

Lesson 8

How a Cactus Survives



Big Idea

Organisms have characteristics that make it possible for them to survive in their habitat.

A QUICK LOOK

Overview

Children observe characteristics of a living cactus plant. They talk about how the cactus looks different from other plants, and then compare models of how cactus and other plants' stems retain water.

Key Notes

- This lesson takes place in two sessions, with time between them. Plan on about 30 minutes for the demonstration, introductory discussion, and the beginning of the exploration. After the flat paper towel has dried (which could take 60 to 90 minutes or overnight...depending on the conditions in your classroom), plan on another 15 minutes for recording observations and conducting the synthesizing discussion.
- If the children in your class need more experience understanding what models are and how they are used in science, consider teaching Skill Building Activity "Using Models in Science" on page 238.
- For more information about the science content in this lesson, see the "Survival Characteristics" section of the Teacher Background Information on page 257.

Lesson 8

Standards and Benchmarks

Focusing on the physical characteristics of a cactus plant that help it survive in a desert habitat, this lesson meets The Living Environment Benchmarks 5A and 5F (Diversity of Life and Evolution of Life), as well as Life Science Standard C (The Characteristics of Organisms): “Each plant or animal has different structures that serve different functions in growth, survival, and reproduction.”

Lesson Goals

1. Compare models of how cactus and other plants’ stems retain water.
2. Realize that a cactus plant’s thick shape and waxy outer coating help keep moisture in.
3. Understand that the physical characteristics that help a cactus retain water allow it to survive in a desert habitat.

Assessment

Observe the children as they construct, use, and reflect on the model plant stems. Do they understand how the paper towels represent different kinds of plant stems? Are they able to understand how cactus plants retain water, based on using the models? Use Assessment 6 to assess the children’s understanding of these ideas.

NOTES

Habitats Assessment 6: Creating and Using Models

As you evaluate the children’s discussions, their work in their science notebooks, and their models, consider whether they demonstrate understanding of the following concepts.

Children’s Names	Assessment Criteria:			
	A. A model is a representation of something.	B. A model can be constructed to represent a scientific idea.	C. It is important to interpret other models such as a peer’s or a scientist’s model.	D. Another model can be critiqued and compared to one’s own model.
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Assessment 6: Creating and Using Models Habitats Teacher Master 8

Teacher Master 8, Assessment 6

Materials

Item	Quantity	Notes
ExploraGear		
Magnifying lenses	1 per group	For optional sensory observation.
Classroom Supplies		
Cactus plants in pots (Aloe vera plants can also be used.)	1-3	For the introductory discussion, demonstration, and further science exploration.
Gardening gloves (optional)	1 pair	To protect hands while cutting cactus.
Knife, sharp (optional)	1	To cut cactus.
Paper towels	13 sheets per group plus 1 extra	To make model stems.
Plates, non-breakable (optional)	1 per group	To hold cactus sections for sensory observation.
Trays	1 per group	To put model stems on.
Twist ties	12 per group	To hold model stems together.
Water in basins	3	To wet model stems.
Waxed paper	1 sheet per group	To wrap around one model stem.
Curriculum Items		
<i>Habitats Science Notebook, pages 16-19</i>		
Habitats Assessment 6: Creating and Using Models (optional)		
Family Link Homework “Your Special Spot Outside: Weekly Visit”		

NOTES

Preparation

- Purchase at least two small cactus plants in about 3 inch pots. If cactus plants are unavailable, another succulent plant such as aloe vera can be used. You need one for the demonstration and one for a further science exploration. Choose plants that have stout spines instead of small, abundant spines. You will also need a small tropical houseplant of the same size for the further science exploration.
- Collect the items needed for the exploration: trays, paper towels, twist ties, and waxed paper.
- Fill three basins with water, where children will wet their paper towel columns.
- This lesson takes place in two sessions. The time between sessions depends on the warmth and dryness of the spot where the children put their wet paper towel columns. You will be able to gauge when to begin the second session by monitoring how long it takes for a flat, wet paper towel to dry. When it has just dried, have children begin recording observations. Their columns should still be damp.

- ❑ Have the mini-habitat available in the **Science Center** for the children to make appropriate observations of the plants in it.
- ❑ Copy the **Family Link Homework, “Your Special Spot Outside: Weekly Visit,”** for each child. Consider adding a “bonus question” to the second page before copying it. An example question might be: Describe a plant in your special spot. What does its stem look like?

Vocabulary

evaporation The process in which liquid water changes to an invisible gas in the air.

Teaching the Lesson

Engage

Introductory Discussion

1. Show the children the cactus plants. Help them discover how a cactus looks different from other plants with which they are familiar. Compile a list from the discussion on the board. *(For example, it’s fat and thick, it doesn’t have leaves, it has spines.)*

TEACHER NOTE: To get more ideas about cactus plant characteristics, you may want to have the children refer to the illustrations on page 16 in their science notebooks.

