Science A-Z
REFERENCE PICTURES

Comparing Plants

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Properties of Plants

Name _____ Date _____

Others on my I.Team _____

Title of *I.File* _____

Key Question

What do all plants have in common?

My First Answer

Explain what you *know* or *think you know* about the answer to the Key Question before reading any of the *I.Files.*

_____

_____

My Key Words and Definitions

List five words from your *I.File* that are important for understanding the topic. Then write a definition for each one in your own words.

Word	My Definition
1.	
2.	
3.	
4.	
5.	

Name _____ Date _____

My Evidence

List details from your *I.File* that may be important for answering the Key Question. Your details do not need to be written in complete sentences.

_____ _____

_____ _____

_____ _____

_____ _____

_____ _____

I.Team Evidence

Use as many lines as you need or use more paper.

List all the details you found in <u>every</u> *I.File* your team read. Use <u>only</u> these details to answer the Key Question.

List details that *might* be true of all the *I.Files*, but you would have to learn more to know for sure. Do <u>not</u> use these details to answer the Key Question.

I.Team Answer

Use complete sentences to answer the Key Question.

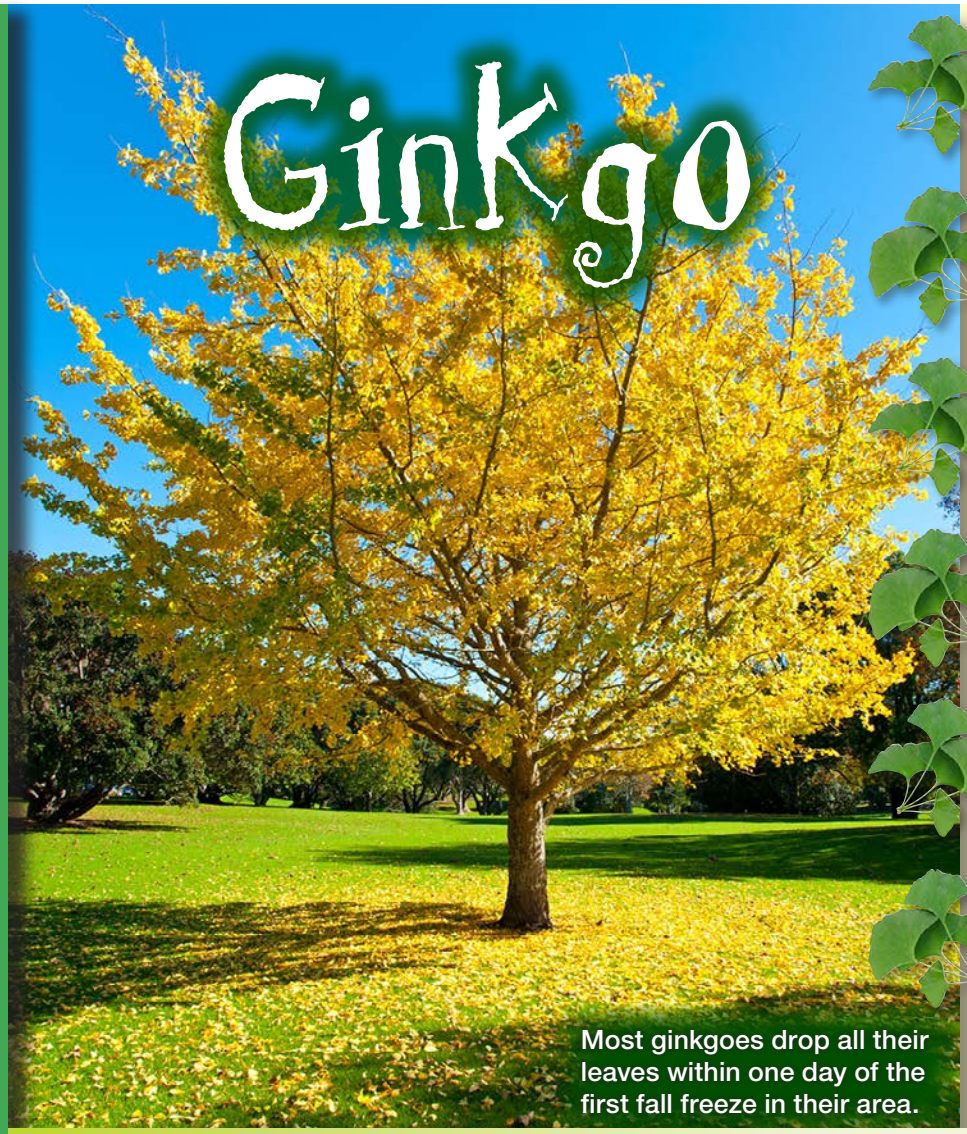
What do all plants have in common?

_____

_____

_____

Ginkgo



Most ginkgoes drop all their leaves within one day of the first fall freeze in their area.

The Survivor

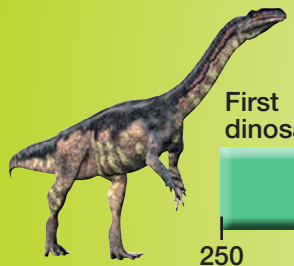
A lot of the plants that lived millions of years ago don't grow anymore. They died out. But ginkgo (GING-ko) trees have been around since the time of dinosaurs. In fact, ginkgoes are one of the oldest species of trees!

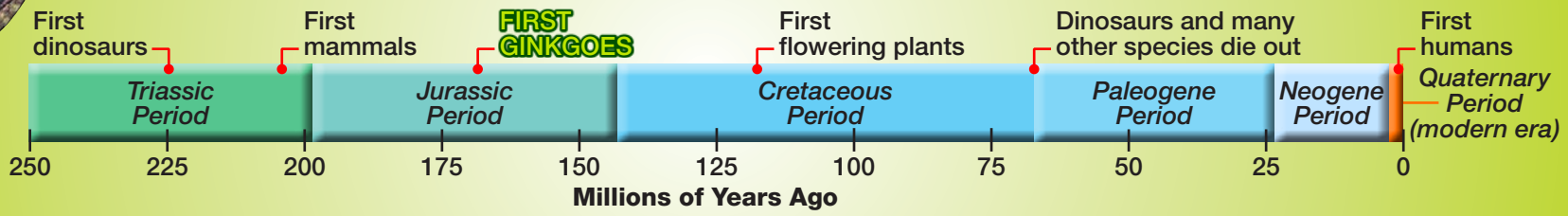
Today, people plant ginkgo trees along streets and in gardens. That's because they're pretty to look at and easy to grow—in heat or cold. They can also live for long periods without rain.

Ginkgoes have unusual, fan-shaped leaves. The leaves are made of many cells. Ginkgo leaves use light, carbon dioxide from the air, and water to make food for the plant. This process is called *photosynthesis.* In the fall, ginkgo leaves turn gold before they fall off. New leaves appear the next spring.

Word Wise

The ginkgo's Japanese name is *ichou*, which means "duck foot."





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Smelly Trees

Ginkgo trees have many kinds of cells. Some of the cells help the plants reproduce. A ginkgo tree can be male or female. Male trees have cells for reproducing in their pollen. Females have these cells in ovules (AWV-youles). The wind carries pollen from male to female trees. Then the ovules on the female trees develop into seeds.

Ginkgo seeds have a fleshy outer layer. This layer smells like stinky cheese when it starts to rot!

Most people only grow male ginkgo trees because the ginkgo seeds from the female trees have an unpleasant smell.

Ancient Trees

Want to see fossils of ginkgo trees? Visit Ginkgo Petrified Forest State Park in the state of Washington. Ginkgoes grew there millions of years ago. But then lava and ash buried many of these trees.

Over time, minerals replaced the dead ginkgo cells. They even replaced the cell walls—the outer part of a plant's cell. Scientists call what's left *petrified wood,* but it is really a rock. They study the petrified wood to learn about ginkgo species that are no longer living.

Think About It

Scientists have found fossils of nineteen species of ginkgoes. But only one ginkgo species is still alive. Why might the others have gone extinct?

This petrified ginkgo wood is over 270 million years old.

Science a-z

PLANT LIFE
Properties of Plants

Investigation File

Horsetail

Most horsetails alive today only grow to a height of about 30 centimeters (1 ft.).

Giants from the Past

Imagine you are on a nature walk. You see plants with long stems and thin leaves. These plants are called *horsetails.* Millions of years ago, giant horsetails grew in thick forests. They were as tall as pine trees are today.

Horsetails grow around ponds and other wet places. They have stems that are empty on the inside, like a straw. A horsetail is made of many cells. Cells in its leaves and stem use air, light, and water to make food for the plant. This process is called *photosynthesis.*

So why aren't there horsetail forests anymore? Millions of years ago, Earth's climate changed from wet to dry. The giant horsetails couldn't survive. Most species died out. Some horsetails still live in wet places today. But they're not nearly as tall as the giant plants of long ago.

