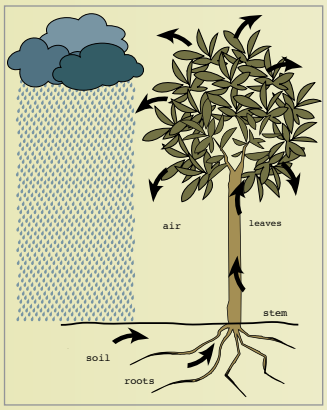
DESERT BOTANICAL garden

TEACHER'S GUIDE FOR SIXTH GRADE
INQUIRY IN THE GARDEN - STAGE 2
Transpiration



Transpiration

Activity Overview

In this investigation, students venture outside for a teacher-led, plant investigations walk in their own schoolyard. This activity is offered as an alternative field investigation for classes unable to visit the Desert Botanical Garden. The purpose of this activity is to get students outside and involved in real, hands-on field investigations about transpiration in plants. It is suggested that classes first conduct the *Transpiration* Inquiry in the Garden-Stage 1 in preparation for this investigation. Although that introductory activity is primarily for classes visiting the Desert Botanical Garden, it provides foundational concepts and activities which are further explored in this investigation.

Teacher Preparation

The purpose of the plant investigations walk is for students to observe plants in nature and to follow the scientific method as they investigate aspects of transpiration. It is suggested that teachers first scout the school grounds before taking the students outside. Decide on a route that would be good for a plant investigations walk. The route should include a variety of plants including trees, shrubs, and cacti (if possible). It is recommended that at least three specific places or "stops" be identified along the route that would serve as focal points to investigate plant roots, stems, and leaves. Students will be better prepared for this investigation if the class first reviews and discusses *Transpiration* Inquiry in the Garden- Stage 1 and conducts the preparatory activities associated with that lesson.

Materials

- Three pieces of rope or string approximately 16 feet in length
- Optional depending on selected activities: soda straws, celery stalks, knife, water, red food dye, beaker or clear glass jar, dry and flattened sponge, several 1" wide x 11" long strips of paper, string, magnifying lenses, 15 ml centrifuge or test tubes, stopper or plastic wrap to cover tubes
- Picture of leaf stomata (provided as a download)
- Student Investigation Journal
- *Student Study Guide-Results and Conclusion*

continued

TEACHER'S GUIDE FOR SIXTH GRADE
INQUIRY IN THE GARDEN - STAGE 2
Transpiration

General Procedures

Guide students on an outdoor plant investigation walk following your pre-planned route. At each stop, conduct an inquiry using the *Discussion Questions* to convey the *Teaching Points* presented for that stop. Following each discussion, conduct one or more of the *Suggested Activities*, having students record in their *Student Investigation Journals*. Wrap up your walk by discussing students' discoveries and reviewing the *General Teaching Points*. Complete student investigations by using the *Student Study Guide- Results and Conclusion*, which replaces Inquiry in the Garden-Stage 3.

Plant Investigations Walk – General Teaching Points

– Transpiration is the evaporative loss of water through the leaves, but the process involves the entire plant.

– Water moves from the soil into plant roots, up through the stems, and up and out through the leaves into the air.

– Osmosis is the movement of water from area of high concentration to low concentration through a cellular membrane.

– Stems transport water from the roots to the leaves.

– Leaves lose water to the air through their stomata.

– In warm, dry, desert climates, some plants develop special adaptations to conserve water during the transpiration process.

– Some plants (succulents) have special features for storing water.

– Some leaves (especially those in dry climates) have adaptations to reduce transpiration and thus conserve water.

Root Stop

Creosote

Description

The roots stop should offer the opportunity to see a variety of plants (including trees, shrubs, and small forbs). A large tree would be a good focal point for the discussion at this stop. Additionally, a flat, grassy area nearby would be an ideal location for playing the osmosis demonstration game.

Teaching Points

– Transpiration is the evaporative loss of water through the leaves, but the process involves water moving into plant roots from the soil, up through the stems, and up and out through the leaves into the air.

continued

continued

Palo Verde

– Water moves into the roots from moist soil.

– Water moves from areas of higher concentrations to areas of lower concentration.

– The movement of water from area of high concentration to low concentration through a cellular membrane is called osmosis.

– Without the continuous process of water moving through the roots, up the stems, and out the leaves, some plants would wilt.

Discussion Questions and Activity Suggestions

At the roots stop, conduct an inquiry using the teaching points as your guide. Questions to help students arrive at the key points for this stop could include the following:

- *Why do plants have roots?*
- *What is transpiration?*
- *If transpiration is water evaporating from the leaves, what role do roots play in transpiration?*
- *How do roots obtain water?*
- *How far out from the plant do roots go? How deep do roots go?*
- *In what cases would plants want to grow deep roots? Shallow roots?*
- *Why doesn't water flow out of the roots?*
- *What happens when there is little or no moisture in the soil?*

After students have had a chance to discuss roots, choose and conduct one or more of the following suggested activities. Students should record findings in their Student Investigation Journals.

Have students…

Sip water through straws playing with the height the water moves up the straw based on the amount of suction they exert on the straw. Have them compare this to the transpiration process.

Observe different types of plants and consider their root structures. Estimate how far out the roots might go if they went as far out as the plant's height.

Feel the soil under different plants for moisture. If they dig down a little, is it more or less moist? Compare and contrast conditions in which plant roots might be more successful if they were deep versus shallow and vice versa.

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Play a game that demonstrates osmosis. Using string or rope, create three circles of about five feet in diameter. Place rope circles on the ground a few feet apart. Have a couple of students stand in the first circle. Keep adding more students until no more can safely fit. When the circle is full, have students move to the next circle one at a time. As students leave the first circle, new students may move in to take their place. As the second circle fills, students may start moving to the third circle, creating more space for students to move into the second circle from the first circle, and so on. Have students discuss how this demonstrates osmosis.

Stem Stop

Agave

Description

If there are cacti in your schoolyard, the stems stop would be best located by a cactus (most preferably, a saguaro). If there are no succulents available, a site that offers a view of both larger trees and smaller herbaceous plants will be sufficient for the discussion and activities regarding the stem's role in transpiration.

Teaching Points

– Transpiration is the evaporative loss of water through the leaves, but the process involves water moving into plant roots from the soil, up through the stems, and up and out through the leaves into the air.

– Stems transport water from the roots to the leaves.

– Stems provide structure and support for plants.

– Some plants (succulents) have special features for storing water.

– Saguaro cacti expand their bodies as they absorb and store water in their stems.

– Without the continuous process of water moving through the roots, up the stems, and out the leaves, some plants would wilt.

Discussion Questions and Activity Suggestions

At the stems stop, conduct an inquiry using the teaching points as your guide. Questions to help students arrive at the key points for this stop could include the following:

- *What is the purpose of a plant's stem?*
- *What role do stems play in the transpiration process?*

continued

continued

Saguaro

- *In general, how do stem sizes change as they move up the plant?*
- *What is the benefit of succulence in plants?*
- *In what environmental conditions do we often see succulent plants?*
- *What happens when there is little or no moisture in the soil?*

After students have had a chance to discuss stems, choose and conduct one or more of the following suggested activities. Students should record findings in their Student Investigation Journals.

Have students…

Explore the area for different types of stems. What kinds of differences and similarities do students notice?

Locate stem succulents in the schoolyard. How are succulents different from other plants? What is the benefit of being succulent?

Place a freshly cut stalk of celery (including the upper stem and leaves) in a beaker of water darkened to a deep red color with food dye. (The celery should be cut under running water and quickly placed in the beaker to a depth of about two inches.) Have students record how long it takes the dye to travel up the celery stalk. Have them calculate the rate of flow. Discuss the experiment.

Pour water on a dry sponge and observe what happens. (This works best with a very thin, tightly pressed sponge.) Explain that some cacti expand like a sponge when they soak up water from their roots into their stems. This is an adaptation for living in a desert. Ask students if they see any plants around them with similar adaptations.

Fold a strip of paper into an accordion with half-inch pleats. (In advance, prepare one-inch wide strips of paper that are 11 inches long.) Place the two ends of the strip together to create an accordion circle. Have students play with their accordions by shrinking and expanding the size of the circle. Explain to the students that the pleats represent the ribs in a saguaro cactus. When the pleats are close together, they represent a thirsty saguaro. When the pleats are stretched out, they represent a saguaro whose ribs have expanded after a big rainfall.

Use a piece of string to measure the circumference of a saguaro cactus (if one is available) during a dry season and again during a rainy season. Make predictions in advance about how the measurements will compare. Be sure to record the data in a safe place because many months might pass between the two measurements. (Remind students to be careful of cactus spines!)

Leaves Stop

Mesquite

Description

The leaves stop should be located in an area offering a variety of plants with different types of leaves. It would be ideal if there were some nearby plants having small or otherwise modified leaves. Trees such as mesquite, palo verde, pine, or juniper would all provide good examples for the discussion points at this stop.

Teaching Points

– Leaves lose water to the air through their stomata.

– As water is lost through the leaves to the air, more water is drawn up by a combination of forces including osmosis from the tissues to replace it.

– Some leaves (especially those in dry climates) have adaptations to reduce transpiration and thus conserve water.

– Some leaves have special characteristics that help them conserve water in the transpiration process including small size, waxy coatings, and hairy textures.

– Without the continuous process of water moving through the roots, up the stems, and out the leaves, some plants would wilt.

Discussion and Activity Suggestions

At the leaves stop, conduct an inquiry using the teaching points as your guide. Questions to help students arrive at the key points for this stop could include the following:

- *What role do leaves play in the transpiration process?*
- *How does water exit leaves?*
- *Why don't leaves wilt as they transpire?*
- *How might leaves slow the process of transpiration?*
- *In what conditions would it be beneficial for leaves to slow the process of transpiration?*
- *Which leaves likely transpire the most, large or small?*

After students have had a chance to discuss leaves, choose and conduct one or more of the following suggested activities. Students should record findings in the Student Investigation Journal.

Have students…

continued

continued

Leaf Stomata

Observe the picture of leaf stomata (using the provided image) and discuss how stomata open and close (like little mouths) as water escapes.

Use a magnifying lens to observe the surfaces of different leaves. Look for hairy leaves, waxy leaves, small leaves, and others. Discuss how different leaf shapes, sizes, and textures affect transpiration.

Conduct an investigation in which they compare the transpiration rate of large leaves versus small leaves. (Note: This continues the investigation started in the Inquiry in the Garden-Stage 1, in which students completed the *Transpiration Adaptations Table*. Students should have stated a hypothesis about how leaf size affects transpiration.) Help students set up the investigation by obtaining two 15 ml centrifuge or test tubes. Fill with equal amounts of water. Drill or poke small holes in the caps (to fit a small plant stem) or create a lid with plastic wrap. Place one cutting of a plant with very large leaves in one centrifuge tube. Place another cutting of a plant with tiny leaves in the other centrifuge tube. Set tubes upright in the sun. Observe throughout the day noting their water use and freshness.

Follow their leaf transpiration investigation through to the results and conclusions stage by completing the Student Study Guide – *Results and Conclusions*.

Post Your Findings on the Internet!

As part of the Inquiry Process students may share their work with others by visiting the DBG *Journal of Student Findings* at www.dbg.digitallearning. Here, students can submit investigation findings, poems, or original art inspired by their Inquiry in the Garden. For more ideas on art projects that tie into Garden themes, go to the Additional Resources section of the Digital Learning website.

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STUDENT INVESTIGATION JOURNAL

Student Name_____

Record the evidence you find during the investigation and results of any experiments. You will use this recorded information later to analyze your findings.

ROOTS

1. What did you learn about how roots collect water?

2. Is there a way to estimate the width of a plant's root structure? What is it?

3. What is osmosis?

STEMS

4. What are some similarities and differences in the stems you see?

5. How is a sponge similar to a cactus stem?

6. Cactus stem diameter

Dry Season	Diameter: _____meters
Wet Season	Diameter: _____meters

7. In what environmental conditions do we often see succulent plants living?

continued

DESERT BOTANICAL garden

STUDENT INVESTIGATION JOURNAL

Student Name_____

LEAVES

Question: Why are some desert leaves small?

Hypothesis: Small leaves reduce the amount of water lost during transpiration.

8. Prediction:

If_____

then_____

9. Experiment: *Describe the steps of this experiment including materials used, time, location, and any other information needed to repeat this experiment.*

10. Record results:

Start time: **End time:**

	AMOUNT OF WATER AT THE BEGINNING	AMOUNT OF WATER AT THE END
Big Leaf	mL	mL
Small Leaf	mL	mL

DESERT BOTANICAL garden

STUDENT STUDY GUIDE - RESULTS AND CONCLUSION

Student Name_____ Teacher_____
Team_____

Instructions: *Answer the questions below. Use the information from your* Student Worksheet – Transpiration Adaptations Table *and from your* Student Investigation Journal *to complete the leaf size investigation. When finished with this Study Guide, prepare a display of your investigation. Be creative! You could make a poster, draw pictures, generate graphs, and/or include photos from your trip or from the internet. Then, think of a fun way to share your display. You could do a team presentation, poster displays, "science fair" displays, mock interviews, 3-D models, etc. Following your teacher's instructions, you may also post your work online on the DBG Journal of Student Findings*

Name of your investigation:_____

1. Question. What question was generated by your original observations of desert plant leaves?

2. Hypothesis. What was your hypothesis?

3. Prediction. What prediction did you make about desert leaves' adaptations for transpiration?

4. Experiment. How did you test your hypothesis?

5. Results. In the space below, copy the results you recorded in your Student Investigation Journal. How much water was used by each leaf?

6. Conclusions: In your own words, what do you conclude about your hypothesis based on your test results? Is your hypothesis supported by your results?

continued

DESERT BOTANICAL garden

STUDENT STUDY GUIDE - RESULTS AND CONCLUSION

Student Name_____ Teacher_____

Team_____

Questions for Discussion

1. What is the main challenge desert plants must deal with during the process of transpiration?

2. Would you consider your investigation a valid (or reasonable) way to test your hypothesis? Are you satisfied with your results? Why or why not?

3. How might you revise your experiment to yield better results? Which variables would you change? Describe.

4. Based on your findings, what are some other questions that arise that might lead to new investigations?

Stomata

Related ADE Standards:

Writing Strand 3: Writing Applications

Concept	Performance Objective
C2: Expository	PO 1: Record information (e.g., observations, notes, lists, charts, map labels and legends) related to the topic.

Science Strand 1: Inquiry Process

Concept	Performance Objective
C2: Scientific Testing (Investigating and Modeling)	PO 1: Demonstrate safe behavior and appropriate procedures (e.g., use and care of technology, materials, organisms) in all science inquiry. PO 2: Design an investigation to test individual variables using scientific processes. PO 3: Conduct a controlled investigation using scientific processes. PO 4: Perform measurements using appropriate scientific tools (e.g., balances, microscopes, probes, micrometers). PO 5: Keep a record of observations, notes, sketches, questions, and ideas using tools such as written and/or computer logs.
C3: Analysis and Conclusions	PO1: Analyze data obtained in a scientific investigation to identify trends. PO6: Formulate new questions based on the results of a completed investigation.
C4: Communication	PO 2: Display data collected from a controlled investigation. PO 5: Communicate the results and conclusion of the investigation.

Science Strand 4: Life Science

Concept	Performance Objective
C1: Structure and Function in Living Systems	PO 1: Explain the importance of water to organisms. PO 6: Relate the following structures of living organisms to their functions: Plants: transpiration – roots absorption – roots PO 7: Describe how the various systems of living organisms work together to perform a vital function
C3: Populations of Organisms in an Ecosystem	PO 2: Describe how the following environmental conditions affect the quality of life: • climate

Science Strand 6: Earth and Space Science

Concept	Performance Objective
C2: Earth's Processes and Systems	PO 1: Explain how water is cycled in nature.

continued

Educational Technology Strand 2: Communication and Collaboration

Concept	Performance Objective
C1: Effective Communications and Digital Interactions	PO 1: Communicate digitally with others by selecting and using a variety of appropriate communication tools.

Workplace Skills Standard 1: Students use principles of effective oral, written and listening communication skills to make decisions and solve workplace problems.

Standard	Performance Objective
1WP-E4: Respond to oral and written presentations by formulating relevant feedback, expressing opinions, discerning the main idea and distinguishing fact from opinion.	PO 3: Formulate related questions in a presentation PO 4: Express opinions relating to the main idea in a presentation

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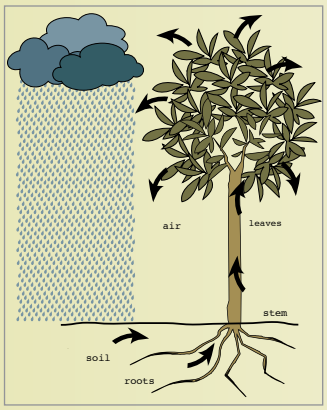

Transpiration

Activity Overview

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- Student Investigation Journal
- *Student Study Guide-Results and Conclusion*

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INQUIRY IN THE GARDEN - STAGE 2
Transpiration

General Procedures

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Plant Investigations Walk – General Teaching Points

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– Leaves lose water to the air through their stomata.

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– Some plants (succulents) have special features for storing water.

– Some leaves (especially those in dry climates) have adaptations to reduce transpiration and thus conserve water.

Root Stop

Creosote

Description

The roots stop should offer the opportunity to see a variety of plants (including trees, shrubs, and small forbs). A large tree would be a good focal point for the discussion at this stop. Additionally, a flat, grassy area nearby would be an ideal location for playing the osmosis demonstration game.

Teaching Points

– Transpiration is the evaporative loss of water through the leaves, but the process involves water moving into plant roots from the soil, up through the stems, and up and out through the leaves into the air.

continued

continued

Palo Verde

– Water moves into the roots from moist soil.

– Water moves from areas of higher concentrations to areas of lower concentration.

– The movement of water from area of high concentration to low concentration through a cellular membrane is called osmosis.

– Without the continuous process of water moving through the roots, up the stems, and out the leaves, some plants would wilt.

Discussion Questions and Activity Suggestions

At the roots stop, conduct an inquiry using the teaching points as your guide. Questions to help students arrive at the key points for this stop could include the following:

- *Why do plants have roots?*
- *What is transpiration?*
- *If transpiration is water evaporating from the leaves, what role do roots play in transpiration?*
- *How do roots obtain water?*
- *How far out from the plant do roots go? How deep do roots go?*
- *In what cases would plants want to grow deep roots? Shallow roots?*
- *Why doesn't water flow out of the roots?*
- *What happens when there is little or no moisture in the soil?*

After students have had a chance to discuss roots, choose and conduct one or more of the following suggested activities. Students should record findings in their Student Investigation Journals.

Have students…

Sip water through straws playing with the height the water moves up the straw based on the amount of suction they exert on the straw. Have them compare this to the transpiration process.

Observe different types of plants and consider their root structures. Estimate how far out the roots might go if they went as far out as the plant's height.

Feel the soil under different plants for moisture. If they dig down a little, is it more or less moist? Compare and contrast conditions in which plant roots might be more successful if they were deep versus shallow and vice versa.

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continued

Play a game that demonstrates osmosis. Using string or rope, create three circles of about five feet in diameter. Place rope circles on the ground a few feet apart. Have a couple of students stand in the first circle. Keep adding more students until no more can safely fit. When the circle is full, have students move to the next circle one at a time. As students leave the first circle, new students may move in to take their place. As the second circle fills, students may start moving to the third circle, creating more space for students to move into the second circle from the first circle, and so on. Have students discuss how this demonstrates osmosis.

Stem Stop

Agave

Description

If there are cacti in your schoolyard, the stems stop would be best located by a cactus (most preferably, a saguaro). If there are no succulents available, a site that offers a view of both larger trees and smaller herbaceous plants will be sufficient for the discussion and activities regarding the stem's role in transpiration.

Teaching Points

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– Stems transport water from the roots to the leaves.

– Stems provide structure and support for plants.

– Some plants (succulents) have special features for storing water.

– Saguaro cacti expand their bodies as they absorb and store water in their stems.

– Without the continuous process of water moving through the roots, up the stems, and out the leaves, some plants would wilt.

Discussion Questions and Activity Suggestions

At the stems stop, conduct an inquiry using the teaching points as your guide. Questions to help students arrive at the key points for this stop could include the following:

- *What is the purpose of a plant's stem?*
- *What role do stems play in the transpiration process?*

continued

continued

Saguaro

- *In general, how do stem sizes change as they move up the plant?*
- *What is the benefit of succulence in plants?*
- *In what environmental conditions do we often see succulent plants?*
- *What happens when there is little or no moisture in the soil?*

After students have had a chance to discuss stems, choose and conduct one or more of the following suggested activities. Students should record findings in their Student Investigation Journals.

Have students…

Explore the area for different types of stems. What kinds of differences and similarities do students notice?

Locate stem succulents in the schoolyard. How are succulents different from other plants? What is the benefit of being succulent?

Place a freshly cut stalk of celery (including the upper stem and leaves) in a beaker of water darkened to a deep red color with food dye. (The celery should be cut under running water and quickly placed in the beaker to a depth of about two inches.) Have students record how long it takes the dye to travel up the celery stalk. Have them calculate the rate of flow. Discuss the experiment.

Pour water on a dry sponge and observe what happens. (This works best with a very thin, tightly pressed sponge.) Explain that some cacti expand like a sponge when they soak up water from their roots into their stems. This is an adaptation for living in a desert. Ask students if they see any plants around them with similar adaptations.

Fold a strip of paper into an accordion with half-inch pleats. (In advance, prepare one-inch wide strips of paper that are 11 inches long.) Place the two ends of the strip together to create an accordion circle. Have students play with their accordions by shrinking and expanding the size of the circle. Explain to the students that the pleats represent the ribs in a saguaro cactus. When the pleats are close together, they represent a thirsty saguaro. When the pleats are stretched out, they represent a saguaro whose ribs have expanded after a big rainfall.

Use a piece of string to measure the circumference of a saguaro cactus (if one is available) during a dry season and again during a rainy season. Make predictions in advance about how the measurements will compare. Be sure to record the data in a safe place because many months might pass between the two measurements. (Remind students to be careful of cactus spines!)

Leaves Stop

Mesquite

Description

The leaves stop should be located in an area offering a variety of plants with different types of leaves. It would be ideal if there were some nearby plants having small or otherwise modified leaves. Trees such as mesquite, palo verde, pine, or juniper would all provide good examples for the discussion points at this stop.

Teaching Points

– Leaves lose water to the air through their stomata.

– As water is lost through the leaves to the air, more water is drawn up by a combination of forces including osmosis from the tissues to replace it.

– Some leaves (especially those in dry climates) have adaptations to reduce transpiration and thus conserve water.

– Some leaves have special characteristics that help them conserve water in the transpiration process including small size, waxy coatings, and hairy textures.

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Discussion and Activity Suggestions

At the leaves stop, conduct an inquiry using the teaching points as your guide. Questions to help students arrive at the key points for this stop could include the following:

- *What role do leaves play in the transpiration process?*
- *How does water exit leaves?*
- *Why don't leaves wilt as they transpire?*
- *How might leaves slow the process of transpiration?*
- *In what conditions would it be beneficial for leaves to slow the process of transpiration?*
- *Which leaves likely transpire the most, large or small?*

After students have had a chance to discuss leaves, choose and conduct one or more of the following suggested activities. Students should record findings in the Student Investigation Journal.

Have students…

continued

continued

Leaf Stomata

Observe the picture of leaf stomata (using the provided image) and discuss how stomata open and close (like little mouths) as water escapes.

Use a magnifying lens to observe the surfaces of different leaves. Look for hairy leaves, waxy leaves, small leaves, and others. Discuss how different leaf shapes, sizes, and textures affect transpiration.

Conduct an investigation in which they compare the transpiration rate of large leaves versus small leaves. (Note: This continues the investigation started in the Inquiry in the Garden-Stage 1, in which students completed the *Transpiration Adaptations Table*. Students should have stated a hypothesis about how leaf size affects transpiration.) Help students set up the investigation by obtaining two 15 ml centrifuge or test tubes. Fill with equal amounts of water. Drill or poke small holes in the caps (to fit a small plant stem) or create a lid with plastic wrap. Place one cutting of a plant with very large leaves in one centrifuge tube. Place another cutting of a plant with tiny leaves in the other centrifuge tube. Set tubes upright in the sun. Observe throughout the day noting their water use and freshness.

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STUDENT INVESTIGATION JOURNAL

Student Name_____

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ROOTS

1. What did you learn about how roots collect water?

2. Is there a way to estimate the width of a plant's root structure? What is it?

3. What is osmosis?

STEMS

4. What are some similarities and differences in the stems you see?

5. How is a sponge similar to a cactus stem?

6. Cactus stem diameter

Dry Season	Diameter: _____meters
Wet Season	Diameter: _____meters

7. In what environmental conditions do we often see succulent plants living?

continued

DESERT BOTANICAL garden

STUDENT INVESTIGATION JOURNAL

Student Name_____

LEAVES

Question: Why are some desert leaves small?

Hypothesis: Small leaves reduce the amount of water lost during transpiration.

8. Prediction:

If_____

then_____

9. Experiment: *Describe the steps of this experiment including materials used, time, location, and any other information needed to repeat this experiment.*

10. Record results:

Start time: **End time:**

	AMOUNT OF WATER AT THE BEGINNING	AMOUNT OF WATER AT THE END
Big Leaf	mL	mL
Small Leaf	mL	mL

DESERT BOTANICAL garden

STUDENT STUDY GUIDE - RESULTS AND CONCLUSION

Student Name_____ Teacher_____
Team_____

Instructions: *Answer the questions below. Use the information from your* Student Worksheet – Transpiration Adaptations Table *and from your* Student Investigation Journal *to complete the leaf size investigation. When finished with this Study Guide, prepare a display of your investigation. Be creative! You could make a poster, draw pictures, generate graphs, and/or include photos from your trip or from the internet. Then, think of a fun way to share your display. You could do a team presentation, poster displays, "science fair" displays, mock interviews, 3-D models, etc. Following your teacher's instructions, you may also post your work online on the DBG Journal of Student Findings*

Name of your investigation:_____

1. Question. What question was generated by your original observations of desert plant leaves?

2. Hypothesis. What was your hypothesis?

3. Prediction. What prediction did you make about desert leaves' adaptations for transpiration?

4. Experiment. How did you test your hypothesis?

5. Results. In the space below, copy the results you recorded in your Student Investigation Journal. How much water was used by each leaf?

6. Conclusions: In your own words, what do you conclude about your hypothesis based on your test results? Is your hypothesis supported by your results?

continued

DESERT BOTANICAL garden

STUDENT STUDY GUIDE - RESULTS AND CONCLUSION

Student Name_____ Teacher_____

Team_____

Questions for Discussion

1. What is the main challenge desert plants must deal with during the process of transpiration?

2. Would you consider your investigation a valid (or reasonable) way to test your hypothesis? Are you satisfied with your results? Why or why not?

3. How might you revise your experiment to yield better results? Which variables would you change? Describe.

4. Based on your findings, what are some other questions that arise that might lead to new investigations?

Stomata

Related ADE Standards:

Writing Strand 3: Writing Applications

Concept	Performance Objective
C2: Expository	PO 1: Record information (e.g., observations, notes, lists, charts, map labels and legends) related to the topic.

Science Strand 1: Inquiry Process

Concept	Performance Objective
C2: Scientific Testing (Investigating and Modeling)	PO 1: Demonstrate safe behavior and appropriate procedures (e.g., use and care of technology, materials, organisms) in all science inquiry. PO 2: Design an investigation to test individual variables using scientific processes. PO 3: Conduct a controlled investigation using scientific processes. PO 4: Perform measurements using appropriate scientific tools (e.g., balances, microscopes, probes, micrometers). PO 5: Keep a record of observations, notes, sketches, questions, and ideas using tools such as written and/or computer logs.
C3: Analysis and Conclusions	PO1: Analyze data obtained in a scientific investigation to identify trends. PO6: Formulate new questions based on the results of a completed investigation.
C4: Communication	PO 2: Display data collected from a controlled investigation. PO 5: Communicate the results and conclusion of the investigation.

Science Strand 4: Life Science

Concept	Performance Objective
C1: Structure and Function in Living Systems	PO 1: Explain the importance of water to organisms. PO 6: Relate the following structures of living organisms to their functions: Plants: transpiration – roots absorption – roots PO 7: Describe how the various systems of living organisms work together to perform a vital function
C3: Populations of Organisms in an Ecosystem	PO 2: Describe how the following environmental conditions affect the quality of life: • climate

Science Strand 6: Earth and Space Science

Concept	Performance Objective
C2: Earth's Processes and Systems	PO 1: Explain how water is cycled in nature.

continued

Educational Technology Strand 2: Communication and Collaboration

Concept	Performance Objective
C1: Effective Communications and Digital Interactions	PO 1: Communicate digitally with others by selecting and using a variety of appropriate communication tools.

Workplace Skills Standard 1: Students use principles of effective oral, written and listening communication skills to make decisions and solve workplace problems.

Standard	Performance Objective
1WP-E4: Respond to oral and written presentations by formulating relevant feedback, expressing opinions, discerning the main idea and distinguishing fact from opinion.	PO 3: Formulate related questions in a presentation PO 4: Express opinions relating to the main idea in a presentation

DESERT BOTANICAL garden

TEACHER'S GUIDE FOR SIXTH GRADE
INQUIRY IN THE GARDEN - STAGE 3
Transpiration

Desert Botanical Garden website

Activity Overview

The purpose of this activity is to move students through the completion of an investigation using the scientific process. Having previously made observations, asked questions, developed hypotheses, and made and tested predictions, students now analyze their results and draw conclusions about ways desert plants are uniquely adapted for transpiration in the desert. After reviewing their experiences from their field trip to the Desert Botanical Garden, students complete a *Study Guide* and develop creative displays to share their results with others. Students are also encouraged to post their work online at the Desert Botanical Garden website.

Materials

- *Transpiration – Data Collection Journal* (from the DBG fieldtrip)
- *Student Study Guide – Transpiration Adaptations – Results and Conclusion*
- *Student Worksheet – Transpiration Adaptations Table* (from the Inquiry Stage 1 – Introductory Activity)

Procedures

1. Review and discuss the students' experiences during their trip to the Desert Botanical Garden. Go over the data collected in the *Transpiration - Data Collection Journal* and use the Organize and Analyze section to review student findings.
2. Review how roots collect water. Review the term **osmosis** and call on students to describe the activity they did at the Botanical Garden to demonstrate how water moves from an area of high concentration to an area of low concentration (students moved into less empty circles of rope when the circle of rope in which they were standing became full of students).
3. Review and discuss the special adaptations of a saguaro cactus stem. Ask students why saguaros have this adaptation. (Saguaros and other cacti live in an arid environment and conserve water by storing it in their stems.) What evidence did students see to show that saguaro stems hold water? Call on students to describe how cacti store water (special cells in the stem absorb water and the cactus expands – in a saguaro, the "ribs" allow the stem to expand).

continued

Palo Verde

4. For the third plant part of the transpiration process – leaves – explain that students will now continue to follow the scientific method and make conclusions about that investigation. Specifically, students should consider the Leaf – Transpiration investigation they conducted in which they compared water use by a little-leaf plant and a big-leaf plant. Students will need to refer to their *Transpiration - Data Collection Journals* from their field trip.
5. Hand out the *Student Study Guide – Transpiration Adaptations – Results and Conclusion*, one to each student. Review the *Study Guide* and explain that they should copy their data from the *Data Collection Journal* onto their *Study Guide*, taking time to clarify their writing. They should then consider their results and articulate their conclusions. Finally, they should answer the "*Questions for Discussion.*"
6. Explain to students that an important part of the scientific process is sharing your findings with others. Discuss the value of sharing scientific information (so that others may learn from the work and to expand everyone's understanding of the subject). Scientists typically publish their work in scientific journals. As described in their *Study Guides*, students will prepare a final presentation of their investigation to share with others, both in class and by submitting online on the *DBG Journal of Student Findings.*
7. Give students time to prepare a final presentation display of their investigation. Using the information from their *Study Guide*, they may choose to create a poster, draw pictures, and/or include photographs taken during their field trip or acquired from the internet. Encourage student creativity in the display of their work. *(Note: For more ideas on art projects that tie into Garden themes, go to the Additional Resources section of the Digital Learning website.)*
8. Have students share their displays and compare their investigations with the rest of the class. Since students worked in different groups at the Botanical Garden, be sure to compare the results from the different groups. Conclude the activity with a discussion of the investigation using the "*Questions for Discussion*" from the *Student Study Guide* as a guide.

Post Your Findings on the Internet!

