



Cambridge (CIE) O Level Biology



Your notes

15.1 Coordination & Response in Plants

Contents

* Tropisms



Gravitropism & Phototropism

Tropisms

- Plants can respond to changes in the environment (stimuli) for survival, e.g. **light, water, gravity**
- Their responses are usually **much slower** than animals
- They grow either **towards a stimulus** (known as a positive response) or **away from a stimulus** (known as a negative response)
- The responses are known as **tropisms**

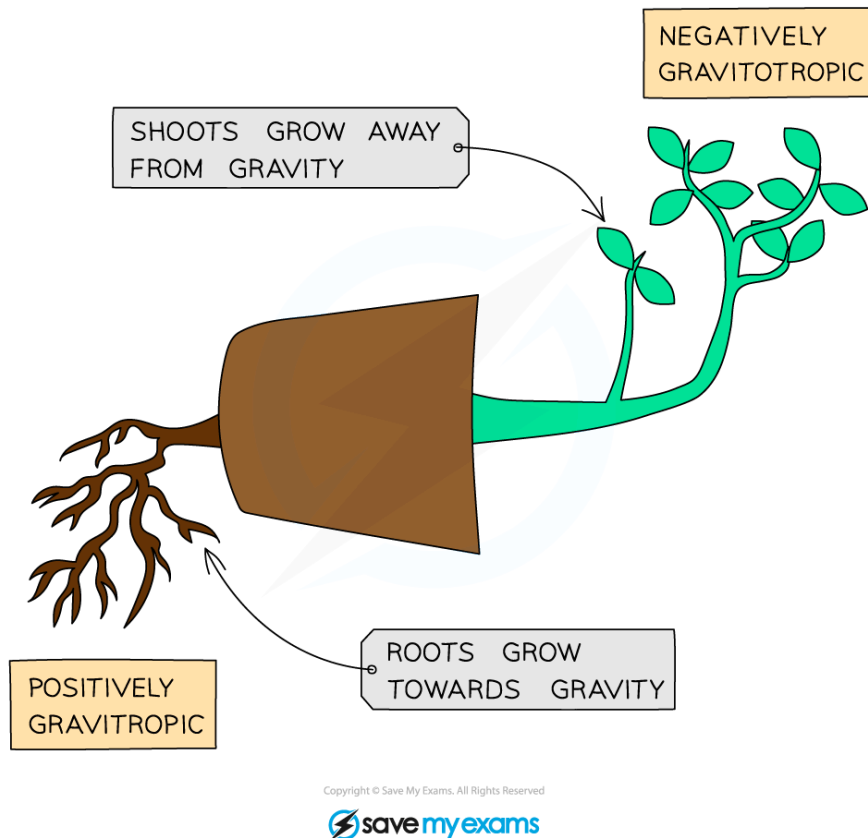
Stimulus	Name of response	Definition	Positive response	Negative response
Light	Phototropism	Growth towards or away from the direction of the light source	Growth towards the light source (e.g. by shoots)	Growth away from the light source (e.g. roots)
Water	Hydrotropism	Growth towards or away from water	Growth towards water (e.g. by roots)	Growth away from water (e.g. shoots)
Gravity	Gravitropism	Growth towards or away from the source of gravity	Growth towards the source of gravity (e.g. by roots)	Growth away from the source of gravity (e.g. shoots)

- It is very important to a plant that its roots and shoots grow in the right directions
- Shoots must grow **upwards**, away from gravity and towards light, so that leaves are able to absorb sunlight
 - This means that shoots have a **positive phototropic response** and a **negative gravitropic response**
- Roots need to grow **downwards** into the soil, away from light and towards gravity, in order to anchor the plant and absorb water and minerals from the soil particles.
 - This means that roots have a **negative phototropic response** and a **positive gravitropic response**

Plant Gravitropism Diagram



Your notes



Placing a plant on its side shows the gravitropic responses (also known as geotropic responses)

