

# GCSE 9-1 Biology Revision Topic 6 – plant structures and their functions (paper 2)

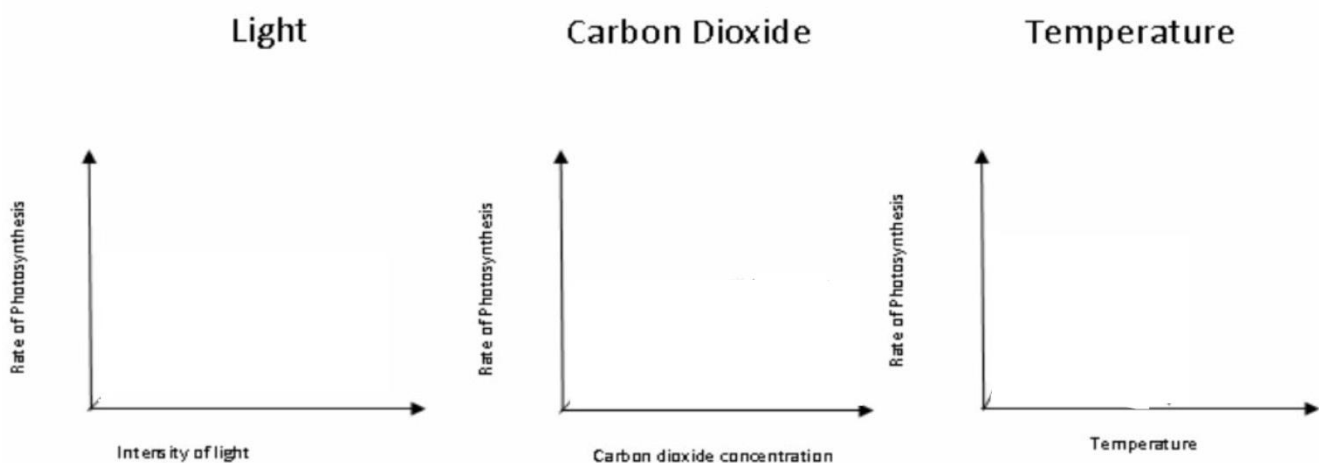
## Photosynthesis

Equation:

Where does the carbon dioxide come from?  
Where does the water come from?  
What can a plant make from the glucose?  
What process in the plant uses glucose?

How does it enter the leaf?  
Where does it enter the plant?      How?

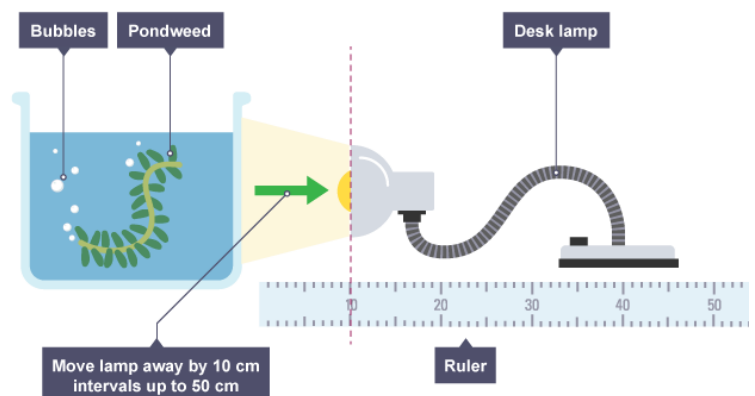
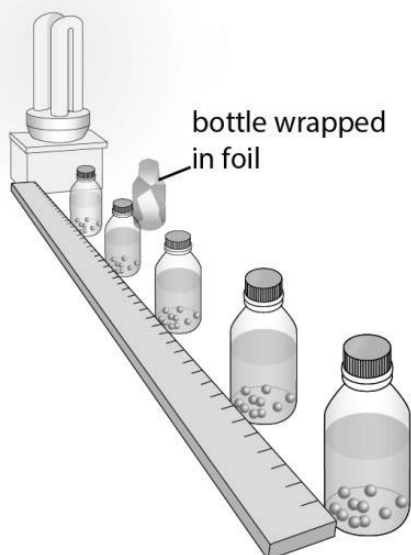
Limiting factors of photosynthesis = any factor when in short supply limits the rate of photosynthesis  
*Complete these graphs:*



