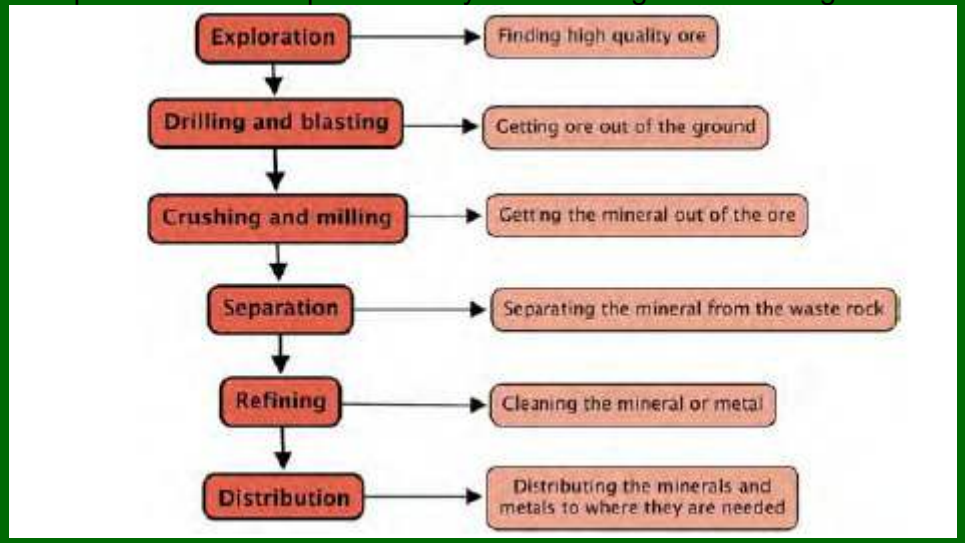
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Teacher's Notes

In the previous two chapters you have learnt about the spheres of the Earth especially the lithosphere. The lithosphere consists of rocks, which contain minerals. Minerals are natural compounds formed through geological processes. A mineral could be a pure element, but more often minerals are made up of many different elements combined. Minerals are useful chemical compounds for making new materials that we can use in our daily lives. In this chapter we are going to look at how to get the minerals out of the rocks and in a form that we can use. This is what the mining industry is all about. Mining is a very important industry in South Africa. We have a lot of mineral resources in our country and a lot of people depend on mining for a living. You already know that minerals in rocks cannot be used. Many processes are used to make minerals available for our use. We need to locate the minerals.
We must determine whether these concentrations are economically viable to mine. Rocks with large concentrations of minerals, are called **ores**. Mining depends on finding good quality ore, preferably within a small area. The next step is to get the rocks which contain the mineral out of the ground. Once the ore is on the surface, the process of getting the mineral you want out of the rock can start. Once the mineral is separated from the rest of the rock, the mineral needs to be cleaned so that it can be used.

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This process can be represented by the following flowchart diagram:



We will now look at each of the steps in more detail. You will also apply what you learn about mining to one specific mining industry.

3.1 Exploration: .Finding minerals

One of the most important steps in mining is to find the minerals. Most minerals are found everywhere in the lithosphere, but in very, very low concentrations, too low to make mining profitable. For mining to be profitable, high quality ore needs to be found in a small area. Mining **exploration** is the term we use for finding out where the valuable minerals are.
Today technology helps mining geologists and surveyors to find high quality ore without having to do any digging. When the geologists and surveyors are quite sure where the right minerals are, only then do they dig test shafts to confirm what their surveying techniques have suggested.

Methods of exploration

In all these methods we use the properties of the minerals and our knowledge of the lithosphere to locate them underground, without going underground ourselves. For example, iron is magnetic so instruments measuring the changes in the magnetic field can give us clues as to where pockets of iron could be. Exploration methods are used to find, and assess the quality of mineral deposits, prior to mining. Generally a number of explorative techniques are used, and the results are then compared to see if a location seems suitable for mining.

Remote sensing is the term used to gain information from a distance. For example, by using radar, sonar and satellite images, we can obtain images of the Earth's surface. These images help us to locate possible mining sites, as well as study existing mining sites for possible expansion.

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This image covers an area of 15 x 19 km and was taken from the NASA research satelliteTerra. It shows the mine at Baiyun Ebo, China, which is the site of almost half the world's rare earth element production.

Geophysical methods make use of geology and the physical properties of the minerals to detect them underground. For example, diamonds are formed deep in the Earth at very high temperatures, in Kimberlite pipes of igneous rock. The Kimberlite pipe is a carrot shape. The first Kimberlite pipe to be detected was in Kimberley in South Africa. The pipe was mined, eventually creating the Big Hole.

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The Kimberley Big Hole was a diamond mine until 1914 when it closed down, and is now a tourist attraction.

Geochemical methods combine the knowledge of the chemistry of the minerals with the geology of an area to help identify which compounds are present in the ore and how much of it is present. For example, when an ore body is identified, samples are taken to analyse the mineral content of the ore.

3.2 Extracting ores

Once the ore body has been identified, the process of getting the ore out of the ground begins. There are two main methods of mining - surface mining and underground mining. In some locations a combination of these methods is used.

Surface mining

Surface mining is exactly what the word says - digging rocks out from the surface, forming a hole or pit. In South Africa, this method is used to mine for iron, copper, chromium, manganese, phosphate and coal. Surface mining is also known as open pit or open cast mining.

Let's look at coal as an example. For surface mining, the minerals need to be close to the surface of the Earth. Most of the coal found in South Africa is shallow enough for surface mining. Usually the rocks are present in layers. To expose the coal layer, the layers above it need to be removed. The vegetation and soil, called the **topsoil**, is removed and kept aside so that it can be re-deposited in the area after mining.

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An open pit coal mine.

If there is a layer of rock above the coal face, called the **overburden**, this is also removed before the coal can be **excavated**. Once all the coal has been removed, the overburden and topsoil are replaced to help in restoring the natural vegetation of the area. This is called **rehabilitation**. There is a growing emphasis on the need to rehabilitate old mine sites that are no longer in use. If it is too difficult to restore the site to what it was before, then a new type of land use might be decided for that area.

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Surface mining coal and mine rehabilitation.

In Phalaborwa in Limpopo province, copper ore is mined using open pit mining. The Phalaborwa open pit is one of the world's largest open pit mines. It is 2 km across and is the largest man-made hole in Africa.



Copper ore from Phalaborwa Mine.

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When you mine you are digging into solid rock. The rock needs to be broken up into smaller pieces before it can be removed. Holes are drilled in the rock and explosives, like dynamite, are placed inside the holes to blast the rock into pieces. The pieces are still very large and extremely heavy. The rocks are loaded onto very large haul trucks and removed. Sometimes the rocks (ore) are crushed at the mining site to make them easier to transport.

Do you remember learning about how coal is formed? What is coal made from?



A mining haul truck being loaded with coal.

Underground mining

Shaft mining

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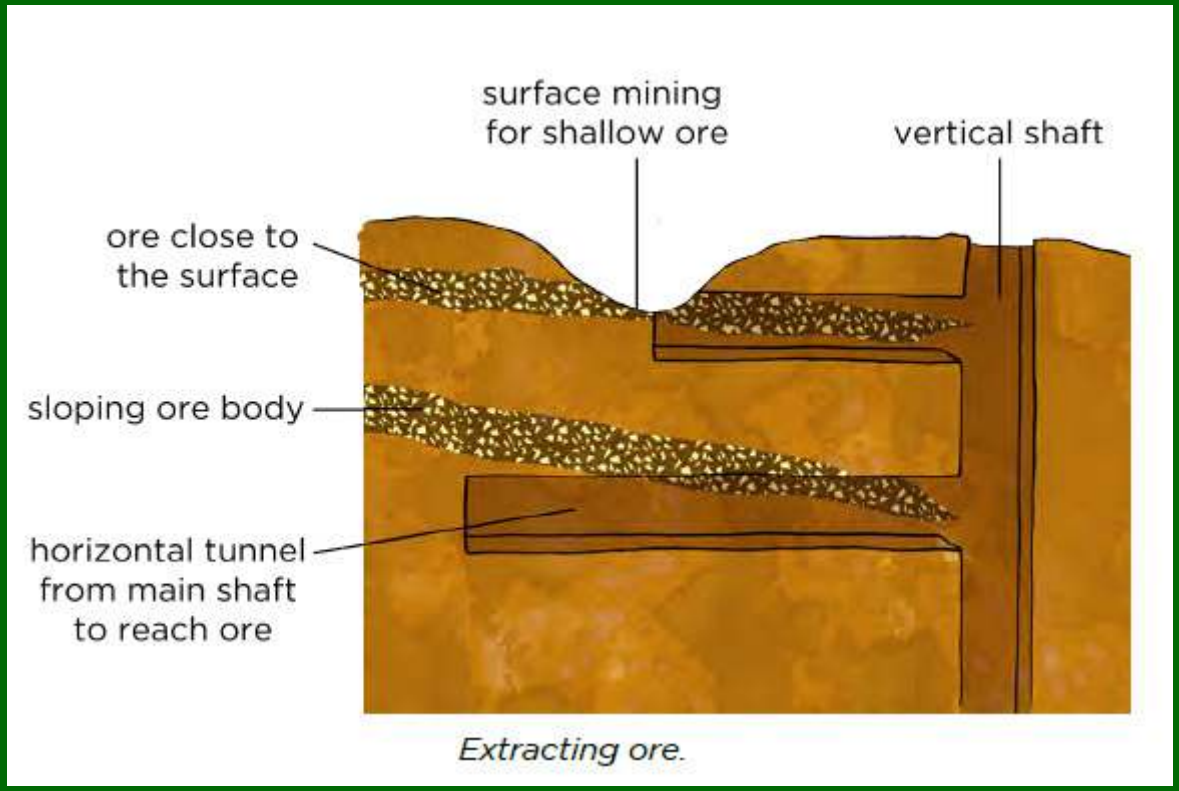
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Often the minerals are not found close to the surface of the Earth, but deeper down. In these cases underground mining, also called shaft mining, is used. Examples of underground mining in South Africa are mining for diamonds, gold and sometimes the platinum group metals (PGM).



Extracting ore.

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Old headgear at the Kimberley Mine in the Northern Cape

Sometimes the ore is very deep, which is often the case with diamonds or gold ore. In these cases mine shafts go vertically down and side tunnels make it possible for the miners and equipment to reach the ore.

A structure called the headgear is constructed above the shaft and controls the lift system into the vertical shaft. Using the lift, it can take miners up to an hour to reach the bottom of the shaft.

The TauTona Mine in Carletonville, Gauteng is the world's deepest mine. It is 3,9 km deep and has 800 km of tunnels. Working this deep underground is very dangerous. It is very hot, up to 55oC. To be able to work there, the air is constantly cooled to about 28 oC using air-conditioning vents.

ACTIVITY 1: Gold mining in South Africa

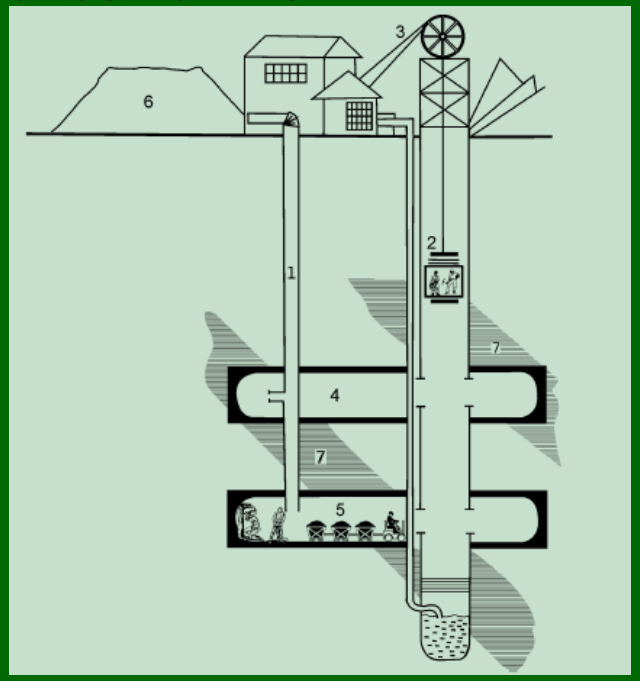
South Africa is a world leader in the gold mining industry. We have mining been gold for more than a century and our mines are the deepest in the world. Until 2010 we were the leading producer of gold in the world. Gold is a lustrous, precious metal which has a very high conductivity.

QUESTIONS:

1. What mining method is used to mine for gold?
2. What type of rock is found where gold is mined?
3. What is gold used for?
4. Do you think gold mining is dangerous? Why do you say so?
5. Provide labels for numbers 1-7 in the following diagram.

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ACTIVITY 2: Gold mining in South Africa - Memorandum

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South Africa is a world leader in the gold mining industry. We have mining been gold for more than a century and our mines are the deepest in the world. Until 2010 we were the leading producer of gold in the world. Gold is a lustrous, precious metal which has a very high conductivity.

QUESTIONS:

1. What mining method is used to mine for gold?
Underground mining or shaft mining.
2. What type of rock is found where gold is mined?
Igneous rock, or metamorphic rock.
3. What is gold used for?
Jewellery, ornaments and decoration, electronics in computers and cell phones.
4. Do you think gold mining is dangerous? Why do you say so?
Yes it is, the mines are very deep, of the deepest in the world. Mining deep underground is difficult and dangerous because of the heat and lack of oxygen. Rocks can also collapse because of the pressure.

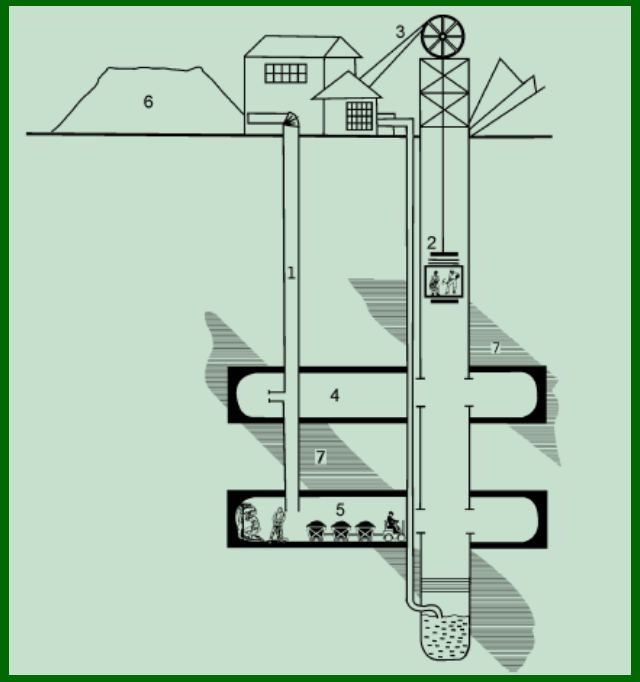
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5.Provide labels for numbers 1-7 in the following diagram.



1. Air supply and air conditioners/heat control
2. Lift to take miners into the mine or down the vertical shaft
3. Headgear
4. Horizontal tunnel
5. Removal of ore
6. Mine dump
7. Ore body

Room and pillar method

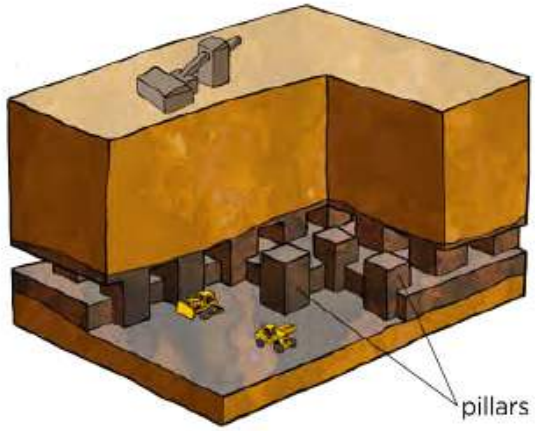
One of the methods used in underground mining is called room and pillar, and is often used for mining coal. Part of the mine is open to the surface and part of it is underground. The coal face is dug out, but pillars of coal are left behind to keep the tunnels open and support the roof.

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Machines called continuous miners are used to remove the coal. The coal is loaded onto conveyor belts and taken up to the surface for further crushing.



A machine called a continuous miner at work at the coal face.



Room and pillar mining

3.3 Crushing. and milling

Mineral crystals are spread throughout rocks, just like chocolate chips are spread throughout a choc chip biscuit. Sometimes we can see the chocolate chips from the outside, but most of the time the chips are not visible because they are inside the biscuit.

The only way to find out how many choc chips there are is to crush the biscuit. In the same way we can sometimes see mineral crystals from the outside of the rock, but mostly we don't know what minerals there are and what concentrations are inside the rock. The only way to find out is to break the rock into smaller and smaller pieces.

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Ore is like choc chip biscuits where the minerals are spread through the rocks.



The ore needs to be crushed, as a choc chip biscuit, to get the minerals out.

Once we have crumbled the choc chip biscuit, the chocolate pieces can be separated from the crumbs. In the same way in the mining process the valuable minerals can be separated from the unwanted rock. The unwanted rock is called waste rock.

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The choc chips are separated from the rest of the biscuit, just as minerals are extracted from the rock.

Let's look at an example. You have learnt in the previous chapter that copper minerals are found in rocks. In South Africa, the Bushveld Igneous Complex is an area which stretches across the North West and Limpopo Provinces. Igneous rock with high mineral content is found here. Here they mine for PGMs, chromium, iron, tin, titanium, vanadium and other minerals using open pit and underground mining. The rocks from the mines are transported by conveyor belts to crushers. Jaw crushers and cone crushers break the huge rocks into smaller rocks.

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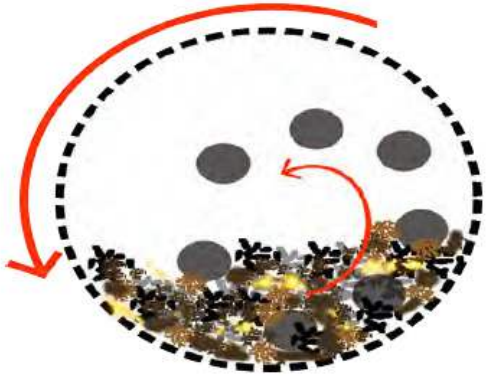


Jaw crusher at a mine. The rocks are fed into the funnel and crushed as the two sides move back and forth.

The smaller rocks are then moved to mills where large rod mills and ball mills grind them further into even smaller pieces until it is as fine as powder.



A ball mill.



Inside a ball mill, the balls move round in a circle as the mill turns, crushing the ore into a powder.

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This process of reducing the size of the rocks requires a lot of energy. Just image how hard it is to break a rock. How much more energy do you think is needed to crush a rock until it is like sand? This is one of the steps in the mining process that is very expensive because energy is needed to drive the process. Most minerals are found as compounds in rocks. Only a few minerals are found in their pure form, in other words not bound to any other element. Examples of minerals found in their pure form are gold and diamonds (diamonds consist of the element carbon).



A rough diamond crystal embedded in rock.



A gold nugget.

Some rocks are used as is, and do not need to be crushed into powder, or involved in minerals extraction. For example phosphate rock itself can be used as a fertiliser, or it can be used to make phosphoric acid. Sand, or the mineral silicon dioxide (SiO_2) is used in the building industry. Coal found in sedimentary rock, is crushed into the appropriate size and used as fuel for electricity generation or the iron-making process.

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Lumps of coal can be used directly as a fuel. However some coal is first washed to make it into 'high grade coal'. It can also be sorted into various sizes, depending on what the fuel is required for.

3.4 Separating minerals from waste

Before the minerals can be used, they need to be separated from the waste rock. A number of different separation techniques are used. These techniques are based on the properties of the minerals. Different minerals are often found together, for example copper and zinc, gold and silver or the PGMs. A combination of techniques are used to separate the minerals from the waste and then the minerals from each other.

Hand sorting

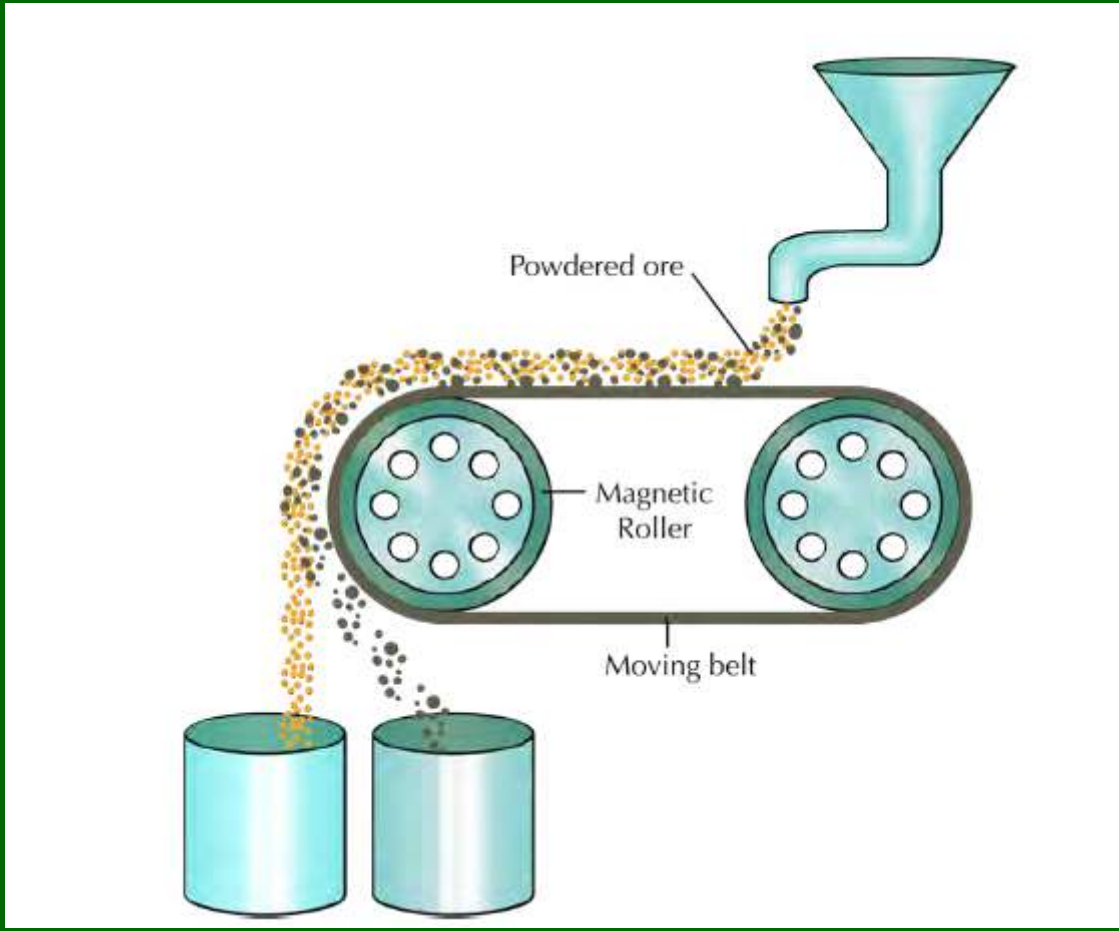
Sorting by hand is not a very effective method to separate out the minerals you want. It can only be used in exceptional situation or by individuals, for example many people mine for alluvial diamonds by hand in rivers in Angola. It is a cheap and easy process to do individually, but it is not feasible on an industrial scale.

Magnetic separation

Iron is a metal with magnetic properties. Iron ore can be separated from waste rock by using magnetic separation techniques. Conveyor belts carry the ore past strong **electromagnets** which remove the magnetic pieces (containing the iron) from the non-magnetic waste. How do you think this works? Study the following diagram:

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DURATION: 90 Minutes **STRAND: EARTH AND BEYOND**
CAPS SENIOR PHASE **TERM : FOUR**



Which container, the left or the right, will contain the magnetic iron ore and which one will contain the non-magnetic waste? Label this on the diagram and provide a reason for your answer below.

Density separation

One of the first methods for mining gold was that of **panning**, a technique where ore is mixed with water and forms a suspension. When it is shaken, the dense particles of gold sink to the bottom and could be removed.

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Panning.

As you have seen in the activity, separating a mixture can be done using different properties, depending on the different properties of the beads. There could be a number of different ways to separate the beads depending on which type of bead you want to select (considered to be the most valuable ones). Size separation is used frequently in mining to classify ore. For example, when iron ore is exported, it needs to be a certain size to be acceptable to the world market. Coal that is used in power stations also needs to be a certain size so that it can be used to generate electricity effectively. Density separation is used widely in mining, and you will see why in the next section.

Flotation

Flotation makes use of density separation, but in a special way.

Chemicals are added to change the surface properties of the valuable minerals so that air bubbles can attach to them. The minerals are mixed with water to make a **slurry**, almost like a watery mud. Air bubbles are blown through the slurry and the minerals attach to the bubbles. The air bubbles are much less dense than the solution and rise to the top where the minerals can be scraped off easily.

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TERM : FOUR



Separating minerals by flotation

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DURATION: 30 Minutes **STRAND: EARTH AND BEYOND**
CAPS SENIOR PHASE **TERM : FOUR**

DURATION: Week Three Lesson Four, Five and Six **TOPIC:** Mining of mineral resources **SUB TOPIC:** Refining minerals	**OBJECTIVES: LEARNERS MUST BE ABLE TO:** • Explain whether the physical or chemical process is used to extract the required material. • Illustrate the physical separation processes used in mining. • Explain the history of mining in South Africa.
REFERENCES	**Sasol Inzalo workbooks- Natural Sciences Grade 9-B**
TERMINOLOGIES:	**Extraction, Coke, topsoil, overburden, excavation, rehabilitation, slurry**
SPECIFIC AIMS	1. DOING SCIENCE 2. KNOWING THE SUBJECT CONTENT & MAKING CONNECTIONS 3. UNDERSTANDING THE USES OF SCIENCES & INDIGENOUS KNOWLEDGE

SCIENCE PROCESS SKILLS							
Accessing & recalling Information			Identifying problems & issues	√		Doing Investigations	
Observing			Raising Questions	√		Recording Information	√
Comparing			Predicting			Interpreting Information	√
Measuring			Hypothesizing			Communicating	√
Sorting & Classifying			Planning Investigations				

	ACTIVITIES	**RESOURCES**
Refining minerals • some other minerals require a chemical or physical process to extract the required material such as iron from iron-ore (chemical) or gold from gold-ore (physical) • knowledge of iron and copper extraction is thousands of years old -- iron ore was heated with charcoal to make lumps of iron -- South African archaeological sites in KwaZulu Natal and Limpopo provide evidence for this • modern processes mix coke (a form of carbon made from coal) and other metals with iron to produce steel	The teacher will explain the refining of minerals using the pictures and notes attached. Learners will complete activity 1. .	Textbook CAPS p. 85

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DURATION: 30 Minutes **STRAND: EARTH AND BEYOND**
CAPS SENIOR PHASE **TERM : FOUR**

		ACTIVITIES	RESOURCES
ASSESSMENT			
TEACHER REFLECTION	Progress:	Challenges:	

Teachers Notes

3.5 Refining minerals

There are many different methods used to concentrate and refine minerals. The choice of methods depends on the **composition** of the ore. Most of the methods however, make use of chemistry to extract the metal from the compound or remove impurities from the final product. We will discuss the extraction of iron from iron ore as an example.

Extraction of iron

Iron atoms are found in the compounds FeO, Fe_2O_3 and Fe_3O_4 and in rocks like haematite and magnetite. South Africa is the seventh largest producer of iron ore in the world. Iron has been mined in South Africa for thousands of years. South African archaeological sites in Kwa-Zulu Natal and Limpopo provide evidence for this. Evidence of early mining activities was found in archaeological sites dating mining and smelting of iron back to the Iron Age around 770 AD. The first iron mining techniques used charcoal which was mixed with iron ore in a **bloomery**. When heating the mixture and blowing air (oxygen) in through **bellows**, the iron ore is converted to the metal, iron. The chemical reaction between iron oxide and carbon is used here to produce iron metal. The balanced chemical equation for the reaction is:

$2Fe_2O_3 + 3C \rightarrow 4Fe + 3CO_2$

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A small bloomery.

