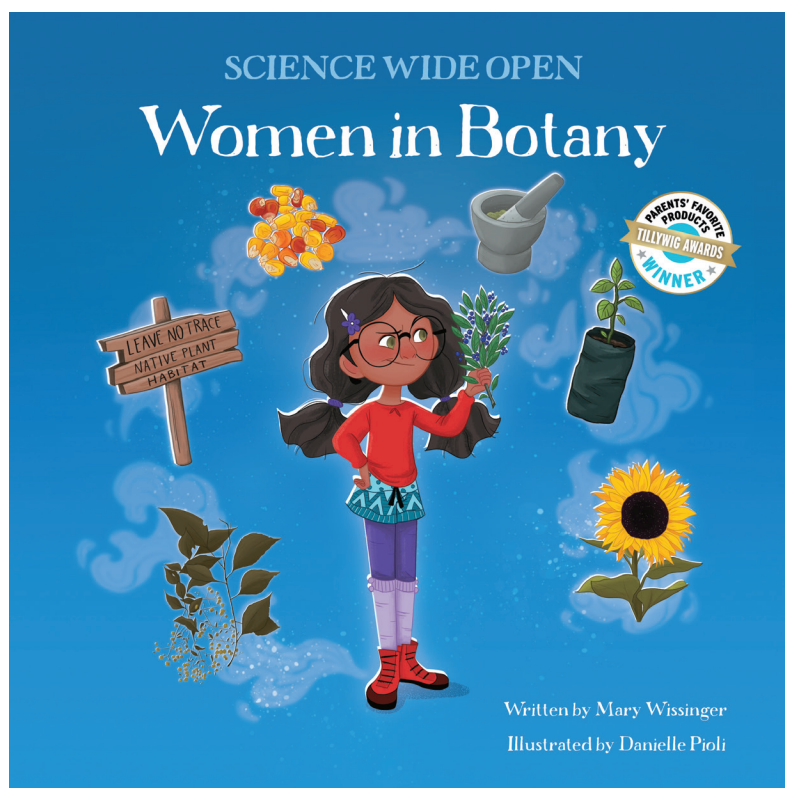


Women in Botany Teacher's Guide

Written and designed by Caitlin Burnham, Hannah Thelen, Marlee Brooks, Chloe Cattaneo, Andie Bjornsfelt, and Liliann Albelbaisi



To be used with: *Women in Botany/Las mujeres en la botánica*

Written by Mary Wissinger

Illustrated by Danielle Pioli

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About the Author: Mary Wissinger



Mary was born in Wisconsin where she spent most of her childhood singing, reading, and daydreaming. She dove into storytelling through acting, singing, and writing (and writing and writing).

While spending time as a classroom teacher sharing the magic of music, she saw firsthand the incredible life-changing power of stories. The stories children read become the stories they play, and then the stories they tell.

Mary can now be found at her standing desk in St. Louis, MO, writing stories that inspire curiosity about the world and connection with others. (But don't worry, she still sings with the Saint Louis Symphony Chorus.)

Mary is also the author of the Science Wide Open series. She can be reached at Mary.Wissinger@ScienceNaturally.com.

About the Illustrator: Danielle Pioli



As children usually do, Danielle always loved drawing. The idea of creating a whole universe—from her mind to paper—made her fall in love with art and storytelling. She also always felt like a healer at some level. As a child in Sao Paulo, Brazil, she was so drawn to magic —what she calls Quantum Physics now—that she was certain she could heal and help people. Because of this, she grew up to become an artist and hypnotherapist/energy healer.

Danielle is the illustrator for the Science Wide Open series. She can be reached at Danielle.Pioli@ScienceNaturally.com.

Women in Botany

Teacher's Guide Contributors

Science Naturally would like to thank the following people for their hard work, invaluable insight, and dedicated time in creating *Women in Botany/Las mujeres en la botanica* and its accompanying Teacher's Guide:



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Resources

Botany is the study of plants and their respective systems, and has been around since the ancient Egyptians and Greeks. From labeling and classifying plants to finding medicinal components in nature that can cure ailments, botany has been imperative to setting the foundation for many sciences and disciplines.

Botany plays an important role in other scientific areas as well, from chemistry, biology, and genetics to agriculture, forestry, and environmental management.

