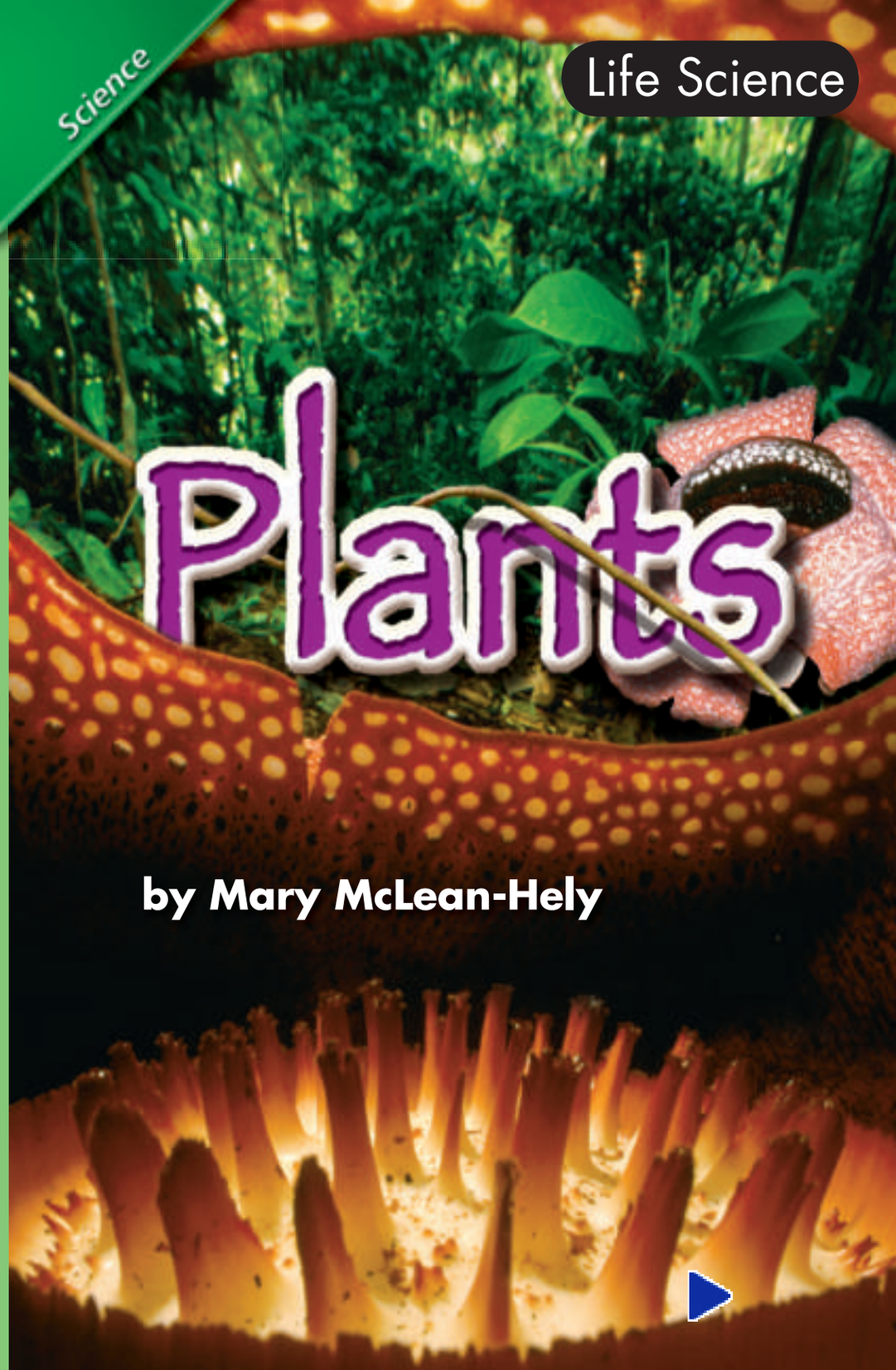
Science

Science

Life Science

Plants

by Mary McLean-Hely



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Vocabulary

embryo

growth hormone

phloem

photosynthesis

pollen

pollination

spore

tropism

xylem

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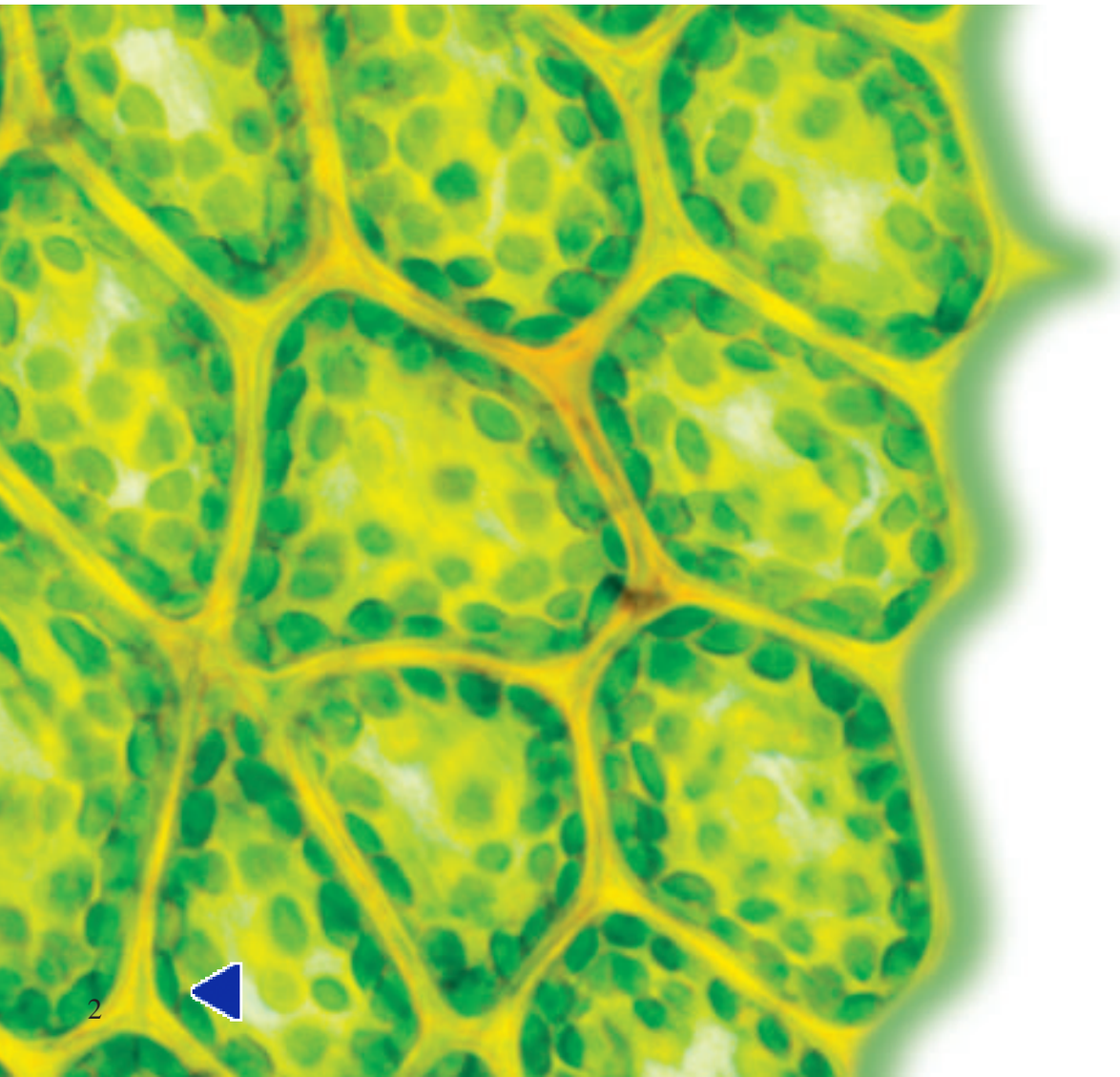
How do leaves help a plant?

Cells and Tissues in Leaves

You have probably eaten some leaves in the last week. Every time you eat a salad with lettuce, you are eating leaves. Lettuce is a leaf, and a leaf is a major plant part.

