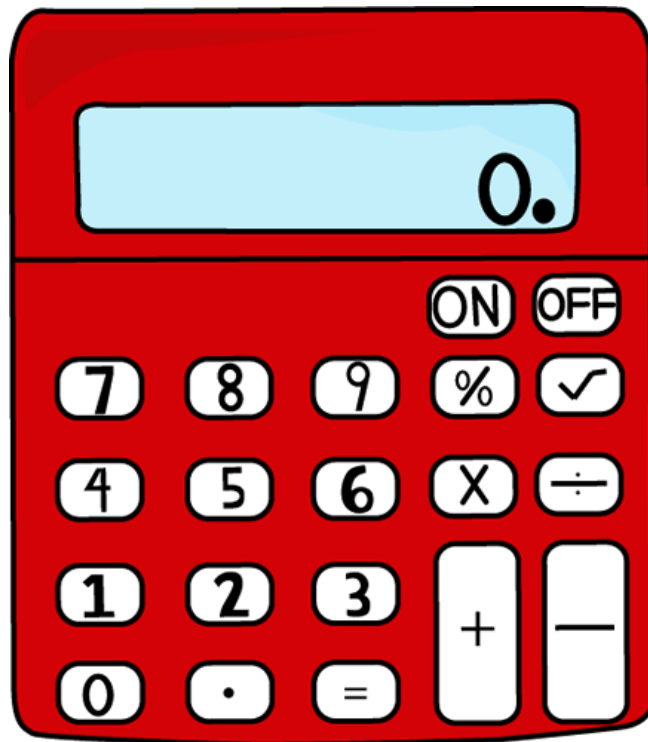


Subject : Life Sciences

Topic – Skills needed in Life Sciences



CALCULATIONS



HOW TO CALCULATE AVERAGES

Find the sum of all the items and divide this total by the number of items.

For example:

The following data represents the weight of male jackals caught in a specific area

Jackals number	Weight (kg)
1	42
2	41
3	38
4	35
5	46
6	39

Avg. weight of jackals: $\frac{\text{sum of the weight}}{\text{total number}}$

$$= \frac{42+41+38+35+46+39}{6}$$

$$= 40.17\text{kg}$$



HOW TO CALCULATE PERCENTAGE

Take the value of which you want the percentage of, and divide it by the total sum of items.

For example;

The following data represents the weight and health of male jackals caught in a specific area:

Jackals nr	Weight (kg)	Health
1	42	Healthy
2	41	Healthy
3	38	Sick
4	35	Sick
5	46	Healthy
6	39	Healthy

Calculate the percentage sick jackals in the investigation

2 out of 6 jackals are sick.

$$\begin{aligned}\text{Percentage: } & \frac{\text{value}}{\text{total}} \times 100 \\ &= \frac{2}{6} \times 100 \\ &= 33.33 \%\end{aligned}$$



HOW TO CALCULATE PERCENTAGE DIFFERENCE

When you have to calculate the **percentage increase or decrease** in data: divide the difference between the values by the starting value.

For example:

The following table is a summary of the Rhino poaching incidents for South Africa from 2004 – 2010.

Province	2004	2005	2006	2007	2008	2009	2010	TOT
North West	0	2	0	0	7	10	44	63
Eastern Cape	0	0	0	0	1	3	2	6

With what percentage did the poaching of rhinos incidents increase in North West since 2008 to 2010? Show all working.



Percentage increase: $\frac{\text{end} - \text{beginning (difference)}}{\text{value at beginning}} \times 100$

$$= \frac{44-7}{7} \times 100$$

$$= 529\%$$

Remember: you want to know how many times it is more than your starting value, that is why you divide by your starting value



USING FORMULAS

Substituting values in formulas.

For example:

Mark recapture experiments

Formula:

$$P = \frac{F \times S}{M}$$

P = Estimated **total** number of individuals in the population.

F = Number caught and marked in **the first catch**.

S = Number **caught** in the **second catch**.

M = Number **marked** in the **second catch**.

A researcher wanted to know how many fish were in a dam. She *caught 20 fish* and marked them by clipping out a small section of their tail fins. She then released them back into the dam. A few days later she caught *25 fish* and found that *8 had been marked*. Calculate how many fish were in the dam.

$$F = 20$$

$$S = 25$$

$$M = 8$$

$$\begin{aligned} P &= \frac{F \times S}{M} \\ &= \frac{20 \times 25}{8} \\ &= 62.5 \end{aligned}$$

Substitute
values in
formula

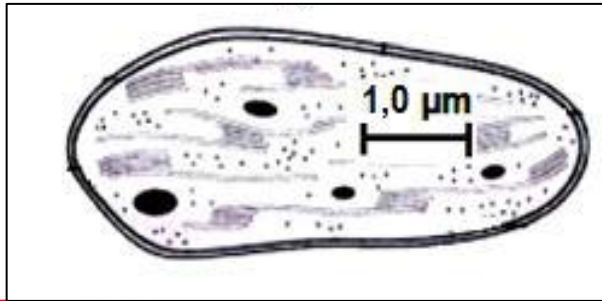


MAGNIFICATION CALCULATION

- Use the formula:
- **Actual length of specimen = $\frac{\text{measured length of specimen} \times \text{length on scale}}{\text{measured length on scale}}$**