This teacher's guide includes assignments, activities, and worksheets to support any student with a keen interest in botany. The resources listed below are a way for students to expand and deepen their knowledge about the subjects covered in *Women in Botany*.

Videos on Botany:

- Parts of a Plant for kids | Parts of a Plant
- How Does A Seed Become A Plant? | Backyard Science | SciShow Kids
- Grow Your Own Plants! - #sciencegoals
- Photosynthesis | Photosynthesis in plants | Photosynthesis - Biology basics for children | elearnin

Books to Foster Curiosity:

- *From Seed to Plant* by Gail Gibbons
- *A Fruit is a Suitcase for Seeds* by Jean Richards
- *In a Nutshell* by Joseph Anthony
- *One Bean* by Anne Rockwell (goes with Activity 3)
- *The Magic School Bus Plants a Seed* by Joanna Cole

Websites to Interact with:

- Carrots are Orange
<https://carrotsareorange.com/botany-for-preschoolers/>
- Ava's Flowers
<https://www.avasflowers.net/the-study-of-plants-and-flowers-a-botany-guide-for-kids-and-stude>
- Sugar Spice and Glitter
<https://sugarspiceandglitter.com/botany/>

Podcasts to Listen to:

- But Why: A Podcast for Curious Kids
<https://podcasts.apple.com/ca/podcast/why-are-cactuses-spiky/id1103320303?i=1000507050836>

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Meet the Women

Women in Botany/Las mujeres en la botánica introduces children to the fascinating world of botany through the lives of some of the most trailblazing women in scientific history. As readers learn about each woman's accomplishments and research methods, they will be able to see the immense impact botanists have had on everyday life.

Women in Botany/Las mujeres en la botánica explores the discoveries of the following women:

Waheenee/Buffalo Bird Woman (Mandan, Hidatsa, & Arikara Nation, ca. 1839-1932): Waheenee grew all the food for her community by using traditional ways of planting that had been passed down for generations, sharing her important history and methods to others. An ethnographer named Gilbert Wilson interviewed Waheenee, her brother, and her son about Hidatsa agricultural practices. Over ten years worth of interviews resulted in *Buffalo Bird Woman's Garden: Agriculture of the Hidatsa Indians*, a book compiled of Waheenee's stories about her life and work, as well as Hidatsa's origin myths, the history of her tribe, and her tribe's culture.

Elizabeth Coleman (United States, 1871-1954): Elizabeth Coleman began working on her father's cranberry farm when she was a teenager and soon became interested in harvesting the wild blueberries that surrounded it. She contacted a botanist at the United States Department of Agriculture, Frederick Coville, and persuaded him to help her cultivate and harvest the blueberries. She was in charge of the land and finding the blueberry bushes for their experiments and he was in charge of providing his expertise. After many years of trial-and-error, the duo finally cultivated the first blueberry crop in 1916 and sold it under the name Tru-Blu-Berries. Thanks to her persistence, blueberries are now grown and eaten all around the world.

Ynés Mexía (United States, 1870-1938): Ynés Mexía started her career in botany at age 52 when she joined an expedition led by the curator of paleontology at UC Berkeley. Her success as a botanist began a couple years later after a two-month excursion to Mexico which yielded 500 specimens, including several new botanical species. She found her work fulfilling and purposeful, and once described to her friend that she had a job where she could "[produce something real and lasting]." Mexía traveled from Alaska to the southernmost region of Chile to conduct her research and findings, which greatly added to the Linnaean system that we use today. Though her career was shorter than most other botanists'—only 13 years—she collected at least 140,000 specimens, including 500 new species, during her expeditions.

Loredana Marcello (Venice, Italy, ca. 1533-1572): Loredana Marcello was aptly referred to as *fiore de'l secolo*, meaning "flower of the century" in Italian. A highly educated woman for her time, she was a scholar and studied botany at the Biological Garden in Padua, Italy. Marcello experimented with plants, using them to create herbal medicines. Her botanical research was used when the plague reached Venice just a few years after her death and her traditional remedies are still used today.

