Edexcel GCSE Biology

Your notes

Plant Hormones

Contents

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Plant Hormones & Growth

- Plants need to be able to grow in response to certain **stimuli**
  - For example, plants need to be able to grow **in response to light**, to ensure their leaves can absorb light for **photosynthesis**
  - They also need to be able to grow **in response to gravity**, to ensure that shoots grow upwards and roots grow downwards
- The **directional growth responses** made by plants in response to light and gravity are known as **tropisms**
  - A response to light is a **phototropism** and a response to gravity is a **geotropism** (or gravitropism)
- If the growth is **towards** the stimulus, the tropism is **positive** and if the growth is **away from** the stimulus, the tropism is **negative**
  - As **shoots** grow **upwards**, away from gravity and towards light (so that leaves are able to absorb sunlight), shoots show a **positive phototropic** response and a **negative geotropic** response
  - As **roots** 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), roots show a **negative phototropic** response and a **positive geotropic** response

Geotropism and Phototropism Table

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Stimulus	Name of response	Definition	Positive response	Negative response
Gravity	Gravitropism (sometimes called geotropism)	Growth towards or away from gravitational pull	Growth towards gravity (eg. roots)	Growth away from gravity (eg. shoots)
Light	Phototropism	Growth towards or away from source of light	Growth towards light (eg. shoots)	Growth away from light (eg. roots)

Auxins

- Plants produce **plant growth regulators** (similar to hormones in animals) called **auxins** to **coordinate** and **control** directional growth responses such as phototropisms and geotropisms
- Auxins are produced in the **tips** of the shoots and the roots; they diffuse to the cells below the tips and have the following effects:
  - In the **shoots**, auxins **promote cell elongation** (growth); more auxin = more cell elongation = more growth
  - In the **roots**, auxins **inhibit cell elongation** (growth); more auxin = less cell elongation = less growth
- The **distribution of auxin** in the **shoots** is affected by **light** and **gravity**, whereas the distribution in the **roots** is primarily affected by **gravity alone**
  - If a shoot or root is placed on its side, auxins will accumulate along the lower side as a result of gravity; so the uppermost side has a lower auxin concentration
  - In the shoots, the lower side grows faster than upper side (more auxin = more cell elongation), so the shoot grows upwards
  - In the roots, the lower side grows slower than the upper side (as auxin inhibits cell elongation and growth in roots), so the root grows downwards

- Unequal distributions of auxin cause unequal growth rates in plant roots and shoots

