



PLANT HORMONES

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LESSON PREPARED BY:
LIFE SCIENTIST: J. NKOSI

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4. ELABORATION OF CONTENT FOR GRADE 12 (CAPS)

A topic-wise elaboration follows, which merely outlines the basic content that needs to be covered. This content can be assessed at all four cognitive levels.

RESPONDING TO THE ENVIRONMENT (PLANTS)

Term 3

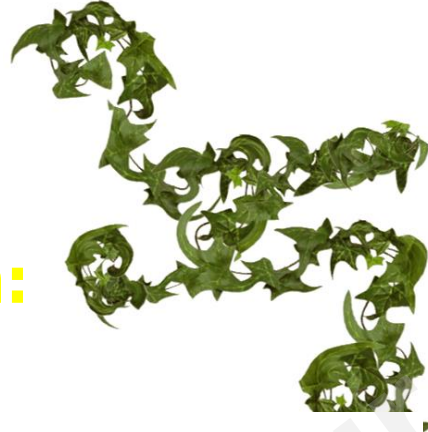
1 week

Paper 1: 11 marks

CONTENT	ELABORATION
Plant hormones	☐ General functions of the following: • Auxins • Gibberellins • Absciscic acid ☐ The control of weeds using plant hormones ☐ The role of auxins in: • Geotropism • Phototropism
Plant defence mechanisms	☐ Role of the following as plant defence mechanisms: • Chemicals • Thorns

CONCEPTS

Tropism:



growth by part of a plant in response to an external stimulus

Phototropism:

growth by part of a plant in response to light

Geotropism:

growth by part of a plant in response to gravity

Hydrotropism:

growth by part of a plant in response to water

Thigmotropism:



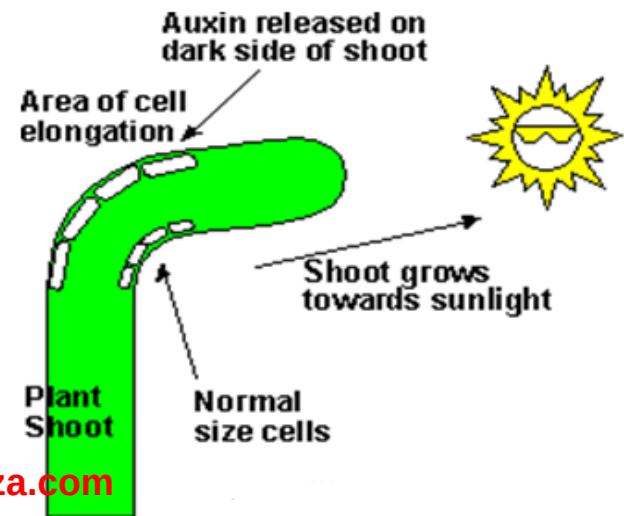
growth by part of a plant in response to touch

Chemotropism:

growth by part of a plant in response to chemicals

WHAT ARE HORMONES?

- **Chemicals** that are made in one part of an organism, but affect another part of the organism
- Allows a **plant to respond** to some **stimulus** in the environment
 - Allows it to **bloom** at an appropriate time
 - Allows it to **grow toward a light source**
 - Allows a **seed to germinate** at the appropriate time



PLANT HORMONES

- **Auxin**
- **Gibberellins**
- **Abscisic acid**



AUXINS (IAA)

Stimulate:

- Cell division
- Cell elongation (growth in stem length)
- The development of fruit
- The abscission of leaves and fruit
- The development of adventitious root in stem cuttings
- Tropic movement in stem and roots
- apical dominance it suppress the growth of the lateral buds

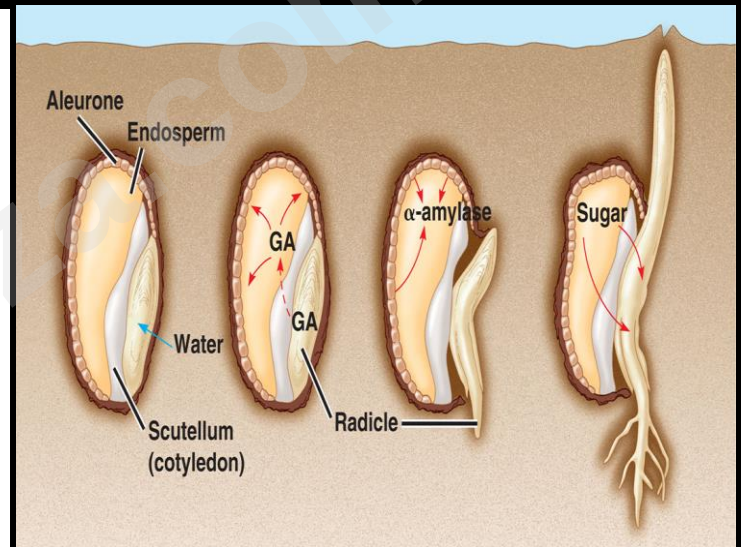


GIBBERELINS

Stimulate:

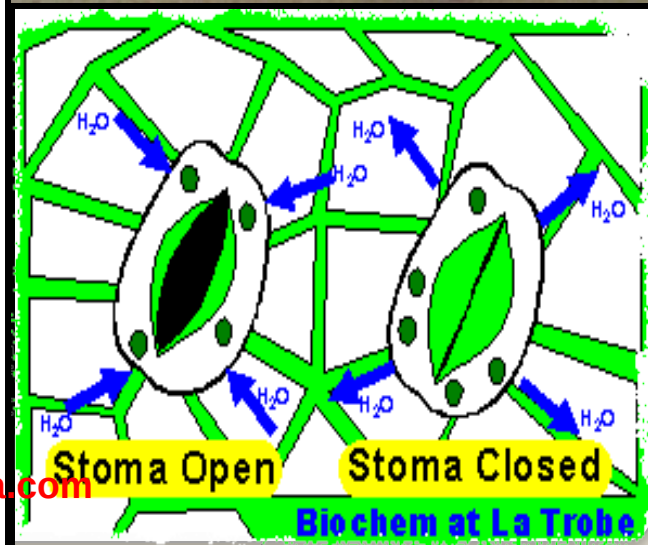
- **Stem** elongation
- **Root** growth
- The germination of **seeds**
- Promotes **flowering**

plump grapes in grocery stores have been treated with **gibberellins** hormones while on the vine