The final step of the Inquiry Process is to share your findings. Students may share their findings by visiting the *DBG Journal of Student Findings* at http://www.dbg.org/index.php/digital/students/journal. Here, students can submit investigation findings or original art inspired by their Inquiry in the Garden.

STUDENT STUDY GUIDE - TRANSPIRATION ADAPTATIONS - RESULTS AND CONCLUSION

Student Name_____ Teacher_____
Team_____

Instructions:
Use the information from your Student Worksheet – Transpiration Adaptations Table *and from the* Transpiration Data Collection Journal *(from your field trip) to answer the questions below. When finished with this Study Guide, prepare a display of your investigation. Be creative! You could make a poster, draw pictures, generate graphs, and/or include photos from your trip or from the internet. Then, think of a fun way to share your display. You could do a team presentation, poster displays, "science fair" displays, mock interviews, 3-D models, etc. Following your teacher's instructions, you may also post your work online on the DBG Journal of Student Findings.*

Name of your investigation:_____

1. Question. What question was generated by your original observations of desert plant leaves?

2. Hypothesis. What was your hypothesis?

3. Prediction: What prediction did you make about desert leaves' adaptations for transpiration?

4. Experiment. How did you test your hypothesis?

5. Results. In the space below, copy the results you recorded in your *Data Collection Journal.*

6. Conclusions: In your own words, what do you conclude about your hypothesis based on your test results? Is your hypothesis supported by your results?

STUDENT STUDY GUIDE- TRANSPIRATION ADAPTATIONS- RESULTS AND CONCLUSION

Student Name_____ Teacher_____
Team_____

1. What is the main challenge desert plants must deal with during the process of transpiration?

2. Would you consider your investigation a valid (or reasonable) way to test your hypothesis? Are you satisfied with your results? Why or why not?

3. How did your data and results compare with other students' who worked in different groups at the Botanical Garden? What were the similarities / differences? What might have caused differing results?

4. How might you revise your experiment to yield better results? Which variables would you change? Describe.

5. Based on your findings, what are some other questions that arise that might lead to new investigations?

Related ADE Standards:

Writing Strand 1: Writing Process

Concept	Performance Objective
C1: Prewriting	PO 1: Generate ideas through a variety of activities (e.g., prior knowledge, discussion with others, printed material or other sources).
C3: Revising	PO 4: Rearrange words, sentences, and paragraphs to clarify the meaning or to enhance the writing style.
C5: Publishing	PO 3: Use graphics (e.g., drawings, charts, graphs), when applicable, to enhance the final product.

Writing Strand 3: Writing Applications

Concept	Performance Objective
C2: Expository	PO 1: Record information (e.g., observations, notes, lists, charts, map labels and legends) related to the topic.

Language Arts Standard 4: Viewing and Presenting

Standard	Performance Objective
Students use a variety of visual media and resources to gather, evaluate and synthesize information and to communicate with others.	VP-E2: Plan, develop and produce a visual presentation, using a variety of media such as videos, films, newspapers, magazines and computer images.

Science Strand 1: Inquiry Process

Concept	Performance Objective
C3: Analysis and Conclusions	PO 1: Analyze data obtained in a scientific investigation to identify trends. PO 3: Evaluate the observations and data reported by others. PO 5: Analyze the results from previous and/or similar investigations to verify the results of the current investigation. PO 6: Formulate new questions based on the results of a completed investigation.
C4: Communication	PO 2: Display data collected from a controlled investigation. PO 5: Communicate the results and conclusion of the investigation.

continued

Science Strand 4: Life Science

Concept	Performance Objective
C1: Structure and Function in Living Systems	PO 1: Explain the importance of water to organisms. PO 6: Relate the following structures of living organisms to their functions: transpiration – roots absorption – roots PO 7: Describe how the various systems of living organisms work together to perform a vital function

Educational Technology Strand 2: Communication and Collaboration

Concept	Performance Objective
C1: Effective Communications and Digital Interactions	PO 1: Communicate digitally with others by selecting and using a variety of appropriate communication tools.
C2: Digital Solutions	PO1: Communicate and collaborate for the purpose of producing original works or solving problems.

Workplace Skills Standard 1: Students use principles of effective oral, written and listening communication skills to make decisions and solve workplace problems.

Standard	Performance Objective
1WP-E4: Respond to oral and written presentations by formulating relevant feedback, expressing opinions, discerning the main idea and distinguishing fact from opinion.	PO 3: Formulate related questions in a presentation PO 4: Express opinions relating to the main idea in a presentation
1WP-E6: Speak in a content area (e.g., science, social studies, literature), using vocabulary of the subject accurately; locate and interpret information in documents such as manuals, graphs, and schedules.	PO 1: Deliver a factual presentation using appropriate terminology. PO 2: Use a variety of formats such as data, graphs and technical manuals to support a presentation

DESERT BOTANICAL garden

TEACHER'S GUIDE FOR SEVENTH GRADE
INQUIRY IN THE GARDEN - STAGE 1
Key to Desert Plants

Activity Overview

In this activity, students practice making and using a dichotomous key to identify objects by their specific characteristics. After creating a dichotomous key using their own shoes (or other objects), students practice keying out and identifying individual shoes (or other objects). Students next work in teams to create a dichotomous key of desert plants. Referring to a set of photographs of selected desert plants, students make careful observations of the plants' characteristics and use those characteristics to create their keys. Teams then switch keys and use another team's key to identify the plants. The teacher then leads a class discussion on the characteristics used to identify plants and specifically, characteristics of desert plants. Finally, in preparation for their investigation at the Desert Botanical Garden, the class develops a hypothesis about how to identify plants in the cactus family.

To support the Inquiry in the Garden lesson plans, you may also use the tutorials and Virtual Habitat in DBG's Digital Desert. These interactive activities will prepare students for their investigations by teaching them about the characteristics of deserts and the Sonoran Desert habitat.

Materials

(Note: All of the following materials are provided as downloadable graphics.)
Steps to Making a Dichotomous Key (prepared for use on an overhead projector or smartboard)
Student Study Guide – Key to Desert Plants

2 pictures of each of the following plants:

- Plant A- Mesquite Tree *(Prosopis spp.)*
- Plant B- Palo Verde Tree *(Parkinsonia microphylla)*
- Plant C- Creosote Bush *(Larrea tridentata)*
- Plant D- Brittle Bush *(Encelia farinosa)*
- Plant E- Engelman's *Hedgehog (Echinocereus engelmannii)*
- Plant F- Sweet Noor *(Euphorbia coerulescens)*
- Plant G- Snowflake *(Euphorbia polygona)*
- Plant H- Moroccan Mound *(Euphorbia resinifera)*
- Plant I- Whortleberry *(Myrtillocactus geometrizans)*
- Plant J-Teddy Bear Cholla *(Cylindopuntia bigelovii)*
- Plant K- Pereskia *(Pereskia sacharosa)*

TEACHER'S GUIDE FOR SEVENTH GRADE
INQUIRY IN THE GARDEN – STAGE 1
Key to Desert Plants

Learning Objectives

Upon completion of this activity, students will be able to…

- Create a dichotomous key to identify individuals in a group.
- Use a dichotomous key to identify individual objects or plant species.
- Use characteristics of plants as identifying features to establish their identity using a dichotomous key.
- List and describe some characteristics of desert plants.
- Explain how some plant characteristics help them survive in their environment.
- State a hypothesis about the characteristics of cacti.

Background Knowledge

These are concepts the educator should understand and that can be found in the glossary.

Dicotomous Key Family Convergent Evolution

Activity Procedures

1. **Introduction.**

   Explain to students that they will be visiting the Desert Botanical Garden where they will be using dichotomous keys to identify and study desert plants. Through an inquiry discussion, review with students the name of our desert (the Sonoran Desert) and the characteristics of deserts in general (hot, dry, high evaporation, low rainfall, and extreme temperature fluctuations).

2. **Review dichotomous key.**

   Ask if any students have experience using a dichotomous key and discuss their experiences. Explain that a dichotomous key is a tool used to identify something (such as plants, insects, rocks) by going through a series of choices that ultimately lead to the identity of the object. Dichotomous means "divided into two parts" and a dichotomous key offers two choices at each step. Scientists typically create and use dichotomous keys to identify things based on their observable characteristics.

continued

3. **Review the steps to making a dichotomous key.**

   Point out that since dichotomous keys use characteristics of objects, you can create them to identify an individual from a group of just about any kind of objects. In this case, the class will create a key to identify individual shoes. Display the *Steps to Making a Dichotomous Key* on the overhead projector or smartboard. Review and discuss the steps with students then ask if they're ready to give it a try.

4. **Create dichotomous key using students' shoes.**

   Explain to students that they will now create a dichotomous key with their own shoes. Call on 10 students to volunteer their right shoes as the objects to key out. Place the shoes where everyone can see them (if necessary, have students sit in a large circle with the shoes in the middle). Using the steps outlined in the *Steps to Making a Dichotomous Key* have students work together to create a dichotomous key to the shoes. As distinguishing characteristics are identified to separate each group of shoes, physically separate the shoes into piles. Each grouping should also be written out on the board in spider form. When all shoes are separately identified, write the key out in traditional form. *(Note: If students are reluctant to use their own shoes, other objects, such as school supplies may be substituted.)*

5. **Use the key to key out individual shoes.**

   Once the key is complete, practice keying out individual shoes. To do this, place all the shoes in one pile and have a student pick up (or point out) any shoe in the pile. Starting at #1 on the key, make the choices presented until the shoe is identified. Try this with several shoes until students are comfortable using the key.

6. **Divide students into teams to create dichotomous keys for plants.**

   Tell the students that they will now use their new skill to create a dichotomous key to identify individual plants from a set of photos. Divide students into 4 teams. Give each team a set of the plant photos. *(Note: You may create more teams if necessary given class size, just be sure there are an even number of teams and that each team has a set of photos.)* Hand out a copy of the *Student Study Guide – Key to Desert Plants* to each student. Instruct students to follow the directions on the Study Guide to key out their plants. Students should work with their team but each student should complete their own study guide.

continued

7. Have students switch keys with other teams. Use those keys to key out plants.

When all teams have created their dichotomous keys, have teams switch keys. Since all the plant photo sets are the same, have teams keep their own photos but use the other team's key to key out each individual plant. If time permits, teams may switch keys again with a different team. All students should then answer the "*Questions for Discussion*" in their Study Guides.

8. Conduct a class discussion using the *"Questions for Discussion"* as a guide.

Focus the class discussion first on *Part A of the Questions for Discussion.* Stress the use of distinguishing characteristics to identify plants. Discuss the characteristics students used in their keys and note similarities and differences in different teams' keys. Point out that they actually did just what scientists do in constructing a key; they used the characteristics they felt were most distinguishing to create their keys. There was likely some difference between teams, which also happens with scientists.

9. Discuss characteristics specific to desert plants.

Discuss the characteristics of desert plants that are likely adaptations for survival. Point out that because water is a limiting factor in the desert, plants with those characteristics may have a better chance of survival. Have students list and discuss how some of those characteristics might aid a plant in survival (e.g., small leaves to conserve water, light colors to stay cool, etc.).

10. Discuss the characteristics of cacti.

Using the *Part B Questions for Discussion* as a guide, discuss the characteristics of cacti. Have students refer to their photo sets during the discussion. Ask students what they listed as distinguishing characteristics of cacti. List their responses on the board. Explain that during their field trip to the Desert Botanical Garden, they will have the opportunity to study cactus up close and learn more about their identifying characteristics. In preparation for that investigation, they need to come up with a hypothesis about what the distinguishing characteristics of plants in the Cactus Family are. Review the list of characteristics with the students and help them come up with a hypothesis about how to identify plants in the cactus family. Guide students to come up with the following hypothesis:

Plants with spines, green, fleshy stems, and rounded growth form are in the Cactus Family.

continued

SPECIAL NOTE TO TEACHERS: This hypothesis is clearly derived from the characteristics observed in the photos of all the "cactus-like" plants in the students' photo sets. Please note that during your trip to the Desert Botanical Garden, this hypothesis will actually be **proven incorrect** as students study a variety of "cactus-like" plants and observe characteristics specific to the cactus and other plant families. By arriving with this hypothesis, students will have the opportunity to work through the scientific method to better understand not only the characteristics of plants in the cactus family, but of how the scientific process works.

11. **Have students write down and remember their hypothesis in preparation for their field trip.**

Remind students that during their field trip, they will be making observations and gathering evidence to test their hypothesis. They will be following the scientific method in their investigation! Have each student write down the class hypothesis on their *Student Study Guide* and be prepared to share their hypothesis with their guide during their field trip.

TEACHER'S GUIDE FOR SEVENTH GRADE
INQUIRY IN THE GARDEN - STAGE 1
Key to Desert Plants

Learning Objectives

1. Look at the group of objects or organisms and note distinguishing characteristics.

   (For shoes, this could be shoes having laces, leather shoes, sandals, tennis shoes, white shoes, etc.)

2. Separate the group into two groups based on a single distinguishing characteristic.

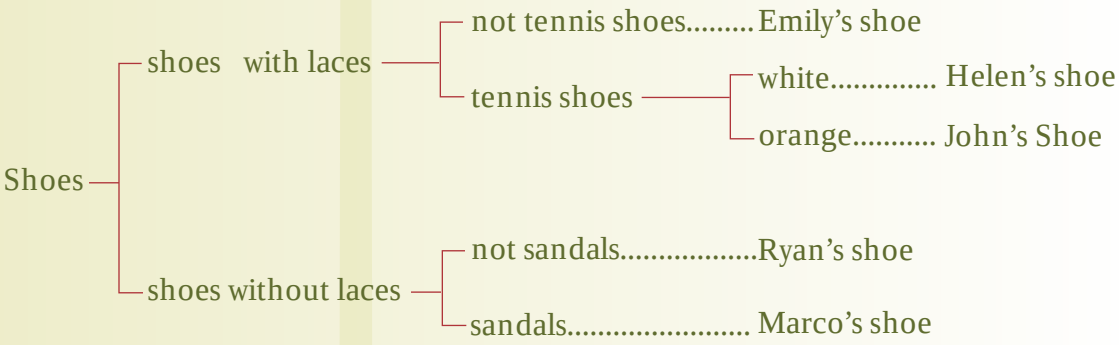
   (For shoes, this could be those with laces and those without laces.)

3. Continue to separate each of the groups into two additional groups again based on a single distinguishing characteristic.

   (For the group of shoes with laces, this could be tennis shoes and not tennis shoes.)

4. Continue separating each grouping until each object has its own separate set of characteristics.

To help visualize the key as it is being created, it is helpful to create a "spider" key to chart the characteristics. For a group of shoes, this might look like the following:



Once the key is complete and every object is identified, the same information may be presented in traditional dichotomous key form:

1. a. shoes with laces……go to #2
   b. shoes without laces……go to #4
2. a. not tennis shoes……..Emily's shoe
   b. tennis shoes……go to #3
3. a. white……...Helen's shoe
   b. orange……John's shoe
4. a. not sandals……..Ryan's shoe
   b. sandals……Marco's shoe

Using the traditional dichotomous key, one should be able to pick up any object included in the key and follow the steps to arrive at its identity. Try it!

STUDENT STUDY GUIDE - KEY TO DESERT PLANTS

Student Name_____ Teacher_____
Others on your team_____

Be sure everyone on the team can see all the plant photos. Observe the photos carefully. As a team, note and discuss the distinguishing characteristics of the plant.

Working in your team, develop a dichotomous key for your eleven plants based on the distinguishing characteristics. Follow the same steps previously used for creating a dichotomous key. The plants' identities for this activity are simply Plant A, Plant B, and so forth. Use those names in your key. Draw a spider key first then create a traditional dichotomous key. Use a separate piece of paper for each.

Once all teams have completed their keys, trade keys with another team. While they are using your key, follow the steps on their key to identify each of the plants. Note differences in the distinguishing characteristics they used and in how they set up their key. If time permits, trade keys with a different team.

Answer the questions below and be prepared to discuss them with the class. For Part B, you will want to refer to your set of plant photos. Save Question 4 of Part B to answer as a class

Part A. Characteristics of Desert Plants

1. What were the distinguishing characteristics of the plants your team used to construct your key? List them below.

2. Were other teams' keys exactly like yours? Describe the differences and similarities in your keys. Include a list of the distinguishing characteristics other teams used in their keys that you did not use in yours.

3. Even if other teams used different characteristics in their dichotomous keys, were the results still the same and did you arrive at the correct plant? Do you think it matters which characteristics are used in a key? Why or why not?

4. All of the plants you keyed out are desert plants. List and describe any distinguishing characteristics you can observe that might be adaptations to help plants survive in the desert. Include how the adaptations likely help the plant survive desert conditions.

5. Did any of the plants you keyed out look familiar? List the plant you think you know. If you do not know the exact name, list what kind of plant you think it might be.

STUDENT STUDY GUIDE - KEY TO DESERT PLANTS

Student Name_____ Teacher_____
Team_____

Part B. What Makes a Cactus, a Cactus?
Answer Questions 1, 2, & 3 on your own. You will answer Question 4 during your class discussion

1. How many plants from your photo set do you think are cacti (in the Cactus Family)? List those below using their "names" from the photos (e.g., Plant A, etc.). *(Note: You may refer to your photos again if necessary.)*

2. What distinguishing characteristics do you observe in your photos that lead you to believe that a particular plant is a cactus? List those characteristics below.

3. Do you think these characteristics are exclusive to plants in the cactus family? Explain your answer.

4. During your trip to the Desert Botanical Garden, you will be following the scientific method to investigate how to identify plants in the cactus family. In preparation for that investigation, based on what you have observed in your photos, your class should develop a hypothesis about what the distinguishing characteristics of plants in the Cactus Family are. State that hypothesis below.

PLANT A

PLANT B

PLANT C

PLANT D

PLANT E

PLANT F

PLANT G

PLANT H

PLANT I

PLANT J

PLANT K

Related ADE Standards:

Reading Strand 1: Reading Process

Concept	Performance Objective
C6: Comprehension Strategies	PO 4: Use graphic organizers in order to clarify the meaning of the text. PO 5: Connect information and events in text to experience and to related text and sources. PO 6: Apply knowledge of the organizational structures (e.g., chronological order, compare and contrast, cause and effect relationships, logical order) of text to aid comprehension. PO 7: Use reading strategies (e.g., drawing conclusions, determining cause and effect, making inferences, sequencing) to interpret text.

Reading Strand 3: Comprehending Informational Text

Concept	Performance Objective
C1: Expository Text C1: Expository Text	PO 5: Locate specific information by using organizational features (e.g., key/guide words) in expository text. PO 8: Interpret graphic features (e.g., charts, maps, diagrams, illustrations, tables, timelines, graphs) of expository text. PO 9: Apply knowledge of organizational structures (e.g., chronological order, comparison and contrast, cause and effect relationships, logical order) of expository text to aid comprehension. PO 10: Make relevant inferences about expository text, supported by text evidence.
C2: Functional Text	PO 1: Use information from text and text features to determine the sequence of activities needed to carry out a procedure. PO 2: Determine what information (e.g., steps in directions, legend, supplies needed, illustrations, diagram, sequence) is missing in functional text. PO 3: Interpret details from a variety of functional text (e.g., warranties, product information, technical manuals, instructional manuals, consumer safety publications) for a specific purpose (e.g., to follow directions, to solve problems, to perform procedures, to answer questions.

Writing Strand 1: Writing Process

Concept	Performance Objective
C1: Prewriting	PO 1: Generate ideas through a variety of activities (e.g., prior knowledge, discussion with others, printed material or other sources). PO 2: Determine the purpose (e.g., to entertain, to inform, to communicate, to persuade, to explain) of an intended writing piece. PO 4: Establish a central idea appropriate to the type of writing. PO 5: Use organizational strategies (e.g., outline, chart, table, graph, Venn Diagram, web, story map, plot pyramid) to plan writing.
C2: Drafting	PO 2: Organize writing into a logical sequence that is clear to the audience.
C5: Publishing	PO 1: Prepare writing in a format (e.g., oral presentation, manuscript, multimedia) appropriate to audience and purpose. PO 4: Write legibly.

Writing Strand 2: Writing Components

Concept	Performance Objective
C2: Organization	PO 1: Use a structure that fits the type of writing (e.g., letter format, narrative, play, essay).
C4: Word Choice	PO 1: Use accurate, specific, powerful words that effectively convey the intended message. PO 2: Use words that consistently support style and type of writing. PO 3: Use vocabulary that is original, varied, and natural. PO 4: Use literal and figurative language where appropriate to purpose.

Writing Strand 3: Writing Applications

Concept	Performance Objective
C2: Expository	PO 1: Record information (e.g., observations, notes, lists, charts, map labels and legends) related to the topic.
C3: Functional	PO 1: Write a variety of functional texts (e.g., directions, recipes, procedures, rubrics, labels, posters, graphs/tables).

Language Arts Standard 4: Viewing and Presenting

Standard	Performance Objective
Students use a variety of visual media and resources to gather, evaluate and synthesize information and to communicate with others.	VP-E1: Analyze visual media for language, subject matter and visual techniques used to influence opinions, decision making and cultural perceptions VP-E2: Plan, develop and produce a visual presentation, using a variety of media such as videos, films, newspapers, magazines and computer images

Science Strand 1: Inquiry Process

Concept	Performance Objective
C1: Observations, Questions, and Hypotheses	PO 1: Formulate questions based on observations that lead to the development of a hypothesis.

Science Strand 4: Life Science

Concept	Performance Objective
C3: Populations of Organisms in an Ecosystem	PO 3: Analyze the interactions of living organisms with their ecosystems: limiting factors

DESERT BOTANICAL garden

TEACHER'S GUIDE FOR EIGHTH GRADE
INQUIRY IN THE GARDEN - STAGE 1
Flower Power- The Genetic Journey

What is a Desert tutorial

How are Deserts Formed tutorial


Virtual Habitat

Activity Overview

In preparation for their visit to the Desert Botanical Garden, students review the reproductive parts and processes of angiosperm plants. Referring to provided graphics, the class reviews the specific parts of flowers, seeds, and fruit and discusses how a flower becomes a fruit, how a fruit produces seeds, and how a seed germinates. The class next explores how parents (of plants and other living things) pass characteristics to their offspring. Students apply basic genetic principals by using a Punnett square to determine the genetic make-up of offspring given parents of various dominant and recessive genes. Finally, students consider how desert plants pass on genetic information through seeds, as they develop a hypothesis about how seeds survive the harsh desert environment and germinate when conditions are favorable.

To support the Inquiry in the Garden lesson plans, you may also use the tutorials and Virtual Habitat in DBG's Digital Desert. These interactive activities will prepare students for their investigations by teaching them about the characteristics of deserts and the Sonoran Desert habitat.

Materials

(Note: All of the following materials are provided as downloadable documents and should be prepared for use on an overhead projector or smartboard.)

- *Parts of a Flower*
- *Teacher's Guide to the Parts of a Flower*
- *How a Fruit Develops*
- *Structure of a Seed*
- *Creating a Punnett Square*

Learning Objectives

Upon completion of this activity, students will be able to…

- List and describe the reproductive parts of a flower.
- Describe how a fruit develops from a pollinated flower.
- Draw, label, and explain the functions of the parts of a seed.
- Define the terms dominant and recessive in relation to genetics.
- Complete and analyze the results of a Punnett square.
- Calculate the probability of offspring having a particular trait.
- State a hypothesis about desert seeds and consider ways to test their hypothesis.

TEACHER'S GUIDE FOR EIGHTH GRADE
INQUIRY IN THE GARDEN - STAGE 1
Flower Power- The Genetic Journey

Background Knowledge

These are concepts that the educator should know and that can be found in the glossary.

Cotyledons	Hypothesis	Question
Dominant	Genes	Recessive
Dormancy	Germinate	Seed coat
Embryo	Observation	Traits
Fertilization	Pollination	

Activity Procedures

1. **Introduction.**

   Explain to students that they will be visiting the Desert Botanical Garden where they will be studying reproduction and heredity in plants – specifically in desert plants. This lesson will help prepare them for that field trip. Through an inquiry discussion, review with students the name of our desert (the Sonoran Desert) and the characteristics of deserts in general (hot, dry, high evaporation, low rainfall, and extreme temperature fluctuations).

2. **Review reproductive parts of plants.**

   Display *Parts of a Flower* on the overhead projector or smartboard. Review and discuss the graphic and ask for students to name the different structures. As students respond with the correct names, fill in the appropriate blanks. (If necessary, refer to the *Teacher's Guide to the Parts of a Flower.*)

3. **How does the flower produce seeds?**

   Display How a Fruit Develops on the overhead projector or smartboard. Review and discuss the graphic pointing out the specific steps in fruit development:

   – *The flower is pollinated (review flower parts involved in **pollination**).*

   – *The pollinated flower is fertilized by the pollen (**fertilization**).*

   – *The flower's fertilized ovary typically swells and becomes the fruit.*

   – *The fruit is the seed-bearing structure produced from the flower.*

   – *The fruit contains from one to many seeds.*

continued

4. How do seeds become new plants?

Display *Structure of a Seed* on the overhead projector or smartboard. Review and discuss the seed structures and their functions, and the process of germination as stated on the graphic and below:

- *The **seed coat** is the protective outer layer that functions to protect the embryo from parasites, injury, and harsh conditions (such as weather or digestive enzymes).*
- *The **cotyledons** are the embryo's "leaves" and are the seedling's energy source until real, photosynthetic leaves develop.*
- *The **embryo** is the immature plant with all the information necessary to become the full grown plant.*
- *A seed **germinates** (begins to grow into a plant) by absorbing water which activates growth. The embryo gets so big that it bursts from the seed coat. The roots and then the cotyledons emerge. With the right conditions, the seedling grows into an adult plant.*

5. Heredity in plants.

As mentioned previously, the embryo contains all the information necessary to become the adult plant. Ask students the following questions:

- *How do plants (and other living things) pass on their characteristics to their offspring?*
- *How does a saguaro produce baby saguaros and not baby palo verde trees?*
- *How does a mesquite tree produce baby mesquites?*
- *What is in a seed that determines what kind of plant it will become?*

Entertain answers then conduct a class discussion about sexual reproduction in plants. Review the following key points about the processes involved in plant reproduction:

- *Sexual reproduction occurs in plants when a flower is pollinated and fertilized.*
- *Once pollinated, flowers typically produce a fruit that contains from one to many seeds.*
- *In the right conditions, seeds will germinate and grow into a plant.*

Following the review of those points make the following statement:

- *The plant that a seed becomes is determined by the **genes** it inherits from its parents.*

continued

6. Heredity in plants Q & A.

Continue the discussion on heredity using the following questions and answers as a guide:

- Question: What kinds of things are inherited from parent plants? *(Answer: species identity, size, shape, color, flower color, etc.)*
- Question: How about human parents? What are some things we inherit from human parents? *(Answer: eye color, height, hair color, etc.)*
- Question: What do we call these inherited characteristics? *(Answer: **traits**)*
- Questions: How are these "traits" inherited? What determines traits? *(Answer: Traits are determined by genes, which are inherited from the parents. In sexual reproduction, half of an individual's genetic makeup (genes) comes from one parent and half from the other parent.)*

7. Tongue curlers or not?

Explain that the lesson will get back around to discussing plants, but for now, as an example, the class will consider genetic traits in humans using a fun activity. As students now know, different genes determine different traits. One trait that is genetic (or carried in the genes) is the ability to curl one's tongue. Ask students to "curl" (or roll) their tongues. Have students that can curl their tongues raise their hands. Next have students that can't curl their tongues raise their hands. Were there more students that were tongue curlers or not tongue curlers? (It is most probable that there are more tongue curlers.) Ask students why there might be more of one group than another. Looking at the numbers in this class, what do students think the probability is of being a tongue curler in a given population? Review and discuss the following points with students:

– *Genes determine the trait.*

– *There may be several possible expressions of a specific trait (e.g., tongue curler or not).*

– *Offspring inherit a gene pair – one gene (hence one trait possibility) from each parent.*

– *The trait that is expressed by the offspring is called the **dominant** trait.*

Considering the above points, which do students think is dominant, being a tongue curler or not?

continued

8. Dominant versus recessive.

Explain that the tongue curling gene is dominant over the non-curling gene. Usually in a population (as in the class) the majority of individuals express the **dominant** gene. The gene that is not dominant (in this case the non-curling gene) is called the **recessive** gene. Point out to students that even though recessive, the non-curling gene is still evident in our population. What does this say about the genetic make up of our population? *(Recessive traits are still in the gene pool.)*

9. Punnett squares.

Display *Creating a Punnett Square* on the overhead or smartboard explaining that a Punnett square can be used to determine the possible traits of an offspring given the genetic make-up of its two parents. Follow the directions on the overhead to walk students through the completion of first a cross of TT x tt parents. Review the discussion points. Next walk students through the cross of Tt x Tt parents.

10. Discuss Punnett squares and genetic traits.

Point out that Punnett squares and genetic variation will be further explored during the field trip to the Desert Botanical Garden. There, students will look at dominant and recessive traits in plants. They will also see a variety of possibilities of offspring in different situations.

11. Preparing for your investigation

As part of the field trip, students will be conducting several investigations. The rest of this lesson prepares students for one of those investigations. Specifically, students will be looking at the germination of selected seeds in the desert. In order to pass on genetic information, seeds need to germinate and grow into new plants.

Once again, display *Structure of a Seed* on the overhead projector or smartboard. Review the seed's structures and ask students the questions below discussing each in turn. Although the answers are provided, use inquiry to help guide students to come up with the answers themselves.

- Question: What activates germination? *(Answer: water)*
- Question: In the desert, are conditions always great for seeds to germinate? *(Answer: no)*
- Question: What would happen to a seed if there was just a little bit of rainfall and then no rain for weeks or months? *(Answer: The seed would sprout then die as there would be no water for the growing seedling.)*

continued

continued

- Question: When (at what parts of the year) are there more reliable, consistent rains in the Sonoran Desert? *(Answer: summer monsoons and winter rains)*
- Question: Might it be beneficial for a seed to wait it out and be able to time its germination with reliable rains? *(Answer: yes)*
- Question: Does anyone know the word for something (like a seed) to "wait it out" or have a resting period? *(Answer: dormancy - Many desert seeds have a* ***dormant*** *stage during which they are resting and waiting for the right conditions.)*
- Question: How might a seed be able to do that? *(Answer: By having some control over when it germinates.)*
- Question: What do you observe on this diagram of a seed that might help it control germination? *(Answer: the seed coat.)*
- Question: How might a seed coat help control germination? *(Answer: By being very durable, the seed coat could prevent water from easily getting in and activating germination. That way it would take more than one light rain to trigger germination.)*
- Question: Would you expect a desert seed coat to be more durable than a seed coat from a less harsh environment? (*This answer is up to the students.)*
- Question: How could we test that? *(This answer is up to the students.)*

12. **State a hypothesis about desert seeds.**

Point out that at the Desert Botanical Garden, students will continue this investigation but with real seeds. Tell students that the Q and A they just went through was actually following the scientific method to prepare them for that investigation. In their answers, they actually just stated observations, came up with a question, and made a hypothesis about desert seeds. On the board, write the words Observation, Question, and Hypothesis leaving space beside each. Lead students to articulate the following:

Observations: *Seeds need water to germinate. Desert rains are seasonal.*

Question: *How can desert seeds delay germination to the best conditions for growth (rainy seasons)?*

Hypothesis: *Desert seeds delay germination by having a hard outer seed coat.*

Write these on the board and instruct each student to copy them down in their journals or on a piece of paper. Tell them to remember what they said about how they could test their hypothesis. Will the test they conduct at the Botanical Garden be what students suggested? Come on the field trip and find out!

Creating a Punnett Square

Key Points:

- Each individual receives one type of the gene from each parent.
- For each trait, offspring receive a gene pair (one gene from each parent).
- The genetic makeup of the offspring is determined by which gene it gets from each parent.
- When representing genes, a capital letter is used for the dominant gene (T) and lower case letter used for the recessive gene (t).
- If the dominant gene (T) is present, the recessive (t) will not be expressed.

Instructions:

- Cross a dominant parent (TT = tongue curler) with a double recessive parent (tt = no curl).
- In the square, write the result of the pairing (the first pairing is done for you).
- State which trait is expressed.
- When all the squares are completed, calculate the probability that offspring born to TT x tt parents will be tongue curlers (to be stated as a ratio and percentage).
- On the next page repeat the process but with Tt parents (the next generation).

	T	T
t	Tt (curl)	
t		

What is the probability that the offspring of TT x tt parents are tongue curlers? (How many out of four possibilities?):

_____ / 4 or _____: 4

= _____%

How many offspring are not tongue curlers?

