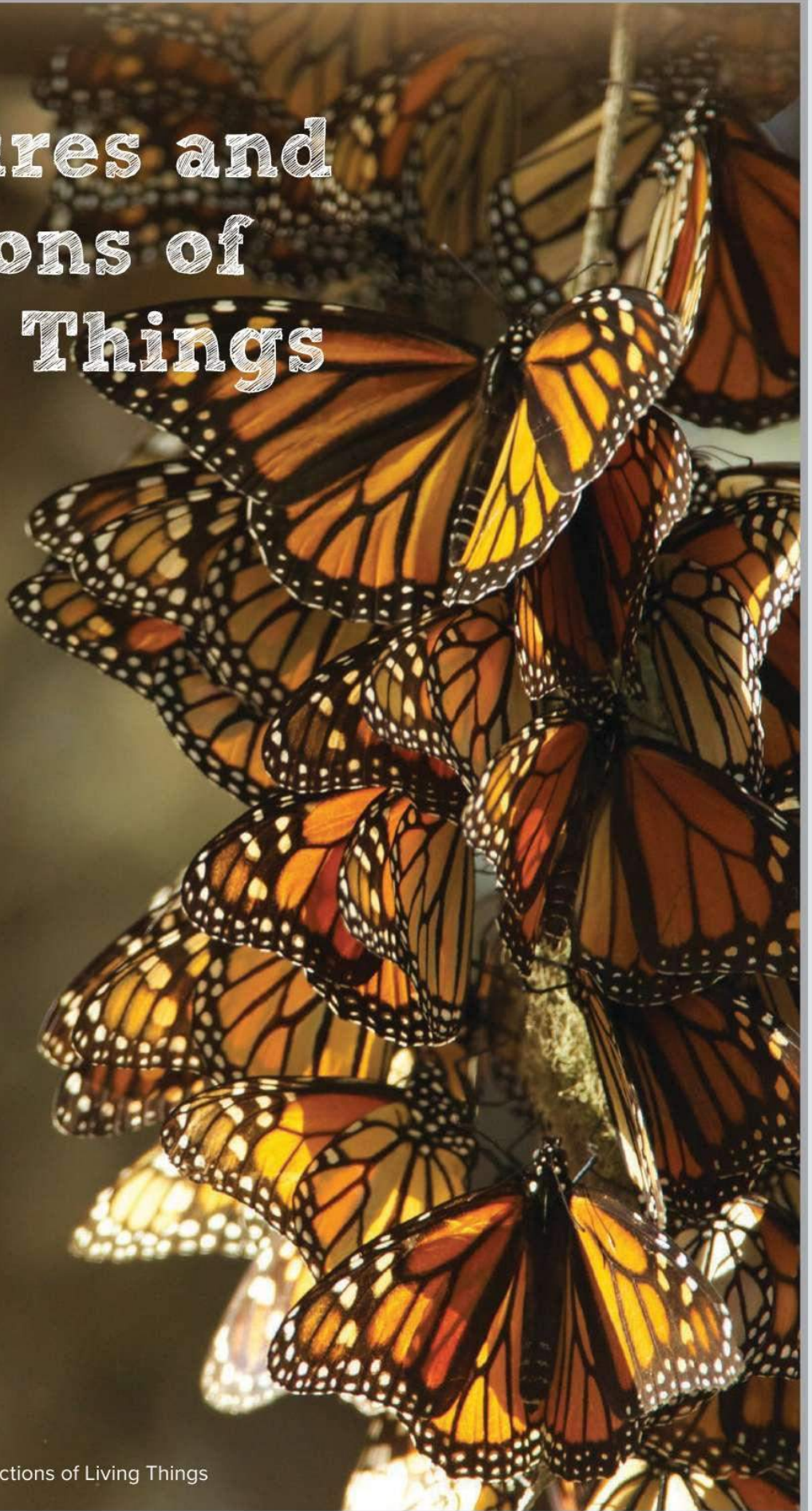


Structures and Functions of Living Things





ENCOUNTER THE PHENOMENON

How do structures help living things survive?



GO ONLINE

Check out *Butterfly* to see the phenomenon in action.

Talk About It

Look at the photo and watch the video of monarch butterflies. What structures do you observe? What are you curious about? Talk about your thoughts with a partner.