Meet the Women continued

Dr. Janaki Ammal (India, 1897-1984): Dr. Janaki Ammal began her higher education at Presidency College in Mandras, India where she obtained a degree in botany. She continued her education at the University of Michigan where she received her master's degree in botany in 1926 and a PhD in 1931. From there, she joined the Sugarcane Breeding Station, which was created to improve India's native sugarcane varieties. At that time, the sweetest sugarcane in the world was a variety from Papua New Guinea, but after years of researching and experimenting with hybrids, Janaki was able to create a sugarcane strain that would thrive in India's environment. Toward the end of her career, the Indian government invited her to lead the Botanical Survey of India, where she documented and studied every type of plant in the country, and fought to protect and preserve nature from development.

Dr. Wangari Maathai (Kenya, 1940-2011): In 1977, Dr. Wangari Maathai founded the Green Belt Movement, a non-governmental organization that focused on planting trees, environmental conservation, and women's rights, in response to the environmental concerns rural Kenyan women expressed. Her experience with environmental studies began in the mid-1960s during her time at the University of Pittsburgh when local activists fought to rid the city of air pollution. The movement expanded throughout Africa in 1986 and led to the beginnings of the Pan-African Green Belt Network. Over the next three years, several representatives from 15 African nations traveled to Kenya to learn from Maathai how to set up similar programs in their own countries. In 2004, she became the first African woman to be awarded the Nobel Peace Prize for her "contribution to sustainable development, democracy and peace."

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Before Reading: Exploring the Natural World

Grades: Pre-K – 3rd grade

NGSS: 2-PS1-1

Materials: *Women in Botany/Las mujeres en la botánica*, pencil, paper, clipboard

Skills: Critical thinking, making observations, making inferences, sorting

Subject: Observing nature

Background

Women in Botany/Las mujeres en la botánica introduces kids to the diversity of the plant world. Studying botany is incredibly fascinating and can start a lifelong curiosity in science! Before jumping into the book with your students, take them outside and see what they can observe on their own in nature.

Activity

1. Choose a sunny day to go for a nature walk. Ask the students to take a pencil, paper, and clipboard with them to write down or draw what they observe.
2. Take fifteen minutes to let the students roam independently (but within sight—make sure the boundaries of where they can and cannot roam are clear) to write down all the plants they can find. If they don't know the name of a plant, tell them to sketch a quick drawing or write a description of what it looks like.
3. Bring the students back inside and come back together as a class. On the whiteboard, write down what everyone saw.
4. Put the students into four groups of equal size. Each group will write down a list (for younger students, they can simply brainstorm aloud) what the plants they saw had in common, and what made them different from one another.
5. Bring the class together and have each group share what they observed about the similarities and differences between their plants.

Discussion

What are some of the similarities you observed between the plants you saw on your walk? Do you think the plants you saw today were mostly similar to each other, or mostly different? Why do you think plants living in the same environment might be similar to one another? How many different colors of plants did you see today? Did you learn any new names for plants today?

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After Reading: Labeling the Parts of Plants

Grades: 3rd grade - 5th grade

NGSS: 3-LS1-1

Materials: *Women in Botany/Las mujeres en la botánica*, Parts of a Plant worksheet, pencil, colored pencils

Skills: Identifying, critical thinking, sorting

Subject: Plant anatomy

Background

There are many parts of a plant—from the roots growing in the ground, to flowers that bloom during the spring and summer. The scientists featured in *Women in Botany/Las mujeres en la botánica* spent years studying different plants to fully understand its functions and capabilities, and in doing so, they were able to help others with their discoveries!

Activity

1. Print out one copy of the Parts of a Plant worksheet for each student (on page 26).
2. Give the students 15–20 minutes to complete the worksheet, offering help when necessary. The students should work independently.
3. When the students are done completing the worksheets, distribute colored pencils so they can color in the parts of the plant.
4. Once the students finish coloring their worksheet, bring the class together to go over each part of the plant and its respective functions.

Discussion

What part of the plant was the most surprising to see? Which functions did you not expect from a plant?

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After Reading: Hands-on Germination

Grades: Kindergarten - 3rd grade

NGSS: 2-LS2-1, 3-LS4-3

Materials: *Women in Botany/Las mujeres en la botánica*, pinto beans, ziploc bags, paper towels, spray bottle filled with water

Skills: identifying, critical thinking, observing

Subject: Germination

Background

This activity allows students to get a closer look at the process of germination. Usually, you can't see a plant beginning to sprout because it's hidden under the soil, but this experiment allows you to observe the process aboveground. By sprouting the beans in between wet paper towels, the process of germination is sped up— the beans are consistently moist, and the plastic bags produce a greenhouse effect (meaning they trap heat and keep it close to the plant) when placed in a bright and warm place. This project is easy and less messy than using soil to plant the seeds. It also takes up less space than using pots for each student.

