PLANT STRUCTURE

Content Statements:

B3.1.7 Adaptations for gas exchange in leaves

B3.1.8 Distribution of tissues in a leaf

B3.2.9 Distribution of tissues in a transverse section of the stem of a dicotyledonous plant

B3.2.10 Distribution of tissues in a transverse section of the root of a dicotyledonous plant

PLANT TISSUES

Plants are **autotrophs** and produce their own organic compounds via the process of photosynthesis. The structural organisation of a vascular plant (into distinct tissues and organs) is related to this core function:

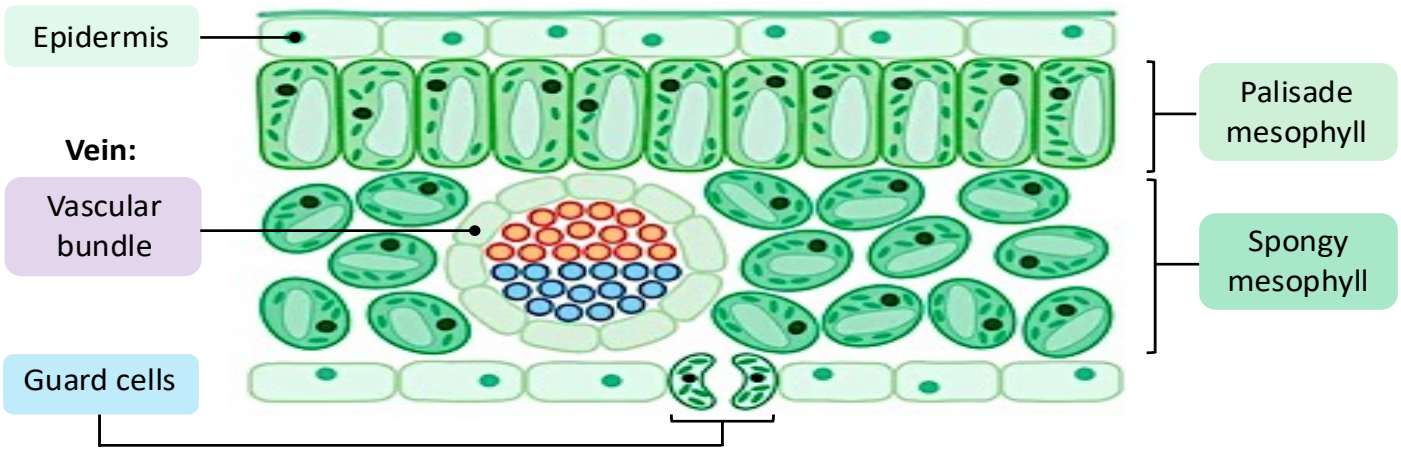
- **Leaves:** Responsible for photosynthesis (contain chloroplasts) and gas exchange (via stomatal pores)
- **Roots:** Responsible for the uptake of inorganic compounds (water and dissolved minerals) from the soil
- **Stems:** Contain vascular bundles (xylem + phloem) for transporting materials between leaves and roots

LEAF TISSUE

The leaves of a plant play a key role in photosynthesis – functioning as the site of both light absorption and gas exchange. Leaves are typically broad, flat and thin to maximise their surface area and most will appear green in colour due to the abundance of the photosynthetic pigment **chlorophyll** – however some leaves may have different colours (or change colour with the seasons) due to the presence of accessory pigments.

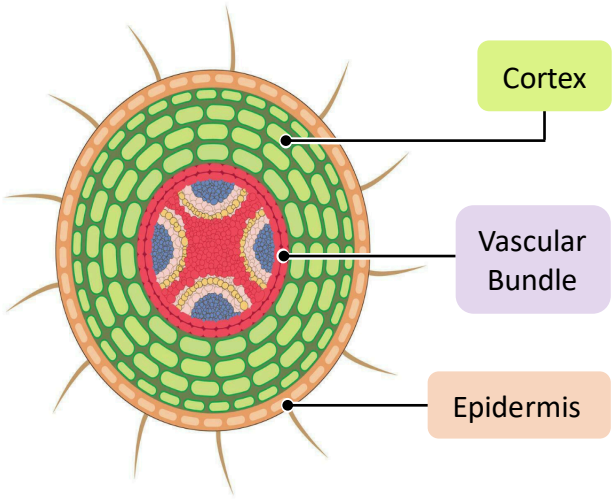
The outer surface of the leaf is composed of a single layer of **epidermal cells**. These cells may be covered by a **waxy cuticle** serving as a hydrophobic barrier to prevent water loss. The underside of a leaf is perforated with many **stomatal pores** to facilitate the exchange of respiratory gases and water vapour. The pores are flanked by **guard cells** which act to regulate the exchange of gases between the leaf tissue and atmosphere.