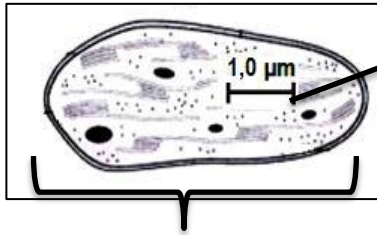
For example:

When Nomsa investigated the cell structure she made some pencil drawings. The diagram below shows a chloroplast as seen on a micrograph that the teacher showed.



Use a ruler to measure the actual length of the scale and the length of the full chloroplast. **Use your answers to calculate the actual length of the chloroplast.**

Show all working and give the answer in **microns (μm)**



Measure scale bar with ruler = 12mm

$$1\text{mm} = 1000 \mu\text{m}$$

$$60\text{mm} \times 1000 = 60\,000 \mu\text{m}$$

$$12\text{mm} \times 1000 = 12\,000 \mu\text{m}$$

Measure whole organelle with ruler = 60mm

Use the formula:

Actual length of chloroplast = $\frac{\text{measured length of chloroplast} \times \text{number on scale}}{\text{measured length of scale}}$

$$\begin{aligned} \text{Actual length of chloroplast} &= \frac{60\,000 \times 1}{12\,000} \checkmark \\ &= 5 \checkmark \mu\text{m} \end{aligned}$$

TABLES

The growth of a plant in centimeters	
Day	Growth
0	0 cm
1	2.0 cm
2	5.3 cm
3	6.1 cm
4	8.4 cm
5	11 cm

Trait	Tom	Dick	Harry
Height (cm)	188	180	188
Weight (kg)	72	87	87
Blood Type	O	AB	O
IQ (measure of intelligence)	138	142	125

DRAWING A TABLE

- A table is used to organise and present data that were collected using as few words as possible.
- A table should have a caption.
- It is used as a summary of data.
- A table is divided into rows and columns.
- Each column and row may have its own heading with units if applicable.
- Rows run from left to right across the table.
- Columns are the vertical blocks of a table.

The amount of solid waste generated in a town over a period of 6 years.

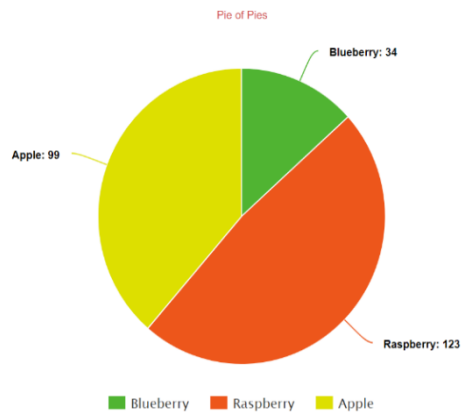
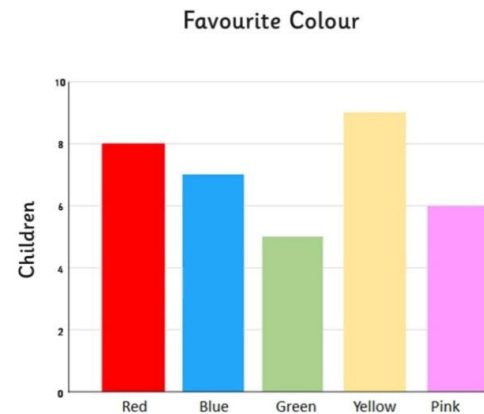
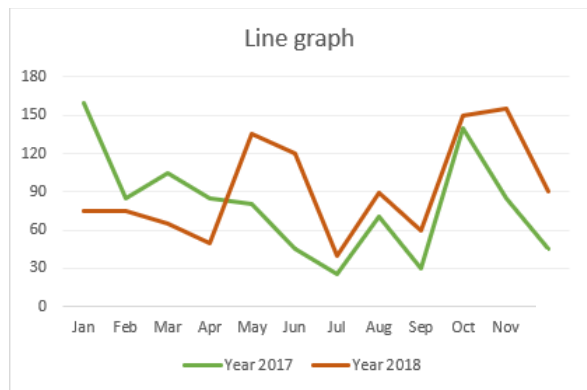
Year	Total Solid Waste (tons)
1999	255
2000	276
2001	300
2002	330
2003	388
2004	428

This is the caption of the table The independent variable is the date/year. The dependent variable is the total solid waste in tons for that year.

This table has 6 rows

These are the 2 columns of the table

GRAPHS



HOW TO DRAW A LINE GRAPH

STEP 1

Identify the dependent and the independent variables from the information you are given (usually in table format).