Math Moment

Ancient horsetails were 30 meters tall. The tallest horsetails today are only 8 meters tall. How many living horsetails would you have to stand on top of each other to be taller than an ancient horsetail?

Scientists study fossils to learn about horsetails that are no longer living.

Credits: left: © Steve Taylor ARPS/Alamy; right: © John Cancalosi/Alamy

No Flowers and No Seeds

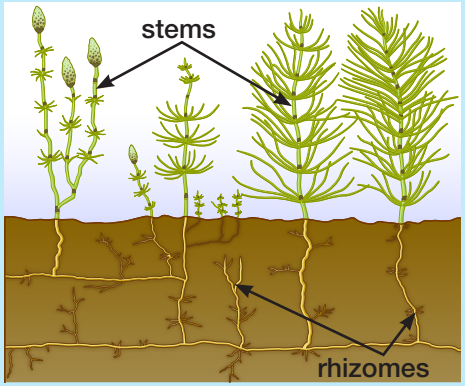
You can study horsetails for many years but never see a flower. Why not? They don't have flowers—or seeds!

Horsetails have many kinds of cells. They can reproduce by making cells called *spores*. Unlike seeds, spores only have one cell. But spores can grow into new plants. Horsetails make spores at the tip of their stems.

Horsetails also reproduce by growing underground parts called *rhizomes* (RY-zomes). A stem grows from each new part.

Not all horsetails have leaves. Some just use their stems for photosynthesis.

SPREADING HORSETAILS



Horsetails can spread quickly by growing rhizomes underground.

Think About It

Why do you think people called these plants *horsetails?* What name would you give them and why?

Tough Plants

What if you go on a camping trip and forget to bring a kitchen scrubber? How will you clean your dirty pots? You can use horsetails!

Horsetails feel rough. That's because they have *silica* in them. Silica is the same mineral that's in sand. Horsetails have a lot of silica in the outer layer of their cells, called *cell walls*. The silica is strong and helps get your pots clean.

Science a-z

PLANT LIFE
Properties of Plants

Investigation File

Orchid

All bee orchids are pollinated by bees. However, some other orchids are pollinated by butterflies, moths, or birds.

Tricksters

You might dress up for fun. But plants called *orchids* (OR-kidz) "dress up" to trick insects!

Orchids have many kinds of cells. Some of them help the plant reproduce. Orchids make small grains, called *pollen*, on their flowers. The plants use that pollen to reproduce.

Orchids must spread their pollen from one plant to another to make seeds. Some orchids trick insects into helping them. They do so by looking—and smelling—like the insects.

Plants called *bee orchids* make flowers that look like female bees. A male bee flies to each flower, thinking he's found a mate. Pollen from the orchid sticks to the bee. Then he flies away, carrying the pollen to a flower on a different orchid plant.

Do You Know?

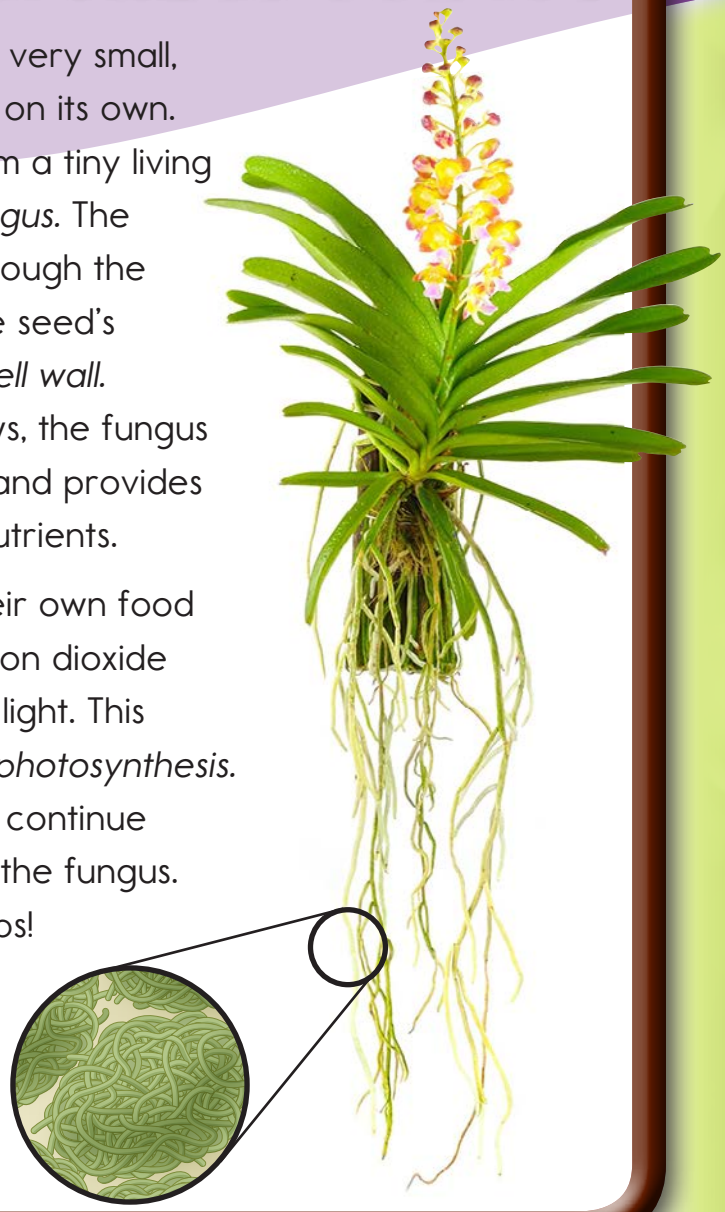
There are over 25,000 species of orchids. They live on every continent except Antarctica.

A male bee carrying pollen packets from an orchid on its back

The Friendly Fungus

An orchid seed is very small, and it can't grow on its own. It needs help from a tiny living thing called a *fungus*. The fungus breaks through the outer layer of the seed's cells, called the *cell wall*. As the plant grows, the fungus lives in the roots and provides the orchid with nutrients.

Orchids make their own food using water, carbon dioxide from the air, and light. This process is called *photosynthesis*. Most orchids also continue to get food from the fungus. Every little bit helps!



A tiny fungus (see inset) grows in the roots of an orchid, helping the plant grow.

YUMMM!

Can you guess a common flavoring that comes from an orchid? (Hint: It's in a popular kind of ice cream.)

It's vanilla! The sweet smell and tasty flavor come from the vanilla orchid's seedpods. Workers dry and chop the pods. Then they mix the pods with water and alcohol. The mixture is slowly heated to draw the flavor from the pods into the liquid. People use this liquid, called *vanilla extract*, in ice cream, baked treats, and perfumes.

Vanilla orchids grow in tropical parts of the world.

wowser!

The smallest orchid flowers are about 2 millimeters (1/16 in.) wide. Even these tiny orchids are made of many cells. However, their petals are just one cell thick!

Science a-z

PLANT LIFE
Properties of Plants

Investigation File

Watermelon

wowser!

A Carolina Cross watermelon—one of the largest types—weighs up to 85 kilograms (187 lb.)!

Watermelons grow on the vine for about three months before they're ready to be picked.

Shape-Shifting Fruit

Imagine biting into a sweet, juicy watermelon. *Yum!* Before this delicious fruit reaches your plate, it grows on a vine. The watermelon plant uses sunlight, water, and carbon dioxide from the air to make its own food through photosynthesis. Then the vine uses some of this food to make fruit. The watermelon fruit is oblong, like a squished circle. No, it's round like a ball. No, wait, it's . . . square?

Actually, watermelons come in all those shapes. The first watermelons were round. But they rolled around and got bruised as they traveled from farms to markets. In 1954, a scientist developed an oblong watermelon that was easier to stack.

In the early 1980s, Japanese farmers began growing square watermelons to save space. The farmers put the melons in square glass cases as they grew. These square watermelons are the perfect size and shape for refrigerator shelves—and they taste just as good as the round ones!

It takes extra work to grow square watermelons.

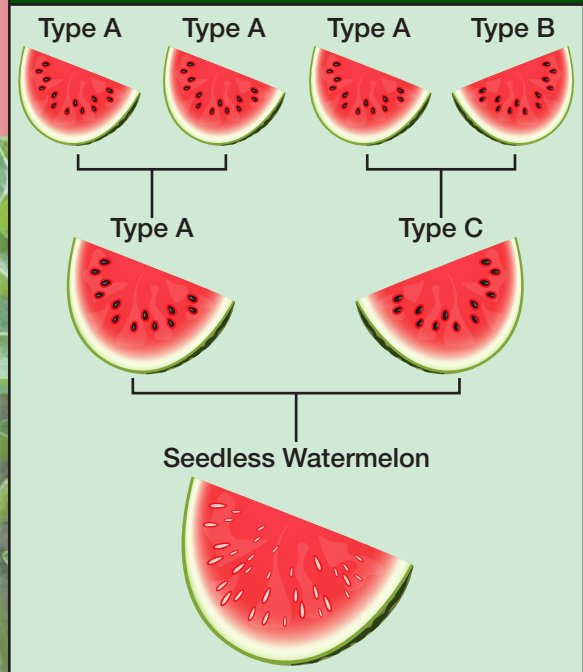
Seeds or No Seeds?