On each graph state what the limiting factor(s) is at each point of your graph

### Core practical – effect of light intensity on the rate of photosynthesis

You investigated the effect in algae wrapped in alginate to form algae balls. Algae photosynthesize and are unicellular, so all cells in the balls photosynthesize unlike a leaf. You monitored the photosynthesis by changes in colour of hydrogen carbonate indicator which is sensitive to changes in the produced gas \_\_\_\_\_. You could be asked questions on this method or on pond weed where oxygen production is monitored (see diagrams below):



In both experiments what is the independent variable?

What is the dependent variable in the algae balls method?

Hydrogen carbonate indicator is red in atmospheric air, it becomes orange/yellow with a decreasing pH (more acidic) and it changes through magenta to deep purple with an increasing pH (more alkaline). Carbon dioxide is acidic, so if the algae balls are photosynthesizing more what happens to the colour of the hydrogen carbonate indicator?

What is the dependent variable in the pond weed method?

What is a suitable control for both?

Why is a beaker of water put in front of the lamp for this experiment?

What happens to the rate of photosynthesis with increasing distance (and decreased light intensity) of the lamp?

What piece of equipment could you use to measure the actual light intensity from the bulb?

### Calculating light intensity – the inverse square law

Light intensity can be calculated using this formula.

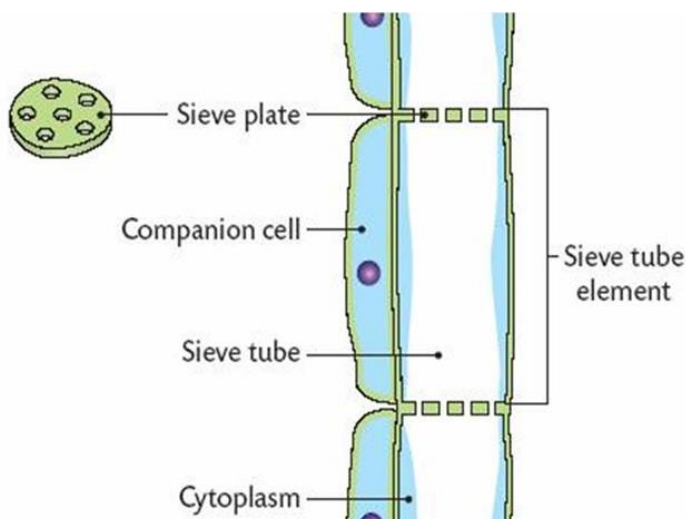
$$\text{Light intensity} \propto \frac{1}{\text{Distance}^2}$$

Therefore, when the light is 20 cm from the plant, it will receive  $\frac{1}{0.2^2} = 25$  arbitrary units

But when the light is 40 cm from the plant, what is the light intensity?

### Plant transport

In plants sucrose, amino acids and hormones are transported in the \_\_\_\_\_ vessel (made of \_\_\_\_\_ tube elements) and can be transported \_\_\_\_\_ and \_\_\_\_\_ the plant, this is called **translocation**. The sucrose (made of glucose and fructose) is produced from \_\_\_\_\_ in the leaves (mainly in the \_\_\_\_\_ mesophyll cells). The sucrose enters the sieve tube elements by \_\_\_\_\_ transport. The \_\_\_\_\_ cells that lie alongside the sieve tube elements contain many \_\_\_\_\_ that provide the energy (from \_\_\_\_\_) for the active transport of sucrose.