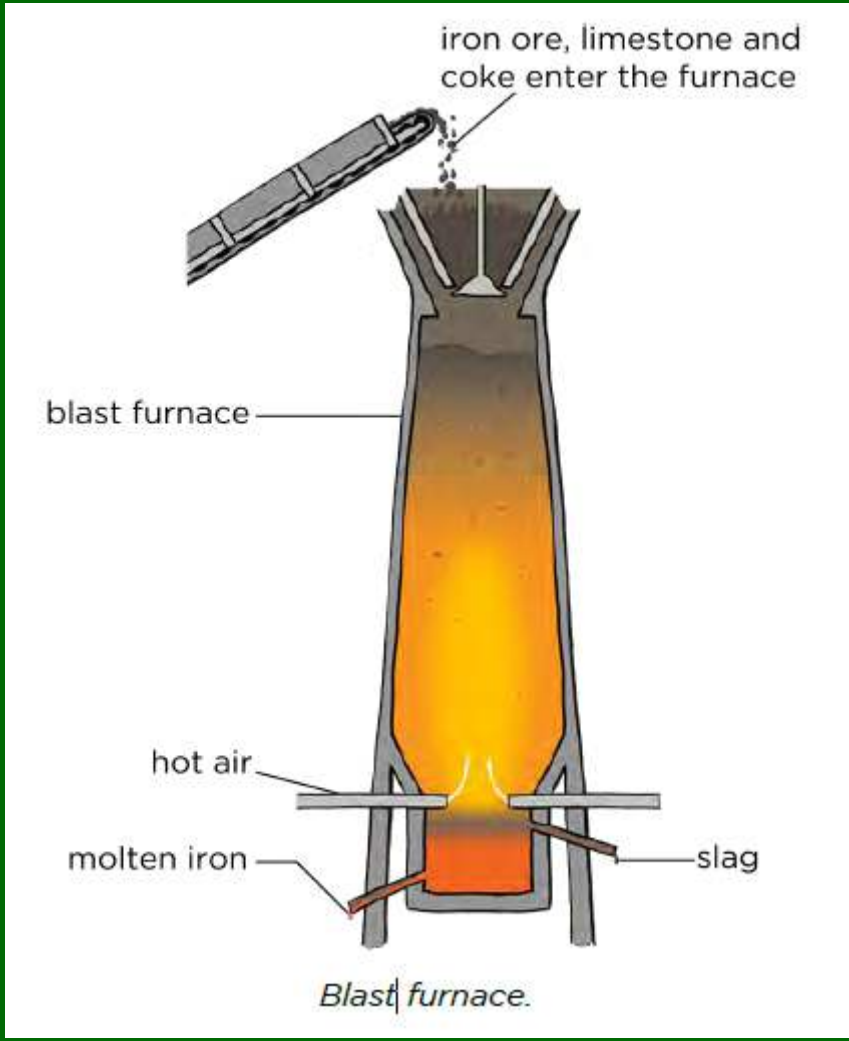
This extraction method is still used today using the chemistry. However, the bloomery is replaced with a **blast furnace**, a huge oven where iron ore is burned with oxygen and coal to produce the metal, iron. Iron ore, a type of coal called coke (which contains 85% carbon) and lime are added to the top of the blast furnace. Hot air provides the oxygen for the reaction. The temperature of a blast furnace can be up to 1200°C.

The reaction takes place inside the furnace and molten iron is removed from the bottom. Lime (calcium carbonate or $CaCO_3$) is added to react with the unwanted materials, such as sand (silicon dioxide or SiO_2). This produces a waste product called **slag**. The slag is removed from the bottom and used for building roads. Iron is used to make steel. Hot gases, mainly carbon dioxide,escape at the top of the furnace.

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GRADE: 9
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TERM : FOUR



Blast furnace.

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DURATION: 30 Minutes **STRAND: EARTH AND BEYOND**
CAPS SENIOR PHASE **TERM : FOUR**

ACTIVITY 1: Separating lead from lead oxide

In this demonstration you are going to react lead(II) oxide with carbon. This is similar to the process used in iron mining where iron ore is reacted with coke (carbon) to form iron metal.



Lead(II) oxide.

MATERIALS:
- lead(II) oxide (red)
- charcoal block
- Bunsen burner
- blowpipe
- spatula
- safety glasses

INSTRUCTIONS:
1. Use safety glasses in this experiment.

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2. Use the spatula to scrape a hollow in the charcoal block. Ensure that the loosened carbon remains in the hollow.
3. Add an equivalent amount of lead oxide to the carbon in the hollow.
4. Add a drop or two of water to make a paste.
5. Use a blow pipe to direct the flame of the Bunsen burner into the hollow where the lead(II) oxide-carbon paste is. Create a steady flow of air through the flame.
6. Keep the flame directed onto the paste for 2-3 minutes.
7. Observe if any changes has taken place. If not, continue blowing for another minute.

QUESTIONS:
1. What have you observed? Were there any colour changes? Describe your observations.
2. Write a balanced equation for the reaction that has taken place.
3. Carbon dioxide is formed in this reaction. What would the impact of this be if the reaction is done on large scale?

In this experiment carbon was used to remove the oxygen from the lead(II)oxide. The carbon and oxygen form carbon dioxide, and the lead is left behind as a metal. This is the same process that is used in iron extraction in the blast furnace, that we discussed above. Coke, which is mainly carbon, removes the oxygens from the iron(III) oxide to form carbon dioxide and leaves behind the iron metal.

Refining iron
The iron that is formed in the blast furnace often contains too much carbon - about 4% where it should contain not more than 2%. Too much carbon makes the iron **brittle**. To improve the quality of the iron, it needs to be refined by lowering the amount of carbon. This is done by melting the metal and reacting the carbon with pure oxygen to form carbon dioxide gas. In this way the carbon is burned off and the quality of the iron improves. The iron can now be used in the steel-making process. Carbon reacts with oxygen according to the following chemical equation:
$C + O_2 \rightarrow CO_2$
Most minerals go through chemical extraction and refining processes to purify them for use in making materials and other chemical products. These are then distributed to where they are needed, for example, coal is distributed to coal power stations and slag is distributed to construction groups for building roads. The mining industry supplies the manufacturing industry and the chemical industry with its raw materials, for example iron is distributed to steel manufacturing industries.

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NATURAL SCIENCES: LESSON PLAN 6 **GRADE: 9**
DURATION: 30 Minutes **STRAND: EARTH AND BEYOND**
CAPS SENIOR PHASE **TERM : FOUR**

MEMORANDUM
ACTIVITY 1: Separating lead from lead oxide

TEACHER'S NOTE
For safety reasons, this experiment should rather be demonstrated. Ensure that you wear safety glasses when performing this experiment. It is quite easy to do, but takes a long time to actually react. The blow pipe needs to redirect the flame into the hollow in the block. Blow through the top of the blue part of the flame. Use a straw to extend the blow pipe so that you can stand a bit further
away from the flame. Ensure that a steady stream of heat gets right into the middle of the mixture so that it glows red hot for a while. The video link in the Visit box also shows how the experiment is performed (and the mistakes made).
The product can clearly be seen in the video. In this demonstration you are going to react lead(II) oxide with carbon. This is similar to the process used in iron mining where iron ore is reacted with coke (carbon) to form iron metal.



Lead(II) oxide.

MATERIALS:
• lead(II) oxide (red)

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- charcoal block
- Bunsen burner
- blowpipe
- spatula
- safety glasses

INSTRUCTIONS:

1. Use safety glasses in this experiment.
2. Use the spatula to scrape a hollow in the charcoal block. Ensure that the loosened carbon remains in the hollow.
3. Add an equivalent amount of lead oxide to the carbon in the hollow.
4. Add a drop or two of water to make a paste.
5. Use a blow pipe to direct the flame of the Bunsen burner into the hollow where the lead(II) oxide-carbon paste is. Create a steady flow of air through the flame.
6. Keep the flame directed onto the paste for 2-3 minutes.
7. Observe if any changes has taken place. If not, continue blowing for another minute.

QUESTIONS:

1. What have you observed? Were there any colour changes? Describe your observations.

The mixture heats up and starts to glow. At the end of the reaction the red colour of the lead oxide has changed to a grey colour and a solid pellet of lead has formed.

2. Write a balanced equation for the reaction that has taken place.

$2PbO + C \rightarrow 2Pb + CO_2$

3. Carbon dioxide is formed in this reaction. What would the impact of this be if the reaction is done on large scale?

Carbon dioxide is a greenhouse gas and large scale production will negatively influence the environment and contribute to global warming. .

In this experiment carbon was used to remove the oxygen from the lead(II) oxide. The carbon and oxygen form carbon dioxide, and the lead is left behind as a metal. This is the same process that is used in iron extraction in the blast furnace, that we discussed above. Coke, which is mainly carbon, removes the oxygen from the iron(III) oxide to form carbon dioxide and leaves behind the iron metal.

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NATURAL SCIENCES: LESSON PLAN 7 **GRADE: 9**
DURATION: 90 Minutes **STRAND: EARTH AND BEYOND**
CAPS SENIOR PHASE **TERM : FOUR**

DURATION: Week Four Lesson One, Two and Three	**OBJECTIVES: LEARNERS MUST BE ABLE TO:** • Know Provinces where iron and copper were mined • Understand how steel is produced
TOPIC: Mining of mineral resources	
SUB TOPIC: Mining in South Africa	
REFERENCES	**Sasol Inzalo workbooks- Natural Sciences Grade 9-B**
TERMINOLOGIES:	**Electromagnets, panning, composition, density separation, size separation, magnetic separation, flotation**
SPECIFIC AIMS	1. DOING SCIENCE
	2. KNOWING THE SUBJECT CONTENT & MAKING CONNECTIONS
	3. UNDERSTANDING THE USES OF SCIENCES & INDIGENOUS KNOWLEDGE

SCIENCE PROCESS SKILLS							
Accessing & recalling Information			Identifying problems & issues	√		Doing Investigations	
Observing	√		Raising Questions	√		Recording Information	√
Comparing			Predicting			Interpreting Information	√
Measuring			Hypothesizing			Communicating	√
Sorting & Classifying			Planning Investigations				

CONTENT AND CONCEPTS	ACTIVITIES	RESOURCES
Mining in South Africa • there is large scale mining activity in South Africa • this activity has significant environmental impacts such as -- creation of mine dumps -- pollution of water resources -- damage to places with high tourist or cultural heritage value -- loss of farming and wild life environments	The teacher will use the notes and graphs attached to explain mining in South Africa. Learners will complete activity 1. The teacher will explain the impact of mining on the environment.	Textbook CAPS p. 85
ASSESSMENT	**Answer the following question:** 1. Which Provinces present evidence that mining of copper in South Africa happened many years ago?	

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CAPS SENIOR PHASE **TERM : FOUR**

CONTENT AND CONCEPTS	ACTIVITIES	RESOURCES
	2. Discuss how steel is produced.	
TEACHER REFLECTION	Progress:	Challenges:

Teachers Notes

3.6 Mining in South Africa

Long before diamonds were discovered in the Kimberley area and the Gold Rush in Pilgrim's Rest and Witwatersrand areas in the late 1800s, minerals have been mined in South Africa. At Mapungubwe in the Limpopo Province evidence of gold and iron mining and smelting was found which dates back to the early 11th century AD. However, it was the large scale mining activities that accelerated the development of the country.

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VISIT

Watch an experiment to extract copper from copper ore. bit.ly/16HX0cl

South Africa has a wealth of minerals. We are the world's largest producers of chromium, manganese, platinum, vanadium and and alusite; and the second largest producer of ilmenite, palladium, rutile and zirconium. We are the third largest coal exporter, fifth largest diamond producer and seventh largest iron ore producer. Up to 2010 we were the world's largest gold producer, but our gold production has declined steadily over a number of years. We are currently fifth on the list of gold producers.

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TERM : FOUR



The Okiep Copper Mine, South Africa, established in the 1850s, is one of the richest bodies of copper ore ever found to this day.

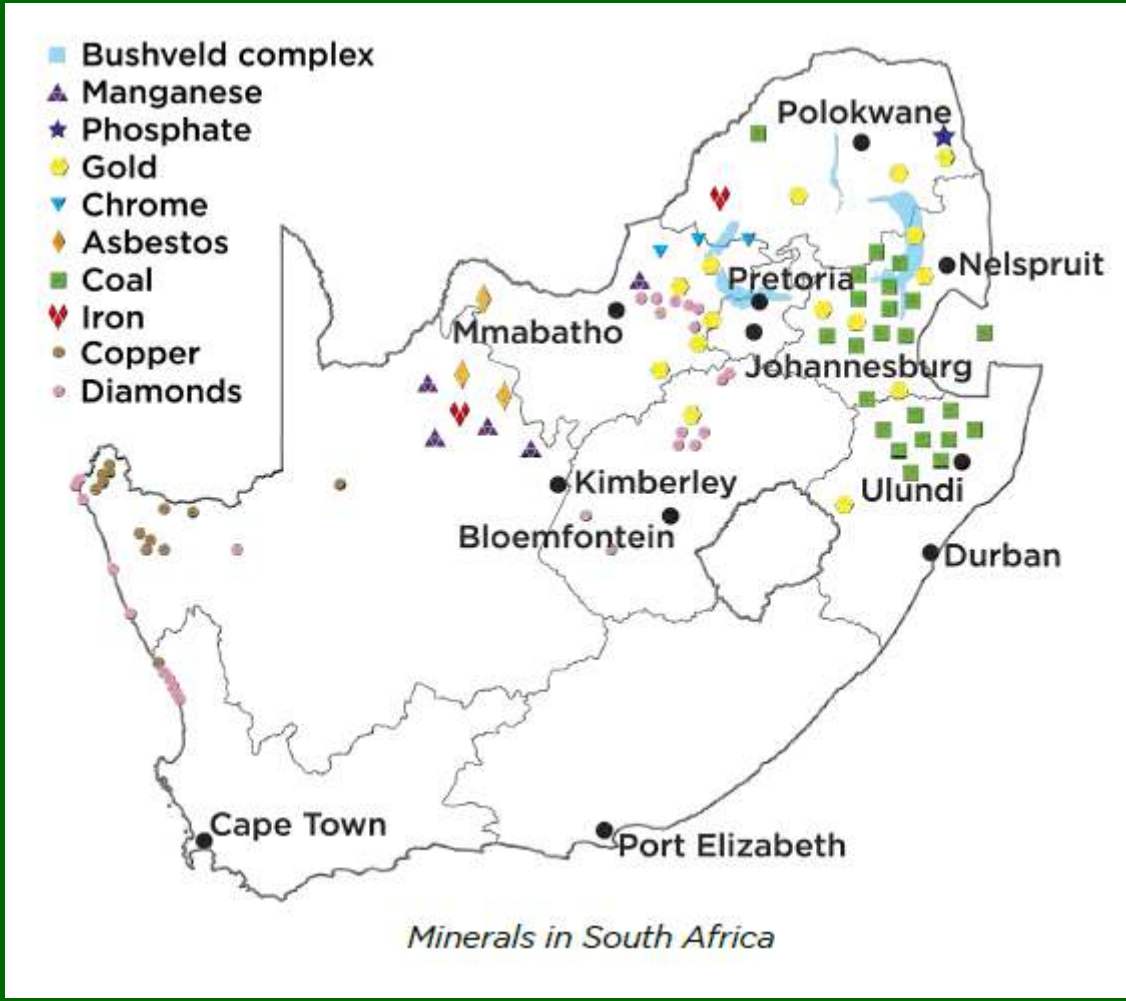
Minerals are mostly found in the northern part of the country. They are often concentrated in specific areas which are linked to the geology of the area.

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Minerals in South Africa

The Bushveld Igneous Complex has the world's largest primary source of platinum group metals, indicated on the map in light blue. It is one of the most important mining areas in South Africa due to its abundance of minerals.

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CAPS SENIOR PHASE **TERM : FOUR**



The Cullinan Premier Diamond Mine, near Pretoria, Gauteng.

ACTIVITY 1: Create your own mining map

INSTRUCTIONS:
1. Use the map of South Africa and the data provided in the table below to draw your own map of where mining in South Africa takes place. You will need to find out where the towns are located in South Africa and indicate them on the map.
2. Your teacher will indicate whether you must show all the locations, or a selection of the ones provided.
3. You need to decide on a key for your map and appropriate labels.
4. Also complete the table by filling in the chemical symbols or formulae and answer the questions that follow.

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NATURAL SCIENCES: LESSON PLAN 7
DURATION: 90 Minutes
CAPS SENIOR PHASE

GRADE: 9
STRAND: EARTH AND BEYOND
TERM : FOUR

Mineral	Chemical symbol/ formula	Where it is found
Lead		Aggenys
Andalusite	Al_2SiO_5	Namakwaland; north of Lydenburg; Eastern Bushveld Complex
Zinc		Aggenys; between Vryburg and Kuruman
Iron		Vredendal; Postmasburg; Sishen/Kathu, Thabazimbi
Salt		Port Elizabeth; Velddrif; between Prieska and De Aar; Douglas; Koffiefontein; Jacobsdal; Petrusburg, Upington
Limestone		Port Elizabeth; Port Shepstone; Saldanha; Lichtenburg; Mahikeng; Zeerust; between Christiana and Bloemhof; West of Thabazimbi
Vermiculite	$(Mg,Fe^{2+},Al)_3(Al,Si)_4O_{10}(OH)_2 \cdot 4(H_2O)$	Between Pietermaritzburg and Durban; east of Musina; west, south and east of Makhado, Phalaborwa
Diamonds		Kimberley; northwest of Kimberley; Alexander Bay; Luderitz; Port Nolloth; on the west coast north of Vredendal; Mahikeng; north of Ventersdorp; Cullinan; west of Musina

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NATURAL SCIENCES: LESSON PLAN 7
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STRAND: EARTH AND BEYOND
TERM : FOUR

Mineral	Chemical symbol/ formula	Where it is found
Titanium		West coast north of Saldanha Bay; Richards Bay
Manganese		North of Kuruman; northeast of Ventersdorp
Zirconium		West coast north of Saldanha Bay; Richards Bay
Gold		Virginia; Welkom; Stilfontein; Klerksdorp; Potchefstroom; Carletonville; Johannesburg, Vereeniging; Vryheid[, Barberton; west of Phalaborwa; Evander
Chromium		Western Bushveld Complex; Eastern Bushveld Complex
PGMs		Western Bushveld Complex; Eastern Bushveld Complex; Northern Bushveld Complex
Phosphate		Phalaborwa

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Coal		Virginia; Welkom; Bothaville; Kroonstad; Vereeniging; Sasolburg; Vanderbijlpark; Dundee; Newcastle; Utrecht; Vryheid; Ermelo; Standerton; Secunda; Evander; Witbank; Middleburg; Carolina; Lephalale
Nickel		West of Barberton
Copper		Aggenys/Springbok; Phalaborwa; Western Bushveld Complex; Eastern Bushveld Complex
Antimony		West of Phalaborwa

QUESTIONS:

1. What mineral(s) are mined closest to where you live?
2. What do you notice about the gold mines in South Africa?
3. There are two types of diamond mining, alluvial (which is found on the coast or in inland rivers which have washed through kimberlite pipes) and kimberlite (which is found inland). What is the link between these two types of diamond mining?
4. Which mining industry do you think is the best or most important one in South Africa? Give a reason for your answer.

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DURATION: 90 Minutes **STRAND: EARTH AND BEYOND**
CAPS SENIOR PHASE **TERM : FOUR**

MEMORANDUM
ACTIVITY 1: Create your own mining map

TEACHER'S NOTE
Learners need to develop their own symbols for each mineral that is mined, and also colour code the map. The map is blank and so they must find out where each town is located and add it to the map. Let them also fill in the name of the city/town/area in which they live. If there are mining activities in your area which is not indicated on this table, let the learners add it to the list. The list provided is not exhaustive, but it is still fairly long. If you want to make the activity simpler, learners can also chose a certain number of minerals to represent.

INSTRUCTIONS:
1. Use the map of South Africa and the data provided in the table below to draw your own map of where mining in South Africa takes place. You will need to find out where the towns are located in South Africa and indicate them on the map.
2. Your teacher will indicate whether you must show all the locations, or a selection of the ones provided.
3. You need to decide on a key for your map and appropriate labels.
4. Also complete the table by filling in the chemical symbols or formulae and answer the questions that follow.

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Mineral	Chemical symbol/ formula	Where it is found
Lead		Aggenys
Andalusite	Al_2SiO_5	Namakwaland; north of Lydenburg; Eastern Bushveld Complex
Zinc		Aggenys; between Vryburg and Kuruman
Iron		Vredendal; Postmasburg; Sishen/Kathu, Thabazimbi
Salt		Port Elizabeth; Velddrif; between Prieska and De Aar; Douglas; Koffiefontein; Jacobsdal; Petrusburg, Upington
Limestone		Port Elizabeth; Port Shepstone; Saldanha; Lichtenburg; Mahikeng; Zeerust; between Christiana and Bloemhof; West of Thabazimbi

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GRADE: 9
STRAND: EARTH AND BEYOND
TERM : FOUR

Mineral	Chemical symbol/ formula	Where it is found
Vermiculite	$(Mg,Fe^{2+},Al)_3(Al,Si)_4O_{10}(OH)_2 \cdot 4(H_2O)$	Between Pietermaritzburg and Durban; east of Musina; west, south and east of Makhado, Phalaborwa
Diamonds		Kimberley; northwest of Kimberley; Alexander Bay; Luderitz; Port Nolloth; on the west coast north of Vredendal; Mahikeng; north of Ventersdorp; Cullinan; west of Musina
Titanium		West coast north of Saldanha Bay; Richards Bay
Manganese		North of Kuruman; northeast of Ventersdorp
Zirconium		West coast north of Saldanha Bay; Richards Bay

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Gold		Virginia; Welkom; Stilfontein; Klerksdorp; Potchefstroom; Carletonville; Johannesburg, Vereeniging; Vryheid[, Barberton; west of Phalaborwa; Evander
Chromium		Western Bushveld Complex; Eastern Bushveld Complex
PGMs		Western Bushveld Complex; Eastern Bushveld Complex; Northern Bushveld Complex
Phosphate		Phalaborwa
Coal		Virginia; Welkom; Bothaville; Kroonstad; Vereeniging; Sasolburg; Vanderbijlpark; Dundee; Newcastle; Utrecht; Vryheid; Ermelo; Standerton; Secunda; Evander; Witbank; Middleburg; Carolina; Lephalale
Nickel		West of Barberton

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Nickel		West of Barberton
Copper		Aggenys/Springbok; Phalaborwa; Western Bushveld Complex; Eastern Bushveld Complex
Antimony		West of Phalaborwa

QUESTIONS:

1. What mineral(s) are mined closest to where you live?
Learner-dependent answer.
2. What do you notice about the gold mines in South Africa?
Most of them are all together in one area in the shape of an arch, mainly in the Free State.
3. There are two types of diamond mining, alluvial (which is found on the coast or in inland rivers which have washed through kimberlite pipes) and kimberlite (which is found inland). What is the link between these two types of diamond mining?
Diamonds from inland were washed to the coast by rivers. These diamonds are now mined from alluvial deposits at the coast.
4. Which mining industry do you think is the best or most important one in South Africa? Give a reason for your answer.
Learner-dependent answer. Accept any mining industry as long as an appropriate reason is given. For example, coal mining because it provides us with energy

The impact of mining

Mining has played a major role in the history of South Africa. It accelerated technological development and created infrastructure in remote areas in South Africa. Many small towns in South Africa started because of mining activity in the area. It also created a demand for roads and railways to be built. Most importantly it created job opportunities for thousands of people. Even today many households are dependent on the mining activities for jobs and an income. Mining is an important part of our economic wealth. We export minerals and ore to many other countries in the world. Mining activities also have a negative impact on the environment. In many cases the landscape is changed. This applies particularly to surface mines (open pit mines), where large amounts of soil and rock must be removed in order to access the minerals.
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VISIT

The price of gold: Chinese mining in Ghana.bit.ly/1aQ8cFk

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NATURAL SCIENCES: LESSON PLAN 7 **GRADE: 9**
DURATION: 90 Minutes **STRAND: EARTH AND BEYOND**
CAPS SENIOR PHASE **TERM : FOUR**

The shape of the landscape can be changed when large amounts of rocks are dug up from the Earth and stacked on the surface. These are called mine dumps. Open pit mines also create very large unsightly and dangerous holes (pits) in the ground that change the shape of the land. Air and water pollution can take place if care is not taken in the design and operation of a mine. Dust from open pit mines, as well as harmful gases such as sulphur dioxide and nitrogen dioxide, could be released from mining processes and contribute to air pollution. Mining activities produce carbon dioxide. Trucks and other vehicles give off exhaust gases. If the mining process is not monitored properly, acid and other chemicals from chemical processing can run into nearby water systems such as rivers. This is poisonous to animals and plants, as well as to humans who may rely on that water for drinking.

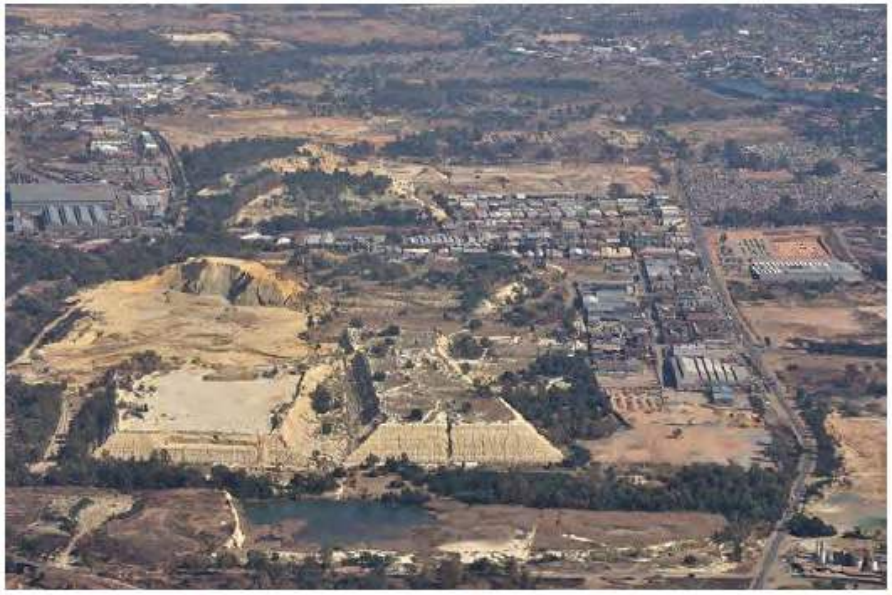
TAKE NOTE
Tailings are the materials left over after separating the valuable minerals from the ore. An example are pollutants (dangerous chemicals), called tailings, left over from gold mining which pose a threat to the environment and the health of nearby communities. Dangerous waste chemicals can leak into the groundwater and contaminate water supplies if the tailings are not contained properly.

