Chapter 12 Introduction to Plants

The Big Idea Plants have several common characteristics and can be classified by their structures.

Section 1 What Is a Plant?

Key Concept Most plants perform photosynthesis, reproduce, and share some physical characteristics.

Plant Characteristics

- Plants are a diverse kingdom of organisms, yet all plants share four basic characteristics.

Cuticles

- The cuticle is a waxy layer that covers the outer surfaces of plants. It helps retain moisture and protects the plant from drying out.

- Plants that live in dry environments have a thicker cuticle than plants that live in moist environments.

Photosynthesis

- Plants are able to make their own food by using energy from sunlight to convert water and carbon dioxide to sugar.

- Photosynthesis takes place in the chloroplasts of plant cells. These organelles contain the green pigment chlorophyll.

- Because plants produce their own food, they are called *producers.*

Cell Walls

- Plants lack a rigid internal skeleton. Their strength and support comes from the rigid cell walls that surround each cell.

- The cell wall is formed of carbohydrates and other materials.

- When mature, some cells form a secondary cell wall. This thick wall provides support but prevents further cell growth.

Review Tip

Drawing Draw one or several pictures to represent the structure of plants.

Reproduction

- Plants have two stages in their life cycle--the sporophyte stage and the

gametophyte stage.

- The sporophyte produces spores. Under proper conditions, the spores grow into the gametophyte.
- The gametophyte produces egg and sperm, which unite during sexual reproduction to produce a new sporophyte.
- The sporophyte stage is often much larger than the gametophyte stage.
- Most plants are also able to reproduce asexually.

Plant Classification

- Plants can be classified into four main groups.

Nonvascular Plants

- A **nonvascular plant** lacks the specialized tissues to move water and nutrients through the plant.
- Nonvascular plants must move water and nutrients through diffusion. For this reason, nonvascular plants remain small.

Vascular Plants

- A plant that has tissues to deliver water and nutrients form one part of the plant to another is called a **vascular plant.**
- There are three groups of plants with vascular tissue: the seedless vascular plants, the nonflowering seed pants, and the flowering seed plants.
- Nonflowering seed plants are called **gymnosperms.** Flowering plants that produce seeds within fruit are called **angiosperms.**
- Because vascular tissues can move water and nutrients to any part of the plant, some vascular plants are able to reach great size.

The Origin of Plants

- Due to many similarities, most scientists think that green algae and plants share a common ancestor.
- Like plants, green algae are photosynthetic. Both groups of organisms have the same type of chlorophyll, store energy as starch, and have similar cell walls.
- Both green algae and plants have a two-stage life cycle.

Section 2 Seedless Plants

Key Concept Seedless plants do not produce seeds but are well adapted for reproduction and survival.

Nonvascular Plants

- Nonvascular plants do not have vascular tissue to transport water and nutrients.
- Each cell of a plant must get water from a nearby cell or from the environment.
- For this reason, nonvascular plants usually grow in damp places and are rather small.
- Nonvascular plants do not have true stems, roots, or leaves. The functions of these organs are carried out by other structures.
- Nonvascular plants include mosses, liverworts, and hornworts.

Mosses

- Mosses are tiny plants that form large groups, covering rocks, soil, and trees.
- Mosses have leafy stalks and rhizoids. A **rhizoid** is a rootlike structure that holds nonvascular plants in place.
- Rhizoids also help the plants get water and nutrients.
- Mosses reproduce sexually and asexually.
- Like all plants, mosses have a two stage life cycle. During the gametophyte stage, sperm and egg are produced.
- The sperm must swim through a film of water to reach an egg for fertilization.

Liverworts and Hornworts

- Liverworts and hornworts share many characteristics with mosses.
- Liverworts may appear mosslike, or may be broad and flattened. Hornworts have broad, flattened gametophytes.

The Importance of Nonvascular Plants

- Nonvascular plants play an important role in the environment. They are usually the first plants to colonize an area.
- As the mosses grow and die, they decompose to form soil for other

plants. They are also food for some animals.

- Peat mosses are used by humans for fuel and as a soil additive.

Seedless Vascular Plants

- Seedless vascular plants include ferns, horsetails, and club mosses. Vascular tissue allows these plants to reach larger sizes than nonvascular plants.

- In the ancient past, seedless vascular plants were as big as today's trees, growing to 40m and forming forests.

Ferns

- Ferns are adapted to a wide range of conditions. Most are small plants, but some tropical tree ferns reach 24 m.

- Most ferns have a rhizome. A **rhizome** is an underground stem from which new leaves and roots grow.

- The fern sporophyte is the familiar fern plant. The fern gametophyte is much smaller, flat, and heart-shaped.

- Like mosses, ferns rely on water and swimming sperm for fertilization during sexual reproduction. Ferns can also reproduce asexually.

Horsetails and Club Mosses

- Most horsetails are relatively small, although some can reach 8m. They usually grow in wet places.