Did You Know?

Monarch butterflies have organs located on their feet and heads that help them identify different plants.



STEM Module Project Launch Science Challenge

Lesson 1
Structures
and
Functions
of Plants



Lesson 2
Structures
and
Functions of
Animals



National Park Presentation

You are a forest technician in a national park. It is your job to put together a presentation for the park's visitors about an endangered species in your park. Your presentation should include a model to explain functions of the organism's structures and identify a problem the species faces. Be sure to let the visitors know how they can help.

Congratulations! As a forest technician, you will teach visitors how an organism's structures help it survive.



POPPY
Park Ranger

Do you enjoy talking to people and being outside? Forest technicians work outside, protecting the woodlands. They also help educate visitors about a park's wildlife and natural history.



STEM Module Project

Plan and Complete the Science Challenge

You will use what you learn to teach others about how an organism's structures help it survive.

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LESSON 1 LAUNCH

Plant Parts

Plants are made up of different parts that help a plant live in its environment. Circle all of the parts that can be found on a plant.

| | | |
|------------|--------------|------------------------|
| Roots | Leaves | Bark |
| Flower | Nuts | Seeds |
| Spines | Stems | Trunk |
| Branch | Pine needles | Tubes that carry water |
| Root hairs | Fruit | Waxy coating |

Explain your thinking. How did you decide which things were parts of a plant?

Sample answer: I think that all of these parts could be found on plants. I used my knowledge of different types of plants to help me answer this question.

You will revisit the Page Keeley Science Probe later in the lesson.

LESSON 1

Structures and Functions of Plants

The coast redwood is a cone-bearing tree found along the coast of the northwest region of the United States.

Copyright © McGraw-Hill Education - Diane Diederich/Photodisc/Getty Images

ENCOUNTER

THE PHENOMENON

Why are these trees so tall?



GO ONLINE

Check out *Forest* to see the phenomenon in action.

Talk About It

Look at the photo and watch the video of the redwood trees. Circle items in the photo that you can compare to the trees to judge their height. What do you observe? Talk about your observations with a partner. Record or illustrate your thoughts below.

Sample answer: How do the trees use their tall trunks? How do they get water and nutrients up to their leaves? How fast do they grow? How do they reproduce?

Did You Know?

Redwood trees can grow to be taller than the Statue of Liberty. They can live to be 2,000 years old.



INQUIRY ACTIVITY

Hands On

Plant Parts

Think of all the plants that you observed on your way to school. Earth has a great variety of plants. All plants are made of structures, or parts, each having a specific purpose. In this investigation, you will be comparing two different plants.

Make a Prediction How do the same plant parts compare between two different plants?

Sample answer: Plants differ in shape and size, but they all have a stem and leaves and are anchored in one spot by roots.

Carry Out an Investigation

BE CAREFUL Observe the plants without touching them.

1. Take a walk around your schoolyard with your class.
2. Find two different plants to observe and sketch. Draw the plants below. Use the hand lens to get a better look at the plants' parts.
3. Identify as many of the plant parts as you can. Label them in your drawings.



Materials



hand lens

Plant 1

Plant 2

Communicate Information

4. How were the shapes of the leaves on the two different plants similar and different?

Sample answer: Both types of leaves that I observed were flat. One was shaped like a heart. The other had five points.

5. How were the shapes of the stems on the two different plants similar and different?

Sample answer: Both types of stems were long and tube-shaped. One stem was skinny, and the other was much thicker.

6. Think about the plants that you observed and other plants that you have seen. How are plants different from one another?

Sample answer: Stems are long, and tube-shaped, but their size and outer covering differ. Leaves are usually thin, and most are flat, but their shapes can vary. Some plants lose their leaves in the winter, while others do not. Some plants have bright colors, while other plants are just green.



Talk About It

Did your observations support your prediction?
Discuss with a partner.



VOCABULARY

Look for these words as you read:

adaptation

response

stimulus

transpiration

tropism

Plant Needs

The redwood trees that you saw in the lesson phenomenon and the two schoolyard plants you observed in the Inquiry Activity, *Plant Parts*, probably look very different. But they aren't as different as you might think. All plants have the same basic needs and a set of typical structures.

The basic needs of plants are air, water, sunlight, nutrients, and space. Plants must live in an environment where their needs are met.