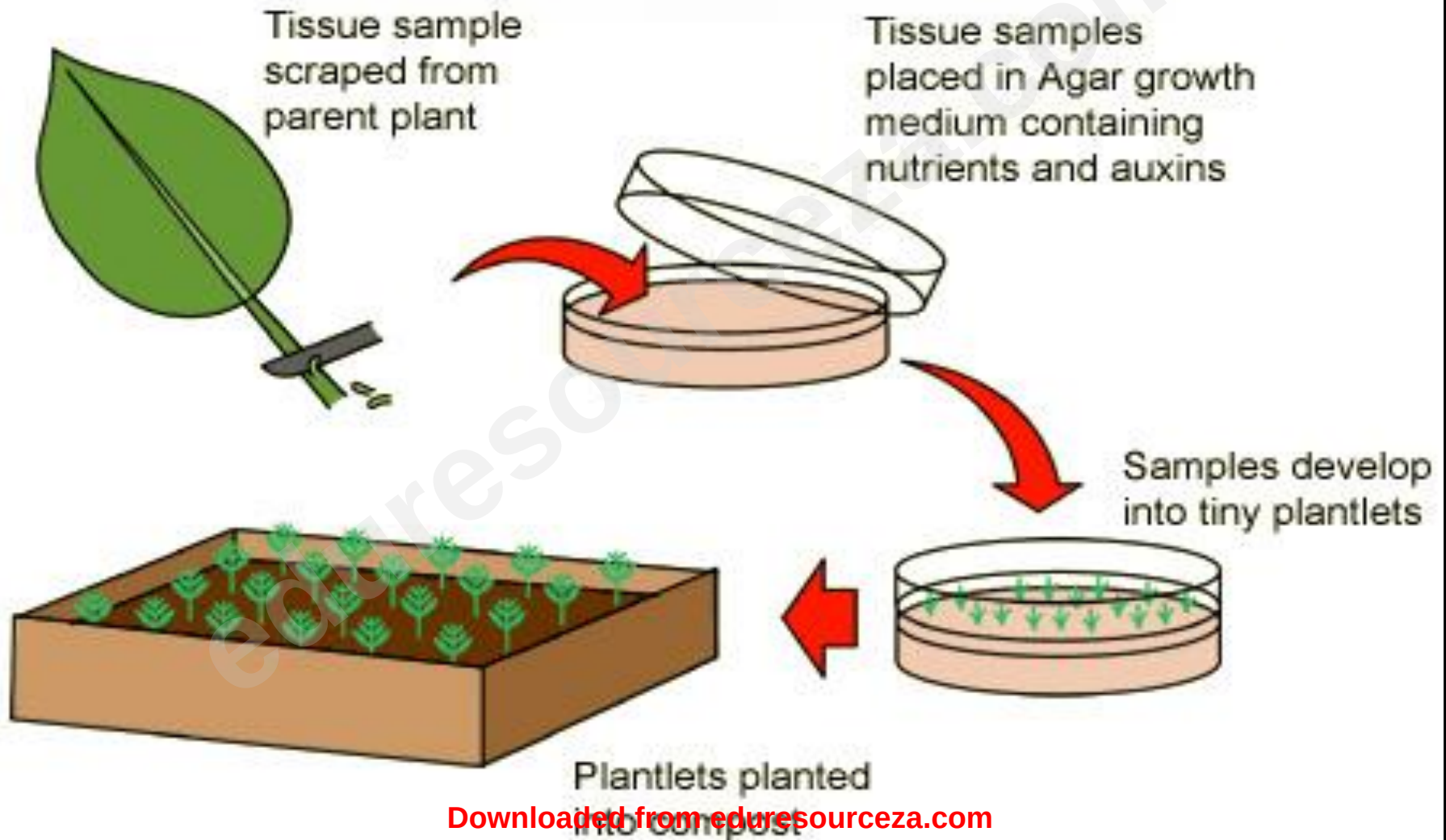


ABSCISIC ACIDS (ABA)

- **Accelerate abscission** in **leaves** and **fruit**. ABA is produced in **ripe fruit** and induced **fruit fall**
- ABA **stimulates the closing** of **stomata** in most plant species. Its synthesis is stimulated by **water deficiency** (water stress)
- Causes **dormancy** in **apical** and **lateral buds** in **winter**
- Controls **seed dormancy** by **inhibiting germination**
- Causes the **closing** of **stomata** when the **plant wilts**



USE OF AUXINS



USE OF AUXINS

- **Plants** respond to the direction and amount of light they receive
- The **seedlings** on the left grew toward the light it received on only one side
- The **plant** in the center received no light
- The **plant** on the right was grown in normal, all-around light



USE OF AUXINS

Auxins as herbicides:

- **Auxins** accelerate the **metabolism** of broad-leaved dicotyledonous weed and therefore **stimulate growth**
- These **weeds** grow so fast that their water absorption and **food production** are insufficient
- The plants **weaken and die**

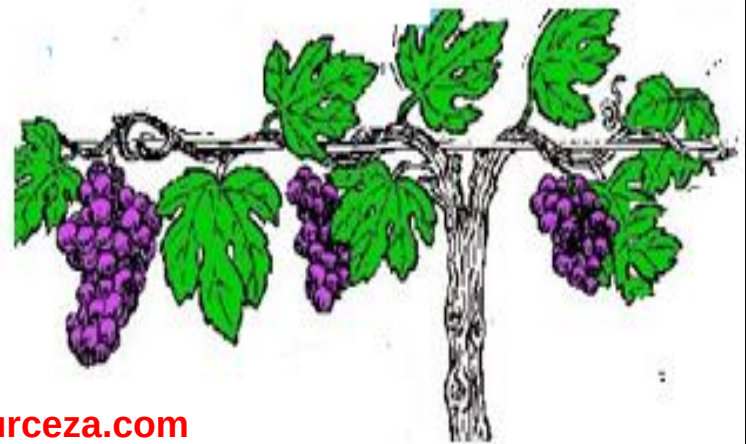
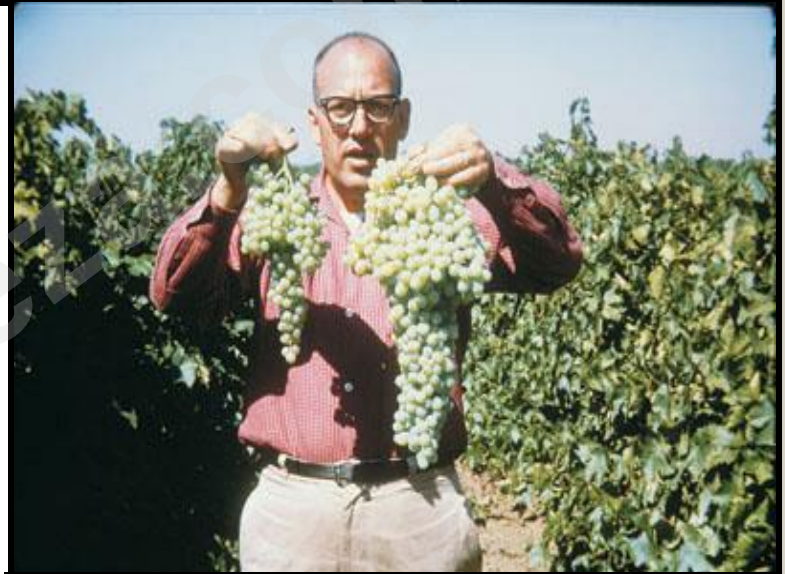


USE OF GIBBERELLINS

- **Gibberellins** induces growth in **grapes**

- The first bunch on the right is an **untreated control**

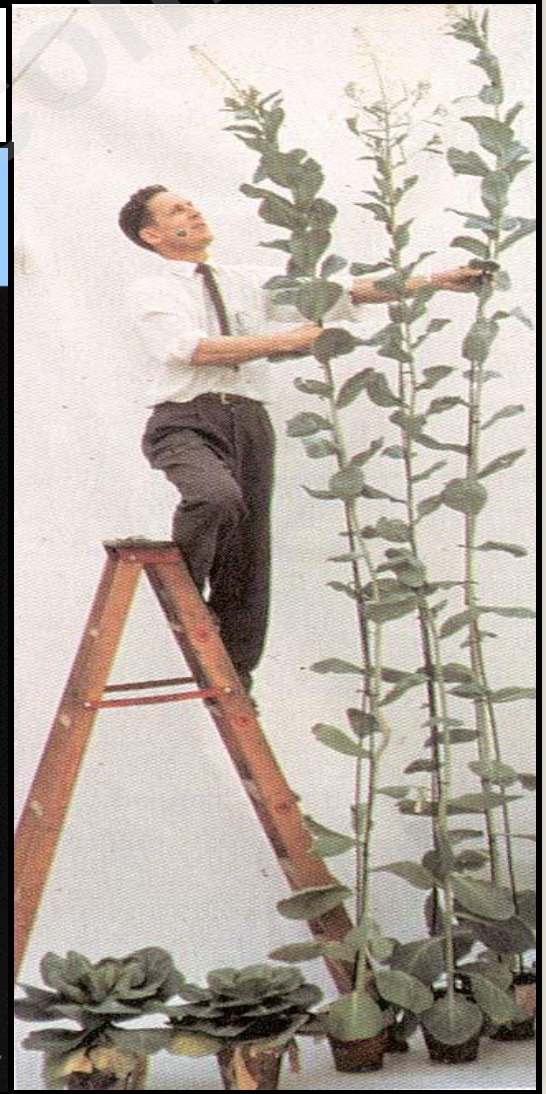
- The second bunch on the right was **sprayed with GA₃** during **fruit development**.