_____ / 4 or _____: 4

= _____%

continued

continued

Creating a Punnett Square

Instructions:

- Cross a Tt parent with a Tt parent. Complete the Punnett square below then calculate the probability that offspring born to Tt x Tt parents will be tongue curlers (to be stated as a ratio and percentage).

	T	t
T		
t		

What is the probability that the offspring of Tt x Tt parents are tongue curlers? (How many out of four possibilities?):

_____ / 4 or _____: 4

= _____%

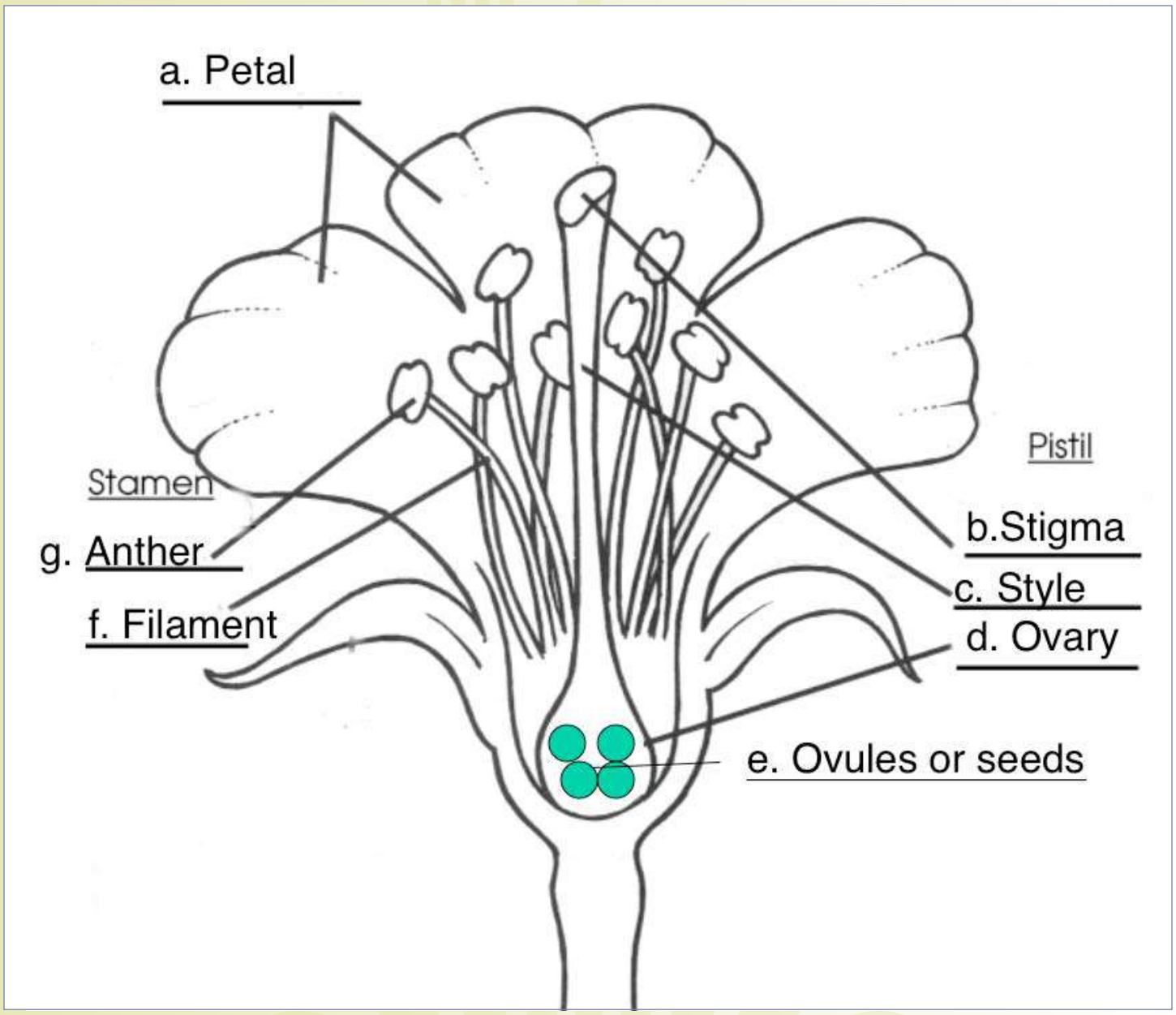
How many offspring are not tongue curlers?

_____ / 4 or _____: 4

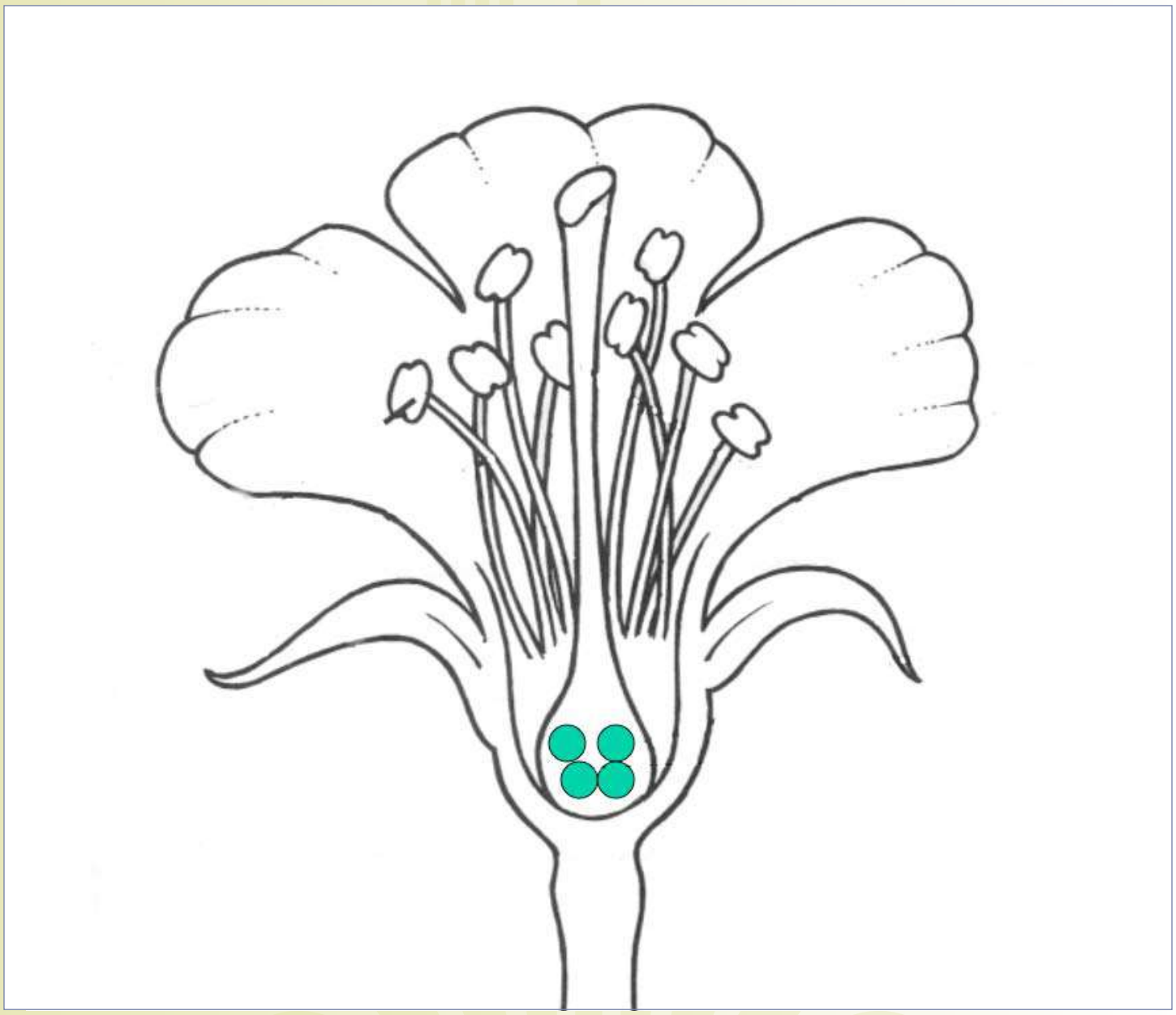
= _____%

Continue making crossings with different pairings using your own Punnett squares.

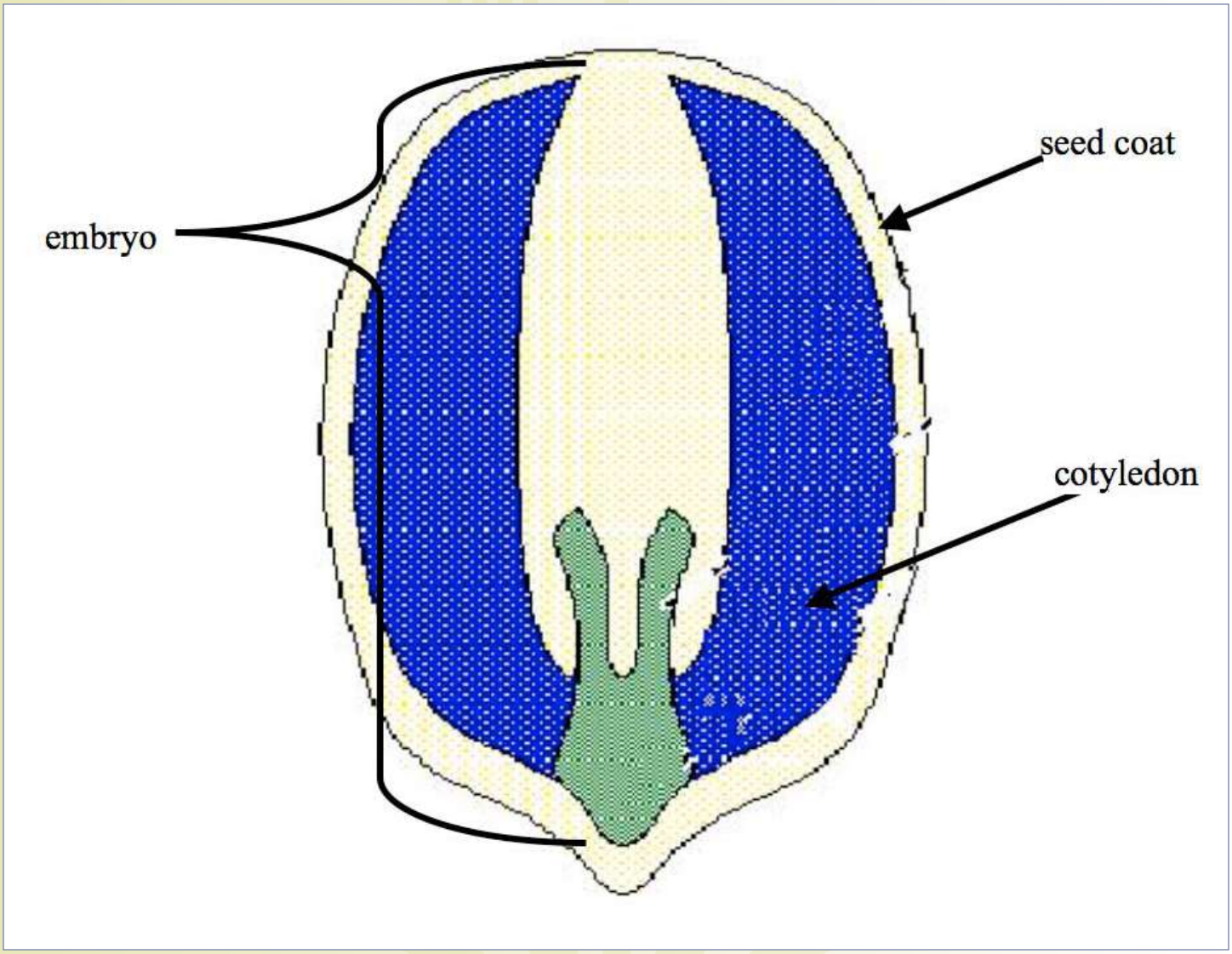
TEACHER'S GUIDE TO THE PARTS OF A FLOWER



PARTS OF A FLOWER



STRUCTURE OF A SEED



HOW FRUIT DEVELOPS

Mature flower
The mature flower appears as a bright yellow open cone and is ready for pollination. For tomatoes, 3 to 5 flowers should be allowed to develop on a healthy truss.

Fertilized flower
Fertized flowers are denoted by the appearance of bruises on the anther cone left by bubble bees clamping onto and pollinating the flower.

continued

HOW FRUIT DEVELOPS

Fruit set
At fruit set, flower petals and anthers sensce (die) and fall away as a pea-sized green fruit appear at each termination of the flower truss. Typically it takes 45-50 more days from this point before fruit is ready to harvest.

Immature Fruit
As a fruit enlarges, it remains light green in color and very firm (high turgor pressure). Fruit closest to the plant stem is the most mature, and thus largest in size.

Related ADE Standards:

Reading Strand 1: Reading Process

Concept	Performance Objective
C4: Vocabulary	PO 2: Use context to identify the intended meaning of unfamiliar words (e.g., definition, example, restatement, synonym, contrast). PO 3: Use context to identify the meaning of words with multiple meanings (e.g., definition, example, restatement, contrast).

Reading Strand 3: Comprehending Informational Text

Concept	Performance Objective
C1: Expository Text	PO 8: Interpret graphic features (e.g., charts, maps, diagrams, illustrations, tables, timelines, graphs) of expository text.
C2: Functional Text	PO 1: Use information from text and text features to determine the sequence of activities needed to carry out a procedure.

Writing Strand 3: Writing Applications

Concept	Performance Objective
C2: Expository	PO 1: Record information (e.g., observations, notes, lists, charts, map labels and legends) related to the topic.

Language Arts Standard 3: Listening and Speaking

Standard	Performance Objective
Students effectively listen and speak in situations that serve different purposes and involve a variety of audiences.	LS-E3: Interpret and respond to questions and evaluate responses both as interviewer and interviewee.

Math Strand 1: Number and Operations

Concept	Performance Objective
C2: Numerical Operations	PO 3: Solve problems involving percent increase, percent decrease, and simple interest rates.

Math Strand 2: Data Analysis, Probability, and Discrete Math-

Concept	Performance Objective
C2: Probability	PO 2: Interpret probabilities within a given context and compare the outcome of an experiment to predictions made prior to performing the experiment.

Science Strand 1: Inquiry Process

Concept	Performance Objective
C1: Observations, Questions, and Hypotheses	PO 1: Formulate questions based on observations that lead to the development of a hypothesis. PO 2: Use appropriate research information, not limited to a single source, to use in the development of a testable hypothesis. PO 3: Generate a hypothesis that can be tested.

Science Strand 4: Life Science

Concept	Performance Objective
C2: Reproduction and Heredity	PO 2: Explain the basic principles of heredity using the human examples of: • eye color • widow's peak • blood type PO 3: Distinguish between the nature of dominant and recessive traits in humans.

Science Strand 4: Life Science

Concept	Performance Objective
C4: Diversity, Adaptation, and Behavior	PO 1: Explain how an organism's behavior allows it to survive in an environment. PO 2: Describe how an organism can maintain a stable internal environment while living in a constantly changing external environment. PO 3: Determine characteristics of organisms that could change over several generations. PO 5: Analyze the following behavioral cycles of organisms: dormancy (plants) PO 6: Describe the following factors that allow for the survival of living organisms: pollination

Workplace Skills Standard 1: Students use principles of effective oral, written and listening communication skills to make decisions and solve workplace problems.

Standard	Performance Objective
1WP-E4: Respond to oral and written presentations by formulating relevant feedback, expressing opinions, discerning the main idea and distinguishing fact from opinion.	PO 1: Summarize main ideas of an oral or written presentation PO 3: Formulate related questions in a presentation PO 4: Express opinions relating to the main idea in a presentation

DESERT BOTANICAL garden

TEACHER'S GUIDE FOR EIGHTH GRADE
INQUIRY IN THE GARDEN - STAGE 2
Flower Power- The Genetic Journey

Desert Botanical Garden website

Activity Overview

In this investigation, students venture outside for a teacher-led, plant investigations walk in their own schoolyard. This activity is offered as an alternative field investigation for classes unable to visit the Desert Botanical Garden. The purpose of this activity is to get students outside and involved in real, hands-on field investigations about plants. It is suggested that classes first conduct the *Flower Power- the Genetic Journey* Inquiry Stage 1- Introductory Activity in preparation for this investigation. Although that introductory activity is primarily for classes visiting the Desert Botanical Garden, it provides foundational concepts and activities which are further explored in this investigation.

Teacher Preparation

The purpose of the plant investigations walk is for students to see plants in various stages of reproduction in nature and to follow the scientific method as they investigate aspects of plant reproduction. It is suggested that teachers first scout the school grounds before taking the students outside. Decide on a route that would be good for a plant investigations walk. The route should include a variety of plants including trees, shrubs, and cacti (if possible). It is recommended that at least three specific places or "stops" be identified along the route that would serve as focal points to investigate plant flowers, fruits, and seeds. Students will be better prepared for the investigation if the class first reviews and discusses the *Parts of a Flower, How a Fruit Develops*, and *Structure of a Seed* graphics provided in the *Flower Power- The Genetic Journey* Inquiry Stage 1- Introductory Activity.

Materials

- *Pollinator Partner* Cards (downloaded and printed, cut as directed, and potentially laminated)
- A variety of fruits including beans, bean pods, apple, orange, peach. etc.
- Optional depending on selected activities: pencils, paper, hand lens, dissecting kit (or simply knives for cutting open fruit), pliers, and/or other tools.
- *Student Investigation Journal*
- *Student Study Guide- Results and Conclusion*

TEACHER'S GUIDE FOR EIGHTH GRADE
INQUIRY IN THE GARDEN – STAGE 2
Flower Power- The Genetic Journey

General Procedures

Guide students on an outdoor plant investigation walk following your pre-planned route. At each stop, conduct an inquiry using the *Discussion Questions* to convey the *Teaching Points* presented for that stop. Following each discussion, conduct one or more of the *Suggested Activities* while students record in their *Student Investigation Journals*. Wrap up your walk by discussing students' discoveries and reviewing the *General Teaching Points*. Complete student investigations by conducting the *Flower Power- The Genetic Journey* Inquiry Stage 3 – Concluding Activity.

Plant Reproduction Investigation – General Teaching Points

- Plant reproduction involves several plant structures (flowers, fruits, and seeds) and results from a series of processes (including pollination and fertilization).
- Plants and their pollinators have a symbiotic relationship and each have specific structures and adaptations to facilitate the process.
- Fruits develop from flowers and contain seeds that become new plants.
- Seeds contain all the genetic information necessary to develop into new plants.
- Some seeds have a dormant stage which is a survival strategy allowing them to rest and wait for the right conditions to germinate.

Flowers Stop

Description

The flowers stop should offer a good view of a variety of flowering or potentially flowering plants. The area should be large enough to accommodate the group and offer good opportunities for nearby observation (and if allowed, collection) of flowers.

Teaching Points

- Flowers are the primary reproductive structure of most plants.
- Pollination is a process in reproduction.
- Plants have specific structures used in the process of pollination.
- Flowers have specific male and female parts each having specific functions in pollination.

continued

– Some pollinators are adapted to pollinating very specific types of flowers.
– The type of animal that pollinates a particular flower can often be surmised by the structure of the flower.
– The type of flower that an animal pollinates can often be surmised by the animal's size, mouth parts, and other body structures.
– Pollination (involving a pollinator and plant) is an example of a symbiotic relationship.

Discussion Questions and Activity Suggestions

At the flowers stop, conduct an inquiry using the teaching points as your guide. Questions to help students arrive at the key points for this stop could include the following:

Why do plants have flowers?

What are some of the differences we see in flowers?

Why are flowers so varied, fragrant, and colorful?

What happens in the process of pollination?

What kinds of things (environmental factors and animals) aid in the process of pollination? How?

What is a symbiotic relationship?

Why is pollination an example of a symbiotic relationship?

After students have had a chance to discuss flowers, choose and conduct one or more of the following suggested activities.

Have students…

– Play a game using the Pollinator Partners cards to see if they can match the pollinator with its specific flower. Selected students could play particular flowers while other students play the pollinators. Can they make the right match?
– Look around the schoolyard to locate flowers and deduce from the shape of flower what kind of animal might pollinate it.
– Sit quietly for a designated amount of time and observe flowers to see what kind of animals visit the flower and potentially pollinate it.
– Use magnifying lenses to study the parts of a real flower. Can they identify the male and female parts?
– Observe, draw, and label the parts of a flower they either find in the schoolyard or bring from home.

Fruit Stop

Description

If possible, locate an area or areas of the schoolyard where there are fruiting plants. These could be fruit or bean trees (such as mesquite), bushes with berries or bean pods, or small forbs (e.g., weeds) in their fruiting stage.

Teaching Points

- Fruits come in many forms.
- The function of fruits in the reproductive process is to bear and nourish the seeds.
- A fruit is the result of a flower being pollinated then fertilized.
- A fruit is the fertilized and ripened ovary of the flower.

Discussion Questions and Activity Suggestions

At the fruits stop, conduct an inquiry using the teaching points as your guide. Questions to help students arrive at the key points for this stop, could include the following:

What is a fruit?

What is the purpose of fruit?

How does a fruit develop? From what plant part does it form?

Can anyone name some different types of fruits?

From where we are sitting, how many different types of fruits can you see?

After students have had a chance to discuss fruit, choose and conduct one or more of the following suggested activities.

Have students…

- Explore the area around the stop to discover different types of plant fruits. Some fruits may have already fallen from the plant so may be found on the ground under the plant.
- Collect different fruits that have fallen from plants. Categorize them according to similar and differing characteristics. What are some similarities and differences of fruits?

continued

continued

- Dissect fruits that have been collected (or brought along on the outing). How many seeds are inside? Can they see how the fruit developed from the flower?
- Draw the fruits they have dissected.
- Play a game in which they decide if a plant part is a fruit or not.
- Find a plant in different stages of fruit development. Collect and/or draw the fruit in its different stages of development.

Seeds Stop

Description

The seeds stop could be similar to the fruits stop. Because the fruit bears the seed, it could even be the same stop. For variety however, it may be best to move to another location where there are a variety of plants that exhibit seeds.

Teaching Points

- The basic structure of a seed includes the seed coat, embryo, and cotyledons.
- Seeds need water to germinate.
- Water must penetrate the seed coat to activate germination.
- A seed's outer coating can vary in thickness and durability.
- Some seeds have a very hard, thick coat.
- A hard seed coat helps delay germination.
- Dormancy is a period of inactivity (during which the seed is in a "resting" or "pausing" stage).
- Many desert seeds have a dormant stage during which they are resting and waiting for the right conditions to germinate.
- Seeds carry the genetic information of plants to ensure the continuation of the species.

Discussion and Activity Suggestions

At the seeds stop, conduct an inquiry using the teaching points as your guide. Questions to help students arrive at the key points for this stop, could include the following:

What are the main parts (structures) of a seed?

Are all seeds the same?

continued

continued

What is the function of seeds?

What do seeds need to germinate?

When do seeds germinate?

Do environmental conditions affect seed germination? How?

Is it always a good time to germinate? Why or why not?

How might seeds control timing of their germination?

What information do seeds carry for/about plants?

After students have had a chance to discuss seeds, choose and conduct one or more of the following suggested activities.

Have students…

- Draw and label the parts of a seed.
- Walk around the area to find and collect different kinds of seeds. What are some of the similarities and differences of seeds? Do some seeds seem harder than other seeds?
- Look for signs of seeds germinating. Look under trees or bushes for new sprouts. Can students find seeds in different stages of germination? Can they find any newly sprouted seeds and see the cotyledons?
- List questions about seeds, based on their observations, that they could potentially research. For some of the questions, have them develop hypotheses and consider ways they could test their hypotheses.
- Conduct an investigation on the hardness of seeds. Are some seeds harder than others? Are desert seeds harder than seeds from other environments? *(Note: This continues the investigation started in the Inquiry Stage 1- Introductory Activity, Procedures 11 and 12 in which students developed a hypothesis about seed hardness.)* Help students set up the investigation by selecting seeds (seeds could be brought in from home) and providing tools to test seed hardness. (Pliers are good because students can tell the difference in how hard they must squeeze in order to crack the seed coat.) Have students compare and record which seeds are hardest to crack.
- Follow their seed hardness investigation through to the results and conclusions stage by completing the *Student Study Guide – Results and Conclusions.*
- Collect seeds from the area and attempt to grow them. Some seeds need their outer coat to be cracked or softened to germinate. Do some seeds germinate easier than others? How can students help activate germination? Conduct an investigation on this following the scientific method.

DESERT BOTANICAL garden

STUDENT INVESTIGATION JOURNAL

Student Name_____

Flowers

1. Pollinator Partners- Who is your mate? Why are these two organisms a good match?

2. Observe, draw, and label the parts of a flower.

Fruit

3. What are some similarities and differences among the fruit you found?

4. Draw your dissected fruit. How many seeds do you see?

DESERT BOTANICAL garden

STUDENT INVESTIGATION JOURNAL

Student Name_____

Seeds

5. Draw and label the parts of a seed.

6. What are some similarities and differences among the seeds you found?

7. Are some seeds harder? Which ones?

STUDENT STUDY GUIDE - RESULTS AND CONCLUSIONS

Student Name_____ Teacher_____

Instructions: *Based on your experiences in class and during your Plant Reproduction Investigation, answer the questions below. If necessary, refer to your* Student Investigation Journal. *Be sure to answer all the "Questions for Discussion." Complete the Final Project. Post your work online on the DBG Journal of Student Findings as instructed by your teacher*

Part A. Investigation Report

1. What was your class hypothesis about desert seeds?

2. What observations did you make both in the classroom and during the Plant Reproduction Investigation that led you to that hypothesis?

3. What question does your hypothesis attempt to answer?

4. Did you make a prediction about desert seeds and if so what was your prediction?

continued

STUDENT STUDY GUIDE-RESULTS AND CONCLUSIONS

Student Name_____ Teacher_____

5. Describe the experiment you conducted at during the Plant Reproduction Investigation to test seed hardness.

6. What were the results of your experiment? Which seeds were easy to crack? Which were more difficult to crack?

7. State your conclusion. Was your hypothesis supported by your results? Be sure to describe the evidence that supports your conclusion.

STUDENT STUDY GUIDE-RESULTS AND CONCLUSIONS

Student Name_____ Teacher_____

Part B. Questions for Discussion

1. What was common to all the seeds that were more difficult to crack?

2. What do you think would be the results if you conducted the experiment with other desert seeds?

3. Do you think there may be some desert seeds that would yield different results? Why? What might be different about those seeds?

4. Based on your findings, what are some other questions that arise that might lead to new investigations?

5. In the space below, draw a picture of a seed and the three main parts you studied:

continued

STUDENT STUDY GUIDE-RESULTS AND CONCLUSIONS

Student Name_____ Teacher_____

6. What is dormancy

7. What part of the seed aids in dormancy? How?

8. Why is dormancy in desert seeds a good survival strategy?

9. Describe some ways a hard seed coat could be cracked or softened in a desert environment.

10. Why is it important for seeds to survive? What information do seeds carry?

Part C. Final Project: *Now that you know something about how desert seeds survive in the harsh, desert environment, consider other environments and the survival challenges seeds might have in those environments. Consider conditions such as freezing temperatures, constant rains and flooding, or salty mud flats. Select an environment and describe the environmental conditions to which plants and their seeds must adapt. Following the scientific method, state observations and questions and create a hypothesis about how seeds adapt to that environment. Describe how you could test your hypothesis, including step by step instructions for following your experiment. If possible, conduct the experiment!*

Post Your Findings on the Internet!

As part of the Inquiry Process students may share their work with others by visiting the DBG *Journal of Student Findings* at **http://www.dbg.org/index.php/digital/students/journal**. Here, students can submit investigation findings, poems, or original art inspired by their Inquiry in the Garden. For more ideas on art projects that tie into Garden themes, go to the Additional Resources section of the Digital Learning website.

Pollinator Partner Cards

Bee- Fuzzy flying insect seeking yellow, blue, or purple pal. Desires daytime interactions and would like to sit down and share a meal of pollen grains or nectar sips! (Do not waste your energy if red- not in my color vision.)

Pollinator Partner Cards

Palo Verde Bloom- Small, yellow flora seeking daytime dude. Will share a homegrown meal of nectar and pollen grains.

Pollinator Partner Cards

Butterfly- Fluttering, perching Lepidoptera seeks brightly colored, clustered pal. I am easily blown around in the wind so I seek a mate that will let me rest while I re-energize with a sugary nectar drink.

Pollinator Partner Cards

Lantana- Seeking winged mate who desires to use my colorful clustered petals to rest a bit.

Pollinator Partner Cards

Bat- Nocturnal mammal seeking nightblooming partner to draw me in with your strong scent. (I rely on my sense of smell more than sight so don't waste your energy with fancy colors.) Prefer to meet atop the tallest location, where I will enjoy a snack of nectar and loads of pollen to energize me.

Pollinator Partner Cards

Saguaro Blossom- Nightblooming columnar cactus seeks hairy vertebrate that won't judge me for my lack of color. I am only available to share my nectar and pollen if you can meet me at a high location.

Pollinator Partner Cards

Penstemon- Hanging, crimson flora seeking fast paced mate to share my nectar with. I do not produce any scents so you will have to find me by my bright color and distinctive tubular shape.

Pollinator Partner Cards

Hummingbird- Hovering busybody seeking bright red partner, but don't waste your energy on perfumes or scents as I cannot smell. My sipping strategy is suited for tubular corollas.

Pollinator Partner Cards

Fly- Bumbling Diptera seeking rotting smells and dark red colors to lure me in. I feed on rotting meat so you will have to play along if we will be pals.

Pollinator Partner Cards

Carrion Flower- Darkly colored trickster seeks two winged partner to consort with. I will lure you in by impersonating rotting meat.

Pollinator Partner Cards

Wind- Force of nature blowing past. I seek no rewards but will help you move your pollen so long as it is lightweight and can ride on my breeze.

Pollinator Partner Cards

Wheat- Colorless, scentless grass seeking simple, unflashy partner to carry my pollen.

Related ADE Standards:

Reading Strand 1: Reading Process

Concept	Performance Objective
C4: Vocabulary	PO 2: Use context to identify the intended meaning of unfamiliar words (e.g., definition, example, restatement, synonym, contrast). PO 3: Use context to identify the meaning of words with multiple meanings (e.g., definition, example, restatement, contrast).

Writing Strand 3: Writing Applications

Concept	Performance Objective
C2: Expository	PO 1: Record information (e.g., observations, notes, lists, charts, map labels and legends) related to the topic.

Language Arts Standard 3: Listening and Speaking

Standard	Performance Objective
Students effectively listen and speak in situations that serve different purposes and involve a variety of audiences.	LS-E3: Interpret and respond to questions and evaluate responses both as interviewer and interviewee.

Science Strand 1: Inquiry Process

Concept	Performance Objective
C1: Observations, Questions, and Hypotheses Formulate predictions, questions, or hypotheses based on observations. Locate appropriate resources.	PO 1: Formulate questions based on observations that lead to the development of a hypothesis. PO 2: Use appropriate research information, not limited to a single source, to use in the development of a testable hypothesis. PO 3: Generate a hypothesis that can be tested.
C2: Scientific Testing (Investigating and Modeling)	PO 1: Demonstrate safe behavior and appropriate procedures (e.g., use and care of technology, materials, organisms) in all science inquiry. PO 2: Design a controlled investigation to support or reject a hypothesis. PO 3: Conduct a controlled investigation to support or reject a hypothesis. PO 5: Keep a record of observations, notes, sketches, questions, and ideas using tools such as written and/or computer logs.
C3: Analysis and Conclusions	PO 3: Interpret data that show a variety of possible relationships between two variables, including: • positive relationship • negative relationship PO 4: Formulate a future investigation based on the data collected. PO 8: Formulate new questions based on the results of a previous investigation.
C4: Communication	PO1: Communicate the results of an investigation. PO5: Communicate the results and conclusion of the investigation.

Science Strand 4: Life Science

Concept	Performance Objective
C4: Diversity, Adaptation, and Behavior	PO 1: Explain how an organism's behavior allows it to survive in an environment. PO 2: Describe how an organism can maintain a stable internal environment while living in a constantly changing external environment. PO 5: Analyze the following behavioral cycles of organisms: • dormancy (plants) PO 6: Describe the following factors that allow for the survival of living organisms: • pollination

Educational Technology Strand 1: Creativity and Innovation

Concept	Performance Objective
C4: Original Works	PO 2: Use digital tools to collaborate with a group to communicate original ideas, products, or projects effectively in a creative or innovative style.