Auxins: Chemical Control of Tropisms

- Plants respond to stimuli by producing a **growth hormone called auxin** which controls the direction of growth of roots or stems
- Therefore we say plants control their growth **chemically**
- Auxin is mostly made in the **tips** of the growing stems and roots and can diffuse to other parts of the stems or roots; spreading from a high concentration in the shoot tips down the shoot to an area of lower concentration.
- This is an important point. Only the region behind the tip of a shoot is able to contribute to growth by cell division and cell elongation. This part of a shoot is called the meristem. Auxin stimulates the cells behind the tip **to elongate** (get larger); the more auxin there is, the faster they will elongate and grow
- If light shines all around the tip, auxin is distributed evenly throughout and the cells in the meristem grow at the same rate - this is what normally happens with plants growing outside
- When light shines on the shoot predominantly from one side though, the auxin produced in the tip **concentrates on the shaded side**, making the cells on that side elongate and

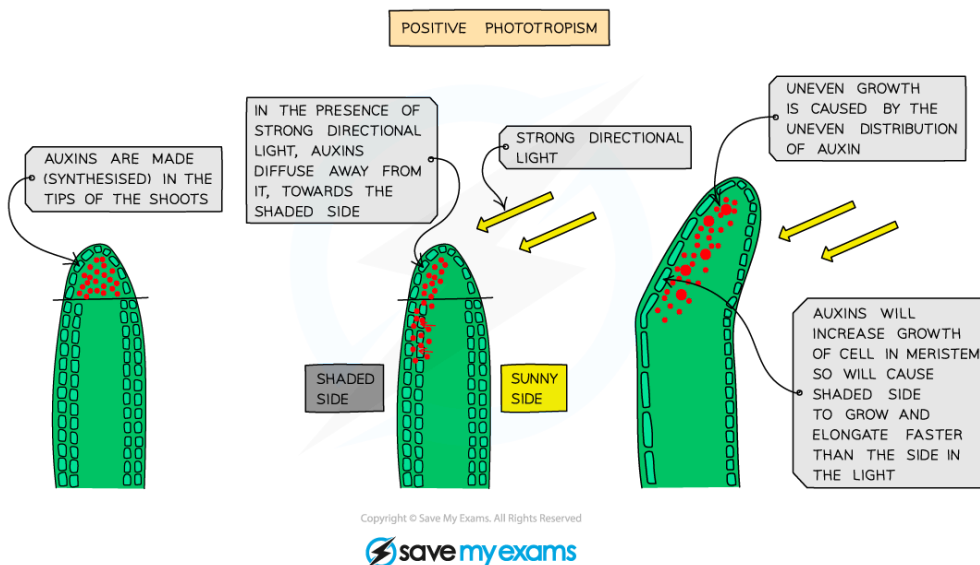
grow faster than the cells on the sunny side

- This unequal growth on either side of the shoot **causes the shoot to bend** and grow in the direction of the light



Your notes

Auxin and Phototropism Responses



Positive phototropism in plant shoots

- Auxin plays a role in a plants response to gravity, affecting plant **shoots** and **roots** in **different ways**
- When **shoots grow away from gravity** it is known as **negative geotropism**
 - Gravity modifies the distribution of **auxin** so that it accumulates on the **lower side** of the shoot
 - As seen in the phototropic response, **auxin increases the rate of growth in shoots**, causing the shoot to grow **upwards**
- When **roots grow towards gravity** it is known as **positive geotropism**
 - In roots, **higher concentrations** of auxin results in a **lower rate of cell elongation**
 - The auxin that accumulates at the **lower side** of the root **inhibits cell elongation**
 - As a result, the lower side grows at a **slower rate** than the upper side of the root
 - This causes the root to bend **downwards**



Examiner Tips and Tricks

You should be able to explain the results of an experiment like this into the effect of light on the growth of shoots.