USE OF GIBBERELLINS

Application of **Gibberellins** cause **cell elongation**

Results of increasing active GA concentration in the 'Tan-ginbozu' Dwarf Rice bioassay

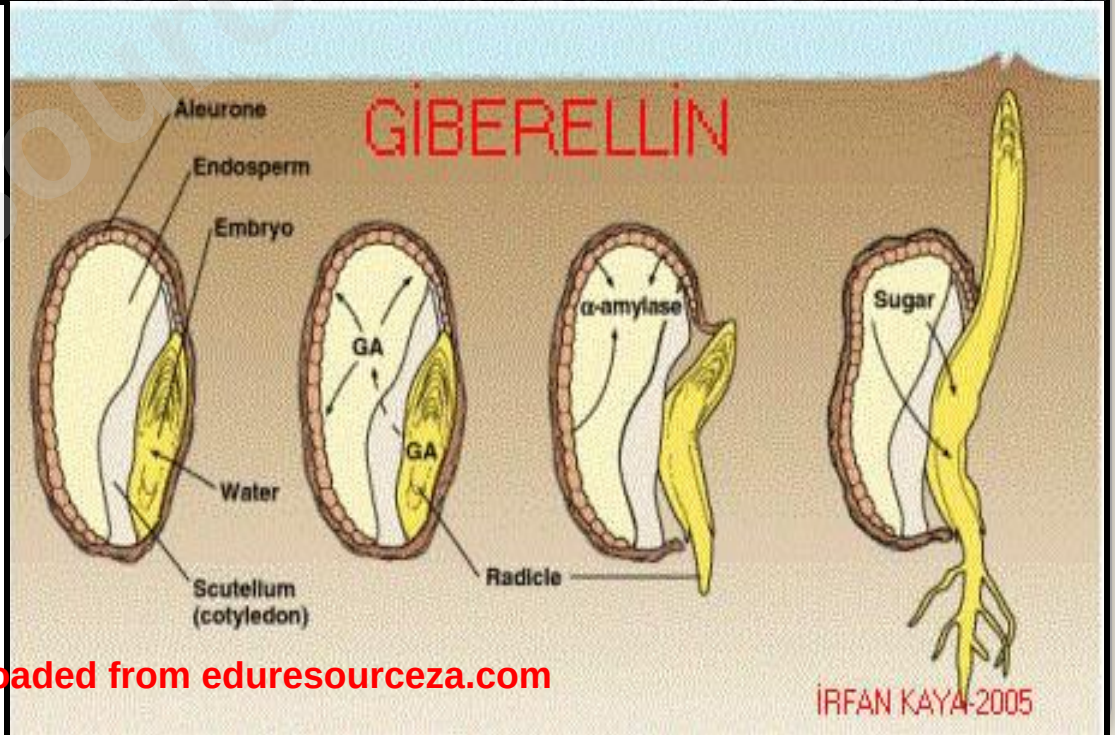


USE OF GIBBERELLINS

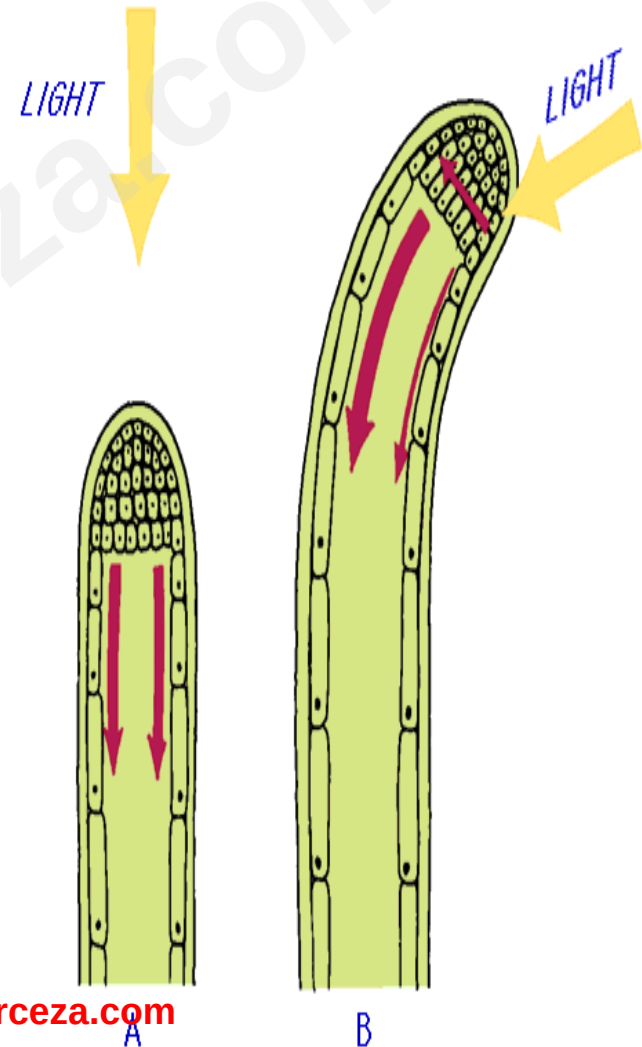
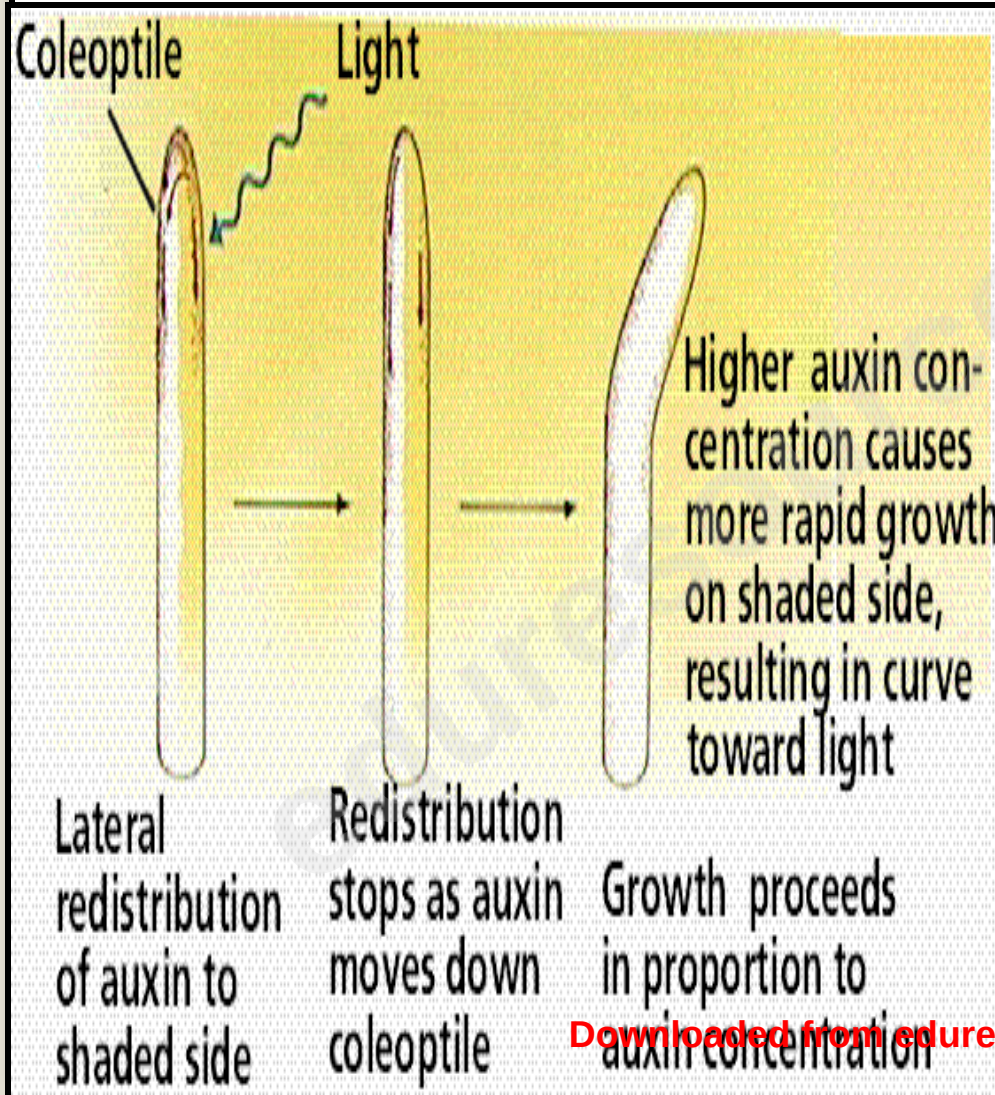
Gibberellins

stimulate seed
germination

In this experiment carried out on germinating barley seeds, the results showed that the release of gibberellins from the embryo, triggers the germination