Educational Technology Strand 2: Communication and Collaboration

Concept	Performance Objective
C1: Effective Communications and Digital Interactions	PO1: Collaborate and communicate with peers, experts, or others employing a variety of digital tools to share findings and/or publish.

Educational Technology Strand 6: Technology Operations and Concepts

Concept	Performance Objective
C2: Applications	PO 7: Identify and use network protocols for moving files and secure web access.

Workplace Skills Standard 1: Students use principles of effective oral, written and listening communication skills to make decisions and solve workplace problems.

Standard	Performance Objective
1WP-E4: Respond to oral and written presentations by formulating relevant feedback, expressing opinions, discerning the main idea and distinguishing fact from opinion.	PO 3: Formulate related questions in a presentation PO 4: Express opinions relating to the main idea in a presentation

DESERT BOTANICAL garden

TEACHER'S GUIDE FOR EIGHTH GRADE
INQUIRY IN THE GARDEN - STAGE 3

Flower Power- The Genetic Journey

Desert Botanical Garden website

Overview

The purpose of this activity is to move students through the completion of an investigation using the scientific process. Before their visit to the Desert Botanical Garden, students made observations, asked questions, and developed a hypothesis which they then tested during their field trip to the Garden. In this activity, students analyze their results and draw conclusions about how seeds germinate when conditions are favorable.

After reviewing their experiences from their field trip to the Desert Botanical Garden, students complete a *Study Guide* in which they describe their investigation and state their conclusions. To share their work with others, students are encouraged to post their findings and diagrams online at the Desert Botanical Garden website.

Materials

- *Data Collection Journal* (from the DBG fieldtrip)
- *Student Study Guide-Flower Power- the Genetic Journey - Results and Conclusions*

Procedures

1. Review and discuss the students' experiences during their trip to the Desert Botanical Garden. Have students share which pollinator or flower they were for the "Partners in Pollination" game. Ask a few pollinator partners to identify each other and state why they were a good match. Ask students what word is used to describe a relationship that benefits both organisms involved (mutualism). What kind of relationship is mutualism? (A type of symbiotic relationship.)
2. Review and discuss the "Defend Your Fruit" game. Who had real fruits? Who didn't? Ask students what makes a fruit, a fruit. (A fruit contains seeds and is the mature ovary of a flower.)
3. Discuss the genetic traits that students looked at during their trip. Have them describe the different traits they observed in plants as well as the traits they looked at in humans. If necessary, have students refer to their *Data Collection Journals*. Which students had which traits? What was the dominant expression of the trait in each characteristic measured? What are the possible gene pairs when the dominant trait is expressed? (TT or Tt)

   After that class discussion, students can individually complete the Organize and Analyze section of their *Data Collection Journals* to recap the lifecycle of angiosperm plants.

continued

4. During their visit to the Garden, students carried out an investigation that they had originally started in the classroom. Call on students to describe the investigation. Review students' hypothesis and discuss how they tested the hypothesis.
5. Hand out the *Student Study Guide – Results and Conclusions*, one to each student. Give students time to complete the *Study Guide Part A* then conduct a wrap-up discussion using *Part B "Questions for Discussion"* as a guide.
6. Allow for adequate time (both in class and as homework) for students to complete *Part C* (the *Final Project*) of their Study Guides. (Students could work in teams for their *Final Projects.*) Have students present their Final Projects to the rest of the class, discussing each in turn. Encourage students to post their projects online at the *DBG Journal of Student Findings.* Discuss with students the importance of sharing scientific information.

Post Your Findings on the Internet!

The final step of the Inquiry Process is to share your findings. Students may share their Final Projects as well as their investigation findings by visiting the DBG Journal of Student Findings at **http://www.dbg.org/index.php/digital/students/journal**. Here, students can submit findings, project work, or original art inspired by their Inquiry in the Garden. For more ideas on art projects that tie into Garden themes, teachers can go to the Additional Resources section of the Digital Learning website.

STUDENT STUDY GUIDE- FLOWER POWER- THE GENETIC JOURNEY- RESULTS AND CONCLUSION

Student Name_____ Teacher_____

Instructions: *Based on your experiences in class and during your field trip to the Desert Botanical Garden, answer the questions below. If necessary, refer to your* Data Collection Journal *(from the field trip). Be sure to answer all the "Questions for Discussion." Complete the Final Project. Submit your work online on the DBG Journal of Student Findings as instructed by your teacher*

Part A. Investigation Report

1. What was your class hypothesis about desert seeds?

2. What observations did you make both in the classroom and at the Desert Botanical Garden that led you to that hypothesis?

3. What question does your hypothesis attempt to answer?

4. Did you make a prediction about desert seeds and if so what was your prediction?

continued

STUDENT STUDY GUIDE- FLOWER POWER- THE GENETIC JOURNEY- RESULTS AND CONCLUSION

Student Name_____ Teacher_____

5. Describe the experiment you conducted at the Desert Botanical Garden to test seed hardness.

6. What were the results of your experiment? Which seeds were easy to crack? Which were more difficult to crack?

7. State your conclusion. Was your hypothesis supported by your results? Be sure to describe the evidence that supports your conclusion.

STUDENT STUDY GUIDE- FLOWER POWER- THE GENETIC JOURNEY- RESULTS AND CONCLUSION

Student Name_____ Teacher_____

Part B. Questions for Discussion

1. What was common to the seeds that were more difficult to crack?

2. What do you think would be the results if you conducted the experiment with other desert seeds?

3. Do you think there may be some desert seeds that would yield different results? Why? What might be different about those seeds?

4. Based on your findings, what are some other questions that arise that might lead to new investigations?

5. In the space below, draw a picture of a seed and the three main parts you studied:

continued

STUDENT STUDY GUIDE- FLOWER POWER- THE GENETIC JOURNEY- RESULTS AND CONCLUSION

Student Name_____ Teacher_____

6. What is dormancy

7. What part of the seed aids in dormancy? How?

8. Why is dormancy in desert seeds a good survival strategy?

9. Describe some ways a hard seed coat could be cracked or softened in a desert environment.

10. Why is it important for seeds to survive? What information do seeds carry?

Part C. Final Project: *Now that you know something about how desert seeds survive in the harsh, desert environment, consider other environments and the survival challenges seeds might have in those environments. Consider conditions such as freezing temperatures, constant rains and flooding, or salty mud flats. Select an environment and describe the environmental conditions to which plants and their seeds must adapt. Following the scientific method, state observations and questions and create a hypothesis about how seeds adapt to that environment. Describe how you could test your hypothesis, including step by step instructions for following your experiment. If possible, conduct the experiment!*

Related ADE Standards:

Reading Strand 3: Comprehending Informational Text

Concept	Performance Objective
C2: Functional Text	PO 1: Use information from text and text features to determine the sequence of activities needed to carry out a procedure.

Writing Strand 3: Writing Applications

Concept	Performance Objective
C2: Expository	PO 1: Record information (e.g., observations, notes, lists, charts, map labels and legends) related to the topic.
C6: Research	PO 2: Write an informational report that includes: a. a focused topic b. appropriate facts and relevant details c. a logical sequence d. a concluding statement e. a list of sources used

Language Arts Standard 3: Listening and Speaking

Standard	Performance Objective
Students effectively listen and speak in situations that serve different purposes and involve a variety of audiences.	LS-E3: Interpret and respond to questions and evaluate responses both as interviewer and interviewee

Science Strand 1: Inquiry Process

Concept	Performance Objective
C1: Observations, Questions, and Hypotheses	PO 1: Formulate questions based on observations that lead to the development of a hypothesis. PO 2: Use appropriate research information, not limited to a single source, to use in the development of a testable hypothesis. PO 3: Generate a hypothesis that can be tested.
C3: Analysis and Conclusions	PO 1: Analyze data obtained in a scientific investigation to identify trends. PO 2: Form a logical argument about a correlation between variables or sequence of events (e.g., construct a cause-and-effect chain that explains a sequence of events). PO 4: Formulate a future investigation based on the data collected. PO 5: Explain how evidence supports the validity and reliability of a conclusion. PO 8: Formulate new questions based on the results of a previous investigation.
C4: Communication	PO 1: Communicate the results of an investigation. PO 3: Present analyses and conclusions in clear, concise formats. PO 4: Write clear, step-by-step instructions for conducting investigations or operating equipment PO 5: Communicate the results and conclusion of the investigation.

Science Strand 4: Life Science

Concept	Performance Objective
C2: Reproduction and Heredity	PO 2: Explain the basic principles of heredity using the human examples of: • eye color • widow's peak • blood type PO 3: Distinguish between the nature of dominant and recessive traits in humans.

Science Strand 4: Life Science

Concept	Performance Objective
C4: Diversity, Adaptation, and Behavior	PO 1: Explain how an organism's behavior allows it to survive in an environment. PO 2: Describe how an organism can maintain a stable internal environment while living in a constantly changing external environment. PO 3: Determine characteristics of organisms that could change over several generations. PO 5: Analyze the following behavioral cycles of organisms: dormancy (plants) PO 6: Describe the following factors that allow for the survival of living organisms: pollination

Educational Technology Strand 1: Creativity and Innovation

Concept	Performance Objective
C4: Original Works	PO 2: Use digital tools to collaborate with a group to communicate original ideas, products, or projects effectively in a creative or innovative style.

Educational Technology Strand 6: Technology Operations and Concepts

Concept	Performance Objective
C2: Applications	PO 7: Identify and use network protocols for moving files and secure web access.

Workplace Skills

Standard	Performance Objective
1WP-E4: Respond to oral and written presentations by formulating relevant feedback, expressing opinions, discerning the main idea and distinguishing fact from opinion.	PO 1: Summarize main ideas of an oral or written presentation PO 3: Formulate related questions in a presentation PO 4: Express opinions relating to the main idea in a presentation

DESERT BOTANICAL garden

TEACHER'S GUIDE FOR FIRST GRADE-
INQUIRY IN THE GARDEN - STAGE 2
Alternate Field Investigation

Saguaro Cactus

Activity Overview

In this investigation, students venture outside for a teacher–led, plant and animal buddies discovery walk in their own schoolyard. This activity is offered as an alternative field investigation for classes unable to visit the Desert Botanical Garden. The purpose of this activity is to get students outside and involved in real, hands–on field investigations about plants and animals. It is suggested that classes first conduct the *Plants and Animals are Buddies, Inquiry Stage 1* – Introductory Activity in preparation for this investigation. Although that introductory activity is primarily for classes visiting the Desert Botanical Garden, it provides foundational concepts and vocabulary which are further explored in this investigation.

Teacher Preparation

The purpose of the plant and animal buddies discovery walk is for students to see real–life examples of "buddy" relationships in nature. For the purposes of this investigation, the term "buddy" is used to describe symbiotic relationships in which both "buddies" benefit. Most of the examples provided are about buddy relationships between a plant and an animal. However, there are many buddy relationships between two animals or between two plants and if encountered, these may also be pointed out to students.

It is suggested that teachers first scout the school grounds before taking the students outside. Decide on a route that would be good for a plant and animal buddies discovery walk. It is recommended that at least three specific places or "stops" be identified along the route that would serve as focal points to discuss buddy relationships between 1) birds and plants; 2) insects and plants; and 3) mammals and plants. Teaching stops should be chosen based on the inherent opportunity to convey the *Teaching Points* presented for each of the buddy relationships. Teachers should feel free to use more than one stop for each buddy relationship if they find additional examples that convey the teaching points. Suggestions of example relationships and specific things to look for at each stop are presented under the respective stop descriptions below.

TEACHER'S GUIDE FOR FIRST GRADE-
INQUIRY IN THE GARDEN - STAGE 2
Alternate Field Investigation

Gila Woodpecker

General Procedures

Guide students on an outdoor walk following your pre–planned route. At each stop, conduct an inquiry to convey the *Teaching Points* presented for that stop. Although you may not find examples of every buddy relationship listed in the teaching points, they may still be conveyed in the discussion. Following each discussion, conduct one or more of the suggested activities. Because many of the suggested activities are similar for each stop, you might "mix it up" by choosing the activities that are most appropriate for a particular stop. Wrap up your walk by discussing students' discoveries and reviewing the *General Teaching Points*. When the class is back inside, review the entire investigation by walking students through the *Concluding Activity*, which replaces Stage 3 of *Inquiry in the Garden*.

Plant and Animal Buddies Discovery Walk – General Teaching Points

- Living things are interconnected in many ways.
- Living things rely on each other for their survival.
- Plants and animals help each other out in unique and interesting ways.

continued…

TEACHER'S GUIDE FOR FIRST GRADE-
INQUIRY IN THE GARDEN - STAGE 2
Alternate Field Investigation

Cactus Wren

General Procedures

Birds and Plants Stop

Description

The birds and plants stop is best located where there are obvious signs of birds in or near plants. Base your stop on a chosen plant or plants but be prepared to stop when a bird is seen elsewhere on your route to take advantage of the "teachable moment." As you choose your stop (or stops) look for plants with the following bird sign:

- A tree with a bird's nest in it
- A tree with obvious woodpecker holes
- A saguaro cactus with holes in it (likely made by a woodpecker)
- A cholla cactus, bush, or other plant with a bird's nest in it
- A plant with berries or other fruit on it
- A plant that frequently has birds perching on it (look for bird droppings beneath the plant)
- A plant with large colorful flowers on it (could be pollinated by hummingbirds)
- A plant with chewed leaves (birds might eat the insects that eat plants)

Teaching Points

- Plants help birds by providing food and shelter for them.
- Birds help plants by pollinating flowers, eating harmful insects, and dispersing seeds.
- Some birds build nests in the branches of a tree or bush.
- Some birds (woodpeckers) peck out holes in tree branches or cactus stems as their home.
- Some birds remove and eat insects from plants that could otherwise harm the plant.
- Some birds drink nectar from flowers and pollinate the plant as they do so.
- Some birds eat a plant's fruits and spread the seeds by defecating them in another location.

continued…

TEACHER'S GUIDE FOR FIRST GRADE-
INQUIRY IN THE GARDEN - STAGE 2
Alternate Field Investigation

Gambels's Quail

General Procedures

Discussion and Activity Suggestions.

At the birds and plants stop, conduct an inquiry using the teaching points as your guide. Questions to help students arrive at the key points for this stop, could include the following:

What signs do you see on this plant that a bird might have been here?

What does this _____ (bird sign such as a nest) tell us about how this plant helps the bird?

What do these chewed leaves on this plant indicate and how might a bird help?

What are the holes in the trunk of this tree and what might have made them?

How might these fruits / berries help a bird?

What might a bird do to this flower to help this plant?

How might this bird help the plant?

How might this plant help the bird?

How do this plant and this bird help each other? Are they buddies?

After students have had a chance to discuss bird and plant buddies, choose and conduct one or more of the following suggested activities.

Have students…

- Sit quietly for 5 minutes and observe birds interacting with plants.
- Count all the birds they see for a specified period of time (1–5 minutes).
- Count all the birds they see for a specified distance (from here to there).
- Draw a picture of a chosen plant and bird buddy relationship.
- Count how many different signs they can find that suggest bird and plant buddies.
- Choose a partner and act out a bird / plant buddy relationship. Like "Charades", have the other students guess the relationship

continued…

TEACHER'S GUIDE FOR FIRST GRADE-
INQUIRY IN THE GARDEN - STAGE 2
Alternate Field Investigation

Monarch butterfly

General Procedures

Insects and Plants Stop

Description

The insects and plants stop would be best located in an area where there are either obvious sign of insects interacting with plants or many blooming plants (to discuss pollination). However, there are many plants that, by their very presence, suggest the activity of insects. Suggestions for insects and plants stops include:

- A flowering plant (look for even the tiniest of flowers)
- A plant with chewed leaves (sign of insects harming plants – not a true "buddy" relationship)
- Common landscape plants (not necessarily in bloom) such as sages, lantana, and cactus (typically pollinated by butterflies, bees, or other insects)
- A paloverde tree (its flowers are pollinated by bees and other insects)
- A mesquite tree (its flowers are pollinated by bees, bruchid beetles, and other insects)
- Any plant with fruit / berries on it

Teaching Points

- Plants help insects by providing food, nectar, and shelter for them.
- Insects help plants by pollinating them and sometimes protecting them from other harmful insects.
- Some insects eat a plant's fruit and help spread the plant's seeds.
- Butterflies and bees drink plant nectar and pollinate plants while doing so.
- Many desert trees are pollinated by insects.

continued…

TEACHER'S GUIDE FOR FIRST GRADE-
INQUIRY IN THE GARDEN - STAGE 2
Alternate Field Investigation

Monarch larva

General Procedures

Discussion and Activity Suggestions

At the insects and plants stop, conduct an inquiry using the teaching points as your guide. Questions to help students arrive at the key points for this stop, could include the following:

What signs do you seen on this plant that an insect might have been here?

What do these chewed leaves indicate? Is it a buddy relationship if the insect harms the plant?

How might these fruits / berries help an insect?

What might an insect do to this flower to help this plant?

How does this plant's flower help the insect?

How might this insect help the plant?

How might this plant help the insect?

How do this plant and this insect help each other? Are they buddies?

After students have had a chance to discuss insects and plants, choose and conduct one or more of the following suggested activities.

Have students…

- Sit quietly for 5 minutes and observe insects interacting with plants.
- Count all the insects they see for a specified period of time (1–5 minutes).
- Count all the insects they see for a specified distance (from here to there).
- Draw a picture of a chosen plant and insect buddy relationship.
- Count how many different signs they can find that suggest insect and plant buddies.
- Choose a partner and act out an insect / plant buddy relationship. Like "Charades", have the other students guess the relationship

continued…

TEACHER'S GUIDE FOR FIRST GRADE-
INQUIRY IN THE GARDEN - STAGE 2
Alternate Field Investigation

Round-Tailed Ground Squirrel

General Procedures

Mammals and Plants Stop

Description

Signs of mammals may be less common in schoolyards than signs of birds and insects. Burrows of small rodents or squirrels may be the only direct sign of mammal presence. However, the presence of certain plants suggest plant / mammal buddy relationships. As you locate your stop(s), look for the following:

- Small holes (burrows) under the base of a bush (it's cooler and more protected under bushes)
- Pile of sticks at the base of a bush or cactus (could be a packrat midden {nest})
- Tall columnar cactus (some cacti are pollinated by bats)
- Signs of chewing on cactus pads (packrats and javelina will eat cactus– not a true "buddy" relationship as it can harm the cactus)
- Any bush that has shady space underneath (many animals rest and cool off in the shade of plants).
- Any plant with fruit / berries on it (food for mammals).

Teaching Points

- Plants help mammals by providing food and shelter for them.
- Mammals help plants by dispersing seed, helping root growth, and pollinating flowers.
- Small mammals, such as rodents or ground squirrels, often build their burrows in the shade of bushes where it is cooler and more protected.
- Mammal burrows loosen the soil around plant roots, helping them to grow.
- Mammals often eat a plant's fruit which helps spread the seeds.
- Some bats drink nectar from certain cactus flowers pollinating them as they do so.
- Some mammals rest in the shade of plants.
- Packrats use plant parts in their "nests" which helps to disperse (spread) the plants.

continued…

TEACHER'S GUIDE FOR FIRST GRADE-
INQUIRY IN THE GARDEN - STAGE 2
Alternate Field Investigation

Newborn cottontail

General Procedures

Discussion and Activity Suggestions

At the mammals and plants stop, conduct an inquiry using the teaching points as your guide. You may need to review the characteristics of mammals and have students name some common mammals before beginning your inquiry. Questions to help students arrive at the key points for this stop, could include the following:

What mammal might lay in the shade under this plant?

What mammal might have made these holes in the ground under this plant?

How might these holes in the ground help the plant?

How might these fruits / berries help a mammal?

What mammal might pollinate the night–blooming flowers at the top of this cactus?

How might this mammal help the plant?

How might this plant help the mammal?

How do this plant and this mammal help each other? Are they buddies?

After students have had a chance to discuss mammals and plants, choose and conduct one or more of the following suggested activities.

Have students…

- See how many different burrows (likely made by mammals) they can find under or near plants.
- Stand for one minute in the shade of a plant, then stand for one minute in the sun. Describe how they felt in each location. Do students think other mammals might feel similar?
- Draw a picture of a chosen plant and mammal buddy relationship.
- Choose a partner and act out a mammal / plant buddy relationship. Like "Charades", have the other students guess the relationship.

continued…

TEACHER'S GUIDE FOR FIRST GRADE-
INQUIRY IN THE GARDEN - STAGE 2
Alternate Field Investigation

Saguaro Cactus

General Procedures

Concluding Activity

Procedures

1. Review and discuss the students' experiences during their Introductory Activity (Stage 1).
2. Review main concepts and terms and how they applied to the *Plant and Animal Buddies Discovery Walk* (the investigation).
3. They should then consider the discoveries they made during the investigation and review their findings. What did students discover during their investigation?
4. Explain to students that an important part of science is sharing your findings with others. Discuss the value of sharing scientific information (so that others may learn from the work and to expand everyone's understanding of the subject). Scientists typically publish their work in scientific journals. Students will prepare a final presentation of their investigation to share with others, both in class and by posting online on the *DBG Journal of Student Findings*.
5. Give students time to prepare a final presentation display of their investigation. Using the information from their investigation, they may choose to create a poster, draw pictures, and/or include photographs taken during their investigation or acquired from the internet. Write a song, poem, skit or story reflecting their experience. Encourage student creativity in the display of their work. (Note: For more ideas on art projects that tie into Garden themes, go to the *Additional Resources* section of the Digital Learning website.)
6. Have students share their displays and compare their findings with the rest of the class.

Post Your Findings on the Internet!

Students may share their findings online by visiting the *DBG Journal of Student Findings* at *http://www.dbg.org/index.php/digital/students/journal.* Here, students can submit investigation findings or original art inspired by their *Inquiry in the Garden*.

TEACHER'S GUIDE FOR FIRST GRADE-
INQUIRY IN THE GARDEN - STAGE 2
Alternate Field Investigation

Related ADE Standards:

Language Arts Strand 4: Viewing and Presenting

Concept	Performance Objective
S4: Viewing and Presenting – Students use a variety of visual media and resources to gather, evaluate and synthesize information and to communicate with others.	VP–F3. Access, view and respond to visual forms such as computer programs, videos, artifacts, drawings, pictures and collages.

Science Strand 1: Inquiry Process

Concept	Performance Objective
C1: Observations, Questions, and Hypotheses – Observe, ask questions, and make predictions.	PO 1. Compare common objects using multiple senses. PO 2. Ask questions based on experiences with objects, organisms, and events in the environment. (See M01–S2C1–01) PO 3. Predict results of an investigation based on life, physical, and Earth and space sciences (e.g., animal life cycles, physical properties, Earth materials).
C2: Scientific Testing (Investigating and Modeling)	PO2. Participate in guided investigations in life, physical, and Earth and space sciences.
C4: Communication	PO 1. Communicate the results of an investigation using pictures, graphs, models, and/or words. PO 2. Communicate with other groups to describe the results of an investigation.

continued…

TEACHER'S GUIDE FOR FIRST GRADE-
INQUIRY IN THE GARDEN - STAGE 2
Alternate Field Investigation

Related ADE Standards:

Science Strand 4: Life Science

Concept	Performance Objective
C3: Organisms and Environments –Understand the relationships among various organisms and their environment.	PO 1. Identify some plants and animals that exist in the local environment. PO 3. Describe how plants and animals within a habitat are dependent on each other.

Educational Technology Strand 2: Communication and Collaboration

Concept	Performance Objective
C1: Effective Communications and Digital Interactions	PO 1. Communicate with others as a whole class using digital tools.
C3: Global Connections	PO1. Participate as a class in communication at a distance.

DESERT BOTANICAL garden

TEACHER'S GUIDE FOR FIRST GRADE-
INQUIRY IN THE GARDEN - STAGE 3
Desert Buddies

Saguaro Cactus

Activity Overview

The purpose of this activity is to move students through the completion of an investigation using the scientific process. Having previously made observations, asked questions, made predictions, and gathered evidence students now analyze their results and draw conclusions about desert plant and animal buddies. After reviewing what they learned during their visit to the Desert Botanical Garden, students create a drawing of a desert plant and animal buddy and communicate their results with others. Students are also encouraged to submit their work for posting online at the Desert Botanical Garden website.

Materials

- *DBG Buddy Cards* from the Inquiry Stage 1 – Introductory Activity (Saguaro Cactus, Gila Woodpecker Creosote Bush, Ground Squirrel, Palo Verde Tree, Pocket Mouse)
- Paper, colored markers, crayons, pencils
- Optional: *Data Collection Journal* from the fieldtrip

TEACHER'S GUIDE FOR FIRST GRADE-
INQUIRY IN THE GARDEN - STAGE 3
Desert Buddies

Gila Woodpecker

Activity Procedures

1. Discuss the students' experiences during their trip to the Desert Botanical Garden. Tell them that in this activity, they are going to compare their predictions to the actual results from their trip. Then they are going to have fun creating a buddy drawing and sharing what they learned.

2. Review with students the name of the desert we live in (Sonoran Desert) and the characteristics of a desert (hot and dry). Review what a buddy is. Show the *DBG Buddy Cards* from the Introductory Activity and review the names of each plant and animal.

3. Review the predictions and questions about possible plant and animal buddies that the students made during the Introductory Activity (refer to the table that was completed during that activity). (Optional: Together the class can complete the Putting It Together section of their *Data Collection Journals* to recap their investigation.) Then for each plant, discuss the correct animal buddy. Review what the students learned on the trip about each buddy pair and compare with the predictions. Complete a new table on the board listing each buddy pair, how they are buddies and the evidence gathered on the trip.

   The first cell is completed as an example:

Buddy Pair	How They Are Buddies	Evidence
Palo verde/Pocket Mouse	1. Palo verde provides many seeds for pocket mouse to eat. 2. Pocket mouse carries away and buries many of the seeds which may sprout to become new trees.	1. Pocket mouse has pouches on the outside of cheeks to carry the seeds away. 2. New palo verde trees grow away from the mother tree.
Saguaro/Gila Woodpecker		
Creosote Bush/ Ground Squirrel		

continued…

Round-Tailed Ground Squirrel

Activity Procedures

4. Tell the students they are now going to do a "Think, Pair, Share" activity. First, ask students to think (to themselves) of other desert plant and animal buddies that they have recently studied or are familiar with (e.g., Lizard/Mesquite, Butterfly/Flower, Bee/Flower, Hummingbird/Flower, Tortoise/Prickly Pear, Bat/Columnar Cactus Flower).

5. Have students work in pairs (as classroom buddies!). Give the pairs several minutes to discuss at least two other desert plant and animal buddies. Ask several pairs to share some examples with the class.

6. Instruct each pair to choose one desert buddy pair. They should think of at least two different ways the plant and animal help each other. Next, they should make a drawing of their buddy pair using the available materials, being sure to show how the plant and animal are buddies. If students are able, they can write the name of their plants and animals and label how they are buddies.

7. When students have finished their buddy drawings, ask pairs to share their drawings with small groups or the entire class. Students should be sure to name the plant and animal and describe how they are buddies when sharing with other students.

8. Commend the class for creating such wonderful buddy drawings and for describing their buddy pairs so well. Remind them that they worked well together as buddy pairs themselves!

Post Your Findings on the Internet!

The final step of the Inquiry Process is to share your findings. One way that scientists do this is by publishing in science journals. You can share your findings by visiting the *DBG Journal of Student Findings* at *http://www.dbg.org/index.php/digital/students/journal*. Here you can submit your investigation findings or original art inspired by your Inquiry in the Garden. For more ideas on art projects that tie into Garden themes, teachers can go to the *Additional Resources* section of the Digital Learning website.

TEACHER'S GUIDE FOR FIRST GRADE– INQUIRY IN THE GARDEN – STAGE 3

Desert Buddies

Related ADE Standards:

Visual Arts Strand 1: Create

Concept 2	Performance Objective
Materials, Tools, and Techniques – The student will use materials, tools, and techniques in his or her own artwork.	PO 001. Identify and experiment with materials, tools, and techniques in his or her own artwork.
Concept 4	
Meanings or Purposes • The student will express ideas to communicate meanings or purposes in artwork.	PO 001. Describe and explain his or her own artwork.

Visual Arts Strand 2: Relate

Concept 4	Performance Objective
Meanings or Purposes – The student will interpret meanings or purposes of artwork based on contextual information.	PO 001. Interpret meanings and/or purposes of an artwork using subject matter and symbols.

Comprehensive Health Strand 5

Concept	Performance Objective
5CH–F2. Describe characteristics needed to be a responsible friend and family member.	PO 1. Explain what it means to care and be a friend.

Reading Strand 3: Comprehending Informational Text

Concept 1: Expository Text	Performance Objective
Identify, analyze, and apply knowledge of the purpose, structures, and elements of expository text.	PO 2. Answer questions (e.g., who, what, where, when, why, how) about expository text, heard or read. PO 5. Locate specific information from graphic features (e.g., charts, maps, diagrams, illustrations, tables, timelines) of expository text.

continued…

Related ADE Standards:

Writing Strand 3: Writing Applications

Concept 2: Expository	Performance Objective
Expository writing includes non–fiction writing that describes, explains, informs, or summarizes ideas and content. The writing supports a thesis based on research, observation, and/or experience	PO 2. Participate in creating simple summaries from informational texts, graphs, tables, or maps.

Language Arts Strand 3: Listening and Speaking

Standard 3: Listening and Speaking	Performance Objective
Students effectively listen and speak in situations that serve different purposes and involve a variety of audiences.	LS–F1. Use effective vocabulary and logical organization to relate or summarize ideas, events and other information. LS–F2. Give and follow multiple–step directions. LS–F3. Prepare and deliver information by generating topics; identifying the audience; and organizing ideas, facts or opinions for a variety of speaking purposes such as giving directions, relating personal experiences, telling a story or presenting a report.

Language Arts Strand 4: Viewing and Presenting

Standard 4: Viewing and Presenting	Performance Objective
Students use a variety of visual media and resources to gather, evaluate and synthesize information and to communicate with others.	VP–F3. Access, view and respond to visual forms such as computer programs, videos, artifacts, drawings, pictures and collages. VP–F4. Interpret visual clues in cartoons, graphs, tables and charts that enhance the comprehension of text.

continued…

Related ADE Standards:

Science Strand 1: Inquiry Process

Concept 1: Observations, Questions, and Hypotheses	Performance Objective
Observe, ask questions, and make predictions.	PO 1. Compare common objects using multiple senses. PO 2. Ask questions based on experiences with objects, organisms, and events in the environment. PO 3. Predict results of an investigation based on life, physical, and Earth and space sciences (e.g., animal life cycles, physical properties, Earth materials).
Concept 2: Scientific Testing (Investigating and Modeling)	
Participate in planning and conducting investigations, and recording data.	PO 4. Record data from guided investigations in an organized and appropriate format (e.g., lab book, log, notebook, chart paper).
Concept 3: Analysis and Conclusions	
Organize and analyze data; compare to predictions.	PO 1. Organize (e.g., compare, classify, and sequence) objects, organisms, and events according to various characteristics. PO 2. Compare the results of the investigation to predictions made prior to the investigation.
Concept 4: Communication	
Communicate results of investigations	PO 1. Communicate the results of an investigation using pictures, graphs, models, and/or words. PO 2. Communicate with other groups to describe the results of an investigation.

Science Strand 4: Life Science

Concept 3: Organisms and Environments	Performance Objective
Understand the relationships among various organisms and their environment.	PO 1. Identify some plants and animals that exist in the local environment. PO 3. Describe how plants and animals within a habitat are dependent on each other.

continued…

Related ADE Standards:

Workplace Skills Strand 1

Standard 1: Students use principles of effective oral, written and listening communication skills to make decisions and solve workplace problems.	**Performance Objective**
1WP–F2. Respond to oral presentations by formulating relevant questions and opinions and summarizing accurately.	PO 1. Recognize the content of an oral presentation. PO 2. Ask questions relating to content. PO 3. State opinions relating to content. PO 4. Develop summary of relevant content.
1WP–F3. Apply critical listening skills (e.g., listening for content, long–term contexts, emotional meaning, following directions).	PO 1. Listen effectively. PO 2. Analyze/evaluate orally received information. PO 3. Respond appropriately.
1WP–F4. Listen to an oral presentation, evaluate, and express an opinion orally.	PO 1. Recognize the content of an oral presentation. PO 2. Develop summary of relevant content.