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NATURAL SCIENCES: LESSON PLAN 7
DURATION: 90 Minutes
CAPS SENIOR PHASE

GRADE: 9
STRAND: EARTH AND BEYOND
TERM : FOUR



An aerial photograph of Primrose Gold Mine. Can you see the piles of gold tailings on the left of the photograph?

rth

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NATURAL SCIENCES: LESSON PLAN 8 **GRADE: 9**
DURATION: 60 Minutes **STRAND: EARTH AND BEYOND**
CAPS SENIOR PHASE **TERM : FOUR**

DURATION: Week Four Lesson Three and Four **TOPIC:** Atmosphere **SUB TOPIC:** Spheres of the Earth	**OBJECTIVES: LEARNERS MUST BE ABLE TO:** • Explain that the atmosphere consist of a mixture of gases. • Understand that the word air refers to the mixture of gases found in the atmosphere. • Explain the concept "density of gases" • Explain why the density of gases decreases as the distance from the Earth increases
REFERENCES	**Sasol Inzalo workbooks- Natural Sciences Grade 9-B**
TERMINOLOGIES:	**Atmosphere, troposphere, stratosphere, mesosphere, thermosphere, exosphere, altitude, temperature gradient**
SPECIFIC AIMS	1. DOING SCIENCE 2. KNOWING THE SUBJECT CONTENT & MAKING CONNECTIONS 3. UNDERSTANDING THE USES OF SCIENCES & INDIGENOUS KNOWLEDGE

SCIENCE PROCESS SKILLS							
Accessing & recalling Information			Identifying problems & issues			Doing Investigations	
Observing	√		Raising Questions	√		Recording Information	√
Comparing			Predicting			Interpreting Information	√
Measuring			Hypothesizing			Communicating	√
Sorting & Classifying			Planning Investigations				

CONTENT AND CONCEPTS	ACTIVITIES	RESOURCES
Atmosphere • the atmosphere is the mixture of gases held around the Earth by gravity • this mixture is known as air and consists of nitrogen (78%), oxygen (21%), carbon dioxide (less than 1%), and other gases, including water vapour (1%) • the density of the gas particles decreases as the distance from the Earth increases (the further away from the Earth, the thinner the air) • the atmosphere has four layers: troposphere, stratosphere, mesosphere, thermosphere	• Revise the definition gravity and explain to learners that gases, like any other object which has mass, are pulled towards the Earth by the force of gravity. • Teacher clarifies the fact that the word "air" refers to the mixture of all gases found in the atmosphere. • Teacher, with learner input, lists all the gases in the atmosphere in a two column table. • The percentage of each gas making up the gas mixture (air) must also be included in the table. • Teacher explains the concept of density of gases (amount of gas per volume of gas)	Textbook, Pictures, Diagrams

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NATURAL SCIENCES: LESSON PLAN 8 **GRADE: 9**
DURATION: 60 Minutes **STRAND: EARTH AND BEYOND**
CAPS SENIOR PHASE **TERM : FOUR**

CONTENT AND CONCEPTS	ACTIVITIES	RESOURCES
• each layer has a different temperature gradient • temperature gradient is how much the temperature changes with height above sea level (altitude)	• Explain the decrease of air (mixture of atmospheric gases) density as the distance from the Earth increases. • Use a diagram which shows that the air gets thinner (less particles per volume) as you move higher up into the atmosphere. • Explain this phenomenon in terms of gravitational pull on the air molecules which become less effective with an increase of height from the surface of the Earth. The teacher will use the pictures to explain the atmosphere. • Draw a labeled diagram of the Earth and all four atmospheric layers Each layer of the atmosphere has a different temperature gradient, in other words, the temperature changes gradually as you move through each layer in a different manner. • Explain the meaning of the term temperature gradient by making use of a graph • Draw a labeled diagram of the Earth and all four atmospheric layers Each layer of the atmosphere has a different temperature gradient, in other words, the temperature changes gradually as you move through each layer in a different manner.	

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NATURAL SCIENCES: LESSON PLAN 8
DURATION: 60 Minutes
CAPS SENIOR PHASE

GRADE: 9
STRAND: EARTH AND BEYOND
TERM : FOUR

CONTENT AND CONCEPTS	ACTIVITIES	RESOURCES
	Explain the meaning of the term temperature gradient by making use of a graph Learners will complete activity 1.	

ASSESSMENT		
TEACHER REFLECTION	Progress:	Challenges:

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NATURAL SCIENCES: LESSON PLAN 8 **GRADE: 9**
DURATION: 60 Minutes **STRAND: EARTH AND BEYOND**
CAPS SENIOR PHASE **TERM : FOUR**

Teachers Notes

In the first chapter of Planet Earth and Beyond, you learnt about the different spheres of the Earth. The atmosphere was mentioned briefly in Chapter 1. In this chapter we will look at the atmosphere in more detail.**he IIIII**



Photograph of the Earth's atmosphere taken from the International Space Station. You can see the curved Earth below the bright atmosphere - a very thin layer of gases around the Earth. Above and beyond the atmosphere is where we find outer space. The bright spot is the Sun just going below the horizon.

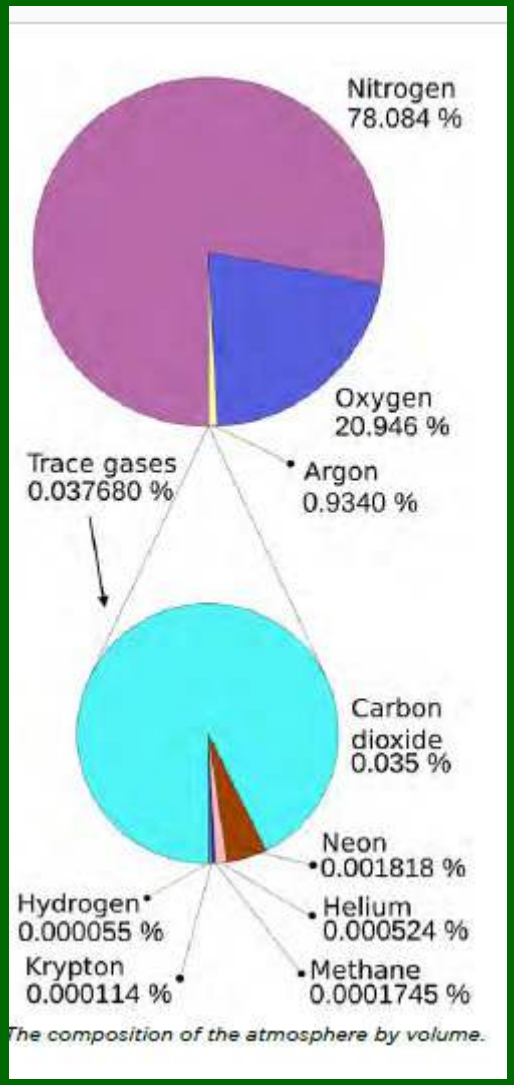
atmosphere

Th4.1 What is the. atmosphere?
The atmosphere is the layer of gases which surrounds the Earth. It contains the following mixture:
• nitrogen (78,08%)
• oxygen (20,95%)
• argon (0,93%)
• carbon dioxide and other trace gases (0,04%)

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NATURAL SCIENCES: LESSON PLAN 8
DURATION: 60 Minutes
CAPS SENIOR PHASE

GRADE: 9
STRAND: EARTH AND BEYOND
TERM : FOUR



The composition of the atmosphere by volume.

The gas molecules in the atmosphere are kept close to the Earth by gravity. The effect of gravity means that there will be more gas molecules closer to the Earth's surface than further away. As you move further and further away from

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the surface of the Earth, the gas molecules become fewer and the spaces between the molecules become larger, until there are no more gas molecules and only spaces left. The atmosphere therefore does not have a set boundary, but rather fades away into space.

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VISIT

Reveal Earth's atmosphere.

bit.ly/1g7rDki

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TAKE NOTE

The exosphere is not considered part of the atmosphere due to the very low density of gases, but it is still briefly discussed in this chapter. In some other resources which you may look at, the exosphere is sometimes discussed as a layer or upper limit of the atmosphere. When we walk up a very high mountain, there is less oxygen present. We may feel out of breath. People sometimes say that the air is thinner higher up. When they say this they mean that there is a lower concentration of oxygen molecules.

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NATURAL SCIENCES: LESSON PLAN 8 GRADE: 9

DURATION: 60 Minutes STRAND: EARTH AND BEYOND

CAPS SENIOR PHASE TERM : FOUR



The layers of the atmosphere, and the exosphere.

The **density** of the atmosphere decreases with an increase in the height above sea level (altitude). Density is an indication of how many particles are present in a specific volume of gas. When the density is high, there are lots of gas molecules present. If the density is low, there are fewer gas molecules present. The atmosphere is a very important part of the Earth. It keeps the planet warm and protects us from the harmful radiation of the Sun. It also ensures a healthy balance between oxygen and carbon dioxide so that life can be sustained on the planet.

The atmosphere has four main layers. We start measuring these from sea level and move towards space. The diagram alongside illustrates this. The surface of the Earth is at the bottom of the diagram, with Mount Everest drawn in. The first layer is the **troposphere**, then the **stratosphere**, the **mesosphere** and the **thermosphere**. Above the thermosphere, the atmosphere merges with outer space in the layer known as the **exosphere**.

The atmosphere is actually a very thin layer compared to the size of the Earth. It is almost like the skin of an orange, relative to the size of the orange.



Space Shuttle Endeavour in between the stratosphere (white layer) and mesosphere (blue layer). The orange layer is the troposphere.

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NATURAL SCIENCES: LESSON PLAN 8 **GRADE: 9**
DURATION: 60 Minutes **STRAND: EARTH AND BEYOND**
CAPS SENIOR PHASE **TERM : FOUR**

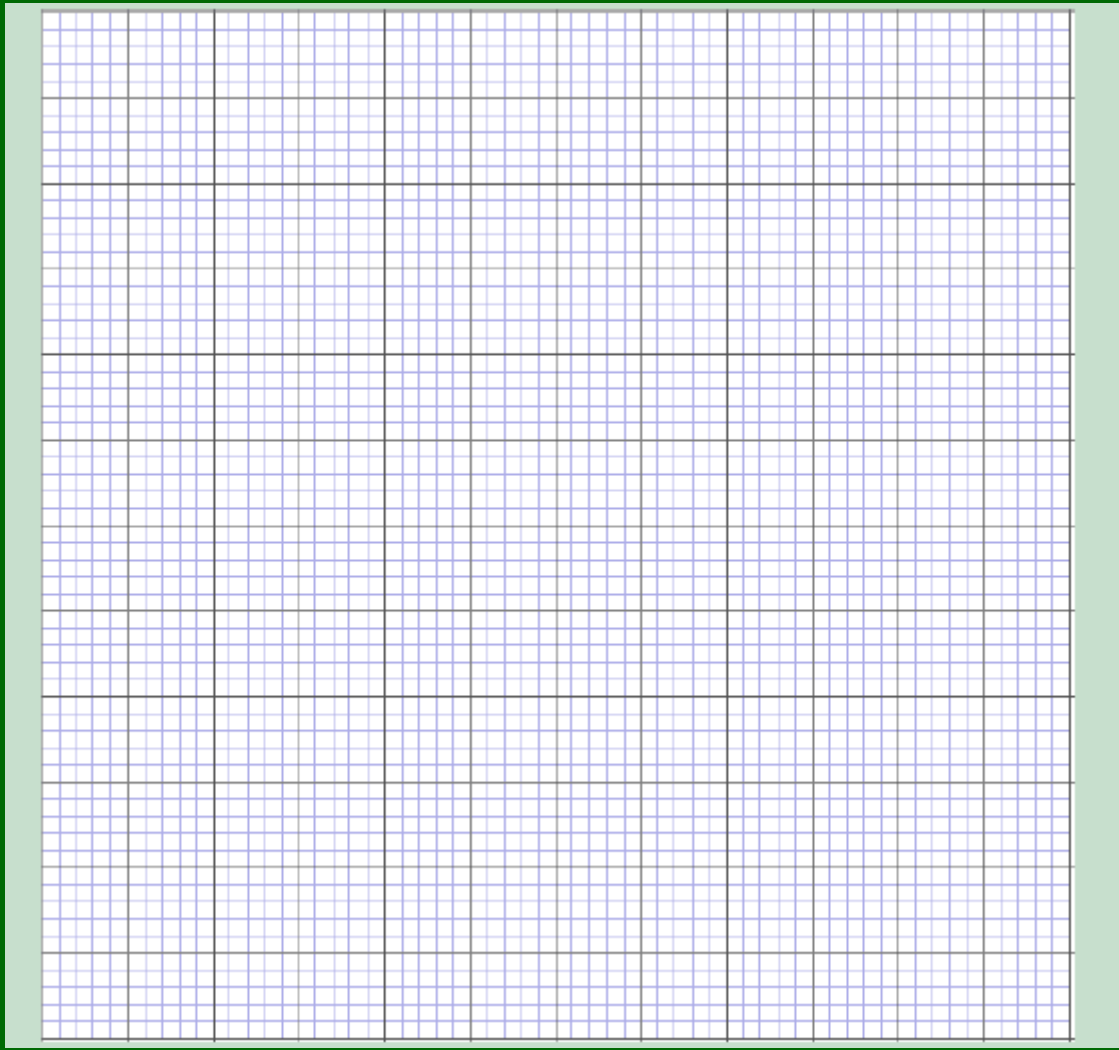
ACTIVITY 1: How thick is the atmosphere compared to the size of the Earth?

INSTRUCTIONS:
1. You need to draw a scale diagram to show how thick (or thin) the atmosphere is in comparison to the size of the Earth. Use the graph paper given below.
2. Answer the following questions to help you draw the diagram.
a) What is the radius of the Earth? Choose an appropriate scale and draw a circle in your notebook to represent the Earth.
b) How thick is the atmosphere in km? Use the same scale as above and draw the atmosphere around the Earth.
c) Indicate the atmosphere density gradient on your diagram.**e**

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NATURAL SCIENCES: LESSON PLAN 8
DURATION: 60 Minutes
CAPS SENIOR PHASE

GRADE: 9
STRAND: EARTH AND BEYOND
TERM : FOUR



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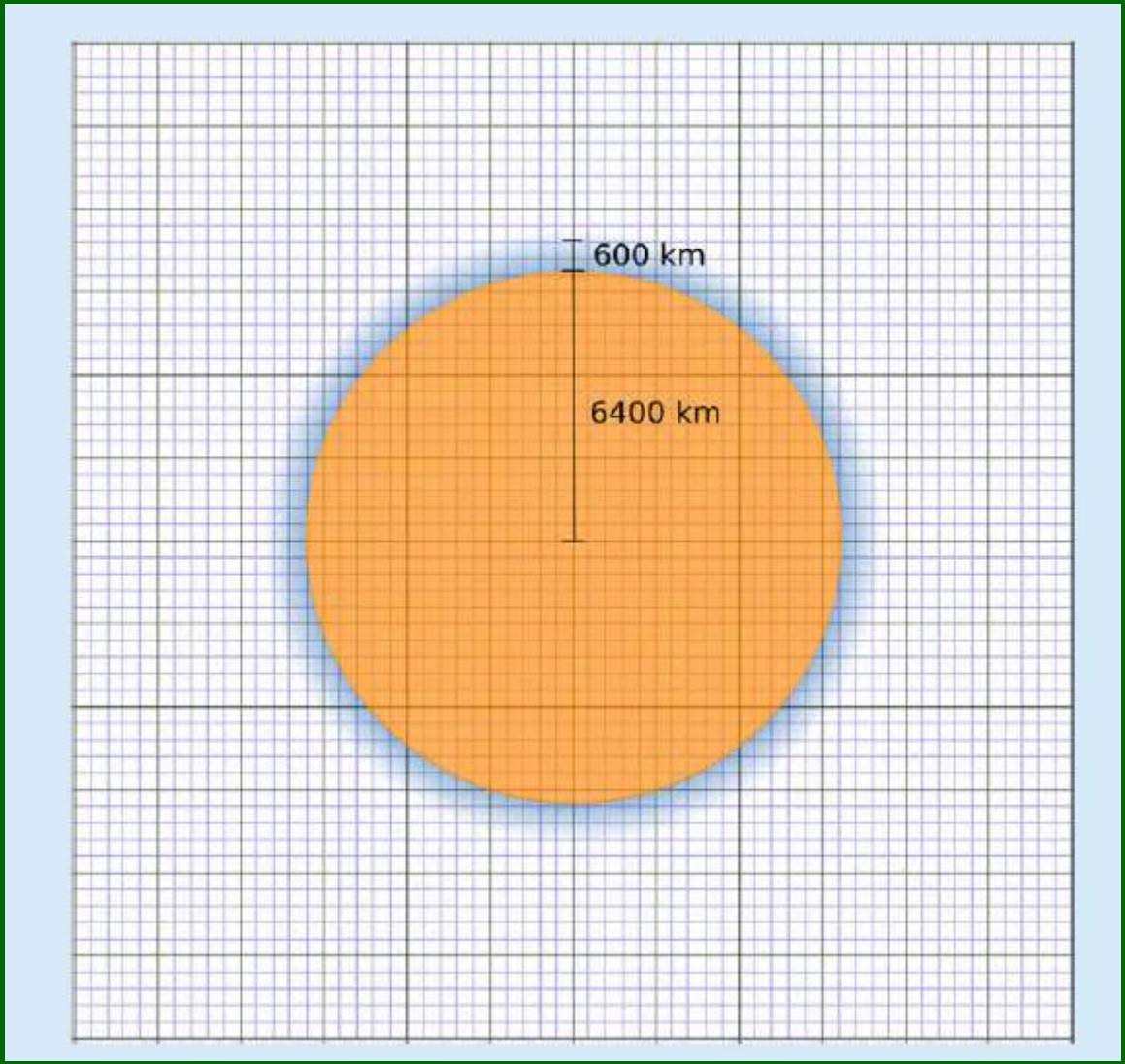
MEMORANDUM
ACTIVITY 1: How thick is the atmosphere compared to the size of the Earth? – Memorandum
a) 6400 km.
b) About 480-600 km (accept any answer within this range).
c) Learner-dependent answer.
. TEACHER'S NOTE
The atmosphere is denser closer to the surface than further away. This can be indicated by using darker going to lighter colours, or using more dots and fewer dots, or any other way of indicating that the atmosphere is denser at the bottom. A scale needs to be included. A possible diagram could look like this:
Scale drawing of the Earth and the surrounding atmosphere. 1 block = 400 km.

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NATURAL SCIENCES: LESSON PLAN 8
DURATION: 60 Minutes
CAPS SENIOR PHASE

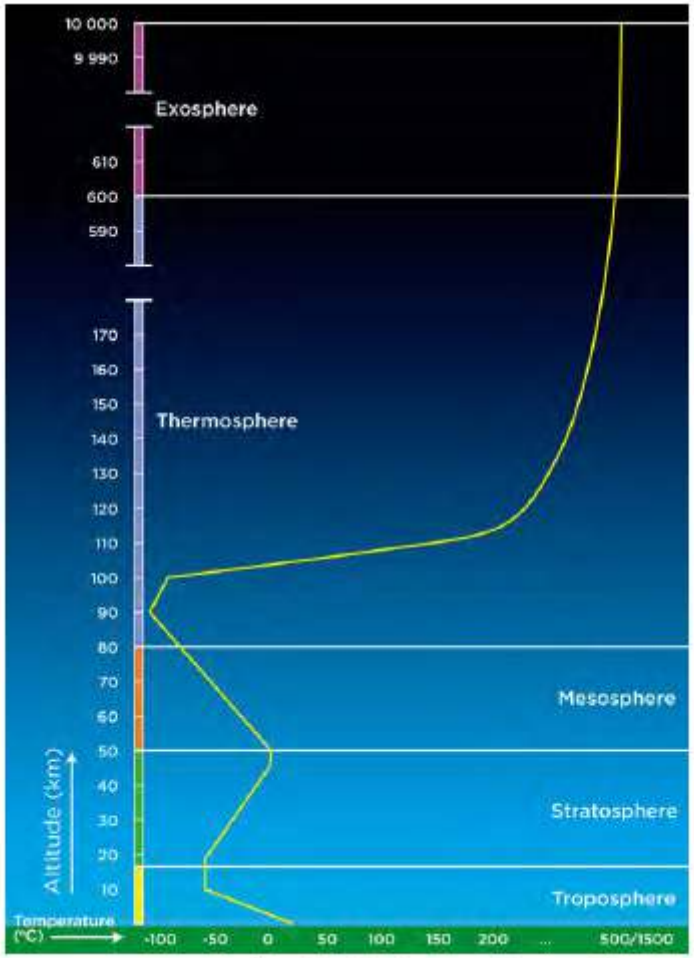
GRADE: 9
STRAND: EARTH AND BEYOND
TERM : FOUR



Each layer of the atmosphere has a different **temperature gradient**, in other words, the temperature changes gradually as you move through each layer. The following graph shows how the temperature changes as you move through the atmosphere. The layers of the atmosphere are also indicated on the graph. Temperature is on the x-axis and altitude is on the y-axis. The red line

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shows the change in temperature. Note that as you move further to the left on the graph it is colder, dropping far below 0 °C, and further to the right is hotter, reaching
over 1000 °C.



The average temperature profile of the Earth's atmosphere and the exosphere.

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NATURAL SCIENCES: LESSON PLAN 9 **GRADE: 9**
DURATION: 60 Minutes **STRAND: EARTH AND BEYOND**
CAPS SENIOR PHASE **TERM : FOUR**

DURATION: Week Four Lesson Six Week Five Lesson One	**OBJECTIVES: LEARNERS MUST BE ABLE TO:** • know that the Troposphere occupies the space from the surface of the Earth upwards to more or less 10 km above the surface of the Earth • know that the Troposphere is the atmospheric layer with the highest density and that 70% of all mass of the atmosphere is contained in the troposphere. • understand why weather occurs in this layer. know and understand why all animals and plants are found in this layer
TOPIC: The Atmosphere	
SUB TOPIC: Troposphere	
REFERENCES	**Sasol Inzalo workbooks- Natural Sciences Grade 9-B**
TERMINOLOGIES:	**Troposphere**
SPECIFIC AIMS	1. DOING SCIENCE
	2. KNOWING THE SUBJECT CONTENT & MAKING CONNECTIONS
	3. UNDERSTANDING THE USES OF SCIENCES & INDIGENOUS KNOWLEDGE

SCIENCE PROCESS SKILLS							
Accessing & recalling Information			Identifying problems & issues			Doing Investigations	
Observing			Raising Questions			Recording Information	
Comparing			Predicting			Interpreting Information	
Measuring			Hypothesizing			Communicating	
Sorting & Classifying			Planning Investigations				

CONTENT AND CONCEPTS	ACTIVITIES	RESOURCES
Troposphere • this layer extends from sea level to about 10 km above the surface of the Earth • it contains more than 70% of the mass of the atmosphere (particles closest together) and it has the greatest density • the temperature decreases as the distance from the surface increases (the further away from the Earth, the colder the air) • weather occurs in this layer • all animals and plants live in this layer	• The teacher will use the notes and pictures to explain the troposphere to the learners. • Learners will complete activity 1.	Textbook, Pictures, Diagrams

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NATURAL SCIENCES: LESSON PLAN 9
DURATION: 60 Minutes
CAPS SENIOR PHASE

GRADE: 9
STRAND: EARTH AND BEYOND
TERM : FOUR

CONTENT AND CONCEPTS	ACTIVITIES	RESOURCES
ASSESSMENT		
TEACHER REFLECTION	Progress:	Challenges:

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Teachers Notes

4.2 The troposphere

The troposphere is the lowest layer in the atmosphere. It stretches from sea level up to about 9 km at the poles and 17 km at the equator. Due to the Earth's rotation, the atmosphere is thicker at the equator than at the poles. On average it is about 12 km thick. The density of air decreases as you move further away from the surface of the Earth. The first two layers of the atmosphere contain most of the mass of the atmosphere. The bottom part of the troposphere has a high enough density for us to breathe and is the layer of the atmosphere in which we live.



Shown here is the orange-coloured troposphere, the lowest and most dense portion of the Earth's atmosphere above the Earth's surface, with the Moon above.

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DURATION: 60 Minutes **STRAND: EARTH AND BEYOND**
CAPS SENIOR PHASE **TERM : FOUR**

The air in the troposphere is in constant motion. As it is warmed by the Earth, the warm air moves away and gets replaced by cooler air which travels in convection currents. This is the basis for cloud formation and weather patterns. All the Earth's weather systems take place close to the Earth in the troposphere.



Cloud formations typical of a tropical cyclone. This one was photographed approaching the southeastern coast of Brazil.



Clouds forming in the troposphere.

The temperature in the troposphere decreases with altitude - the further you move away from the surface, the colder it becomes. The temperature decreases about 6,4oC for every kilometre increase in altitude. In the following activity you will investigate the change in temperature as height above sea level increases.

ACTIVITY 1: Drawing a graph of the temperature gradient in the troposphere

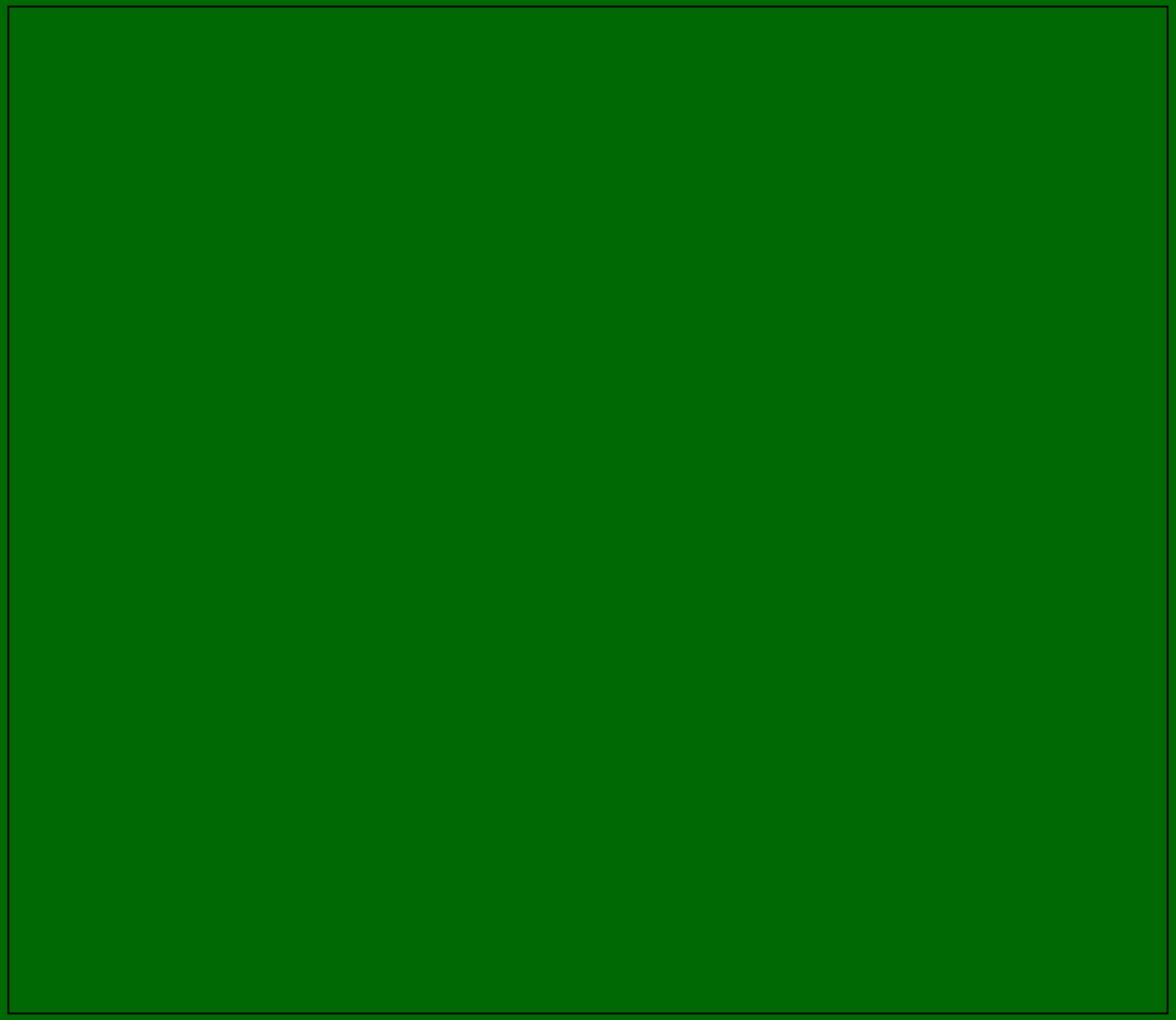
INSTRUCTIONS:
1. Using the information in the previous text, set up your own table displaying the temperature change in the troposphere from 0 - 12 km.
2. Then draw a neat, accurate graph of this data.
3. Assume that the average temperature on the surface of the Earth is 16oC.
4. Choose an appropriate scale for the x- and y-axes of your graph.
5. Label the axes and give the graph a heading.

Use the following space to draw a table for your data.

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DURATION: 60 Minutes
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GRADE: 9
STRAND: EARTH AND BEYOND
TERM : FOUR



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Use the following space to draw your graph.

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MEMORANDUM

ACTIVITY 1: Drawing a graph of the temperature gradient in the troposphere

TEACHER'S NOTE

If you would like to assess learners' tables and graphs you can use Assessment Rubric 3 and 4 to do so. As an extension you could get the learners to draw a similar graph for the change in pressure as you move through the troposphere. They will have to first find out what the pressure gradient is in the atmosphere.

INSTRUCTIONS:

1. Using the information in the previous text, set up your own table displaying the temperature change in the troposphere from 0 - 12 km.
2. Then draw a neat, accurate graph of this data.
3. Assume that the average temperature on the surface of the Earth is 16oC.
4. Choose an appropriate scale for the x- and y-axes of your graph.
5. Label the axes and give the graph a heading.

Use the following space to draw a table for your data.

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TEACHER'S NOTE

An example table is given below:

Change in temperature as altitude increases in the troposphere

Altitude (m)	Temperature (°C)
0	16
1000	9.6
2000	3.2
3000	-3.2
4000	-9.6
5000	-16
6000	-22.4
7000	-28.8
8000	-35.2
9000	-41.6
10 000	-48
11 000	-54.4
12 000	-60.8

Use the following space to draw your graph.