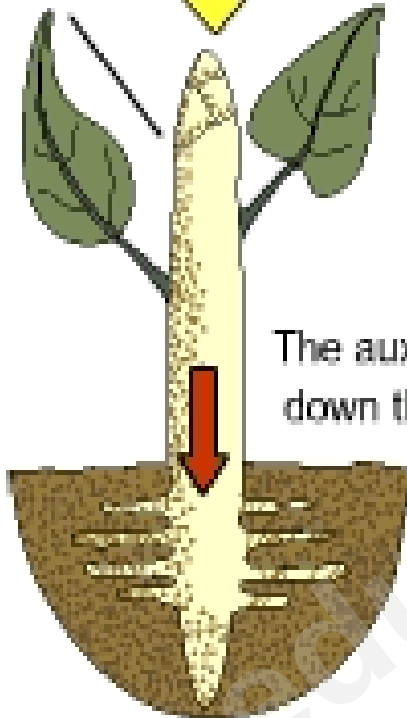
PHOTOTROPISM



PHOTOTROPISM

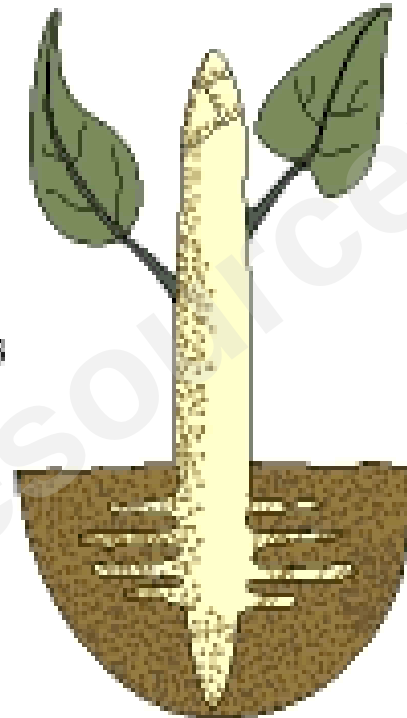
Auxin is made here

Light



The auxin moves down the stem

Auxin diffuses down the shoot stimulating growth.



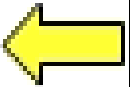
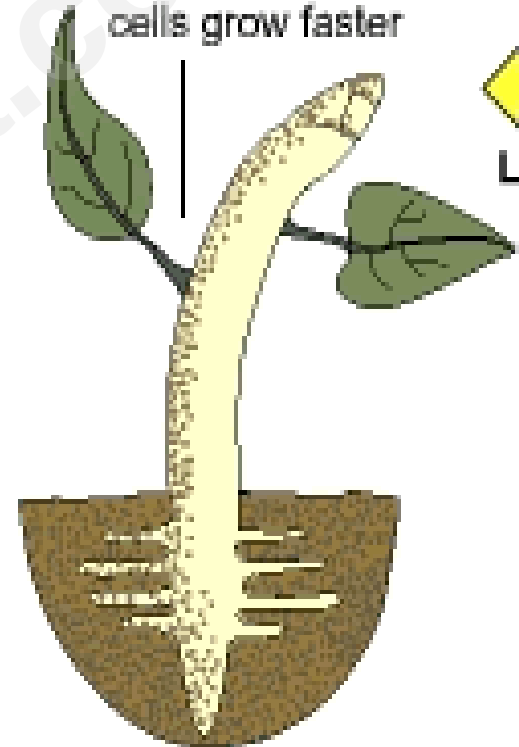
If one side of the shoot is in the light, auxin diffuses away from the light.

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Auxin here makes cells grow faster