Your notes

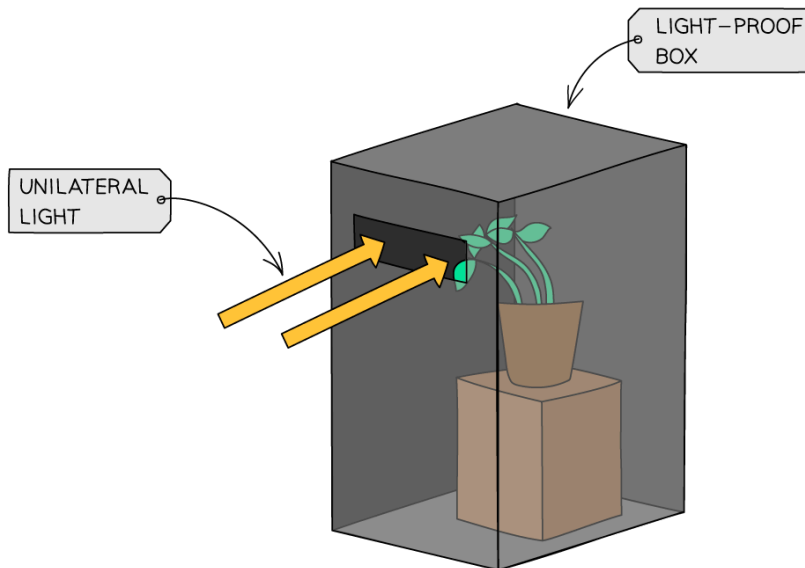
Investigating Tropisms

Investigating Phototropisms

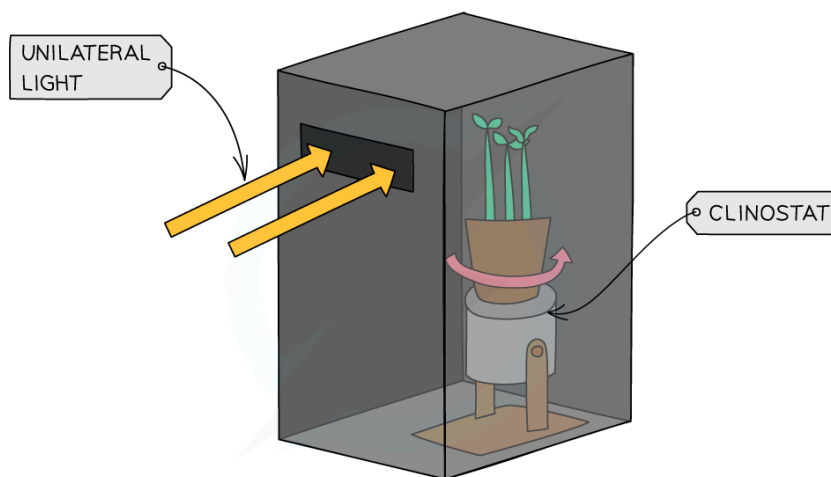
- Three identical plants are set up as shown below (A, B and C)



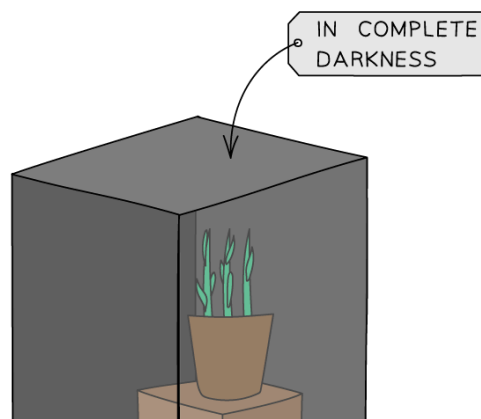
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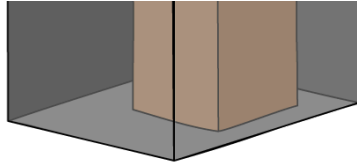