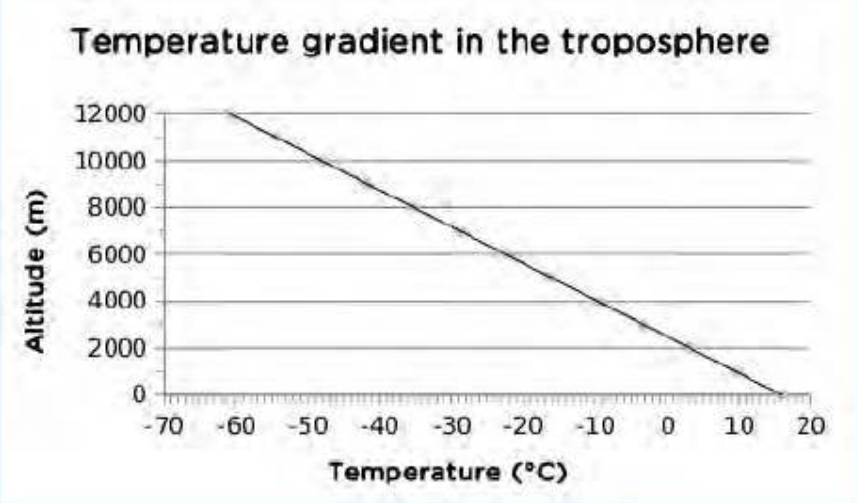
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STRAND: EARTH AND BEYOND
TERM : FOUR

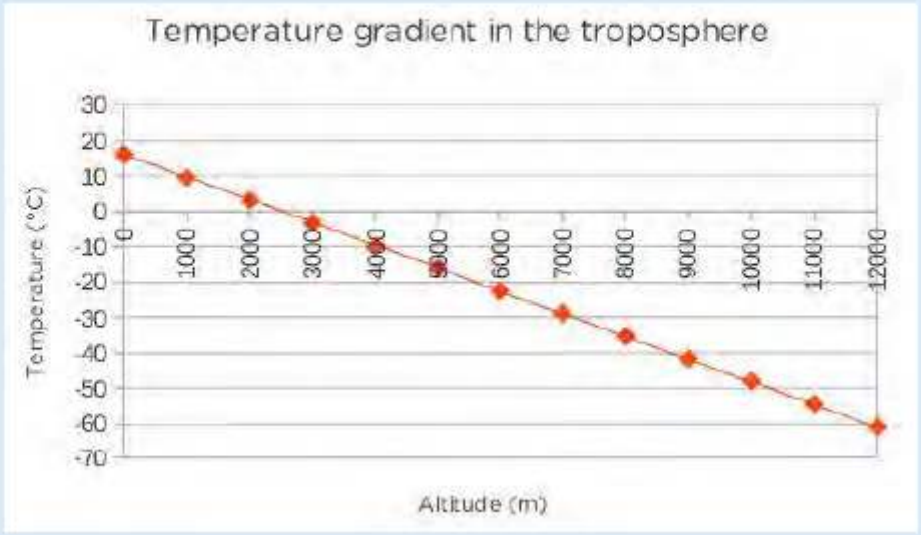
TEACHER'S NOTE

An example graph is given below.



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An alternative graph with the altitude on the x-axis is shown below:



The temperature in the troposphere decreases steadily until it reaches about -60oC at about 10-12 km above sea level. The temperature here stabilises before it increases again. This is the transition zone between the troposphere and the stratosphere. This layer forms an invisible barrier which prevents the warmer moist air from escaping from the troposphere. Beyond this region air does not circulate much and weather patterns are not found any more.

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NATURAL SCIENCES: LESSON PLAN 10 **GRADE: 9**

DURATION: 60 Minutes **STRAND: EARTH AND BEYOND**

CAPS SENIOR PHASE **TERM : FOUR**

DATE: Week Five Lesson Two and Three **TOPIC:** The Atmosphere **SUB TOPIC:** Stratosphere	**OBJECTIVES: LEARNERS MUST BE ABLE TO:** • know the position of the stratosphere relative to the other layers of the atmosphere • know that it occupies the space in-between 10km and 50km above the surface of the Earth • know and understand why the air in the stratosphere is much thinner in comparison to the air in the troposphere understand why large intercontinental jet planes fly in this layer.
REFERENCES	**Sasol Inzalo workbooks- Natural Sciences Grade 9-B**
TERMINOLOGIES:	**Ozone, CFC**
SPECIFIC AIMS	1. DOING SCIENCE 2. KNOWING THE SUBJECT CONTENT & MAKING CONNECTIONS 3. UNDERSTANDING THE USES OF SCIENCES & INDIGENOUS KNOWLEDGE

SCIENCE PROCESS SKILLS							
Accessing & recalling Information			Identifying problems & issues			Doing Investigations	
Observing			Raising Questions			Recording Information	
Comparing			Predicting			Interpreting Information	
Measuring			Hypothesizing			Communicating	
Sorting & Classifying			Planning Investigations				

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NATURAL SCIENCES: LESSON PLAN 10 **GRADE: 9**
DURATION: 60 Minutes **STRAND: EARTH AND BEYOND**
CAPS SENIOR PHASE **TERM : FOUR**

CONTENT AND CONCEPTS	ACTIVITIES	RESOURCES
Stratosphere • this layer extends from about 10 km to about 50 km above the Earth's surface • the air in the stratosphere is very thin compared to the air in the troposphere • some aeroplanes fly as high as the stratosphere • the stratosphere includes a band of ozone gas (O3) which absorbs ultraviolet radiation from the Sun • this absorption of ultraviolet radiation increases the temperature of the stratosphere - as a result, the further away from the Earth, the warmer the air becomes • too much ultraviolet radiation interferes with life on Earth (human health, photosynthesis, life cycles and sizes of • populations of species)	The teacher uses the diagram and notes to explain the stratosphere. – indicate the position of the stratosphere on the diagram by writing the latitudes(km) where the stratosphere begins and ends on the y-axis of the diagram • Revise air density and explain to learners why the air is much thinner (lower air density) in the stratosphere, in comparison to the troposphere. • Explain to learners why jet aircraft preferably fly in the stratosphere and not in the troposphere • Learners will copy the summary in their note books.	Textbook, Pictures, Diagrams

ASSESSMENT		
TEACHER REFLECTION	Progress:	Challenges:

Teachers Notes

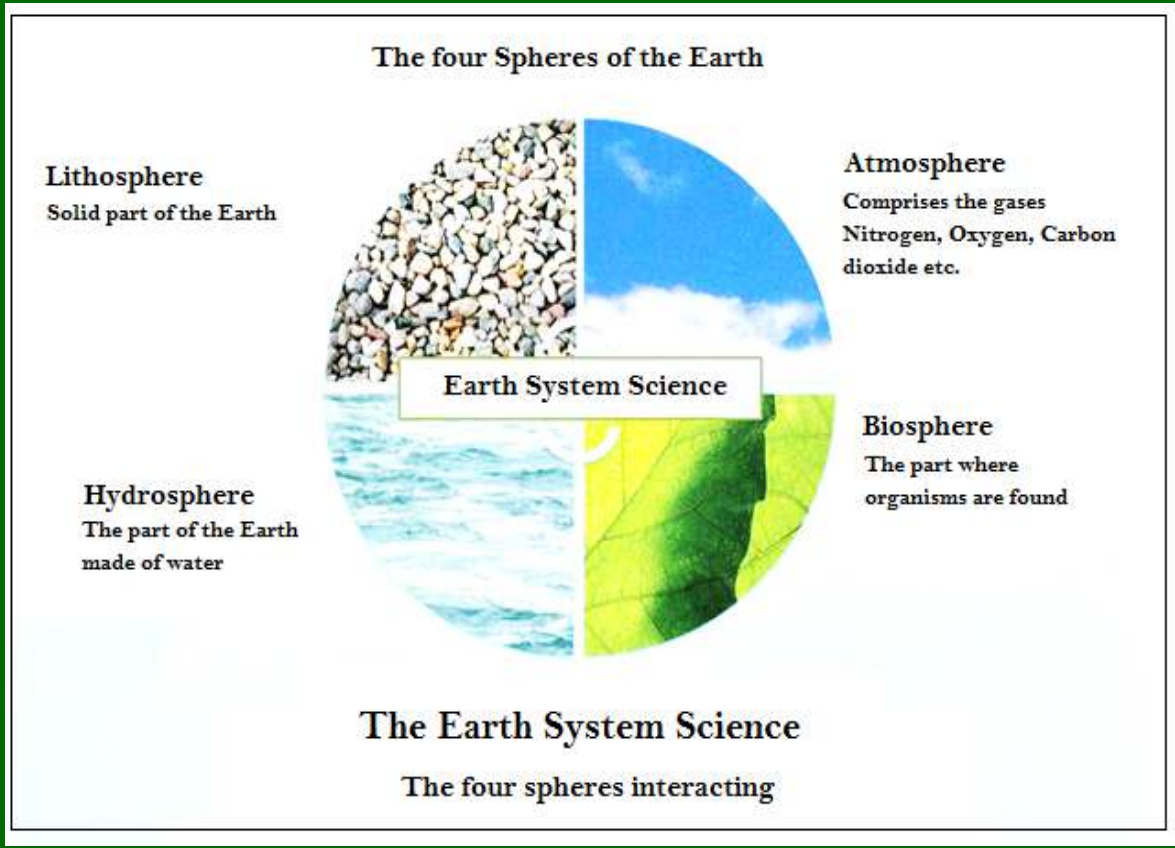
The four spheres:

- The four spheres of the Earth make a coordinated system.
- There is interdependency between the systems.
- The biosphere is a sphere where life is and the spheres in the biosphere are also interlinked.
- The parts of the biosphere are connected

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NATURAL SCIENCES: LESSON PLAN 10
DURATION: 60 Minutes
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TERM : FOUR

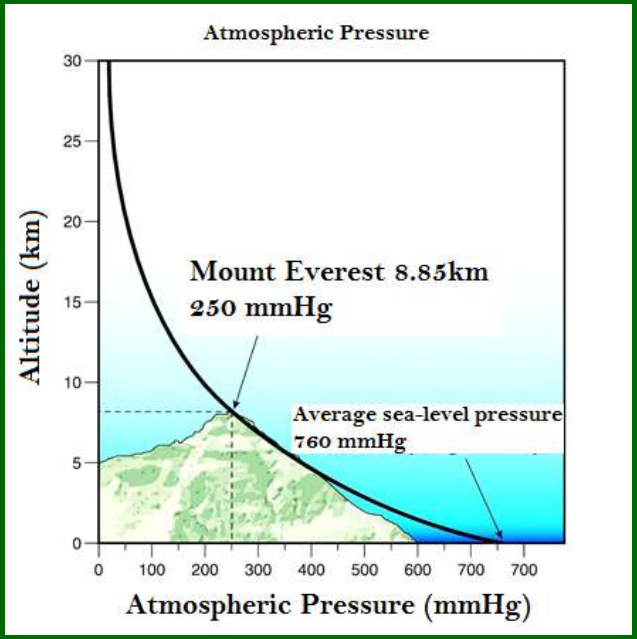


Gravity and pressure:

- Gravity pulls gas molecules (air) towards the Earth.
- The density of the gas mixture (air) decreases with the increase in altitude.
- Air pressure at sea level is at a maximum (More collisions between the higher density air molecules is responsible for the higher air pressure.
- The diagram here shows how pressure decreases with altitude.
- The average pressure at sea level as shown in the diagram is 760 mmHg and 250 mmHg at the highest point.
- Generally it is expected that there would be more oxygen at sea level than at a high altitude.

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- At high altitude people have a difficulty in breathing resulting in what is known as altitude sickness.
  1.1



4.3 The stratosphere

The stratosphere is the layer above the troposphere. It stretches from 12 km to 50 km above the surface of the Earth. 90% of the mass of the atmosphere is found in the troposphere and the stratosphere. Aeroplanes fly in the lower stratosphere because the air is much more stable than in the troposphere. The density of the air in the stratosphere is very low
and decreases with altitude. Scientists use **weather balloons** to gather information on the temperature and pressure as they move up from the Earth's surface to the stratosphere. A weather balloons carries a small device, called a radios on , which sends back information on atmospheric pressure, temperature, humidity and wind speed.

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NATURAL SCIENCES: LESSON PLAN 10 **GRADE: 9**
DURATION: 60 Minutes **STRAND: EARTH AND BEYOND**
CAPS SENIOR PHASE **TERM : FOUR**



A weather balloon being released from a US Navy ship.



A photograph taken by a weather balloon 30 km above Earth in the stratosphere.

Weather balloons are filled with helium or hydrogen and rise higher and higher into the atmosphere. Do you think they continue rising up for ever? What do you think happens to the balloon as it increases in altitude? Hint: Think of what happens to the gas inside the balloon as the altitude increases. Discuss this with your class and take some notes below.

Ozone gas (O3) is found in the stratosphere. Ozone gas is made up of ozone molecules. Each molecule consists of three oxygen atoms. Ozone plays an important role in absorbing harmful UV rays from the Sun by forming, breaking down and reforming ozone molecules over and over again. When UV light reaches the Earth, it can cause cancer, affect plant growth, and the life cycles of species.

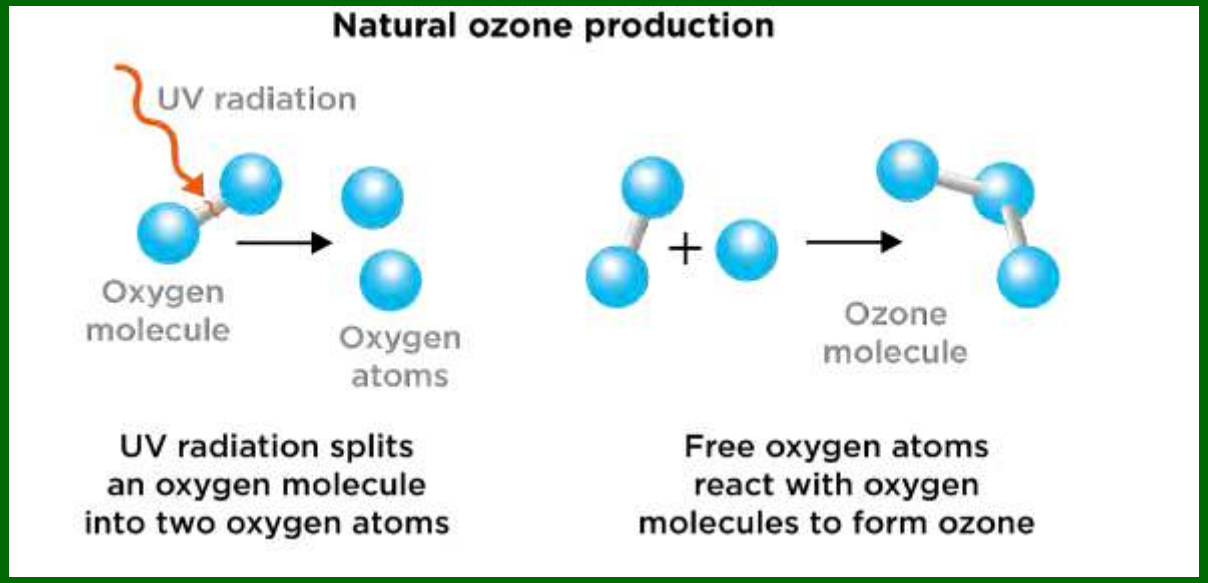
What happens to ozone in the atmosphere?

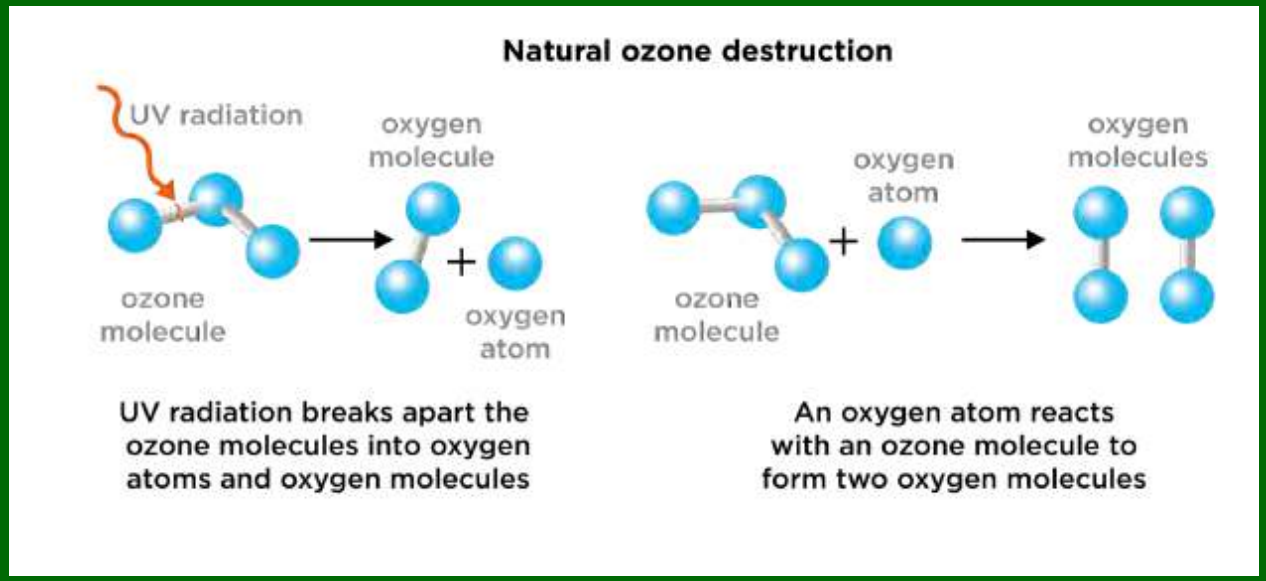
The formation and destruction of ozone is a natural process that takes place in the stratosphere. Oxygen forms ozone, and ozone breaks apart again to form oxygen. The following diagram shows the reactions that take place.

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NATURAL SCIENCES: LESSON PLAN 10
DURATION: 60 Minutes
CAPS SENIOR PHASE

GRADE: 9
STRAND: EARTH AND BEYOND
TERM : FOUR





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What holds the oxygen atoms together in a molecule?
What is the term given to a molecule of oxygen which consists of two atoms of the same element bonded together?
ANSWERS

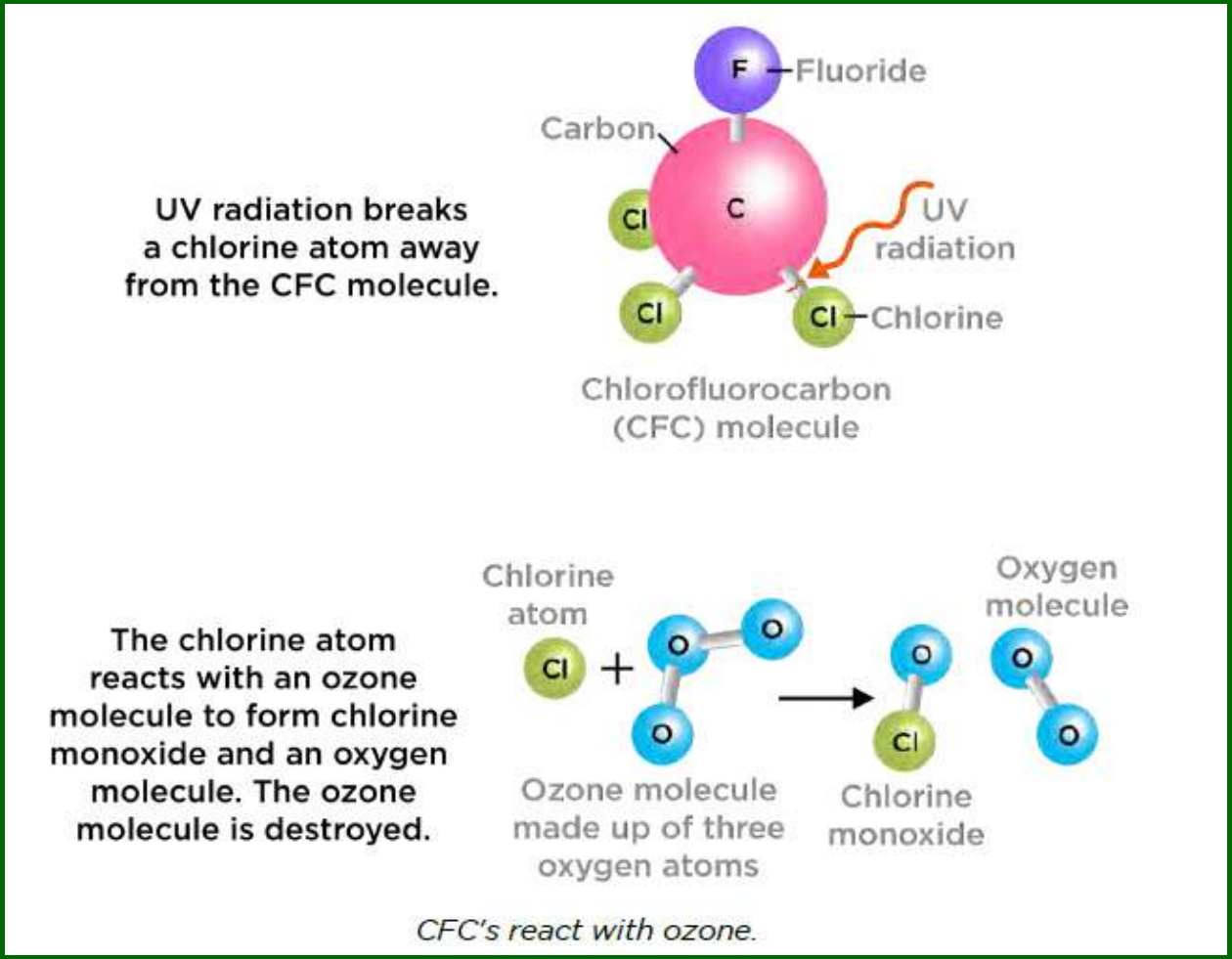
Chemical Bond

Diatomic molecule

The ozone reactions lead to the heating of the stratosphere, increasing the temperature from -60oC to about 0oC. As a result, the air becomes warmer as you move further away from the Earth in the stratosphere. The problem comes in when there are molecules present which interfere with these natural processes. Chlorofluorocarbons, or CFCs, are molecules which release chlorine atoms into the stratosphere. Chlorine atoms react with ozone, destroying it before it can absorb harmful UV rays. The following diagram show how CFCs react with ozone.

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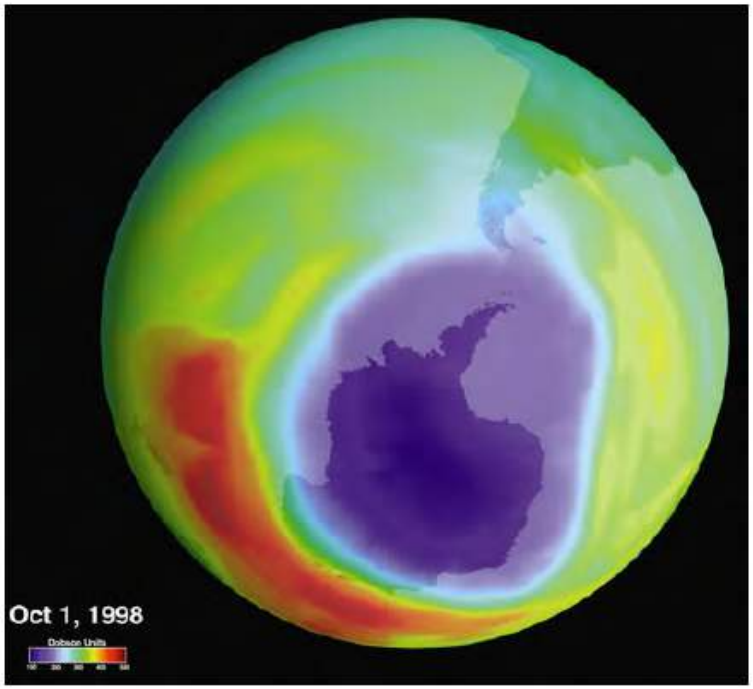


CFC's react with ozone.

CFCs used to be found in aerosols and refrigerator gas, and were given off by industrial processes. Scientists noticed that these gases interfered with ozone. This could have had a serious impact on life on Earth and the use of CFCs was banned.

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NATURAL SCIENCES: LESSON PLAN 10 **GRADE: 9**
DURATION: 60 Minutes **STRAND: EARTH AND BEYOND**
CAPS SENIOR PHASE **TERM : FOUR**



In 1985, a British scientist working in Antarctica discovered a 40 percent loss in the ozone layer over the continent. In the 1990s, this prompted a worldwide ban on CFCs. In this image, the blue/purple areas show low ozone, while the red areas indicate higher ozone levels.

TEACHER'S NOTE

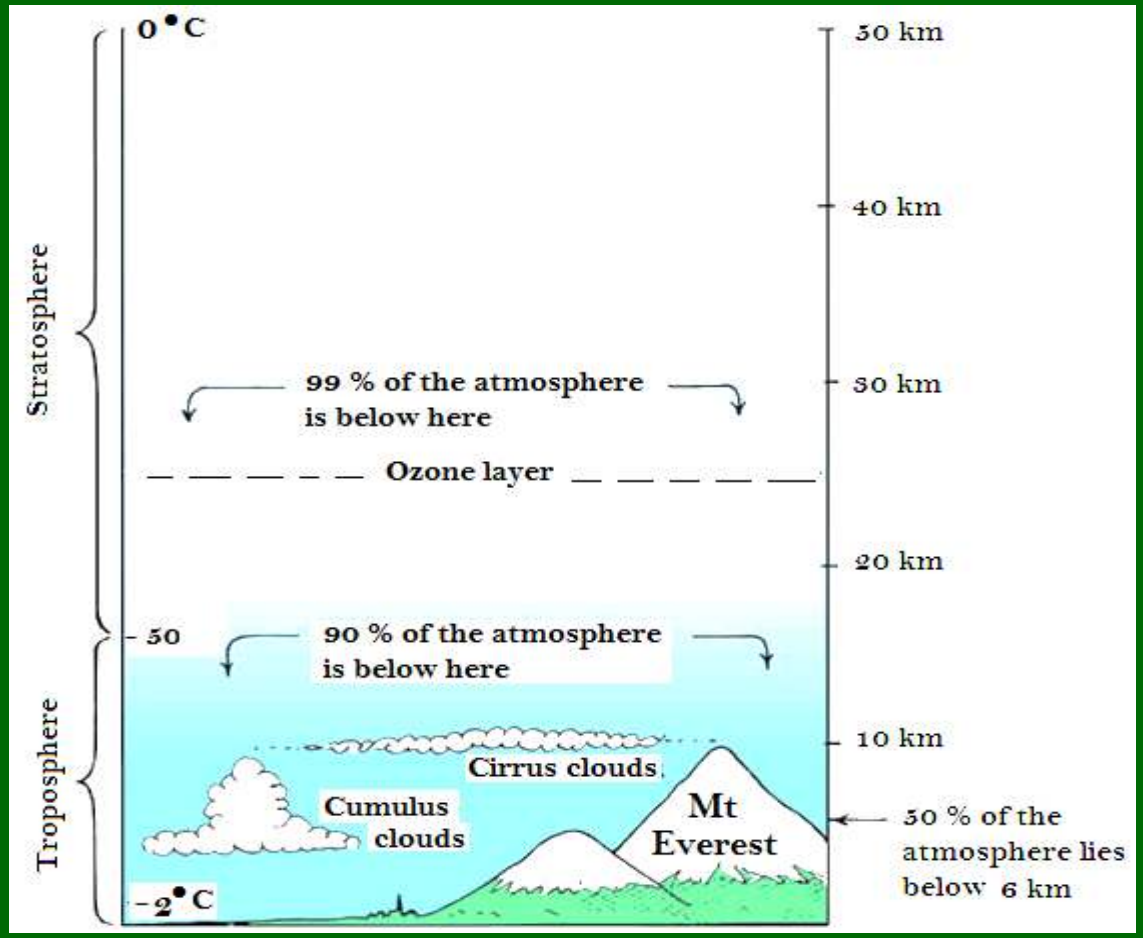
Discuss this with your class as it provides a good opportunity to revise some of the concepts learned in Gr 8 on the particle model of matter, as well as extend this knowledge. As the weather balloon rises higher and higher in the atmosphere, the pressure decreases. The volume of gas inside the balloon therefore increases and the balloon expands. Eventually it gets to a point where the balloon material cannot stretch anymore and the balloon bursts. This usually happens between 25 and 30 km above the Earth's surface. You can also explain to learners that the radios on has a small parachute attached to it which opens up when it begins to fall back to Earth. This is to slow its fall so that it does not crash down and cause damage to someone or something. Also, these sensors are never retrieved. Scientists don't need to retrieve them to get the information back because data will have been sent by radio signals.