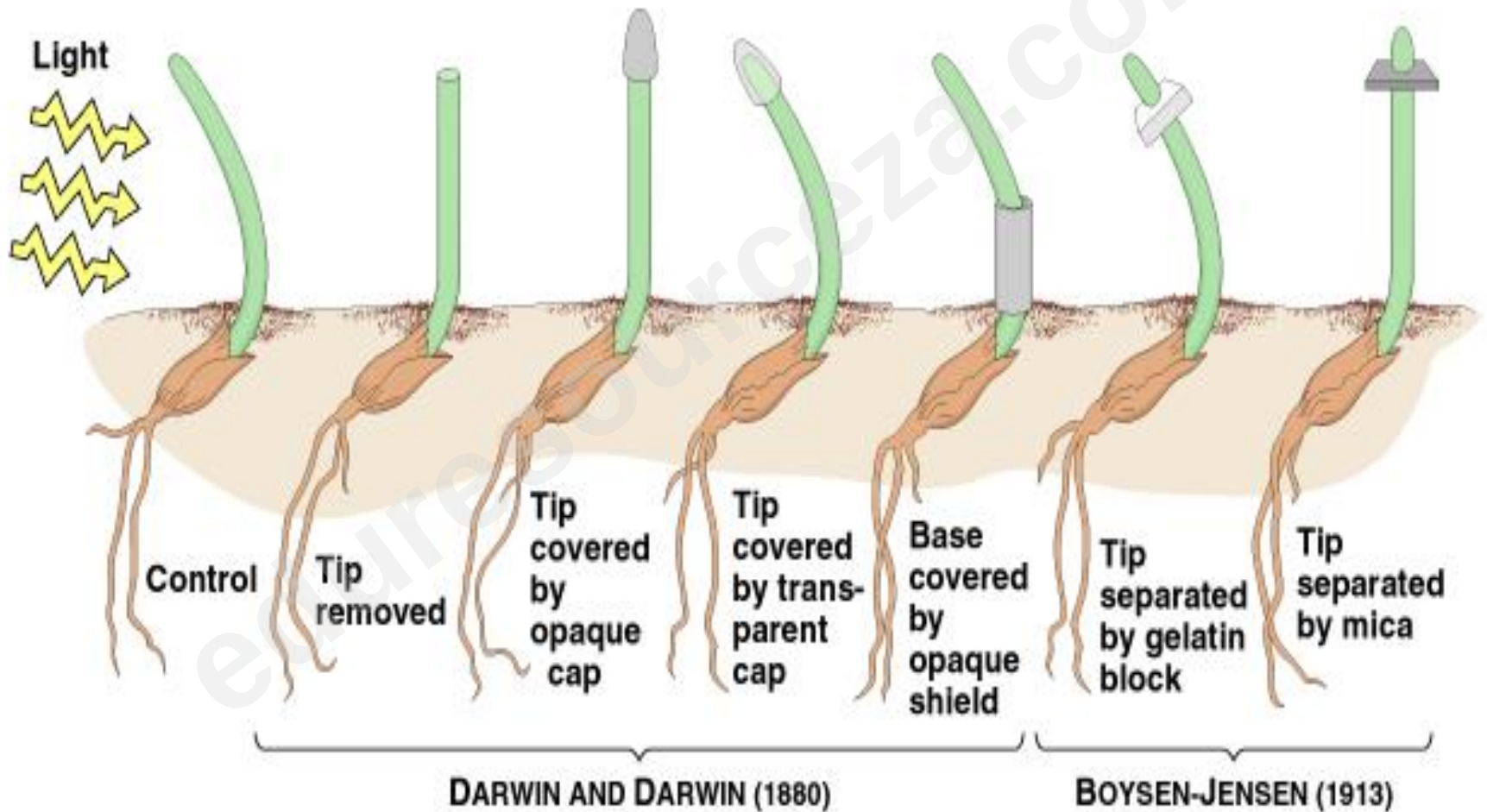
Light



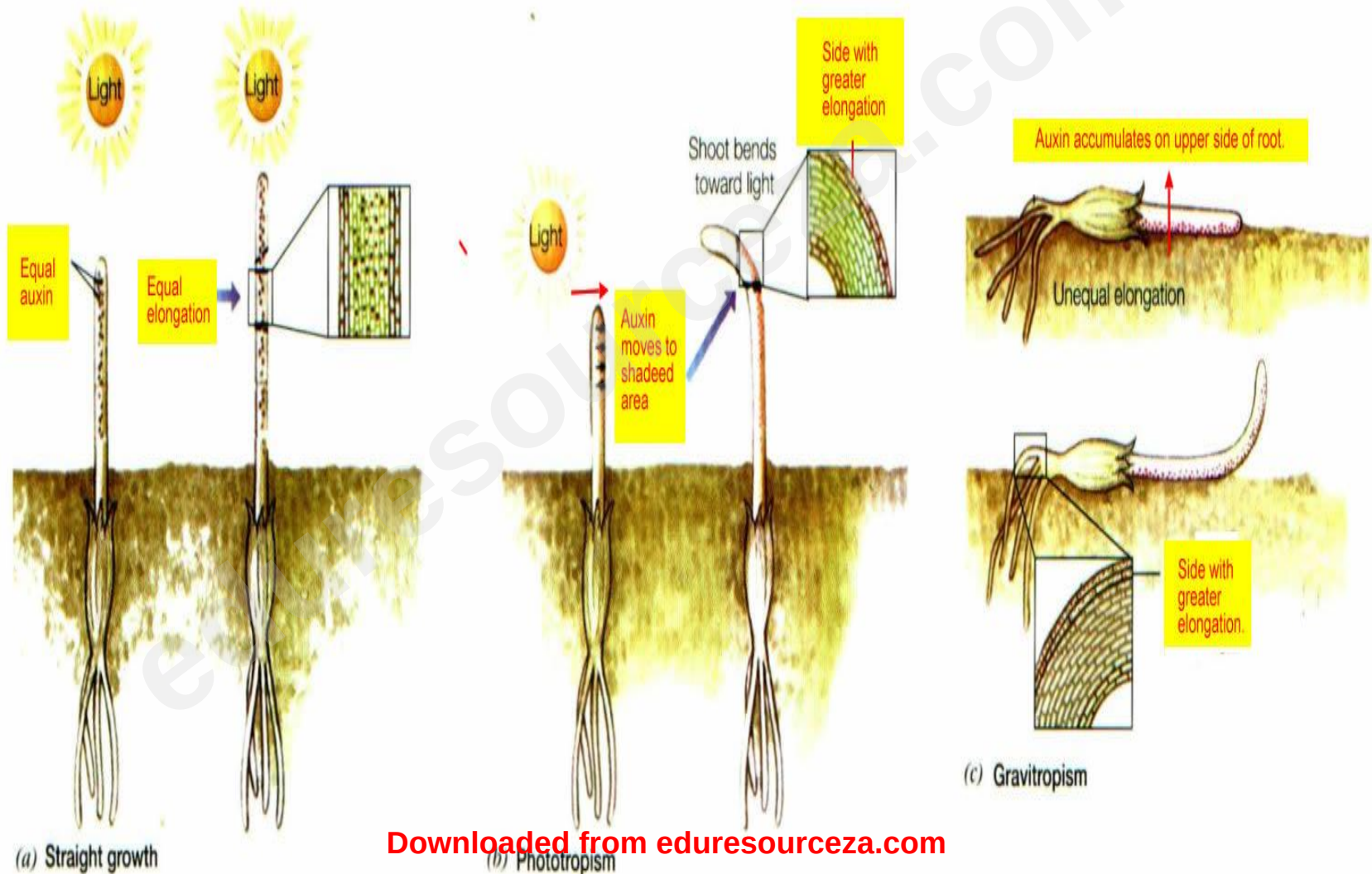
Light

The side of the shoot in the shade has more auxin, so grows faster, causing the shoot to bend towards the light.

PHOTOTROPISM

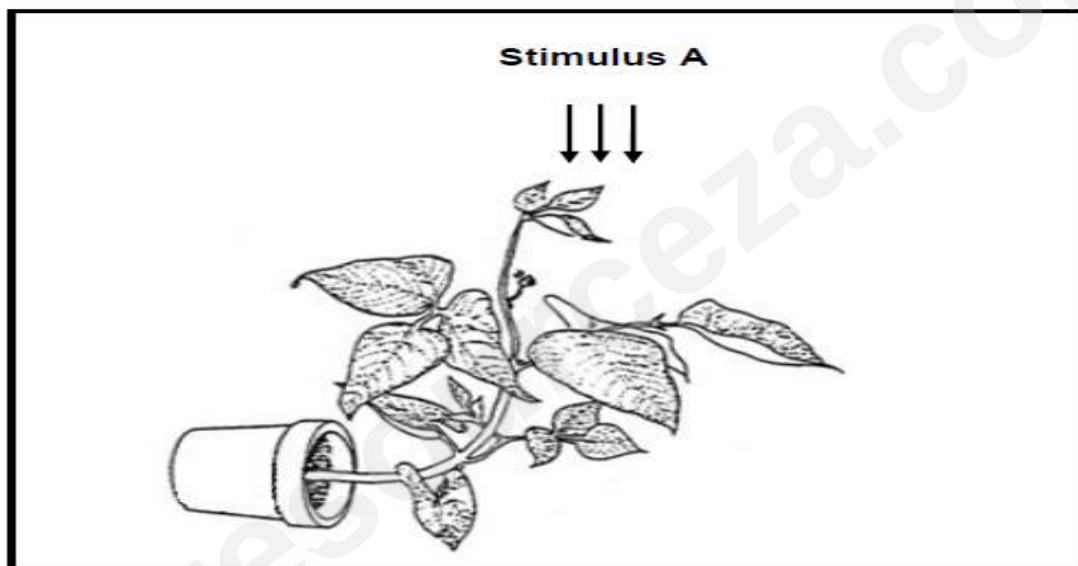


PHOTOTROPISM



ACTIVITY 1

- 1.5 The diagram below shows the growth movement of a part of a plant towards a stimulus.



- 1.5.1 What growth movement is represented in the diagram? (1)
- 1.5.2 Identify the stimulus labelled A. (1)
- 1.5.3 Name the growth hormone that is responsible for the growth movement named in QUESTION 1.5.1. (1)
- 1.5.4 Will a high concentration of the growth hormone named in QUESTION 1.5.3 **stimulate** or **inhibit** growth in the roots? (1)
- 1.5.5 Name the phenomenon where the buds at the tip of the plant regulate the growth of the lateral branches. (1)
- (5)

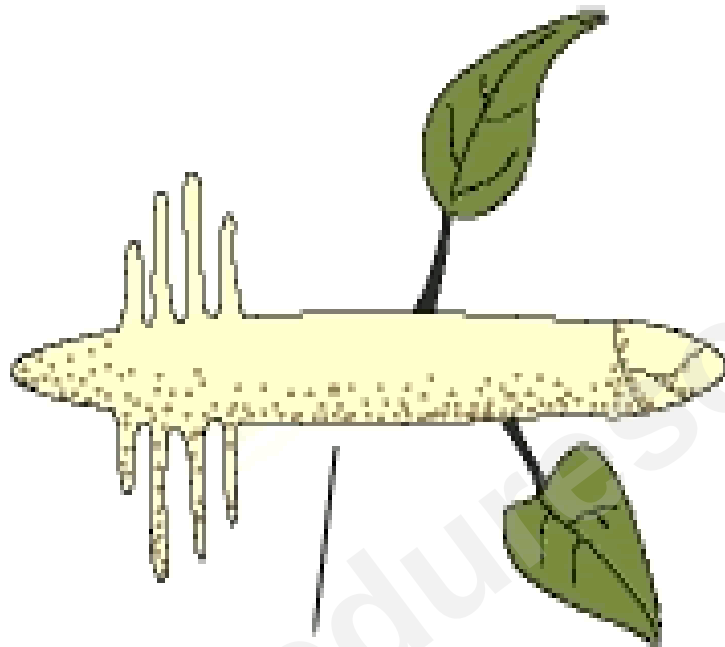
ACTIVITY 1 – ANSWERS

1.5	1.5.1	Phototropism✓	(1)
	1.5.2	Light✓/Sunlight/Radiant energy	(1)
	1.5.3	Auxins✓/ IAA/ Indole acetic acid	(1)
	1.5.4	Inhibit ✓	(1)
	1.5.5	Apical dominance✓	(1)
			(5)