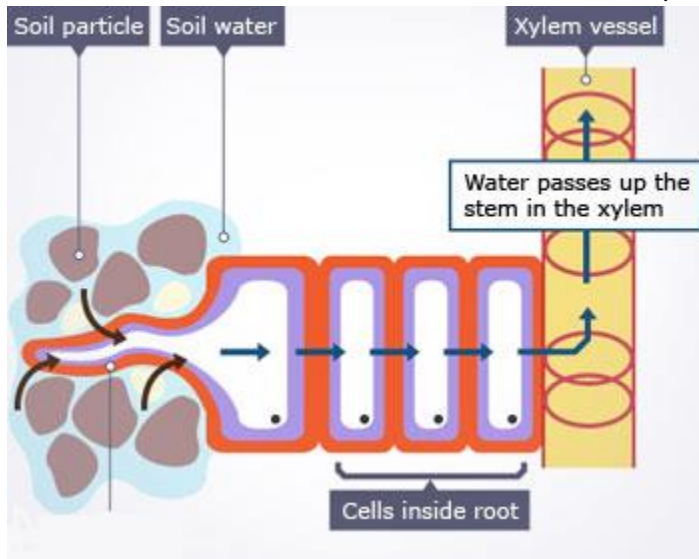
The sieve tube elements contain a little \_\_\_\_\_ along the edges and very few organelles, this creates more \_\_\_\_\_ for the sucrose to flow from high to \_\_\_\_\_ pressure. For examples from the leaves in summer down to the \_\_\_\_\_ for storage as \_\_\_\_\_ (eg in potatoes).

Question:

If a plant is provided with radioactive carbon as CO<sub>2</sub>, why will the radioactivity be detected in the phloem?

Which way will the contents of phloem flow in a germinating seed?

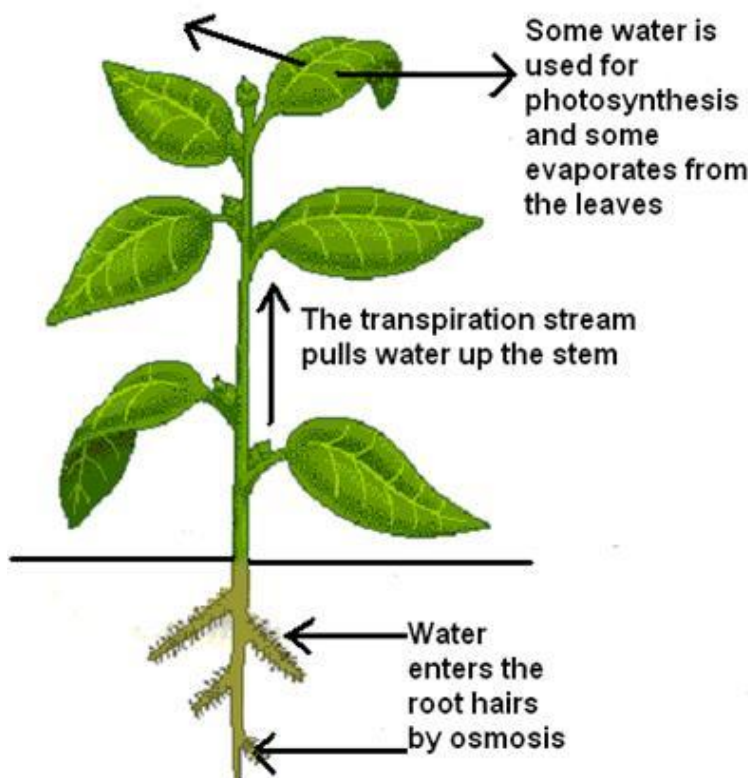
In plants mineral ions are taken up by \_\_\_\_\_ and water is taken up by \_\_\_\_\_ in the \_\_\_\_\_ cells. These cells are adapted by having:



Why do plants need water?