The air around Earth is a mixture of gases. Plants need one of these gases, carbon dioxide, to make food. They need another gas, oxygen, to break down the food. Plants have pores, or stomata, in their leaves that allow gases to move in and out of the plant.

Plants use sunlight to make food. They use the energy from sunlight to make sugar. The sugar provides the energy plants need to survive. Some plants need more sunlight than others. Plants use their leaves to gather sunlight.



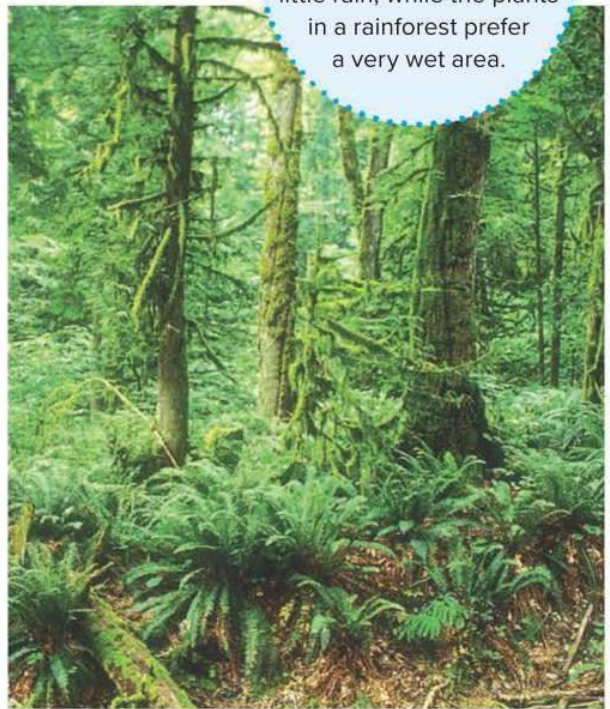
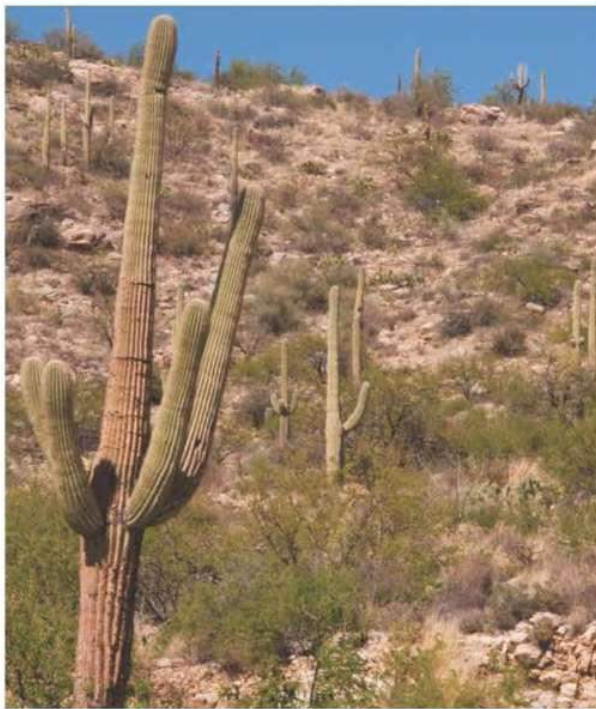
Palm trees require a lot of sunlight. Mosses and ferns can grow in shady areas.

All living things, including plants, need water. Water is another material that plants use to make food. Water is also used to move nutrients through plants. In plants, water also provides support. Plants that do not get enough water will start to droop, or wilt. Most plants take in water through their roots. The water then moves into a system of tubes that distribute the water throughout the plant.

Substances that a living thing needs to stay healthy are called nutrients. Plants need nutrients found in their environment. Most plants take in nutrients, which are dissolved in water, through their roots.

Plants need enough space to get the air, water, sunlight, and nutrients they need to survive. Plants that are crowded close together have a harder time getting the things they need.

Some plants need more water than others. Cacti can survive in deserts with little rain, while the plants in a rainforest prefer a very wet area.



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What needs might not be met if you plant the plants in your garden too close together?

Sample answer: The plants will not have enough space, so they might not be able to get enough water, air, sunlight, or nutrients. They might die.