Plants are different from animals. They make their own food. Food for the whole plant is made inside of leaves.

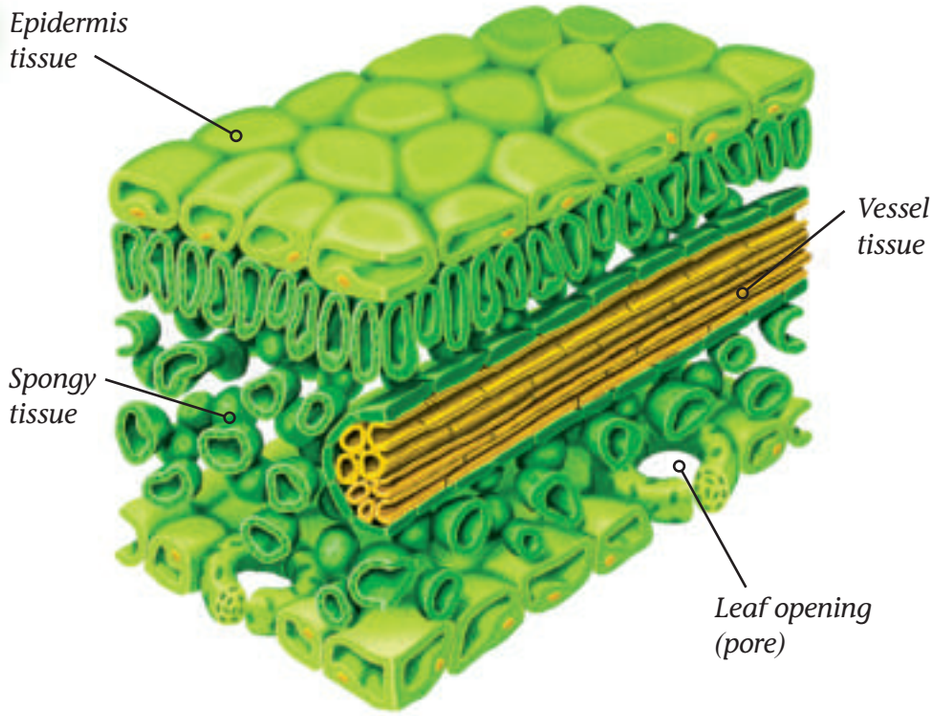


Leaves are organs. In the picture below you can see that layers of cells make up leaves. Layers of the same cells are called tissues. At the top, the epidermis tissue is made up of flat cells. In some ways your skin is similar to the epidermis. Your skin helps protect you, and the epidermis helps to protect the plant.

Next comes the inner tissue. It looks like a sponge. Air can pass through spaces in this tissue. On the bottom of the leaf are tiny openings. They allow air to move in and out of the inner tissue.

