Before You Read

In your mind, picture different plants that you have seen. Scientists classify living things by their characteristics. On the lines below, write at least four characteristics of plants.

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Read to Learn

Plant Evolution

Plants are necessary for human survival. Much of the oxygen in the atmosphere comes from plants. Humans use plants for food. Many of the things that make our lives comfortable, such as clothing and furniture, come from plants. When you think of a plant, you might picture a tree, a shrub, or a houseplant.

Biologists describe plants as multicellular eukaryotes with tissues and organs. The tissues and organs have specialized structures that perform various functions. For example, most plants have tissues where photosynthesis occurs. Organs such as roots that anchor plants to the soil or to another object also have specific functions.

Primitive land plants first appeared about 400 million years ago. Biochemical and fossil evidence suggests that freshwater green algae have a common ancestor with land plants. Some of these ancient green algae might have been able to survive periods of drought. Through natural selection, these drought-resistant green algae might have passed adaptations to future generations that helped them survive life on land.
What do plants and algae have in common?

Scientists have compared present-day plants and algae. They have found the following common characteristics:

- cellulose cell walls
- the formation of a cell plate during cell division
- similar genes for ribosomal RNA
- food stored as starch
- the same types of enzymes in cellular vesicles.

The evolutionary tree below shows the relationship between ancient freshwater green algae and present-day plants.

**Picture This**

1. **Circle** the name of the ancestor of present-day land plants.

**Plant Adaptations to Land Environments**

Land organisms face many challenges that aquatic organisms do not face. Land organisms must survive with limited water resources. Over time, land plants developed adaptations that helped them survive when water was scarce. Land plants also developed adaptations to other environmental factors.

**What purpose does cuticle serve in land plants?**

Most plant parts that grow above ground have a coating called a cuticle on the outer surface of their cells. The cuticle is formed by wax and fats, which are lipids that do not dissolve in water. It is the wax in the cuticle that gives some plant leaves their gray appearance. The cuticle helps keep water from evaporating from the plant tissues. The cuticle also stops microorganisms from invading the plant.
What structure enables gas exchange?

Most plants carry on photosynthesis. Photosynthesis produces glucose and oxygen from carbon dioxide and water. For photosynthesis to occur, gases need to move between the plant and the environment. If the cuticle reduces water loss, it might prevent the movement of gases.

Stomata (STOH muh tuh) (singular, stoma) are adaptations that enable gas exchange. Stomata are openings in the outer cell layer of leaves and some stems. Most stomata are found in plant leaves, which are the site of most plant photosynthesis.

What are the functions of vascular tissues?

Vascular (VAS kyuh lur) tissue is a specialized transport tissue that is another plant adaptation to life on land. Plants with vascular tissues are called vascular plants. Plants that lack specialized transport structures are nonvascular plants. Water travels from cell to cell in nonvascular plants by osmosis and diffusion.

Vascular tissues provide support and structure to vascular plants. They help substances move faster than in nonvascular plants. Vascular tissues with thickened cell walls allow vascular plants to grow larger than nonvascular plants.

What are the features of a seed?

The evolution of the seed was another adaptation that helped vascular plants succeed on land. A seed is a plant structure that contains an embryo and nutrients for the embryo. The embryo and nutrients are protected by a seed coat. Seeds are adapted to survive in harsh environmental conditions and then sprout when favorable conditions exist.

Alternation of Generations

The life cycle of plants includes two stages, or alternating generations. One generation is the gametophyte generation. The other is the sporophyte generation.

The gametophyte generation produces gametes—sperm and eggs. Sperm and eggs are both haploid cells. Some plants produce both sperm and eggs on one gametophyte. Other plants produce sperm and eggs on separate gametophytes. When the sperm fertilizes the egg, a diploid zygote forms. The zygote goes through mitosis repeatedly to form a multicellular sporophyte.

The sporophyte generation produces spores. The spores can grow to form the next gametophyte generation.

3. Explain how the cuticle and stomata function together.

4. Name the two plant generations.
How is the dominant generation identified?

Depending on the type of plant, one generation is dominant over the other. The dominant generation is larger and more easily seen. For example, the grass growing in a park is the sporophyte generation of the plant. Most plants you see are the sporophyte generation for those plants. The trend in plant evolution was from dominant gametophytes to dominant sporophytes that contain vascular tissue.

Plant Classification

All plants belong to the plant kingdom. Over time, plant adaptations led to a diversity of plant characteristics. Botanists use these characteristics to classify plants into divisions. You will learn more about the characteristics of these divisions in the next three sections.

Division names end in an a. Botanists commonly drop the a from the division name and add es. Therefore, members of division Bryophyta are called bryophytes (BRI uh fites).

The 12 plant divisions are organized into two groups—nonvascular plants and vascular plants. Vascular plants are organized further into plants that produce seeds and plants that do not produce seeds. The basic organization of the plant kingdom is shown below.

Picture This

6. Label on the lines in the chart the ways in which water and other substances are transported in nonvascular and vascular plants.

5. Predict Which generation is dominant in most nonvascular plants? (Circle your answer.)
   a. gametophyte
   b. sporophyte

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