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NATURAL SCIENCES: LESSON PLAN 10
DURATION: 60 Minutes
CAPS SENIOR PHASE

GRADE: 9
STRAND: EARTH AND BEYOND
TERM : FOUR

Diagram



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NATURAL SCIENCES: LESSON PLAN 10 **GRADE: 9**
DURATION: 60 Minutes **STRAND: EARTH AND BEYOND**
CAPS SENIOR PHASE **TERM : FOUR**

Atmospheric Layers

The atmosphere itself is not physically uniform but has significant variations in temperature and pressure with altitude.

The boundaries between the four layers troposphere, stratosphere, mesosphere and thermosphere are also defined by abrupt changes in temperature and air density.

In the troposphere and mesosphere, temperature generally falls with increasing altitude, whilst in the stratosphere and thermosphere, temperature rises with increasing altitude.

Another well-known layer of the atmosphere is the ozone layer, occupying much of the stratosphere. This layer is defined by its chemical composition - where ozone is especially abundant.

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Troposphere

The Troposphere is the lowest layer of the Atmosphere. While variations may occur, temperature usually declines with increasing altitude in the troposphere. The Troposphere generally contains up to 75% of the mass of the Atmosphere. It is primarily composed of 78% Nitrogen, 21 % Oxygen and 1% of the other gases such as Carbon dioxide. Nearly all of the atmospheric water vapor is found in this sphere (Troposphere).

The world's weather takes place in this layer since there is warm air readily rise resulting in the generation of clouds followed by rain. The moisture in this layer results in the weather that we experience.

Stratosphere

The second layer is the Stratosphere which lies in the region of 12 to 50 km, although its lower boundary tends to be higher nearer the equator and lower nearer the poles. In this layer, temperature rises with altitude. As a result of this, the Stratosphere is completely free of clouds and other forms of weather.

It is in this layer long distant flights find comfort since it is above stormy weather with strong, steady and horizontal winds.

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Mesosphere

The Mesosphere (literally middle sphere) is in the region 50 km to 80 km above the surface of the Earth. Temperatures in the mesosphere drop with increasing altitude to about -100°C. It follows that the Mesosphere is the coldest of the atmospheric layers. The mesosphere is also the layer in which a lot of meteors burn up while entering the Earth's atmosphere. From the Earth they are seen as shooting stars.

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NATURAL SCIENCES: LESSON PLAN 11
DURATION: 60 Minutes
CAPS SENIOR PHASE

GRADE: 9
STRAND: EARTH AND BEYOND
TERM : FOUR

DURATION: Week Five Lesson Four and Five **TOPIC:** The Atmosphere **SUB TOPIC:** Mesophere	**OBJECTIVES: LEARNERS MUST BE ABLE TO:** • understand what influence CFC's (gases) has on the ozone layer. • understand what negative environmental impact the depletion of the ozone layer by CFC's have on: -human health; -photosynthesis; • life cycles and sizes of populations of species
REFERENCES	**Sasol Inzalo workbooks- Natural Sciences Grade 9-B**
TERMINOLOGIES:	**Meteor, meteorite**
SPECIFIC AIMS	1. DOING SCIENCE 2. KNOWING THE SUBJECT CONTENT & MAKING CONNECTIONS 3. UNDERSTANDING THE USES OF SCIENCES & INDIGENOUS KNOWLEDGE

SCIENCE PROCESS SKILLS							
Accessing & recalling Information			Identifying problems & issues			Doing Investigations	
Observing			Raising Questions			Recording Information	
Comparing			Predicting			Interpreting Information	
Measuring			Hypothesizing			Communicating	
Sorting & Classifying			Planning Investigations				

CONTENT AND CONCEPTS	ACTIVITIES	RESOURCES
Mesosphere • this layer extends from about 50 – 80 km above the Earth's surface • the air is extremely thin and very cold • there is still enough air in this layer to burn up small rocks and dust entering from space • burning rocks are visible from the Earth and known as 'shooting stars'	• The teacher will use the pictures, diagrams and notes to explain the Mesophere. • Learners will copy the summary in their note books.	Textbook, Pictures, Diagrams

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NATURAL SCIENCES: LESSON PLAN 11
DURATION: 60 Minutes
CAPS SENIOR PHASE

GRADE: 9
STRAND: EARTH AND BEYOND
TERM : FOUR

CONTENT AND CONCEPTS	ACTIVITIES	RESOURCES
ASSESSMENT		
TEACHER REFLECTION	Progress:	Challenges:

Teachers Notes

4.4 The mesosphere

The mesosphere extends from around 50 km to 80 km above the Earth's surface. The atmosphere reaches its lowest temperature (-90 oC) in the mesosphere. The air density is extremely low, but there is still enough air to burn up rocks and dust entering from space.



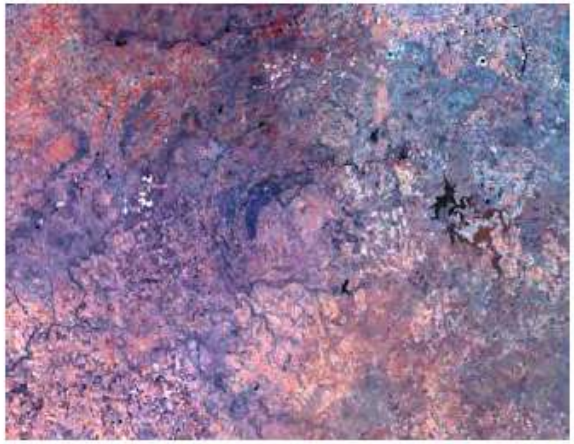
A meteor is a rock burning up in our atmosphere.

A **meteor** is a rock that enters the atmosphere from space. It travels at extremely high speed, up to 30 000 m/s. As a meteor enters the atmosphere, the air in front of it is compressed. The air heats up and the meteor burns up as a result of heat and friction. When we look up at the night sky, we might see a streak of light flashing for a brief moment. This is commonly called a shooting star, but is in fact a meteor burning up in the mesosphere.

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NATURAL SCIENCES: LESSON PLAN 11 **GRADE: 9**
DURATION: 60 Minutes **STRAND: EARTH AND BEYOND**
CAPS SENIOR PHASE **TERM : FOUR**

Most meteors are fairly small and burn up completely while whizzing through the mesosphere. Some of the larger, denser meteors can reach the Earth and are then called **meteorites**. When the meteorite strikes the ground, it kicks up dust and soil and leaves an impact crater on the Earth's surface. The size of the crater depends on the size, density and speed of the meteorite.



The impact crater at Vredefort in South Africa has a diameter of 300 km, and nearly fills the complete aerial photograph shown here.



The Tswaing Crater, just north of Pretoria, is 1.1 km wide and formed as the result of a meteorite impact about 200 000 years ago.

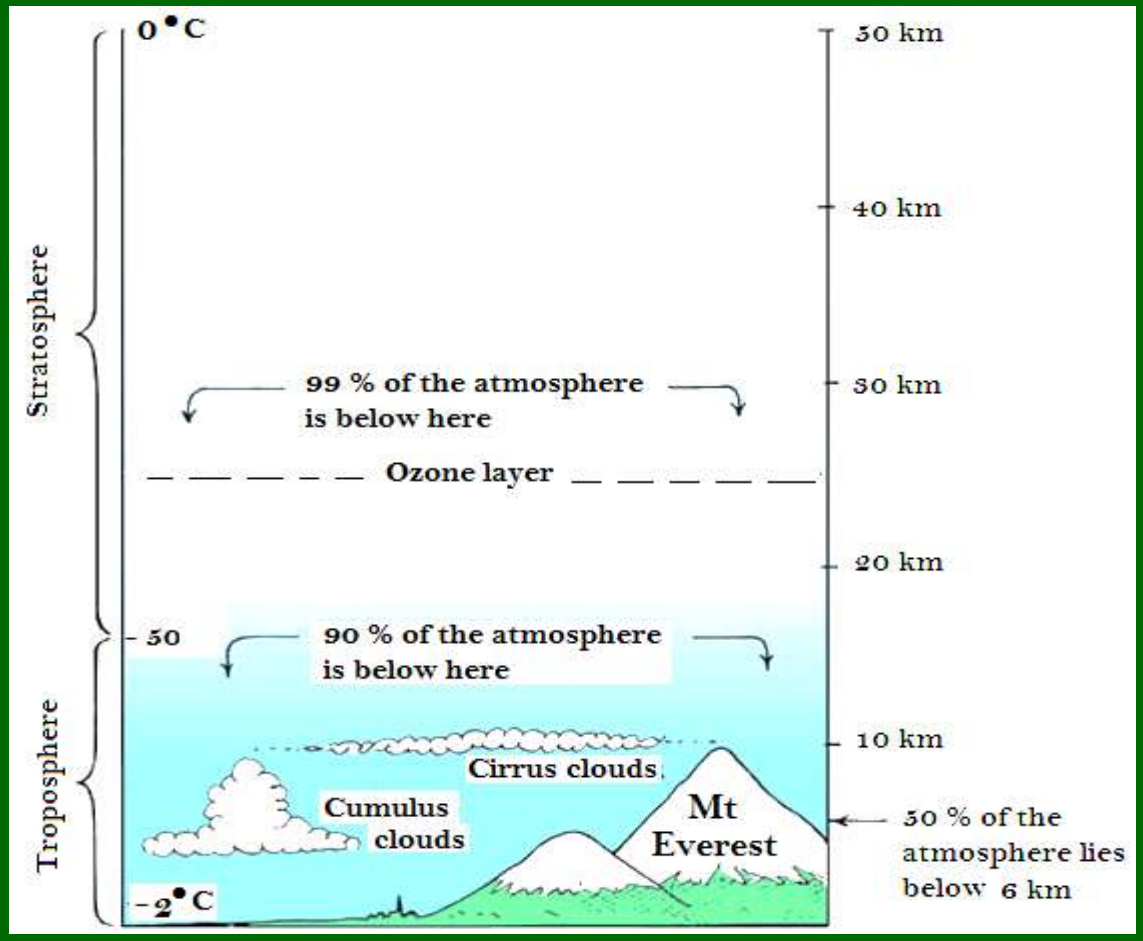
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DURATION: 60 Minutes
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GRADE: 9
STRAND: EARTH AND BEYOND
TERM : FOUR

Diagram



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NATURAL SCIENCES: LESSON PLAN 11 **GRADE: 9**
DURATION: 60 Minutes **STRAND: EARTH AND BEYOND**
CAPS SENIOR PHASE **TERM : FOUR**

Atmospheric Layers

The atmosphere itself is not physically uniform but has significant variations in temperature and pressure with altitude.The boundaries between the four layers troposphere, stratosphere, mesosphere and thermosphere are also defined by abrupt changes in temperature and air density. In the troposphere and mesosphere, temperature generally falls with increasing altitude, whilst in the stratosphere and thermosphere, temperature rises with increasing altitude.Another well-known layer of the atmosphere is the ozone layer, occupying much of the stratosphere. This layer is defined by its chemical composition - where ozone is especially abundant.

Troposphere

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Stratosphere

The second layer is the Stratosphere which lies in the region of 12 to 50 km, although its lower boundary tends to be higher nearer the equator and lower nearer the poles. In this layer, temperature rises with altitude. As a result of this, the Stratosphere is completely free of clouds and other forms of weather. It is in this layer long distant flights find comfort since it is above stormy weather with strong, steady and horizontal winds.

Mesosphere

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NATURAL SCIENCES: LESSON PLAN 12 **GRADE: 9**
DURATION: 60 Minutes **STRAND: EARTH AND BEYOND**
CAPS SENIOR PHASE **TERM : FOUR**

Duration Week Five Lesson Six Week Six Lesson One	**OBJECTIVES: LEARNERS MUST BE ABLE TO:** • know the position of the thermosphere relative to the other layers of the atmosphere. • know what satellites are and where they are found. • know what the International Space Station (ISS) is and where it is found. • must be able to explain why the temperature gradient increases in the Thermosphere –which in turns explain why the Thermosphere is a warmer layer than the Mesosphere be able to explain what role the thermosphere plays in terms of the communication network (which includes TV and radio broadcasts) on Earth.
TOPIC: The Atmosphere	
SUB TOPIC: Thermosphere	
REFERENCES	**Sasol Inzalo workbooks- Natural Sciences Grade 9-B**
TERMINOLOGIES:	**Ionosphere, aurora, northern lights(aurora borealis), southern light (aurora australis), international space station**
SPECIFIC AIMS	1. DOING SCIENCE
	2. KNOWING THE SUBJECT CONTENT & MAKING CONNECTIONS
	3. UNDERSTANDING THE USES OF SCIENCES & INDIGENOUS KNOWLEDGE

SCIENCE PROCESS SKILLS							
Accessing & recalling Information	√		Identifying problems & issues			Doing Investigations	
Observing			Raising Questions	√		Recording Information	√
Comparing			Predicting			Interpreting Information	√
Measuring			Hypothesizing			Communicating	
Sorting & Classifying			Planning Investigations				

CONTENT AND CONCEPTS	ACTIVITIES	RESOURCES
The Thermosphere: • this layer starts above 80 km from the Earth (the thermosphere slowly diminishes at about 350 km and space begins after that. Satellites orbit much further away) • the International Space Station (ISS), where astronauts work in space orbits the Earth at a height of about 370 km	• Refer to the diagram(teacher's guide) – indicate the position of the Thermosphere on the diagram by writing the latitudes(km) where the thermosphere begins and ends on the y-axis of the diagram • Let learners do a textbook research on what satellites and the ISS are. • Explain to learners why the temperature gradient	Textbook CAPS p. 78 Textbook, Pictures, Diagrams

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CONTENT AND CONCEPTS	ACTIVITIES	RESOURCES
• the lowest part of the thermosphere absorbs ultraviolet radiation and dangerous X-rays from the Sun it also reflects radio waves back to Earth for TV and radio broadcasts	in the thermosphere increases in the same way as the increase in the stratosphere. Highlight the similarities and difference which exist between the two layers which is responsible for this occurrence. • Teacher lead a classroom discussion on what role the thermosphere plays in terms of communication networks. (E.g. on TV and radio broadcasts)	

ASSESSMENT		
TEACHER REFLECTION	Progress:	Challenges:

TEACHER NOTES

The thermosphere is the layer of the atmosphere from 80 km upwards. The density of the air is extremely low. The further away you move from the Earth, the less dense the concentration of molecules becomes until the atmosphere becomes space. Most satellites that we depend on every day are in Low Earth Orbit (LEO), orbiting the Earth at an altitude between 160 km and 2,000 km. The International Space Station (ISS) is situated at 370 km in the thermosphere. This
is an international facility in space that is used for research purposes.

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NATURAL SCIENCES: LESSON PLAN 12
DURATION: 60 Minutes
CAPS SENIOR PHASE

GRADE: 9
STRAND: EARTH AND BEYOND
TERM : FOUR



The International Space Station orbits the Earth in the thermosphere

The temperature in the thermosphere increases from - 90oC to as high as 1500oC. The thermosphere is very sensitive to an increase in energy and a small
change in energy results in a high temperature increase. At times of increased solar activity, the temperature can easily increase up to 1500oC. However, the thermosphere will feel cold as there are few particles present to collide with our skin and transfer enough energy for us to feel the heat. High energy light (for example, UV light) can cause atoms or molecules to lose electrons, forming ions. The region where this takes place is called the **ionosphere**. The ionosphere is found mainly in the thermosphere. The Sun also gives off charged particles (the solar wind), which can enter the Earth's atmosphere (mostly near the poles) and react with the ions and electrons in the ionosphere, causing a phenomenon called the **aurora**. It is a colourful display of light in the sky at the poles. In the northern hemisphere, it is called the **northern lights** or **aurora borealis**, and the **southern lights** or **aurora australis** in the southern hemisphere. The ionosphere reflects longer wavelength radio waves, for

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example the radio waves we use for radio and surface-broadcast television (not satellite television), allowing the signal to be broadcast over a larger distance. The ions in the ionosphere also absorb ultraviolet radiation and X-rays.
The region beyond the thermosphere is called the **exosphere**. This layer has very few molecules and extends into space.



Sunset from the International Space Station. The troposphere is the deep orange and yellow layer. Several dark clouds are visible within this layer. The pink white layer above is the stratosphere. Above the stratosphere, blue layers show the mesosphere, thermosphere (dark blue) and exosphere (very dark blue), until it gradually fades to the blackness of outer space.

ACTIVITY 1: How thick are the layers of the atmosphere?
.

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NATURAL SCIENCES: LESSON PLAN 12 **GRADE: 9**
DURATION: 60 Minutes **STRAND: EARTH AND BEYOND**
CAPS SENIOR PHASE **TERM : FOUR**

In this activity you will build a model to represent the different layers of the atmosphere. In addition to the model, you need to draw an accurate diagram in
your workbook to represent the thickness of each layer. Use a ruler to draw an accurate scale diagram.

MATERIALS:
• large measuring cylinder or tall drinking glass
• corn kernels (popcorn)
• samp
• dried peas
• beans



INSTRUCTIONS:
1. Add a 0,5 cm layer of dried split peas to represent the troposphere (1 layer of peas thick).
2. Add a 1,5 cm layer of corn kernels on top of the peas to represent the stratosphere.
3. Add a 1,5 cm layer of samp on top of the corn kernels to represent the mesosphere.
4. Add a 24 cm layer of beans on top of the samp to represent the thermosphere.

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Your column should look something like this.



A close-up photograph of the layers.

You will notice that the area where the two layers meet is not always clear cut. The kernels might have mixed a little bit. The atmosphere is the same. There is a not a clear line separating two layers, but they mingle in the area of contact.

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NATURAL SCIENCES: LESSON PLAN 12
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TERM : FOUR

Table showing the heights of the layers in Earth's atmosphere and in the mode

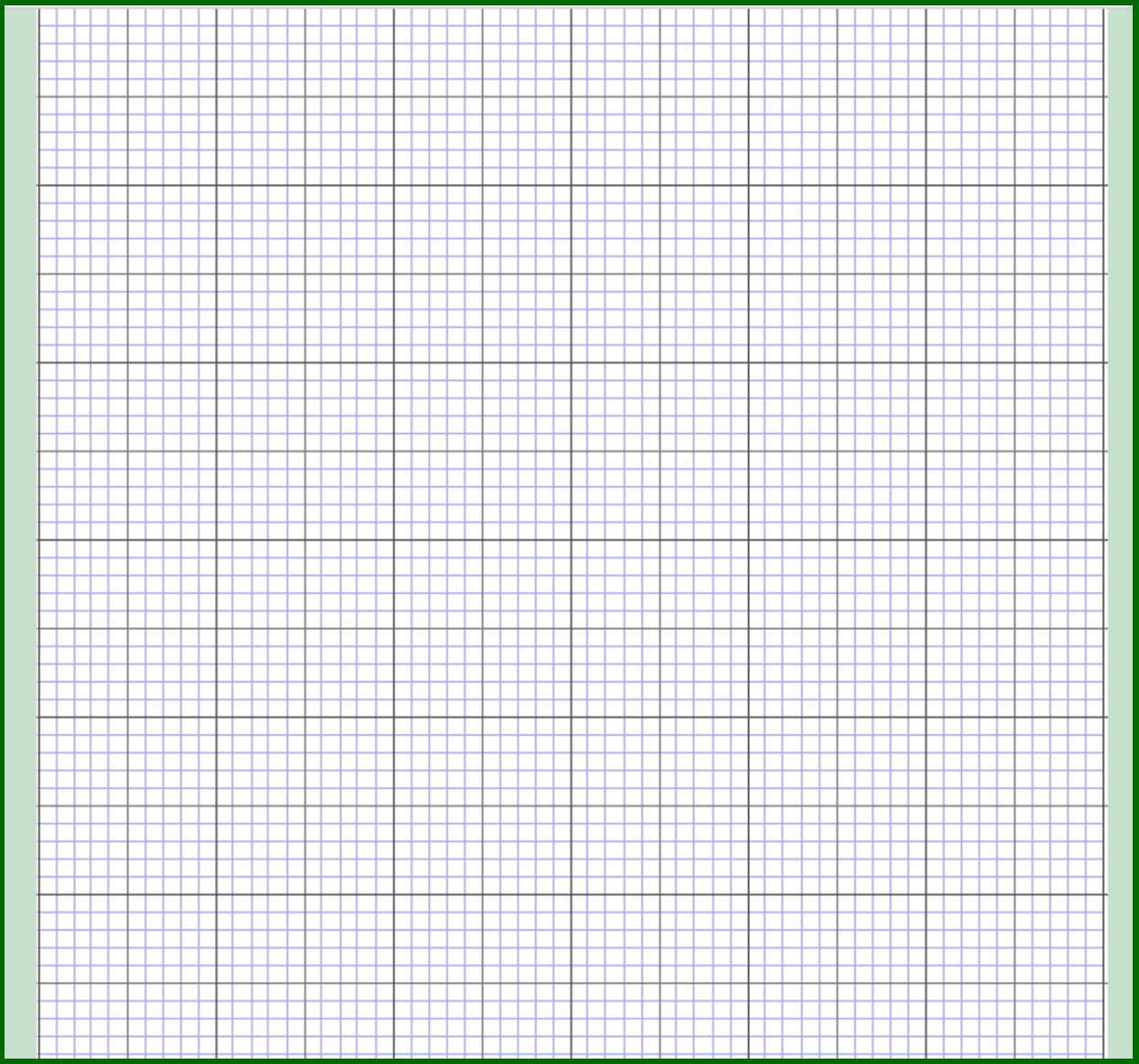
Layer	Represented by	Height of layer (km)	Height of layer (cm)
Troposphere	Dried split peas	10	0,5
Stratosphere	Corn kernels	30	1,5
Mesosphere	Samp	30	1,5
Thermosphere	Beans	480	24

3
30
. **QUESTIONS:**
1. Draw a labelled diagram of the model using the graph paper. Include a scale. The density of the atmosphere decreases with altitude. Show this on your diagram as well.

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NATURAL SCIENCES: LESSON PLAN 12
DURATION: 60 Minutes
CAPS SENIOR PHASE

GRADE: 9
STRAND: EARTH AND BEYOND
TERM : FOUR



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2. What atmospheric layers are represented by the different grains in the model?
3. In the model in the activity, how many kilometers does 1 cm represent?
4. How much thicker is the stratosphere compared to the troposphere?
5. How much thicker is the thermosphere compared to all the other layers combined?
6. Where in this model would you expect to find clouds?
7. Where in this model would you expect to find the Drakensberg Mountains?
8. Where in this model would you expect to find a satellite?
9. Where in this model would you expect to find meteors burning up?
10. In which layer is there life? What is different about this layer?

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MEMORANDUM

ACTIVITY 1: How thick are the layers of the atmosphere?

.

In this activity you will build a model to represent the different layers of the atmosphere. In addition to the model, you need to draw an accurate diagram in
your workbook to represent the thickness of each layer. Use a ruler to draw an accurate scale diagram.

TEACHER'S NOTE

This activity demonstrates the relative thickness of the layers of the atmosphere. Learners might not realise how thin the troposphere, the layer in which we live, is compared to the rest of the atmosphere. After this activity they should have a better comprehension of the thickness of the layers of the atmosphere relative to each other.

TEACHER'S NOTE

Alternative materials are different types of dry breakfast cereals, or different shapes of pasta (shells, screws, macaroni, gnocchi, etc. Any tall, thin transparent
container can be used.)

1. Draw a labelled diagram of the model using the graph paper. Include a scale. The density of the atmosphere decreases with altitude. Show this on
your diagram as well.

Learners can either draw a diagram here on the graph paper in their workbooks or on another piece of larger paper. If they draw it here in their workbooks, they will not be able to draw the diagram using the same scale as the model, as there is not enough space to draw a diagram 27,5 cm long. They can do this on another separate piece of paper. Using the graph paper, they must indicate what scale they have used, for example, 1 block or cm represents 20 km, etc.
To indicate density, learners can use darker and lighter colours or use lots of dots at the bottom and gradually fewer dots higher up.