Long ago, all watermelons had big seeds inside. But today, most watermelons at the grocery store don't have seeds. Why not?

Watermelon plants have many kinds of cells. Some cells help the plant grow and develop. But plants also have many cells to help them reproduce. When living things reproduce, the offspring are a little different from their parents. Scientists use these differences to make seedless watermelons.

About fifty years ago, plant scientists took *pollen*, which plants use to reproduce, from one kind of watermelon. Then they put the pollen on the flower of another kind of watermelon. The plant that received the pollen made new watermelon fruits. Those fruits had seeds. Next, scientists planted seeds from these new watermelons. The seeds grew into plants. Scientists found that the fruit of these watermelon plants didn't have seeds. The seedless watermelon was born!

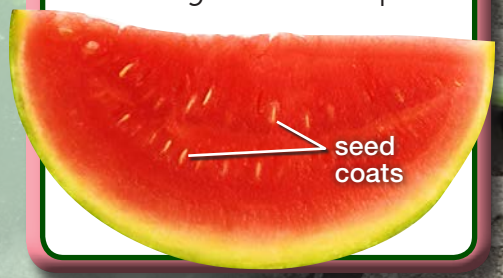
GROWING SEEDLESS WATERMELONS



1. Scientists grow Type A and Type B watermelons and cross them.
2. When two Type A watermelons are crossed, they make more Type A watermelons. When Type A and Type B watermelons are crossed, they make a new kind of watermelon—Type C.
3. Scientists grow Type A and Type C watermelons. They take pollen from a Type A flower. Then the scientists place the pollen on a Type C flower. The Type C plant makes watermelons without seeds.

Do You Know?

Some seedless watermelons have what look like small white seeds. These are called *seed coats*. They are empty inside and can't grow into new plants.



Watermelons with seeds (left) are called *seeded*. Watermelons without seeds (right) are called *seedless*.

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Science a-z

PLANT LIFE
Properties of Plants

Moss

Mystery File Question

Is moss a plant?

Mystery File

It's a myth that moss only grows on the north side of trees. Moss will grow on any side that has enough water.

A Living Carpet

Have you ever seen what looks like a soft carpet of green growing on a tree trunk? It's moss—a small living thing made of many cells. Moss doesn't just grow on trees. It also grows in soil and on rocks.

If you look closely at moss, you'll see thin, stringy stems covered with tiny leaves. If you were to dig one up, you'd discover that moss doesn't have roots. Instead, tiny threads called *rhizoids* (RY-zoids) hold it in place. Unlike roots, rhizoids don't take in water and nutrients. Moss gets water and nutrients through its tiny leaves. It uses water, carbon dioxide in air, and sunlight to make food through photosynthesis.

Moss may look soft and small, but it's powerful! It can even break up rocks. Moss grows in small holes and cracks in rocks. It holds water and expands when that water freezes. As it expands, the cracks in the rock get bigger. Over time, the cracks get so big that the rock breaks apart.

Wowser!

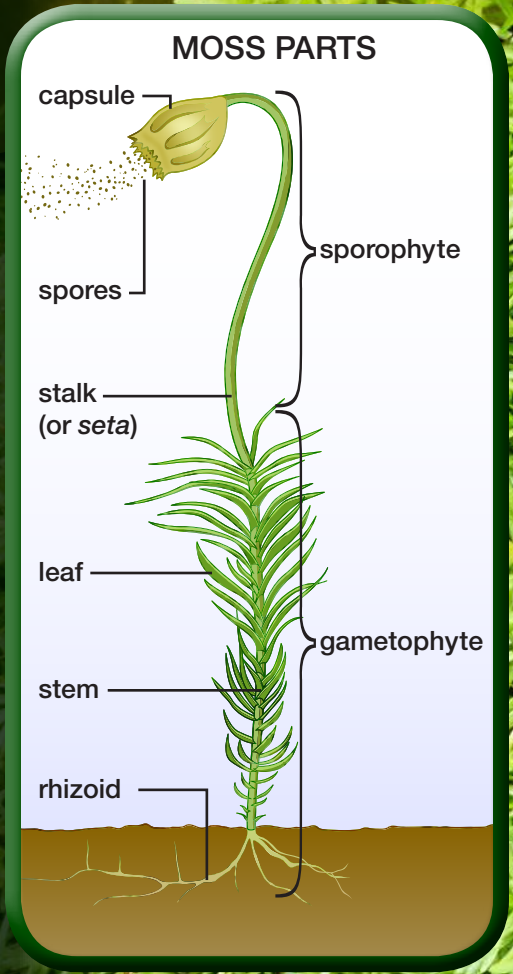
A moss leaf is just one cell thick! Each cell is surrounded by a cell wall that helps keep the leaf from drying out.

MAKING MORE MOSS

Mosses don't make flowers or seeds. So how do they reproduce?

An individual moss is either male or female. Both are made of many kinds of cells. Some of these cells help the moss grow and develop. Other kinds of cells help it reproduce.

A male moss makes special cells to reproduce. Water carries these cells to a female moss. Then the female grows a tall stalk. A capsule at the end of the stalk stores thousands of small cells called *spores*. After the moss releases the spores, the wind carries them away. If they land in a good location, new moss grows.



Do You Know?

Sphagnum (SFAG-num) moss was used as a bandage for wounds during the Civil War and World War I.

Mystery File Response Sheet

Key Question: *What do all plants have in common?*

List the details you found in every *I.File* that your team read. Use the **I.Team Evidence** section of your *I.File Response Sheet*.

_____ T F ?

_____ T F ?

_____ T F ?

_____ T F ?

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_____ T F ?

Now decide whether each of the details you listed is also true for the *Mystery File*. Circle one answer for each detail: **T** = true **F** = false **?** = not sure

Did you circle **T** (true) for all the details? **Yes No**

Mystery File Question: Is moss a plant? **Yes No**

Use evidence to answer the Mystery File Question. Write in complete sentences.

_____

_____

_____

_____

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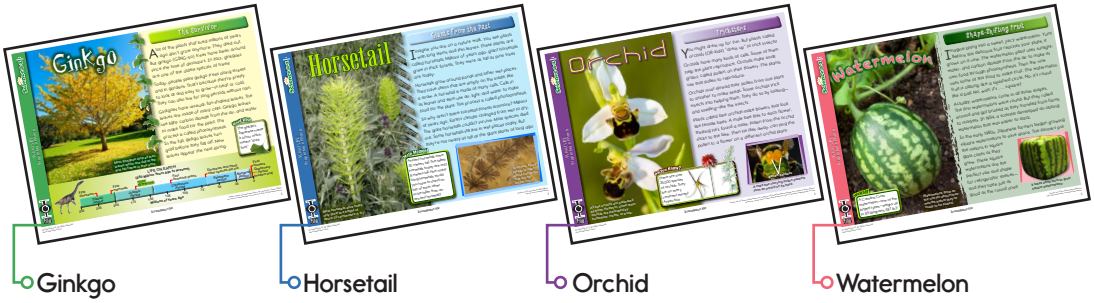
_____

Properties of Plants

This Investigation Pack focuses on plants, which make up one kingdom of living things.



Ginkgo Horsetail Orchid Watermelon

KEY QUESTION SUGGESTED RESPONSES

Key Question

What do all plants have in common?

List all the details you found in every *I.File* your team read. Use only these details to answer the Key Question.
They are made of many cells.
They have many kinds of cells.
Their cells have cell walls.
They make their own food through photosynthesis.
They reproduce.

I.Team Answer

All plants are made of many cells and many kinds of cells. Each cell has a cell wall. All plants reproduce and make their own food through photosynthesis.

Additional Information for Teachers

Plants are one of the kingdoms of living things. Plants are classified as vascular—*having specialized tissues to carry water, sap, and nutrients—or* nonvascular. *Nonvascular plants include mosses and liverworts. Vascular plants are further divided into plants with and without seeds. Plants with seeds include angiosperms (flowering plants) and gymnosperms (nonflowering plants such as firs and pines).*

All plants are multicellular and have many different kinds of cells within the organism. Unlike animal cells, plant cells have a rigid outer layer called a cell wall. *The cell wall provides support and protection for the plant. Plants make their own food from sunlight, water, and carbon dioxide in a process called* photosynthesis.

