Edexcel Biology GCSE

Topics 6.7 to 6.14B - Transport in plants

Flashcards

Why do plants require water? (3)

Why do plants require water? (3)

- Photosynthesis
- Maintenance of structure (turgidity)
- Cooling effect

Why do plants require mineral ions?

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For growth e.g. nitrates are required to produce proteins

Which structure in plants is adapted for the uptake of water and minerals?

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Root hairs

How is water transported into root hairs?

How is water transported into root hairs?

- Lower concentration of water in root hair cells than in the soil
- Water diffuses down its concentration gradient into root hair cells by osmosis

How are minerals transported into root hairs?

How are minerals transported into root hairs?

- Lower concentration of mineral ions in the soil than in the root
- Root hair cells take up mineral ions by active transport

Outline how plant roots are adapted for the absorption of water and minerals

Outline how plant roots are adapted for the absorption of water and minerals

Plant roots are composed of millions of root hair cells which have:

- Long hairs that extend from the cell body, increasing the surface area for absorption
- Many mitochondria which produce ATP for active transport of mineral ions

Name the two plant transport tissues

Name the two plant transport tissues

Xylem

Phloem

What is the function of the xylem?

What is the function of the xylem?

Transports **water** and **minerals** up the plant, from the roots to the leaves via the transpiration stream

Describe how the xylem is adapted to its function

Describe how the xylem is adapted to its function

- Composed of dead cells laid end-to-end to form a long, hollow, continuous column
- No end walls which provides little resistance to the passage of water
- Thick cell wall strengthened with lignin to provide support

What is the function of the phloem?

What is the function of the phloem?

Transports **sugars** up and down the stem from photosynthetic tissues (e.g. mature green leaves) to non-photosynthetic tissues (e.g. developing seeds) via translocation

What are the two cell types that make up the phloem?

What are the two cell types that make up the phloem?

Sieve tube elements

Companion cells

Describe how the phloem is adapted to its function

Describe how the phloem is adapted to its function

- **Sieve tube elements** are long, thin cells, laid end-to-end with perforated end plates to enable the flow of sugars. They contain no nucleus and little cytoplasm to allow sugars to flow easily.

- **Companion cells** (adjacent to sieve tube elements) contain a dense cytoplasm, nucleus and mitochondria. They provide energy for processes in both cell types.

What is transpiration?

What is transpiration?

The loss of water vapour from the parts of a plant exposed to the air due to evaporation and diffusion

Where does the majority of transpiration take place?

Where does the majority of transpiration take place?

Leaves

Describe the process of transpiration

Describe the process of transpiration

- Water evaporates from the mesophyll cell surfaces and diffuses out of the stomata
- Water molecules (which have cohesive properties) are drawn up the xylem vessels to replace the water that has been lost
- This causes more water molecules to be absorbed from the soil into root hair cells

How does the transpiration stream transport mineral ions?

How does the transpiration stream transport mineral ions?

Mineral ions are dissolved in the water that is carried by the transpiration stream

What are stomata?

What are stomata?

They are pores found in the lower epidermis of a leaf which allow gas exchange

What are guard cells?

What are guard cells?

Specialised cells surrounding the stoma that change shape to control the size of the pore

How do guard cells control the size of stomata?

How do guard cells control the size of stomata?

To open the stomata:

Water enters guard cells. They swell and become turgid. They bend and draw away from each other, opening the stomata.

To close the stomata:

Water leaves guard cells. They become flaccid, closing the stomata.

What factors affect the rate of transpiration? (3)

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- Light intensity
- Temperature
- Air movement

Describe how high light intensity affects the rate of transpiration

Describe how high light intensity affects the rate of transpiration

- High light intensity, greater number of stomata open to allow gas exchange for photosynthesis
- Rate of photosynthesis increases so more water is taken up from the soil, pushing water up the xylem
- More water vapour diffuses out of the stomata
  ∴ rate of transpiration increases

Describe how low light intensity affects the rate of transpiration

Describe how low light intensity affects the rate of transpiration

At a low light intensity, fewer stomata are open so the rate of transpiration decreases.

Describe how temperature affects the rate of transpiration

Describe how temperature affects the rate of transpiration

- Temperature increases, water molecules have more KE so rate of diffusion increases
- Photosynthesis also increases so more water is taken up from the soil, pushing water up the xylem
- More water vapour diffuses out of the stomata
  ∴ rate of transpiration increases

Describe how air movement affects the rate of transpiration

Describe how air movement affects the rate of transpiration

- Air movement increases, high water concentration gradient maintained between the air spaces in the leaf and atmosphere
- Increased rate of diffusion of water molecules out of the stomata
- Rate of transpiration increases

What apparatus is used to measure the rate of transpiration?