The leaf interior is composed of a tissue layer called the mesophyll – which is organised into two sections. The upper layer is the **palisade mesophyll** and consists of tightly packed cells containing many chloroplasts (for light absorption). The lower layer is called the **spongy mesophyll** and consists of loosely packed cells with many air spaces (for gas exchange). Leaves are extensively vascularised, with the **veins** made up of vascular bundles containing both xylem and phloem. The **xylem** transports water and minerals from the roots of the plant (via transpiration), while the **phloem** transports dissolved sugars produced by the leaves.



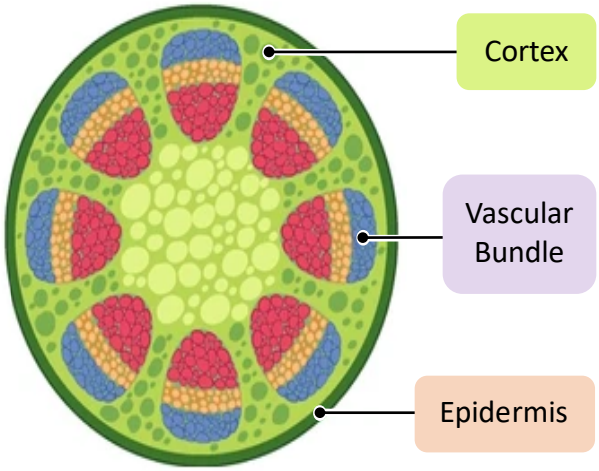
ROOT TISSUE

The roots of a plant form a branched network that is responsible for the absorption of water and minerals in the soil. The **outer epidermis** may have protrusions (root hairs) to maximise surface area. The middle layer is called the **cortex** and primarily functions as a storage site for starch. The innermost layer of **vascular tissue** allows for the transport of materials to other parts of the plant. The xylem is located centrally (red tissue), while phloem is located in outer clusters (blue tissue). A **casparian strip** surrounds the vascular bundle and allows the movement of water to be tightly regulated.



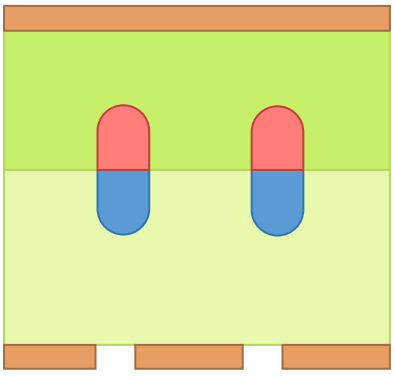
STEM TISSUE

The stem of a plant functions to support and elevate the leaves, flowers and fruits. A stem possesses three main tissue layers organised to optimise the transport of water and nutrients between the leaves and roots. The **epidermis** covers the outer surface and surrounds the inner ground tissue (**cortex** and **pith**). The vascular tissue is arranged into concentric bundles around the outer edge of the stem – the xylem is located on the inner side and the phloem on the outer side. A layer of tissue called the **cambium** separates these tissues and provides undifferentiated cells for lateral growth.

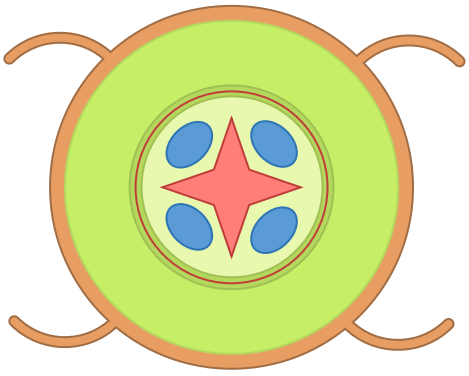


PLAN DIAGRAMS

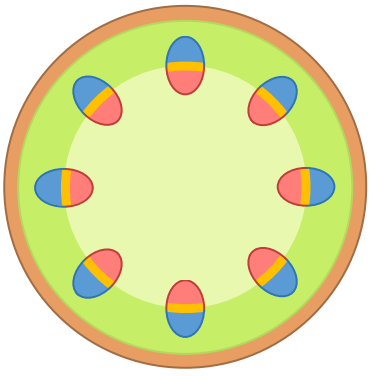
Plan diagrams are drawings of tissues, showing their outlines and relative proportions, without including any cells. Plan diagrams can provide insight into the functions of tissues based on their organisation. For example, the diameter of the cortex and pith could indicate the width of a stem. Meanwhile, the thickness of the spongy mesophyll could indicate if the leaf is specialised for gas exchange or the retention of water. Plan diagrams also show the position of xylem and phloem within the vascular bundles. In the stems and the roots, the xylem is located internally (phl**o**em = **o**utside), while in the leaves it is located on the upper facing side (phl**o**em = l**o**wer). Plan diagrams are intended to be simplistic representations, lacking detail.



Leaf Tissue



Root Tissue



Stem Tissue