Leaves also have vessel tissues that look like tubes. These tubes carry food and water through the plant. In this way, they are like our blood vessels.

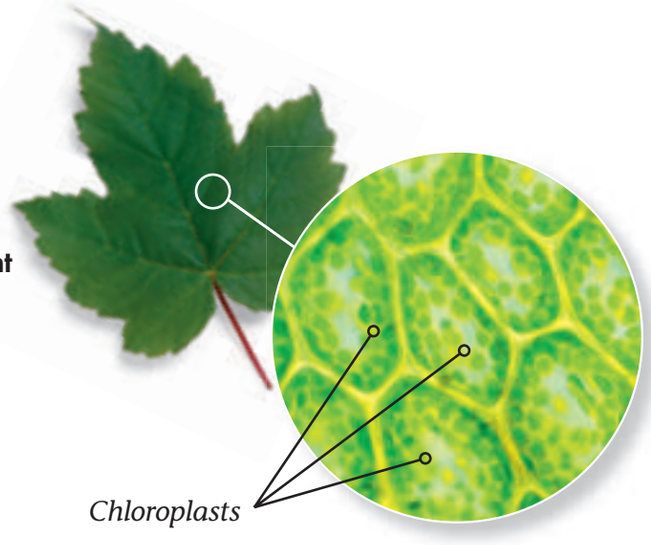
Magnified leaf cross-section



Photosynthesis

Plants need energy from sunlight to live. But how do they use this energy? And what do plants do at night, when there is no sunlight?

Plants use cellular respiration to get energy. They combine oxygen with food to get the energy they need to grow, to repair themselves, and to reproduce.



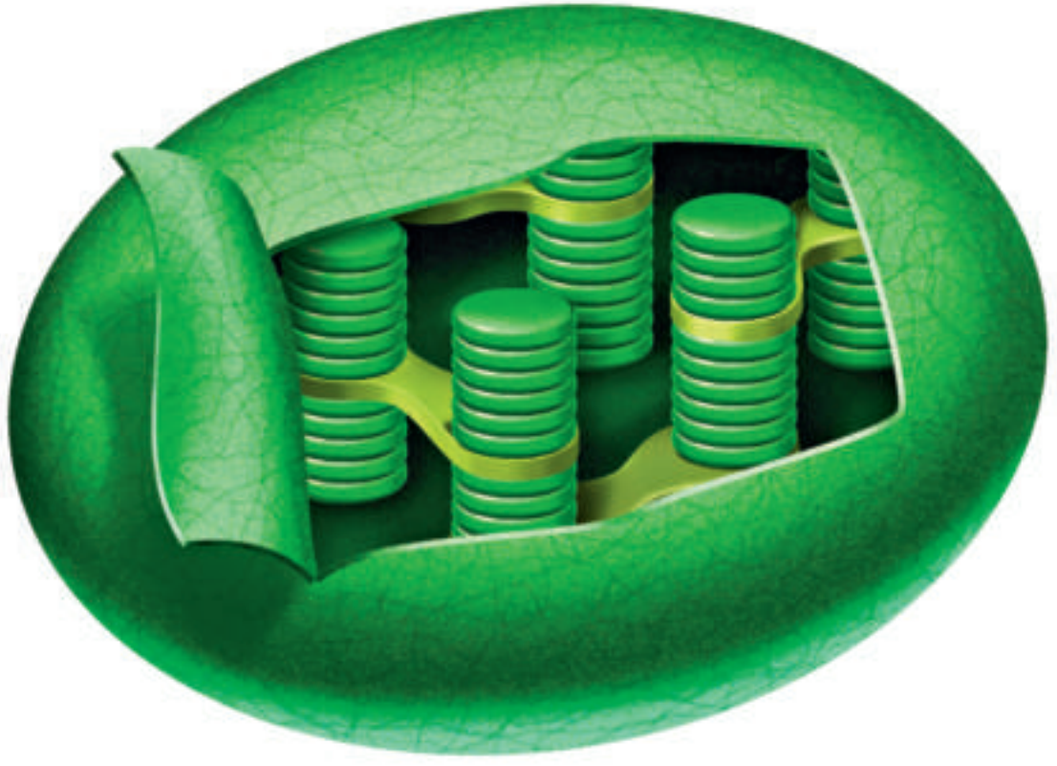
This picture shows a leaf through a microscope. The chloroplasts in the cells make the plant look green.

Photosynthesis is the process through which a plant makes sugar for food. Photosynthesis takes place in the chloroplasts of plant cells. It does not take place in animal cells. They do not have chloroplasts. In photosynthesis, sugar and oxygen are made from carbon dioxide and water. In fact, plants give us much of the oxygen we breathe.

The light from the Sun gives the energy needed for photosynthesis to take place. You can write the process as:

carbon dioxide + water + sunlight energy → oxygen + sugar

Plants use sugar as food. All of the cells of the plants use sugar, even the ones in the roots. Not all the sugar is used right away. Some is stored. Plants use some of this stored sugar at night. Other stored sugar is changed into starch. Plants can store starch for a long time.



Inside the chloroplast there are parts that look like plates. Chlorophyll is in these plates.

Your body uses sugar from plants. How is that possible? When you eat foods from plants, such as lettuce, tomatoes, and beans, your body uses the sugars and starches stored in them. Potatoes and grains come from parts of plants that store starch. Your cells use these sugars and starch to get energy.

Sugar gives plants other things too. In plants, sugars join to form something called cellulose. The strong walls of cells in plants are made of cellulose.