Plant Parts

Most plants have roots, stems, and leaves. These parts, or structures, help the plant meet its needs and carry out life functions.

Roots

Plant roots take in water and dissolved nutrients from the soil. Roots also hold the plant in place. Some roots store food the plant has made.

Stem

The stem supports the plant. It is also part of a plant's transport system. There are two types of stems: soft stems and woody stems. Soft stems are green and are flexible. Woody stems are hard and are often covered in bark. Tree trunks are examples of woody stems.

Stems also allow materials to move inside the plant through a system of tubes. The tubes in the stems carry water and dissolved nutrients.

Label a Diagram: Roots, Stems, and Leaves

Label the different parts of the plant. Then describe the functions of each of the plant parts below.

Roots:

hold the plant in place,
take in water and
nutrients

Stems:

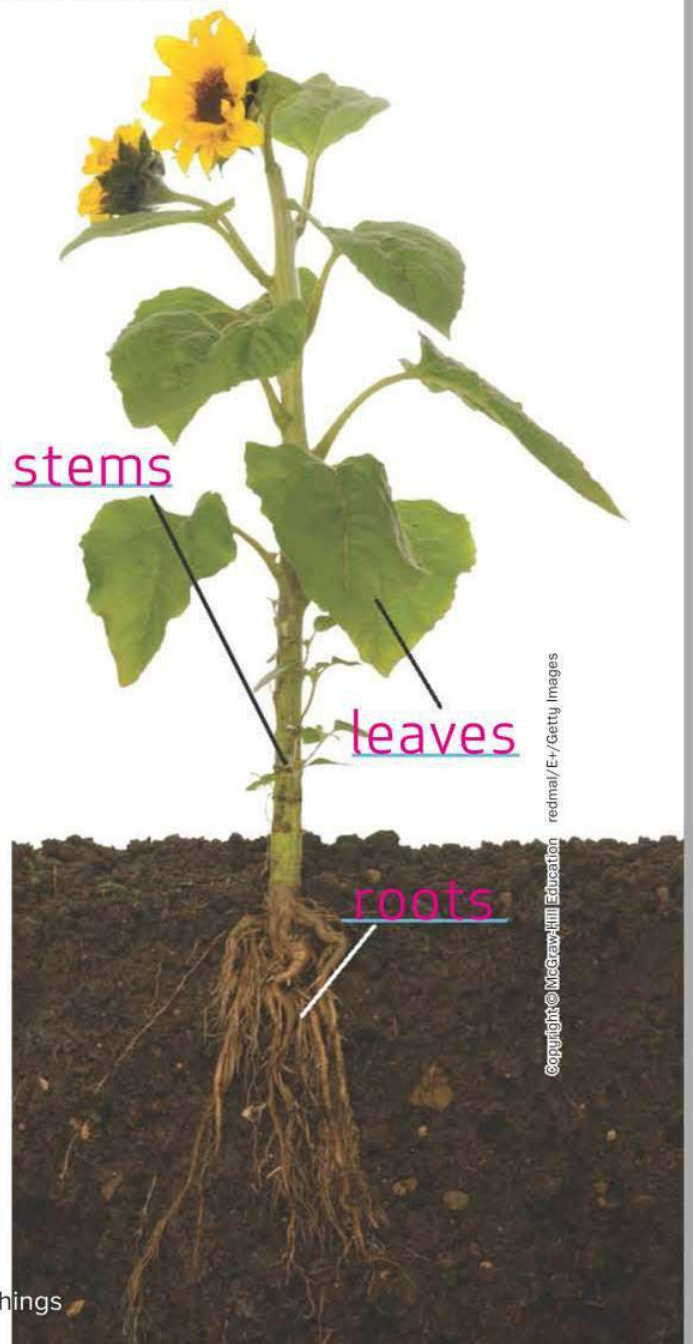
support the plant,
transport materials

Leaves:

capture light and are the
site of gas exchange

Talk About It


Use evidence to construct an argument that plant structures function to support survival.



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Leaves

Leaves vary in shape and size. Most leaves have a line of symmetry, which means their shape can be divided into two identical parts. Leaves are the site of gas exchange and food production. Most leaves are broad and flat, which allows them to collect sunlight efficiently. Plants break down the food they make in the leaves and use it for growth and repair. **Transpiration** is the release of water vapor, mainly through the small openings in the underside of leaves. This process drives the movement of material throughout a plant.