Independent: This is the variable that the investigator can *change*. The dependent variable changes as the independent variable changes, i.e. the time in hours in this example

Dependent: This is the variable or factor that is being *measured*, i.e. the temperature in degrees Celsius in this example.

**FOR
EXAMPLE :**



Time (hours)	Temperature(°C)
0	16
5	24
9	28
13	26

STEP 2

Identify the dependent and the independent variables from the information you are given (usually in table format).



The independent variable is usually plotted on the X axis

STEP 3

Choose a **scale** for the X and the Y axes.

Make sure that the scale includes the highest numbers in the table for each of the variables. **Do not** use the values for the Y-axis **directly from the table** unless they have regular intervals.

STEP 4

Place a dot at the point where the two values for each result intersect (meet)

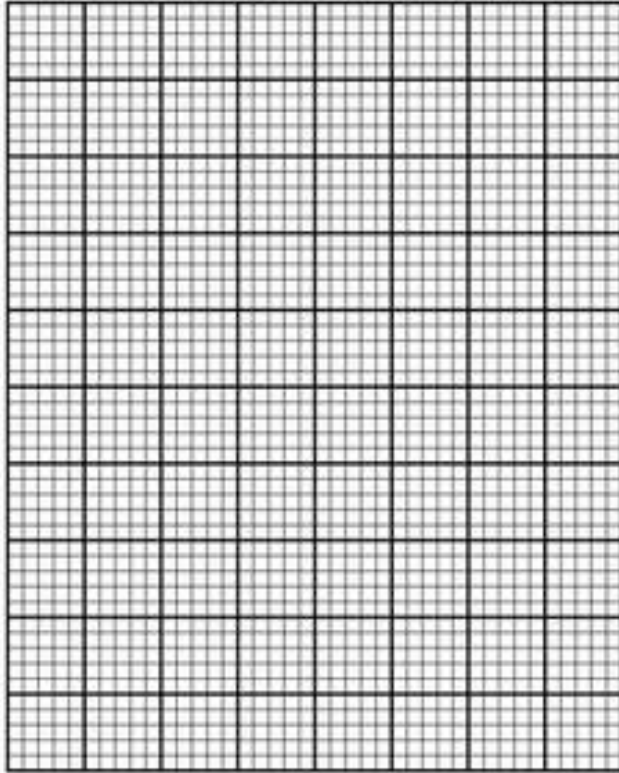
STEP 5

Join the dots using a ruler until all the dots have been joined in sequence.

STEP 6

- Give the graph a heading or caption.
- The heading or caption should include ***both variables***.
- In this case both ***air temperature*** and the ***time period of 13 hours*** must be mentioned in the heading.

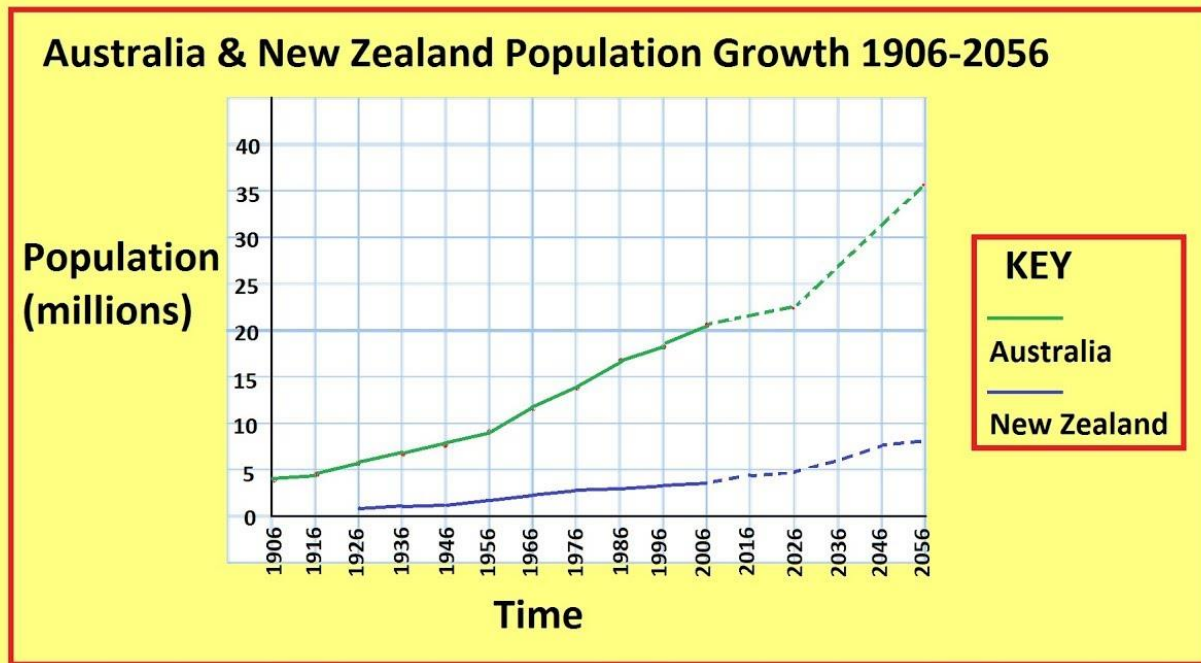




Time (hours)	Temperature($^{\circ}\text{C}$)
0	16
5	24
9	28
13	26



If the graph has two lines on it, then you should draw a key to show what the different lines represent. For example:

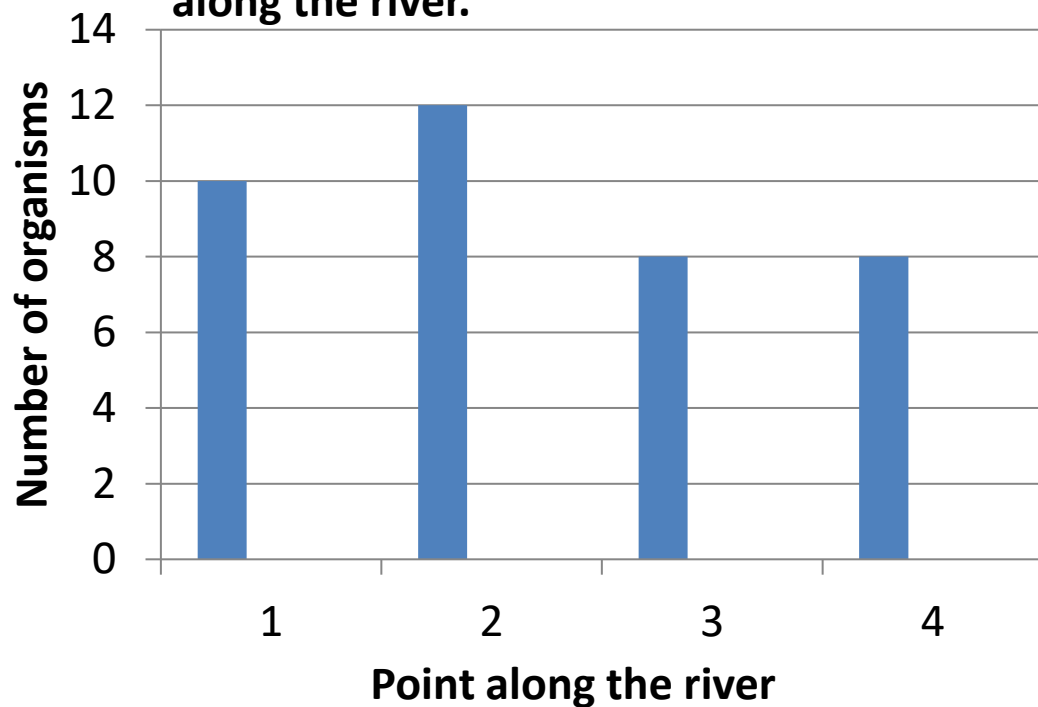


HOW TO DRAW A BAR GRAPH

- Write the **heading or caption**.
- The heading or caption should include **both variables**.
- Identify the dependent and the independent variables from the information you are given (usually in table format).
- Draw bars to represent the data .
- The bars **should not touch** one another.
- The bars must be of the same width and must be of the same distance apart from each other.
- Bars can be presented vertically or horizontally.



Bar graph representing the **number of organisms** found at each of the **points** along the river.