Workplace Skills Strand 3

Standard 3: Students apply critical and creative thinking skills to make decisions and solve workplace problems.	**Performance Objective**
3WP–F5. Identify the need for data, obtaining it from existing sources such as the library, on–line databases or field research	PO 2. Apply data from existing sources, such as the library, on-line database and field research

DESERT BOTANICAL garden

TEACHER'S GUIDE FOR SECOND GRADE-
INQUIRY IN THE GARDEN - STAGE 2
Alternate Field Investigation

Saguaro

Activity Overview

In this investigation, students venture outside for a teacher–led, plant and animal life cycles discovery walk in their own schoolyard. This activity is offered as an alternative field investigation for classes unable to visit the Desert Botanical Garden. The purpose of this activity is to get students outside and involved in real, hands–on field investigations about plants and animals. It is suggested that classes first conduct the Desert Detectives, Inquiry Stage 1 – Introductory Activity in preparation for this investigation. Although that introductory activity is primarily for classes visiting the Desert Botanical Garden, it provides foundational concepts and vocabulary which are further explored in this investigation.

Teacher Preparation

The purpose of the plant and animal life cycles discovery walk is for students to see real–life examples of life cycle stages in nature. It is suggested that teachers first scout the school grounds before taking the students outside. Decide on a route that would be good for a plant and animal life cycles discovery walk. It is recommended that at least three specific places or "stops" be identified along the route that would serve as focal areas to present the introduction, life cycles of plants, and life cycles of animals teaching points. However, teachers should feel free to use more stops if necessary to take into account the inherent teaching opportunities offered by their unique schoolyard.

TEACHER'S GUIDE FOR SECOND GRADE-
INQUIRY IN THE GARDEN - STAGE 2
Alternate Field Investigation

Agave

General Procedures

Guide students on an outdoor walk following your pre–planned route. At each stop, conduct an inquiry to convey the *Teaching Points* presented for that stop. If necessary, more stops may be used to convey all the points. Following each discussion, conduct one or more of the suggested activities. Wrap up your walk by discussing students' discoveries and reviewing the *General Teaching Points*. When the class is back inside, review the entire investigation by walking students through the *Concluding Activity*, which replaces Stage 3 of *Inquiry in the Garden*.

Life Cycles Discovery Walk

General Teaching Points

- All plants and animals have a life cycle.
- Life cycles have distinctly different, recognizable stages.
- The life cycle describes the different stages of life including birth (live or as an egg), childhood, adulthood, and reproduction (a new birth).
- It is called the life "cycle" because it has no beginning and no end (cycle = circle).
- It is also called a cycle because it repeats itself.
- Although death is part of the life cycle, it is the reproductive stage that keeps the cycle going.
- Even in death, the cycle of life continues as living things decompose and return to the earth as soil.
- Some plants and animals have very unique life cycles.

continued…

TEACHER'S GUIDE FOR SECOND GRADE-
INQUIRY IN THE GARDEN - STAGE 2
Alternate Field Investigation

Mesquite seeds

General Procedures

Introductory Stop

Description

The life cycle introductory stop is best located in an area that provides the best overview of the schoolyard. It would be ideal if a variety of plants were visible from this stop, both up close and in the distance. If there is room, it would be good for students to sit on the ground for the discussion and activities.

Teaching Points

- All plants and animals have a life cycle.
- An organism's life cycle has distinctly different, recognizable stages.
- The life cycle describes the different stages of life including birth (live or as an egg), childhood, adulthood, and reproduction (a new birth).
- It is called the life "cycle" because it has no beginning and no end (cycle = circle).
- It is also called a cycle because it repeats itself.
- In nature, we can see examples all around us of plants and animals in different stages of their life cycles.
- Humans too, have a life cycle.

Discussion and Activity Suggestions

At the life cycle introductory stop, first conduct a review of the life cycle and its different stages. Follow the review with an inquiry using the teaching points as a guide. Questions to guide the discussion and prepare students for the rest of the walk could include the following:

What are some stages of the cycle of life?

What is the life cycle of humans?

What might we see that would suggest a plant or animal's life cycle?

How many different stages of plants or animals do you think we might see?

What might be a sign of the life cycle stage of birth? (bird's nest, insect egg case, flowers or seeds of a plant, animal burrow)

What are signs of childhood (or early life) – (baby birds in a nest, caterpillars or other larvae, young children, young plants (seedlings or sprouts)

continued…

TEACHER'S GUIDE FOR SECOND GRADE-
INQUIRY IN THE GARDEN - STAGE 2
Alternate Field Investigation

Mesquite seedling

General Procedures

After students have had a chance to discuss the cycle of life, choose and conduct one or more of the following suggested activities.

Have students…

- Sit quietly for 3 minutes and see how many different examples they can find of plant and animal life cycles.
- Point out different plants or animals they see and state what stage of their life cycle they're in.
- Play a game similar to "I Spy" in which one student gives a clue such as "I spy an orange insect in its adult stage." or "I spy a small plant in its reproductive stage (with flowers)." The other students should try to locate the plant or animal in question.
- Choose a plant or animal in the area and act out its life stages, like "charades." The rest of the class should try to guess the plant or animal.

Life Cycles of Plants Stop

Description

The life cycles of plants stop is best located near a tree or bush that shows signs of its reproductive cycle (such as obvious flowers, fruits, seeds, or old seed pods on the ground below it). If your schoolyard has any agave or cactus, it would be good to have those in sight of this stop. A dead and/or fallen plant would also be a good focal point for the discussion about decomposition.

Teaching Points

- All plants have a life cycle.
- The stages of a plant's life cycle typically include seed, sprout, young plant, and adult plant (in its reproductive stage).
- Some plants can reproduce without seeds. They sprout young plants called "pups." This is called vegetative reproduction.
- Some agaves and cactus are able to reproduce without seeds.
- When plants die and decompose, they continue in the life cycle by returning to the earth and becoming soil.

continued…

TEACHER'S GUIDE FOR SECOND GRADE-
INQUIRY IN THE GARDEN - STAGE 2
Alternate Field Investigation

Mesquite tree

General Procedures

Discussion and Activity Suggestions

At the life cycles of plants stop, conduct an inquiry using the teaching points as your guide. Questions to help students arrive at the key points for this stop, could include the following:

How many different stages of this plant's life cycle can we see here?

What stage of life is this plant in right now?

What stage of life do these flowers (or seeds, or seed pods) represent?

What are the other life cycle stages of this plant that we don't see here?

Does the season (time of year) have anything to do with the cycle of life? If so, in what way?

What might be another way that a plant such as this agave/cactus could reproduce?

What happens when plants die? How do they continue in the life cycle?

After students have had a chance to discuss the life cycle of plants, choose and conduct one or more of the following suggested activities.

Have students…

- Sit quietly for 3 minutes and see how many different examples they can find of plant life cycles.
- Find an example of a plant in each stage of the life cycle (seed, seedling, adult plant, reproductive stage)
- See how many different plants they can find that are in their reproductive stage (have flowers, fruit, or seed pods)
- Find examples of vegetative reproduction through a plant's roots (a plant sending out a shoot underground that becomes another plant [e.g., grass, creosote, etc.])
- Find examples of a decomposing plant.
- Collect and study the soil under a bushy plant. Use a hand lens or other magnifying device to see the various particles in the soil. Look for decomposed plant parts.
- Choose a particular plant and draw its life cycle.

continued…

TEACHER'S GUIDE FOR SECOND GRADE-
INQUIRY IN THE GARDEN - STAGE 2
Alternate Field Investigation

Mesquite tree with pods

General Procedures

Life Cycles of Animals Stop

Description

The life cycles of animals stop may be anywhere in the schoolyard where there are obvious signs of animals. Remember, insects are animals, too! Good places for this stop could include: near a tree with bird's nest, a place with animal burrows in the ground, or a plant in bloom attracting pollinators. Although a specific location should be chosen to convey the teaching points and conduct the activities, be prepared to stop when an insect, bird, or other animal is seen elsewhere on your route to take advantage of the "teachable moment."

Teaching Points

- All animals have a life cycle.
- The stages of an animal's life cycle include birth (live or as an egg), childhood, adulthood, and reproduction (a new birth).
- A bird's life cycle includes egg, chick, adult, and egg again (when the adult reproduces).
- Many animals find or build a shelter in which to bear young.
- Some insects go through a "metamorphosis" stage in which they undergo a dramatic change in their form.
- An example of an insect's metamorphosis stage is a cocoon or pupa.
- Many insects in their young stage (such as caterpillars) are called larva.
- Animals typically reproduce in their adult stage and bear young which continue the life cycle.
- Animals often rely on plants for food or shelter during various stages of their life cycles.

continued…

TEACHER'S GUIDE FOR SECOND GRADE-
INQUIRY IN THE GARDEN - STAGE 2
Alternate Field Investigation

Saguaro

General Procedures

Discussion and Activity Suggestions

At the life cycles of animals stop, conduct an inquiry using the teaching points as your guide. Questions to help students arrive at the key points for this stop, could include the following:

Why do birds build nests? What stage of their life cycle might a nest represent?

Why do some animals dig burrows (holes)? What stages of an animal's life cycle might a burrow represent?

What are some animals that use burrows in which to have their young?

At what stage in a butterfly's life cycle does it fly?

What does a young butterfly look like? What is that stage called?

What are some ways that animals use (or interact with) plants during their life cycle?

After students have had a chance to discuss the life cycles of animals, choose and conduct one or more of the following suggested activities.

Have students…

- See how many different animal burrows they can find and state what life cycle stage the holes represent.
- See how many different signs of insects they can find and state what life cycle stage is represented.
- Draw a picture of a chosen animal's life cycle.
- Play a game like "Pictionary" in which they draw an animal and have other students guess the animal and/or its life cycle stage.
- Choose an animal in the area and act out its life cycle stages, like "charades." The rest of the class should try to guess the animal.
- Sit quietly for 5 minutes and observe animals. Discuss the different animals and life cycle stages seen.

continued…

TEACHER'S GUIDE FOR SECOND GRADE-
INQUIRY IN THE GARDEN - STAGE 2
Alternate Field Investigation

Agave

Concluding Activity

Procedures

1. Back in the classroom review and discuss the students' experiences during their *Introductory Activity* (Stage 1).
2. Review main concepts and terms and how they applied to the *Life Cycles Discovery Walk* (the investigation). They should then consider the discoveries they made during the investigation and review their findings. What did students discover during their investigation? Each student should also come up with a new question that they would like to know the answer to based on what they learned during the *Discovery Walk*.
3. Explain to students that an important part of science is sharing your findings with others. Discuss the value of sharing scientific information (so that others may learn from the work and to expand everyone's understanding of the subject). Scientists typically publish their work in scientific journals. Students will prepare a final presentation of their investigation to share with others, both in class and by posting online on the *DBG Journal of Student Findings*.
4. Give students time to prepare a final presentation display of their investigation (*Discovery Walk*). Using the information from their investigation, they may choose to create a poster, draw pictures, and/or include photographs taken during their investigation or acquired from the internet. Write a song, poem, skit or story reflecting their experience. Encourage student creativity in the display of their work. (Note: For more ideas on art projects that tie into Garden themes, go to the *Additional Resources* section of the Digital Learning website.)
5. Have students share their displays and compare their findings with the rest of the class.

Post Your Findings on the Internet!

Students may share their findings online by visiting the *DBG Journal of Student Findings* at *http://www.dbg.org/index.php/digital/students/journal*. Here, students can submit investigation findings or original art inspired by their *Inquiry in the Garden*.

Related ADE Standards:

Language Arts Strand 3: Listening and Speaking

Concept	Performance Objective
C3: Students effectively listen and speak in situations that serve different purposes and involve a variety of audiences.	LS–F1. Use effective vocabulary and logical organization to relate or summarize ideas, events and other information.

Beginning Theater Strand 1: Create

Concept	Performance Objective
C2: Acting	PO 101. Imagine and describe characters, their relationships, what they want and why (e.g., through variations of movement and gesture, vocal pitch, volume, and tempo).

Beginning Visual Arts Strand 2: Relate

Concept	Performance Objective
C4: Meanings or Purposes	PO 101. Interpret meanings and/or purposes of an artwork using subject matter and symbols.

continued…

Related ADE Standards:

Science Strand 1: Inquiry Process

Concept	Performance Objective
C1: Observations, Questions, and Hypotheses	PO 1. Formulate relevant questions about the properties of objects, organisms, and events in the environment.
C2:Scientific Testing (Investigating and Modeling)	PO 2. Participate in guided investigations in life, physical, and Earth and space sciences.
C3: Analysis and Conclusions	PO 4. Generate questions for possible future investigations based on the conclusions of the investigation.
C4: Communication	PO1. Communicate the results and conclusions of an investigation. PO2. Communicate with other groups to describe the results of an investigation.

Science Strand 2: History and Nature of Science

Concept	Performance Objective
C2: Nature of Scientific Knowledge	PO 1. Identify components of familiar systems (e.g., organs of the digestive system, bicycle).

continued…

Related ADE Standards:

Science Strand 4: Life Science

Concept	Performance Objective
C2: Life Cycles	PO 1. Describe the life cycles of various insects. PO 2. Describe the life cycles of various mammals. PO 3. Compare the life cycles of various organisms.

Educational Technology Strand 2: Communication and Collaboration

Concept	Performance Objective
C1: Effective Communications and Digital Interactions	PO 1. Communicate with others as a whole class or small group using digital tools. PO 2. Identify and demonstrate safe and appropriate behavior when using digital environments to communicate with others.

DESERT BOTANICAL garden

TEACHER'S GUIDE FOR SECOND GRADE-
INQUIRY IN THE GARDEN - STAGE 3
Life Cycle Detectives

Saguaro

Activity Overview

The purpose of this activity is to move students through the completion of an investigation using the scientific process. Having previously made observations, asked questions, made predictions, and gathered evidence, students now analyze their results and draw conclusions about the life cycles of desert plants and animals. After reviewing what they learned during their visit to the Desert Botanical Garden, students complete a Study Guide and communicate their results with others. Students are also encouraged to submit their work for posting online at the Desert Botanical Garden website.

Materials

- *Life Cycle Stages Example Cards from Stage 1* – Introductory Activity (Butterfly Life Cycle Stages, Red Spotted Toad Life Cycle Stages, Gambel's Quail Life Cycle Stages, Mesquite Tree Life Cycle Stages, Desert Cottontail Life Cycle Stages)
- Pictures of plants and animal from Stage 1 – Introductory Activity (Cactus Wren, Agave, Saguaro Cactus)
- *Student Study Guide – Desert Plant and Animal Life Cycles – Results and Conclusions*
- Colored pencils, crayons and/or markers
- Optional: *Desert Detectives Data Collection Journal* from the fieldtrip

TEACHER'S GUIDE FOR SECOND GRADE-
INQUIRY IN THE GARDEN - STAGE 3
Life Cycle Detectives

Saguaro

Activity Procedures

1. Discuss the students' experiences during their trip to the Desert Botanical Garden. Tell them that in this activity, they are going to use evidence from their trip to make conclusions about the life cycles of desert plants and animals. Then they are going to complete a Study Guide and share their results with others.

2. Review with students the name of the desert we live in (Sonoran Desert) and the characteristics of a desert (hot and dry). Review the term, "life cycle" and, using the Life Cycle Stages Example Cards from the Introductory Activity, review the life cycles of those plants and animals. (Optional: Use the Venn diagram from the Putting it together section of the Data Collection Journal to remind the students that all living things have a life cycle but that their lifecycles are different.)

3. Show the picture of the cactus wren from the Introductory Activity. Ask students to name the animal and describe its life cycle (egg, chick, adult, egg). (Optional: Have students refer to the cactus wren page of their *Data Collection Journal* from the fieldtrip.)

4. Remind students that there is one important event that happens at the end of a life cycle. Review the importance of decomposition in the life cycle. Ask students the following questions:

   What happens at the end of a life cycle?

   What evidence of decomposition did you see at the Desert Botanical Garden?

   How does the desert benefit from decomposition?

5. Remind students that during the trip to the Desert Botanical Garden, they were detectives investigating the life cycle of the cactus wren. Review what it means to investigate. Ask students the following questions:

   How did you investigate the cactus wren at the Desert Botanical Garden?

   Did you gather evidence on the trip?

   How did you gather the evidence?

   What kinds of observations did you make?

continued…

Cactus Wren

Activity Procedures

6. Prepare a table on the board using the table below as a guide (it is best to have this prepared in advance). Remind students that in the Introductory Activity, they came up with questions to help them with their investigation at the Desert Botanical Garden. Ask students to remember some of the questions about cactus wren nests. As students recall the questions, write them in the table. The first cell includes suggested questions as an example:

Plant/Animal	Questions	Answers Based on Evidence
Cactus Wren	*1. Where do cactus wrens build their nests?* *2. What do cactus wrens use in their nests?* *3. Do cactus wrens build special kinds of nests?* *4. What might we observe if we watched a cactus wren for a long time?* *5. What's special about a cactus wren's nest?*	
Agave		
Saguaro		

7. Ask students the following questions:

Does the evidence you gathered on your trip help you to answer the questions in the table?

What questions can you answer using your evidence?

8. As students share evidence from the trip, write the answers to the questions in the table. When all questions are answered, tell students they were excellent detectives on the field trip because they collected so much evidence that could be used to answer their questions. Next, ask students:

Based on the evidence you collected, do the answers to your questions make sense?

continued…

TEACHER'S GUIDE FOR SECOND GRADE-
INQUIRY IN THE GARDEN - STAGE 3
Life Cycle Detectives

Agave

Activity Procedures

9. Repeat this procedure for the agave and the saguaro so that the table is complete. (Optional: When discussing the saguaro, have students refer to the saguaro pages of their *Data Collection Journal* from the fieldtrip.)

10. Hand out the *Student Study Guide – Desert Plant and Animal Life Cycles – Results and Conclusions* to each student. Have students work in pairs to complete the *Study Guide* (each student should complete his/her own Guide, but they can work together to do so). For questions that require drawing, provide colored pencils, crayons and/or markers.

11. When students have completed the *Study Guide,* student pairs can share their work in small groups (several pairs) or with the whole class.

12. Next, ask students the following questions:

Did your investigations make you want to continue to be desert detectives?

Have your conclusions made you want to investigate more about the life cycles of desert plants and animals?

What are some other observations you could make with your magnifying glasses?

What are some questions that you would like to discover the answers to?

13. Commend the class for collecting so much evidence on the trip and then using it to make such informative conclusions on the Study Guide, as well as thinking about other questions they would like to answer in future investigations.

Post Your Findings on the Internet!

The final step of the Inquiry Process is to share your findings. One way that scientists do this is by publishing in science journals. You can share your findings by visiting the *DBG Journal of Student Findings* at *http://www.dbg.org/index.php/digital/students/journal*. Here you can submit your investigation findings or original art inspired by your Inquiry in the Garden. For more ideas on art projects that tie into Garden themes, teachers can go to the *Additional Resources* section of the Digital Learning website.

STUDENT STUDY GUIDE – DESERT PLANT AND ANIMAL LIFE CYCLES - RESULTS AND CONCLUSIONS

Name _____ Partner Name _____

Instructions:

As a desert detective, you made observations and collected evidence about the life cycles of some desert plants and animals. Use this evidence to answer the questions below.

1. Draw the life cycle of the cactus wren. Label each part.

2. As a detective, what did you discover about cactus wrens nests?

STUDENT STUDY GUIDE – DESERT PLANT AND ANIMAL LIFE CYCLES – RESULTS AND CONCLUSIONS

Name _____ Partner Name _____

continued...

3. Draw the evidence you saw of the three different agave life cycles. Label each part.

4. As a detective, what did you discover about the life cycle of the agave that makes it different from other plants?

5. Draw the actual height of a saguaro that is 7 years old.

Related ADE Standards:

Visual Arts Strand 1: Create

Concept 1	Performance Objective
Creative Process – The student will develop, revise, and reflect on ideas for expression in his or her own artwork	PO 101. Contribute to a discussion about ideas for his or her own artwork .
Concept 4	
Meanings or Purposes – The student will judge an artist's success in communicating meaning or purpose in their artwork.	PO 101. Select and use subject matter and/or symbols in his or her own artwork .

Visual Arts Strand 2: Relate

Concept 4	Performance Objective
Meanings or Purposes – The student will judge an artist's success in communicating meaning or purpose in their artwork.	PO 101. Interpret meanings and/or purposes of an artwork using subject matter and symbols.

Reading Strand 3: Comprehending Informational Text

Concept 2: Functional Text	Performance Objective
Identify, analyze, and apply knowledge of the purpose, structures, clarity, and relevancy of functional text.	PO 1. Follow a set of written multi–step directions.

Writing Strand 3: Writing Applications

Concept 2: Expository	Performance Objective
Expository writing includes nonfiction writing that describes, explains, informs, or summarizes ideas and content. The writing supports a thesis based on research, observation, and/or experience.	PO 1. Write expository texts (e.g., labels, lists, observations, journals). PO 2. Participate in creating simple summaries from informational texts, graphs, tables, or maps.

continued…

Related ADE Standards:

Language Arts Strand 3: Listening and Speaking

Standard 3: Listening and Speaking	Performance Objective
Students effectively listen and speak in situations that serve different purposes and involve a variety of audiences.	LS–F1. Use effective vocabulary and logical organization to relate or summarize ideas, events and other information. LS–F2. Give and follow multiple–step directions. LS–F3. Prepare and deliver information by generating topics; identifying the audience; and organizing ideas, facts or opinions for a variety of speaking purposes such as giving directions, relating personal experiences, telling a story or presenting a report.

Language Arts Strand 4: Viewing and Presenting

Standard 4: Viewing and Presenting	Performance Objective
Students use a variety of visual media and resources to gather, evaluate and synthesize information and to communicate with others.	VP–F3. Access, view and respond to visual forms such as computer programs, videos, artifacts, drawings, pictures and collages. VP–F4. Interpret visual clues in cartoons, graphs, tables and charts that enhance the comprehension of text.

continued…

Related ADE Standards:

Science Strand 1: Inquiry Process

Concept	Performance Objective
C1: Observations, Questions, and Hypotheses – Observe, ask questions, and make predictions.	PO 1. Formulate relevant questions about the properties of objects, organisms, and events in the environment. PO 2. Predict the results of an investigation (e.g., in animal life cycles, phases of matter, the water cycle).
C3: Analysis and Conclusions – Organize and analyze data; compare to predictions.	PO 1. Organize data using graphs (i.e., pictograph, tally chart), tables, and journals. PO 2. Construct reasonable explanations of observations on the basis of data obtained (e.g., Based on the data, does this make sense? Could this really happen?). PO 3. Compare the results of the investigation to predictions made prior to the investigation. PO 4. Generate questions for possible future investigations based on the conclusions of the investigation.
C4: Communication – Communication of results of investigations.	PO 1. Communicate the results and conclusions of an investigation (e.g., verbal, drawn, or written). PO 2. Communicate with other groups to describe the results of an investigation. (See LS–F1)

Science Strand 2: History and Nature of Science

Concept	Performance Objective
C2: Nature of Scientific Knowledge – Understand how science is a process for generating knowledge.	PO 1. Identify components of familiar systems (e.g., organs of the digestive system, bicycle).

Science Strand 4: Life Science

Concept	Performance Objective
C2: Life Cycles – Understand the life cycles of plants and animals.	PO 1. Describe the life cycles of various insects. PO 2. Describe the life cycles of various mammals. PO 3. Compare the life cycles of various organisms.

continued…

Related ADE Standards:

Workplace Skills

Standard 1: Students use principles of effective oral, written and listening communication skills to make decisions and solve workplace problems.	**Performance Objective**
1WP–F2. Respond to oral presentations by formulating relevant questions and opinions and summarizing accurately.	PO 1. Recognize the content of an oral presentation. PO 2. Ask questions relating to content. PO 3. State opinions relating to content. PO 4. Develop summary of relevant content.
1WP–F3. Apply critical listening skills (e.g., listening for content, long–term contexts, emotional meaning, following directions).	PO 1. Listen effectively. PO 2. Analyze/evaluate orally received information. PO 3. Respond appropriately.
1WP–F4. Listen to an oral presentation, evaluate, and express an opinion orally.	PO 1. Recognize the content of an oral presentation. PO 2. Develop summary of relevant content.
1WP–F5. Share ideas, opinions and information with a group, choosing vocabulary that communicates messages clearly, precisely and effectively.	PO 1. Participate in groups. PO 2. Speak to a group. PO 3. Share writing with a group.

Workplace Skills

Standard 3: Students apply critical and creative thinking skills to make decisions and solve workplace problems.	**Performance Objective**
3WP–F5. Identify the need for data, obtaining it from existing sources such as the library, on–line databases or field research	PO 2. Apply data from existing sources, such as the library, on–line database and field research

DESERT BOTANICAL garden

TEACHER'S GUIDE FOR THIRD GRADE– INQUIRY IN THE GARDEN – STAGE 2

Alternate Field Investigation

Saguaro Cactus

Activity Overview

In this investigation, students venture outside for a teacher–led, plant adaptations discovery walk in their own schoolyard. This activity is offered as an alternative field investigation for classes unable to visit the Desert Botanical Garden. The purpose of this activity is to get students outside and involved in real, hands–on field investigations about plants. It is suggested that classes first conduct the Secrets of Desert Plants, Inquiry Stage 1– Introductory Activity in preparation for this investigation. Although that introductory activity is primarily for classes visiting the Desert Botanical Garden, it provides foundational concepts which are further explored in this investigation.

Teacher Preparation

The purpose of the plant adaptations discovery walk is for students to see plants in nature that exhibit a variety of root, stem, and leaf adaptations. It is suggested that teachers first scout the school grounds before taking the students outside. Decide on a route which would be good for a plant adaptations discovery walk. The route should include a variety of plants including trees, shrubs, and cacti (if possible). It is recommended that at least three specific places or "stops" be identified along the route that would serve as focal points to discover the "secrets" of plants: special adaptations of plant roots, stems, or leaves. The teaching stops should include a focal plant or plants that allow for the conveyance of the *Teaching Points* presented for each of the plant parts. Teachers should feel free to use more than one stop for each plant part if they are unable to find examples for all the teaching points at one stop.

TEACHER'S GUIDE FOR THIRD GRADE-
INQUIRY IN THE GARDEN - STAGE 2
Alternate Field Investigation

Agave

General Procedures

Guide students on an outdoor walk following your pre–planned route. At each stop, conduct an inquiry to convey the *Teaching Points* presented for that stop. Students should use their *Student Investigation Journals* to record observations and evidence during the discovery walk. Following each discussion, conduct one or more of the suggested activities. Wrap up your walk by discussing students' discoveries and reviewing the *General Teaching Points*. When the class is back inside, review the entire investigation by walking students through the *Concluding Activity*.

Plant Adaptations Discovery Walk

General Teaching Points

- The three main parts of plants are the roots, stems, and leaves.
- Roots, stems, and leaves differ in form but provide the same basic functions for plants.
- Plant roots, stems, and leaves have adaptations to help them survive.
- Plants respond to environmental factors.

continued…

Roots: Saguaro Cactus

General Procedures

Roots Stop

Description

The roots stop is best located near a large tree. It would be ideal (though not necessary) if there were some large tree roots exposed above ground. It is also preferable for there to be other types of plants (such as smaller trees, shrubs, cacti and/or grasses) nearby for comparison.

Teaching Points

- Roots differ in form but provide the same basic function for plants.
- Roots provide support for plants (help them stay up).
- Roots collect (or drink) water for plants.
- In many plants, the roots are at least as deep and wide as the part of the plant above ground.
- Some tree roots, like mesquite and cottonwood, grow very, very deep into the ground.
- Some roots have special adaptations for survival.

Discussion and Activity Suggestions

At the roots stop, conduct an inquiry using the teaching points as your guide. Questions to help students arrive at the key points for this stop could include the following:

Where are the roots located on this tree?

Can you see any of the roots?

What is the function of a root system?

What do you think the shape and size of a root system looks like for this tree?

What water source(s) do you think this tree will use?

Are this tree's roots adapted to this environment? How?

continued…

TEACHER'S GUIDE FOR THIRD GRADE–
INQUIRY IN THE GARDEN – STAGE 2
Alternate Field Investigation

Roots: Agave

General Procedures

After students have had a chance to discuss roots, choose and conduct one or more of the following suggested activities. Students should record in their *Investigation Journals.*

Have students…

- Stand up with feet together and arms spread wide. Tell them to keep their feet together but move their upper bodies as if they were trees swaying in the wind. Then have students spread their feet apart about shoulder width and "sway" around some more. Ask students which feels more stable, feet apart or together? How might a tree's roots be underground to give it more stability, apart or together?
- Divide into small groups. Tell students that in many plants the roots are at least as deep and wide as the part of the plant above ground. Have one person in each group stand up to represent a tree. Have the other students in the group use a piece of string to measure how tall the "student tree" is and determine how far out its roots could spread. Students should also visualize how deep that piece of string would go into the ground. Have students consider how the placement of roots is an adaptation for collecting water. Estimate approximately how many inches/centimeters or feet/meters their length of string measures. Use rulers when back in the classroom to compare the accuracy of the estimations.
- Look at other plants nearby. Draw pictures of several plants, based on what they observe above ground and what they predict the roots look like underground.

continued…

Stems: Saguaro Cactus

General Procedures

Stems Stop

Description

The stems stop should offer a variety of plants with different kinds of stems. Including a cactus in the stem stop would be useful. (If there are no cacti in your schoolyard, consider using a small potted cactus.) A tree at or near this stop offers the opportunity to point out its trunk and branches.

Teaching Points

- Plant stems differ in form but provide the same basic function for plants.
- Plant stems provide support and structure for plants.
- Plant stems help support leaves, flowers and fruit.
- Plant stems provide the "highway" in which food and water travel throughout the plant.
- Some stems have special adaptations for survival.

Discussion and Activity Suggestions.

At the stems stop, conduct an inquiry using the teaching points as your guide. Questions to help students arrive at the key points for this stop, could include the following:

Are all these stems alike?

How are this plant's stems similar/different to that plant's stems?

What do these stems do for this plant?

Are this plant's stems adapted to this environment? How?

What is different about this cactus's stems?

continued…

TEACHER'S GUIDE FOR THIRD GRADE–
INQUIRY IN THE GARDEN – STAGE 2
Alternate Field Investigation

Stems: Agave

General Procedures

After students have had a chance to discuss stems, choose and conduct one or more of the following suggested activities. Students should be recording in their *Investigation Journals* during this exploration.

Have students…

- Find, describe, and draw stems with different textures. Ask students to consider how the texture of a stem could be an adaptation to the environment.
- Find and draw two different colors of stems. Ask students to consider how the color of a stem could be an adaptation to the environment.
- Pour water on a dry sponge and observe what happens. (This works best with a very thin, tightly pressed sponge.) Explain that some cacti expand like a sponge when they soak up water from their roots into their stems. This is an adaptation for living in a desert. Ask students if they see any plants around them with similar adaptations.
- Fold a strip of paper into an accordion with half–inch pleats. (In advance, prepare one–inch wide strips of paper that are 11 inches long.) Place the two ends of the strip together to create an accordion circle. Have students play with their accordions by shrinking and expanding the size of the circle. Explain to the students that the pleats represent the ribs in a saguaro cactus. When the pleats are close together, they represent a thirsty saguaro. When the pleats are stretched out, they represent a saguaro whose ribs have expanded after a big rainfall.
- Use a piece of string to measure the circumference of a saguaro cactus (if one is available) during a dry season and again during a rainy season. Make predictions in advance about how the measurements will compare. Be sure to record the data in a safe place because many months might pass between the two measurements. (Remind students to be careful of cactus spines!)

continued…

Leaves: Saguaro Cactus

General Procedures

Leaves Stop

Description

Locate an area near which are a variety of plants with different types of leaves. Students will venture from this stop to discover the variety of leaves nearby. Look for plants that have leaves that are small, large, round, pointed, very tiny, different colored, odd shaped, etc. Include cactus in this stop if possible. (If there are no cacti in your schoolyard, consider using a small potted cactus). If there are any agave in your schoolyard, discuss the point that agave have fiber in their leaves. The fibers provide structure for the agave.

Teaching Points

- Plant leaves differ in form but provide the same basic function for plants.
- Leaves make food for plants.
- Leaves allow water to evaporate from the plant.
- Some leaves have special adaptations for survival.

Discussion and Activity Suggestions

At the leaves stop, conduct an inquiry using the teaching points as your guide. Questions to help students arrive at the key points for this stop, could include the following:

From where we are, how many different kinds of leaves do you see?

Can you name some ways that leaves are different/similar?

Do any of the leaves we see have special characteristics?

What do leaves do for a plant?

Are this plant's leaves adapted to this environment? How?