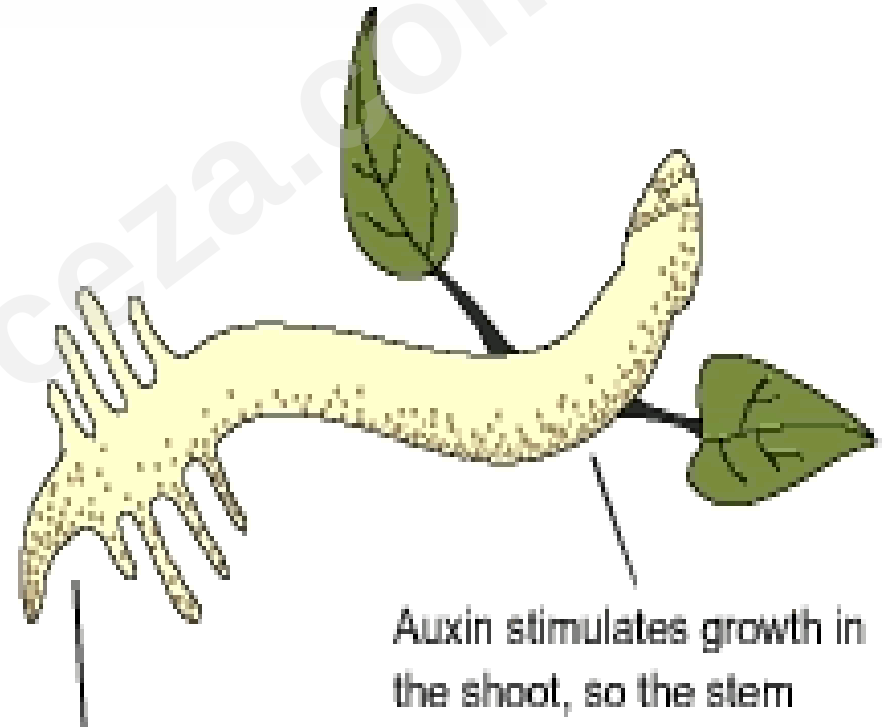
GEOTROPISM



GEOTROPISM



If a plant is laid on its side, auxin gathers in the lower half of the stem and root



Auxin slows growth in the root, so the root curves downwards.

Auxin stimulates growth in the shoot, so the stem curves upwards

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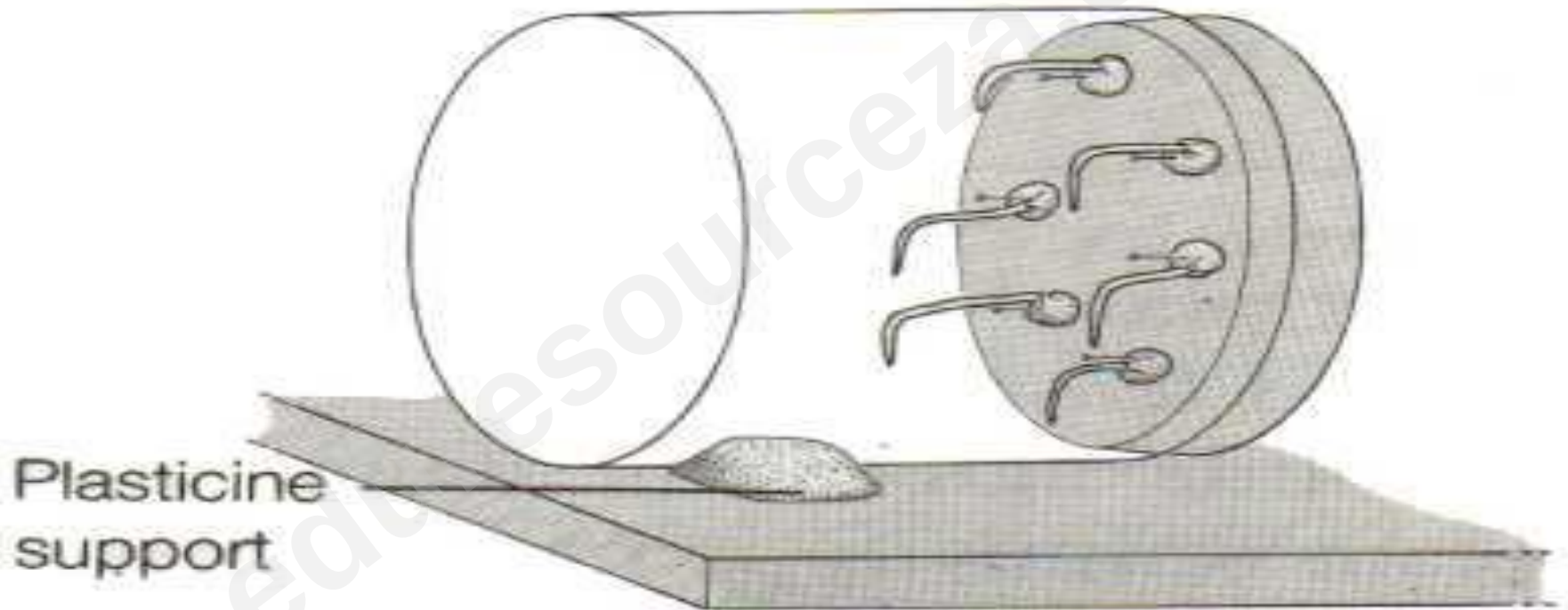
GEOTROPISM



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EXPERIMENT TO ILLUSTRATE GEOTROPISM

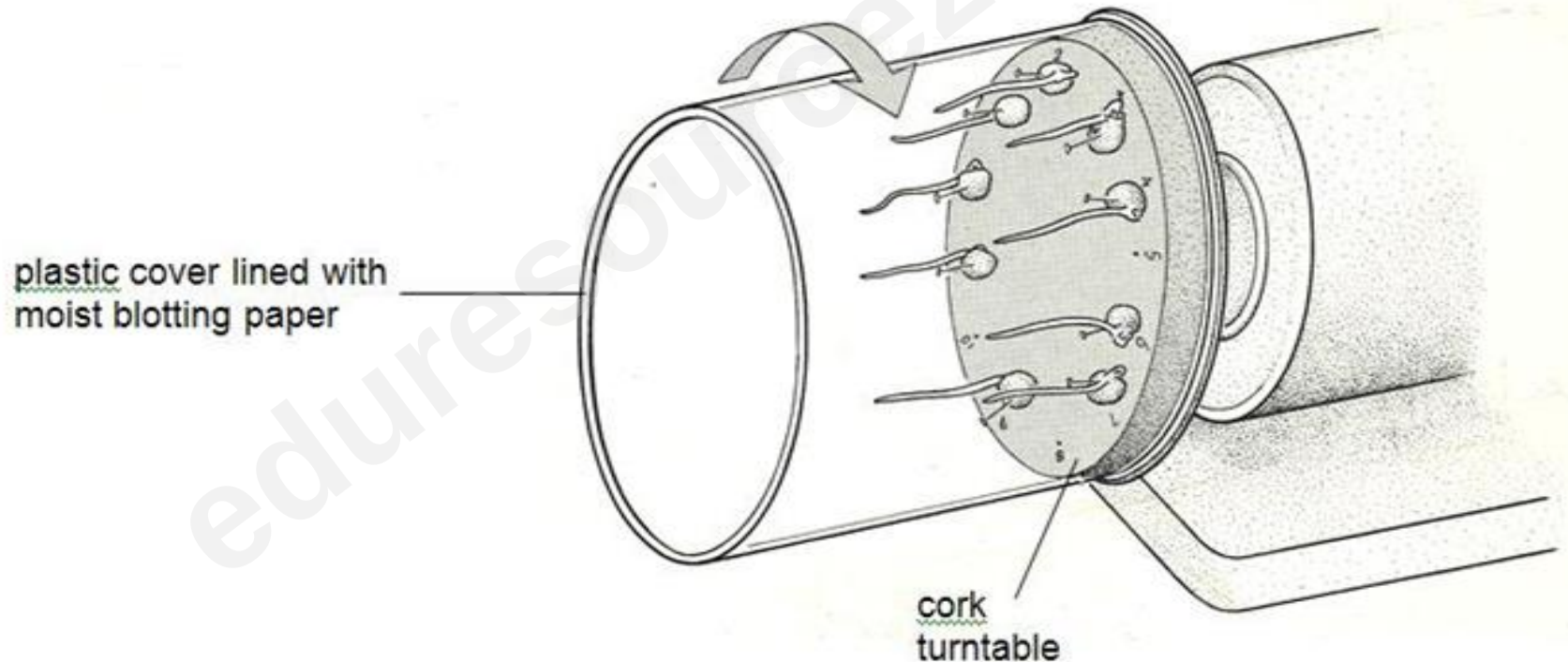
Clinostat not rotating – roots growth downwards