 **GO ONLINE** Watch the video *Plant Structure and Function* to see more plant structures and functions.

Talk About It

What parts of a plant have a line of symmetry? Discuss with a partner.

FOLDABLES

Cut out the Notebook Foldables tabs given to you by your teacher. Glue the anchor tabs. Use evidence to explain how the structures present in the photo help plants survive and grow.

Glue anchor tab here.

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Plant Reproduction

Plants have many structures that are used for reproduction. Some of the structures are flowers, cones, seeds, and fruits.

Flowers

Most flowers contain male and female parts. The stamen is the male part. It contains the anther, where pollen is produced. The pistil is the female part. It contains the ovary, where egg cells are produced. Insects, birds, and wind help move pollen. Fertilization occurs once the content inside the pollen joins the egg cells inside the ovary. Seeds develop after fertilization.

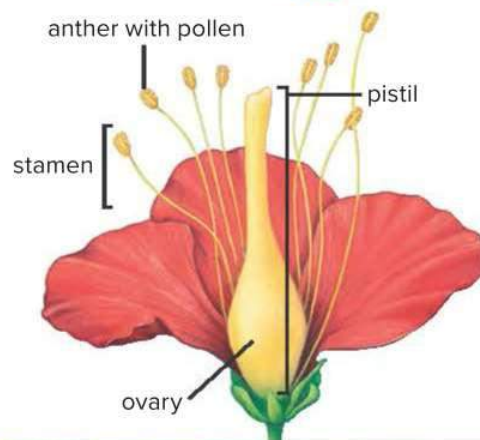
Although flowers come in different colors and shapes, they all contain the same structures used in reproduction.

Cones

Some seed plants reproduce with cones. These plants usually produce both male and female cones. The male cones produce pollen that is released into the wind. The female cones produce a sticky liquid that captures the pollen. Fertilization occurs in the female cone.

Talk About It

Explain to a classmate the parts of a flower that help it reproduce.



Pollen is produced in the smaller male cones. Seeds develop in the larger female cones.

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Seeds

A seed contains an embryo surrounded by a food supply, or cotyledon, and an outer seed coat. An embryo is the beginning of a new organism. It will live off of the food supply until it is big enough to make its own food.

Fruits

As a seed develops, the ovary enlarges into a fruit, which protects the seed. Some fruits appeal to animals, which eat the fruits and spread the plant's seed in their droppings.



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Use evidence to construct an argument that a plant's system has parts that work together to support reproduction.

Sample answer: An embryo is needed for reproduction. The embryo gets food from the seed and is protected by the seed coat.

REVISIT Revisit the Page Keeley Science Probe on page 5.
**PAGE KEELEY
SCIENCE
PROBES**

Plant Survival and Behavior

Environments can present challenges to the organisms that live there. An **adaptation** is a physical trait or behavior that helps an organism survive in its environment.

GO ONLINE Use the simulation *Plant Structures* to learn how the structures in plants function.

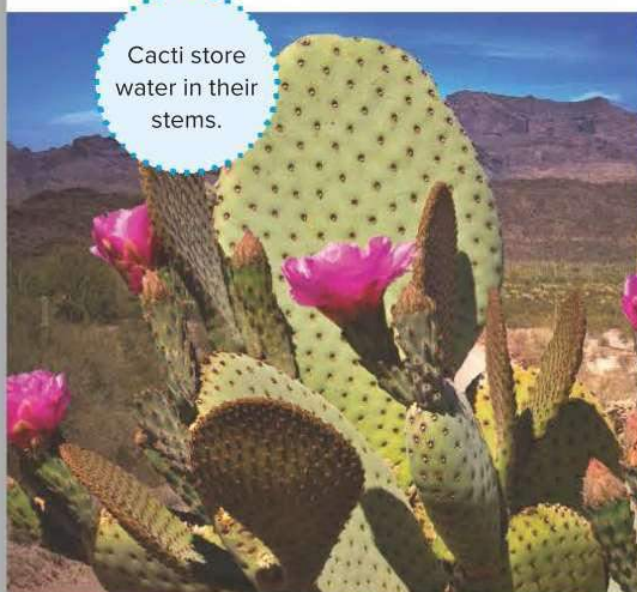
Many plants have parts that are physical adaptations. For example, desert plants have adaptations for living in a hot, dry environment. Cacti have thick, waxy stems that store water. They have dense, shallow roots to soak up rain quickly. Rainforest plants, such as orchids, have adaptations that help them survive in hot, wet conditions. An orchid's aerial roots absorb nutrients and anchor the plant high in a tree. Orchids also have leaves that are shaped to drain excess water to prevent rotting.