ENRICHING VOCABULARY

These terms appear in one or more student files. You may want to introduce them before students begin reading the I.Files.

fossil	a plant or animal's remains that turned to rock over time, or rock that contains signs of life from long ago
fungus	a living thing that grows on and lives off of other living material and reproduces using spores
nutrients	substances that living things need to live, stay healthy, and grow
photosynthesis	the process by which plants turn energy from the Sun into food
pollen	male reproductive cells of a plant, which are found in the flower and often look like fine powder
reproduce	to make offspring that are similar to the original living thing
species	a group of living things that are physically similar and can make offspring

MISCONCEPTIONS

Use this section as a resource for more information about plants and to clarify the content for students if misconceptions arise.

Q: *Do plants "eat" soil as food?*

A: No. The raw materials that plants use during photosynthesis are not considered food. Plants use light to help them make their own food from water, carbon dioxide, and minerals. They absorb water and minerals from the soil, but this is not the same as eating food.

Q: *Do all plants use photosynthesis?*

A: No, but most do. Most plants rely on chlorophyll to complete the process of photosynthesis. However, a few types of plants are *parasitic;* that is, they are dependent on other living things in order to get the nutrients they need. For example, one group of orchids—coralroot orchids—rely on fungi for their nutritional needs. Coralroot orchids have little or no chlorophyll, so they are unable to photosynthesize. However, they all evolved from photosynthesizing ancestors. Another group of plants, the dodders, have tiny scales instead of leaves and contain very little chlorophyll. Some dodders have limited photosynthetic capabilities, while others have none at all and are exclusively parasitic on green plants.

Q: *Do all plants live in the same kind of soil?*

A: No. Different plants have different soil requirements, and some plants are more adaptable and flexible in their requirements than others. Different types of plants evolved over thousands of years in different parts of the world and in different soil types. For example, pine trees in a forest and palm trees near a beach have different soil requirements. Plants have structures and functions that are specially adapted to specific soil conditions (including soil pH and amount of moisture), and may suffer or die if exposed to different conditions.

Q: *Do all plants have seeds and flowers?*

A: No. Seedless plants include ferns, horsetails, and club mosses (all of which are seedless vascular plants) as well as mosses and liverworts (which are nonvascular plants). These plants use one or more of the following four means of reproducing. Some produce *spores*—cells that are released into the wind and grow into new plants. Others produce *rhizomes*—modified stems that grow horizontally just above or below the soil surface, producing roots and new plants. Still others produce fully formed *plantlets* or undergo a process called *fragmentation,* which involves forming small cuplike structures that produce sprouts. Being seedless and nonflowering go hand in hand.

Q: *Do all plants rely on animals for pollination?*

A: No. Roughly 90 percent of plant species are pollinated by animals, and the other 10 percent are pollinated by wind or water. Wind-pollinated plants include important food crops such as wheat, corn, and rice. Common animal pollinators include insects, birds, and fruit bats. However, ground-dwelling mammals, including rodents, elephant shrews, and certain marsupials, also pollinate some plants.

Q: *Do all plants live on land?*

A: No, although most do. Some plants have adapted to aquatic environments. Most grow in freshwater environments; only a few plants, including seagrasses, can survive in water with a high salt content. Most aquatic plants, whether submerged (such as wild rice) or floating (such as water lilies) have their roots in soil under the body of water. A notable exception is duckweeds—small, simple plants, most of which lack roots. They float on still or slow-moving water or remain suspended just under the water's surface. Many people think kelp is a plant—and it used to be classified as such—but it is more accurately classified as a *protist.* This kingdom, which consists of organisms that cannot be placed into the other kingdoms, also includes algae and protozoa.

Q: *Do all plants have big, flat leaves?*

A: No! Leaves come in an amazing range of shapes and sizes. They can be wide, narrow, oval, lobed, divided, simple, compound, heart-shaped, spear-shaped, or needle-shaped. An African palm tree has leaves up to 24 meters (80 ft.) long. The common water fern may have the smallest leaves of any plant, measuring only 1 millimeter (0.04 in.) in length.

Math Moment Solutions

In the Horsetail *I.File*, the following Math Moment appears on page 1:

Math Moment

Ancient horsetails were 30 meters tall. The tallest horsetails today are only 8 meters tall. How many living horsetails would you have to stand on top of each other to be taller than an ancient horsetail?

To solve this problem, add the height of each living horsetail, 8 meters, to itself until the sum exceeds the height of ancient horsetails, 30 meters.

8 m + 8 m + 8 m = 24 m (not taller than 30 m)
8 m + 8 m + 8 m + 8 m = 32 m (taller than 30 m)

Alternatively, divide the height of ancient horsetails, 30 meters, by the height of the tallest modern horsetails, 8 meters:

30 m ÷ 8 m = 3.75

Since ancient horsetails were 30 meters tall, it would take 3.75 living horsetails to equal their height. Therefore, you would have to stand **4 living horsetails** on top of each other to be *taller than* the height of ancient horsetails.

MYSTERY FILE SUGGESTED RESPONSES

Use the completed sample Mystery File Response Sheet and further explanation below to assess students' responses on page 2 of the Mystery File.

Mystery File Response Sheet

Key Question: *What do all plants have in common?*

List the details you found in every *I.File* that your team read. Use the **I.Team Evidence** section of your *I.File Response Sheet*.

They are made of many cells. T F ?

Mosses are made of many cells.

They have many kinds of cells. T F ?

Mosses have cells that help them grow, develop, and reproduce.

Their cells have cell walls. T F ?

Moss cells have cell walls.

They make their own food through photosynthesis. T F ?

Mosses make their own food through photosynthesis.

They reproduce. T F ?

Mosses reproduce using spores.

Now decide whether each of the details you listed is also true for the *Mystery File*.

Circle one answer for each detail: T = true F = false ? = not sure

Did you circle **T** (true) for all the details? Yes No

Mystery File Question: *Is moss a plant?* Yes No

Use evidence to answer the Mystery File Question. Write in complete sentences.

Moss is a plant because it is made of many cells and has many kinds of cells. Moss cells have cell walls. Also, moss makes its own food through photosynthesis, and it reproduces.

Moss

Additional Information for Teachers

Mosses are a group of plants. They may be tricky for students to classify as plants because they don't conform to common notions about what makes a plant a plant. For example, they don't have true roots, stems, or leaves, and they don't take in water and nutrients through soil. Most plants that students are familiar with are vascular. *But mosses are* nonvascular plants*—they lack vascular tissue (xylem and phloem) for transporting water and nutrients to every cell. As a result, the height of moss is limited since it is unable to move water and nutrients far above the ground. In the absence of a vascular system, mosses have developed other structures that allow them to carry out all functions necessary for life. Despite their differences from the prototypical plant, mosses meet all the criteria for plants and are categorized as such by biologists.*