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Potometer

What is assumed when measuring the rate of transpiration using a potometer?

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rate of water uptake ≈ rate of transpiration

How can the rate of transpiration be calculated using a potometer?

How can the rate of transpiration be calculated using a potometer?

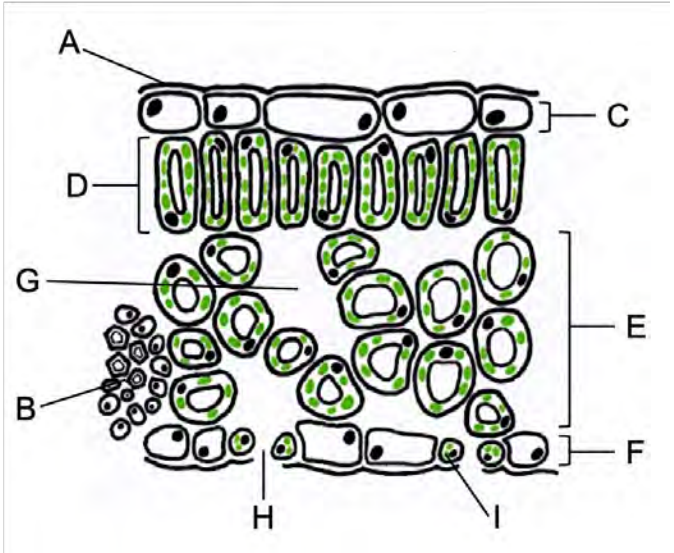
$$\text{rate of transpiration} = \frac{\text{distance moved by bubble}}{\text{time taken}}$$

What is translocation?

What is translocation?

The movement of sugars (sucrose, amino acids etc.) up and down a plant, from the source to the sink, via the phloem. Requires ATP

Identify the structures of the leaf labelled in the diagram below



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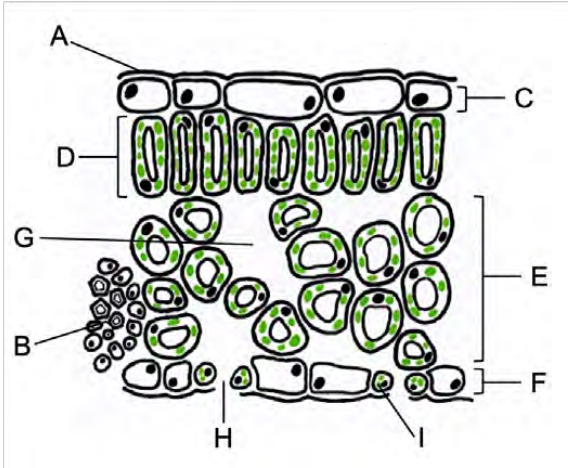

A	waxy cuticle	**F**	lower epidermis
B	vascular bundle	**G**	air-filled space
C	upper epidermis	**H**	stoma
D	palisade mesophyll tissue	**I**	guard cell
E	spongy mesophyll tissue		

Describe how **leaves** are adapted for photosynthesis (biology only)

Describe how **leaves** are adapted for photosynthesis and gas exchange (biology only)

- **Broad** - large SA for light absorption
- **Thin** - short diffusion distance for gases, allows light to reach all cells
- **Vascular bundles** (xylem and phloem) form a network to deliver water and remove glucose. Also provide support.
- Photosynthetic pigments (e.g. chlorophyll) absorb light

Describe how **tissues** of the leaves are adapted for photosynthesis and gas exchange (biology only)

Describe how **tissues** of the leaves are adapted for photosynthesis and gas exchange (biology only)

- **Palisade mesophyll layer** - receives most light so contains greatest concentration of chloroplasts
- **Upper epidermis** - transparent, allows light to reach palisade layer
- **Spongy mesophyll layer** - air spaces increase the rate of diffusion
- **Lower epidermis** - contains many stomata for gas exchange

Describe how plants are adapted to live in hot, dry conditions (biology only)

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- **Small leaves/spines** - reduce SA for water loss
- **Thick waxy cuticle** - reduces evaporation, conserving water
- **Thick stem** - provides a storage of water
- **Shallow but widespread roots** - large SA to absorb water
- **Stomata sunken in pits** and **leaves curled** - reduces air flow, lowering diffusion gradient and reducing water loss by evaporation
- **Stomata close** to reduce water loss