- Horsetail stems contain silica, which gives them a gritty texture. Pioneers used them to scour pots and pans.

- Club mosses grow in woodlands and may look like tiny evergreen trees. Unlike true mosses, club mosses have vascular tissue.

- Ferns, horsetails, and club mosses have similar life cycles.

The Importance of Vascular Plants

- Like mosses, seedless vascular plants help to form soil and help to prevent erosion.

- Ferns and some club mosses are popular houseplants. Some fiddleheads, or young fern fronds, can be cooked and eaten.

- The remains of ancient ferns, horsetails, and club mosses became coal, and provide much of the world's energy needs today.

Review Tip

Creating Diagrams Create a diagram that shows the relationship between the different groups of plants discussed in this section.

Section 3 Seed Plants

Key Concept Seed plants produce seeds and are categorized as gymnosperms or angiosperms.

Characteristics of Seed Plants

- Seed plants include gymnosperms and angiosperms. All seed plants have three characteristics in common.
- Seed plants produce seeds. Seeds nourish and protect young sporophytes.
- The gametophytes of seed plants are tiny, and form within reproductive structures on the sporophyte.
- Unlike the gametophytes of seedless plants, the gametophytes of seed plants cannot live on their own.

Pollen

- The sperm of seed plants do not need water to reach an egg. They form within structures called **pollen.**
- Pollen is transported by wind or animals.
- Seeds, small dependent gametophytes, and pollen allow seed plants to grow in almost any environment.
- Because of these characteristics, seed plants are the most common plants on Earth today.

The Structure of Seeds

- Seeds are composed of three main parts: the young plant (sporophyte), stored food, and a protective seed coat.
- Much of the seed is stored food, often found in the *cotyledons*, or seed leaves of the young plant.
- Seeds have several advantages over the spores of seedless plants.
- As the young plant within the seed begins to grow, it uses food stored in the seed. Spores do not contain stored food.

- Seeds can often be spread by animals. Spores are only spread by the wind, which is less effective.

Gymnosperms

- Seed plants that do not produce flowers or fruit are called *gymnosperms*.
- Instead of fruits, gymnosperm seeds are usually protected by a cone.
- The four groups of gymnosperms are conifers, ginkgoes, cycads, and gnetophytes.

Types of Gymnosperms

- Conifers are the most economically important gymnosperms. They provide building materials and paper products.
- Sticky resins from pines are used to make soap, turpentine, paint, and ink. Other conifers are used to make drugs.
- Conifers, cycads, and ginkgoes are used in landscaping gardens and parks.
- Conifers are the most familiar gymnosperms. The word *conifer* means "cone bearing."
- Conifers produce gametophytes within their cones. The female gametophytes produce eggs, and the male gametophytes produce sperm within the pollen.

Pollination

- Wind carries the pollen from the male cones to the female cones. This transfer of pollen is called **pollination.**
- A young sporophyte develops from the fertilized egg inside the female cone. A seed develops around the sporophyte.
- The seeds may be released right away, or only under special conditions, as after a fire.

Review Tip

Telling a Story Tell a story about gymnosperms. Be sure to explain how gymnosperms reproduce.

Angiosperms

- Vascular plants that produce flowers and fruit are called *angiosperms.*

- Flowers are the reproductive structures of angiosperms. Some produce pollen to be dispersed by the wind.

- Others angiosperms produce showy flowers to attract animal pollinators. These animals take pollen from flower to flower.

Fruits

- Fruits surround and protect the maturing seeds. Fruits play an important role in spreading the seeds to new sites.

- Some fruits have structures that allow them to be carried by the wind. Other fruits stick to passing animals.

- Many other fruits attract animals. Animals eat the fruits and discard the seeds elsewhere.

Classes of Angiosperms

- Most angiosperms are divided into two classes--the monocots and the eudicots.

- The two classes differ in the number of cotyledons, or seed leaves, found in their seeds. They differ in other ways as well.

- Monocots have one cotyledon. Grasses, orchids, onions, lilies, and palms are monocots.

- Eudicots have two cotyledons. Roses, cactuses, sunflowers, and peas are eudicots.

Benefits of Angiosperms

- Flowering plants are a food source for many land animals. Many consumers eat plants directly. Other consumers eat animals that eat plants.

- Flowering plants are important food crops for people as well, including corn, wheat, and rice.

- Clothing, rope, medicines, rubber, and perfume oils are also made from flowering plants.

Section 4 Structures of Seed Plants

Key Concept Seed plants are made up of roots and shoots. Each part carries out functions for the seed plant.

Roots

- There are two types of vascular tissue that connect all parts of a plant.

- **Xylem** is vascular tissue that transports water and minerals through the plant.

- **Phloem** is vascular tissue that transports food molecules to all parts of a plant.