Point Number	Number of organisms
1	10
2	12
3	8
4	8
5	4

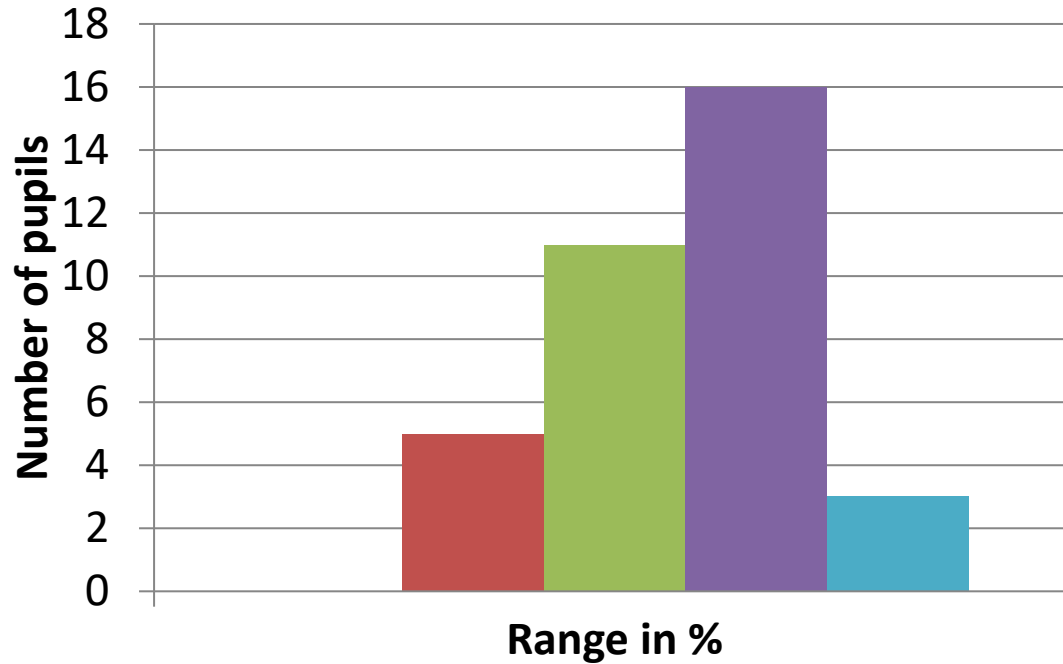


HOW TO DRAW A HISTOGRAM

- A histogram is drawn in the same way as a bar graph.
- The only difference is that a histogram is used when the **independent variable is groups of information along a continuous scale.**
- Note that in a histogram, the **bars are drawn without any spaces** between them.



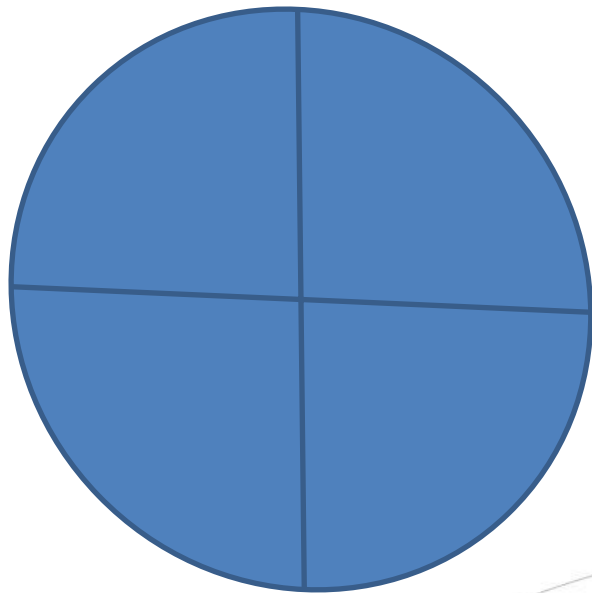
- Eg: A histogram representing the number of pupils in each percentage range



RANGE IN %	NUMBER OF PUPILS
0-19	0
20-39	5
40-59	11
60-79	16
80-100	3

HOW TO DRAW A PIE CHART

- A pie chart shows data as a percentage or as a relative proportion of the total of a circle.
- You draw a pie chart by dividing a circle into sectors/ slices (think of a pizza) to represent each item as a percentage of the whole.
- A complete circle represents the whole of 100 %, a half circle represents 50 %, and so on.
- This circle is divided into 4 quarters, each representing 25% of the Circle



- To draw a pie chart, we need to represent each part of the data as a proportion of 360° , why....
- Because there are 360° in a circle.
- A compass must be used to draw the circle.
- A protractor must be used to construct accurate angles for each sector or slice.

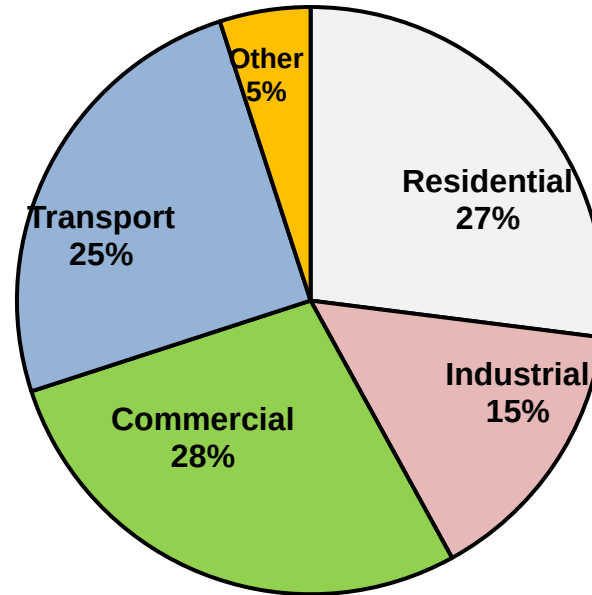
The table below shows the percentage of carbon dioxide (CO₂) emitted by different sectors in a certain city in South Africa.

SECTOR	CO ₂ EMISSION (%)
Transport	25
Residential	27
Industrial	15
Commercial	28
Other	5
Draw a pie chart to represent the data in the table above. Show ALL calculations.	