Are there any plants with no leaves at all? Why?

continued…

TEACHER'S GUIDE FOR THIRD GRADE-
INQUIRY IN THE GARDEN - STAGE 2
Alternate Field Investigation

Leaves: Agave

General Procedures

After students have had a chance to discuss leaves, choose and conduct one or more of the following suggested activities. Students should record in their *Investigation Journals.*

Have students…

- Sit quietly for 2 minutes and see how many different types of leaves they can find.
- Find and draw at least three different types of leaves.
- Find, draw and color at least two different colors of leaves.
- Find, feel and describe at least two different leaf textures.
- Find and describe a leaf adaptation for cooling the leaf surface.
- Find and describe a leaf adaptation for reducing the rate of water evaporation from the plant.

continued…

Saguaro Cactus

Create a Picture with Words

Remain at the leaves stop (or choose a fourth location with a variety of vegetation and space for the students to sit). Ask students to sit quietly for a few minutes and observe their surroundings. Ask them to use their senses to see, hear, and smell the environment around them without any discussion. They should also recall the sense of touch from the leaves activity. Suggest using one sense at a time to really focus their observations. Then students can use their *Investigation Journals* to write a poem based on their reflections.

Tell them they are each going to write a poem based on their sensory experiences during this outing. What did they experience with their senses? What stands out in their memory? For each sense (touch, sight, sound, smell), students should write a descriptive line. The last line should be a description of how the experience makes the student feel emotionally. Follow the example below to guide students in the development of their sensory poems.

Example:

I *feel* the rough bark of the tree.

I *see* the leaves blowing in the wind.

I *hear* birds singing.

I *smell* spring flowers.

I *feel* happy.

When the students have completed their poems, ask for volunteers to read their poems out loud to the class. Ask students the following questions:

Did you make similar observations?

Did writing and listening to poems help you to see new or unexpected secrets about the environment?

Classroom "Poet–Tree" follow–up: In advance, post a paper tree trunk with branches on a classroom bulletin board or wall. During class, have each student draw and cut out one of the leaf shapes they observed on the discovery walk, and copy their poem onto it. Have students post their leaves on the branches to create a "Poet–Tree".

continued…

TEACHER'S GUIDE FOR THIRD GRADE– INQUIRY IN THE GARDEN – STAGE 2

Alternate Field Investigation

Agave

Concluding Activity

Procedures

1. Back in the classroom review and discuss the students' experiences during their Classroom Investigation.
2. Review main concepts and terms and how they applied to the Plant Adaptations Discovery Walk (the investigation).
3. Go over the data collected from the students' journals and have students analyze or interpret their data.
4. Explain that students will now continue to follow the scientific method and make conclusions about that investigation.
5. They should then consider their results and articulate their conclusions. Each student should come up with a new question they would like to investigate based on their Discovery Walk today.
6. Explain to students that an important part of the scientific process is sharing your findings with others. Discuss the value of sharing scientific information (so that others may learn from the work and to expand everyone's understanding of the subject). Scientists typically publish their work in scientific journals. Students will prepare a final presentation of their investigation to share with others, both in class and by posting online on the *DBG Journal of Student Findings*.
7. Give students time to prepare a final presentation display of their investigation. Using the information from their Investigative Journals, they may choose to create a poster, create graphs or tables for their data, draw pictures, and/or include photographs taken during their Discovery Walk or acquired from the internet. Encourage student creativity in the display of their work. *(Note: For more ideas on art projects that tie into Garden themes, go to the Additional Resources section of the Digital Learning website.)*
8. Have students share their displays and compare their investigations with the rest of the class.

Post Your Findings on the Internet!

As part of the Inquiry Process students may share their work with others by visiting the *DBG Journal of Student Findings* at *http://www.dbg.org/index.php/digital/students/journal*. Here, students can submit investigation findings, poems, or original art inspired by their *Inquiry in the Garden*. For more ideas on art projects that tie into Garden themes, go to the *Additional Resources* section of the *Digital Learning* website.

ALTERNATE FIELD INVESTIGATION
PLANT ADAPTION DISCOVERY WALK
STUDENT INVESTIGATION JOURNAL

Name _____

1. **Roots**

Use string to **estimate** how tall the Student Tree is and how wide the Student Tree's roots are.

_____ meters tall _____ meters wide

Actual length of string (back in class, using a ruler) _____ meters

Predict what roots of real plants would look like underground.
Draw the plant, then draw its underground roots.

2. **Stems**

Draw the texture of different stems around you.

Record the colors of stems around you.

_____ _____ _____

_____ _____ _____

Distance around a saguaro stem:

Dry Season	Rainy Season
_____ centimeters	_____ centimeters

ALTERNATE FIELD INVESTIGATION
PLANT ADAPTION DISCOVERY WALK
STUDENT INVESTIGATION JOURNAL

DESERT BOTANICAL garden

Name _____

3. Leaves

How many different types of leaves can you find? _____

Draw at least 3 different types of leaves.

How many different colors of leaves can you find? _____

How many different textures of leaves can you find? _____

Describe 2 different textures of leaves.

_____ _____

4. **Create a Picture with Words**

I feel _____

I see _____

I hear _____

I smell _____

I feel _____

5. **New Question**

Back in class come up with a new question that you would like to know the answer to.

I wonder…..

_____

_____

TEACHER'S GUIDE FOR THIRD GRADE-
INQUIRY IN THE GARDEN - STAGE 2
Alternate Field Investigation

Related ADE Standards:

Writing Strand 1: Writing Process

Concept	Performance Objective
C5: Publishing	PO 1: Prepare writing in a format (e.g., oral presentation, manuscript, multimedia) appropriate to audience and purpose. PO 2: Share the writing with the intended audience.

Writing Strand 3: Writing Applications

Concept	Performance Objective
C1: Expressive	PO 2: Write in a variety of expressive forms (e.g., poetry, skit) that may employ: a. figurative language f. appropriate format

Language Arts Strand 3: Listening and Speaking

Standard	Performance Objective
S3: Listening and Speaking	LS-F1: Use effective vocabulary and logical organization to relate or summarize ideas, events and other information. LS-F2: Give and follow multiple-step directions.

Math Strand 1: Number Sense and Operation

Concept	Performance Objective
C3: Estimation	PO2: Estimate length and weight using U.S. customary units. PO3: Record estimated and actual linear measurements for real-life objects (e.g., length of fingernail; height of desk). PO4: Compare estimations of appropriate measures to the actual measures.

continued…

Related ADE Standards:

Math Strand 4: Geometry and Measurement

Concept	Performance Objective
C4: Measurement - Units of Measure -Geometric Objects	PO1: Select the appropriate measure of accuracy: • length – centimeters, meters, kilometers, PO4: Measure a given object using the appropriate unit of measure: • length – centimeters, millimeters, meters, kilometers, PO8: Compare the length of two objects using U.S. customary or metric units.

Science Strand 1: Inquiry Process

Concept	Performance Objective
C1: Observations, Questions, and Hypotheses	PO1: Formulate relevant questions about the properties of objects, organisms, and events of the environment using observations and prior knowledge. PO2: Predict the results of an investigation based on observed patterns, not random guessing.
C2: Scientific Testing (Investigating and Modeling)	PO4: Use metric and U.S. customary units to measure objects. PO5: Record data in an organized and appropriate format.
C3: Analysis and Conclusions	PO2: Construct reasonable interpretations of the collected data based on formulated questions. PO5: Record questions for further inquiry based on the conclusions of the investigation.
C4: Communication	PO3: Communicate with other groups to describe the results of an investigation.

continued…

Related ADE Standards:

Science Strand 4: Life Science

Concept	Performance Objective
C1: Characteristics of Organisms	PO 1: Describe the function of the following plant structures: • roots – absorb nutrients • stems – provide support • leaves – synthesize food
C3: Organisms and Environments	PO 5: Describe how environmental factors (e.g., soil composition, range of temperature, quantity and quality of light or water) in the ecosystem may affect a member organism's ability to grow, reproduce, and thrive.
C4: Diversity, Adaptation, and Behavior	PO 1: Identify adaptations of plants and animals that allow them to live in specific environments.

Educational Technology Strand 2: Communication and Collaboration

Concept	Performance Objective
C1: Effective Communications and Digital Interactions	PO 1: Communicate digitally with others by selecting and using a variety of appropriate communication tools.
C2: Digital Solutions	PO1: Contribute to a cooperative learning project and demonstrate effective group behaviors while using digital collaborative resources.

continued…

Related ADE Standards:

Workplace Skills Standard 1: Students use principles of effective oral, written and listening communication skills to make decisions and solve workplace problems.

Standard	Performance Objective
1WP-F1. Describe how the five senses are used in communications.	PO 1: Identify the five senses. PO 2: Provide examples of each sense in action.
1WP-F3. Apply critical listening skills (e.g., listening for content, long-term contexts, emotional meaning, following directions).	PO 1: Listen effectively. PO 2: Analyze/evaluate orally received information. PO 3: Respond appropriately.
1WP-F5. Share ideas, opinions and information with a group, choosing vocabulary that communicates messages clearly, precisely and effectively.	PO 1: Participate in groups. PO 2: Speak to a group. PO 3: Share writing with a group.

DESERT BOTANICAL garden

TEACHER'S GUIDE FOR THIRD GRADE-
INQUIRY IN THE GARDEN - STAGE 3
Secrets of Desert Plants

Saguaro Cactus

Activity Overview

The purpose of this activity is to move students through the completion of an investigation using the scientific process. Having previously made observations, asked questions, made predictions, and gathered evidence students now analyze their results and draw conclusions about the adaptations of desert plants. After reviewing what they learned during their visit to the Desert Botanical Garden, students complete a Study Guide, design a poster, generate questions for future investigations, and communicate their results with others. Students are also encouraged to submit their work for posting online at the Desert Botanical Garden website.

Materials

- Pictures of Mesquite Tree and Saguaro Cactus from Stage 1 – Introductory Activity
- *Student Study Guide – Secrets of Desert Plants – Results and Conclusions*
- List of questions generated by students during the Stage 1 – Introductory Activity
- Poster paper, colored pencils, crayons and/or markers
- Optional: bead bracelet from the fieldtrip
- Optional: *Data Collection Journal* from fieldtrip

TEACHER'S GUIDE FOR THIRD GRADE-
INQUIRY IN THE GARDEN - STAGE 3
Secrets of Desert Plants

Saguaro

Activity Procedures

1. Discuss the students' experiences during their trip to the Desert Botanical Garden. Tell them that in this activity, they are going to use evidence from their trip to make conclusions about the adaptations of desert plants. Then they are going to complete a Study Guide, create a poster, and share their results with others.

2. Ask students to name the environment in which we live – the Desert! Review with students the name of the desert we live in (Sonoran Desert) and the characteristics of a desert (hot, dry, sunny). Ask students if they used their senses to help them describe the desert environment when they wrote their poems during the field trip. What senses did they use?

3. Review the term "adaptation," and discuss the difference between physical and behavioral adaptations. Review the three parts of a plant that can physically adapt to the desert environment and their functions (roots, stems, and leaves). (Optional: Refer to the different colored beads on the students' bracelets to help them remember. Have the class fill in the Putting it together section of their *Data Collection Journal* to review general desert plant adaptations.)

continued…

Mesquite tree with pods

Activity Procedures

4. Prepare a table on the board using the table below as a guide (it is best to have this prepared in advance). Review the environmental conditions/survival challenges for plants in the desert.

Environment	Environmental Conditions / Survival Challenges	Adaptations for Survival
Desert	*hot, dry, sunny…*	*Mesquite:* *Saguaro:*

Remind students that during the trip to the Desert Botanical Garden, they were investigating the secret desert adaptations of the mesquite and saguaro. Display and refer to the pictures of the mesquite tree and saguaro cactus from Stage 1 – Introductory Activity. Review what it means to investigate. Complete the table with the class by having students share what they learned about the adaptations of mesquite and saguaro during their investigation. When the table is complete, discuss their investigations using the following questions as a guide:

How did you investigate adaptations of the mesquite and saguaro at the Desert Botanical Garden?

What kinds of observations did you make?

Did the evidence you gathered on the trip to help you answer the questions you prepared in advance of your trip?

Which questions were answered? What evidence was used to answer those questions?

Are there still some questions left unanswered?

continued…

TEACHER'S GUIDE FOR THIRD GRADE– INQUIRY IN THE GARDEN – STAGE 3

Secrets of Desert Plants

Mesquite

Activity Procedures

5. Commend the students for being such good investigators on the trip because they collected evidence and used that evidence to answer questions. The desert adaptations of the mesquite and saguaro are no longer secrets!

6. Hand out the *Student Study Guide – Secrets of Desert Plants – Results and Conclusions* to each student. Divide students into small groups to complete the *Study Guide* (each student should complete his/her own Guide, but they should work together to do so). Assign half of the groups the mesquite tree and the other half the saguaro, with an equal number of groups for each plant. Each group should create a team name that includes the plant name (e.g., The Mysterious Mesquites, The Secret Saguaros). Provide poster paper, colored pencils, crayons and/or markers. Give teams time to complete their posters as instructed on their *Study Guide.*

6. When the groups have completed their *Study Guides,* match mesquite groups with saguaro groups. Mesquite groups should present to saguaro groups by sharing their poster, information in the *Study Guide* table, and questions for further investigation. Then, saguaro groups should do the same.

6. When all groups have finished presenting, gather the class as a whole. Commend the class for collecting so much evidence on the trip and then using it to make such informative conclusions on the *Study Guide,* drawing such detailed posters, and thinking about other questions they would like to answer in future investigations.

Post Your Findings on the Internet!

The final step of the Inquiry Process is to share your findings. One way that scientists do this is by publishing in science journals. You can share your findings by visiting the *DBG Journal of Student Findings* at *http://www.dbg.org/index.php/digital/students/journal.* Here you can submit your investigation findings or original art inspired by your Inquiry in the Garden. For more ideas on art projects that tie into Garden themes, teachers can go to the *Additional Resources* section of the Digital Learning website.

DESERT BOTANICAL garden

STUDENT STUDY GUIDE – DESERT PLANT ADAPTATIONS
RESULTS AND CONCLUSIONS

Name _____ Team Name _____

Instructions: *While on your trip to the Desert Botanic Garden, you made observations and gathered evidence to uncover secrets about desert plant adaptations. Working as a team, use your evidence to complete this Study Guide.*

1. Name your team. Be sure to include your plant name.

2. Complete the table below for your team's plant. (Note: You may not have enough evidence to fill in the entire table.):

Plant Part	Functions	Adaptations for Survival
Roots		
Stems		
Leaves		

3. As a team, draw a picture of your assigned desert plant on a piece of poster paper. Be sure to include and label the three main parts of your plant.

4. Title the poster with the name of your plant.

5. Now that you've uncovered some secrets of desert plant adaptations, what other secrets would you like to find more about? Were there some questions from the field trip unanswered? Were there parts of the table you were unable to complete? Brainstorm with your group to write three questions about desert plants that you would like to investigate further.

1. _____

2. _____

3. _____

Related ADE Standards:

Visual Arts Strand 1: Create

Concept 1	Performance Objective
Creative Process – The student will develop, revise, and reflect on ideas for expression in his or her own artwork	PO 101. Contribute to a discussion about ideas for his or her own artwork.
Concept 4	
Meanings or Purposes – The student will express ideas to communicate meanings or purposes in artwork.	PO 001. Describe and explain his or her own artwork.

Visual Arts Strand 2: Relate

Concept 4	Performance Objective
Meanings or Purposes – The student will judge an artist's success in communicating meaning or purpose in their artwork.	PO 101. Select and use subject matter and/or symbols in his or her own artwork.

Reading Strand 3: Comprehending Informational Text

Concept 1: Expository Text	Performance Objective
Identify, analyze, and apply knowledge of the purpose, structures, and elements of expository text.	PO 5. Interpret information from graphic features (e.g., charts, maps, diagrams, illustrations, tables, timelines) of expository text.
Concept 2: Functional Text	
Identify, analyze, and apply knowledge of the purpose, structures, clarity, and relevancy of functional text.	PO 1. Follow a set of written multi–step directions.

continued…

Related ADE Standards:

Writing Strand 1: Writing Process

Concept 1: Prewriting	Performance Objective
Prewriting includes using strategies to generate, plan, and organize ideas for specific purposes.	PO 1. Generate ideas through a variety of activities (e.g., brainstorming, graphic organizers, drawing, writer's notebook, group discussion, printed material).
Concept 5: Publishing	
Publishing includes formatting and presenting a final product for the intended audience.	PO 1. Prepare writing in a format (e.g., oral presentation, manuscript, multimedia) appropriate to audience and purpose. PO 2. Share the writing with the intended audience. PO 4. Write legibly.

Writing Strand 3: Writing Applications

Concept 2: Expository	Performance Objective
Expository writing includes non–fiction writing that describes, explains, or summarizes ideas and content. The writing supports a thesis based on research, observation, and/or experience.	PO 1. Record information (e.g., observations, notes, lists, charts, map labels and legends) related to the topic.
Concept 3: Functional	
Functional writing provides specific directions or information related to real–world tasks. This includes letters, memos, schedules, directories, signs, manuals, forms, recipes, and technical pieces for specific content areas.	PO 1. Write a variety of functional text (e.g., directions, recipes, procedures, rubrics, labels, graphs/tables).
Concept 6: Research	
Research writing is a process in which the writer identifies a topic or question to be answered. The writer locates and evaluates information about the topic or question, and then organizes, summarizes, and synthesizes the information into a finished product.	PO 1. Paraphrase information from at least one source (e.g., Internet, reference materials).

continued…

Related ADE Standards:

Language Arts Strand 3: Listening and Speaking

Standard 3: Listening and Speaking	Performance Objective
Students effectively listen and speak in situations that serve different purposes and involve a variety of audiences.	LS–F1. Use effective vocabulary and logical organization to relate or summarize ideas, events and other information. LS–F2. Give and follow multiple–step directions. LS–F3. Prepare and deliver information by generating topics; identifying the audience; and organizing ideas, facts or opinions for a variety of speaking purposes such as giving directions, relating personal experiences, telling a story or presenting a report.

Language Arts Strand 4: Viewing and Presenting

Standard 4: Viewing and Presenting	Performance Objective
Students use a variety of visual media and resources to gather, evaluate and synthesize information and to communicate with others.	VP–F3. Access, view and respond to visual forms such as computer programs, videos, artifacts, drawings, pictures and collages. VP–F4. Interpret visual clues in cartoons, graphs, tables and charts that enhance the comprehension of text.

continued…

Related ADE Standards:

Science Strand 1: Inquiry Process

Concept 1: Observations, Questions, and Hypotheses	Performance Objective
Observe, ask questions, and make predictions.	PO 1. Formulate relevant questions about the properties of objects, organisms, and events of the environment using observations and prior knowledge.
Concept 2: Scientific Testing (Investigating and Modeling)	
Participate in planning and conducting investigations, and recording data.	PO 5. Record data in an organized and appropriate format (e.g., t–chart, table, list, written log).
Concept 3: Analysis and Conclusions	
Organize and analyze data; compare to predictions.	PO 2. Construct reasonable interpretations of the collected data based on formulated questions. PO 3. Compare the results of the investigation to predictions made prior to the investigation. PO 4. Generate questions for possible future investigations based on the conclusions of the investigation. PO 5. Record questions for further inquiry based on the conclusions of the investigation.
Concept 4: Communication	
Communicate results of investigations.	PO 1. Communicate investigations and explanations using evidence and appropriate terminology. PO 2. Describe an investigation in ways that enable others to repeat it. PO 3. Communicate with other groups to describe the results of an investigation.

continued…

Related ADE Standards:

Science Strand 4: Life Science

Concept 1: Characteristics of Organisms	Performance Objective
Understand that basic structures in plants and animals serve a function.	PO 1. Describe the function of the following plant structures: • roots – absorb nutrients • stems – provide support • leaves – synthesize food
Concept 3: Organisms and Environments	
Understand the relationships among various organisms and their environment.	PO 5. Describe how environmental factors (e.g., soil composition, range of temperature, quantity and quality of light or water) in the ecosystem may affect a member organism's ability to grow, reproduce, and thrive.
Concept 4: Diversity, Adaptation, and Behavior	
Identify plant and animal adaptations.	PO 1. Identify adaptations of plants and animals that allow them to live in specific environments

continued…

Related ADE Standards:

Workplace Skills

Standard 1: Students use principles of effective oral, written and listening communication skills to make decisions and solve workplace problems.	**Performance Objective**
1WP–F1. Describe how the five senses are used in communications.	PO 1. Identify the five senses. PO 2. Provide examples of each sense in action.
1WP–F2. Respond to oral presentations by formulating relevant questions and opinions and summarizing accurately.	PO 1. Recognize the content of an oral presentation. PO 2. Ask questions relating to content. PO 3. State opinions relating to content. PO 4. Develop summary of relevant content.
1WP–F3. Apply critical listening skills (e.g., listening for content, long–term contexts, emotional meaning, following directions).	PO 1. Listen effectively. PO 2. Analyze/evaluate orally received information. PO 3. Respond appropriately.
1WP–F4. Listen to an oral presentation, evaluate, and express an opinion orally.	PO 1. Recognize the content of an oral presentation. PO 2. Develop summary of relevant content.
1WP–F5. Share ideas, opinions and information with a group, choosing vocabulary that communicates messages clearly, precisely and effectively.	PO 1. Participate in groups. PO 2. Speak to a group. PO 3. Share writing with a group.

Workplace Skills

Standard 3: Students apply critical and creative thinking skills to make decisions and solve workplace problems.	**Performance Objective**
3WP–F5. Identify the need for data, obtaining it from existing sources such as the library, on–line databases or field research	PO 2. Apply data from existing sources, such as the library, on–line database and field research

Workplace Skills

Standard 4: Students work individually and collaboratively within team settings to accomplish objectives.	**Performance Objective**
4WP–F3. Demonstrate teamwork skills by contributing ideas, suggestions and effort; resolving conflicts; and handling peer pressure.	PO 1. Demonstrate skills necessary for positive group dynamics.

DESERT BOTANICAL garden

TEACHER'S GUIDE FOR FOURTH GRADE-
INQUIRY IN THE GARDEN - STAGE 1
Plants and People

Saguaro / Desert Habitat

Activity Overview

After reviewing key vocabulary as a class, students are divided into five teams to study the ethnobotany of selected Sonoran Desert plants. Each team is assigned a distinct habitat of the Sonoran Desert. Using provided materials, students study photos of their habitats and selected plants from their habitat. Student teams then consider ways that humans might use the different plants – either as food, shelter, tools, fiber or other purposes. Students complete a worksheet stating their predictions for how the plants are used including which plant part is used and what it is used for. Student teams present their predictions to the class for a discussion in preparation of their trip to the Desert Botanical Garden.

To support the Inquiry in the Garden lesson plans, you may also use the tutorials and Virtual Habitat in DBG's Digital Desert. These interactive activities will prepare students for their investigations by teaching them about the characteristics of deserts and the Sonoran Desert habitat.

Materials

(Note: All of the following materials are provided as downloadable graphics.)

Vocabulary Word Cards:

- Ethnobotany – The study of the relationship between plants and people.
- Biodiversity – The variety of life including different species, habitats, and ecosystems.
- Habitat diversity – The variety of different habitat types within a specific area.

Written description of the following Sonoran Desert habitats:

- Saguaro / Desert Habitat
- Riparian Habitat
- Chaparral Habitat
- Mesquite Bosque Habitat
- Yucca / Grassland Habitat

continued…

TEACHER'S GUIDE FOR FOURTH GRADE-
INQUIRY IN THE GARDEN - STAGE 1
Plants and People

Riparian Habitat

Materials

Pictures of the following habitats and plants:

- Saguaro / Desert Habitat
  - saguaro cactus with fruit
  - picture of dead saguaro with ribs
  - cholla cactus with buds
  - prickly pear cactus with cochineal
- Riparian Habitat
  - arrowweed
  - cattail
  - yerba mansa
  - cottonwood tree
  - willow tree
- Chaparral Habitat
  - agave
- Mesquite Bosque Habitat
  - mesquite with bean pods
- Yucca / Grassland Habitat
  - soaptree yucca
  - field of desert grass

Student Research Guide – Ethnobotany in Sonoran Desert Habitats

Student Worksheet – Ethnobotany Predictions Table

continued…

TEACHER'S GUIDE FOR FOURTH GRADE-
INQUIRY IN THE GARDEN - STAGE 1
Plants and People

Chaparral Habitat

Learning Objectives

Upon completion of this activity, students will be able to…

- define the words ethnobotany, biodiversity, and habitat diversity.
- name and describe five different habitat types that occur within the Sonoran Desert.
- name at least two plants that occur within the Sonoran Desert.
- predict possible human uses of specific plants and plant parts.

Background Knowledge

These are concepts the educator should understand and can be found in the glossary.

Ethnobotany

Biodiversity

Habitat Diversity

Riparian

TEACHER'S GUIDE FOR FOURTH GRADE-
INQUIRY IN THE GARDEN - STAGE 1
Plants and People

Mesquite Bosque Habitat

Activity Procedures

1. Introduction.

Explain to students that they will be visiting the Desert Botanical Garden where they will be studying desert plants and their uses. Through an inquiry discussion, review with students the name of our desert (the Sonoran Desert) and the characteristics of deserts in general (hot, dry, high evaporation, low rainfall, and extreme temperature fluctuations).

2. Review key vocabulary.

Remind students that on their field trip they will be studying desert plants and their uses. Explain that there are some key vocabulary words that will be used during the field trip. To prepare, the class will review those terms. Call on three students and hand out one Vocabulary Card to each student. Have each hold up their card and read the word and the definition to the class. Ask the class to repeat each word aloud together.

3. Use key terms to explain activity.

Explain that during the field trip, the class will be studying the ethnobotany of selected plants in the different habitats of the Sonoran Desert. Because the Sonoran Desert has a diversity of habitats (that is, it exhibits habitat diversity), there are actually five different habitat types that the class will be studying. Each habitat has specific plants associated with it. In this activity, the class will divide into five teams with each team being assigned a habitat to study and then share with the rest of the class.

4. Create habitat teams and hand out materials.

Divide the class into five teams and assign each team a habitat to study. Hand out the Habitat Description and photographs associated with each habitat to the corresponding team. Also, to each student, hand out a Student Research Guide – Ethnobotany in Sonoran Desert Habitats. Review the materials pointing out that each team has photos and descriptions of their habitat, photos of selected plants, and a Student Research Guide. Review the Student Research Guide, answering any questions students may have. Point out that although they are working in teams, students should complete their own Research Guides.

continued…

Yucca / Grassland Habitat

Activity Procedures

5. Student teams work time.

Allow adequate time for teams to study their habitats and plants and complete their Student Research Guides. Encourage team work and discussion. Remind teams that they will be sharing their photos and information with the rest of the class so they need to prepare their presentations including who will present which parts.

6. Hand out and review Student Worksheet – Ethnobotany Predictions Table.

Hand out (one to each student) and review the Student Worksheet – Ethnobotany Predictions Table. Point out that during the team presentations, all students should fill in their table with the information provided by the presenting teams. If they have predictions about plant uses that differ from the presenting team, there is space for them to include their own predictions.

7. Student habitat and ethnobotany predictions presentations.

Have each team come up and present their habitat, plants, and plant use predictions to the rest of the class. They should use the Presentation Guide Table from their Student Research Guide to be sure they cover all information. As teams are making their presentations, the rest of the class should be filling in their Student Worksheet – Ethnobotany Predictions Tables. Allow time for questions and discussion following each presentation.

8. Activity wrap up.

Wrap up the activity by reminding students that they will visit examples of each of these Sonoran Desert habitats during their field trip to the Desert Botanical Garden. They will see the actual plants they just studied and they will learn how people actually use those plants. They will see if their predictions are correct! They might also impress their guides with the knowledge they already have based on what they just studied!

DESERT BOTANICAL garden

INQUIRY IN THE GARDEN

Plants and People

Agave

DESERT BOTANICAL garden

INQUIRY IN THE GARDEN

Plants and People

Arrowweed

DESERT BOTANICAL garden

INQUIRY IN THE GARDEN

Plants and People

Cattails

DESERT BOTANICAL garden

INQUIRY IN THE GARDEN

Plants and People

Chaparral Habitat

DESERT BOTANICAL garden

INQUIRY IN THE GARDEN

Plants and People

Cholla Cactus Buds

DESERT BOTANICAL garden

INQUIRY IN THE GARDEN

Plants and People

Cottonwood

DESERT BOTANICAL garden

INQUIRY IN THE GARDEN

Plants and People

Field of Desert Grass

DESERT BOTANICAL garden

INQUIRY IN THE GARDEN

Plants and People

Mesquite with Bean Pods

DESERT BOTANICAL garden

INQUIRY IN THE GARDEN

Plants and People

Mesquite Bosque Habitat

DESERT BOTANICAL garden

INQUIRY IN THE GARDEN

Plants and People

Riparian/Desert Oasis Habitat

DESERT BOTANICAL garden

INQUIRY IN THE GARDEN

Plants and People

Prickly Pear Cactus with Cochineal

DESERT BOTANICAL garden

INQUIRY IN THE GARDEN

Plants and People

Saguaro Fruit

DESERT BOTANICAL garden

INQUIRY IN THE GARDEN

Plants and People

Saguaro/Desert Habitat

DESERT BOTANICAL garden

INQUIRY IN THE GARDEN

Plants and People

Saguaro Wood Skeleton

DESERT BOTANICAL garden

INQUIRY IN THE GARDEN

Plants and People

Soaptree Yucca

DESERT BOTANICAL garden

INQUIRY IN THE GARDEN

Plants and People

Willow

DESERT BOTANICAL garden

INQUIRY IN THE GARDEN

Plants and People

Yerba Mansa

DESERT BOTANICAL garden

INQUIRY IN THE GARDEN

Plants and People

Yucca Grassland Habitat

Saguaro / Desert Habitat

Sonoran Desert Habitat Descriptions

Saguaro / Desert Habitat Description

Elevation: 260 – 3,000 feet

With its many mountains and valleys, the desert is the largest of the habitats in the Sonoran Desert. Tall cacti, small trees and hardy shrubs survive with less than 10 inches of rainfall a year. The desert has a unique kind of beauty. Towering saguaro cacti and green–trunked palo verde trees thrive in the foothills. Creosote bushes fill the valleys. Trees, like mesquite and ironwood, grow in washes where runoff supplements the desert's limited rainfall. Other important plants that are found in this habitat include the cholla, prickly–pear, and the ocotillo. Many people appreciate the tranquility and beauty of the desert landscape, and they turn to it as a place to explore and enjoy. In earlier times, people valued this habitat and the plants that thrive here. These plants provided shelter, medicine, and food. How would you use desert plants?

Along with this habitat description, you should have the following habitat and plant pictures:

- Saguaro / Desert Habitat
- saguaro cactus with fruit
- picture of dead saguaro with ribs
- cholla cactus with buds
- prickly pear cactus with cochineal

continued…

Riparian Habitat

Sonoran Desert Habitat Descriptions

Riparian / Desert Oasis Habitat Description

Elevation: Sea level – 3,000 feet

Water is scarce in the desert, but it can be found in streams and occasional seeps and springs. Even with limited rainfall (usually less than 10 inches a year), these desert oasis support many plants that would not otherwise be found in the desert. Cottonwood, willow, and other trees grow beside these sources of water, and plants like cattail grow in the water. Other plants, such as yerba mansa and arrowweed can also be found in these stream–side habitats. There are many uses for plants found in this habitat including materials for tools and construction, and food and medicinal plants. Poles from cottonwood and mesquite trees make strong supports. Willow saplings can be bent easily for frames, and plants like arrow–weed make excellent thatching materials. In the last century increased water use has meant that many desert oasis have disappeared along with the rich variety of plants found in them. How would you use riparian plants?

Along with this habitat description, you should have the following habitat and plant pictures:

- Riparian Habitat
- arrowweed
- cattail
- yerba mansa
- cottonwood tree
- willow tree

continued…

Chaparral Habitat

Sonoran Desert Habitat Descriptions

Chaparral Habitat Description

Elevation: 3,400 – 6,100 feet

Chaparral habitats occur mainly along the northern margins of the Sonoran Desert and receive 15 to 25 inches of rain each year. Chaparral habitats are noted for their dense growth of evergreen shrubs and small trees. Plants like agave, desert spoon, juniper, and manzanita thrive here. Chaparral shrubs often have deep roots that help prevent erosion. Most species grow back quickly after burning. Because chaparral occurs at a higher elevation than other desert habitats, temperatures here are often cooler. People from the desert often traveled to the chaparral habitats to take advantage of the rich diversity plants there. Many chaparral plants provided important sources of food, fiber, timber, medicine and dye. Did you know? Cowboys traveling through chaparral wear leggings called "chaps" to protect themselves from the tough vegetation. How would you use chaparral plants?