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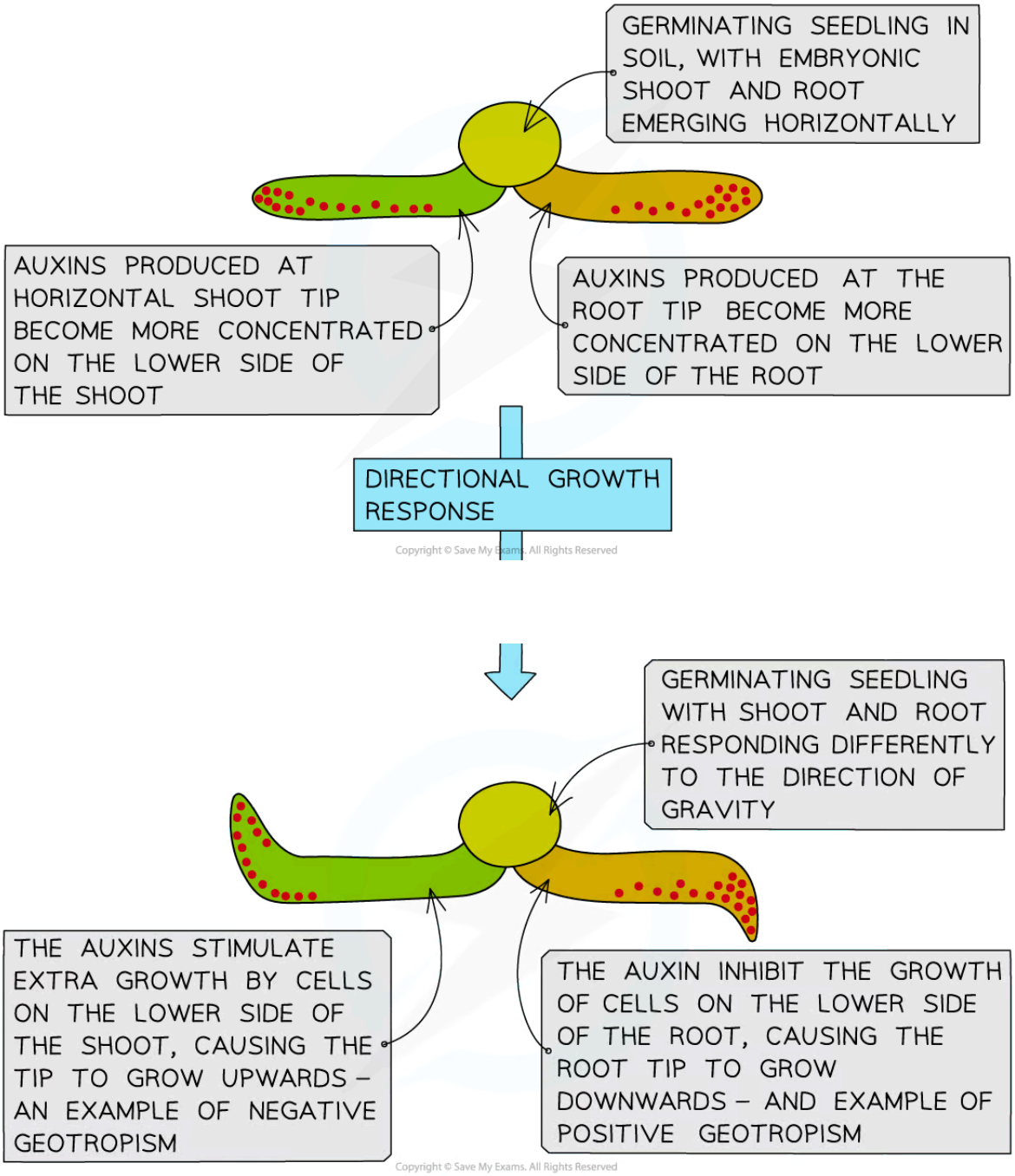

The geotropism response in roots and shoots

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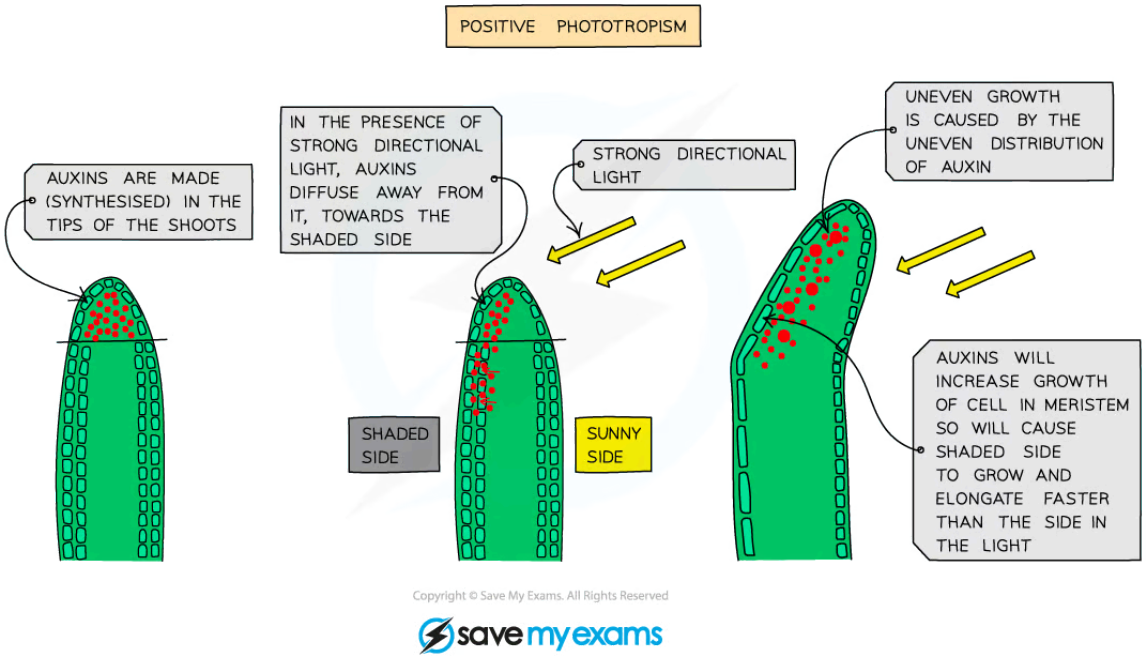
- If light shines on a growing shoot from all directions, auxin is distributed **evenly** throughout the shoot and the cells in the shoot grow at the **same rate** - this is what normally happens with plants growing outside
- When light shines on the shoot **predominantly from one side**, the auxin produced in the shoot tip concentrates on the **shaded side** of the shoot, 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**