Calculations:

- Transport = $25/100 \times 360^\circ = 90^\circ$
- Residential = $27/100 \times 360^\circ = 97,2^\circ$
- Industrial = $15/100 \times 360^\circ = 54^\circ$
- Commercial = $28/100 \times 360^\circ = 100,8^\circ$
- Other = $5/100 \times 360^\circ = 18^\circ$

Carbon dioxide emissions in different sectors of a city



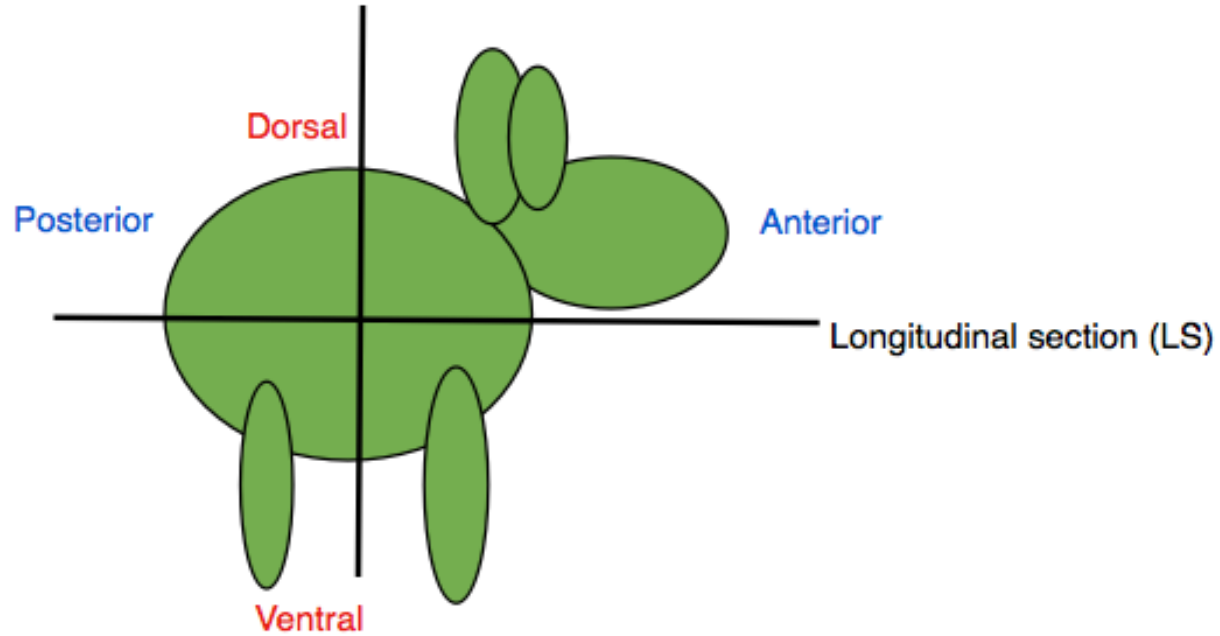
THE ASSESSMENT OF A PIE CHART

CRITERIA	MARK
Correct type of graph	1
Title of graph(CO ₂ emission + Sector)	1
Calculations:	1: 1-4 calculations correct 2: All 5 calculations correct
Correct proportion for each labelled slice	1: 1 to 2 slices correct 2: 3 slices correct 3: 4-5 slices correct



DIAGRAMS

Transverse section (TS)



DRAWING A DIAGRAM

DOs

- Write title or caption.
- Use pencil to draw clear smooth lines.
- Label in ink(pen).
- The diagram must be large enough to see all the structures that are in the diagram.
- Diagram must be positioned in the centre of the page.
- Diagram must be two dimensional (show length and width only).

DON'Ts

- No shading.
- Lines must not cross each other.
- Lines must not have arrows at the end.