Activity

1. Give each student a piece of paper towel and provide a spray bottle for each table/group of 4 students. When every student has a paper towel, instruct them to use the spray bottle to thoroughly dampen the paper towel with water (for younger students, circulate and dampen each student's paper towel for them). The paper towels should be quite damp, but not completely soaked.
2. Next, each student will place a bean on top of the wet paper towel. Make sure the bean is moist (patting it with the wet paper towel can help).
3. Have each student fold the paper towel in half over the bean, so it is sandwiched between the folded paper towel.
4. Provide each student with a ziploc bag and instruct them to label the bags with their names using a sharpie (or washable markers for younger students).
5. Instruct each student to place their paper towel-wrapped bean into their ziploc bag and seal it tightly. There should not be any cracks for air to escape. Students can test this by squeezing the bag gently to see if air escapes and if they need to seal the bag more tightly.
6. Collect the bags from each student and place them in a warm area. A sunny window or in front of a heating vent would be ideal.
7. In 3-5 days, each student may open up their plastic bags, unfold the paper towel and observe their plants beginning to sprout!

Hands-on Germination continued

Discussion

Begin by asking the students what they think every plant needs to sprout? Does every student's bean look the same? Did some sprout more or less than others? If so, why do you think there are differences between the sprouts?

Look closely at the bean sprouts. What do you notice about them? What do you think they would look like if they were sprouting in the soil, instead of between paper towels (an illustration may be found on page 10 of *Women in Botany/Las mujeres en la botánica*)? What do you think the plants will look like in a few more days? Sketch what your plant looks like now, and then what you think it will look like in a few days.

Expanding the Activity

1. Divide the class in half. Half the students will prepare their beans exactly as directed above, and the other half will follow all the same instructions, except they will place their bags in a shady, darker area instead of a sunny one. Over the next few days, have the students observe the similarities and differences between the bags in a sunny area and the bags in a shady area. Ask them to reflect on their observations and the importance of sunlight in growing plants. Do plants need to be in the sun all the time in order to grow, or just sometimes? Are plants still able to grow in the shade? Does sunlight only speed up the process of plant growth, or is it necessary for plants to grow at all?
2. Divide the class in half. Half the students will prepare their beans exactly as directed above, opening their bags to observe the beans only after five days. The other half will follow all the same instructions, except they will open their bags and observe the beans after three days. What differences do the students notice between the beans after three days versus the beans after five days? Were the students able to predict the differences between the beans, or were they surprised? Based on the activity, ask the students to predict how long a seed (or a bean) might take to fully germinate/sprout.

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After Reading: Environmental Conservation vs. Preservation

Grades: 3rd grade - 5th grade

NGSS: 4-ESS3-1, 5-ESS3-1

Materials: *Women in Botany/Las mujeres en la botánica* and cards (located on page 28)

Skills: Critical thinking, comparing and contrasting, partner work, learning new vocabulary, sorting

Subject: Conservation and Preservation

Background

When it comes to our future on this planet, many environmentalists look to conservation and preservation. Both are efforts to protect the environment and our natural resources, but conservation is made to regulate human use and damage of natural resources while preservation takes a more severe approach of removing human use entirely.

Conservation focuses on creating a balanced relationship between humans and nature, so that humans do not cause too much damage to the environment while still being able to use its resources. Preservation, on the other hand, removes the human from the equation to keep nature as it was and without any modifications from humans.

This activity lets the students realize the two different ways humans protect nature, and lets them see the distinction between these two tactics.

Activity

1. Cut out the cards along the dotted lines.
2. Divide class into groups, or have them find a partner if the class is small.
3. Tell your students the definition of conservation and preservation.
4. Give the students the cards that have listed examples of things done to protect the planet. Students must decide whether it is conservation or preservation. Allow them 5-10 minutes to sort the cards.
5. Once the students have finished sorting the cards, bring them back to go over the answers, and explain why each example is conservation or preservation.