roots have grown down
vertically (positive geotropism)

EXPERIMENT TO ILLUSTRATE GEOTROPISM

Clinostat turned – roots growth straight



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CLINOSTAT

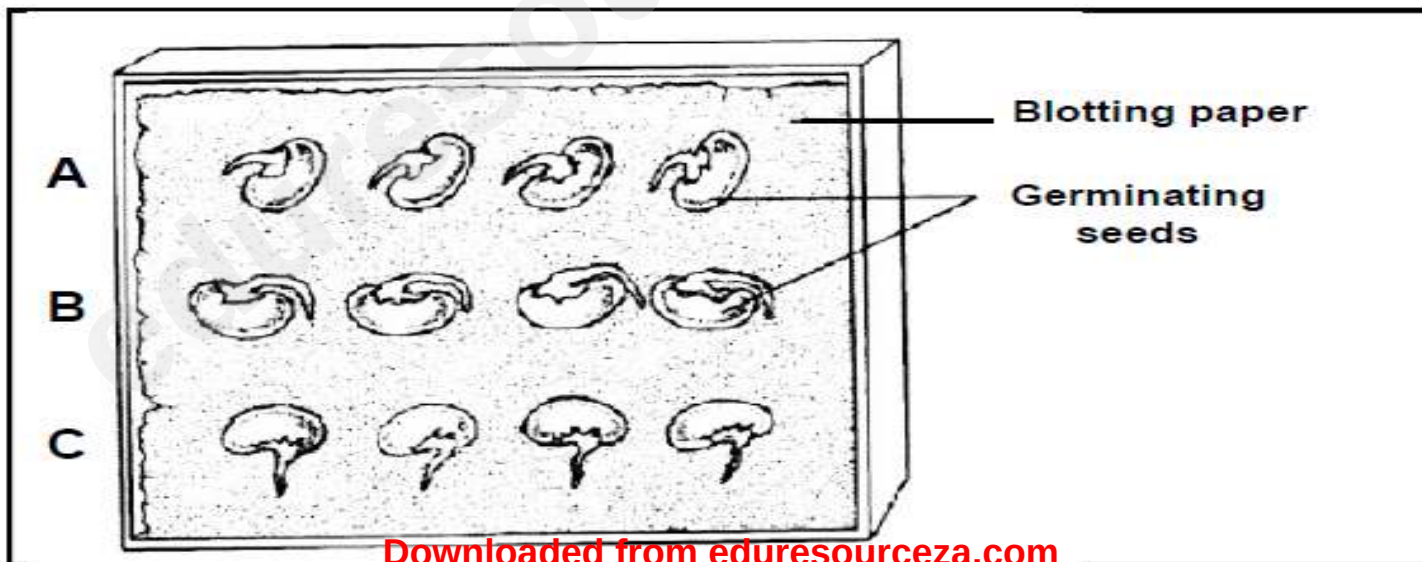
ACTIVITY 2

- 2.4 An investigation was conducted to determine the effect of gravity on the direction of root growth in germinating seeds.

The procedure was as follows:

- A glass jar was lined with a layer of thick blotting paper
- 12 germinating bean seeds were placed between the glass jar and the blotting paper as follows:
 - A. 4 seedlings with their root tips pointing horizontal
 - B. 4 seedlings with their root tips pointing upwards
 - C. 4 seedlings with their root tips pointing downwards
- The glass jar received light from all directions
- The growth response of the root tips was observed

The diagram below shows the observation made after a week.



ACTIVITY 2 CONT...

- 2.4.1 In this investigation, identify the:
- (a) Independent variable (1)
 - (b) Dependent variable (1)
- 2.4.2 Mention TWO ways in which the validity of the investigation could have been improved. (2)
- 2.4.3 Give the name of the growth in response to gravity as observed in this investigation. (1)
- 2.4.4 Why did the investigator use 4 bean seeds for each group? (1)
- 2.4.5 Explain the results of the investigation as observed in group A. (5)
- (11)**

ACTIVITY 2 – ANSWERS

2.4	2.4.1	(a) Gravity✓	(1)
		(b) Direction of root growth✓	(1)
	2.4.2	- Use beans of the same species✓ - Expose seeds to the same environmental conditions✓/ light/ temperature (Mark first TWO only)	Any (2)
	2.4.3	Geotropism✓	(1)
	2.4.4	To improve reliability✓ of the results	(1)
	2.4.5	- Auxins✓ - moved to the lower side of the root✓ - because gravity attracts auxins✓ - Therefore, there was high concentration on the lower side of the root✓ - There will be a low concentration of auxins on the upper side of the root✓ - More growth occurs on the upper side of the root✓ - on the lower side the high concentration inhibits/slows down growth✓ - Uneven growth will result with the root bending downwards✓ towards gravity.	Any (5)

MECHANICAL DEFENCE

Xerophytes:

They are **desert plants** that have their leaves reduced to **thorns** to **prevent water loss**



MECHANICAL DEFENCE

Spiny shrubs:

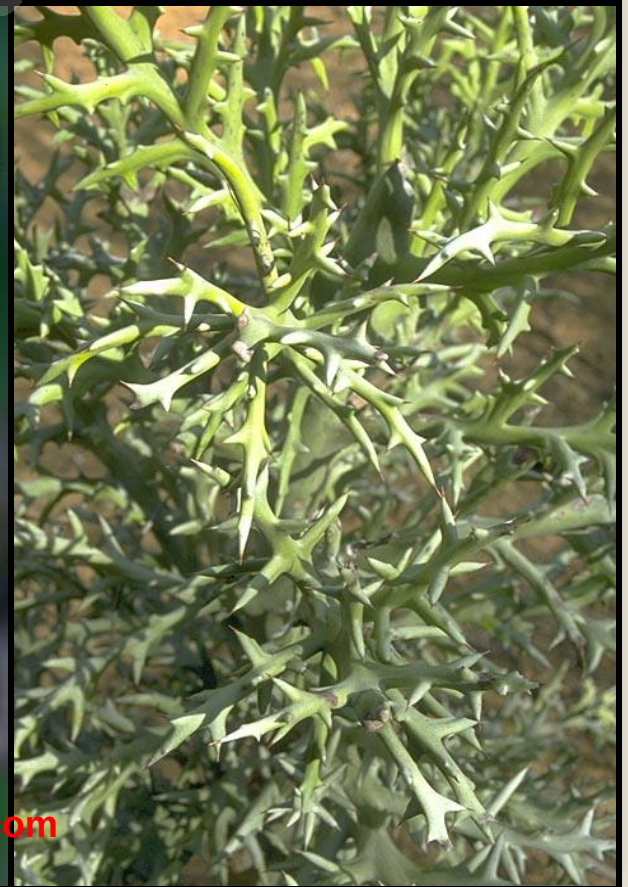
They have **thorns** that act as defence mechanism against **herbivores feeding** on them (cactuses, raspberry etc)