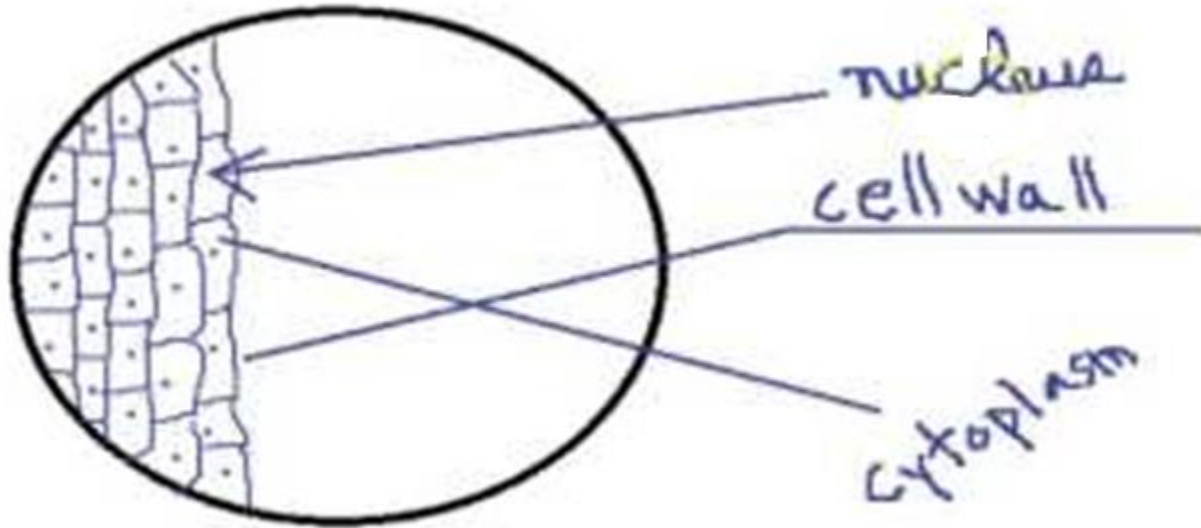


DRAWING A DIAGRAM

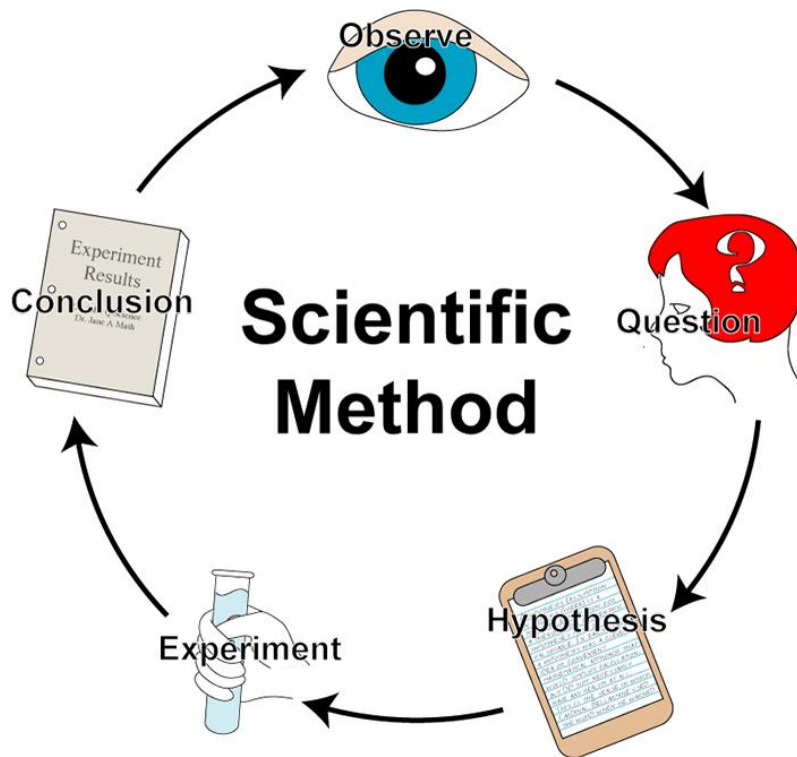
DOs	DON'Ts
• Draw lines with a ruler. • Lines must touch the structure that is labelled. • Lines on one side of the diagram if they are few . • Labels must be aligned neatly, preferably one label below the other.	



WHAT IS WRONG?



SCIENTIFIC INVESTIGATIONS



VARIABLES

- In planning the investigation you need to test various possibilities (FACTORS) one at a time so that we can be sure which factor gives us the result.
- Each factor is known as a VARIABLE and each investigation should test only ONE variable.
- Generally a scientific investigation has an EXPERIMENT and a CONTROL.

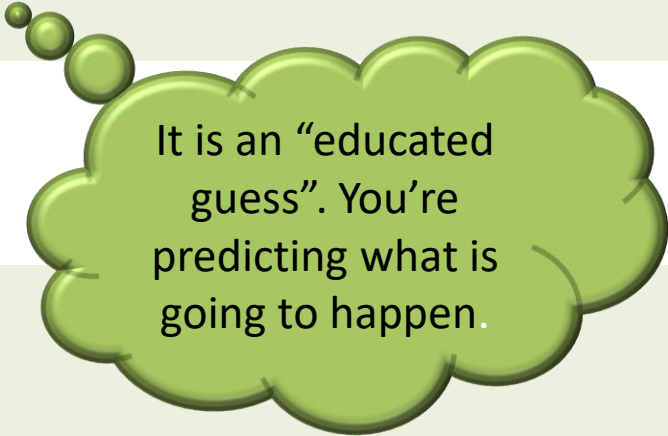
VARIABLES

- **Independent/manipulated variable** – variable that is controlled or changed by the investigator to determine what effect it has. In graphs it is the variable that is drawn on the horizontal axis/X-axis
- **Dependent /responding variable** – variable that is the effect of the independent variable – this is the response that is measured or monitored during the investigation. In a graph, it is the variable that is drawn on the vertical axis/Y-axis.
- **Fixed/Constant variable** –. all the factors that must be controlled/fixed when conducting an investigation



HYPOTHESIS TESTING

A hypothesis is an attempt to explain some event or observation, using whatever information which is currently available.