How do stems and roots help a plant?

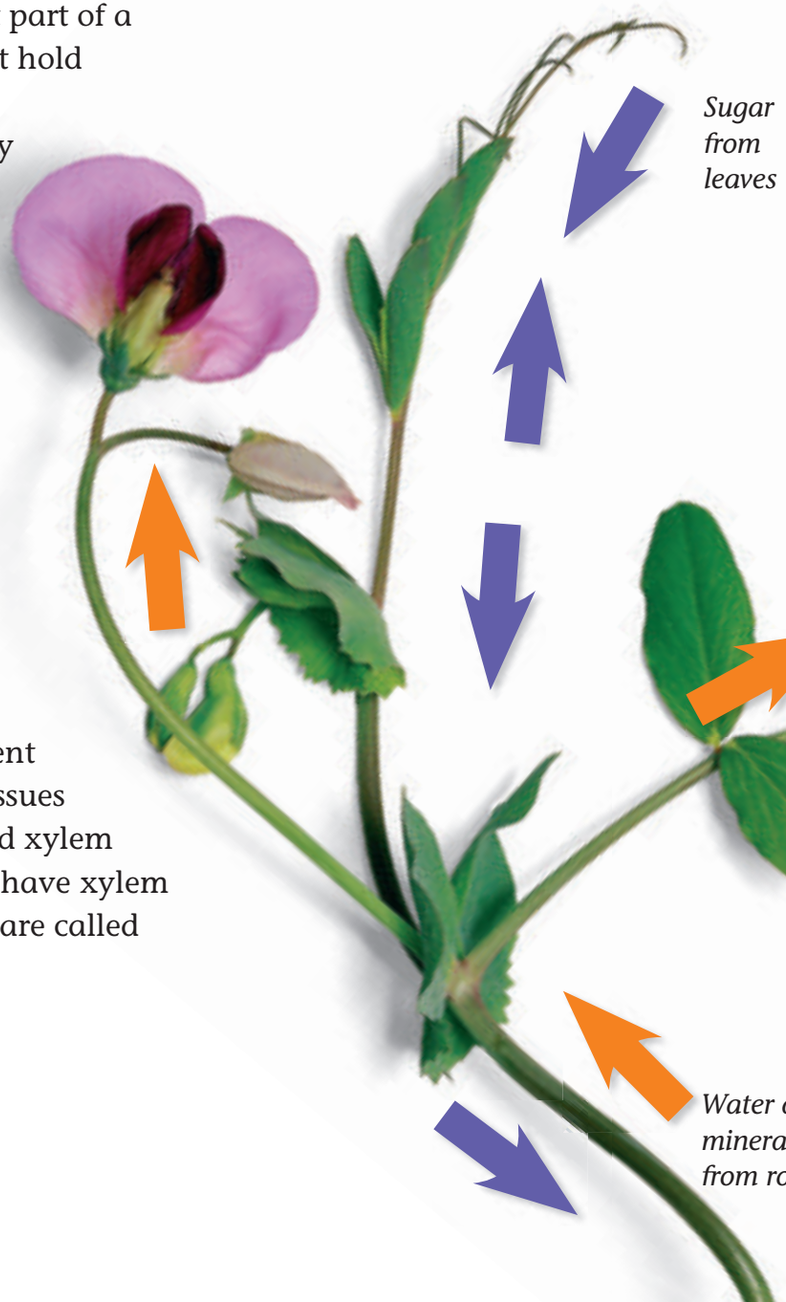
Stems

The stem is an important part of a plant. Stems are organs that hold fruit and flowers on plants. Leaves grow on stems. Many stems hold leaves high in the air. This way, the leaves can reach above other plants around them to get the sunlight they need to live.

Some plants have special stems. Have you ever felt a thorn on a rose stem? That thorn is a kind of stem.

Xylem and Phloem

Plants carry water, sugar, and minerals to their different parts. In some plants two tissues move things. They are called xylem and phloem. Not all plants have xylem and phloem. Those that do are called vascular plants.

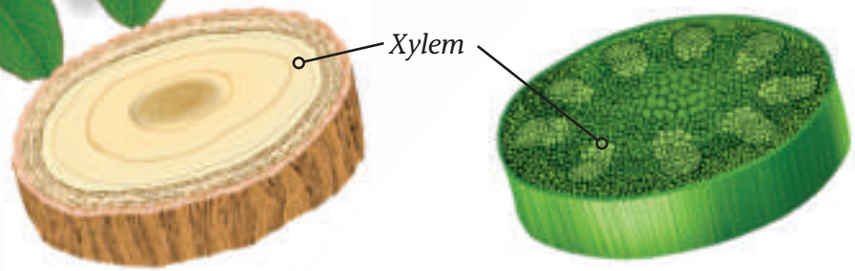


Xylem tissues are tubes that move things from the roots to the leaves. Roots take in water and minerals from the soil. Cells in the leaves need these minerals for photosynthesis. The xylem carries water and minerals from the roots through the stems to the leaves.

Phloem tissues are tubes that carry a mixture of sugar and water from the leaves. The mixture flows through the phloem to all the other parts of the plant. It is then either used for energy or stored.

Tree bark is made of old, dead phloem cells. Trees are always making new phloem, just below the bark. New phloem cells in a tree push old, dead phloem cells outward and they become the bark of the tree. The bark protects the new living phloem.

Plants with lots of xylem have woody stems. Plants such as dandelions have soft stems. They have much less xylem.