2. What atmospheric layers are represented by the different grains in the model?
This answer depends on the model made.
Peas - troposphere
Corn - stratosphere
Samp - mesosphere
Beans – thermosphere

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3. In the model in the activity, how many kilometers does 1 cm represent?
This can be calculated, for example: 10 km / 0,5 cm = 20 km/cm.
4. How much thicker is the stratosphere compared to the troposphere?
It is three times thicker.
5. How much thicker is the thermosphere compared to all the other layers combined?
It is seven times thicker.
6. Where in this model would you expect to find clouds?
Troposphere
7. Where in this model would you expect to find the Drakensberg Mountains?
Troposphere
8. Where in this model would you expect to find a satellite?
Thermosphere
9. Where in this model would you expect to find meteors burning up?
Mesosphere
10. In which layer is there life? What is different about this layer?
Troposphere. It is the thinnest layer.
Planet Ear

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NATURAL SCIENCES: LESSON PLAN 13 **GRADE: 9**
DURATION: 60 Minutes **STRAND: EARTH AND BEYOND**
CAPS SENIOR PHASE **TERM : FOUR**

DURATION: Week Six Lesson Two and Three **TOPIC:** The Atmosphere **SUB TOPIC:** Greenhouse Effect	**OBJECTIVES: LEARNERS MUST BE ABLE TO:** Objective(s) Learners must • be able to define the natural phenomenon, namely the greenhouse effect. • know what greenhouse gases are and the function of these gases in the greenhouse effect. • know the most common greenhouse gases in our atmosphere. Know the origin of these gases. know the effect of an increase of greenhouse gases. (Global warming)
REFERENCES	**Sasol Inzalo workbooks- Natural Sciences Grade 9-B**
TERMINOLOGIES:	**Greenhouse gases, greenhouse effect, global warming, climate changing, carbon dioxide, methane, water vapour, radiation**
SPECIFIC AIMS	1. DOING SCIENCE 2. KNOWING THE SUBJECT CONTENT & MAKING CONNECTIONS 3. UNDERSTANDING THE USES OF SCIENCES & INDIGENOUS KNOWLEDGE

SCIENCE PROCESS SKILLS							
Accessing & recalling Information	√		Identifying problems & issues			Doing Investigations	
Observing			Raising Questions			Recording Information	√
Comparing			Predicting			Interpreting Information	√
Measuring			Hypothesizing			Communicating	√
Sorting & Classifying			Planning Investigations				

CONTENT AND CONCEPTS	ACTIVITIES	RESOURCES
The Greenhouse Effect: • the greenhouse effect is a natural phenomenon – it warms the atmosphere sufficiently to sustain life • greenhouse gases trap the ultraviolet radiation which then warms the air closest to the surface of the Earth (like inside a greenhouse) • the most common greenhouse gases are carbon dioxide, water vapour and methane • an increase in greenhouse gases leads to global warming	• Refer to the diagram(teacher's guide) – indicate the position of the Thermosphere on the diagram by writing the latitudes(km) where the thermosphere begins and ends on the y-axis of the diagram • Let learners do a textbook research on what satellites and the ISS are. • Explain to learners why the temperature gradient in the thermosphere increases in the same way	Textbook CAPS p. 78 Textbook, Pictures, Diagrams

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NATURAL SCIENCES: LESSON PLAN 13 **GRADE: 9**
DURATION: 60 Minutes **STRAND: EARTH AND BEYOND**
CAPS SENIOR PHASE **TERM : FOUR**

CONTENT AND CONCEPTS	ACTIVITIES	RESOURCES
• global warming is an increase in the average temperature of the atmosphere • global warming is a potentially life threatening problem on Earth. It can lead to: -- climate change -- rising sea levels -- food shortages • -- mass extinctions	as the increase in the stratosphere. Highlight the similarities and difference which exist between the two layers which is responsible for this occurrence. • Teacher lead a classroom discussion on what role the thermosphere plays in terms of communication networks. (E.g. on TV and radio broadcasts)	
ASSESSMENT		
TEACHER REFLECTION	Progress:	Challenges:

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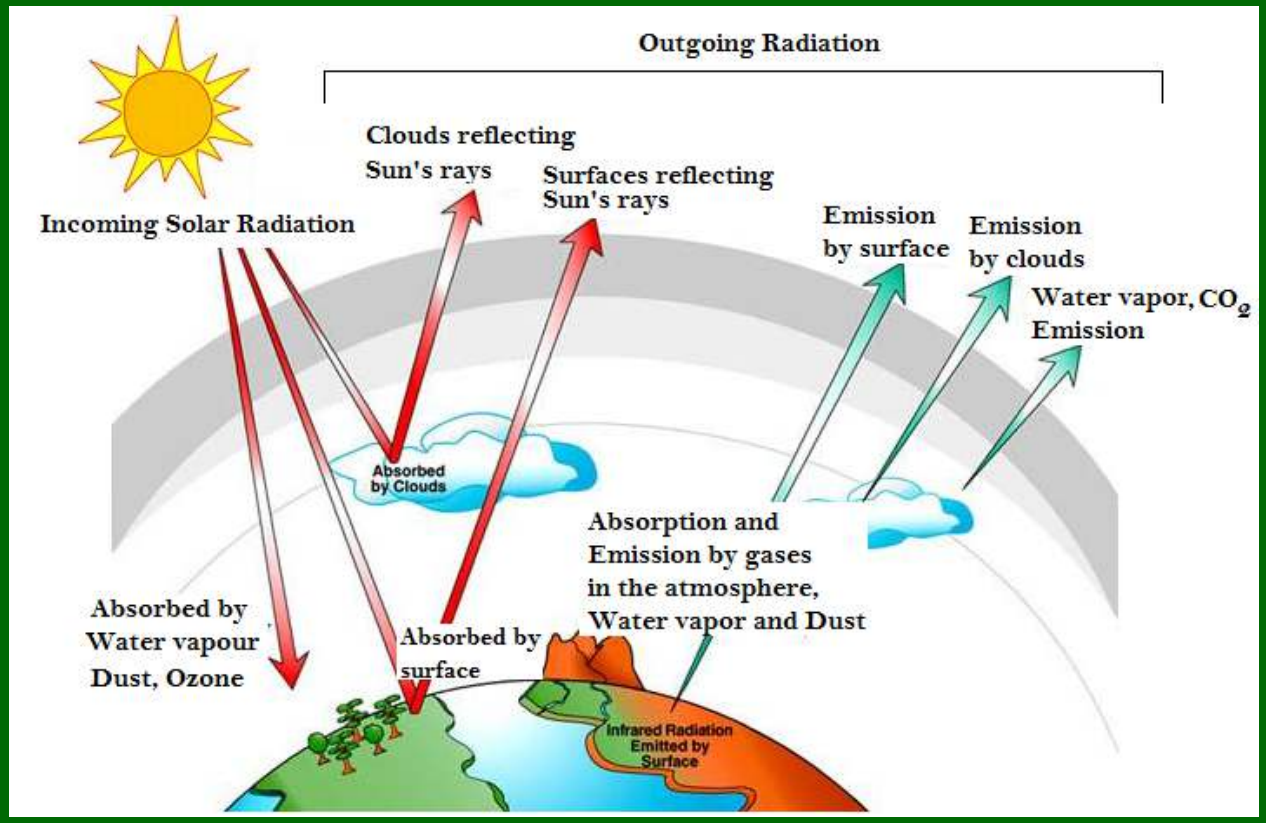
TEACHERS NOTES

You have learned a lot about greenhouse gases in Natural Sciences. In this section we will be looking at how important greenhouse gases are to sustain life on Earth.
Earth's atmosphere contains mostly (99%) nitrogen and oxygen, but a smallpercentage (1%) of the atmosphere contains gases like **water vapour** (H_2O), **carbon dioxide** (CO_2) and **methane** (CH_4). Carbon dioxide is a product of respiration in all organisms and also a gas given off by industrial processes and the burning of fossil fuels and vegetation. Methane is a gas, also called natural gas, which occurs in reservoirs beneath the surface of the Earth. It is also given off by decomposing plant and animal material and animals give off methane as part of their digestion. Water vapour is formed when water evaporates on Earth. Water vapour, methane and carbon dioxide are gases which let through incoming visible light from the Sun. The incoming radiation from the Sun is absorbed by the Earth's surface and warms it. The Earth's surface emits **infrared radiation**. Infrared radiation is absorbed by the greenhouse gases and re-emitted in all directions. This increases the temperature of the Earth's surface and lower atmosphere, above what it would be without the gases, called the **greenhouse effect**. These gases are very important to regulate the Earth's temperature.

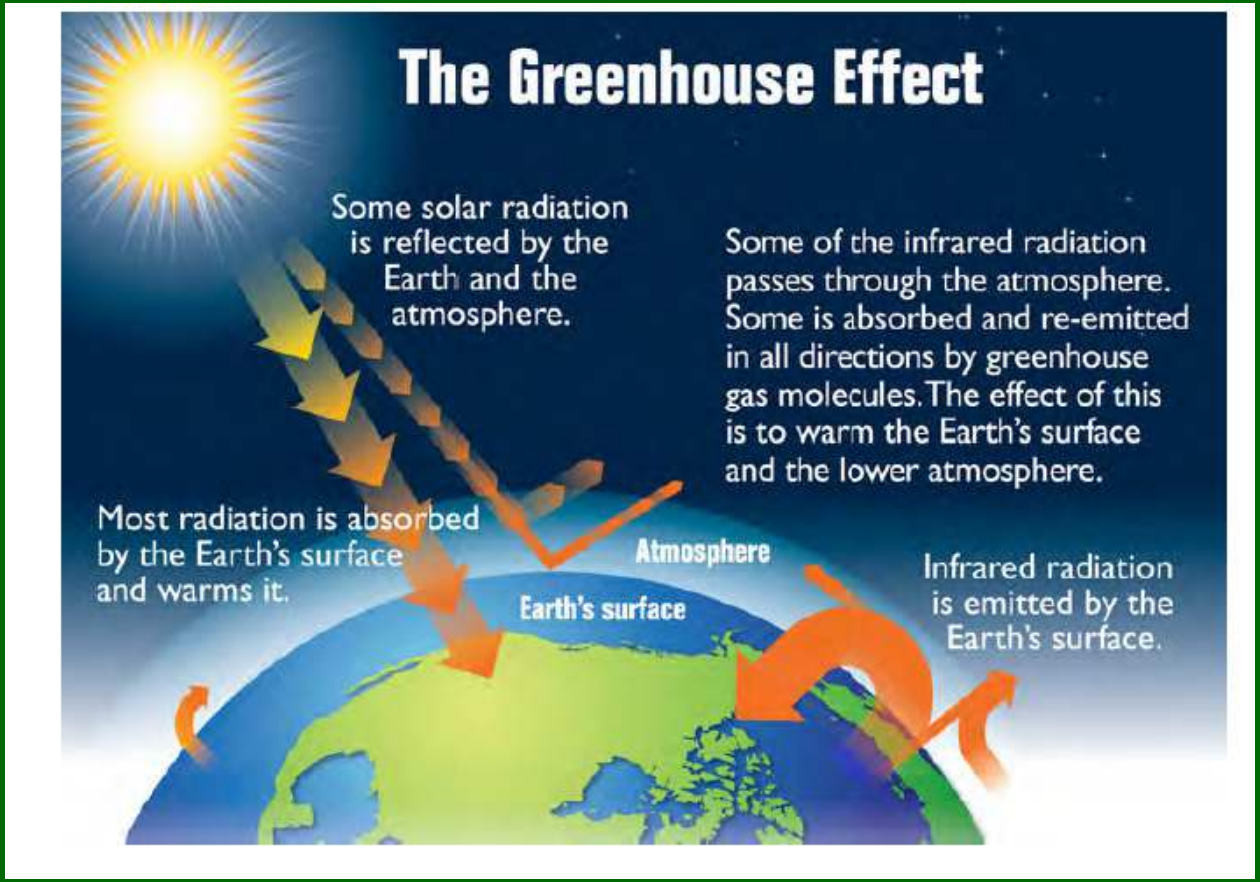
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NATURAL SCIENCES: LESSON PLAN 13
DURATION: 60 Minutes
CAPS SENIOR PHASE

GRADE: 9
STRAND: EARTH AND BEYOND
TERM : FOUR



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As you can see in the diagram, the radiation from the Sun is able to reach the Earth and warm it up. The energy that is given off by the Earth is trapped by the water vapour, carbon dioxide and methane. This ensures that the Earth stays warm. It is almost as if the gases form a blanket around the Earth keeping some of the heat inside. The gases are referred to as **greenhouse gases**. A greenhouse is a glass structure that is used to grow plants. The glass lets the heat of the Sun through, but then keeps the heat inside the structure so that the plants have a moderate climate in which to grow. Water vapour, carbon dioxide and methane act in the same way. The Earth is a very unique planet due to the make-up of its atmosphere. In this chapter you have learned about the composition of the Earth's atmosphere.

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NATURAL SCIENCES: LESSON PLAN 13 **GRADE: 9**
DURATION: 60 Minutes **STRAND: EARTH AND BEYOND**
CAPS SENIOR PHASE **TERM : FOUR**

ACTIVITY 1: A model of the greenhouse effect

In the greenhouse effect, carbon dioxide traps the heat of the Sun. In this investigation, you will use bottles with air and carbon dioxide, respectively, to model the greenhouse effect. You are going to investigate the following question: Does air or carbon dioxide absorb more heat?

AIM: Write an aim for this investigation.

_____

_____

HYPOTHESIS: Write a hypothesis for this investigation.

_____

_____

MATERIALS AND APPARATUS:

- two glass bottles or clear cold drink bottles with lids
- 2 thermometers
- Prestik
- heat source (two study lamps)
- vinegar
- bicarbonate of soda
- small cold drink bottle with lid

METHOD:

Set up the experiment as in the photograph.

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NATURAL SCIENCES: LESSON PLAN 13
DURATION: 60 Minutes
CAPS SENIOR PHASE

GRADE: 9
STRAND: EARTH AND BEYOND
TERM : FOUR



Experimental set-up.

1. Mark one bottle as 'Air' and the other bottle as 'CO2'.
2. If the lids do not have the thermometers in them already, prepared by your teacher, make a hole in each of the lids. You can do this using a hammer and nail and hammering the nail through the lid into a wooden block. Secure the thermometer in each lid. You can use Prestik to do this.
3. Fill the first bottle with air and secure the thermometer and close the lid tightly.
4. Fill the second bottle with carbon dioxide:

a) To collect a bottle of carbon dioxide, add one tablespoon of bicarbonate of soda to the small bottle.
b) Add 10-20 ml of vinegar and place the lid back on.
c) Hold the mouth of the small bottle over the large CO2 container and pour the CO2 collecting in the small container into the large container. Hold the small bottle horizontal so that the vinegar does not spill into the bigger bottle, only the heavier carbon dioxide gas pours into the large container.
d) Add more vinegar when the effervescence stops. Repeat 2-3 times until the bottle is full. If a burning match at the mouth of the bottle goes out immediately, the bottle is full.
e) Secure the thermometer and close the lid tightly.

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Pouring carbon dioxide from the small bottle into the large bottle. Your teacher will prepare the carbon dioxide for you.

5. Measure and record the starting temperature of both bottles.
6. Switch on the heat source and measure the temperature increase in both bottles. You need to decide for yourself what time increments are appropriate and record these in the table.

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The CO2 container with the light positioned to shine on it.

RESULTS:
Complete the following table.

Time (minutes)	Temperature of air bottle (°C)	Temperature of CO_2 bottle (°C)

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Represent your results by drawing a graph for each of the experiments to show how the temperature for each bottle changed over time. You need to decide what values to use for each axis. Label the axes clearly and provide a heading for each graph.

What have you observed?

CONCLUSION:
What do you conclude for your experiment?

Extension investigation: What factors make the temperature of the atmosphere increase faster?

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Design your own investigation to answer one or more of the followingquestions. Use the experiment above to guide your experimental set-up.

1. Does dark soil make the temperature increase faster?

2. Does water vapour make the temperature increase faster?

3. Does the thickness of the layer of gases make the temperature increase faster?

4. Does the presence of dust/aerosols make the temperature increase faster?

5. Does the distance of the Sun make the temperature increase faster?

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NATURAL SCIENCES: LESSON PLAN 13 **GRADE: 9**
DURATION: 60 Minutes **STRAND: EARTH AND BEYOND**
CAPS SENIOR PHASE **TERM : FOUR**

MEMORANDUM
A model of the greenhouse effect
VISIT
A greenhouse gas
demonstration.
bit.ly/1f02zss
In the greenhouse effect, carbon dioxide traps the heat of the Sun. In this investigation, you will use bottles with air and carbon dioxide, respectively, to model the greenhouse effect. You are going to investigate the following question: Does air or carbon dioxide absorb more heat?

TEACHER'S NOTE
CAPS prescribes plastic bags, we have used plastic cold drink bottles as it makes data collection easier. You can make the holes in the lids of the bottles beforehand using a knife or by hammering a nail in through the lid. Otherwise learners will need to do this and you will need a hammer, a nail about the width of the thermometer and a wooden block to hammer into. You can prepare and collect small bottles of carbon dioxide beforehand, otherwise learners will need to do this. To collect a bottle of carbon dioxide, add one tablespoon of bicarbonate of soda to the small bottle. Add 10-20 ml of vinegar and place the lid back on. Hold the mouth of the small bottle over the CO_2 container and pour the carbon dioxide into the large bottle. Carbon dioxide is denser than air and can therefore be poured into the large bottle. Add more vinegar when the effervescence stops. Repeat 2-3 times until the large bottle is full. If a burning match at the mouth of the bottle goes out immediately, the bottle is full.

AIM: Write an aim for this investigation.
TEACHER'S NOTE
A possible answer is 'To determine whether carbon dioxide or air traps more heat.
HYPOTHESIS: Write a hypothesis for this investigation.
TEACHER'S NOTE
Learner-dependent answer.
MATERIALS AND APPARATUS:
• two glass bottles or clear cold drink bottles with lids
• 2 thermometers
• Prestik
• heat source (two study lamps)
• vinegar

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• bicarbonate of soda
• small cold drink bottle with lid

METHOD:

Set up the experiment as in the photograph.



Experimental set-up

2. If the lids do not have the thermometers in them already, prepared by your teacher, make a hole in each of the lids. You can do this using a hammer and nail and hammering the nail through the lid into a wooden block. Secure the thermometer in each lid. You can use Prestik to do this.
3. Fill the first bottle with air and secure the thermometer and close the lid tightly.
4. Fill the second bottle with carbon dioxide:

a) To collect a bottle of carbon dioxide, add one tablespoon of bicarbonate of soda to the small bottle.
b) Add 10-20 ml of vinegar and place the lid back on.

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c) Hold the mouth of the small bottle over the large CO2 container and pour the CO2 collecting in the small container into the large container. Hold the small bottle horizontal so that the vinegar does not spill into the bigger bottle, only the heavier carbon dioxide gas pours into the large container.
d) Add more vinegar when the effervescence stops. Repeat 2-3 times until the bottle is full. If a burning match at the mouth of the bottle goes out immediately, the bottle is full.
e) Secure the thermometer and close the lid tightly.



Pouring carbon dioxide from the small bottle into the large bottle. Your teacher will prepare the carbon dioxide for you.

5. Measure and record the starting temperature of both bottles.
6. Switch on the heat source and measure the temperature increase in both bottles. You need to decide for yourself what time increments are appropriate and record these in the table.

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The CO2 container with the light positioned to shine on it.

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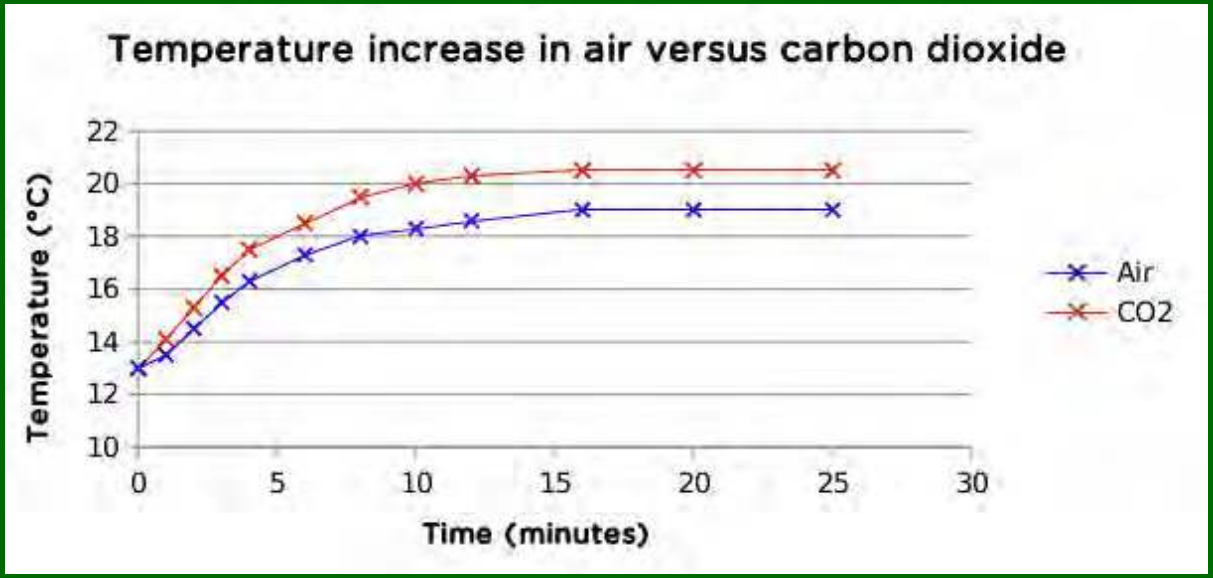
Time (minutes)	Temperature of air bottle (ºC)	Temperature of CO_2 bottle (ºC)

Represent your results by drawing a graph for each of the experiments to show how the temperature for each bottle changed over time. You need to decide what values to use for each axis. Label the axes clearly and provide a heading for each graph.

TEACHER'S NOTE
Learners should draw both graphs on the same set of axes, or if not, then both graphs should have the same scales so that the graphs can be compared,
An example graph is shown here:

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Both graphs follow a similar trend, but the carbon dioxide graph flattens out at a higher temperature. This means that carbon dioxide has trapped more heat than air. Although it is only a small difference (1,5oC), it is significant. The temperature change takes place quite quickly (within 20 minutes) and can easily be demonstrated within one lesson.
What have you observed?
.

TEACHER'S NOTE
The temperature in the carbon dioxide bottle increased more than in the bottle with air.
In both cases the temperature increased quickly, and then stabilised from about 15 minutes.

CONCLUSION:
What do you conclude for your experiment?

TEACHER'S NOTE
The carbon dioxide has trapped more heat than the air.

VISIT
A demonstration of this experiment can be found here. bit.ly/16EMVTI

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NATURAL SCIENCES: LESSON PLAN 14
DURATION: 60 Minutes
CAPS SENIOR PHASE

GRADE: 9
STRAND: EARTH AND BEYOND
TERM : FOUR

DURATION: Week Six Lesson Five and Six	**OBJECTIVES: LEARNERS MUST BE ABLE TO:** Sequence and explain the birth of a star
TOPIC: Birth, life and death of stars	
SUB TOPIC: The birth of a star	
REFERENCES	**Sasol Inzalo workbooks- Natural Sciences Grade 9-B**
TERMINOLOGIES:	**Stellar, evolution, nebula, protostar, constellation, nuclear fission, stellar wind**
SPECIFIC AIMS	1. DOING SCIENCE
	2. KNOWING THE SUBJECT CONTENT & MAKING CONNECTIONS
	3. UNDERSTANDING THE USES OF SCIENCES & INDIGENOUS KNOWLEDGE

		SCIENCE PROCESS SKILLS					
Accessing & recalling Information			Identifying problems & issues			Doing Investigations	
Observing			Raising Questions	√		Recording Information	√
Comparing			Predicting			Interpreting Information	√
Measuring			Hypothesizing			Communicating	√
Sorting & Classifying	√		Planning Investigations				

CONTENT AND CONCEPTS	ACTIVITIES	RESOURCES
The birth of a star • stars exist for a finite period of time • stars form inside huge clouds of gas and dust called *nebulae*, far out in space • these *nebulae* (huge amounts of dust and gas) are pulled together by gravity and slowly collapse • as they contract they heat up	• Introduce the topic by explaining the word “finite” and ‘infinite”. Make sure that learners understand that the Universe is extremely old and that the formation of heavenly bodies takes a very long time. Learners must also know that Starts like our Sun will eventually stop to exist - Come to an end of its existence(life) cycle	Textbook, Video on Nuclear Fusion:

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NATURAL SCIENCES: LESSON PLAN 14
DURATION: 60 Minutes
CAPS SENIOR PHASE

GRADE: 9
STRAND: EARTH AND BEYOND
TERM : FOUR

CONTENT AND CONCEPTS	ACTIVITIES	RESOURCES
• once the temperature is high enough a nuclear fusion reaction begins, that changes hydrogen to helium • this reaction radiates large amounts of energy into space	• Clarify and explain the word "Nebula(e)", revise the term "gravity" and explain how stars form. • Explain the nuclear fusion reaction which takes place in the Sun with a written chemical reaction : Hydrogen + Hydrogen → Helium + Light and Heat Energy. • Highlight the fact that the product of the nuclear fusion reaction in the Sun produces a large amount of heat and light energy which is Earth's main source of energy. • Learners will copy the summary in their note books.	https://www.youtube.com/watch?v=pusKlK1L5To

ASSESSMENT		
TEACHER REFLECTION	Progress:	Challenges:

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TEACHER NOTES

In Grades 6 and 8 learners covered material regarding the solar system including the Sun. In Grade 7, they focused on the system which includes the Sun, Earth and Moon. Learners should be familiar with the fact that the Sun is a star and produces heat and light (energy) via nuclear reactions. In this chapter the focus is on the life cycle of stars, including how they are born and die. The exact evolution that a star follows depends on the initial mass of the star. The Sun's evolution is presented as an example. The main aims of this chapter are to ensure that learners understand the following:

• stars are born in vast clouds of gas and dust
• stars spend most of their lives on the *main sequence* fusing hydrogen gas to helium gas
• stars eventually swell up to form a red giant star

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• stars like the Sun end their lives as planetary nebulae and white dwarfs

Some learners may ask why stars look 'spiky' in the photographs from telescopes, but in the diagrams shown here, they are presented as spheres. Watch this video to find out and explain to your learners: bit.ly/16iqmkW

Do you think it is important to teach astronomy to learners at school? Read this interesting and informative article detailing the benefits and applications of astronomy: bit.ly/17iVgpw

A good way to introduce the topic of stellar evolution is to start by asking learners how long they think stars last . Many will answer forever. Many people are unaware that, like humans, stars are born, live their lives and then die. You can also ask them what is meant by 'living' when referring to a star, after all, stars do not perform the seven life processes, as taught in Life and Living. Astronomers generally consider stars that are undergoing nuclear reactions in their cores to be living stars.

Stars are also compared in terms of relative concepts, such as:

• young and old
• cool and hot
• how big they are
• how massive they are (the mass is important in terms of looking at how stars die)

Stars do not live forever, just like people. Stars are born, live their lives, changing or *evolving* as they age, and eventually they die. Often stars do this in a much more spectacular way than humans do! Scientists speak of **stellar evolution** when talking about the birth, life and death of stars. The lifetime of individual stars is way too long for humans to observe the evolution of a single star, so how do scientists study stellar evolution? This is possible as there are so many stars in our galaxy, so we can see lots of them at different stages of their lives. In this way, astronomers can build up an overall picture of the process of stellar evolution. In this chapter you will discover how stars are born, how they evolve, and how they die.

5.1 The birth of a star

.

VISIT

How far is a light year?
bit.ly/HpYFOh

.

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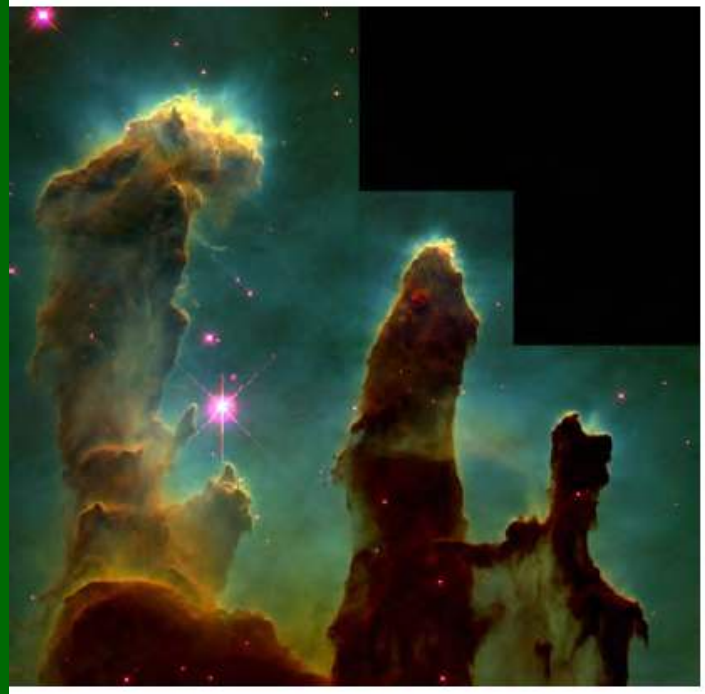
TEACHER'S NOTE

In this section learners will discover that stars are born in giant clouds of dust and gas, called nebulae, in space. In order to understand how collapsing gas clouds heat up to eventually form stars, learners need to understand that compressing a gas heats it up and that allowing a gas to expand cools it down. If they are unfamiliar with this concept a good analogy is to think about

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over-inflating a bicycle tyre (without bursting it). You could demonstrate this in class by getting learners to slightly over-inflate a tyre. They will find that the pump and tyre get hot! In the case of inflating a tyre, you are forcing more and more molecules into a given volume (assuming that the tyre is now at full capacity). So you are compressing or squeezing the gas. Each molecule has a certain amount of kinetic energy. As more molecules are forced in by the pump, the air in the tyre is compressed and the total thermal energy increases because there are more molecules colliding inside the tyre. As more particles are contained in the same volume, the air's temperature in the tyre increases. As you deflate the tyre, you allow the gas to expand, the molecules are more spread out. There is then less thermal energy and so the temperature decreases. You could let students feel the air as it is released from the tyre - it should be colder than the ambient air as it is rapidly expanding as it escapes from the tyre.
Stars are born in vast, slowly rotating, clouds of cold gas and dust called nebulae (singular **nebula**). These large clouds are enormous, they have masses somewhere between 100 thousand and two million times the mass of the Sun and their diameters range from 50 to 300 light years across.

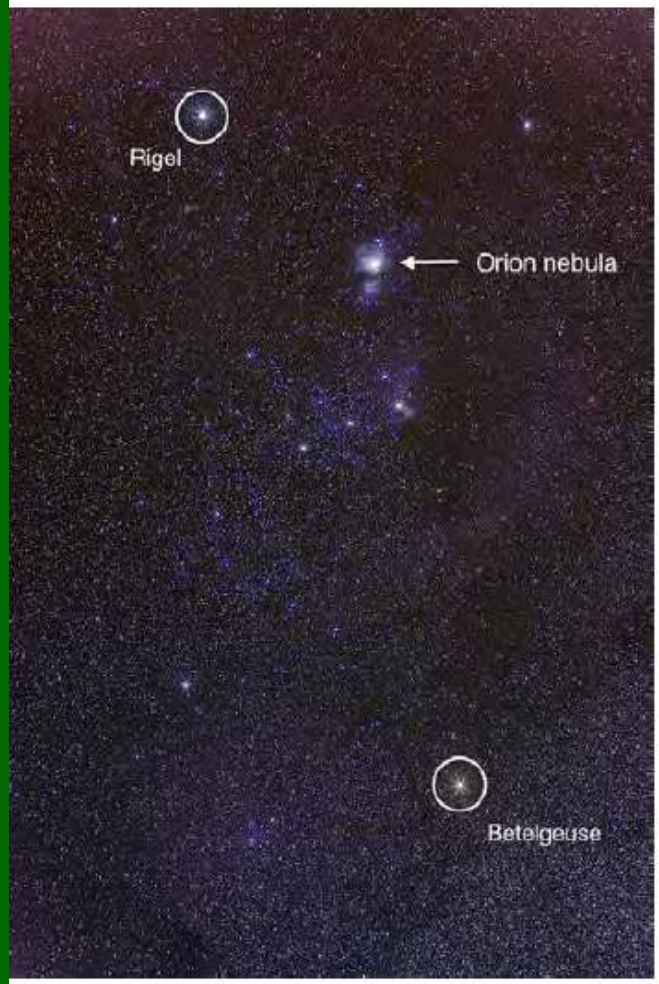


The "Pillars of creation". These giant, dense dusty clouds of hydrogen gas are vast stellar nurseries where new stars are born. (NASA)

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A famous example of one of these huge clouds is the Orion nebula in the constellation of Orion. It is visible with the naked eye if the sky is dark enough. These clouds are so massive that they can collapse under their own gravity if they are disturbed.