Xylem vessels transport water and the soluble mineral ions up the root and stem to the leaves due to the **transpiration stream**:

- Transpiration = loss of water vapour from the surface of leaves (usually through the \_\_\_\_\_)
- Xylem vessels form a continuous \_\_\_\_\_ from the roots to the leaves
- In the air spaces of a leaf the water \_\_\_\_\_ into water \_\_\_\_\_
- The water vapour leaves the stomata by \_\_\_\_\_ (from high to a low concentration in the atmosphere)
- The loss of water in the leaves causes \_\_\_\_\_ pressure and the roots maintain the \_\_\_\_\_ pressure by more water being absorbed by the roots, so the water keeps moving from high to low pressure up the xylem



**The transpiration rate can be increased by:**

Air temperature that is \_\_\_\_\_ (this means there is more evaporation of water into water vapour)

Humidity that is \_\_\_\_\_ (maintains the diffusion gradient)

An increase in \_\_\_\_\_ (to blow away the water vapour)

Leaf size - \_\_\_\_\_ leaves  
\_\_\_\_\_ and bigger stomata

Transpiration is stopped when the stomata \_\_\_\_\_, this prevents a plant from wilting.

More leaves = greater \_\_\_\_\_ \_\_\_\_\_ for transpiration to occur from

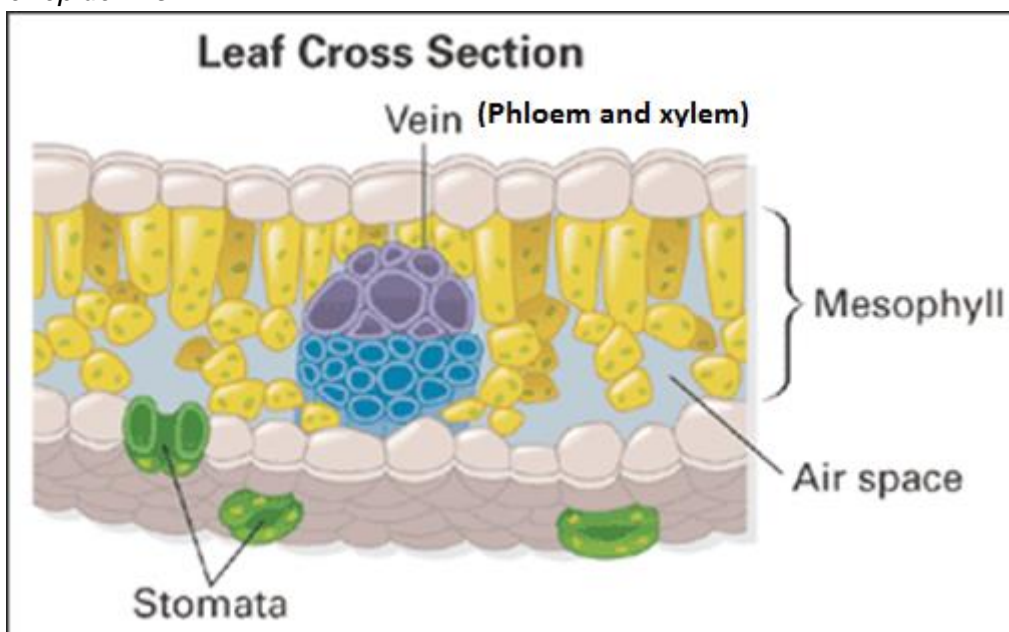
Quicker uptake of water in the roots eg extensive roots

How is the xylem and phloem adapted to its function – decide if each feature is for xylem or phloem

Made of dead cells	Made of living cells
Has companion cells that are alongside the continuous tube	Flows upwards from roots only
Made of sieve tube elements, which have very little cytoplasm and a few organelles, so more space for fluid to flow	Flows up or down depending on pressure
Contents enter by osmosis	Contents enter tube by active transport
Contains sucrose, amino acids	Contains water and mineral ions
The lignin in cell walls makes the continuous tube is waterproof and strong	No cytoplasm or organelles, so more space for fluid to flow
No end walls forming a long tube	Pits (holes) in the walls to allow sideways movement of water eg if a blockage

### Looking at leaf structure

Add onto the diagram: palisade mesophyll cell, spongy mesophyll, guard cells, waxy cuticle, upper epidermis, lower epidermis