Positive phototropism in plant shoots is a result of auxin accumulating on the shaded side of a shoot

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Using Plant Hormones Commercially

- Plant hormones can be extracted or artificially made and used by gardeners and farmers in horticulture and agriculture to usefully control plant growth to obtain larger yields
- For example, the use of auxins, **ethene** and **gibberellins** commercially has been very beneficial is helping producing food and plants for decoration
- However the everyday use of hormones as weed killers can have a negative effect on biodiversity; as the growth of unwanted but natural plants such as weeds is inhibited
  - Many different species of plants are classed as weeds commercially, but to other organisms they are a food source and potential habitat, so destroying them can have negative effects on other organisms in the ecosystem

Auxins

- Auxins can be used as **selective weed killers**; negatively affecting the growth of broad-leaved plants which are weeds in comparison to the narrow-leaved grasses and cereals grown as crops for food production (which are desired)
- The growth of weeds is controlled by farmers who don't want their yields to be smaller as a result of competition between crops and weeds for space and nutrients from the soil
  - Selective weedkillers disrupt the growth of weeds only, causing them to die
  - However once applied to a crop their spread cannot be controlled, and they could affect other plant species negatively
- If a gardener or farmer wants to easily and cheaply produce lots of clones of a desirable plant, then they can take **cuttings** of the plant and dip the tips in auxins which are sold as '**rooting powders**' as they encourage the rapid development of roots
- The same principle as above can be used to clone plants in the lab; auxins in this way are used to **promote growth** in **tissue culture** where scrapings of cells can be taken from a desirable plant and used to produce clones in a petri dish that are then planted and allowed to grow in soil

Ethene

- Ethene is used in the food industry to **control ripening** of fruit during storage and transport
- It is far more effective to transport unripe fruit, as ripe fruit is softer and therefore more easily damaged and spoiled

- The production of **ethene** can be inhibited to delay ripening of fruits in storage; this can either be achieved directly by adding chemicals that prevent ethene from being produced, or by reacting ethene in the air around fruit with substances that can remove it
- When ripening needs to be encouraged (eg. when fruit is in the supermarket), artificially produced ethene gas can be released to speed up the process


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Gibberellins

- **Gibberellins** can be used to:
  - **End seed dormancy** - a high concentration of gibberellin, promotes seed germination. Gibberellin levels naturally rise after a period of dormancy (exposure to cold and dry conditions) - usually, dormancy ends with an intake of water into the seed and warmer weather
  - **Promote flowering** - regardless of the weather conditions the plant is in
  - **Increase fruit size** - higher levels of gibberellin promote the development and growth of fruit
  - Produce **seedless** fruit - normally, fruit with seeds in the middle only grows on flowering plants that have been pollinated. If gibberellins are applied to the unpollinated flowers of some plants, the fruit grows but no seeds develop within it