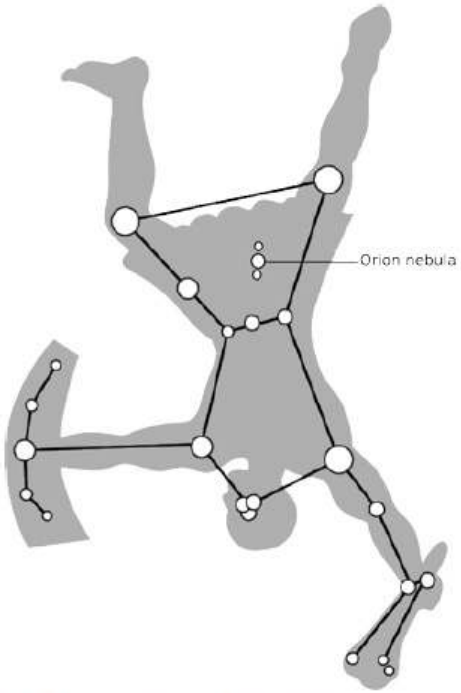


The constellation of Orion as viewed from the southern hemisphere. The Hunter Orion is "upside down" when viewed from the south and his sword lies above the three stars in his belt. The jewel in his sword which looks like a white-pink smudge is the Orion nebula.

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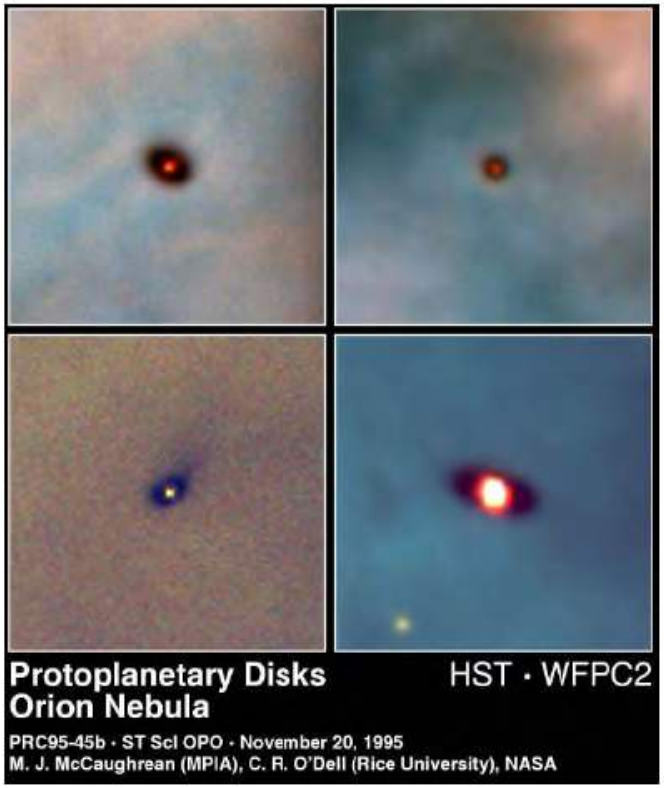
Over time the clouds contract, become denser and slowly heat up. The clouds also break up into smaller clumps. As the clumps get smaller they begin to flatten out into a disk shape. The centre of each clump will eventually contain a star and the outer disk of gas and dust may eventually form planets around the star.



This diagram shows how the stars make up the constellation of Orion, as seen in the southern hemisphere.

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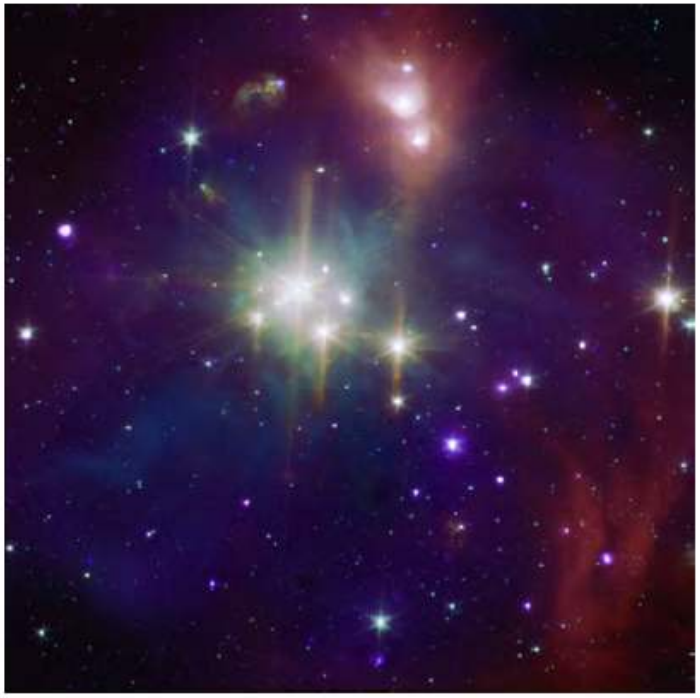
Hubble Space Telescope image of the Orion Nebula showing different protostars surrounded by a dark disk of gas and dust. These disks (called protoplanetary disks) may eventually form planets around the star.

As the contracting clump continues to heat up, a **protostar** is formed at the centre. A protostar is a dense ball of gas that is not yet hot enough at the centre to start nuclear reactions. This stage lasts for roughly 50 million years. As the collapse continues, the mass of the protostar increases, squeezing it further and increasing the temperature. If the protostar is massive enough for the temperature to reach 10 million degrees Celsius, then it becomes hot enough for nuclear reactions to start and the protostar will will technically be referred to as a star.

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Not as well known as its star formation cousin Orion, the Corona Australis region, with the Coronet cluster at its centre, is one one of the nearest and most active star formation regions to us. This image shows the young stars at the centre, with gas and dust emissions.



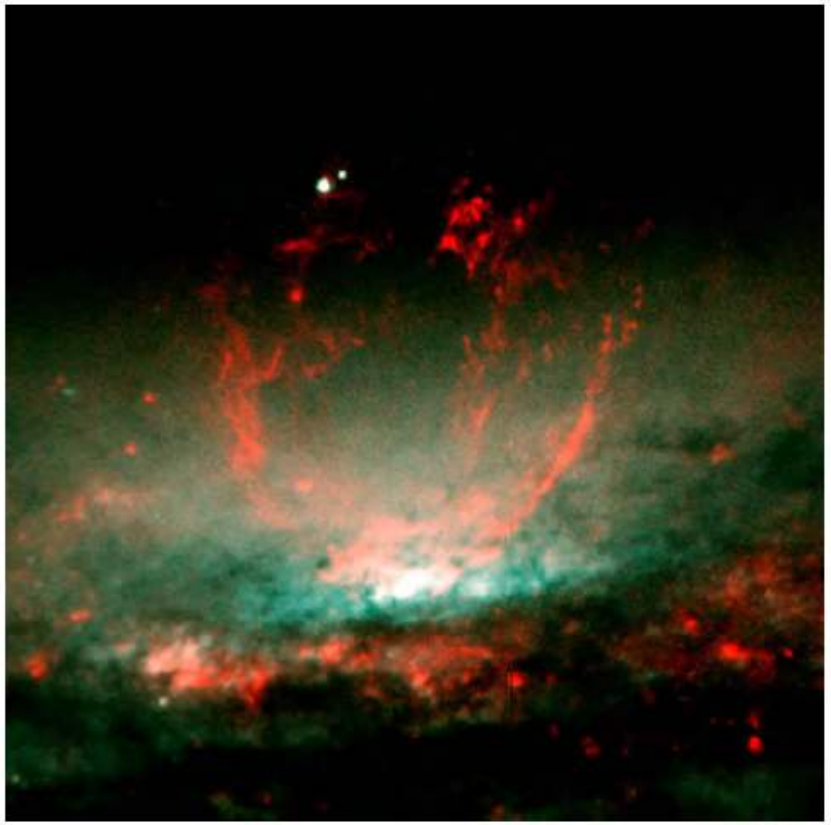
The young star starts converting hydrogen to helium via **nuclear fusion** reactions. Nuclear reactions in stars produce vast amounts of energy in the form of heat and light, which is radiated into space. This energy production prevents the star from contracting further. As the star shines, the disk of dust and gas surrounding the star is slowly blown away by the star's **stellar wind** which leaves behind any planets if they have already formed.

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NATURAL SCIENCES: LESSON PLAN 14
DURATION: 60 Minutes
CAPS SENIOR PHASE

GRADE: 9
STRAND: EARTH AND BEYOND
TERM : FOUR



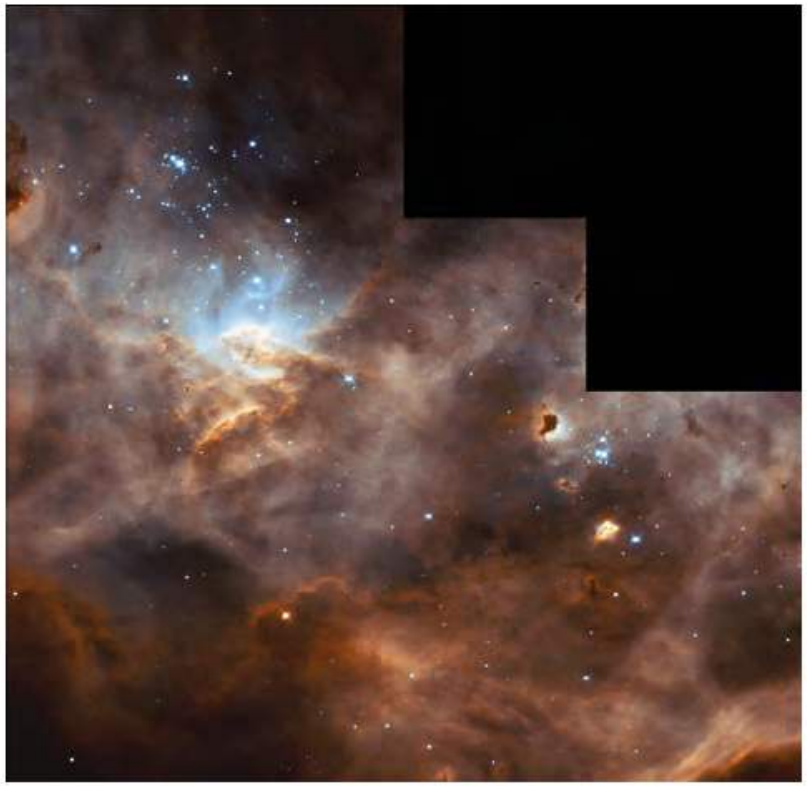
A large bubble of hot gas rising from glowing matter in a galaxy 50 million light years from Earth. Astronomers suspect the bubble is being blown by stellar winds, released during a burst of star formation.

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NATURAL SCIENCES: LESSON PLAN 14
DURATION: 60 Minutes
CAPS SENIOR PHASE

GRADE: 9
STRAND: EARTH AND BEYOND
TERM : FOUR



Star formation in the nearest galaxy outside the Milky Way, called the Large Magellanic Cloud (LMC), taken with the Hubble Space Telescope. This image shows glowing gas, dark dust clouds and young, hot stars.

TEACHER'S NOTE

The image shown here of the Large Magellanic Cloud, a satellite galaxy to the Milky Way, illustrates very clearly, an example of sequential star formation, where new star birth is triggered by the previous generation of massive stars.
You can point some of these observations out to learners:

• Just below the cluster of hot stars in the top left, is an area of brightly emitting hydrogen gas, illuminated by the nearby hot stars. Further to the right are several smaller dark dust clouds with odd shapes. They can be seen silhouetted against the glowing gas. Several of these dark clouds have a bright rim as they are illuminated and being evaporated due to the action of radiation from neighboring hot stars.

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• The region around the cluster of hot stars in the image is relatively clear of gas as the stellar winds and radiation from the stars have pushed the gas away.
• When this gas collides with and compresses surrounding dense clouds, the clouds can collapse under their own gravity and start to form new stars.
• The cluster of new stars in the upper left may have been formed this way, as it is located on the rim of the large central interstellar bubble of the complex. The stars in this cluster are now beginning to clear away the cloud from their birth, and are producing new opportunities for subsequent star birth.
• Learners may ask why some of these images have black boxes in the top, right corner, as though some of the image is missing. These strange, stair-shaped images come from the Hubble Telescope's Wide Field and Planetary Camera 2, or WFPC2. WFPC2 consists of four cameras, each of which takes a picture of a section of the target. It is like taking four pictures of a single scene, then putting them together to create the whole picture. But one of WFPC2's cameras, the top right, takes a magnified view of the section it is observing, to allow astronomers to study that section in finer detail. When the images are processed, that magnified section is shrunk down to the same size as the other sections, so that it fits into the image, resulting in the stair-shaped pattern. You can read more about it here: bit.ly/Hszbz3

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NATURAL SCIENCES: LESSON PLAN 15
DURATION: 60 Minutes
CAPS SENIOR PHASE

GRADE: 9
STRAND: EARTH AND BEYOND
TERM : FOUR

DURATION: Week Six Lesson Six Week Seven Lesson One	**OBJECTIVES: LEARNERS MUST BE ABLE TO:** Sequence and explain the life of a star
TOPIC: Birth, life and death of stars	
SUB TOPIC: The life of a star	
REFERENCES	**Sasol Inzalo workbooks- Natural Sciences Grade 9-B**
TERMINOLOGIES:	**Main sequence star, red giant star**
SPECIFIC AIMS	1. DOING SCIENCE
	2. KNOWING THE SUBJECT CONTENT & MAKING CONNECTIONS
	3. UNDERSTANDING THE USES OF SCIENCES & INDIGENOUS KNOWLEDGE

SCIENCE PROCESS SKILLS							
Accessing & recalling Information			Identifying problems & issues			Doing Investigations	
Observing			Raising Questions			Recording Information	
Comparing			Predicting			Interpreting Information	
Measuring			Hypothesizing			Communicating	
Sorting & Classifying			Planning Investigations				

CONTENT AND CONCEPTS	ACTIVITIES	RESOURCES
Life of a star • stars change in their appearance over billions of years • stars that look blue are hotter and usually younger than stars that appear red • our Sun is about half way through its life cycle – it is a medium-sized yellow star with a lifespan of about 9 billion years	The teacher will explain using the notes and pictures the life of a star. Learners will match the temperatures to the colour of the stars.	Textbook,

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NATURAL SCIENCES: LESSON PLAN 15
DURATION: 60 Minutes
CAPS SENIOR PHASE

GRADE: 9
STRAND: EARTH AND BEYOND
TERM : FOUR

CONTENT AND CONCEPTS	ACTIVITIES	RESOURCES
• for most of their life, stars change hydrogen to helium • later, towards the end of their life, stars like the Sun will swell up to form a 'red giant'		Video on Nuclear Fusion: https://www.youtube.com/watch?v=pusKlK1L5To
ASSESSMENT		
TEACHER REFLECTION	Progress:	Challenges:

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TEACHER NOTES

5.2 Life of a star

This section covers the main stages of a star's life, from infancy to old age. Learners will also discover why stars do not all look the same and why they evolve at different rates and have different lifetimes: it is a consequence of having different masses. They will learn how important the mass of a star is in determining its evolution and observable characteristics.

VISIT
Stars: Life and death.
bit.ly/16GkRyE

A star is considered to be 'born' once nuclear fusion reactions begin at its centre. Initially hydrogen is converted to helium deep inside the star. A star that is converting hydrogen to helium is called a **main sequence star**. Stars spend most of their lives as main sequence stars, converting hydrogen to helium at their centres or cores. A star may remain as a main sequence star for millions or billions of years. Main sequence stars are not all the same. They have different masses when they are born, depending on how much matter is available in the nebula from which they formed. These stars can range from about a tenth of the mass of the Sun up to 200 times as massive. Different mass stars have different observable properties.

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CAPS SENIOR PHASE

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Main sequence stars come in different sizes and colours. Their sizes range from around 0.1 to 200 times the size of the Sun. Their surface temperatures determine their colours and can range from under 3000°C (red) to over 30 000 °C (blue).

Main sequence stars also have different colours, depending on the temperatures of their surfaces. Look at the following picture and correctly label the temperatures of all the stars using the list of temperatures below. Which star represents our Sun?

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TERM : FOUR

Temperature list: 3000 ^{o}C, 4500 ^{o}C, 6000 ^{o}C, 10 000 ^{o}C, 40 000 ^{O}c

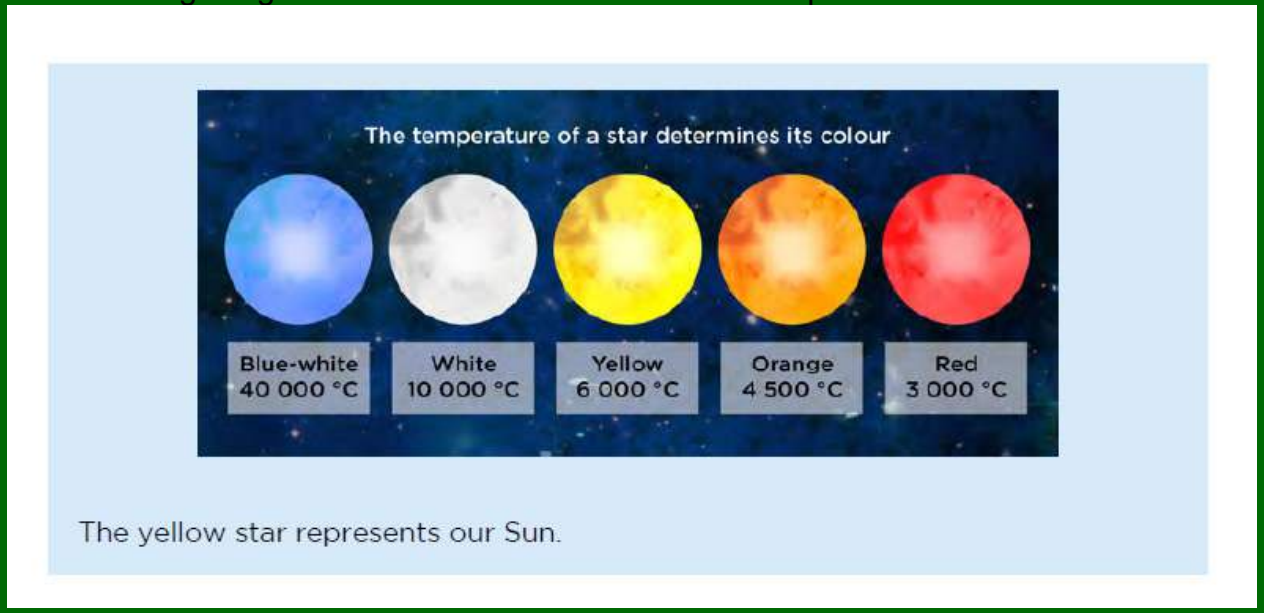


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MEMORANDUM

The following image shows the correct labels for the temperatures of different stars:



Why are hotter stars bluer in colour? Can you remember what you learnt about the spectrum of visible light in Grade 8? The colour blue corresponds to light at shorter wavelengths (higher frequencies) than the colour red. Shorter wavelengths (higher frequencies) correspond to higher energies and thus hotter temperatures. This is also seen in the flames of a fire or candle. If you look at the flames, the central regions are bluer (and hotter) than the outer regions, which are orange and yellow.

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This artist's impression shows the relative sizes of young stars, from the smallest "red dwarfs", at about 0.1 solar masses, low mass "yellow dwarfs" such as the Sun, to massive "blue dwarf" stars weighing eight times more than the Sun, as well as the 300 solar mass star named R136a1.

How long a main sequence star lives depends on how massive it is. More massive stars move onto the next stages of their lives more quickly than lower mass stars. In fact they are main sequence stars for a shorter time than lower mass stars.
A higher-mass star might have more material, but it also uses up the material more quickly due to its higher temperature. For example, the Sun will spend about 10 billion years as a main sequence star, but a star 10 times as massive will last for only 20 million years. A red dwarf, which is half the mass of the Sun, can last 80 to 100 billion years. When the hydrogen in the centre of the star is depleted, the star's core shrinks and heats up. This causes the outer part of the star, the star's atmosphere, which is still mostly hydrogen, to start to expand. The star becomes larger and brighter and its surface temperature cools so it glows red. The star is now a **red giant star**. Betelgeuse, as you observed in the last activity, is a red giant star.

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A colourful view of the globular star cluster NGC 6093 in the Milky Way, containing hundreds of thousands of ancient stars. Especially obvious are the bright red giants, which are stars similar to the Sun in mass that are nearing the ends of their lives.

Why does a red giant glow red?

TEACHER'S NOTE
It is red because it has cooled compared to when it was a main sequence star.

Why do you think red giants are called "giant" stars?

TEACHER'S NOTE
It is called a giant because the outer layers have expanded outwards and the star has got much larger than it was when it was a main sequence star.

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Eventually the core of the star becomes hot enough for the next nuclea reaction to start: atoms of helium collide and fuse into heavier elements such as carbon and oxygen. However, eventually the helium in the core will also be depleted. From this point onwards, the fate of the star is determined by its mass.

VISIT

Scientists discover star
devouring nearby planet.
bit.ly/1aDCvCz

For medium-sized stars, such as the Sun, the temperature in their centres will never get high enough to fuse the newly-formed carbon and oxygen into heavier elements and so they do not evolve much further. Following the red giant phase, the star becomes unstable and will eventually die as you will discover in the next section.

TEACHER'S NOTE

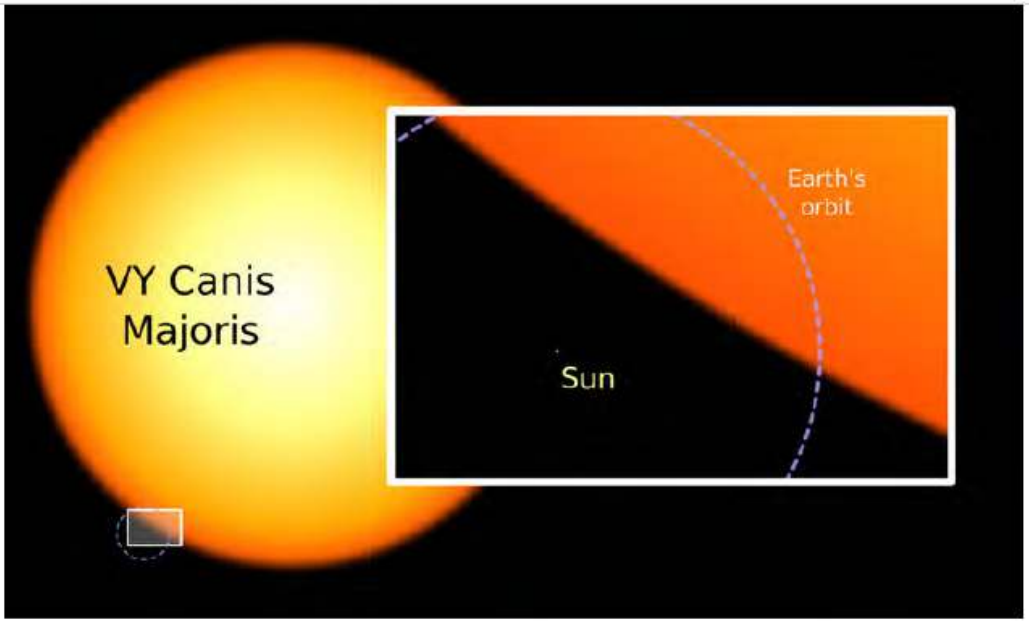
The animation listed in the **Visit** box provides a very useful tool to give learners a sense of the scale of the Universe. If possible, you can project it up in your classroom and scale through it from a human all the way out until you get to some of the massive supergiants, and then beyond. You will also be able to see the scale of some of the objects mentioned in this chapter, such as the Crab Nebula, the Large Magellanic Cloud and Pillars of Creation.

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DURATION: 60 Minutes
CAPS SENIOR PHASE

GRADE: 9
STRAND: EARTH AND BEYOND
TERM : FOUR



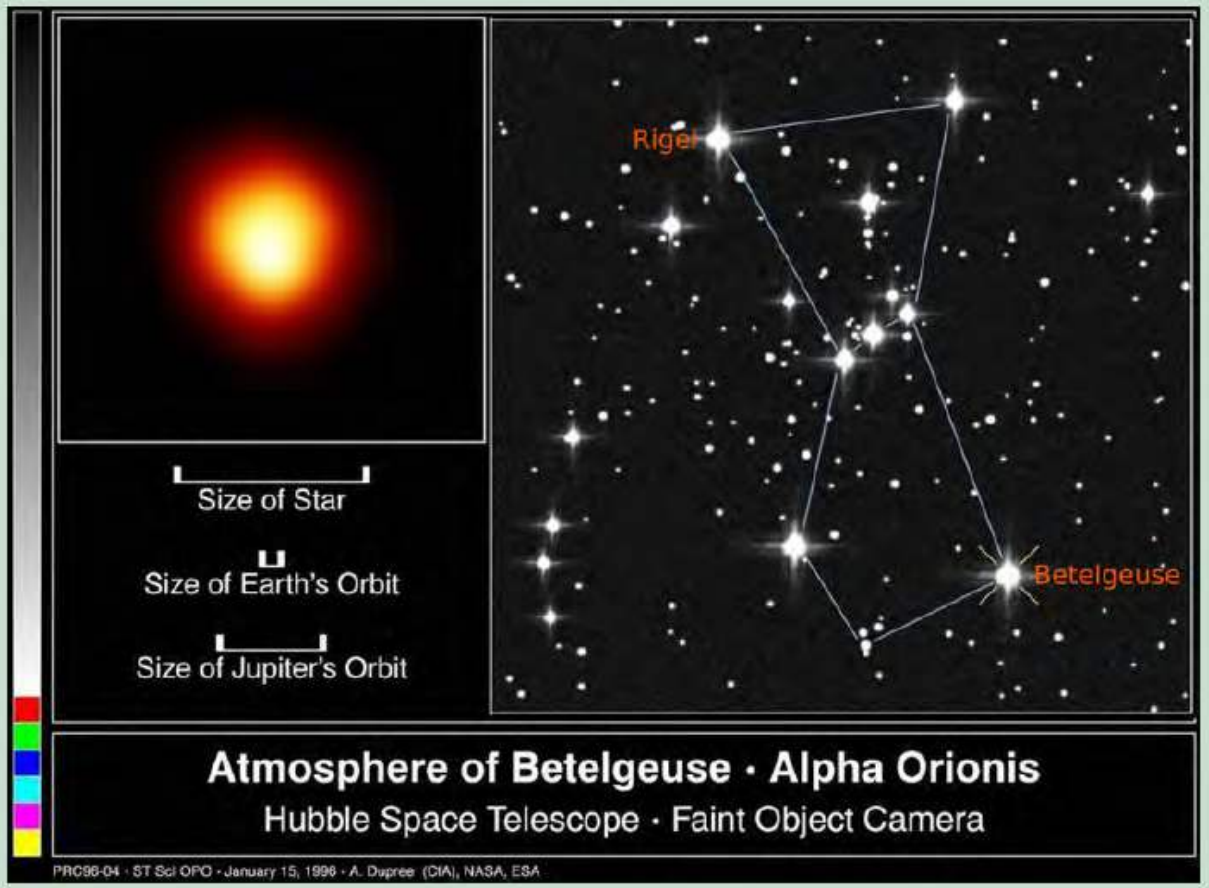
The relative sizes of the Earth, the present day Sun and a red supergiant star, Canis Majoris, in the constellation. The Sun will eventually evolve into a red giant star in about 4.5 billion years time.

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TERM : FOUR



This is the first direct image of a star other than the Sun, made with NASA's Hubble Space Telescope. This is Betelgeuse, the star marking the shoulder of Orion, which we see in the bottom right of the constellation, when viewing Orion in the southern hemisphere.