Woody stem

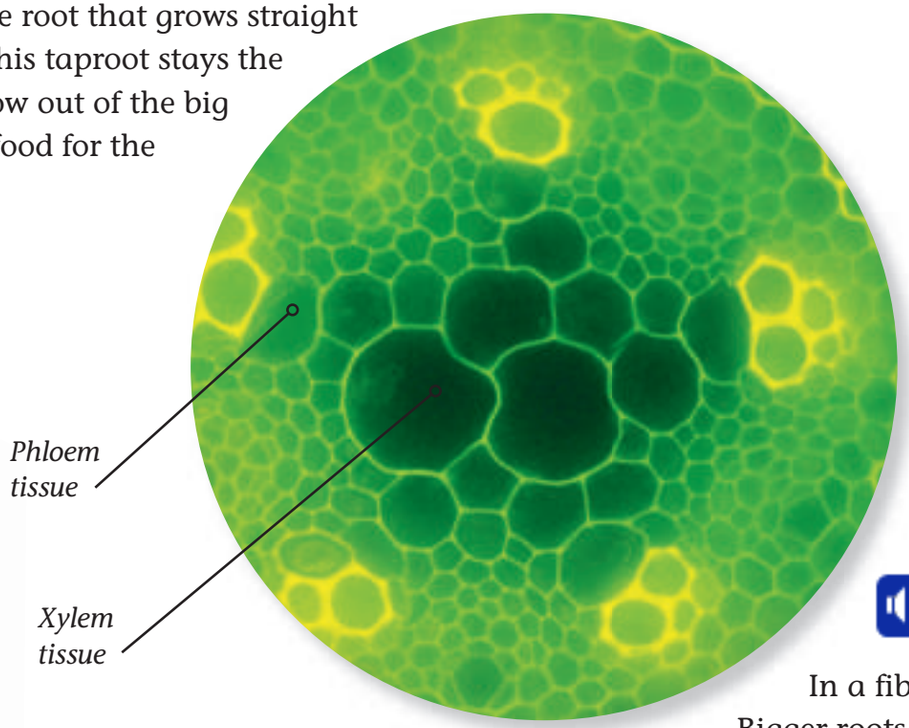
Soft stem

Roots

A root is also a plant organ. Roots can be thin and long, but they are strong. They hold a plant in place. The roots grow and spread below the ground as the stem and leaves grow up and outward above.

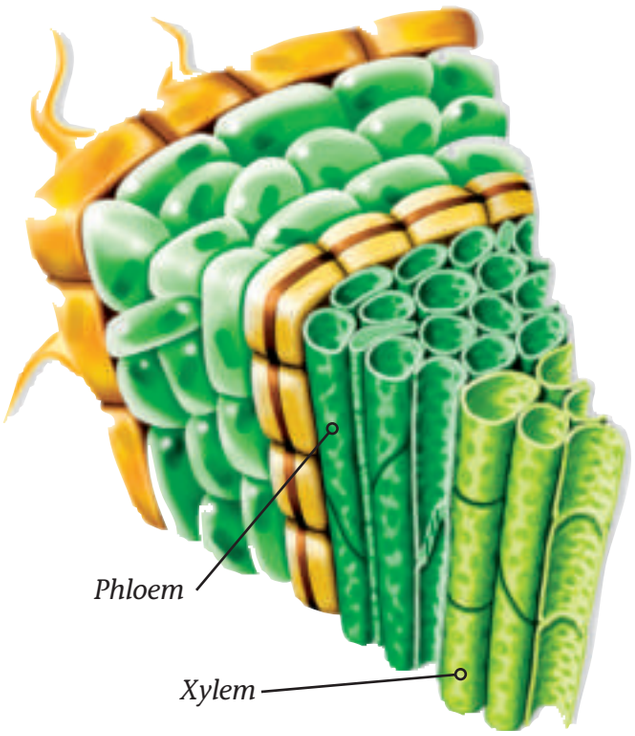
Different plants have different kinds of root systems. A taproot system has a large root that grows straight down. As the plant grows, this taproot stays the largest. Small roots may grow out of the big taproot. The taproot stores food for the plant.

Carrots are taproots.



This is a buttercup root seen through a microscope. The xylem is larger than the phloem.

Root hairs are tiny root cells. Water enters the plant through them.



This is a cross section of a root. It shows tubes made of xylem and phloem cells.

In a fibrous root system, roots grow in all directions. Bigger roots divide into smaller roots as the roots spread. Then, the smaller roots divide into more roots.

Roots have tissues near their tips that make them grow longer. The cells on the tips divide quickly to make new cells. As they do, the root pushes deeper into the ground.