Along with this habitat description, you should have the following habitat and plant pictures:

- Chaparral Habitat
- agave

continued…

Mesquite Bosque Habitat

Sonoran Desert Habitat Descriptions

Mesquite Bosque

Elevation: Sea level–1,500 feet

Small mesquite forests are found along meandering water channels where ground water is high. Here, the mesquite tree's roots are able to reach the underground water. Depending on where they are located, mesquite bosques receive around 10 – 12 inches of rain a year. Dense mesquite bosques provide islands of shelter in the desert and offer desirable habitat for wildlife and people. The word "bosque" means forest in Spanish. The mesquite tree is one of the most important plants to desert people. All parts of the mesquite tree can and have been used by people –– providing food, shelter, medicine, fiber and dye. Because of this, the mesquite is sometimes referred to as the tree of life. How would you use mesquite?

Along with this habitat description, you should have the following habitat and plant pictures:

- Mesquite Bosque Habitat
- mesquite with bean pods

continued…

Yucca / Grassland Habitat

Sonoran Desert Habitat Descriptions

Yucca / Grassland Habitat

Elevation: 3,600–5,600 feet

Yucca and Grassland habitat borders the eastern edges of the Sonoran Desert at higher elevations. With an annual rainfall of 10 to 18 inches, grasses, yucca and acacia are abundant. These desert grasslands have more than just grasses. They also support shrubs, succulents and a few trees. Grassland plants such as yucca and grass have many valuable uses for people. They provide materials for fiber, food, tools, and building material. People from the desert often traveled to nearby semi–desert grasslands. They went to these grasslands to gather plants and hunt animals on a seasonal basis. How would you use grassland plants?

Along with this habitat description, you should have the following habitat and plant pictures:

- Yucca / Grassland Habitat
- soaptree yucca
- field of desert grass

DESERT BOTANICAL garden

PLANTS AND PEOPLE STUDENT RESEARCH GUIDE – ETHNOBOTANY IN SONORAN DESERT HABITATS

Name _____ Teacher _____

Habitat:

Elevation where habitat occurs: **Rainfall:**

Habitat Description:

Key Plants in this Habitat:

Carefully study all the plant photos associated with your habitat. Consider how people might use these plants. Choose one of your key plants (if you have more than one), and complete the information and answer the questions below.

Plant Name:

Relative Height (circle one):	**tall**	**short**	**medium**	
Succulent (circle one):	**no**	**yes**		
Growth type:	**tree**	**bush**	**forb/grass**	**cactus**
	other (describe):			

General plant description (in your own words describe this plant):

What part(s) of this plant do you think are or can be used by people?
(Consider the leaves, stems, roots, fruits, flowers, etc.)

For each plant part listed (above), describe how you think the plant is used.
(Consider uses as a tool, shelter, food, fiber, or other.)

How would the plant part be prepared for use? (Would it be cut, soaked, cooked, etc.?)

If you have additional plants, use the space below to describe how you think they might be used:

DESERT BOTANICAL garden

PLANTS AND PEOPLE STUDENT RESEARCH GUIDE – ETHNOBOTANY IN SONORAN DESERT HABITATS

Name _____ Teacher _____

Prepare for your team presentation. Use the table below as a guide for your team's presentation. Be sure everything listed to share is presented and be sure each student participates. There is space for you to assign parts of your presentation to different students on your team.

Presentation Guide Table

What to share with the class	Who on the team will do it
Name and describe your habitat	
Hold up photos of the habitat	
Name all the key plants in your habitat	
Hold up photos of the key plants	
Describe your selected plant	
Hold up photos of your selected plant and plant parts	
Describe what part(s) of the plant your team thinks is (are) used	
Describe how your team thinks the plant parts are used	
Describe how your team thinks the plant is prepared for use	

DESERT BOTANICAL garden

PLANTS AND PEOPLE STUDENT WORKSHEET – ETHNOBOTANY PREDICTIONS TABLE

Name _____ Teacher _____

Habitat	Selected Plant	How Used (Team Predictions)	How Prepared (Team Predictions)	Actual Use

Use this space below to describe any other predictions you'd like to make (about other plants or if you think differently from another team's prediction):

Ethnobotany –

The study of the relationship between plants and people.

Biodiversity –

The variety of life including different species, habitats, and ecosystems.

Habitat Diversity –

The variety of different habitat types within a specific area.

Related ADE Standards:

Reading Strand 1: Reading Process

Concept 4: Vocabulary	Performance Objective
Acquire and use new vocabulary in relevant contexts.	PO 2. Use context to determine the relevant meaning of a word.

Reading Strand 1: Reading Process

Concept 6: Comprehension Strategies	Performance Objective
Employ strategies to comprehend text.	PO 4. Use graphic organizers in order to clarify the meaning of the text.

Reading Strand 3: Comprehending Informational Text

Concept 1: Expository Text	Performance Objective
Identify, analyze, and apply knowledge of the purpose, structures, and elements of expository text.	PO 8. Draw valid conclusions based on information gathered from expository text.

Writing Strand 1: Writing Process

Concept 1: Prewriting	Performance Objective
Prewriting includes using strategies to generate, plan, and organize ideas for specific purposes.	PO 1.Generate ideas through a variety of activities (e.g., brainstorming, graphic organizers, drawing, writer's notebook, group discussion, printed material). PO 4. Use organizational strategies (e.g., graphic organizer, KWL chart, log) to plan writing.

continued…

Related ADE Standards:

Writing Strand 2: Writing Elements

Concept 1: Ideas and Content	Performance Objective
Writing is clear and focused, holding the reader's attention throughout. Main ideas stand out and are developed by strong support and rich details. Purpose is accomplished.	PO 1. Express ideas that are clear and directly related to the topic. PO 2. Provide content and selected details that are well–suited to audience and purpose. PO 3. Use relevant details to provide adequate support for the ideas.

Writing Strand 3: Writing Applications

Concept 2: Expository	Performance Objective
Expository writing includes nonfiction writing that describes, explains, informs, or summarizes ideas and content. The writing supports a thesis based on research, observation, and/or experience.	PO 1. Record information (e.g., observations, notes, lists, charts, map labels and legends) related to the topic.

Writing Strand 3: Writing Applications

Concept 6: Research	Performance Objective
Research writing is a process in which the writer identifies a topic or question to be answered. The writer locates and evaluates information about the topic or question, and then organizes, summarizes, and synthesizes the information into a finished product.	PO 1. Paraphrase information from a variety of sources (e.g., Internet, reference materials).

Language Arts Strand 3: Listening and Speaking

Standard 3: Listening and Speaking	Performance Objective
Students effectively listen and speak in situations that serve different purposes and involve a variety of audiences.	LS–E2. Prepare and deliver an oral report in a content area and effectively convey the information through verbal and nonverbal communications with a specific audience

continued…

Related ADE Standards:

Science Strand 1: Inquiry Process

Concept 1: Observations, Questions, and Hypotheses	Performance Objective
Observe, ask questions, and make predictions.	PO 2. Formulate a relevant question through observations that can be tested by an investigation. PO 3. Formulate predictions in the realm of science based on observed cause and effect relationships.

Science Strand 1: Inquiry Process

Concept 2: Scientific Testing (Investigating and Modeling)	Performance Objective
Participate in planning and conducting investigations, and recording data.	PO 5. Record data in an organized and appropriate format (e.g., t–chart, table, list, written log).

Science Strand 4: Life Science

Concept 1: Characteristics of Organisms	Performance Objective
Understand that basic structures in plants and animals serve a function.	PO 1. Compare structures in plants (e.g., roots, stems, leaves, flowers) and animals (e.g., muscles, bones, nerves) that serve different functions in growth and survival.

Science Strand 4: Life Science

Concept 3: Organisms and Environments	Performance Objective
Understand the relationships among various organisms and their environment.	PO 1. Describe ways various resources (e.g., air, water, plants, animals, soil) are utilized to meet the needs of a population.

continued…

Related ADE Standards:

Social Studies Strand 4: Geography

Concept 2: Places and Regions	Performance Objective
Places and regions have distinct physical and cultural characteristics.	PO 1. Describe how the Southwest has distinct physical and cultural characteristics.

Social Studies Strand 4: Geography

Concept 3: Physical Systems	Performance Objective
Physical processes shape the Earth and interact with plant and animal life to create, sustain, and modify ecosystems. These processes affect the distribution of resources and economic development.	Science Strand 4 Concept 3 Describe uses, types, and conservation of natural resources.

Social Studies Strand 4: Geography

Concept 5: Environment and Society	Performance Objective
Human and environmental interactions are interdependent upon one another. Humans interact with the environment–they depend upon it, they modify it; and they adapt to it. The health and well–being of all humans depends upon an understanding of the interconnections and interdependence of human and physical systems.	PO 1. Describe human dependence on the physical environment and natural resources to satisfy basic needs.

continued…

Related ADE Standards:

Workplace Skills Strand 1

Standard 1 - Students use principles of effective oral, written and listening communication skills to make decisions and solve workplace problems.	Performance Objective
1WP–E6. Speak in a content area (e.g., science, social studies, literature), using vocabulary of the subject accurately;	PO 1. Deliver a factual presentation using appropriate terminology
1WP–E7. Identify the relevant details and facts of written materials	PO 2. Identify relevant facts contained in selected written material

Workplace Skills Strand 1

Standard 4 - Students work individually and collaboratively within team settings to accomplish objectives.	Performance Objective
4WP–E3. Exert a high level of effort and perseverance toward goal attainment, as a team member	PO 2. Identify the team member roles and responsibilities

DESERT BOTANICAL garden

TEACHER'S GUIDE FOR FOURTH GRADE– INQUIRY IN THE GARDEN – STAGE 2

Alternate Field Investigation

Saguaro / Desert Habitat

Activity Overview

In this investigation, students venture outside for a teacher–led, plant investigations walk in their own schoolyard. This activity is offered as an alternative field investigation for classes unable to visit the Desert Botanical Garden. The purpose of this activity is to get students outside and involved in real, hands–on field investigations about plants and their uses. It is suggested that classes first conduct the *Plants and People Inquiry Stage 1* – Introductory Activity in preparation for this investigation. Although that introductory activity is primarily for classes visiting the Desert Botanical Garden, it provides foundational concepts which are further explored in this investigation.

Teacher Preparation

The purpose of the plant investigations walk is for students to see plants in nature that are or can be used by people. It is suggested that teachers first scout the school grounds before taking the students outside. Decide on a route which would be good for a plant investigations walk. The route should include a variety of plants including trees, shrubs, cacti (if possible), and small herbaceous plants. Plan to divide the walk into three portions focusing on "ethnobotany," "habitats" and "plants in our lives." For each portion of the walk, select one or more stops along the route to convey the specific *Teaching Points.*

Materials

- Pictures of Sonoran Desert habitats from *Plants and People Inquiry in the Garden– Stage 1*
- *Teacher's Guide to Sonoran Desert Habitats and Plant Uses*
- Pictures of an Akimel O'odham roundhouse (olas ki) and kitchen (ko:sin).
- Optional depending on selected activities: clipboards, paper, pencils, colored pencils/markers, objects for making models, objects made from plants
- *Student Study Guide– Results and Conclusion*

DESERT BOTANICAL garden

TEACHER'S GUIDE FOR FOURTH GRADE–
INQUIRY IN THE GARDEN – STAGE 2
Alternate Field Investigation

Saguaro Fruit

General Procedures

Guide students on an outdoor walk following your pre–planned route. During your walk and at each stop, conduct an inquiry to convey the *Teaching Points* presented for that portion of the walk. Following each discussion, conduct one or more of the suggested activities. When the class is back inside, review the entire investigation by reviewing the *General Teaching Points* and walking students through the *Student Study Guide– Results and Conclusion* Concluding Activity, which replaces Stage 3 of *Inquiry in the Garden*. Provide students with the opportunity to post their findings online at the DBG website.

Schoolyard Plant Investigation

General Teaching Points

- Ethnobotany is the study of people's use of plants.
- Plants can provide for human needs such as food, building, fuel, medicine, fiber, tools, etc.
- Many plants can provide for more than one need.
- Different habitats have different plants which may be used by people.
- Most basic human needs can be met using natural resources found in one's immediate environment.

Ethnobotany Stop

Description

The ethnobotany portion of the walk should cover a large part of the schoolyard in order for students to see the greatest variety of plants. If possible, the walk should include views of trees, shrubs, cacti (if possible), and small herbaceous plants. Several stops (identified in advance) may be incorporated into the walk where specific teaching points are best addressed.

Teaching Points

- Ethnobotany is the study of people's use of plants.
- Humans have needs for food, building, fuel, medicine, fiber, tools, etc.
- People historically used and still use plants for various purposes.
- Some plants can be used for a variety of purposes.

continued

TEACHER'S GUIDE FOR FOURTH GRADE–
INQUIRY IN THE GARDEN – STAGE 2
Alternate Field Investigation

Agave

General Procedures

Discussion and Activity Suggestions

Along your walk and at your pre–planned stops, conduct inquiry discussions using the teaching points as your guide. Questions to help students arrive at the key points for this stop could include the following:

What is ethnobotany?

What are human needs?

Which plants in the schoolyard might help you meet those needs?

What are the different parts of plants? What parts of plants might be used?

Are there some plants that have multiple uses?

After students have had a chance to observe and discuss ethnobotany, choose and conduct one or more of the following suggested activities.

Have students…

- Observe and draw several plants in the schoolyard that might be used by people. Label the parts of the plants and what they might be used for.
- Play a game similar to "I Spy" in which a student describes a plant by its use and other students have to guess the plant.
- Think of a need and consider how a plant could be used to meet that need.
- Collect a plant part from the schoolyard (or bring it from home) and describe its possible use. (Be sure to discuss safety issues with students.)
- Collect and build objects from schoolyard plants.
- Find examples of plants being used by humans around the school campus.
- Bring an item from home that was made from a plant and describe its use. If possible, name the plant, describe what part of the plant was used, and how it was prepared.

continued

Yucca / Grassland Habitat

General Procedures

Habitats Stop

Description

Many schoolyards are landscaped with a variety of ornamental plants not native to the area. If possible, this stop would best be located in an area of native vegetation.

Teaching Points

- Different habitats have different plants which may be used by people.
- Landscaped habitats can be different from native habitats.
- Native habitats are naturally occurring given an area's climate and geography.
- In some cultures, plants provide for most human needs. Even today in the Sonoran Desert, people use plants.
- Plants can be used to meet most human needs (food, building, fuel, medicine, fiber, tools, etc.)
- Many plants can provide for more than one need.

continued

TEACHER'S GUIDE FOR FOURTH GRADE-
INQUIRY IN THE GARDEN – STAGE 2
Alternate Field Investigation

Chaparral Habitat

General Procedures

Discussion and Activity Suggestions

At the habitats stop, conduct an inquiry discussion using the teaching points as your guide. Review the different Sonoran Desert habitats using the pictures from *Plants and People Inquiry Stage 1* – Introductory Activity. Use the *Teacher's Guide to Sonoran Desert Habitats and Plant Uses* to discuss the plants in each habitat and how they meet human needs. Next, observe the schoolyard habitat. Questions to help students arrive at the key points for this stop could include the following:

How is your schoolyard similar to or different from the surrounding native habitat?

In what kind of native habitat is your school located?

Are there any plants with special uses in your native habitat?

How is the schoolyard similar to or different from the five habitats discussed?

Are there any plants in your schoolyard that occur in one of the five habitats discussed?

After students have had a chance to observe and discuss different Sonoran Desert habitats as well as their schoolyard and native habitats, choose and conduct one or more of the following suggested activities.

Have students…

- Observe and discuss the plants that are in the schoolyard and also in the surrounding native habitat.
- Locate three plants that are likely landscape plants and three plants that are probably native to the area.
- Close their eyes and imagine what the area looked like before it was developed. Have them think about specific plants they would see.
- Select and draw one of the habitats discussed. Consider including humans using plants in the drawing.
- Complete their *Ethnobotany Predictions Table* by filling in the "Actual Uses" column from *Plants and People Inquiry in the Garden – Stage 1.*

continued

TEACHER'S GUIDE FOR FOURTH GRADE-
INQUIRY IN THE GARDEN - STAGE 2
Alternate Field Investigation

Olas Ki

General Procedures

Plants in Our Lives Stop

Description

This stop should include the greatest variety of plants with many potential uses. It would be best if students could sit on the ground for the guided imagery activity and discussion.

Teaching Points

- An Olas Ki is a traditional roundhouse of the Akimel O'odham.
- Ko:sin is a food preparation space with a fire ring, open ceiling to let smoke out, and mortars and pestles
- Olas Ki and ko:sin are typically built from arrowweed, willow, and mesquite.
- Native people traditionally use native plants in their habitat as building materials.
- Most basic human needs can be met using natural resources found in one's immediate environment.

continued

TEACHER'S GUIDE FOR FOURTH GRADE-
INQUIRY IN THE GARDEN - STAGE 2
Alternate Field Investigation

Ko:sin

General Procedures

Discussion and Activity Suggestions

During this stop, conduct an inquiry discussion using the teaching points as your guide. Show students the pictures of an Akimel O'odham house and "kitchen" with items and tools and discuss its features. Have students look around the schoolyard and imagine building and living in a house using only the resources in the habitat around them (similar to what the Akimel O'odham do, as well as what their Hohokam ancestors did). Questions to guide students in their guided imagery could include the following:

Could you build a house similar to the Olas Ki using the plants and other resources around you?

What would you have in your house?

Which plants would you use for food, building, fuel, medicine, fiber, tools?

What part(s) of the plants would you use? How would you use them?

What plants/resources would you need that aren't found in the schoolyard? How would you obtain them?

After students have had a chance to describe and discuss their "imagined" houses, choose and conduct one or more of the following suggested activities.

Have students…

- Draw their "imagined" houses.
- Create 3D models of their imagined houses using plant parts or objects collected in the schoolyard and/or brought from home.
- Share their models with other students explaining how plants are being used to meet human needs.
- Compare how the homes they live in are similar to and different from their imagined houses.
- Compare how the homes they live in are similar to and different from the Olas Ki.
- Compare how human needs are met today with how those needs were met before modern society.

continued

TEACHER'S GUIDE FOR FOURTH GRADE-
INQUIRY IN THE GARDEN - STAGE 2
Alternate Field Investigation

Terba Mansa

Concluding Activity

Complete the investigation back in the classroom by completing the *Student Study Guide– Results and Conclusion*. (This replaces *Inquiry in the Garden– Stage 3*)

Post Your Findings on the Internet!

As part of the Inquiry Process students may share their work with others by visiting the *DBG Journal of Student Findings* at *http://www.dbg.org/index.php/digital/students/journal*. Here, students can submit investigation findings, poems, or original art inspired by their *Inquiry in the Garden*. For more ideas on art projects that tie into Garden themes, go to the *Additional Resources* section of the *Digital Learning* website.

DESERT BOTANICAL garden

INQUIRY IN THE GARDEN

Alternate Field Investigation

Olas Ki

DESERT BOTANICAL garden

INQUIRY IN THE GARDEN

Alternate Field Investigation

Ko:sin

TEACHER'S GUIDE FOR FOURTH GRADE-
INQUIRY IN THE GARDEN - STAGE 2
Alternate Field Investigation

Riparian Habitat

Teacher's Guide

Use this guide and the pictures of Sonoran Desert habitats from Plants and People Inquiry Stage 1– Introductory Activity to guide a discussion on Sonoran Desert habitats.

Saguaro / Desert Habitat

- saguaro cactus with fruit – fruit can be used for food (the O'odham make jams, candies, syrups, and wines)
- dead saguaro with ribs – ribs can be used for building and tools (O'odham harvesting poles are built to help collect fruit from the top of the saguaro)
- cholla cactus with buds – buds can be used for food when roasted and dried (provide calcium)
- prickly pear cactus with cochineal – young prickly pear stems, pads, and fruits can be used for food; prickly pear can be a host plant for cochineal, an insect that can be harvested for its dye (white, fluffy material found on prickly pear pads is secretion from the cochineal for camouflage and to prevent desiccation)

Riparian Habitat

- arrowweed – branches can be used for thatching, large storage baskets, shelves, and arrow shafts
- cattail – cattail pollen, stalks and roots can be used for food; leaves can be used for mats; dried flower stalks can be used in baskets
- yerba mansa – roots can be used for medicine (can be chewed or brewed into tea for respiratory ailments; tea can also be used as a wash for wounds)
- cottonwood tree – timbers can be used for construction; pliable branches can be used for baskets
- willow tree – saplings can be used for buildings; pliable branches can be used for baskets; leaves and bark can be used to brew a fever–reducing tea

continued…

TEACHER'S GUIDE FOR FOURTH GRADE-
INQUIRY IN THE GARDEN - STAGE 2
Alternate Field Investigation

Mesquite Bosque Habitat

Teacher's Guide

Chaparral Habitat

- agave – leaves provide fibers for making cloth, mats, rope, brushes; some agave hearts can be used for food (when roasted)
- desert spoon – leaves provide fibers for making mats and baskets
- juniper – berries can be used as a spice; wood can be used for tools, fuel and shelter

Mesquite Bosque Habitat

- mesquite with bean pods – beans can be used for food (when ground into flour); hardwood can be used for tools, fuel and shelter; pitch can be used as pottery paint; sap can be used for "cough drops"
- field of desert grass under a bosque – stems or roots can be used to make brooms, brushes or baskets

Yucca / Grassland Habitat

- soaptree yucca – yuccas provide fiber to weave baskets or to make brushes for painting pottery; pounding the roots in water makes soap–like suds for cleaning
- field of desert grass – stems or roots can be used to make brooms, brushes or baskets

DESERT BOTANICAL garden

STUDENT STUDY GUIDE – RESULTS AND CONCLUSIONS

Name _____ Partner Name _____

Team (desert habitat) _____

Part A – Results and Conclusions

Instructions: *Use the information from your Student Worksheet – Ethnobotany Predictions Table to answer the questions below.*

1. What were the key plants you studied in your desert habitat?

2. What predictions did you make about the use of those plants?

3. What evidence did you gather (what did you see or do) during your Schoolyard Investigation that involved your plant? Did the evidence support your predictions about how the plant is used?

4. What conclusions can you make about ethnobotany in your desert habitat?

DESERT BOTANICAL garden

STUDENT STUDY GUIDE – RESULTS AND CONCLUSIONS

Name _____ Partner Name _____

Team (desert habitat) _____

Part B – Questions for Discussion

Instructions: *Answer the questions below and be prepared to discuss them with the class after everyone has completed their presentations (Part C).*

1. In what ways do people use plants? List as many uses as you can.

2. If you had a specific need (for food, medicine, tools, etc.) and all that was available were the desert plants around you, how would you determine which plant would be best to help you meet your need?

3. Now that you know about the uses of some desert plants, list at least one question and make at least one prediction about the use of another desert plant you saw during your investigation.

Part C. Present Your Results

Instructions: *As a team, prepare a skit for a final presentation of your investigation. Your skit should inform your audience about how people use the desert plants in your habitat. You can act out a story, produce a mock interview, present a news broadcast, create a puppet show, etc. Be creative! Use notebook paper to first write an outline; then write the script. Create your own scenery and props using a variety of material either from home or provided by your teacher.*

Related ADE Standards:

Visual Arts Strand 1: Create

Concept	Performance Objective
C1: Creative Process	PO 203: Develop plans for his or her own artwork, (e.g., sketches, models, and notes).
C2: Materials, Tools, and Techniques	PO 201: Identify and experiment with materials, tools, and techniques appropriately and expressively in his or her own artwork. PO 202: Demonstrate purposeful use of materials, tools, and techniques in his or her own artwork.

Visual Arts Strand 2: Relate

Concept	Performance Objective
C4: Meanings or Purposes	PO 201: Interpret meanings and/or purposes of an artwork using subject matter, symbols, and/or themes.

Writing Strand 3: Writing Applications

Concept	Performance Objective
C2: Expository	PO 1: Record information (e.g., observations, notes, lists, charts, map labels and legends) related to the topic. PO 3: Write in a variety of expository forms (e.g., essay, summary, newspaper article, reflective paper, log, journal).

continued…

Related ADE Standards:

Science Strand 1: Inquiry Process

Concept	Performance Objective
C1: Observations, Questions, and Hypotheses	PO 3: Formulate predictions in the realm of science based on observed cause and effect relationships.
C2: Scientific Testing (Investigating and Modeling)	PO 5: Record data in an organized and appropriate format (e.g., t–chart, table, list, written log).
C3: Analysis and Conclusion	PO5: Develop new questions and predictions based on the data collected in the investigation.
C4: Communication	PO1: Communicate verbally or in writing the results of an inquiry. PO3: Communicate with other groups or individuals to compare the results of a common investigation.

Science Strand 4: Life Science

Concept	Performance Objective
C1: Characteristics of Organisms	PO 1: Compare structures in plants (e.g., roots, stems, leaves, flowers) and animals (e.g., muscles, bones, nerves) that serve different functions in growth and survival.
C3: Organisms and Environments	PO 1: Describe ways various resources (e.g., air, water, plants, animals, soil) are utilized to meet the needs of a population.

continued…

Related ADE Standards:

Social Studies Strand 1: American History

Concept	Performance Objective
C2: Early Civilizations	PO 2: Describe the cultures and contributions of the Mogollon, Ancestral Puebloans (Anasazi), and Hohokam (e.g., location, agriculture, housing, arts, trade networks; adaptation and alteration of the environment).

Social Studies Strand 4: Geography

Concept	Performance Objective
C2: Places and Regions	PO 1: Describe how the Southwest has distinct physical and cultural characteristics.
C4: Human Systems	PO 4: Describe the cultural characteristics (e.g., food, clothing, housing, sports, customs, beliefs) of Arizona's diverse population. PO 5: Describe the major economic activities and land use patterns (e.g., agricultural, industrial, residential, commercial, recreational, harvesting of natural resources) of regions studied.
C5: Environment and Society	PO 1: Describe human dependence on the physical environment and natural resources to satisfy basic needs.

Educational Technology Strand 2: Collaboration and Communication

Concept	Performance Objective
C1: Effective Communications and Digital Interactions	PO1: Communicate digitally with others by selecting and using a variety of appropriate communication tools.
C2: Digital Solutions	PO1: Contribute to a cooperative learning project and demonstrate effective group behaviors while using digital collaborative resources.

DESERT BOTANICAL garden

TEACHER'S GUIDE FOR FOURTH GRADE-
INQUIRY IN THE GARDEN - STAGE 3
Plants and People

Saguaro / Desert Habitat

Overview

The purpose of this activity is to move students through the completion of an investigation using the scientific method. Having previously made observations, asked questions, made predictions, and gathered evidence, students now analyze their results and draw conclusions about the ethnobotany of selected Sonoran Desert plants. After reviewing what they learned during their visit to the Desert Botanical Garden, students complete a study guide and create a presentation to share their results with others. Students are also encouraged to submit their work for posting online at the Desert Botanical Garden website.

Materials

- Pictures of Sonoran Desert habitats from Stage 1 – Introductory Activity (Saguaro / Desert Habitat, Riparian Habitat, Chaparral Habitat, Mesquite Bosque Habitat, Yucca / Grassland Habitat)
- *Student Worksheet – Ethnobotany Predictions Table* from Stage 1 – Introductory Activity
- *Student Study Guide – Ethnobotany of Sonoran Desert Plants – Results and Conclusion*
- *Data Collection Journals* (from field trip)
- Poster paper, construction paper, colored markers, scissors, glue

TEACHER'S GUIDE FOR FOURTH GRADE-
INQUIRY IN THE GARDEN - STAGE 3
Plants and People

Yucca / Grassland Habitat

Procedures

1. Discuss the students' experiences during their trip to the Desert Botanical Garden. Tell them that in this activity, they are going to use evidence from their trip to make conclusions about the ethnobotany of selected plants from different habitats in the Sonoran Desert. Then they are going to complete a *Study Guide* and create a presentation to share their results with others.

2. Review with students the name of the desert we live in (Sonoran Desert) and the characteristics of a desert in general (hot, dry, high evaporation, low rainfall, and extreme temperature fluctuations). Review the terms ethnobotany, habitat diversity and biodiversity. As a class, refer to the Putting it Together section of the *Data Collection Journals* to review some basic uses of desert plants before they divide up and discuss more **specific** uses of each plant.

3. Divide students back into their investigative teams (the teams assigned in Stage 1 of this inquiry).

   Give each group the pictures of their habitat used in the Introductory Activity.

4. Hand out to each student a copy of the *Student Study Guide – Ethnobotany of Sonoran Desert Plants – Results and Conclusions.* Students should work together as a team and focus on their specific habitat, but each student should complete their own *Study Guide.* They should refer to their *Student Worksheets – Ethnobotany Predictions Tables* and *Data Collection Journals* as needed to complete Part A of the *Study Guide.*

continued…

TEACHER'S GUIDE FOR FOURTH GRADE-
INQUIRY IN THE GARDEN - STAGE 3
Plants and People

Riparian Habitat

Procedures

5. As described in Part C of their *Study Guides,* students should prepare a final presentation of their investigation to share their results and conclusions with the rest of the class. They should develop a creative skit, mock interview, news broadcast, puppet show, etc. that includes information about their Sonoran Desert habitat and how people use the desert plants in their habitat. Students can use the habitat pictures from the Introductory Activity as props, and they can also design simple scenery and props with provided materials (e.g., poster paper, construction paper, colored markers, scissors, glue, etc.). (Optional: Students can bring in props or clothing from home if the skits will be presented the following day.)

6. Have each group present to the rest of the class.

7. When all groups have finished presenting, gather the class as a whole to conduct a wrap up discussion, using the *"Questions for Discussion"* in Part B of the *Student Study Guide.*

8. Commend the class for collecting so much evidence on the trip and then using it to make such informative conclusions on the *Study Guide* and producing such creative presentations.

Post Your Findings on the Internet!

As part of the Inquiry Process students may share their work with others by visiting the *DBG Journal of Student Findings* at *http://www.dbg.org/index.php/digital/students/journal.* Here, students can submit investigation findings, poems, or original art inspired by their *Inquiry in the Garden.* For more ideas on art projects that tie into Garden themes, go to the *Additional Resources* section of the *Digital Learning* website.

DESERT BOTANICAL garden

STUDENT STUDY GUIDE – ETHNOBOTANY OF SONORAN DESERT PLANTS – RESULTS AND CONCLUSIONS

Name _____ Partner Name _____

Team (desert habitat) _____

Part A – Results and Conclusions

Instructions: *Use the information from your Student Worksheet – Ethnobotany Predictions Table and Data Collection Journal to answer the questions below.*

1. What were the key plants you studied in your desert habitat?

2. What predictions did you make about the use of those plants?

3. What evidence did you gather (what did you see or do) at the Desert Botanical Garden that involved your plant? Did the evidence support your predictions about how the plant is used?

4. How did your predictions compare to the actual uses of the desert plants in your habitat?

5. What conclusions can you make about ethnobotany in your desert habitat?

DESERT BOTANICAL garden

STUDENT STUDY GUIDE – ETHNOBOTANY OF SONORAN DESERT PLANTS – RESULTS AND CONCLUSIONS

Name _____ Partner Name _____

Team (desert habitat) _____

Part B – Questions for Discussion

Instructions: *Answer the questions below and be prepared to discuss them with the class after everyone has completed their presentations (Part C).*

1. In what ways do people use plants? List as many uses as you can.

2. If you had a specific need (for food, medicine, tools, etc.) and all that was available were the desert plants around you, how would you determine which plant would be best to help you meet your need?

3. Now that you know about the uses of some desert plants, list at least one question and make at least one prediction about the use of another desert plant you saw during your investigation.

Part C. Present Your Results

Instructions: *As a team, prepare a skit for a final presentation of your investigation. Your skit should inform your audience about how people use the desert plants in your habitat. You can act out a story, produce a mock interview, present a news broadcast, create a puppet show, etc. Be creative! Use notebook paper to first write an outline; then write the script. Create your own scenery and props using a variety of material either from home or provided by your teacher.*

Related ADE Standards:

Theater Strand 1: Create

Concept	Performance Objective
C1: Collaboration	PO 201: Collaborate to create a scenario/script as a team. PO 202: Collaborate to design and choose the environmental elements for a scenario/script. PO 203: Collaborate and communicate in the rehearsal process. PO 204: Collaborate in informal performances.
C2: Acting	PO 201: Work individually to create characters for theatre and/or other media productions (e.g., for classical, contemporary, realistic, and non–realistic improvisations and scripted plays). PO 202: As a character, play out her/his wants by interacting with others, maintaining concentration, and contributing to the action of classroom improvisations (e.g., scenes based on personal experience and heritage, imagination, literature, and history). PO 204: Communicate sensory images through movement, vocal, visual, or written expression.
C3: Theatre Technology and Design	PO 201: Develop designs that use visual and aural elements to convey environments that clearly support the text. PO 203: Use available art materials, tools, and/or stock scenery (e.g., rehearsal blocks, puppets, curtains, backdrops) to create and convey props and/or setting. PO 204: Create floor plans and props. PO 205: Construct or locate appropriate props to enhance a scene or production.