Many plants have adaptations to defend themselves from animals that would eat them. Some plants have thorns. Others produce chemicals that are poisonous or taste bad.



Construct an argument from evidence to explain how the **parts** of each plant's **system** help it survive.

Sample answer: The roots, stems, leaves, and flowers help them get the resources that they need to survive and reproduce in their unique habitats. Their structures look different but still have mostly the same purpose.



Cacti store water in their stems.



Orchids have aerial roots and drip tip leaves that help them survive in warm, moist conditions.

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Plant Behavior

Plants have internal structures that enable them to react to changes in their environments. A change in an environment that causes an organism to respond is called a **stimulus**. The reaction or change in behavior of an organism is called a **response**. Plants respond to stimuli such as sunlight, water, and gravity.

A plant responds to a stimulus by changing its pattern of growth. A plant's response to water, gravity, light, and touch is called **tropism**.

Plants respond to light by growing toward the light source. This response is known as phototropism. Most plant roots grow downward, the same direction as the pull of gravity, while most stems grow upward. This is called gravitropism. Roots sense water in the soil and grow toward or away from it. This response is known as hydrotropism. Some plants respond to touch, or contact with an object, by curling around that object or clinging to it. This is known as thigmotropism.

1. List the types of tropisms on the lines below. Identify and label the types of tropism shown in the photos on this page.

phototropism,
gravitropism,
hydrotropism,
thigmotropism

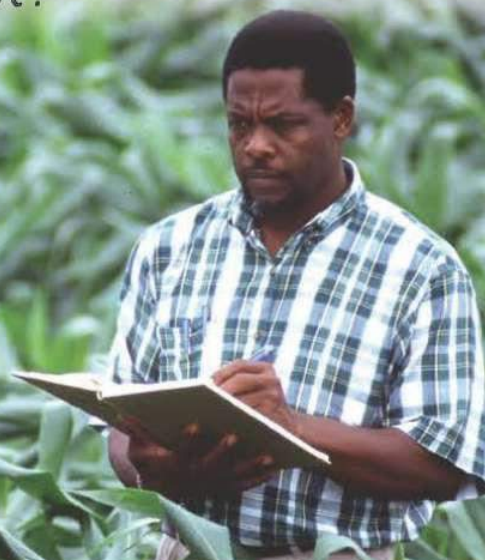
2. Use evidence to construct an argument that plants have structures that support behavior.

Sample answer: Plants have internal structures that allow them to react to a stimulus and change their behavior in order to get the resources they need to live and grow.



STEM Connection

How Could You Become a Horticultural Scientist?



Do you like growing plants and helping people? **Horticultural scientists** help farmers improve crop production. Plants are an essential part of our lives. All of the food that we eat comes directly or indirectly from plants. Horticultural scientists play an important role in making sure we have enough food to eat. Some horticultural scientists conduct research. Others work with farmers to help them grow more plants. They have knowledge of plant biology, soils, and pests that might affect crops. Some study genetics and diseases.

To become a horticultural scientist, you will take courses in biology, botany, soil science, and entomology, the study of insects.

It's Your Turn

Think like a horticultural scientist as you study plants in different habitats in the next activity.



Talk About It

How would knowing about different habitats help a horticultural scientist?

INQUIRY ACTIVITY

Research



Survival in Different Habitats

The plants that you observed in the Inquiry Activity, *Plant Parts*, all live in the same habitat, yet their structures are different. There are many different habitats found throughout the United States. How will the structures of plants that live in different habitats differ?

Make a Prediction Choose two habitats from the table below. Make a prediction about how plants from the two habitats will differ.

Sample answer: A plant from the North American desert will have adaptations to prevent water loss, like a thick stem with a waxy cuticle. A plant from the northwestern coastal forest will have adaptations to fog, like leaves that allow water in the fog to drip off onto the roots, where it can be absorbed.