EXTENSIONS AND VARIATIONS

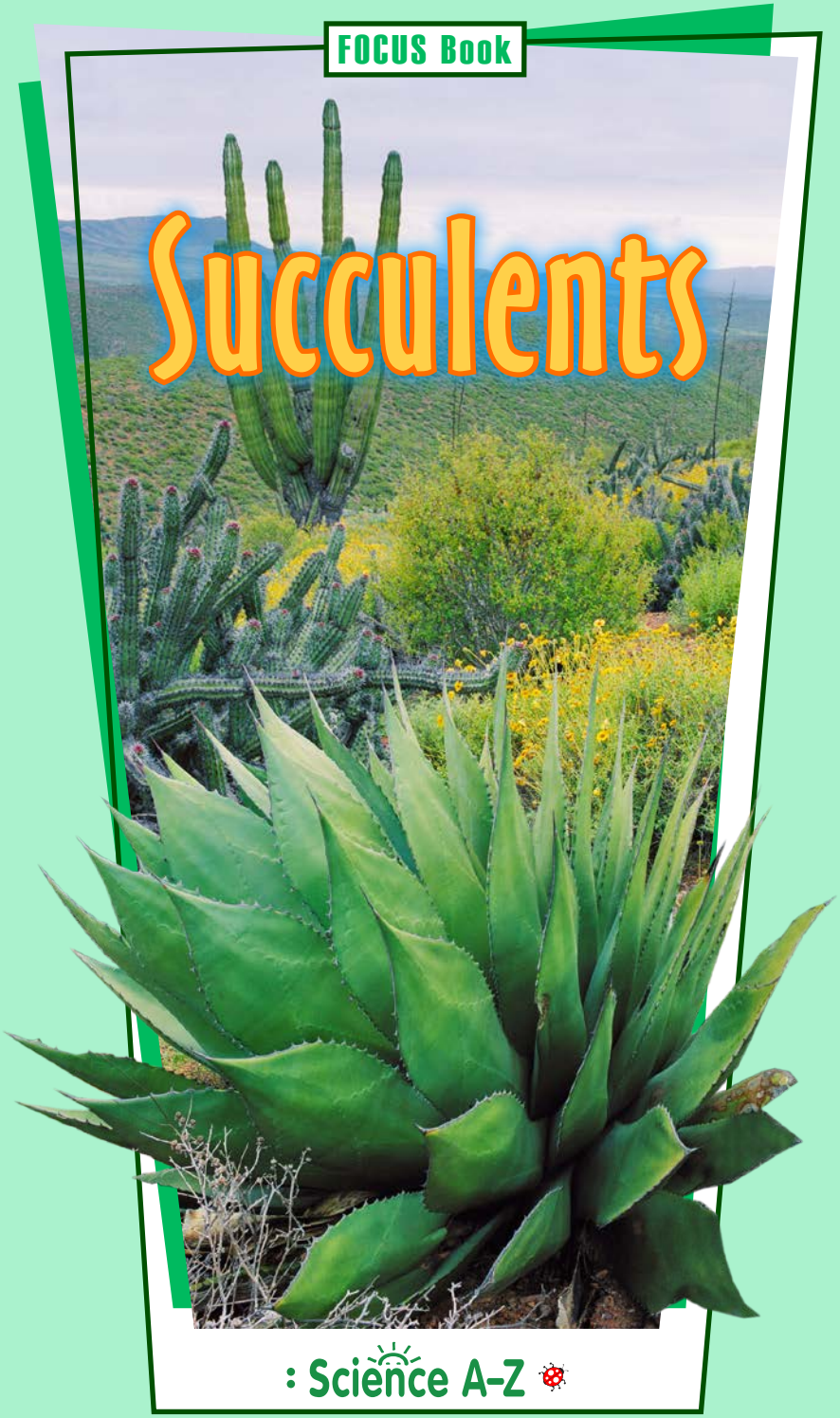
- *Guest:* Invite a farmer, gardener, or orchardist to speak to the class about varieties of plants and how the choice is made to cultivate only certain ones.
- *Field Trip:* Visit a farm, botanical garden, or orchard to discover what different plants need in order to grow.
- *Research/Writing:* Help students choose a specific pollinator, such as a hummingbird, bumblebee, or ant, to research. Have students learn about the pollinator and the plant that it pollinates. Then invite students to write a fictional story about one day in the life of their pollinator.
- *Research/Arts:* Challenge students to research another group of flowering plants besides orchids (such as sunflowers, lupines, roses, or geraniums). Help them discover important traits of their chosen group. Then have them create a poster or other art project introducing classmates to their chosen plant.
- *Arts/Game:* Have students work in pairs to research different plant parts (e.g., root, stem, leaf, or flower). Then ask them to create two playing cards: one with the name and a drawing of the plant part, and the other with a sentence about the main job it performs. Collect class cards and have groups of students play a matching game in which they match the plant part with the description of its role.
- *Math:* Have students research the average height and lifespan of different plants. Be sure to include a variety of plants, including grasses, trees, and ornamental plants. As a class, create a graph comparing plant height and lifespan. Discuss any patterns that emerge.
- *Research/Technology:* Help students conduct online research to discover how plants are classified and why certain other species that resemble plants are not considered part of the Plantae kingdom. Then encourage students to create simplified diagrams of the plant kingdom's taxonomy using digital tools.

Be a Scientist!

You have just learned about succulents and how they collect and store water. Now, get two succulent plants of the same size. Give one plant very little water and the other plant a lot of water. Write down how often you water each plant, and how much water you give it. Do this for a month. Keep everything else the same between the plants. Observe how the plants respond to different amounts of water during the month.

Beyond the Book

Use the Internet to research another kind of succulent not described in this book. Create a drawing of the plant. Label the parts that help it to survive in its habitat.



Succulents

FOCUS Question

What helps succulents survive in dry habitats?

Patterns

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Succulents
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Reading Levels	
Learning A–Z	Q
Lexile	590L

Correlations	
Fountas and Pinnell*	N

*Correlated independent reading level

The Juicy Plants

Check out the plants on this page. They are called *succulents* (SUH-kyoo-lints). They come in many interesting shapes and sizes. Unlike many other plants, most succulents grow in places with little rainfall.

How do succulents survive in such dry habitats? They have special *adaptations*—features that help them survive. These adaptations help them collect water during rainstorms and store it for dry times.

Some succulents have thick stems. Others store water in their leaves. Thick, waxy layers help to hold water inside the plant.

Thick stems and waxy leaves both help store water.

Succulent Habitats

Succulents can grow in low, dry deserts and on high, freezing mountaintops. They even grow on sandy beaches. Their adaptations help them live in many different areas.

Let's take a trip around the world and identify some succulents.

HABITAT	SUCCULENT
Desert	Barrel cactus
Mountain	Monk's hood cactus
Seashore	Copiapoa

Succulents of the Desert

Succulents are common plants in deserts. Deserts often go for long periods without any rain. The succulents that live there have special adaptations that help them to collect and save water.

Yuccas (YUK-uhs) live in the desert. These plants have tough, spear-shaped leaves. The leaves are shaped so that rain flows down to the roots. The leaves are also covered with a thick, waxy skin, which keeps them from losing water. They have a deep, thick root to help store water.

Cacti are a type of succulent. Many kinds of cacti, such as prickly pears and barrel cacti, live in the desert. Barrel cacti have large trunks to store water.

Jumping cholla (CHOY-yuh) cacti are sometimes called *teddy bear cacti*. From far away, they look fuzzy and cuddly. Do not hug them, though! These plants are covered with thousands of sharp spines. The spines make shade for the plants, helping them survive in the desert heat. Cacti need less water when they are cooler.

jumping cholla cactus

The stem of a jumping cholla is separated into sections, or *segments*, that store water. These segments break away easily. In fact, even the wind can break them off. Each broken segment can become a new plant.

Word Wise

The jumping cholla gets its name because people once thought the segments "jumped" off of the plant. Actually, the segments just break off easily.

Succulents of the Mountains

If you hike to the top of a mountain, you might see succulents growing. Some mountaintops get little water. They can also be very cold. Succulents such as the monk's hood cactus and sand dollar cactus are found in mountains.

Monk's hood cacti are small and do not need much water. Sand dollar cacti are very small. When there is very little water available, these cacti turn brown and flatten to the ground until more water is available.

monk's hood cactus

The sand dollar cactus (above) turns brown when there is little water.

Prickly pear cacti can grow on mountaintops and deserts. Their roots are very long and thin. This allows them to soak up every bit of water nearby.

prickly pear cacti

In the winter, it gets very cold. Prickly pear cacti shrink to hold less water than normal. This protects them from freezing temperatures. The weather in the spring gets warmer and brings rain. The cacti will soak up lots of water and bloom.

Prickly pear cacti shrink and shrivel during the winter.

Succulents of the Beach

Most beaches get plenty of rain. However, some beaches can go *years* without rain! Succulents still live in these dry, sandy areas.

A succulent called the *copiapoa* (COH-pea-uh-POH-uh) collects water from the air! Cool air moves over warm ocean water. The change in temperature makes fog. Copiapoa survive by soaking up the water in the fog. A thick, waxy coating keeps the water inside the plant.

Copiapoa collect water from fog.

Succulents as Medicine

If you have a sunburn, you might put *aloe vera* (AL-oh VARE-uh) lotion on your skin. The cool lotion helps to soothe and heal a burn. Did you know that the lotion is made from a succulent?

Aloe lotion comes from the leaves of the *Aloe vera* plant. These plants have thick, fleshy leaves for storing water. A waxy layer on the outside helps to keep this water inside the plant.

Juice from another succulent called the *ice plant* is used in ointments. People use it to treat cuts, scrapes, and sunburn.

Aloe vera

ice plant

Read-Think-Write

Write your answers on separate paper. Use details from the text as evidence.

1. Would you expect to find more succulent plants in dry areas or areas with a lot of rain? Explain your answer.
2. Look at the picture of the yucca on page 4. What do you think will happen when rain hits the leaves?
3. How do succulents survive in cold, dry mountains?
4. Would a succulent grow well in your area? Explain why or why not.
5. What is another word that has about the same meaning as *segment?*

FOCUS Question

What helps succulents survive in dry habitats? Choose a photograph from the book. Write a paragraph explaining the adaptations this succulent has that help it to survive in its habitat.

