Summary

23–1 Specialized Tissues in Plants

The cells of seed plants are organized into different tissues and organs. The three main plant organs are roots, stems, and leaves. These organs are made up of three main kinds of tissues: dermal tissue, vascular tissue, and ground tissue.

Dermal tissue is like the "skin" of a plant. It protects the plant and prevents water loss. Dermal tissue is made up of epidermal cells that have different shapes and functions.

Vascular tissue moves water and nutrients throughout the plant. It consists of xylem tissue and phloem tissue. Xylem tissue moves water. It is made up of two kinds of specialized cells called tracheids and vessel elements. Phloem tissue moves sugars. It consists of sieve tube elements and companion cells.

Ground tissue is made up of all the cells that lie between dermal and vascular tissues. Ground tissue is made up mostly of parenchyma cells. Parenchyma cells have thin cell walls and function in photosynthesis and storage. Collenchyma and sclerenchyma cells are also part of ground tissue. These cells have thick cell walls that help support the plant.

A fourth kind of tissue is responsible for plant growth. Meristematic tissue produces new cells by mitosis. These new cells have not yet become specialized for specific functions. As the new cells mature, they develop specialized structures and functions, a process called differentiation. Meristematic tissue is found at the tips of stems and roots.

23–2 Roots

As soon as a seedling begins to grow, it sends out a primary root. Other roots branch out from the primary root. They are called secondary roots.

In some plants, the primary root grows long and thick. The secondary roots stay small. This kind of primary root is called a taproot. In other plants, secondary roots grow and branch. The roots of these plants are called fibrous roots.

Roots are made up of cells from the four tissue systems—dermal, vascular, ground, and meristematic. A mature root has an outside layer of dermal tissue called the epidermis. It also has a central cylinder of vascular tissue called the vascular cylinder. Between these two tissues lies ground tissue, which is called the cortex. A thin layer of cells called the endodermis completely surrounds the vascular cylinder, separating it from the cortex. An apical meristem in the root causes it to grow in length.

Roots have two functions. One function is to anchor a plant in the ground. The other function is to absorb water and dissolved nutrients from the soil.

Once absorbed by the root hairs, water and nutrients move inward through the cortex. After passing through the endodermis into the vascular cylinder, the water cannot leave. This causes pressure to build up. This pressure is called root pressure. Root pressure forces water upward through the xylem toward the stem. In short plants, root pressure can push water up to the leaves. In tall plants, root pressure alone is not enough.

23–3 Stems

Stems have three important jobs. They produce leaves, branches, and flowers. They hold leaves up to the sunlight. They also carry water and nutrients between roots and leaves.

The arrangement of tissues in a stem differs among seed plants. In monocots, vascular bundles are scattered throughout the stem. In dicots and most gymnosperms, vascular bundles are arranged in a ring. These vascular bundles contain xylem and phloem tissue.

Plant stems can grow in two different ways. They have primary growth and secondary growth. In primary growth, stems grow longer as meristematic tissue at the ends of the stems produce new cells. In secondary growth, a stem grows wider as meristematic tissue on its sides produces new cells. This growth produces wood and bark. Only plants with woody stems have secondary growth.

23–4 Leaves

The leaves of a plant are its main organs of photosynthesis. In photosynthesis, plants make food. Sugars, starches, and oils made by plants provide food for all land animals.

Leaves have a structure that enables them to absorb light and make food. Most leaves have thin, flattened sections called blades to collect sunlight. Most leaves are also made up of a specialized ground tissue called mesophyll. Mesophyll cells have many chloroplasts. It is in these cells that the process of photosynthesis occurs.

Xylem and phloem tissues in leaves are gathered in bundles called veins. These veins are connected to the xylem and phloem in the stem.

Plants must exchange gases with the air around them. They can lose a lot of water during this process. Leaves have an adaptation to prevent water loss. They allow air in and out of their waterproof covering only through small openings called stomata.

23–5 Transport in Plants

Xylem tissue forms tubes that stretch from roots through stems and out into leaves. Root pressure forces water and nutrients into the xylem. Other forces pull water and nutrients through the plant.

Water can be pulled up through xylem because its molecules are pulled together by a force called cohesion. Water molecules are also attracted to other molecules. This force is called adhesion. Together, cohesion and adhesion cause water to move upward. This movement is called capillary action.

Capillary action is too weak to pull water up the xylem tubes in a large plant. Another force pulls water up to the leaves. It is called transpiration pull. Transpiration pull happens because water moves from areas where there is plenty of water to areas where there is little water. When water evaporates from leaves, water is drawn upward from the roots to replace it.

The vascular tissue called phloem transports the sugars made in photosynthesis. Phloem carries sugars from the leaves into the stems and roots. The food is then either used or stored.

Scientists have only formed hypotheses to explain how phloem transport happens. One hypothesis is called the pressure-flow hypothesis. This hypothesis explains that sugars move from areas of high concentration to areas of low concentration. When sugars are pumped into or removed from phloem, the change in concentration causes a movement of sugars in that same direction.