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MECHANICAL DEFENCE

Spiny shrubs:



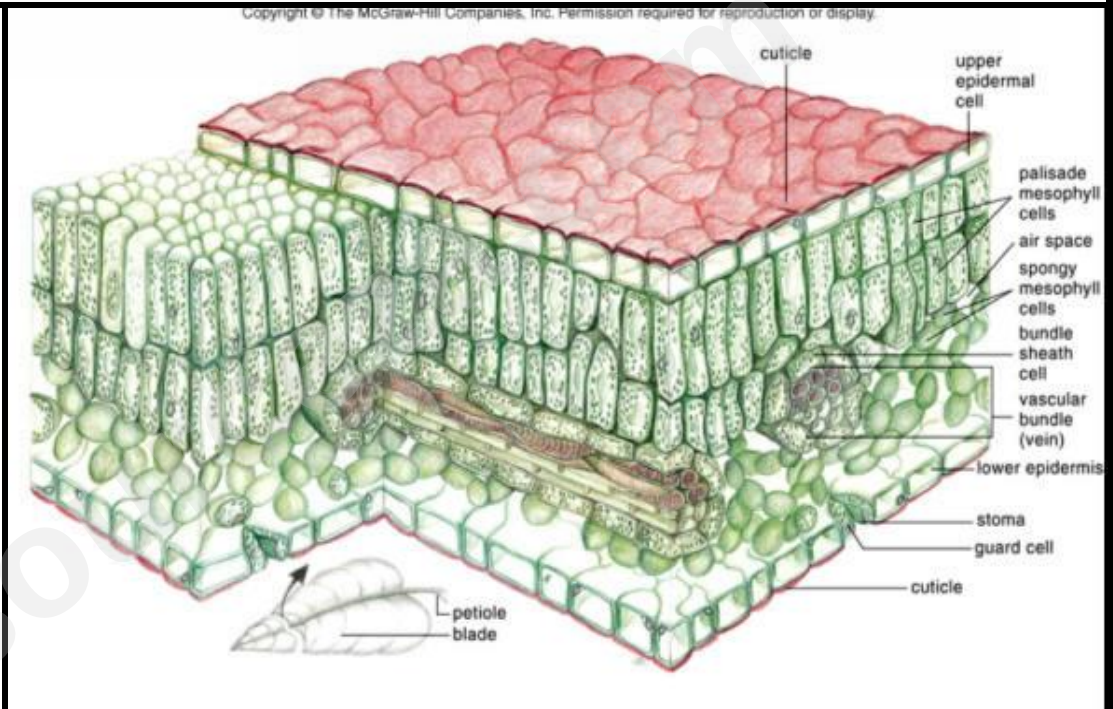
MECHANICAL DEFENCE

- **Acacia species** have **thorns** to prevent excessive feeding by **giraffes, kudu, impala** etc



MECHANICAL DEFENCE

- **Plants** are covered by **hard bark** or **waxy cuticle** to **prevent enemy penetration**



MECHANICAL DEFENCE

The **fruit of a coconut** is covered by multiple layers of fibres that make penetration difficult and protects the seed



CHEMICAL DEFENCE

- Many plants produce **chemicals** known as **secondary metabolites** that help protect them from herbivores
- These **chemicals** acts as **poisons, repellent**, or affect the herbivores digestion
- These include:



CHEMICAL DEFENCE

- **Alkaloids** – group of **nitrogen** containing compounds found in plants which **act as poison**
- **Tannin (phenol)** – brownish substance found in plants with **antiseptic properties** that **disrupt** endocrine activities
- **Terpenoids** – these chemicals **destroy** the herbivores **red blood cells**

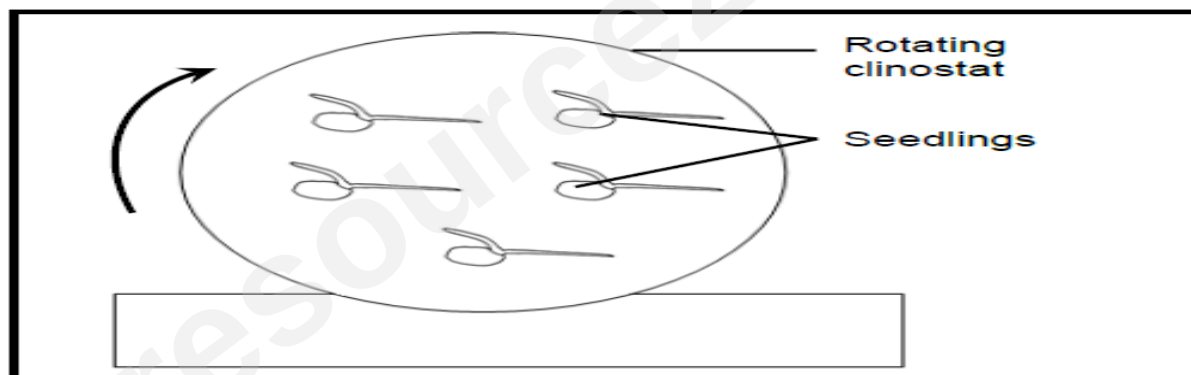
ACTIVITY 3

2.3

A learner conducted an investigation to determine the effect of auxins and the effect of gravity on root growth in pea seedlings. He used the following procedure:

- He germinated pea seeds for seven days.
- He then took a sample of 15 seedlings and divided them into 3 groups (A to C) of 5 seedlings each.
- In each group the 5 seedlings were placed horizontally on 3 different clinostats.

A clinostat is a device which has a disc that rotates at a constant speed. A diagram of a clinostat is shown below.



- He removed the root tips of all 5 seedlings at the same length in group B.
- In groups A and B the clinostats were left stationary (no rotation).
- In group C the clinostat was allowed to rotate.
- All 3 clinostats were placed in a dark cupboard.

A summary of the learner's procedure is shown in the table below.

GROUP A	GROUP B	GROUP C
Root tips present	No root tips	Root tips present
Stationary clinostat	Stationary clinostat	Rotating clinostat

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After two days the direction of root growth was observed.

ACTIVITY 3 CONT...

- 2.3.1 Which TWO groups were used to obtain information about:
- (a) The effect of auxins on root growth (1)
 - (b) The effect of gravity on root growth (1)
- 2.3.2 Explain why the apparatus was placed in a dark cupboard. (2)
- 2.3.3 Describe the expected results for each of groups **B** and **C** in this investigation. (2)
- 2.3.4 Explain the expected results for group **A**. (3)
- 2.3.5 State THREE ways in which the learner ensured a high level of validity for this investigation. (3)
- (12)**

ACTIVITY 3 – ANSWERS

2.3	2.3.1	(a) A and B✓	(1)
		(b) A and C✓	(1)
	2.3.2	- To ensure that the results are attributed to gravity✓ - and not light✓/ to eliminate the effect of light	(2)
	2.3.3	B – No growth will be observed✓ C – Roots will grow horizontally✓/not change direction	(2)
	2.3.4	- Auxins will move to the lower side of the root✓/attracted by gravity - and a high concentration will inhibit growth on the lower side of the roots✓ - while growth will occur faster on the upper side of the root✓ - causing the root to bend downwards✓	Any (3)
	2.3.5	- Used same type of plant✓/pea only - Seedlings were the same age✓/germination period was 7 days - All groups were exposed to the same environment✓/light intensity/ placed in dark cupboard - Same number of seedlings for each group✓ - Root tips were cut at the same length✓ - All seedlings placed in same position✓/horizontally - Allowed same amount of time for the 3 groups✓ - Appropriate controls were set up✓ (Mark first THREE only)	Any (3) (12)



**SIYABONGA
THANK YOU
BAIE DANKIE**

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