Discussion

What did you think of the differences between conservation and preservation? Which of these examples surprised you the most? Which one do you find more protective of the environment? Do you find one of these methods more productive and better? Why?

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After Reading: Visualizing Photosynthesis

Grades: 1st grade - 3rd grade

NGSS: 2-LS2-1

Materials: *Women in Botany/Las mujeres en la botánica*, small clear jars, 5-10 different varieties of leaves, pens, sticky notes, a timer

Skills: Critical thinking, observation, finding patterns

Subject: Photosynthesis

Background

This activity introduces the basics of photosynthesis (the process of turning sunlight into energy). During photosynthesis, chlorophyll within the chloroplasts of the plant absorbs energy from the sun. This energy is then used to combine water, which the plant absorbs through its roots, and carbon dioxide, which the plants absorb from the air. This combination of carbon dioxide and water makes food for the plant. The plant consumes this “food” and releases all the extra oxygen that it doesn’t need back into the air through its leaves. In this activity, you can visualize this process right inside your classroom: when the leaves release oxygen, it gets trapped underwater and creates bubbles.

Activity

1. Review the process of photosynthesis with your students. A basic description of the process with an accompanying illustration may be found on page 15 of *Women in Botany/Las mujeres en la botánica*.
2. Instruct students to pick five different leaves from various trees and bushes for the experiment (for a larger class, pick up to ten). Make sure each leaf is from a different tree or bush. You can take the students outside before class to pick leaves, or simply pick them beforehand.
3. While the class watches, pour equal amounts of water into clear jars (one for each leaf). The leaves should be completely covered with water.
4. Place one leaf into each jar.
5. Write the name of each leaf/the name of the tree or bush from which they came on a sticky note. If you do not know the names of the different leaves, simply label them as “leaf 1-5/10”. Place the sticky notes on the corresponding jars.
6. Set a timer for thirty minutes. While you wait, discuss the process of photosynthesis with your students. Ask them if they feel they understand the process well enough to explain it to a partner. If not, review the information and diagram on page 15 of *Women in Botany/Las mujeres en la botánica*.
7. After thirty minutes, call the class back together to look at the leaves in their jars and observe which leaves have produced the most bubbles.

After Reading: Visualizing Photosynthesis

Discussion

Why do you think some plants produced more bubbles than others? What does this mean about the process of photosynthesis (is it different or the same for every plant)? Did you notice that smaller leaves made more bubbles, or did larger leaves make more bubbles? What other patterns can you observe about which kinds of leaves made more bubbles, and which kinds of leaves made less?

Have you ever tried blowing bubbles with your face in water, or blowing bubbles into a glass of water through a straw? Can you guess why humans are also able to create bubbles underwater?

The process of photosynthesis is very important for all life on earth. Why do you think it's so important? Do us humans need plants to continue performing photosynthesis, too? How do we benefit from photosynthesis? What would happen if plants didn't create a lot of oxygen during photosynthesis?

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After Reading: Capillary Action

Grades: 3rd grade - 5th grade

NGSS: 3-LS2-1

Materials: *Women in Botany/Las mujeres en la botánica*, white flowers, four cups of water, four shades of food coloring

Skills: Critical thinking, making references

Subject: Osmosis

Background

Flowers need water to grow, so the roots and stem of the flower drink any water it may find to help the petals on the flower grow. The stem and roots bring the water up to the rest of the flower's body, this is called capillary action. Capillary action is defined as the movement of water in a narrow space without the help of gravity—sometimes moving against gravity! Gravity is the reason why we come down after jumping instead of floating in the air, so naturally water must always move downwards unless it is in capillary action!

This experiment is going to demonstrate firsthand how capillary action works, as we will actually see the water we use to help our flowers grow.

Activity

1. Bring out four white flowers, four cups of water, and four different colors of food coloring.
2. Allow students (if old enough) to help you color the four cups of water a different color. Then cut the tip of the stems to help the flower soak up the water quickly. Place the waters in a sunny spot and let them sit for a day.
3. The next day, allow the students to make notes of what changes occurred since yesterday. Note: the white petals should have turned to whatever color was in the water. Explain to them what occurred to the flowers.