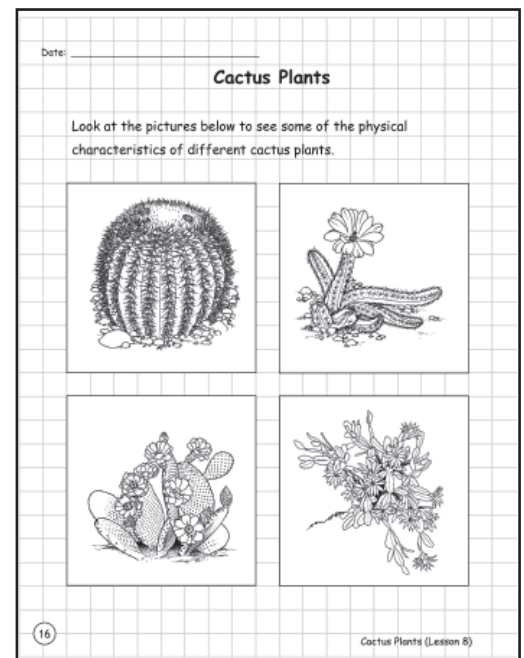
2. Tell the children that today they will explore how and why many of these characteristics help cactus plants save water in a dry habitat.

Demonstration and Sensory Observation (Optional)

1. Use a sharp knife to cut a cactus plant in half, crosswise. Cut several cross sections, being careful to maneuver between the spines. Lay the pieces on plates and pass them around the classroom along with magnifying lenses.
2. As the children observe and mention additional characteristics they can see by using the magnifying lenses to examine the cactus pieces, add them to the list on the board. *(For example, the cactus has a juicy inside stem, or there’s a waxy outer coating that can be peeled off.)*

+ SAFETY NOTE: Do not let any children touch the ends of the spines of a cactus. They are very sharp and get under the skin easily.

NOTES



Science Notebook page 16

language arts connection

Following simple, multi-step directions reinforces interpretation of written materials.

Date: _____

Modeling How a Cactus Saves Water

Materials		
Item	Quantity	Notes
Paper towels	13 sheets per group	To make into model "stems."
Trays	1 per group	To put the stems on in a warm place.
Twist ties	12 per group	To hold the stems together.
Water		To soak the model stems.
Waxed paper	1 sheet per group	To wrap around one model stem.

Directions

- Model the shape of a regular plant's narrow stem:
 - Roll one paper towel tightly into a column.
 - Tie three twist ties around the column: one at the top, one at the bottom, and one in the middle.
 - Put the paper towel column in water.
 - Squeeze out the extra water and place the column on the tray.
- Model the shape of a cactus plant's fat stem:
 - Stack six paper towels in a pile.
 - Roll the pile tightly into a column.
 - Tie three twist ties around the column: one at the top, one at the bottom, and one in the middle.
 - Put the paper towel column in water.
 - Squeeze out the extra water and place the column on the tray, not touching the first column.
- Model a cactus plant stem with its waxy outer coating:
 - Stack six paper towels in a pile.
 - Roll the pile tightly into a column.
 - Tie three twist ties around the column: one at the top, one at the bottom, and one in the middle.
 - Put the paper towel column in water.
 - Squeeze out the extra water.
 - Wrap the column with waxed paper, and add three more twist ties on the column.
 - Place the column on the tray, not touching the others.
- Place the tray in a warm and dry spot, such as in the sun.

17

Modeling How a Cactus Saves Water (Lesson 8)

Science Notebook page 17

Explore

Modeling How a Cactus Saves Water

- Divide the children into groups. Instruct them to examine the pictures of the cactus plants in their science notebooks on page 16 and to follow the directions for the exploration on page 17.
- Give each group their supplies:
 - 13 paper towels
 - 12 twist ties
 - 1 sheet of waxed paper
 - 1 tray

MANAGEMENT NOTE: Help the children read and follow the directions in their science notebooks. Make sure they know they are supposed to make all three stem types.

- Explain that the three different columns of paper towels they make are models of different plant stems. By seeing what happens when they wet and dry the model plant stems, they can think about what would happen with real plant stems.
- Have groups take turns using the three basins of water for soaking their three paper towel columns.

MANAGEMENT NOTE: Remind children that they want to get their paper towel columns wet, but not leave them in the water so long that they fall apart. Have children squeeze excess water from the columns, so water doesn't puddle on the tray.

- Once the groups have placed all three, wet paper towel columns on a tray in a warm, dry place (such as outside in the sun) or in an area that receives some sort of breeze (such as by an open window), wet a single paper towel, and lay it flat in the same location.
- Let the children know that they will return to the lesson as soon as the flat paper towel has dried.