Carry Out an Investigation

1. Use the table below to choose two plants from different habitats.

| Type of Habitat | Common Plants |
|---------------------------------|-----------------------------------|
| Tundra | arctic moss, reindeer lichen |
| Northwestern Forested Mountains | thimbleberry |
| Eastern Temperate Forests | spruce, magnolia |
| Great Plains | big bluestem grass, buffalo grass |
| North American Desert | saguaro cactus, desert holly |
| Northwestern Coastal Forests | coast redwood |

INQUIRY ACTIVITY

2. Research the two habitats from which you chose your plants. Describe the habitats below.

Sample answer: The northwestern coastal forest has moist, foggy conditions. The North American desert has a low elevation and is hot and dry year-round.

3. Research each plant you chose. Identify and describe its structures, including any adaptations. Draw the plants and label their structures below.

Students should draw each plant and label major external structures, including roots, stems, and leaves. They should

point out any adaptations, such as thorns or thick stems or leaves that store water.

4. What adaptations are found in each of the plants that you chose?

Sample answer: The coast redwood has thick bark that helps it survive wildfires and shallow, spreading roots that protect the trees from flood damage and help them stand up to strong winds. The saguaro cactus has white flowers that attract pollinators and spines for protection. Its roots grow 4-6 inches deep into the ground, which allows it to absorb surface water. Saguaro cacti have pleats that expand to store extra water.

5. **ENVIRONMENTAL Connection** Do more research to find out how humans have affected each of the habitats that you chose. Take notes below.

Sample answer: The northwestern coastal forest has been changed by logging. The North American desert is affected by habitat modification by humans and invasive species.

Communicate Information

6. How did the plants that you chose for your investigation differ?

Sample answer: The coast redwood is tall and has flat needles. The saguaro cactus expands to store water, and contracts as it uses its water supply. It has prickly spines and waxy skin.



Engage in an argument from evidence to explain how the plants from your investigation have **structures that function** to support survival in different environments.

Sample answer: Most plants have roots, stems, and leaves. They vary in shape and size. Plant structures are adapted to obtain the resources a plant needs to survive. Plants in moist habitats do not have thick stems because they have plenty of water compared to plants in desert areas.



Talk About It

How is an organism's structure related to its function? Discuss your ideas with a partner.





LESSON 1

Review

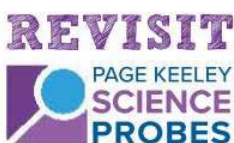
EXPLAIN THE PHENOMENON

Why are these trees so tall?

Summarize It

Construct an argument about how structure in plants support growth, survival, and reproduction.

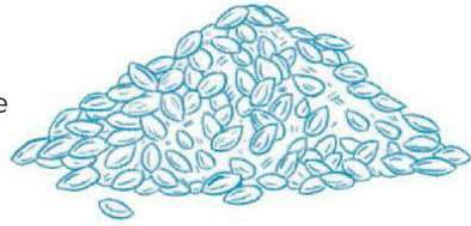
Sample answer: The structure of the redwood trees helps them grow, survive, and reproduce. Their stems are very tall and woody to support them. The tall trunks also help them reach the foggy sky. Their leaves help move the moisture from the fog to the ground, where it can be absorbed by their roots. Their thick bark helps them survive forest fires.



Revisit the Page Keeley Science Probe on page 5. Has your thinking changed? If so, explain how it has changed.

Extend It

How does human activity affect plants? Think back to the Inquiry Activity, *Survival in Different Habitats*. Identify a negative effect that human activity has on plants, and propose a solution to the problem.



Sample answer: Habitat modification and development threaten many plants in my area. Habitats are destroyed to make room for homes and businesses, and water is rerouted. To solve this problem, development can be limited to certain areas, and people can use native species to landscape their lawns. This will help to keep habitats from being broken up. By landscaping with native plant species, people will not need to worry about the climate and amount of water needed for the plants to survive.

OPEN INQUIRY

What questions do you still have about plants' structures and their functions?

Sample answer: Can a plant's structure change over time?

Plan and carry out an investigation or research to find the answer to your question.

KEEP PLANNING

STEM Module Project
Science Challenge



Now that you have learned about the structures and functions of plants, go to your Module Project to explain how this information will affect your plan for your national park presentation.