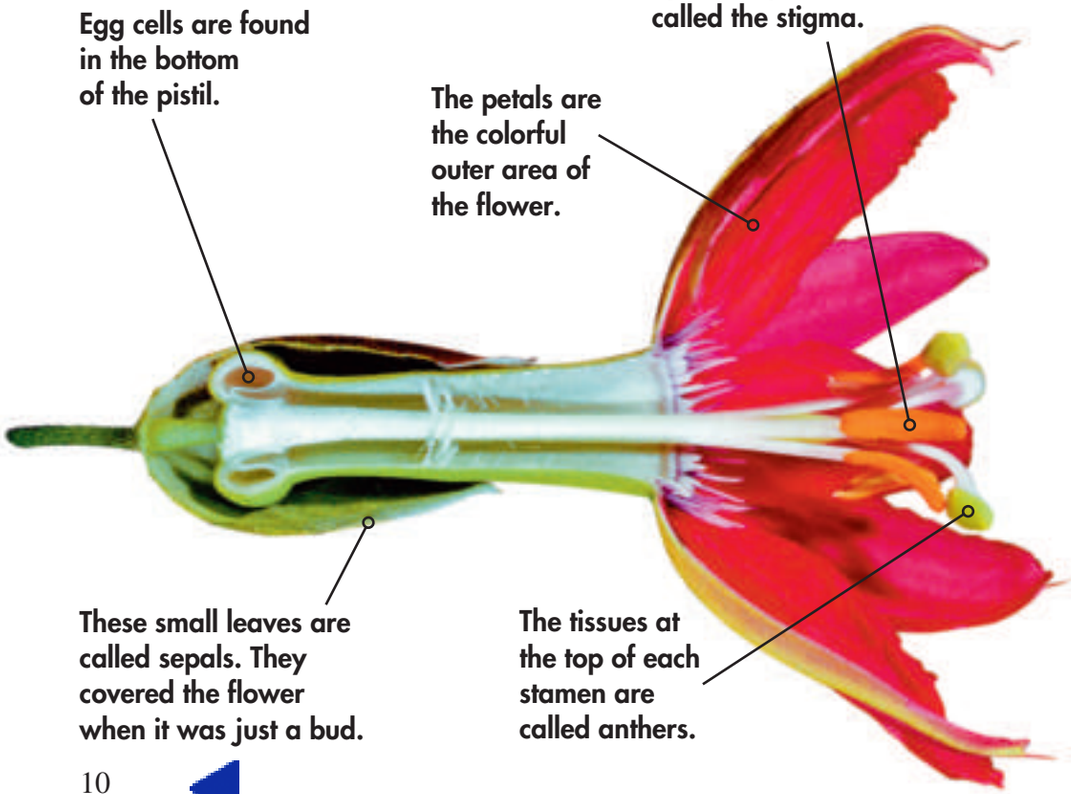
Functions of Roots

Roots take in water from the soil. That is their major job. Minerals come into the root with the water. The plant needs these minerals to grow, repair, and reproduce. Roots also hold a plant in place and may store food.

How do plants reproduce?

Parts of the Flower

In many plants, a flower is the organ that allows the plant to reproduce. Flowers can have both male and female parts. The female part of a flower is called the pistil. Often, it is shaped like a bottle. It has a wide bottom and a narrow neck. A flower may have one or more pistils. The male part of a flower is called the stamen. A flower may have many stamens. **Pollen** is a yellow powder made at the top of the stamen.



Some flowers have both male and female parts, and some have just one. Flowers with both are called perfect flowers. The passion flower on page 10 is one example. Flowers with only one part, such as some maple tree flowers, are called imperfect flowers.

Composite Flowers

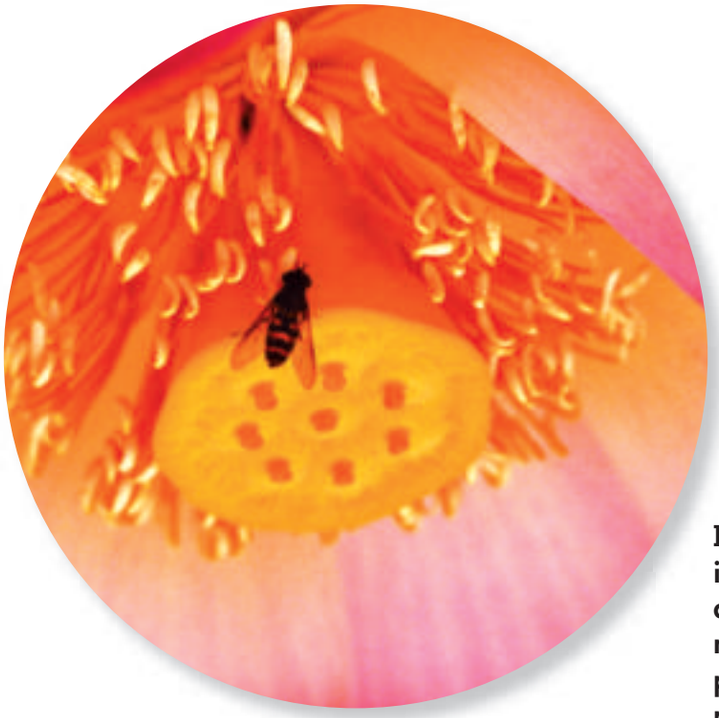
Have you ever looked closely at a sunflower? At first, it looks like one big round flower. But if you look carefully, you will see more flowers. Hundreds of tiny flowers make up a sunflower. It is in the family of composite flowers. Those are flowers that are made up of many smaller flowers.

Sunflower

Passing Information

Plants need to reproduce. If they do not, their species will not go on. The offspring of plants look like their parents. The flowers will be the same shape. The leaves will be the same size. Plants have a way of passing on this kind of information. It is passed through DNA. The DNA contains the information to make every part of the plant. When plants reproduce, DNA is passed on. This takes place in flowers.

Small differences in DNA lead to different flower colors in the same species of plant.



Insects find sweet nectar in flowers. As insects move around a flower to get nectar, they may move pollen from stamens to pistils.

Pollination

Reproduction in plants starts with pollination. **Pollination** is when the pollen moves from the stamen to the pistil. Pollination can take place in one plant between the male and female parts. It can also take place between two different plants.

Pollen does not move on its own. Something else must move it. Bats, birds, and insects can take pollen from flower to flower. Or they can move it within a single flower. So can wind and water. Some plants are pollinated in just one way. Others are pollinated in several ways.