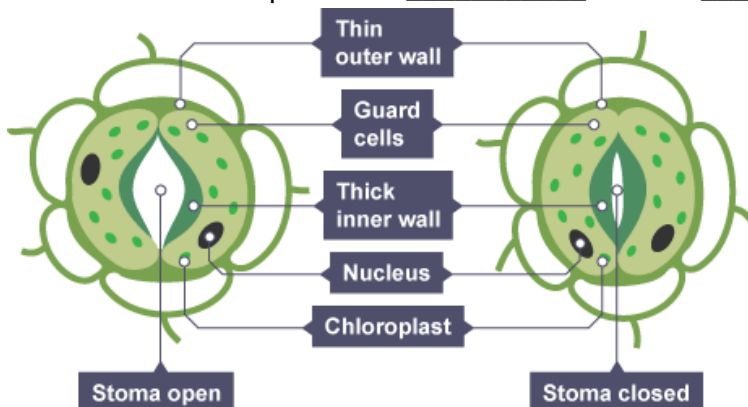


Now add on arrows to show which way the water vapour moves, the carbon dioxide and oxygen through the stomata

### Adaptions of leaves:

Large surface area to absorb more \_\_\_\_\_ and \_\_\_\_\_. Chloroplasts contain \_\_\_\_\_ to absorb the light (most chloroplasts are found in the \_\_\_\_\_ cells, closer to the upper epidermis). Thin leaves allow \_\_\_\_\_ to penetrate through cells quickly. Air spaces to allow \_\_\_\_\_ and \_\_\_\_\_ to diffuse to/from cells. \_\_\_\_\_ to provide water. \_\_\_\_\_ to take away the glucose as \_\_\_\_\_ to transport to other cells. Leaves are held upright due to \_\_\_\_\_ and petiole.

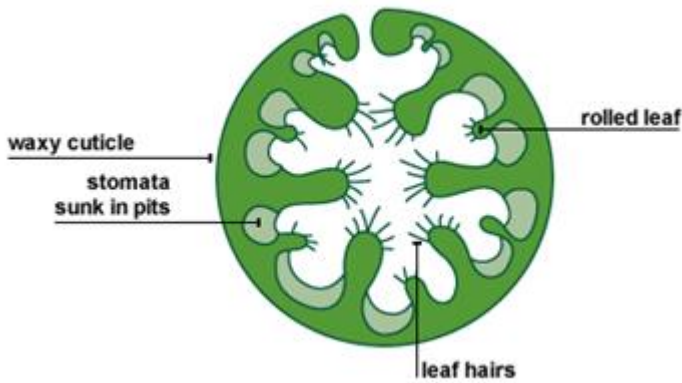
- Stomata that can open in the \_\_\_\_\_ to allow \_\_\_\_\_ entry and close in the \_\_\_\_\_



when \_\_\_\_\_ is not required as no photosynthesis is happening. Guard cells have a thicker cell \_\_\_\_\_ on the \_\_\_\_\_ surface, so when they swell due to entry of \_\_\_\_\_ by \_\_\_\_\_ causing the stomata to open. On losing water by \_\_\_\_\_ the guard cells become flaccid and the stomata \_\_\_\_\_

## Leaf adaptations

Leaves in a dry environment are adapted to minimise loss of \_\_\_\_\_. This is a diagram of marram grass found on sand dunes



How does each labelled feature minimise water loss?