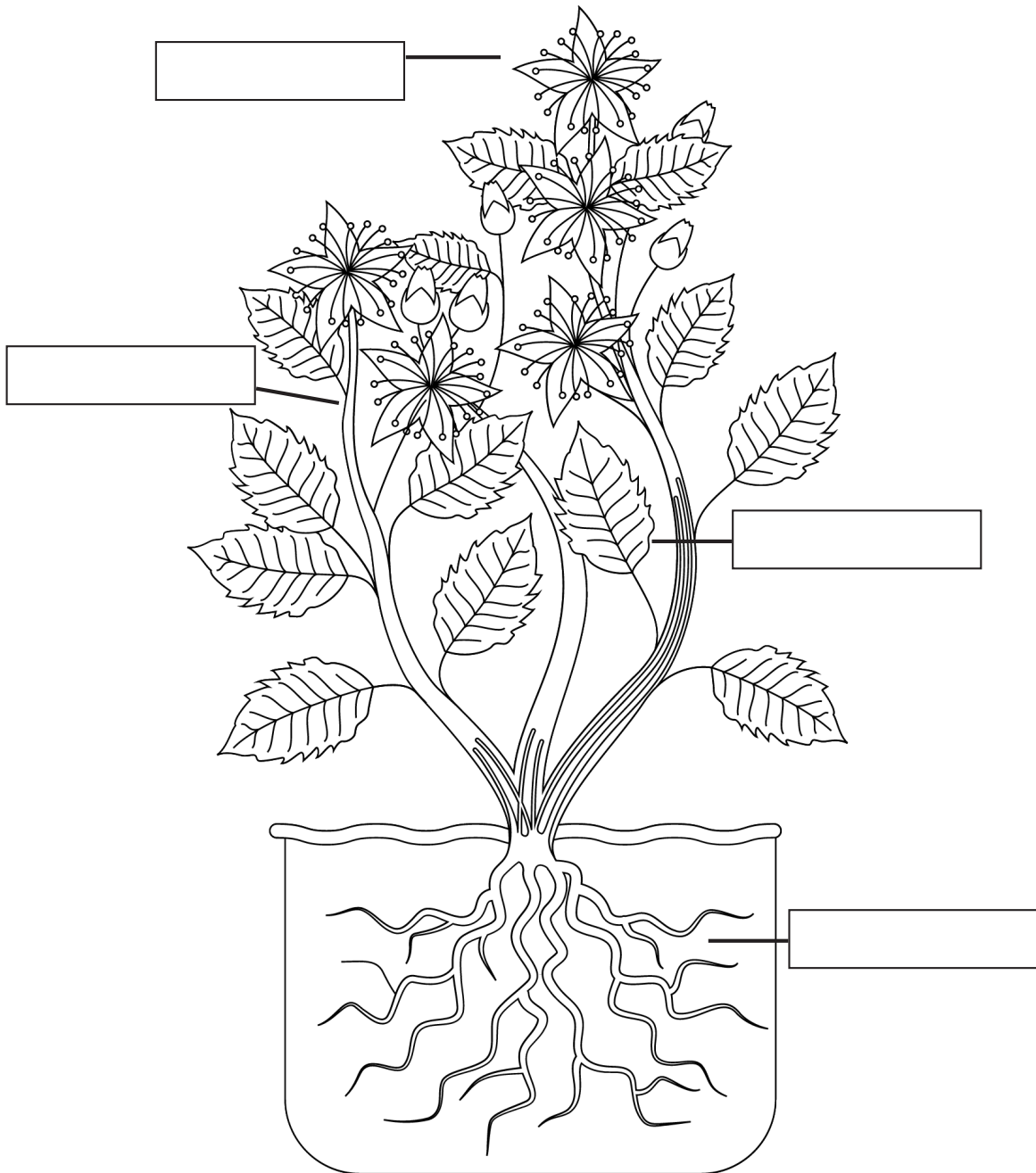
Discussion

Why do you think the flower changed colors? How do flowers drink water?