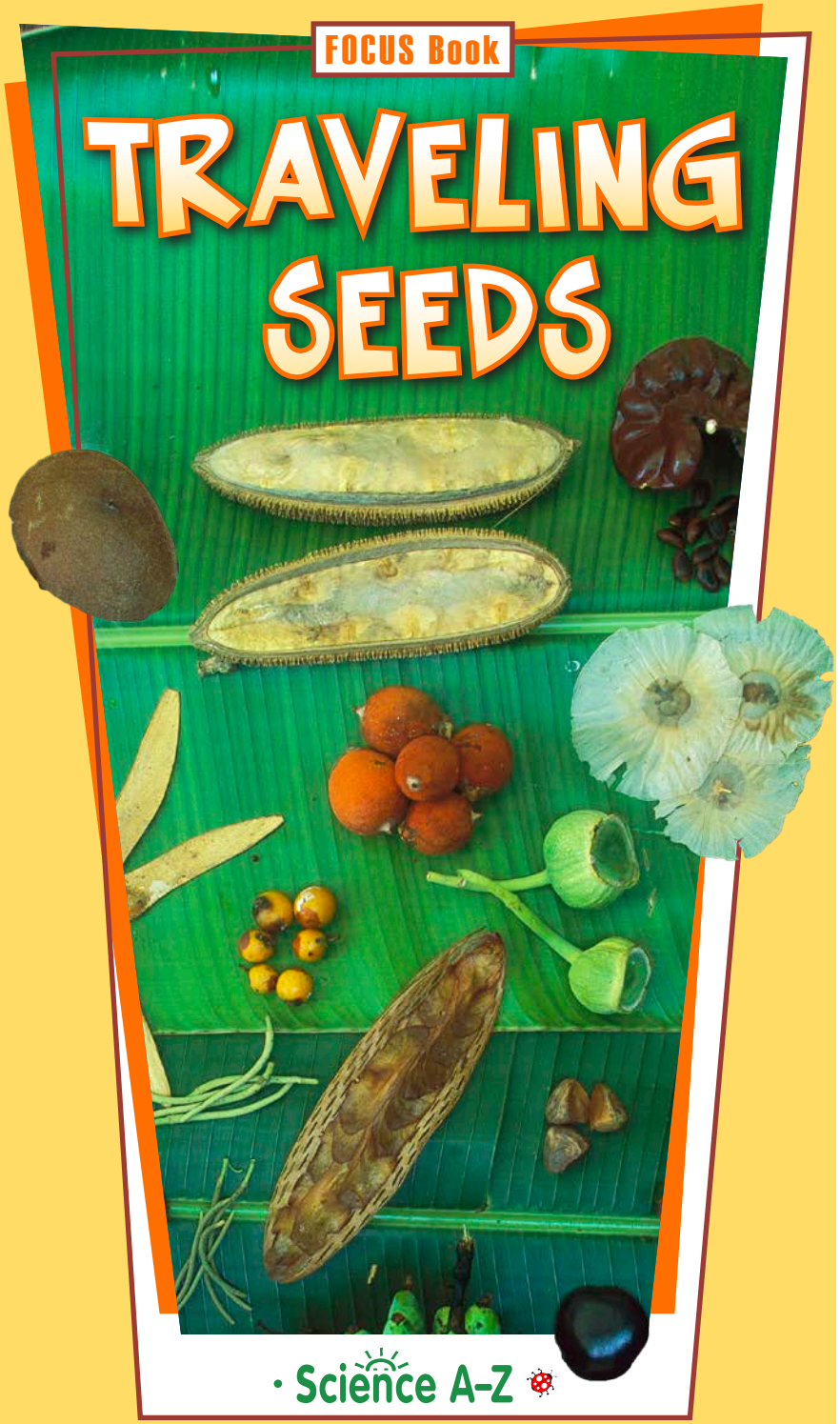
Be a Scientist!

Compare a variety of types of seeds, and test how far each type can travel. Start by gathering different kinds of seeds. You may use seeds from a packet or those found in nature. Use a fan to test how far each type of seed travels by wind.

Test the same seeds to see if they can travel by water. Then come up with two other ways to test the best way to spread, or *disperse*, the seeds.

Beyond the Book

Interview a gardener at a nursery or a botanist to find out other ways seeds find new places to grow.



TRAVELING SEEDS

FOCUS Question

How does the structure of seeds help plants survive?

Structure and Function

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Traveling Seeds
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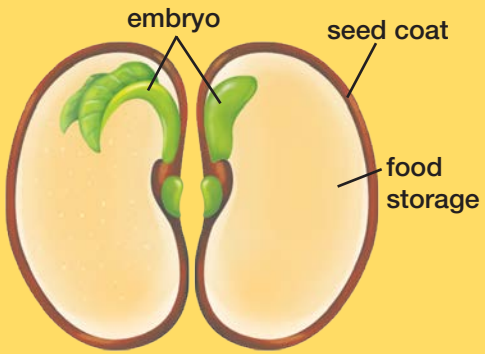
Reading Levels	
Learning A–Z	N
Lexile	550L

Correlations	
Fountas and Pinnell*	M

*Correlated independent reading level

Seeds



What do corn kernels, peas, and dandelion puffs all have in common? They are all seeds! A seed is the part of a plant that can grow into a new plant. Each seed has a strong outer shell called the *seed coat*. Inside the seed is a tiny plant, or *embryo* (EM-bree-oh). The embryo grows into a new plant. The seed also contains food for the tiny plant. This food gives the growing plant energy until it can make its own food.

Before they can grow, seeds need to find the perfect place. Seeds can grow only in places with water, air, light, and space.

Animals move by using their legs, wings, or flippers. How do seeds find the perfect place to grow? The way a seed moves depends on its size, shape, and the habitat where it grows.


bean seed sprouting

Gravity

Many seeds move by falling to the ground. Gravity causes them to move. Think about an apple. The fruit gets heavy and falls off the tree. The fruit may roll a little, but it stays close to the tree. Inside the fruit are the seeds. The fruit may rot and release seeds. Softer fruits may break open when they fall.

Eventually, the seeds get buried in the soil. There they can sprout into new plants.

Passion fruit seeds fill the fruit.

Wind

Some seeds move farther away from their parents. This way, new plants do not have to compete with their parents for water, sunlight, and space.

The wind can blow seeds far away. Seeds that move by wind have special parts to help them lift up and blow away. For example, dandelion seeds are very small and light, with a puff of fluff on top. This makes it easy for them to fly in the wind.

Dandelion seeds are light enough to float in the wind.

Think About It

Why do you think a dandelion produces so many seeds?

If you have ever watched an old Western movie, you probably saw tumbleweeds rolling down a dusty street. Tumbleweeds are dried-up plants that still have seeds. As the tumbleweeds roll, seeds break off and land in new places. Tumbleweeds can spread their seeds very far.


tumbleweed

Maple seeds also move in the wind. These seeds are sometimes called whirlybirds or helicopter seeds. They have thin wings that help them spin and fly in the wind.

Math Moment

Winged seeds can travel 200 miles in the wind, while dandelion seeds can travel 500 miles. How much farther can the dandelion seeds travel?


maple seeds

Animals

Have you ever seen a bird with a berry or a squirrel with a nut? If so, you know another way that seeds move. Animals carry them.

Animals carry seeds to new places. Insects move seeds only short distances, but birds can carry seeds far away.

Ants that move seeds use them for food. They eat the seed coat and leave the embryo to grow.

Some animals, such as squirrels and birds, bury seeds in the ground to eat later. This keeps them from being eaten by other animals. Most of the seeds do get eaten, but some of the seeds grow into new plants.

wowser!

Scientists found 32,000-year-old seeds in an old animal burrow. Amazingly, the scientists were still able to grow the seeds!

Animals can move seeds in other ways. They eat fruits filled with seeds and move to a different place. The seeds go through the animal's *digestive system*. Then they are dropped as waste. The seeds grow where they are dropped.

Other seeds have special parts such as hooks, pins, and barbs. These parts help the seed attach to an animal's fur or feathers. The animal carries the seed until it falls off. Some seeds even have a layer of slime. It makes the seeds sticky so they stay on the animal for a long time.

What structure helps this seed move?

Water

Water lilies are plants that grow in water. They make fruit that drops to the bottom. Once there, the seeds inside grow.

a water lily

Mangroves also grow in and near the water. If the water is deep, the seeds may land in the water and be carried to another place.

a mangrove seed in water

You may be surprised to know that coconuts are seeds. If these trees are growing near the ocean, their huge seeds may fall into the waves. The hard shell, made of wood, helps them float. The moving water carries them far away. Once the coconuts wash up on shore, they can grow into new trees.

a floating coconut

Explosions!

Some seeds shoot out of their seedpods.

The seedpods of a geranium (djer-AY-nee-um) are one example. As the seedpod dries out in the sun, it begins to split apart until it suddenly stops. The sudden stop causes the seeds to explode out of the seedpod.

geranium seeds

1. A geranium seedpod dries out in the sun.

2. The seedpod begins to split apart.

3. The sudden stop disperses the seeds.

The euphorbia (you-FOR-bee-uh) plant also spreads its seeds this way. When the seedpods dry, they split open in three places, and the seeds start flying.

Read-Think-Write

Write your answers on separate paper. Use details from the text as evidence.

1. Why do you think a *seed coat* is important to a plant?
2. Why might seeds that are moved by wind be different from other kinds of seeds?
3. How does hiding acorns help a squirrel? How does it help the seeds?
4. Why do some seeds move far away from their parent plant? Use an example from the book in your answer.
5. How does popping out of a seedpod help geranium seeds?

FOCUS Question

How does the structure of seeds help plants survive? Create a graphic organizer that shows how different seeds find new places to grow. Include information about how the structure of each seed helps its type of plant survive.