It is an “educated guess”. You’re predicting what is going to happen.

How to state a hypothesis

- There must be **two variables**.
- State the **relationship between** the two variables.
- It must be testable.
- **Independent variable first** (cause) and the dependent variable second (effect).



HYPOTHESIS TESTING

- A hypothesis is an idea that a person gets from observation made. It is a suggested solution to a question.
- The hypothesis needs to be tested before one can draw any conclusions.



RELIABILITY AND VALIDITY

What is reliability?

- The idea behind reliability is that any significant results of an investigation must be more than a once-off finding and be **repeatable**.
- Other researchers must be able to perform exactly the same experiment, **under the same condition** and generate the **same results**.

In questions asked in exam papers to state how the reliability of the investigation could have been improved, the correct answers could generally be the following: **repeat the experiment/investigation, increase the sample size, select a sample randomly, increase the period of the investigation or take many readings and use the average**

RELIABILITY AND VALIDITY

What is Validity?

- Validity questions **how** the experiment/investigation was carried out.
- Have all the **factors/variables been controlled/fixed** except the variable/factor being tested?
- Have the **samples** been chosen randomly?
- Is the **design** for the investigation appropriate?
- In questions which ask to suggest some factors that might have decreased the validity of an investigation, the answers should centre around criticism of the scientific process, for example some **factors/variables that were not fixed/controlled** when carrying out the investigation.



STEPS OF THE SCIENTIFIC METHOD



EXAMPLE OF A SCIENTIFIC INVESTIGATION

OBSERVATION:

- A researcher observed that the potted plants he covered with a black plastic bag did not grow.



- His **HYPOTHESIS:** Sunlight is essential for plant growth.

VARIABLES:

- In planning the investigation, he set up TWO sets of 50 plants as follows:
- **EXPERIMENT: 50 plants** placed in a **greenhouse**
- **CONTROL: 50 plants** placed in an **identical greenhouse, blackened** so that no light could enter.
- NB. The **experiment** and **control** differed in only one factor (VARIABLE) i.e.in the experiment plants were given light and the control plants were NOT exposed to light

VALIDITY

The plants in both the experiment and control received the **same soil**, amount of **water**, **temperature** etc. – in other words, they were given the same requirements

- He measured the growth of the plants over a period of time in the experiment and in the control



- He found that those plants placed in sunlight (EXPERIMENT) grew.
 - He found that those plants placed in darkness (CONTROL) did not grow.
- He concluded that his hypothesis was correct for the type of plant that he investigated.

THE ESSAY



ANSWERING AN ESSAY

- The essay is found in Section C of the final examination question paper.
- The content of the essay is worth 17 marks and the synthesis, which assesses whether your essay has been answered with insight, understanding, and logical sequence, is allocated 3 marks.
- Therefore the essay in the final examination is allocated 20 marks
- Answering this question requires step-by-step planning.



STEPS TO WRITE AN ESSAY

- **STEP 1:** Read the essay question thoroughly to determine the topics that are being covered. Underline the key words in the essay question that provide clues to the different topics.
- **STEP 2:** Interpret and analyse the essay question. Identify the aspects or processes that are required from each of the topics identified. You may need to read the question more than once to enable you to do this.



EXAMPLE

Simphiwe took part in the Comrades Marathon which is a long distance race that starts very early on a cold, winter's morning.

Describe the effect of adrenalin on his body and how his body temperature was regulated as he waited to start the race on a cold day. Also describe the changes that took place in his eyes to adjust to the increasing light as the sun was rising.

Content	(17)
Synthesis	(3)
	(20)

NOTE: No marks will be awarded for answers in the form of tables, flow charts or diagrams.

STEPS TO WRITE AN ESSAY

- **STEP 3:** Write the first draft of your essay in a logical and organised manner, linking each aspect that is discussed. This will help you obtain a high mark from the 3 marks allocated for the synthesis of your essay.

Your plan or draft of the essay may take the form of a flow diagram. But **note that your final answer to the essay CANNOT be in the form of a flow diagram.**

- **STEP 4:** Write out the final version of your essay. Put a line across the plan of your essay so that the marker assesses your final answer and not your plan or draft.



ASSESSING THE PRESENTATION OF THE ESSAY:

Relevance	Logical sequence	Comprehension
All the information required is relevant to the topic	Ideas are presented in an orderly, sensible sequence and are well grouped together	All the aspects required by the topic have been discussed
1	1	1



**“IT IS IN YOUR
HANDS TO
CREATE A BETTER
WORLD FOR ALL
WHO LIVE IN IT.”**

NELSON MANDELA

Every child is a National Asset

Thank you!

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