TEACHER NOTE: Stop the lesson here and return to it once the flat paper towel has dried. Depending on how quickly the water evaporates, this could take 60-90 minutes or overnight.

- When the children return to the lesson, have them get the trays and answer the questions in their science notebooks on pages 18-19.

Reflect and Discuss

Sharing

- Encourage the groups to share their results with each other.

TEACHER NOTE: Mention that inconsistent results may come from a group's using different methods, or from differences in the circumstances in which the towels dried.

- Encourage the children to share their ideas about how the model stems saved water, especially about the following:
 - Why the flat paper towel dried first. (*The flat paper towel had the most surface area exposed to the sun and warm air. Heat causes water to evaporate into the air.*)
 - Why the rolled columns with just one paper towel took longer to dry than the flat paper towel. (*Because they had less surface area exposed to the warm air.*)
 - Why the rolled columns with six paper towels remained moist. (*Because the thick shape helped keep water inside, away from the heat source.*)
 - Why the rolled columns covered with waxed paper remained the moistest. (*Because the waxed paper trapped the water and prevented it from evaporating into the air.*)

Synthesizing

- Review the list the class compiled about how a cactus looks different from other plants.
- Based on what they know about the stems they modeled, have the children discuss how the following characteristics help a cactus survive in a desert habitat:
 - It has a waxy outer coating. (*The waxy outer walls stop water the cactus has absorbed from being lost to evaporation.*)
 - It is fat and thick. (*The shape makes it so there is less surface area for water evaporation.*)
 - It doesn't have leaves. (*With no leaves, less surface area is exposed to the sun. It photosynthesizes—makes food—in its green, water-storing stem.*)
 - It has spines. (*They protect it from hungry, thirsty animals that want the water stored inside. Spines also help shade the plant from the sun.*)



Date: _____

Modeling How a Cactus Saves Water

Date: _____

Modeling How a Cactus Saves Water

After leaving the three model "stems" on a tray in a warm and dry place until the flat paper towel dries, do this:

- Unroll the one-towel column that models a regular plant's narrow stem.
Describe the inside. Is the inside still wet? How does it feel?
- Unroll the six-towel column that models a cactus plant's fat stem.
Describe the inside. Is the inside still wet? Is it more wet or less wet than the narrow stem?

18 Modeling How a Cactus Saves Water (Lesson 8)

Science Notebook pages 18-19



assessment opportunity
As the children compare their model stems with the characteristics of a cactus, assess their skill at using models.

Materials: Terrarium “mini-habitat,”
magnifying lenses

Name: _____ Date: _____

Family Link with Science—Homework

Your Special Spot Outside

Weekly Visit

Return to your special spot outside. Sit there for at least 10 minutes.

1. What is the weather like today? _____
2. Look closely at everything below you, above you, and around you. Use words or pictures to describe the living things you observe.

3. Do you notice any differences from the last time you visited your special spot?

Please complete this assignment for science class.

Family Link: Your Special Spot Outside—Weekly Visit (Lessons 7-9, 11-13) Habitats Teacher Master 50

Teacher Master 50, Family Link

Name: _____ Date: _____

Family Link with Science—Homework

Your Special Spot Outside

Weekly Visit, page 2

4. Bonus Question:

Please complete this assignment for science class.

Family Link: Your Special Spot Outside—Weekly Visit (Lessons 7-9, 11-13) Habitats Teacher Master 51

Teacher Master 51, Family Link

Ongoing Learning

Science Center

Survival Characteristics of Terrarium Plants

Post the following challenge for the children to write about in the “Habitats Journal” section (pages 46-64) of their science notebooks: Observe the plants in the terrarium. Do they have any special characteristics that help them survive in this habitat? Draw pictures and write about these characteristics.

Special Spot Notes

1. Post the children’s notes about their special spots.
2. Post the following question for the children to write about in the “Habitats Journal” section (pages 46-64) of their science notebooks: Compare your classmates’ notes about their special spots. What do you notice?

Family Link

The Family Link Homework “Your Special Spot Outside: Weekly Visit” reminds children to visit their special spot for 10 minutes, and to describe the living things they observe there.

Maintenance

- Review the questions the children generated in Lesson 7. If any of the questions were answered during this lesson, write and post the answers in the Science Center, or discuss them with the class.
- Have children share any new observations they made during their weekly visits to their special spot.
- Continue with the class’s environmental stewardship project.

Extending the Lesson

Further Science Exploration

Comparing Plants' Water Needs

Place a small potted cactus and a small, tropical potted houseplant next to each other, preferably in a sunny window. Have the children water both, and mark the date on a calendar. Tell the children not to water again, and to notify you when they notice that one of the plants looks like it needs water. How many days does it take before the houseplant's leaves wilt? How dry is the soil? What does the cactus look like at the same time?