Transporting Materials Throughout the Plant

- There are three main functions of roots:

- Roots absorb water and dissolved minerals.

- Roots hold plants securely in the soil.

- Roots store surplus food as sugar or starch.

- The layer of cells that covers the surface of roots is called the *epidermis.* Some cells extend from the surface as tiny *root hairs.*

- The root hairs increase the surface area of the root and help absorb water and minerals.

- Roots grow longer at their tips. These tips are protected by the *root cap*, which provides a slime that helps the root push through the soil.

Root Organization

- Roots are organized into one of two systems.

- In a taproot system, a long main root grows downward, reaching water deep underground. Eudicots and gymnosperms usually have taproots.

- In a fibrous root system, several roots of equal size spread from the base of the plant. These roots get most of their water near the surface. Monocots usually have fibrous roots.

Stems

- Stems support the plant body. This helps leaves get sunlight for photosynthesis. By increasing height, stems also help disperse pollen and attract pollinators.

- Stems transport materials between the root system and the leaves and reproductive structures.

- Some stems store materials. For example, cactus stems store water.

Herbaceous and Woody Stems

- Many plants have stems that are soft, thin, and flexible. These stems are called *herbaceous stems*.
- Wildflowers, such as clover and poppies, have herbaceous stems.
- Many crops, such as beans, tomatoes, and corn, have herbaceous stems.
- Trees and shrubs have rigid stems made of wood and bark. These stems are called *woody stems*.
- Plants with woody stems may live many years and produce growth rings of xylem each year.
- Large xylem cells are produced in the warm, wet months. Smaller xylem cells are produced in cooler, dryer months.
- No xylem is produced while the woody plant is dormant, typically in the winter.
- The thicker layer of xylem cells appears lighter, and the thin layer of xylem cells appears darker.
- The alternation of dark and light layers of xylem are called growth rings, and can be counted to determine the age of the plant.

Leaves

- Leaves vary greatly in size and shape.
- Some leaves are specially adapted for functions other than photosynthesis.
- The protective spines of cactuses are modified leaves.
- The sundew has leaves modified to catch and digest insects. The insects provide much needed nitrogen.

Structure of a Leaf

- The structure of leaves is related to their primary function: photosynthesis. The broad surface area of many leaves allows them to capture more sunlight.
- The undersides of leaves contain openings called *stomata*. The stomata allow gasses to flow in and out of the leaf.

- A cuticle covers the outer surface of a leaf. The cuticle prevents the leaf from losing water.

- Most photosynthesis takes place in the middle of a leaf. Here, in the palisade layer, chloroplasts absorb sunlight.

- Beneath the palisade layer is the spongy layer. The spongy layer allows carbon dioxide to reach the palisade layer.

Flowers

- Flowers are structures for sexual reproduction in flowering plants.

- Brightly colored and fragrant flowers attract animals. The animals may visit the flower in search of food.

- Some flowers provide a sweet liquid, nectar, to visiting pollinators. Pollination occurs as the animal moves from flower to flower.

- Not all flowers are showy. Plants that lack showy flowers and fragrances are pollinated by the wind.

Part of a Flower

- There are four basic parts of a flower: sepals, petals, stamens, and pistils. Not all flowers have all four parts.

- Flowers that have all four basic parts are called *perfect flowers*.

- **Sepals** are modified leaves that make up the outer part of a flower. They protect the flower bud while it is growing.

- As the flower matures, the sepals fold back to reveal the petals. **Petals** are broad flat, thin leaf-like parts of a flower.

- Petals vary in color and shape.

Male Reproductive Structures of a Flower

- Flowers that have stamen but no pistils are called male flowers.

- The **stamens** are the male reproductive structures of flowers. Each stamen has a thin stalk called a filament. The filament is topped by the pollen- producing anther.

Female Reproductive Structures of a Flower

- Flowers that have one or more pistils but no stamen are called female flowers.

- At the center of most flowers is one or more pistils. A **pistil** is the

female reproductive structure of a flower.

- The tip of the pistil is called the *stigma*. Pollen grains stick to the stigma during pollination.
- A long slender *style* connects the stigma to the base of the pistil.
- The rounded base of the pistil that contains one or more ovules is called the **ovary.**
- Each **ovule** contains an egg. When the egg is fertilized the ovule develops into a seed. The ovary develops into a fruit.

Importance of Flowers

- Flowers play an important role in pollination and fertilization during the sexual reproduction of angiosperms.
- Flowers are used in many commercial products, such as flower arrangements, teas, spices, perfumes, lotions, and shampoos.
- Some flowers or flower buds are eaten, such as broccoli, cauliflower, and artichokes.

Review Tip

Describing Concepts How would you describe angiosperms? Say or write your description.

Review Tip Wrap-Up

Think about the methods you have used to study the concepts in this chapter. Which types of Review Tips are the most helpful to you? What types of concepts do they help you study? Think about review methods you can use when you are studying.