SET-UP A



SET-UP B





SET-UP C

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Investigating the phototropic response

- The seedlings in A grow **towards** the light source
- In B the effect of the light only coming from one direction has been **cancelled out** by using a **clinostat**
 - A clinostat is a device that revolves **slowly** and **repeatedly**, so the shoots are evenly exposed to light
- This means all sides of the seedlings get **equal exposure to light** so they do not curve towards the light source but grow straight up
- In C the seedlings grow straight up **looking for light** and the plant becomes tall and slender with yellowing leaves due to the lack of light

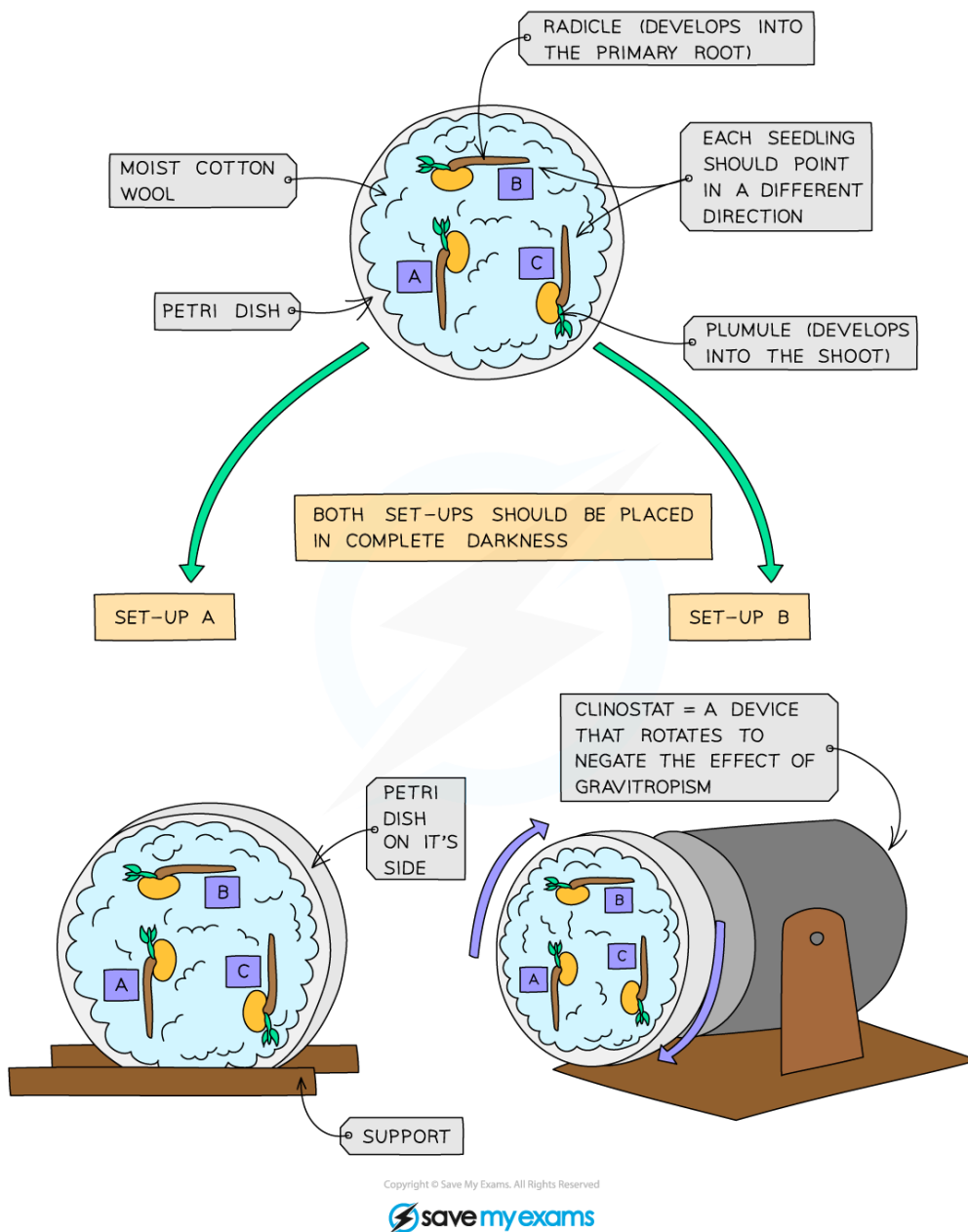
Investigating Gravitropism



Your notes



Your notes



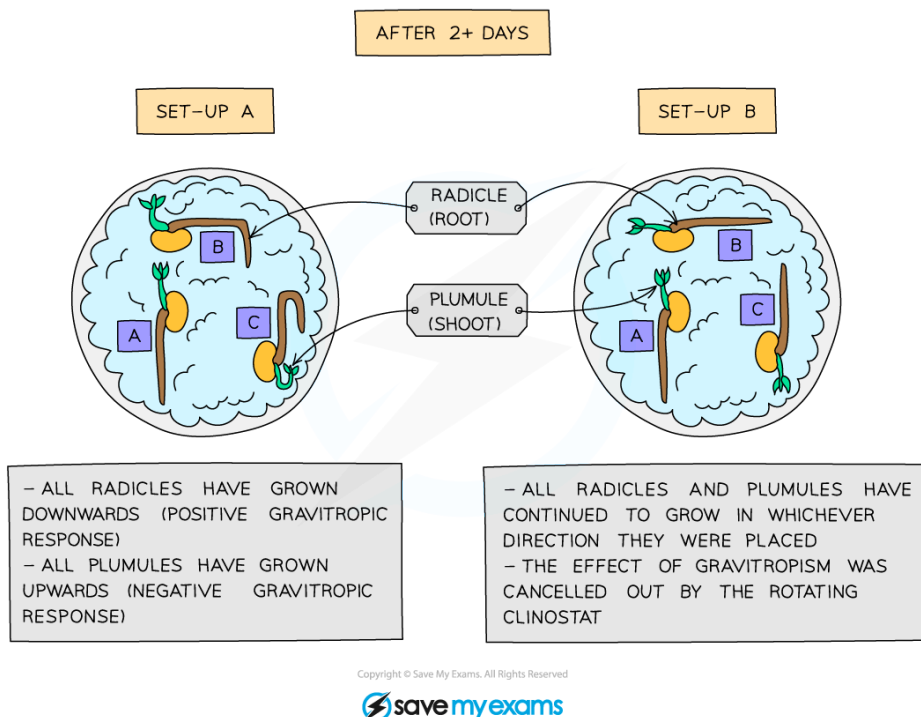
Investigating the gravitropic response (set-up)

- Add some damp cotton wool to two Petri dishes
- Place 3 bean seedlings in the cotton wool in each petri dish
 - A - radicle facing **downwards**
 - B - horizontally
 - C - radicle (root grows from here) facing **upwards**
- Cover each dish with a lid
- Attach one petri dish to a support so that it's on its side

- Attach the second petri dish to a clinostat (as shown in the diagrams above).
- Place both in a **light-proof box** (so that the seedlings are in complete darkness), leave for two days and then observe the growth of the seedlings



Your notes



Investigating the gravitropic response (results)

- In the first petri dish, **all radicles (roots) have grown downwards** (positive gravitropic response) regardless of which way they were initially facing (horizontal, up or down) and **all plumules (shoots) have grown upwards** (negative gravitropic response)
- In the second petri dish, all radicles and all plumules have all grown **neither up nor down** but straight outwards **in whichever direction they were placed** as the **effect of gravity** has been **cancelled out by the revolving of the clinostat** – they have shown no gravitropic response at all
- The experiment needs to be done in a lightproof box to **cancel out the effect of light on the growth of the seedlings**