Science A-Z
GRAPHIC ORGANIZER

Claim, Evidence, and Reasoning

Name _____ Date _____

Directions: Ask a question that you can investigate. Once you complete the investigation, fill in each column of the chart.

Question: _____

_____

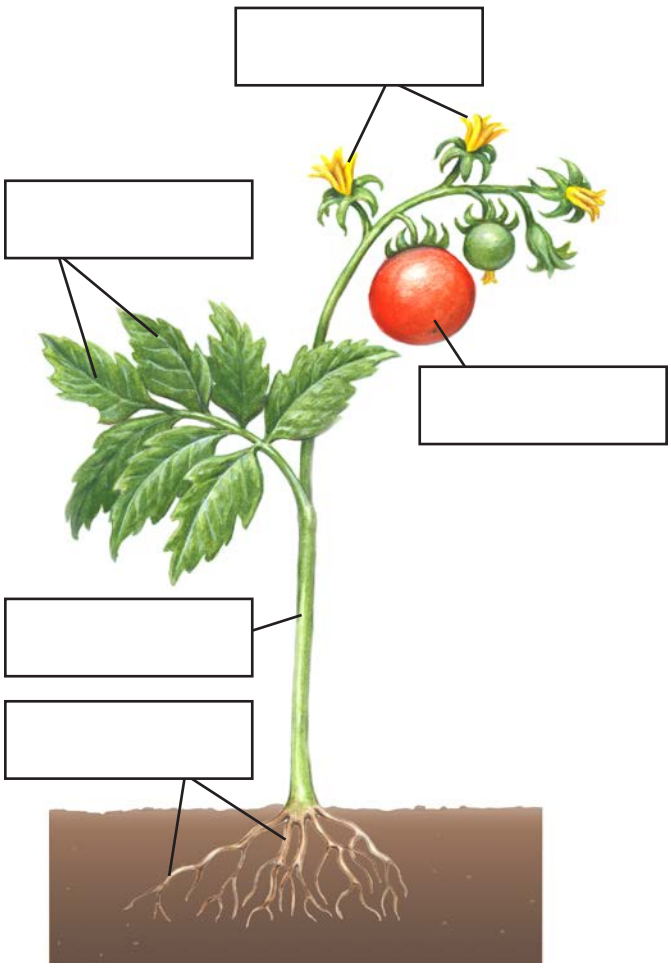
Claim a statement that answers your question	**Evidence** data and observations that support your claim	**Reasoning** how or why the evidence supports your claim
I claim that . . .	*The evidence I used to make the claim is . . .*	*The evidence helped me make the claim because . . .*

Name _____ Date _____

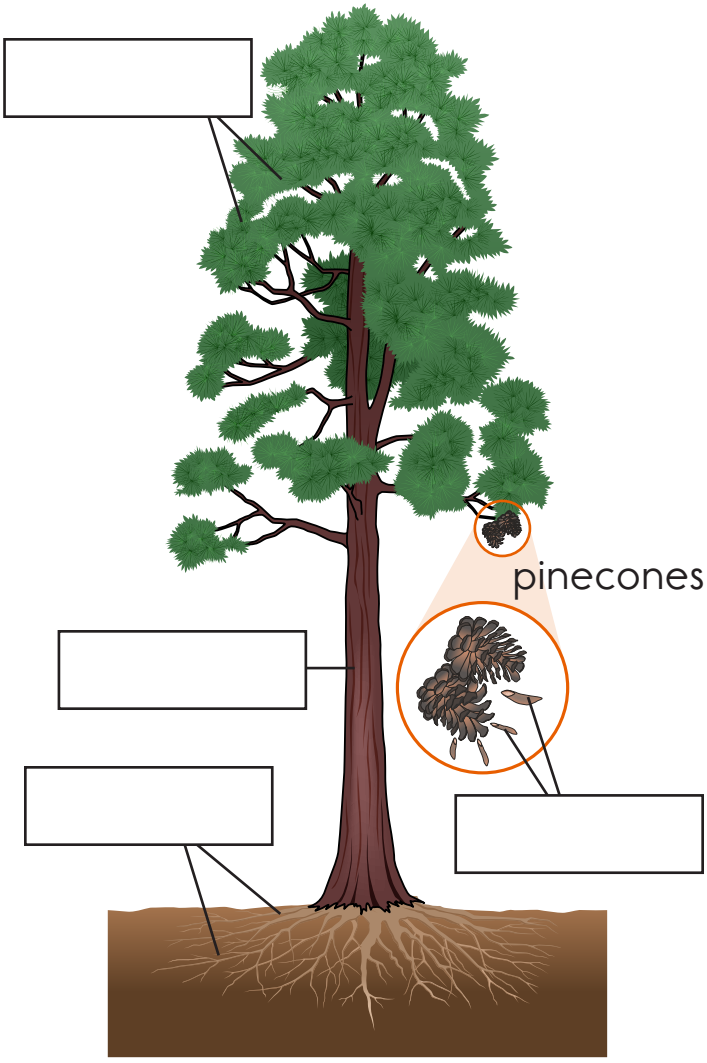
Part 1: Label the Diagrams

Look at the diagrams. Using the word bank, label the structures of each plant by filling in the boxes on the diagrams. You may need to use certain words more than once. Then complete the task to compare the plants.

flowers	leaves	fruit	roots	needles
trunk	spores	rhizoids	seeds	stem



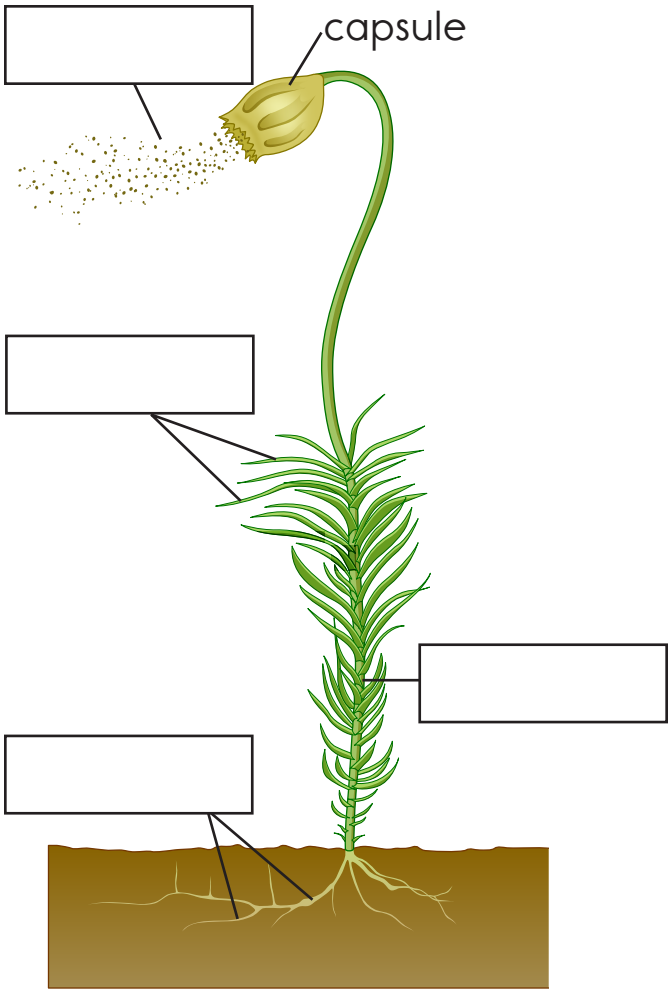
tomato plant



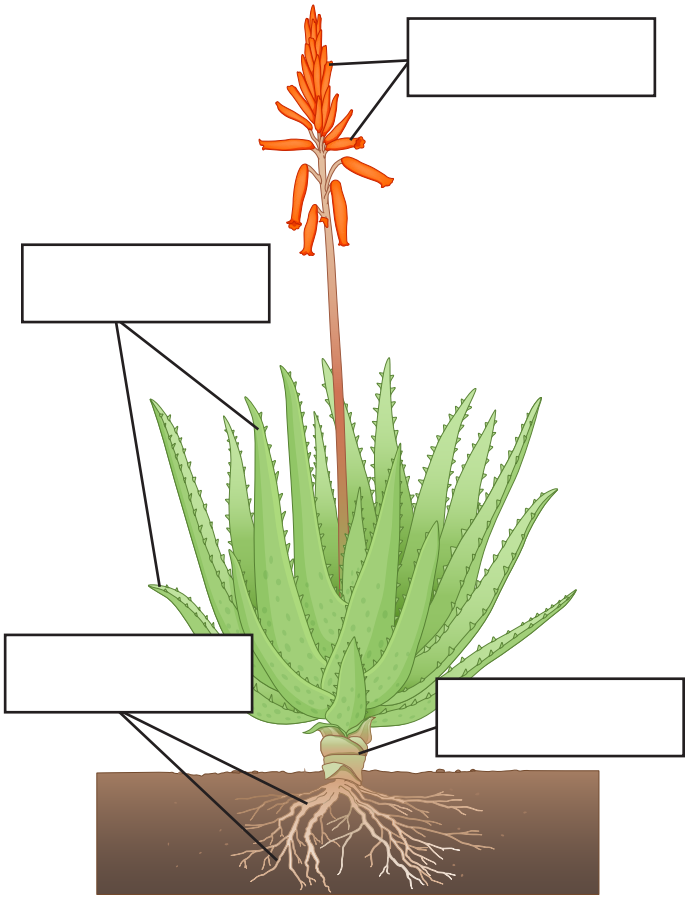
pine tree

Name _____ Date _____

flowers	leaves	fruit	roots	needles
trunk	spores	rhizoids	seeds	stem



moss



aloe

Compare the diagrams of the plants. Describe two ways these plants are similar and two ways they are different.