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CAPS SENIOR PHASE

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STRAND: EARTH AND BEYOND
TERM : FOUR

DURATION: Week Seven Lesson Two, Three and Four	**OBJECTIVES: LEARNERS MUST BE ABLE TO:** Sequence and explain the death of a star
TOPIC: Birth, life and death of stars	
SUB TOPIC: The death of a star	
REFERENCES	**Sasol Inzalo workbooks- Natural Sciences Grade 9-B**
TERMINOLOGIES:	**Planetary nebula, white dwarf, black dwarf, supernova, neutron star**
SPECIFIC AIMS	1. DOING SCIENCE
	2. KNOWING THE SUBJECT CONTENT & MAKING CONNECTIONS
	3. UNDERSTANDING THE USES OF SCIENCES & INDIGENOUS KNOWLEDGE

SCIENCE PROCESS SKILLS							
Accessing & recalling Information			Identifying problems & issues			Doing Investigations	
Observing			Raising Questions			Recording Information	
Comparing			Predicting			Interpreting Information	
Measuring			Hypothesizing			Communicating	
Sorting & Classifying			Planning Investigations				

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DURATION: 60 Minutes
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GRADE: 9
STRAND: EARTH AND BEYOND
TERM : FOUR

CONTENT AND CONCEPTS	ACTIVITIES	RESOURCES
Death of a star • at some point the nuclear reaction runs out of fuel • for stars like the Sun, the core of the star contracts to become a 'white dwarf' • for stars like the Sun, the outer gases of the star are ejected into space, where they form an expanding cloud around the white dwarf called a *planetary nebula* • *planetary nebulae* are lit up by their central white dwarf star and are beautiful objects to observe	The teacher will explain using the notes and pictures to explain the death of a star. Learners will complete the attached activities.	Textbook, Video on Nuclear Fusion: https://www.youtube.com/watch?v=pusKlK1L5To

ASSESSMENT		
TEACHER REFLECTION	Progress:	Challenges:

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TEACHER NOTES

TEACHER'S NOTE
In this section learners will discover how stars die. The focus is on the death of a low mass star like the Sun. However, for completeness, the way that high mass stars die is also briefly mentioned. There are two activities in this section related to the life of Sun-like stars. Both of these are intended to help learners remember and understand the sequence of phases that a star like the Sun undergoes during its life. There is a lot of unfamiliar terminology in stellar evolution and it can be confusing for learners. Hopefully by doing activities rather than simply reading about the different stages in a Sun-like star's evolution, learners will find the subject easier to understand.

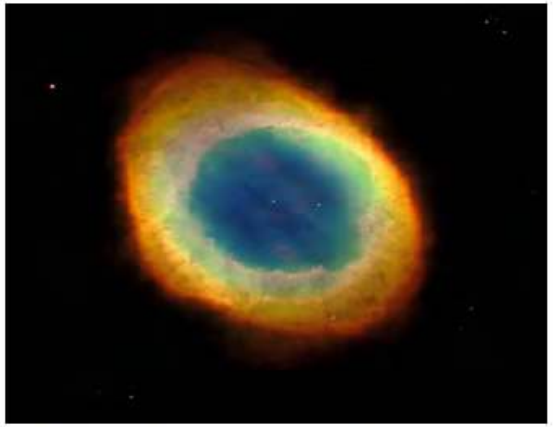
VISIT
Read interesting articles on the latest developments in astronomical research on **Space Scoop**, an astronomy news service.
bit.ly/1dkMBbU

As a star enters the final stages of its life, after it has become a red giant, the star becomes unstable and expands and contracts over and over. This causes the star's outer layers to become detached from the central part of the star and they gently puff off into space. When the last of the gas in the star's outer layers is blown away, it forms an expanding shell around the core of the star called a **planetary nebula**. Planetary nebulae glow beautifully as they absorb the energy emitted from the hot central star. They can be found in many different shapes, as shown in the following images.

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The beautiful Ring Nebula. The gas is lit up by the light from the central star which is the faint white dot in the centre of the nebula.



The Boomerang Nebula is a young planetary nebula and the coldest object found in the Universe so far.

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Kohoutek 4-55 Nebula contains the outer layers of a red giant star that were expelled into interstellar space when the star was in the late stages of its life.



The Butterfly Nebula. The dying central star itself cannot be seen, because it is hidden within a doughnut-shaped ring of dust.

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The Dumbbell Nebula.



The Helix Nebula.

Some time after puffing off its outer layers, the central star will run out of fuel. When this happens the central star begins to die. Gravity causes the star to collapse inwards and the star becomes incredibly dense and compact, about the size of the Earth. The star has then become a **white dwarf** star.

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An ultraviolet image of the Helix Nebula. As the star in the centre approaches the end of its life and runs out of fuel, it shrinks into a much smaller, hotter and denser white dwarf star.

White dwarfs have this name because of their small size and because they are so hot that they shine with a white hot light. The central parts of stars are much hotter than their surfaces, and a white dwarf is made from the remaining central parts of a star which explains why they are so hot.

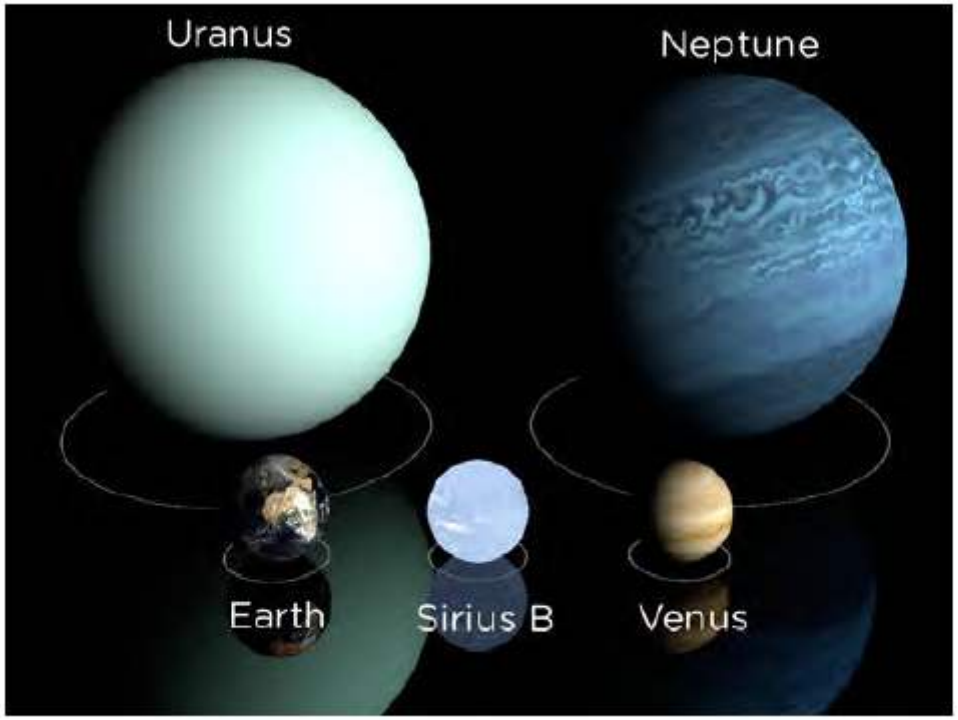
The following image shows the relative size of Sirius B, a nearby white dwarf star, compared to some of the planets in our solar system. Stars and stellar remains can be smaller than planets.

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TERM : FOUR



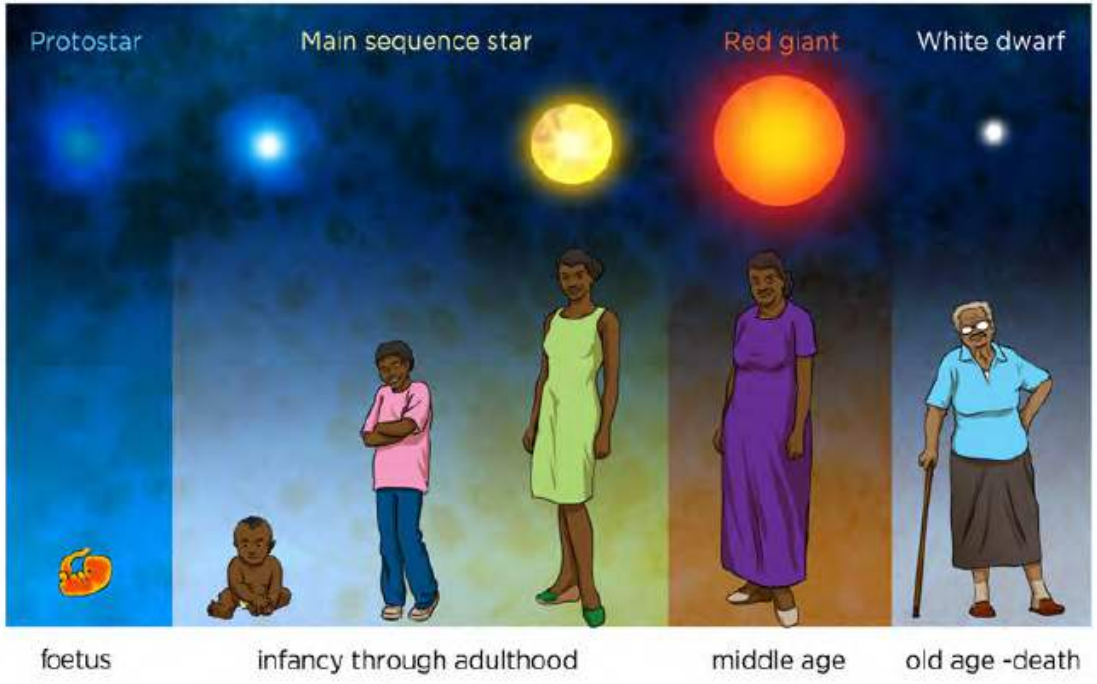
White dwarfs no longer produce energy via nuclear reactions and so as they radiate their energy into space in the form of light and heat. They slowly cool down over time. Eventually, once all of their energy is gone, they no longer emit any light. The star is now a dead **black dwarf** star and will remain like this forever. The different stages of evolution of a star like the Sun are summarised in the diagram below and compared to the lifecycle of a person. Let's take a closer look at the life of our star, the Sun.

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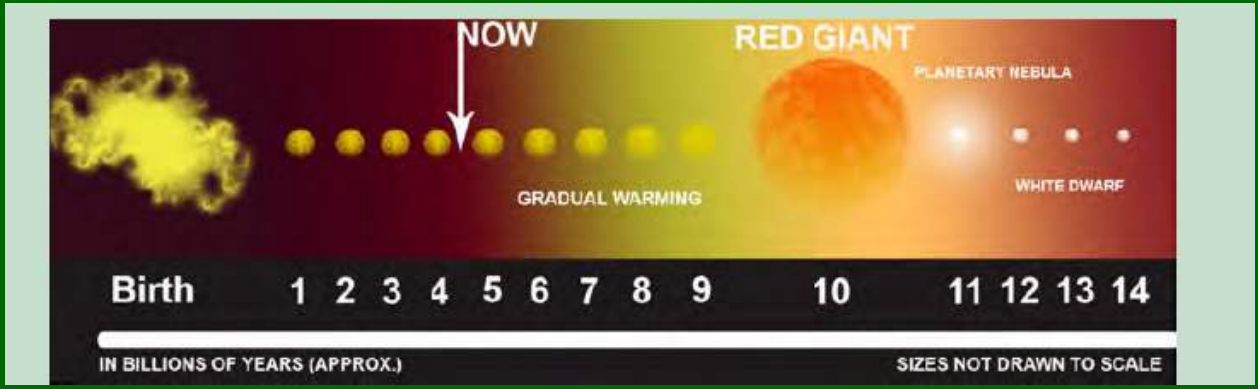
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DURATION: 60 Minutes
CAPS SENIOR PHASE

GRADE: 9
STRAND: EARTH AND BEYOND
TERM : FOUR

ACTIVITY 1: The life cycle of the Sun
.

INSTRUCTIONS:
1. The diagram below shows the life of our Sun. The Sun is a common type of star of average size and mass.
2. Complete the sentences by filling in the gaps which summarize the evolution of our Sun over time.



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QUESTIONS:

1. The Sun is currently about halfway through its lifetime as a _____ star. In about 4.5 billion years time the Sun will swell up to form a _____ star engulfing the Earth as it does so.

2. After the Sun has become a red giant, it will eventually become unstable and puff off its outer layers forming a beautiful _____ . The central core of the Sun will be left exposed in the centre of the planetary nebula.

3. Once the fuel runs out in the core of the Sun, nuclear reactions will _____. The Sun will then have become a hot _____ star, left behind at the centre of the planetary nebula.

4. As there are no ongoing nuclear reactions, as the white dwarf shines it slowly cools and will eventually form a _____ dwarf.

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DURATION: 60 Minutes **STRAND: EARTH AND BEYOND**
CAPS SENIOR PHASE **TERM : FOUR**

ACTIVITY 2: Flow diagram poster showing the life of a Sun-like star.

MATERIALS:
• paper or card for the poster
• pencils, crayons or paint for drawing
• printouts of photographs or pictures of the various stages in the Sun's life

INSTRUCTIONS:
1. Draw a flow diagram showing the key stages in a Sun-like star's life. Include the birth, life, aging and death of the star. If you have access to printouts of photos or drawings of the key stages you could paste them onto the poster instead of drawing the key stages.
2. Label each stage and indicate clearly with arrows the direction of flow in the evolutionary stages.
3. *Advanced:* Write down approximately how long each stage lasts. You can use the timeline of the Sun's evolution in this chapter to help you.

QUESTIONS:
1. Where are stars born?
2. Why is a red giant so named?
3. What kind of stellar remnant is left behind once a star like the Sun dies?
4. What is a planetary nebula?
5. How big is a white dwarf?

So far we have looked at stars that are about the same mass as our Sun. But, what about stars that are more massive? How do they die?

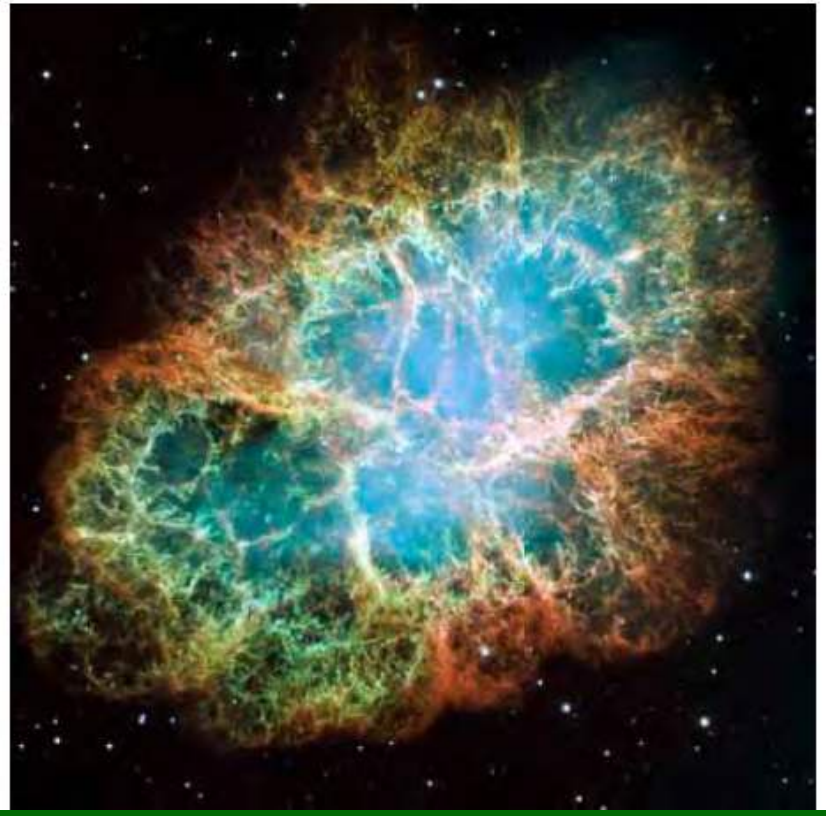
TAKE NOTE
Here we are not talking about **bigger** stars, but rather stars that are more **massive**. It is not the size that counts, but the mass of the star. Stars more than eight times the mass of the Sun end their lives spectacularly. When the hydrogen at their cores becomes depleted, they swell into red supergiants which are even larger than red giants. A red supergiant can fuse successively heavier and heavier elements for a few million years until its core is filled with iron. At this point, nuclear reactions stop and the star collapses rapidly under its own gravity. The collapsing outer layers of the star hit the small central core with such a force that they rebound and send a ripple outwards through the star blowing the outer layers of the star into space in a huge explosion called a **supernova**.

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TERM : FOUR



The Crab Nebula. This giant glowing cloud of gas is the remains of the outer layers of a star that exploded in a supernova explosion. In the centre is a rapidly spinning neutron star.

For a week or so, a supernova can outshine all of the other stars in its galaxy. However, they quickly fade over time. The central star left behind is either made of neutrons and it is called a **neutron star**, or if the initial star was really massive, a **black hole** forms. The leftover neutron star or black hole is surrounded by an expanding cloud of very hot gas.

TEACHER'S NOTE
A black hole is a region of space where gravity is so strong that even light cannot escape. The gravity is so strong because matter has been squeezed into a tiny space. This can happen when a star dies. As light cannot escape you cannot actually see a black hole. Black holes can be detected by their gravitational effects on nearby visible objects, or in the case of a black hole that is actively absorbing material from its

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surroundings, the material may emit light before it is sucked into the black hole. As well as stellar mass black holes, there are much more massive black holes in the centres of galaxies, called
supermassive black holes. In February 1987, astronomers observed a supernova explosion, called Supernova 1987A. It is one of the brightest stellar explosions observed since the invention of the telescope 400 years ago. The supernova belongs to the Large
Magellanic Cloud, a nearby galaxy about 168 000 light-years away. Even though the stellar explosion took place around 166 000 BC, its light arrived here less than 25 years ago.
An image

VISIT

The largest black holes in
the Universe
bit.ly/Hq36sl and
what's inside black holes
bit.ly/1aDGtet

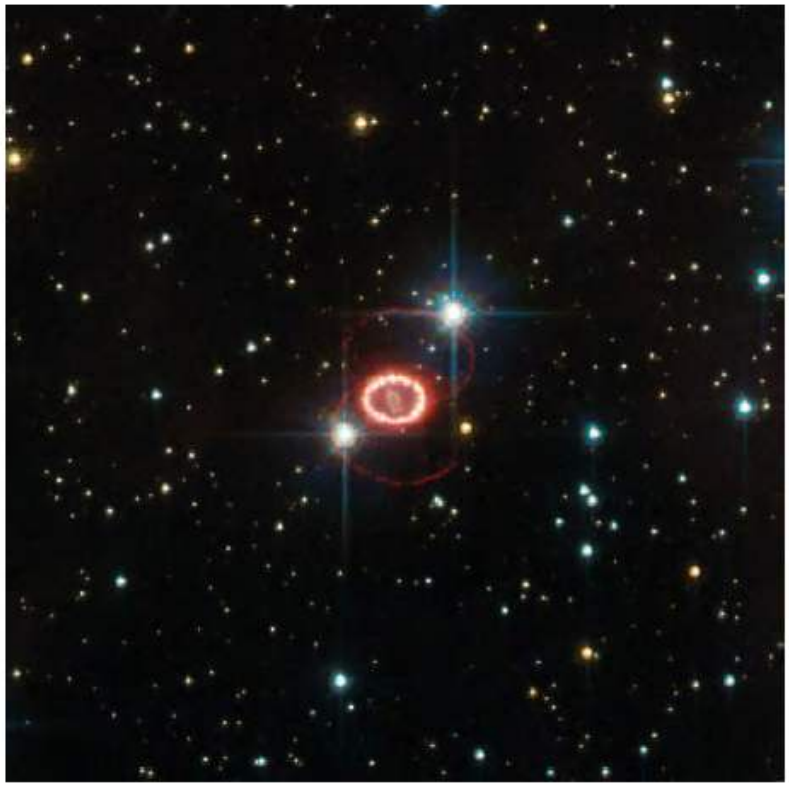
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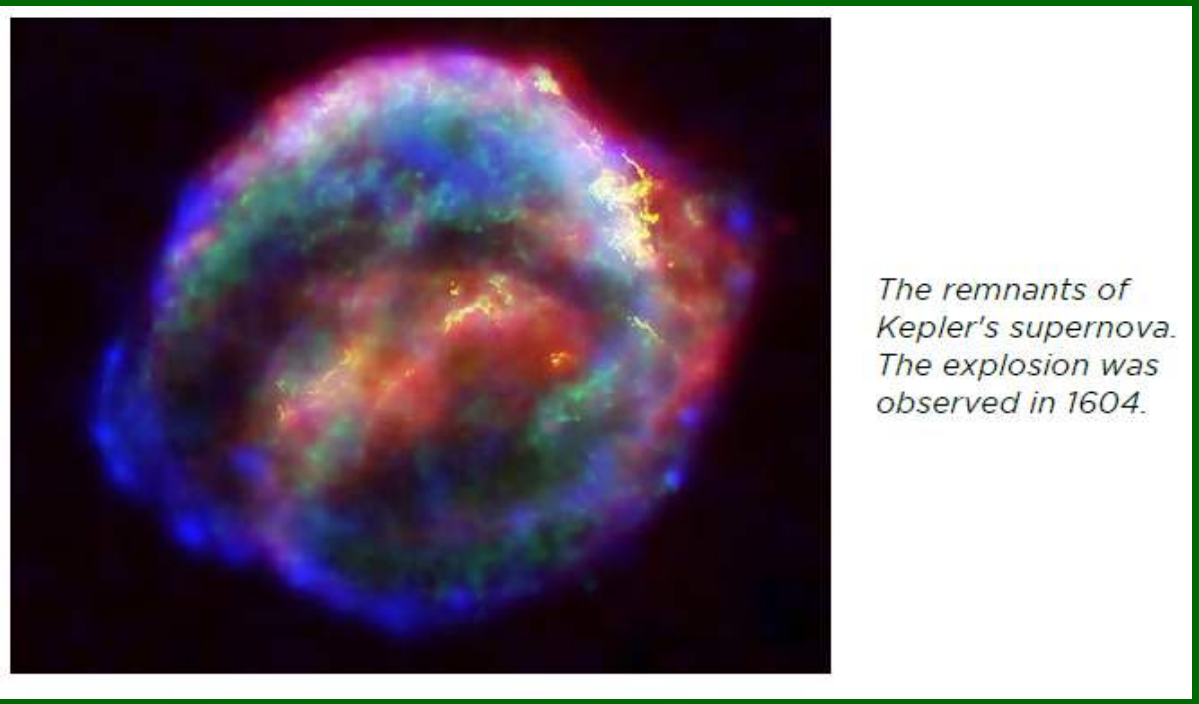
An image of the supernova called Supernova 1987A. The outer layers of the star have formed beautiful rings expanding into space.

Supernovae have also been observed previously with the naked eye before the invention of the telescope. On 9 October 1604, sky watchers, including astronomer Johannes Kepler, spotted a "new star" in the sky. Now, we have images of the remnants of the supernova and know that it is not a new star, but rather the death of a massive star.

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The remnants of Kepler's supernova. The explosion was observed in 1604.

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DURATION: 60 Minutes **STRAND: EARTH AND BEYOND**
CAPS SENIOR PHASE **TERM : FOUR**

MEMORANDUM

ACTIVITY 1: The life cycle of the Sun - MEMORANDUM

1.The Sun is currently about halfway through its lifetime as a main sequence star. In about 4.5 billion years time the Sun will swell up to form a red giant star engulfing the Earth as it does so.

2. After the Sun has become a red giant, it will eventually become unstable and puff off its outer layers forming a beautiful planetary nebula. The central core of the Sun will be left exposed in the centre of the planetary nebula.

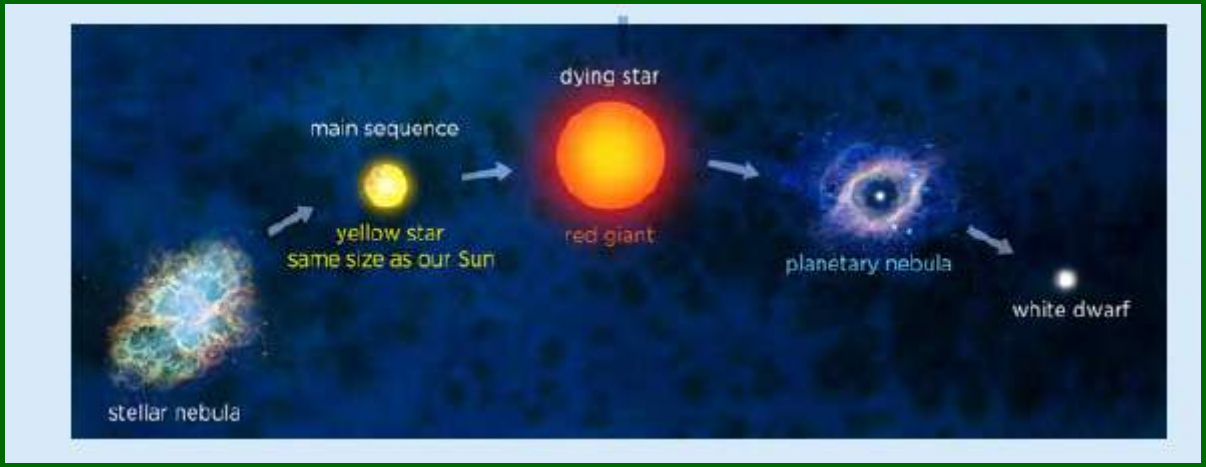
3.Once the fuel runs out in the core of the Sun, nuclear reactions will stop. The Sun will then have become a hot white dwarf star, left behind at the centre of the planetary nebula.

4. As there are no ongoing nuclear reactions, as the white dwarf shines it slowly cools and will eventually form a black dwarf.

ACTIVITY 2: Flow diagram poster showing the life of a Sun-like star

TEACHER'S NOTE

In this activity learners will make a poster showing the different stages of stellar evolution experienced by a Sun-like star. The idea is to create a flow diagram showing which stage leads on to the next. Learners can use photographs or pictures printed from the internet or they may draw their own pictures depending on time and resources available. An example is presented below for guidance.



TEACHER'S NOTE

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DURATION: 60 Minutes **STRAND: EARTH AND BEYOND**
CAPS SENIOR PHASE **TERM : FOUR**

If learners have access to the internet, they can print out images of the various stages. otherwise they can use the reference diagrams in the workbook to draw pictures.

INSTRUCTIONS:

1. Draw a flow diagram showing the key stages in a Sun-like star's life. Include the birth, life, aging and death of the star. If you have access to printouts of photos or drawings of the key stages you could paste them onto the poster instead of drawing the key stages.
2. Label each stage and indicate clearly with arrows the direction of flow in the evolutionary stages.
3. Advanced: Write down approximately how long each stage lasts. You can use the timeline of the Sun's evolution in this chapter to help you.

QUESTIONS:

1. Where are stars born?
In vast cold clouds of gas and dust called nebulae.

2. Why is a red giant so named?
It is called a red giant because it is red in colour and much larger than a main sequence star.
3. What kind of stellar remnant is left behind once a star like the Sun dies?
A white dwarf star.

4. What is a planetary nebula?
A glowing nebula formed by an expanding shell of gas around an aging star.

5. How big is a white dwarf?
About the size of the Earth.

TEACHER'S NOTE

The following content on supernovae is not in CAPS, but has been included here as the stellar evolution discussed previously explains small and medium-sized stars. Giant stars have a different end, as discussed here. So far we have looked at stars that are about the same mass as our Sun. But, what about stars that are more massive? How do they die? Stars more than eight times the mass of the Sun end their lives spectacularly. When the hydrogen at their cores becomes depleted, they swell into red supergiants which are even larger than red giants.

TEACHER'S NOTE

The temperature in the cores of these supergiants gets high enough for them to fuse elements heavier than hydrogen and helium.

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NATURAL SCIENCES: LESSON PLAN 16 **GRADE: 9**
DURATION: 60 Minutes **STRAND: EARTH AND BEYOND**
CAPS SENIOR PHASE **TERM : FOUR**

A red supergiant can fuse successively heavier and heavier elements for a few million years until its core is filled with iron. At this point, nuclear reactions stop and the star collapses rapidly under its own gravity. The collapsing outer layers of the star hit the small central core with such a force that they rebound and send a ripple outwards through the star blowing the outer layers of the star into space in a huge explosion called a **supernova**.

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