Mathematics Extension

Ask the children to think about different ways of measuring how much water a plant stem absorbs. Prompt them to consider many different kinds of measurement (liquid volume, weight, or linear measure of circumference) and why they would or would not choose each. If time allows, have them experiment with either paper towel models or with wilted celery in a glass of water.

Art Extension

Provide different types of potted cacti, and have the children draw them, focusing especially on their shapes, ribbing, and spines.

Planning Ahead

For Lesson 9

Contact a local plant expert and ask them to lead a guided walk through—or present a slide show about—local, native plant habitats.

- If you decide on an outing, arrange for adult volunteers to accompany the class, and send home permission slips to be signed.
- If you decide on a classroom presentation, have the children compose questions, and provide them to the presenter ahead of time. This enables the presenter to tailor the talk to the children's interests.

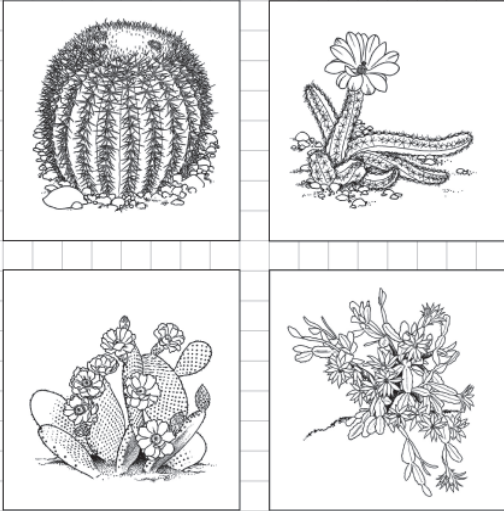


Science Notebook page 16

Date: _____

Cactus Plants

Look at the pictures below to see some of the physical characteristics of different cactus plants.



16 Cactus Plants (Lesson 8)

Science Notebook page 17

Date: _____

Modeling How a Cactus Saves Water

Materials

Item	Quantity	Notes
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 - Stack six paper towels in a pile.
 - Roll the pile tightly into a column.
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- Model a cactus plant stem with its waxy outer coating:
 - Stack six paper towels in a pile.
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 - Tie three twist ties around the column: one at the top, one at the bottom, and one in the middle.
 - Put the paper towel column in water.
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 - Wrap the column with waxed paper, and add three more twist ties on the column.
 - Place the column on the tray, not touching the others.
- Place the tray in a warm and dry spot, such as in the sun.

17 Modeling How a Cactus Saves Water (Lesson 8)

Science Notebook page 18

Date: _____

Modeling How a Cactus Saves Water

After leaving the three model "stems" on a tray in a warm and dry place until the flat paper towel dries, do this:

- Unroll the one-towel column that models a regular plant's narrow stem.
Describe the inside. Is the inside still wet? How does it feel?
- Unroll the six-towel column that models a cactus plant's fat stem.
Describe the inside. Is the inside still wet? Is it more wet or less wet than the narrow stem?

18 Modeling How a Cactus Saves Water (Lesson 8)

Science Notebook page 19

Date: _____

Modeling How a Cactus Saves Water

- Unroll the six-towel-plus-waxed paper column that models a cactus plant stem with its waxy outer coating.
Describe the inside. Is the inside still wet? Is it more wet or less wet than the other two stems?
- Think. What physical characteristics does a cactus have that help it save water?

19 Modeling How a Cactus Saves Water (Lesson 8)

Teacher Master 8, Assessment 6

Habitats Assessment 6: Creating and Using Models

As you evaluate the children's discussions, their work in their science notebooks, and their models, consider whether they demonstrate understanding of the following concepts.

Children's Names	Assessment Criteria:			
	A. A model is a representation of something.	B. A model can be constructed to represent a scientific idea.	C. It is important to interpret other models such as a peer's or a scientific model.	D. Another model can be critiqued and compared to one's own model.
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Assessment 6: Creating and Using Models Habitats Teacher Master 8

Teacher Master 50, Family Link

Name: _____ Date: _____

Family Link with Science—Homework

Your Special Spot Outside

Weekly Visit

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1. What is the weather like today? _____
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Please complete this assignment for science class.

Family Link: Your Special Spot Outside—Weekly Visit (Lessons 7-9, 11-13) Habitats Teacher Master 50

Teacher Master 51, Family Link

Name: _____ Date: _____

Family Link with Science—Homework

Your Special Spot Outside

Weekly Visit, page 2

4. Bonus Question:

Please complete this assignment for science class.

Family Link: Your Special Spot Outside—Weekly Visit (Lessons 7-9, 11-13) Habitats Teacher Master 51