_____

_____

_____

Name _____ Date _____

Part 2: Complete the Table

Look at the diagrams and the word bank in Part 1. Complete the table by putting each of the plant structures from the word bank under its function.

Holds the plant in place	Carries water to leaves	Gathers sunlight to make food	Produces or stores seeds	Grows into another plant

Part 3: Make an Argument

Read the following passages. Answer the questions by making a claim, giving evidence, and explaining your reasoning.

1. A lawn mower chops the stem of a sunflower plant in half. The stem is separated from the roots. All the leaves are cut away from the rest of the plant. Will the sunflower plant be able to survive?

Claim: _____

_____

Evidence: _____

_____

Reasoning: _____

_____

_____

Name _____ Date _____

2. Birds munch all the fruits on a bush, but they don't eat the leaves or the stem. Will the bush survive?

Claim: _____

_____

Evidence: _____

_____

Reasoning: _____

_____

_____

3. Insect grubs eat all the roots of a young tree. Will the tree survive?

Claim: _____

_____

Evidence: _____

_____

Reasoning: _____

_____

_____

ANSWER KEY AND TEACHING TIPS

Connections to the Next Generation Science Standards*

Target Science and Engineering Practice: *Engaging in Argument from Evidence*

- Construct an argument with evidence, data, and/or a model.

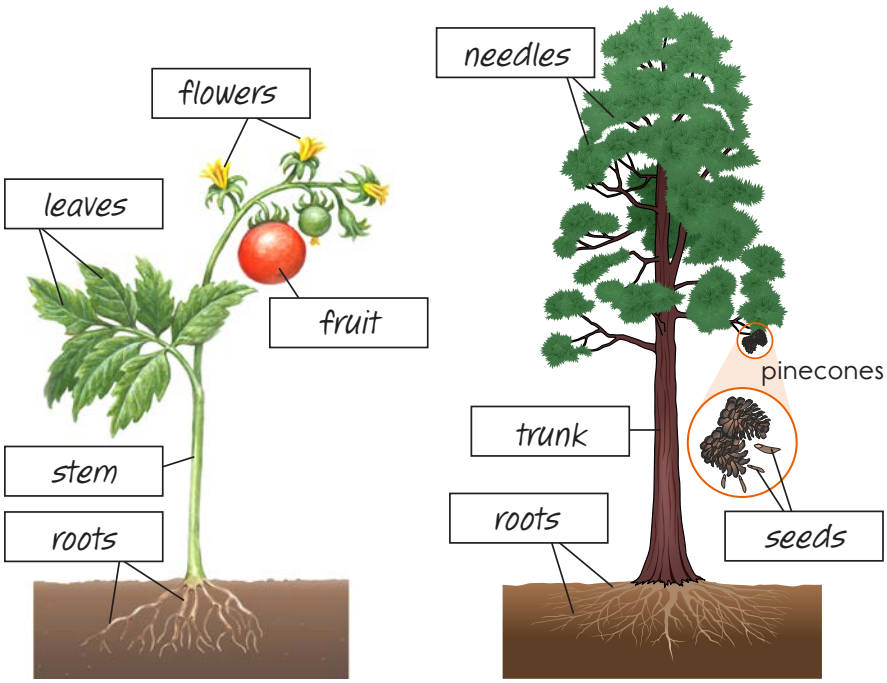
Associated Performance Expectation: *4-LS1-1. Construct an argument that plants and animals have internal and external structures that function to support survival, growth, behavior, and reproduction.*

All questions in this assessment relate to the Disciplinary Core Ideas DCI of this Performance Expectation. Look for the SEP and CCC symbols for questions that specifically address Science and Engineering Practices and Crosscutting Concepts.

Summary

Students identify plant structures and compare the similarities and differences among four plants. They group the various plant structures by their function and then use this information to make arguments related to whether plants can survive under different circumstances.

SEP Part 1: Label the Diagrams



tomato plant pine tree

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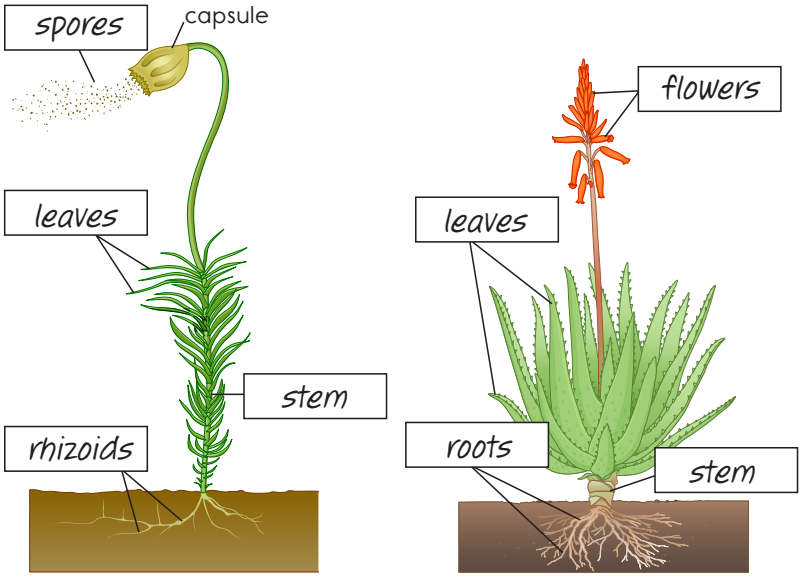

moss aloe

Other acceptable answers for the pine tree labels include: leaves *instead of* needles *and* stem *instead of* trunk.

Responses to the writing task will vary depending on how students choose to compare the plants. Accept all answers that demonstrate careful analysis of similar and different structures on the four plants. Sample response:

All the plants have some kind of leaves or needles. All the plants have a stem or a trunk.

The leaves or needles of the plants are different shapes. The plants don't all have flowers.

CCC Part 2: Complete the Table

Students should fill in the table as shown below. Accept the answers in parentheses, if given. While not directly involved in the stated function, the roots do draw in water that eventually goes to the leaves, and the fruit holds the seeds that eventually become a new plant.

Holds the plant in place	Carries water to leaves	Gathers sunlight to make food	Produces or stores seeds	Grows into another plant
rhizoids roots	stem trunk (roots)	leaves needles	flowers fruit	seeds spores (fruit)

SEP CCC Part 3: Make an Argument

1. Claim: *The sunflower plant will not survive.*

   Evidence: *The sunflower plant will not survive because the lawn mower cut down the stem. The stem was separated from the roots, and the leaves were separated from the rest of the plant.*

   Reasoning: *Without the stem, the sunflower plant cannot bring water from its roots to its leaves. Without leaves, the plant cannot gather sunlight to make food. The plant needs water and food to survive.*

2. Claim: *The bush will survive.*

   Evidence: *The bush will survive because the birds ate only the fruits. The birds did not eat the leaves or the stem.*

   Reasoning: *Fruits are the part of a plant that holds seeds. The seeds grow into new plants and help the plant reproduce, but they don't help the plant itself survive. The birds didn't eat the leaves or the stem, which the bush does need to survive.*

3. Claim: *The tree will not survive.*

   Evidence: *The tree will not survive because the insect grubs ate all of the tree's roots.*

   Reasoning: *The roots hold the tree in place and help it get water from the soil. Without the roots, the tree cannot get water and will likely fall over.*

Teaching Tips

If students have trouble performing the tasks on this assessment, ask them to look back at the observations they recorded while analyzing the texts during Lesson 1. As a class, discuss the structures and functions of the various plant parts they listed in their table. Then work together to identify the structures and related functions of the plants in Parts 1 and 2 of the assessment. Also, ask students to review the *Claim, Evidence, and Reasoning Graphic Organizer* they completed to answer the Guiding Question. Help them understand how this type of argument can be used to answer the questions in Part 3.

Extensions

For students who complete their work early or are ready for an extra challenge, assign additional resources related to this topic found on the Grade 4 Structure, Function, and Information Processing NGSS page on Science A–Z.

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