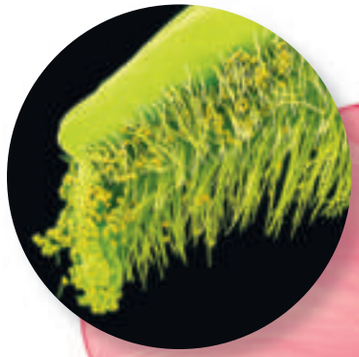
When a plant is pollinated, a tube grows from the pollen. It grows down to the bottom of the pistil, where there are egg cells. Then other cells, called sperm cells, move down the tube. They join the egg cells. This is called fertilization. It is the beginning of a new plant.

The egg and sperm cells each have half of the parent plant's DNA. When the two cells join, the two halves come together. They make a cell with a whole set of DNA.

The new cell divides again and again, growing all the time. In time, it becomes a seed with a plant inside. Every cell in this new plant will have the same set of DNA inside.

A new plant gets half of its DNA from each parent. It will look much like its parents, but there might be differences. If a plant with red flowers is pollinated by a plant with white flowers, a plant with pink flowers could follow.

Pollination of a Pea Plant



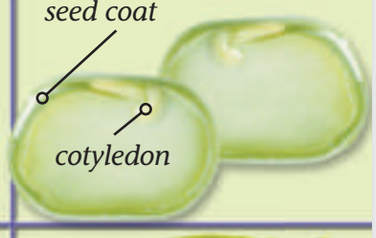
Notice all the hairlike parts in this close-up of the end of a pea plant pistil. The tiny yellow grains are pollen.

After pollination, pollen tubes grow from pollen grains. This allows sperm to move to the egg cell.

Going to Seed

A seed has three main parts. They are the seed coat, the **embryo,** and the endosperm. The seed coat is on the outside. It protects the embryo, which is the new plant growing inside. The seed coat also guards the endosperm, which stores food.

The embryo has parts called seed leaves, or cotyledons. The seeds of some plants have one cotyledon. These plants are called monocots. Others have two. They are called dicots. There are many differences between the two kinds of plants. The chart below shows some of the differences.

	monocot	dicot
A monocot seed, such as corn, has one area of stored food. A dicot, such as a bean, has two areas that are easily split apart.		
A monocot leaf has parallel veins. A dicot leaf's veins branch out.		
Many monocots have fibrous root systems. Many dicots have taproot systems.		

Some seeds, such as this coconut, can float on ocean currents. They can be carried for many miles.

Burrs can get tangled on an animal's fur and may be carried far from the parent plant. When they drop to the ground, the seeds inside may grow into a new plant.

Animals can spread seeds when they eat berries.

Spreading Seeds

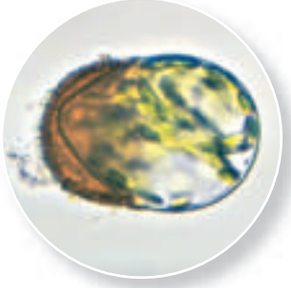
How do seeds get from a plant into the ground? In some cases, the seeds just fall on the ground near the plant. From there, they grow into a new plant. But it's not always that simple. Sometimes, animals help. Some plants grow fruit around their seeds. Animals eat the fruit, and they eat the seeds with it. Some of these seeds will pass through the animal. Once the seeds are in the ground, they will grow into new plants.

The embryo in a seed will start to grow when conditions such as temperature and amount of water are right. The new plant grows and makes its own seeds and fruit. A seed cannot wait too long to sprout. In time, the stored food in the seed will run out. Without food, the embryo will die.

Spores

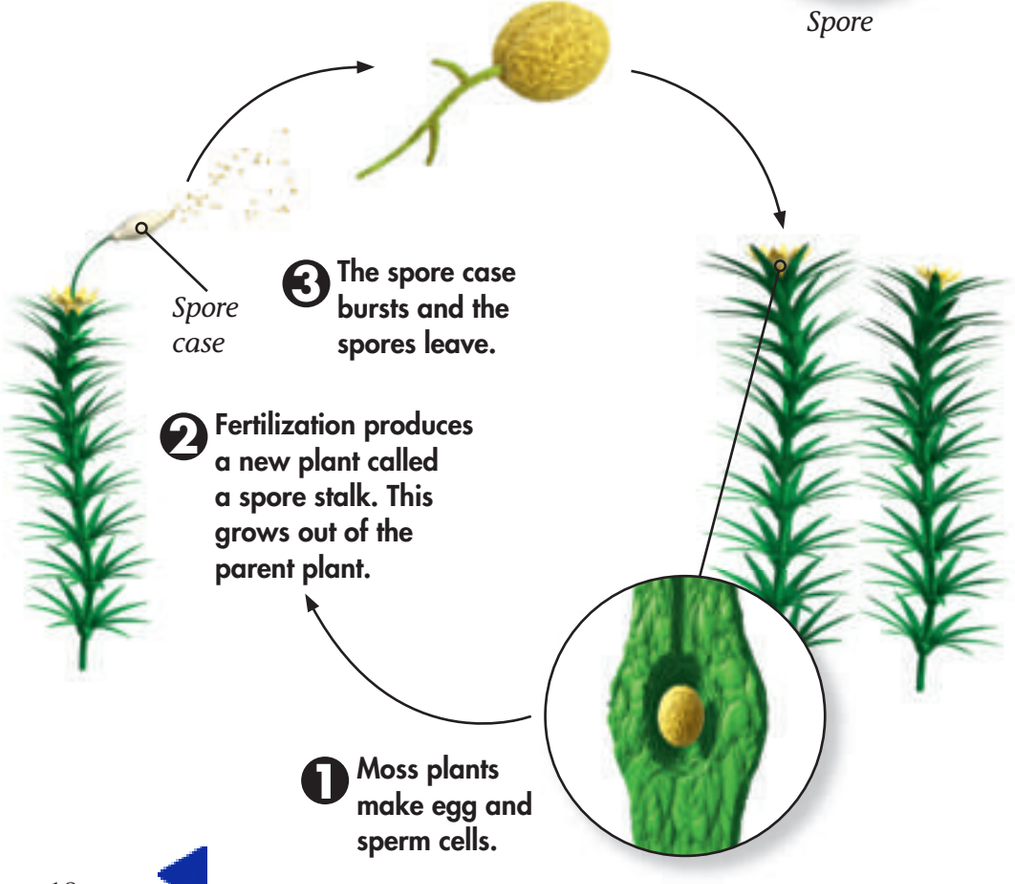
Some plants, such as mosses and ferns, do not make flowers. These plants have a two-part life cycle. In the first part, the plant will have fertilization. In the second part, it uses spores to spread. **Spores** are single plant cells that grow into new plants.