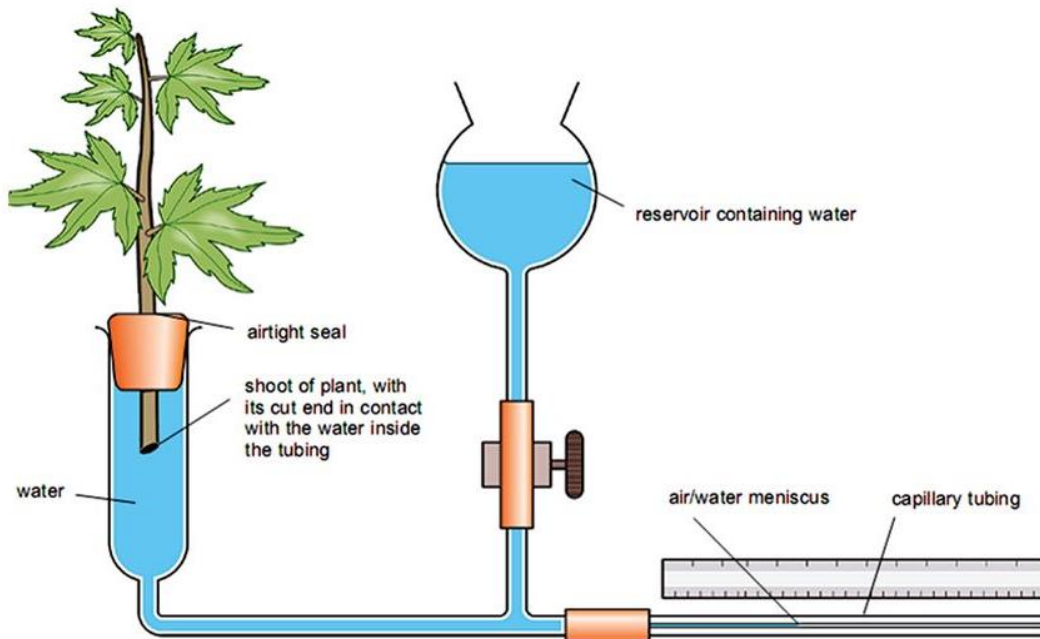
Plants in tropical areas with high rainfall but a very dense tree canopy which reduces the light intensity are adapted in different ways:

Leaf size is

Stems and leaves

Leaf drip trips causes

## Measuring transpiration and calculating the rate with a potometer



Which way does the air/water meniscus move when the plant is doing transpiration?

If the meniscus moves a distance of 54mm in 5 minutes and the internal diameter of the circular tube is 1mm, calculate:

The volume of water taken up by the plant

Then calculate the rate of transpiration

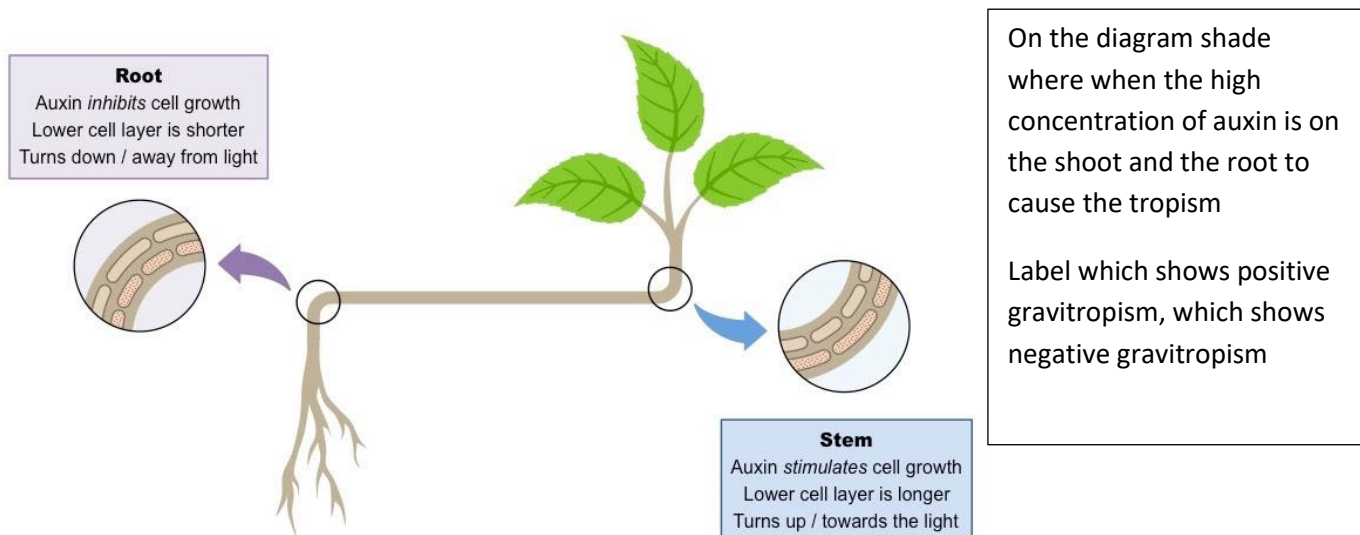
## Plant hormones

The responses of a plant to stimuli are called **tropisms** as it causes a directional growth of the plant.

It is caused by an uneven distribution of **hormones** called **auxins** which causes **unequal cell elongation (growth)** of the plant shoot or root.

Auxins are produced in the growing tips of shoots and roots in plants. They move by \_\_\_\_\_ through cells.

A common exam question will ask you to interpret experimental data on gravitropism/geotropism or phototropism and explain the result



Stimulus	Root response	Shoot response	Reason for response
Light  <b>Phototropism</b>	N/A	Auxins produced in the <b>tip</b> of the shoot diffuses away from light and a higher concentration on <b>side of shoot away from the light</b> (the dark side) stimulates faster cell elongation and shoot bends and grows towards the light  <b>= Positive phototropism</b>	To keep leaves exposed to the maximum light intensity for greater _____, producing more _____ that can be used for _____ providing energy to the cells
Gravity  <b>Gravitropism / geotropism</b>	Auxins produced in the root cap diffuse and <b>collect on the lower side of the root and inhibit cell elongation</b> so root grows faster on upper side and grows downwards against gravity  <b>= Positive gravitropism (or geotropism)</b>	Shoots grow _____ from gravity and will grow upwards	To keep the roots in the soil anchoring the plant.  Allow roots to absorb more _____ by osmosis (this is needed for photosynthesis and to stop wilting) and mineral ions by _____ transport (eg nitrates for _____ synthesis, for growth, magnesium ions for _____ production)

**Gibberellins** are another hormone in plants – they cause stems to grow, so the plant is taller, seed germination, fruit production and flowering

**Commercial use of plant hormones** – plant hormones can be made synthetically and used commercially

- **Rooting hormone** - plant cuttings can be dipped in auxins to stimulate root production creating clones of the parent plant quickly and cheaply
- **To control the ripening of fruit** – ethene a gas can be exposed to unripe fruits such as bananas to ripen them ready to sell, most fruit is picked unripe, shipped and then ripened
- **To produce seedless fruits** – gibberellins can be sprayed on plants which tricks them into thinking they have been pollinated so they mature the ovary which becomes the fruit that doesn't have seeds (a seed is a fertilised ovule which requires pollination to occur first)
- **Selective weed killers** – by spraying auxins on weeds that have broad leaves it makes them grow rapidly and become spindly, causing their collapse and death. This reduces competition in a crop for space, light, mineral ions, water etc so the yield can then be greater without the weeds.

**Past paper questions – mark schemes all on moodle**

B1 sample paper Q5

**\*(c) Explain how phototropism and geotropism affect the development of plants so they can grow more successfully.**

**(6)**

**B1 march 2013 Q5**

**\*(c) Fruit ripening is one use of plant hormones.**

**Describe the other uses of plant hormones in crop production.**

**(6)**

**B2 additional sample Q5**

**\*(ii) The wilted *Coleus* plant was observed to recover more quickly than a wilted *Begonia* plant when they were both watered.**

**Explain this observation.**

**(6)**

**B2 june 2013 Q6**

**\*(b) Explain how water, glucose and mineral salts are transported through a plant.**

**(6)**

**B2 june 2014 Q6**

**\*(c) Explain how active transport and diffusion provide a plant with named substances it needs for growth.**

**(6)**

**B2 june 2016 Q6**

**\*(c) Explain how water enters a plant and is moved to the leaf.**

**(6)**