CAIE Biology A-level

Topic 7: Transport in Plants

Flashcards

Define dicotyledonous.

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Plants that produce seeds that contain two cotyledons. They have two primary leaves.

Why do plants require a transport system?

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- To ensure all cells receive a sufficient supply of the nutrients they require
- Especially important as a plant must be able to transport substances up their stem, against gravity

What is the xylem?

What is the xylem?

A non-living, heavily lignified plant transport vessel responsible for the transfer of water and minerals from the roots to the shoots and leaves.

What is the phloem?

What is the phloem?

A living plant transport vessel responsible for the transfer of assimilates to all parts of the plant. The phloem consists of sieve tube elements and companion cells.

State what is meant by the term “vascular bundle” in plants.

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The vascular system in dicotyledonous plants. It consists of two transport vessels, the xylem and the phloem.

Relate the structure of the xylem to its function.

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- Long, continuous columns made of dead tissue, allowing transportation of water
- Contains pits which allow sideways movement of water between vessels
- Thickened with a tough substance called lignin which provides structural support

Relate the structure of the phloem to its function.

Relate the structure of the phloem to its function.

- Sieve tube elements transport sugars around the plant
- Companion cells designed for active transport of sugars into tubes
- Plasmodesmata allow flow of substances between cytoplasm of different cells

Describe the arrangement of the vascular bundle in dicotyledonous roots.

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- **Vascular bundle** enable transport as well as structural support
- Xylem vessels arranged in an **X shape** in centre of vascular bundle. This enables plant to withstand various **mechanical forces** such as pulling
- X shape arrangement of xylem vessels is surrounded by **endodermis**, an outer layer of cells which supply xylem vessels with water
- Inner layer of meristem cells known as the **pericycle**

Describe the arrangement of the vascular bundle in dicotyledonous stems.

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- Xylem located on inside in **non-wooded plants** to provide support and flexibility to stem
- Phloem found on outside of vascular bundle
- Layer of **cambium** in between xylem and phloem. This is made of meristem cells which are involved in production of new xylem and phloem tissue

Describe the arrangement of the vascular bundle in dicotyledonous leaves.

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- Vascular bundles form the **midrib and veins** of a leaf
- **Dicotyledonous** leaves have a network of **veins**, starting at midrib and spreading outwards which are involved in transport and support

Draw a labelled diagram of the arrangement of the vascular bundle in the root and stem of dicotyledonous plants.

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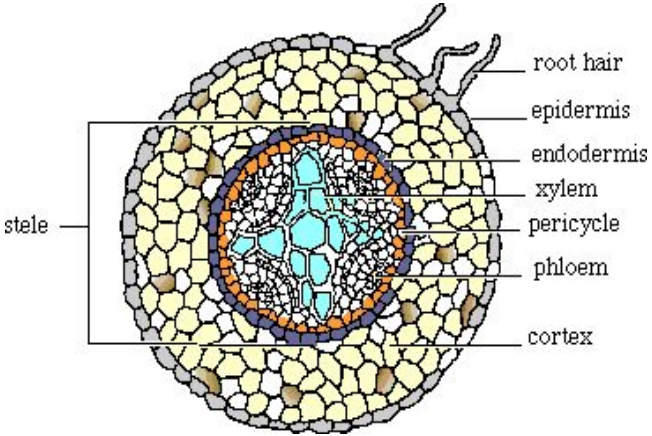
Root



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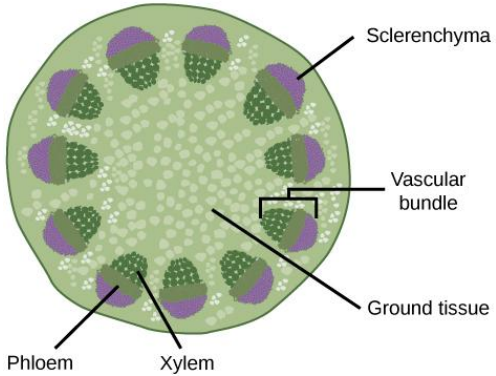
Stem



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State the importance of water potential (ψ) in the movement of water from roots to shoots.

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- Water moves down a ψ gradient
- Roots have a high concentration of minerals. Water moves from the soil into the root, down its ψ gradient
- ψ decreases as you move up the plant. This results in a ψ gradient, facilitating the movement of water through the plant by osmosis

Define transpiration.

Define transpiration.

- The evaporation of water from the leaves of a plant via open stomata
- Consequence of gaseous exchange. Occurs when the plant opens the stomata to exchange oxygen and carbon dioxide

Name the factors that affect the rate of transpiration.

Name the factors that affect the rate of transpiration.

- Increased **light** increases transpiration
- Increased **temperature** increases transpiration
- Increased **humidity** decreases transpiration
- Increased **air movement** increases transpiration
- **Waxy cuticle** prevents transpiration

How can we measure transpiration rate?

How can we measure transpiration rate?

- Using a **potometer**
- Plant cutting placed in a water-filled tube that contains an air bubble. Rate of transpiration is calculated by measuring the movement of the air bubble over time

Explain what is meant by the apoplastic pathway.

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- One of three pathways by which water and minerals move across the root
- Water moves through intercellular spaces between cellulose molecules in the cell wall
- Water reaches the casparian strip (impermeable layer made of suberin) and is forced through the symplastic pathway

Explain what is meant by the symplastic pathway.

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- One of three pathways by which water and minerals move across the root
- Water enters the cytoplasm through the plasma membrane and moves between adjacent cells via **plasmodesmata**
- To begin this pathway, water must be actively transported into cells

Explain the cohesion-tension theory.

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- Water molecules form hydrogen bonds with each other, causing them to ‘stick’ together (cohesion)
- The surface tension of the water also creates this sticking effect, preventing water slipping down the xylem. As water is lost through transpiration, more can be drawn up the stem from the roots

Define the term xerophyte.

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Plants that are adapted to live and reproduce in dry habitats where water availability is low, e.g. cacti.

Give adaptations of xerophytes that allow them to live in dry conditions.

Give adaptations of xerophytes that allow them to live in dry conditions.

- Small/rolled leaves
- Densely packed mesophyll
- Thick waxy cuticle
- Stomata often closed
- Hairs to trap moist air

State what is meant by “source to sink”.

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The movement of plant assimilates from a producing or storage region, the “source” (e.g. leaves) to a region of requirement, the “sink” (e.g. developing fruits).

Define translocation.

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The bulk movement of organic compounds in plants from sources to sinks via the phloem.

Summarise the mechanism of translocation.

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- Companion cells actively transport H^+ to surrounding tissue, establishing a concentration gradient
- H^+ flows down their concentration gradient via a **cotransporter** (facilitated diffusion) along with **sucrose**
- Sucrose builds up in companion cells and diffuses into sieve tube elements via **plasmodesmata**
- This lowers ψ, causing water to move in from xylem (increasing hydrostatic pressure)
- Assimilates move along sieve tube towards areas of lower hydrostatic pressure (sink). Sucrose diffuses into surrounding cells where it is needed