Like seeds, spores store food. Some also have a strong wall. Spores will grow only when conditions are right. But spores are different from seeds in some ways. Spores do not have embryos. They are not made by fertilization, as seeds are.



Spore

Moss Life Cycle



Reproducing Without Seeds

Some plants do not need seeds to spread. There are no sperm cells. There are no egg cells. It is called asexual reproduction.

In this kind of reproduction, there is only one parent. All the genes come from this parent. The new plant will have the same genes as the parent.

Runners and Budding

Spider plants reproduce asexually. They do this by growing new plants on long stems called runners. Grasses can grow new plants on their own too. They spread by growing new plants from roots under the ground. These plants can also grow from seeds.

Duckweed is a plant that grows on ponds. It can reproduce asexually by budding. That means little buds form on the plant. Then, they drop off to grow as new plants.

Budding allows duckweed to reproduce very quickly.

How do plants grow?

DNA and Growth

When conditions are right, a seed will sprout, or germinate. The amount of water and the temperature needed depend on the plant's DNA. Different plants have different needs.

Maybe you have noticed that plants have different sizes and looks. Bushes can be round. Trees can be tall or short. The plant's DNA decides what the plant will look like.

These Joshua trees have just a few branches that grow in many directions without a pattern. They are mostly found in dry areas, where they grow very slowly. They might grow 2 or 3 centimeters each year.

DNA tells a plant how fast to grow. Weather and soil conditions also quicken or slow its growth. If it is too warm or too cold, or the soil is very dry or very wet, the plant will not grow as fast.

Plants grow at different rates depending on their DNA. Even if conditions are just right for two plants, one may grow faster than the other. That's because of their different DNA.

As these conifer trees grow taller, small new branches form at the top. The branches on the bottom were the first to form. That is why they are the longest. This gives the trees their cone shape.

Tropisms

Have you ever noticed a flower that is bending toward the Sun? It does this to get more sunlight. Plants will also extend their roots toward water. These actions are called tropisms. **Tropisms** are ways a plant changes the direction it grows because of something outside of it.

Tropisms happen when the environment causes more cells to grow on one side of a plant than the other. When cells grow faster or larger on one side of a stem, the stem will bend.

Different parts of plants grow more or less, based on how much growth hormone they have. A **growth hormone** is a chemical that affects plant growth. Plants make their own growth hormone. It causes more cells to grow. It can also cause cells to grow larger.

Changing the amount of water in cells can also change their size. Plant cells have parts called vacuoles that store water. More water can make the cell larger than another cell. Larger cells on one side can cause a plant to bend in a different direction.

An onion's stem grows upward.

Gravitropism

Gravitropism is the growth of a plant in response to the pull of gravity. This growth can be seen in plant stems and roots. The roots tend to grow downward, the way that gravity pulls. The stems tend to grow upward, against the pull of gravity.

Phototropism

A plant's stem may grow toward a light. Or, just a plant's leaves turn toward light. This is called phototropism. Look at the picture of the plant. What would happen if you turned the plant so it leaned to the right?

Thigmotropism

Thigmotropism is a plant's growth in response to touching an object. It can happen in stems or in roots. Stems of vines will often grow around posts and fences. Roots may bend to grow away from rocks and hard soil.

Glossary

embryo	the new plant inside of a seed
growth hormone	a kind of chemical that affects the growth of plant cells
phloem	tubes in vascular plants that carry sugar to other parts of the plant
photosynthesis	the process that plants use to make sugar for food
pollen	a grainy, yellow powder made at the top of each stamen of a flower
pollination	the process of moving pollen from the stamen to the pistil
spore	a single plant cell that can develop into a new plant
tropism	the way that plants change the direction they grow because of something outside of them
xylem	tiny tubes in vascular plants that carry water and minerals from the roots to the rest of the plant

What did you learn?

1. What happens in the process of photosynthesis?
2. What is the major job of a plant root?
3. What are three main parts of a seed?
4. **Writing** in Science Seeds can fall right next to their parent plant, or they can be spread far away. What are some ways that a seed can be carried a great distance from its parent plant? Use examples from the book to support your answer.
5. **Cause and Effect** Sometimes a plant's environment can cause it to change the direction of its growth. List three things that can cause such a change, and the effects that they have.