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Parts of a Plant

Name: _____ Date: _____



Word Bank

FLOWER

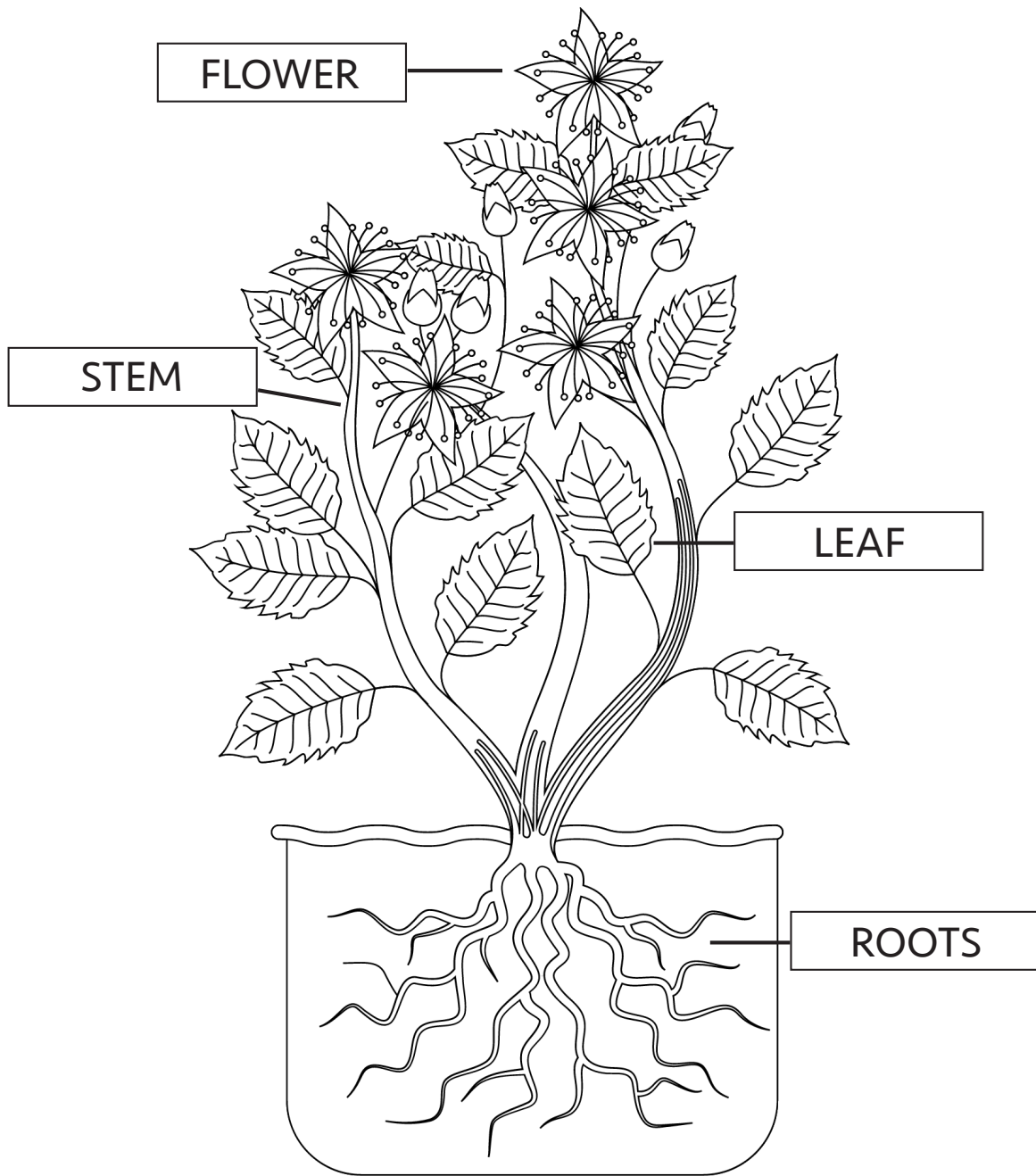
LEAF

STEM

ROOTS

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Parts of a Plant: Answer Key



Word Bank

FLOWER

LEAF

STEM

ROOTS

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Environmental Conservation vs. Preservation Cards

Conservation:

Using our natural resources properly and not stripping our environment of its resources.

Preservation:

Protecting our natural resources from being overused and lost
by prohibiting the use of it from humans.

Planting Trees

Panda Habitat

Creating a Nature Reserve

Hunting Restrictions

Recycling

Endangered Species Act

Sustainable Logging

Sectioning off a part of the forest from the public

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**Sparking curiosity
through reading**