Reading Strand 3: Comprehending Informational Text

Concept	Performance Objective
C1: Expository Text	PO 6: Interpret information from graphic features (e.g., charts, maps, diagrams, illustrations, tables, timelines) in expository text. PO 8: Draw valid conclusions based on information gathered from expository text.

continued…

Related ADE Standards:

Writing Strand 1: Writing Process

Concept	Performance Objective
C1: Prewriting	PO 1: Generate ideas through a variety of activities (e.g., brainstorming, graphic organizers, drawing, writer's notebook, group discussion, printed material). PO 4: Use organizational strategies (e.g., graphic organizer, KWL chart, log) to plan writing.

Writing Strand 2: Writing Elements

Concept	Performance Objective
C1: Ideas and Content	PO 1: Express ideas that are clear and directly related to the topic. PO 2: Provide content and selected details that are well–suited to audience and purpose. PO 3: Use relevant details to provide adequate support for the ideas.

Writing Strand 3: Writing Applications

Concept	Performance Objective
C2: Expository	PO 1: Record information (e.g., observations, notes, lists, charts, map labels and legends) related to the topic. PO 3: Write in a variety of expository forms (e.g., essay, summary, newspaper article, reflective paper, log, journal).

Language Arts Strand 3: Listening and Speaking

Standard	Performance Objective
Students effectively listen and speak in situations that serve different purposes and involve a variety of audiences.	LS–E2: Prepare and deliver an oral report in a content area and effectively convey the information through verbal and nonverbal communications with a specific audience.

continued…

Related ADE Standards:

Science Strand 1: Inquiry Process

Concept	
C3: Analysis and Conclusions	PO 3: Determine that data collected is consistent with the formulated question. PO 4: Determine whether the data supports the prediction for an investigation. PO 5: Develop new questions and predictions based upon the data collected in the investigation.
C4: Communication	PO 1: Communicate verbally or in writing the results of an inquiry. PO 3: Communicate with other groups or individuals to compare the results of a common investigation.

Science Strand 4: Life Science

Concept	Performance Objective
C1: Characteristics of Organisms	PO 1: Compare structures in plants (e.g., roots, stems, leaves, flowers) and animals (e.g., muscles, bones, nerves) that serve different functions in growth and survival.
C3: Organisms and Environments	PO 1: Describe ways various resources (e.g., air, water, plants, animals, soil) are utilized to meet the needs of a population.

continued…

Related ADE Standards:

Social Studies Strand 1: American History

Concept	Performance Objective
C2: Early Civilizations	PO 1: Describe the legacy and cultures of prehistoric people in the Americas: a. characteristics of hunter–gatherer societies b. development of agriculture PO 2: Describe the cultures and contributions of the Mogollon, Ancestral Puebloans (Anasazi), and Hohokam (e.g., location, agriculture, housing, arts, trade networks; adaptation and alteration of the environment).

Social Studies Strand 4: Geography

Concept	Performance Objective
C2: Places and Regions	PO 1: Describe how the Southwest has distinct physical and cultural characteristics.
C5: Environment and Society	PO 1: Describe human dependence on the physical environment and natural resources to satisfy basic needs.

Educational Technology Strand 2: Communication and Collaboration

Concept	Performance Objective
C1: Effective Communications and Digital Interactions	PO1: Communicate digitally with others by selecting and using a variety of appropriate communication tools.
C2: Digital Solutions	PO1: Contribute to a cooperative learning project and demonstrate effective group behaviors while using digital collaborative resources.

continued…

Related ADE Standards:

Workplace Skills Standard 1: Students use principles of effective oral, written and listening communication skills to make decisions and solve workplace problems.

Standard	Performance Objective
1WP–E6: Speak in a content area (e.g., science, social studies, literature), using vocabulary of the subject accurately; locate and interpret information in documents such as manuals, graphs, and schedules.	PO 1: Deliver a factual presentation using appropriate terminology. PO 2: Use a variety of formats such as data, graphs and technical manuals to support a presentation.

Workplace Skills Standard 3: Students apply critical and creative thinking skills to make decisions and solve workplace problems.

Standard	Performance Objective
3WP–E1: Utilize information acquired from several sources and transfer information learned in one situation to another.	PO 1: Research a designated topic using a wide array of information sources. PO 2: Analyze the information obtained from the research. PO 3: Classify the information obtained from the research.v

DESERT BOTANICAL garden

TEACHER'S GUIDE FOR FIFTH GRADE– INQUIRY IN THE GARDEN – STAGE 2

Alternate Field Investigation

Sonoran Desert Habitat

Activity Overview

In this investigation, students venture outside for a teacher–led, plant investigations walk in their own schoolyard. This activity is offered as an alternative field investigation for classes unable to visit the Desert Botanical Garden. The purpose of this activity is to get students outside and involved in real, hands–on field investigations about adaptations in plants. It is suggested that classes first conduct the *Science of Survival Inquiry in the Garden Stage 1* – Introductory Activity in preparation for this investigation. Although that introductory activity is primarily for classes visiting the Desert Botanical Garden, it provides foundational concepts and activities which are further explored in this investigation.

Teacher Preparation

The purpose of the plant investigations walk is for students to observe plants in nature and to follow the scientific method as they investigate aspects of plant adaptations to different environments. It is suggested that teachers first scout the school grounds before taking the students outside. Decide on a route that would be good for a plant investigations walk. The route should include a variety of plants including trees, shrubs, and cacti (if possible). Three specific places or "stops" be should identified along the route that would serve as focal points to investigate leaf size, seed dispersal, and leaf color. Students will be better prepared for these investigations if they first review the scientific method. The class should also review and discuss the *Science of Survival Inquiry Stage 1*– Introductory Activity and conduct the preparatory activities associated with that lesson.

continued…

TEACHER'S GUIDE FOR FIFTH GRADE–
INQUIRY IN THE GARDEN – STAGE 2
Alternate Field Investigation

Rainforest Habitat

Materials

- Leaf Size, Seed Dispersal, and Leaf Color Team Pictures from the Science of *Survival Inquiry Stage 1*– Introductory Activity.
- Optional depending on selected activities: pencils, paper, cuttings from small–leafed plant and large–leafed plant, two 15 ml centrifuge or test tubes, caps, single–hole stoppers or plastic wrap to cover tubes, water, one large piece of felt cut into a leaf shape (about 12" long), one small piece of felt cut into a leaf shape (about 6" long), a variety of seeds (see Seed Dispersal Stop), two to five leaf–shaped pieces of heavy construction paper, flat foam board, or other flat material of varying shades of color (see Leaf Color Stop), thermometers
- *Student Investigation Journal*
- *Student Study Guide–Results and Conclusion*

TEACHER'S GUIDE FOR FIFTH GRADE– INQUIRY IN THE GARDEN – STAGE 2

Alternate Field Investigation

Parent plants and offspring

General Procedures

Guide students on an outdoor plant investigations walk following your pre–planned route. At each stop, conduct an inquiry using the *Discussion Questions* to convey the *Teaching Points* presented for that stop. Following each discussion, conduct one or more of the *Suggested Activities,* having students record their findings in the *Student Investigation Journal.* Wrap up your walk by discussing students' discoveries and reviewing the *General Teaching Points.* Complete student investigations by completing the *Student Study Guide – Results and Conclusion,* which replaces *Inquiry in the Garden–Stage 3.*

Plant Investigations Walk

General Teaching Points

- Making observations, asking questions, and stating and testing hypotheses are part of the scientific method.
- The scientific method can be used to investigate plant adaptations.
- Students are actually scientists themselves when they follow the scientific method to answer questions and solve problems.
- In warm, dry, desert climates, some plants develop special adaptations to stay cool and conserve water.
- Leaf size is typically an adaptation to environmental conditions.
- Seeds disperse through various means including sticking to animal fur, being ingested by animals, floating away, and flying in the wind.
- Leaf color is typically an adaptation to environmental conditions.

continued…

TEACHER'S GUIDE FOR FIFTH GRADE– INQUIRY IN THE GARDEN – STAGE 2

Alternate Field Investigation

Leaf Size – Desert Plants

General Procedures

Leaf Size Stop

Description

The leaf size stop should offer the opportunity to see a variety of plant leaves up close – specifically plants with different sized leaves. If your schoolyard has any native landscaping, choose a place with plants native to the area that may offer the opportunity to study leaves adapted to your area's environment. Referring to the Leaf Size Team Pictures from the *Inquiry in the Garden– Stage 1, Science of Survival,* will also help students visualize the concepts at this stop.

Teaching Points

- Leaves vary in size.
- Leaf size is typically an adaptation to environmental conditions.
- Plants in dry environments often have tiny leaves to conserve water.
- Plants in wet environments often have large leaves to transpire more water.
- The scientific method can be used to investigate leaf size

Discussion Questions and Activity Suggestions

At the leaf size stop, conduct an inquiry using the teaching points as your guide. Through your discussion, help students come up with the hypothesis that *desert plants have small leaves to conserve water.* Questions to help students arrive at the key points for this stop could include the following:

What do you notice about the size of leaves in the plants around us?

In what kind of climate do we live, dry or wet?

Are the plants around us native to this area? Do they occur in unlandscaped, natural areas near here?

Might any of the plants we see be adapted to our environment? How?

Do leaves in drier climates (deserts) tend to be large or small?

How might leaf size be an adaptation to the environment?

continued…

TEACHER'S GUIDE FOR FIFTH GRADE– INQUIRY IN THE GARDEN – STAGE 2

Alternate Field Investigation

Leaf Size – Rainforest Plants

General Procedures

What do you recall about the sizes of leaves in the pictures from the Introductory Activity?

Can we propose a hypothesis about why plants from dry climates have small leaves?

What are some ways we could test our hypothesis?

After students have had a chance to discuss leaf size, choose and conduct one or more of the following suggested activities. Students should record in their *Investigation Journals.*

Have students…

- Look around the schoolyard and note how many different plants they find with small leaves. How many with large leaves? If possible, note whether the plants are ornamental or native. Are there more of one kind than another?
- Review and discuss the Leaf Size Team Pictures from the *Inquiry in the Garden– Stage 1, Science of Survival.*
- Set up an experiment to investigate leaf size and test their hypothesis that *desert plants have small leaves to conserve water.* Help students set up an investigation by obtaining two 15 ml centrifuge or test tubes. Fill with equal amounts of water. Record beginning water volume (by level in tube or before adding to tube). Drill or poke small holes in the caps (to fit a small plant stem), use a single–hole rubber stopper, or create a lid with plastic wrap. Place one cutting of a plant with very large leaves in one tube. Place another cutting of a plant with tiny leaves in the other tube. Set tubes upright in the sun. Observe throughout the day noting decline in water volume. Record observations. Remove cuttings, measure and record water volume at end of experiment. Record and calculate results. (Note: If both tubes are empty, calculate the rate of water use.)
- Use a large, leaf–shaped piece of felt and a small, leaf–shaped piece of felt instead of real plant cuttings for the above experiment if plant cuttings are difficult to obtain.
- Follow their leaf size investigation through to the results and conclusions stage by completing the *Student Study Guide – Results and Conclusions.*

continued…

TEACHER'S GUIDE FOR FIFTH GRADE– INQUIRY IN THE GARDEN – STAGE 2

Alternate Field Investigation

Seed Dispersal

General Procedures

Seed Dispersal Stop

Description

The seed dispersal stop would be best located in an area where young plants are sprouting. This may often occur under or near trees. If the schoolyard is primarily landscaped with ornamental, non–native plants, a tree may be used as a reference point but students will need to consider the natural landscape and how young plants sprout up near parent plants. Referring to the Seed Dispersal Team Pictures from the *Inquiry in the Garden– Stage 1, Science of Survival* will help students visualize the concept.

Teaching Points

- A seed is a baby plant surrounded with a small food reserve so it can start to grow.
- Seeds need space, light, water, and nutrients to grow.
- Seeds that fall and start to grow under their parent plant must compete with their parent for resources and may not survive.
- To grow and survive, seeds need to disperse (travel) away from their parent plant.
- Seeds disperse through various means including flying in the wind, sticking to animal fur, being ingested by animals, and floating away.
- The scientific method can be used to investigate seed dispersal in plants.

Discussion Questions and Activity Suggestions

At the seed dispersal stop, conduct an inquiry using the teaching points as your guide. Through your discussion, help students come up with the hypothesis that *seeds may be able to fly in the wind, stick to animal fur, be eaten, or float to disperse.* Questions to help students arrive at the key points for this stop, could include the following:

What are seeds?

What do seeds do for plants?

What do seeds need to survive and grow?

How did the plants we see here get here?

continued…

TEACHER'S GUIDE FOR FIFTH GRADE– INQUIRY IN THE GARDEN – STAGE 2

Alternate Field Investigation

Clematis Seed

General Procedures

How do plants get where they are found in a natural, unlandscaped environment?

If all the seeds from a large tree fell under the parent plant, would they all be able to grow into big trees?

Why or why not?

What do seeds need to do in order to grow and not compete for resources with their parent?

How do seeds get around? How do they disperse from their parent?

Can we propose a hypothesis about how seeds get around?

What are some ways we could test our hypothesis?

After students have had a chance to discuss seed dispersal, choose and conduct one or more of the following suggested activities. Students should record in their *Investigation Journals.*

Have students…

- Explore the area for different seeds either on plants or fallen to the ground. Note the differences in seeds. Do some appear to have different shapes, sizes, textures, and/or weights?
- Review and discuss the Seed Dispersal Team Pictures from the *Inquiry Stage 1– Introductory Activity, Science of Survival.*
- Set up an experiment to test the hypothesis that *seeds may be able to fly in the wind, stick to animal fur, be eaten, or float to disperse.* If possible, in advance, have students bring in a variety of seeds that are likely to fly, stick to animal fur, be eaten by an animal, or float. (Suggestions include ash, willow, cottonwood, maple, mesquite, palo verde, ironwood, clematis, bursage, goat head, devil's claw, jojoba, juniper, etc.). Have students test each seed to see how it might move. Tests might include: Fly – hold up seeds and blow; Stick – flick a seed on cloth; Float – place seeds in water; Eaten – the teacher will have to tell students (most seeds except the obviously sticky are eaten). Have students record their data.
- Follow their seed dispersal investigation through to the results and conclusions stage by completing the *Student Study Guide – Results and Conclusions.*

continued…

TEACHER'S GUIDE FOR FIFTH GRADE–
INQUIRY IN THE GARDEN – STAGE 2
Alternate Field Investigation

Leaf Colors in a Sonoran Desert Scene

General Procedures

Leaf Color Stop

Description

The leaf color stop would be best located in an area where there are a variety of leaves of different colors. It would be ideal to have some sun in the area for student activities. Referring to the Leaf Color Team Pictures from the *Inquiry in the Garden–Stage 1, Science of Survival* will also help students visualize the concepts at this stop.

Teaching Points

- Leaves occur in a variety of colors.
- Dark colors are warmer because they absorb light.
- Light colors are cooler because they reflect light.
- Plants in dry climates need to conserve water.
- Staying cool conserves water.
- Light colored plants need less water to stay cool than dark colored plants.
- Desert plants often have light colored leaves to help them conserve water.
- The scientific method can be used to investigate leaf color in plants.

Discussion and Activity Suggestions

At the leaf color stop, conduct an inquiry using the teaching points as your guide. Through your discussion, help students come up with the hypothesis that *plants from hot climates have light colored leaves to help them stay cool and conserve water.* Questions to help students arrive at the key points for this stop, could include the following:

Are all leaves the same color?

What are some of the different colors you see on the leaves around us?

How might leaf color be an adaptation to the environment?

Do leaves in hotter climates (deserts) tend to be dark or light in color?

continued…

TEACHER'S GUIDE FOR FIFTH GRADE– INQUIRY IN THE GARDEN – STAGE 2

Alternate Field Investigation

Leaf Color – Desert Plants

General Procedures

What do you recall about leaf color from the pictures from the Introductory Activity?

Do you tend to drink more water when you're hot or cold? Why?

Which tend to get warmer in the sun, things that are dark colored or light colored? Why?

Can we propose a hypothesis about why plants in hot climates have light colored leaves?

What are some ways we could test our hypothesis?

After students have had a chance to discuss leaf color, choose and conduct one or more of the following suggested activities. Students should record in their *Investigation Journals.*

Have students…

- Look around the school and note how many different colors of leaves they can find. Are there more dark leaves or light leaves? Is this a factor of landscaping or are they naturally occurring?
- Review and discuss the Leaf Color Team Pictures from the *Inquiry Stage 1– Introductory Activity, Science of Survival.*
- Stand in the sun for at least five minutes. Some students should have dark colored shirts on and some should be wearing light colored shirts. Have students feel a dark colored and a light colored shirt. Does one feel warmer than the other?
- Set up an experiment to investigate leaf color in plants and test their hypothesis that *plants from hot climates have light colored leaves to help them stay cool and conserve water.* Prepare two, leaf–shaped pieces of heavy construction paper, flat foam board, or other flat material. Each should be about 1 foot long. One should be white and one black. If possible attach a thermometer (a stick–on aquarium thermometer would work) or place a thermometer under each. Both "leaves" should be identical except for their color. Allow "leaves" to sit in the sun for at least an hour. Record the temperatures of each. If a thermometer is unavailable, feel the "leaves" and record relative temperatures.

continued…

TEACHER'S GUIDE FOR FIFTH GRADE-
INQUIRY IN THE GARDEN - STAGE 2
Alternate Field Investigation

Leaf Color – Forest Plants

General Procedures

- Add one to three more intermediate colored "leaves" to the experiment to note more subtle differences in temperature given a range of colors. Use shades of green.
- Follow their leaf color investigation through to the results and conclusions stage by completing the *Student Study Guide – Results and Conclusions.*

Post Your Findings on the Internet!

As part of the Inquiry Process students may share their work with others by visiting the *DBG Journal of Student Findings* at *http://www.dbg.org/index.php/digital/students/journal.* Here, students can submit investigation findings, poems, or original art inspired by their *Inquiry in the Garden*. For more ideas on art projects that tie into Garden themes, go to the *Additional Resources* section of the *Digital Learning* website.

SCIENCE OF SURVIVAL
STUDENT INVESTIGATION JOURNAL

Name _____ Teacher _____

Team _____

Leaf Size

Use this journal to record your findings during the Plant Investigation Walk.

How many trees with small leaves do you see? Large leaves?

Observation:

Question:

Hypothesis:

Prediction:

Experiment Method *(How did you set up experiment? What did you do during experiment?):*

Record Results:

DESERT BOTANICAL garden

SCIENCE OF SURVIVAL
STUDENT INVESTIGATION JOURNAL

Name _____ **Teacher** _____

Team _____

Seeds

Use this journal to record your findings during the Plant Investigation Walk.

What are some different shapes, textures, sizes of leaves that you see?

Observation:

Question:

Hypothesis:

Prediction:

Experiment Method *(How did you set up experiment? What did you do during experiment?):*

Record Results:

DESERT BOTANICAL garden

SCIENCE OF SURVIVAL
STUDENT INVESTIGATION JOURNAL

Name _____ **Teacher** _____

Team _____

Leaf Color

Use this journal to record your findings during the Plant Investigation Walk.

How many trees with light colored leaves do you see? Dark colored leaves?

Observation:

Question:

Hypothesis:

Prediction:

Experiment Method *(How did you set up experiment? What did you do during experiment?):*

Record Results:

DESERT BOTANICAL garden

STUDENT STUDY GUIDE – SCIENCE OF SURVIVAL
RESULTS AND CONCLUSIONS

Name _____ Teacher _____

Team _____

Instructions: *Use the information from your Student Investigation Journal to answer the questions below. When finished with this Study Guide, prepare a display for a final presentation of your investigation. Be creative! You could make a poster, prepare a slide show, draw pictures, generate graphs, and/or include photos from your trip or from the internet. Then, think of a fun way to share your display. You could do a team presentation, poster displays, "science fair" displays, mock interviews, 3–D models, etc.*

Plant adaptation your team investigated: _____

1. **Questions.** What questions were generated by your observations of this plant adaptation?

2. **Hypothesis.** What was your hypothesis about this adaptation?

3. **Prediction.** What predictions did you make about this adaptation?

4. **Experiment.** How did you test your prediction?

5. **Results.** In the space below, copy the results from your *Student Investigation Journal:*

6. **Conclusions.** In your own words, what do you conclude about your hypothesis based on your test results? Is your hypothesis supported by your results?

DESERT BOTANICAL garden

STUDENT STUDY GUIDE – SCIENCE OF SURVIVAL
RESULTS AND CONCLUSIONS

Name _____ Teacher _____

Team _____

Questions for Discussion

1. What is the basic thing that plants are trying to do to survive in desert conditions? What are some ways they are doing this?

2. Would you consider your investigation a valid (or reasonable) way to test your hypothesis? Are you satisfied with your results? Why or why not?

3. How might you alter your experiment to study different plants in different habitats? Would your results be the same? Why or why not?

4. Based on your findings, what are some other questions that arise that might lead to new investigations?

Related ADE Standards:

Writing Strand 1: Writing Process

Concept	Performance Objective
C1: Prewriting	PO 1: Generate ideas through a variety of activities (e.g., brainstorming, graphic organizers, drawing, writer's notebook, group discussion, printed material).

Writing Strand 3: Writing Applications

Concept	Performance Objective
C2: Expository	PO 1: Record information (e.g., observations, notes, lists, charts, map labels and legends) related to the topic.

Language Arts Strand 4: Viewing and Presenting

Standard	Performance Objective
Students use a variety of visual media and resources to gather, evaluate and synthesize information and to communicate with others.	VP–E1: Analyze visual media for language, subject matter and visual techniques used to influence opinions, decision making and cultural perceptions

continued…

TEACHER'S GUIDE FOR FIFTH GRADE- INQUIRY IN THE GARDEN - STAGE 2

Alternate Field Investigation

Related ADE Standards:

Science Strand 1: Inquiry Process

Concept	Performance Objective
C1: Observations, Questions, and Hypotheses	PO 1: Formulate a relevant question through observations that can be tested by an investigation. PO 2: Formulate predictions in the realm of science based on observed cause and effect relationships.
C2: Scientific Testing (Investigating and Modeling)	PO 1: Demonstrate safe behavior and appropriate procedures (e.g., use and care of technology, materials, organisms) in all science inquiry. PO 2: Plan a simple investigation that identifies the variables to be controlled. PO 3: Conduct simple investigations (e.g., related to forces and motion, Earth processes) based on student–developed questions in life, physical, and Earth and space sciences. PO 4: Measure using appropriate tools (e.g., ruler, scale, balance) and units of measure. PO 5: Record data in an organized and appropriate format.
C3: Analysis and Conclusion	PO1: Analyze data obtained in a scientific investigation to identify trends and form conclusions. PO2: Analyze whether the data is consistent with the proposed explanation that motivated the investigation. PO4: Develop new investigations and predictions based on the questions that arise from the findings of an investigation.
C4: Communication	PO1: Communicate verbally or in writing the results of an inquiry. PO3: Communicate with other groups or individuals to compare the results of a common investigation.

continued…

Related ADE Standards:

Educational Technology Strand 2: Communication and Collaboration

Concept	Performance Objective
C1: Effective Communications and Digital Interactions	PO1: Communicate digitally with others by selecting and using a variety of appropriate communication tools.
C2: Digital Solutions	PO1: Contribute to a cooperative learning project and demonstrate effective group behaviors while using digital collaborative resources.

Workplace Skills Standard 1: Students use principles of effective oral, written and listening communication skills to make decisions and solve workplace problems.

Standard	Performance Objective
1WP–E4: Respond to oral and written presentations by formulating relevant feedback, expressing opinions, discerning the main idea and distinguishing fact from opinion.	PO 1: Summarize main ideas of an oral or written presentation. PO 3: Formulate related questions in a presentation. PO 4: Express opinions relating to the main idea in a presentation.

DESERT BOTANICAL garden

TEACHER'S GUIDE FOR FIFTH GRADE-
INQUIRY IN THE GARDEN - STAGE 3
Desert Plant Detectives

Sonoran Desert Habitat

Activity Overview

The purpose of this activity is to move students through the completion of an investigation using the scientific process. Having previously made observations, asked questions, developed hypotheses, and made and tested predictions, students now analyze their results and draw conclusions about desert plant adaptations. Students complete a Study Guide and develop creative displays to share their results with others. Students are also encouraged to post their work online at the Desert Botanical Garden website.

Materials

- *Data Collection Journals*
- *Student Study Guide – Investigating Desert Plant Adaptations – Results and Conclusion*

TEACHER'S GUIDE FOR FIFTH GRADE-
INQUIRY IN THE GARDEN – STAGE 3
Desert Plant Detectives

Seed Dispersal

Activity Procedures

1. Review and discuss the students' experiences during their trip to the Desert Botanical Garden. Go over the data collected in their *Data Collection Journals* and answer any questions students may have. Use the provided graph and Venn diagram in the *Journals* to review the class's field investigation at the Garden.

2. Divide students back into their investigative teams (the teams assigned in Stage 1 of this inquiry). Hand out the *Student Study Guide – Investigating Desert Plant Adaptations – Results and Conclusion* one to each student. Each team should focus on their specific plant adaptation (as assigned in Stage 1) as they complete their *Study Guides*. They will continue to follow the scientific method as they wrap up their investigations.

3. Explain that the final step in the scientific process is sharing your findings with others. Discuss the importance of sharing scientific information (so that others may learn from the work and to expand everyone's understanding of the subject). Scientists typically publish their work in scientific journals. As described in their *Study Guides,* students will prepare a final presentation of their investigation to share with others, both in class and by posting online on the *DBG Journal of Student Findings*.

4. Allow students to work together to complete their *Student Study Guides* and prepare their final presentations. They should refer to their *Data Collection Journals* (completed during their field investigation at the Desert Botanical Garden) and copy that data onto their Study Guides. Although students may work together as a team, each student should complete their own *Study Guide*. For their presentations, students may choose to create a poster, design a slide show, draw pictures, generate graphs of their data, and/or include photographs taken during their field trip or acquired from the internet. Encourage student creativity in the display of their work. *(Note: For more ideas on art projects that tie into Garden themes, go to the Additional Resources section of the Digital Learning website.)*

continued…

TEACHER'S GUIDE FOR FIFTH GRADE– INQUIRY IN THE GARDEN – STAGE 3

Desert Plant Detectives

Sonoran Desert Scene

Activity Procedures

5. Have students present their investigations to the rest of the class. Again, encourage creativity! Suggestions for final presentations include team presentations, poster displays, "science fair" displays, mock interviews, 3–D models, etc. Remind students that their final products should include each step of the scientific process.

6. Conclude the activity with a discussion of each of the four investigations. Use the *"Questions for Discussion"* from the *Student Study Guide* as a guide for the discussion.

Post Your Findings on the Internet!

The final step of the Inquiry Process is to share your findings. One way that scientists do this is by publishing in science journals. You can share your findings by visiting the *DBG Journal of Student Findings* at *http://www.dbg.org/index.php/digital/students/journal*. Here you can submit your investigation findings or original art inspired by your Inquiry in the Garden. For more ideas on art projects that tie into Garden themes, teachers can go to the *Additional Resources* section of the Digital Learning website.

Related ADE Standards:

Language Arts Strand 3: Listening and Speaking

Standard 3: Listening and Speaking	Performance Objective
Students effectively listen and speak in situations that serve different purposes and involve a variety of audiences.	LS–E2. Prepare and deliver an oral report in a content area and effectively convey the information through verbal and nonverbal communications with a specific audience

Language Arts Strand 4: Viewing and Presenting

Standard 4: Viewing and Presenting	Performance Objective
Students use a variety of visual media and resources to gather, evaluate and synthesize information and to communicate with others.	VP–E2. Plan, develop and produce a visual presentation, using a variety of media such as videos, films, newspapers, magazines and computer images.

Science Strand 1: Inquiry Process

Concept 3: Analysis and Conclusions	Performance Objective
Analyze and interpret data to explain correlations and results; formulate new questions.	PO 1. Analyze data obtained in a scientific investigation to identify trends and form conclusions. PO 2. Analyze whether the data is consistent with the proposed explanation that motivated the investigation. PO 3. Evaluate the reasonableness of the outcome of an investigation. PO 4. Develop new investigations and predictions based on questions that arise from the findings of an investigation.

continued…

Related ADE Standards:

Science Strand 1: Inquiry Process

Concept 4: Communication	Performance Objective
Communicate results of investigations.	PO 1. Communicate verbally or in writing the results of an inquiry. PO 2. Choose an appropriate graphic representation for collected data: • bar graph • line graph • Venn diagram • model PO 3. Communicate with other groups or individuals to compare the results of a common investigation.

Technology Skills Strand 4

Standard 4: Technology Communications Tools	Performance Objective
4T–E2. Use technology tools for individual and collaborative writing, communication and publishing activities to create curricular related products for audiences inside and outside the classroom.	PO 1. Plan, design and present an academic product using technology tools (e.g., multimedia authoring, presentation software, digital cameras, scanners, projection devices).

continued…

Related ADE Standards:

Workplace Skills

Standard 1 – Students use principles of effective oral, written and listening communication skills to make decisions and solve workplace problems.	**Performance Objective**
1WP–E6. Speak in a content area (e.g., science, social studies, literature), using vocabulary of the subject accurately; locate and interpret information in documents such as manuals, graphs, and schedules.	PO 1. Deliver a factual presentation using appropriate terminology. PO 2. Use a variety of formats such as data, graphs and technical manuals to support a presentation.

Workplace Skills

Standard 3 – Students apply critical and creative thinking skills to make decisions and solve workplace problems.	**Performance Objective**
3WP–E1. Utilize information acquired from several sources and transfer information learned in one situation to another.	PO 1. Research a designated topic using a wide array of information sources. PO 2. Analyze the information obtained from the research. PO 3. Classify the information obtained from the research.

DESERT BOTANICAL garden

TEACHER'S GUIDE FOR SIXTH GRADE – INQUIRY IN THE GARDEN – STAGE 1

Transpiration

Desert Scene 1

Activity Overview

In preparation for their visit to the Desert Botanical Garden, students examine the process of transpiration and, following the scientific method, explore ways that desert plants have adapted to meet the challenge of transpiring in a desert environment. The activity begins with a review of the transpiration process in which students consider the role that roots, stems, and leaves each have in the process. Next, the class studies photos of selected desert plants and completes a table describing their observations, questions, and hypotheses about how each plant part might be uniquely adapted for transpiration in the desert. Each student completes their own *Student Worksheet* to bring to the Desert Botanical Garden where they will continue their investigation.

To support the Inquiry in the Garden lesson plans, you may also use the tutorials and Virtual Habitat in DBG's Digital Desert. These interactive activities will prepare students for their investigations by teaching them about the characteristics of deserts and the Sonoran Desert habitat.

continued…

TEACHER'S GUIDE FOR SIXTH GRADE – INQUIRY IN THE GARDEN – STAGE 1

Transpiration

Desert Scene 2

Materials Note:

(Note: All of the following materials are provided as downloadable graphics.)

- *The Water Cycle and Transpiration Process* (prepared to share with the class as a print, on an overhead transparency, on a smart board, or as a student handout)
- *Student Worksheet – Transpiration Adaptations Table* (one copy prepared to share with the class as a print, on an overhead transparency, or on a smart board and one copy per student)
- *Teacher Reference – Transpiration Adaptations Table* (to use as a guide when completing the Table as a class)
- Roots – photos of desert scene and desert plants:
  - Desert scene 1 (showing dry, desert environment but lush mesquite and saguaro)
  - Desert rainfall data
  - Mesquite tree
  - Saguaro
- Stems – photos of desert scene and succulent desert plants:
  - Desert scene 2 (with many succulents)
  - Saguaro
  - Prickly pear cactus
  - Agave
  - Barrel cactus
- Leaves – photos of desert scene and leaves:
  - Desert scene 3 (showing plants with tiny leaves)
  - Ocotillo
  - Palo Verde Tree
  - Mesquite Tree
  - Creosote bush

continued…

TEACHER'S GUIDE FOR SIXTH GRADE-
INQUIRY IN THE GARDEN - STAGE 1
Transpiration

Desert Scene 3

Learning Objectives

Upon completion of this activity, students will be able to…

- Explain how water cycles through plants in the transpiration process.
- Describe the challenges to which plants must adapt in a desert environment.
- Explain the role that roots, stems and leaves have in the transpiration process.
- Ask questions based on observations of desert plants.
- State a relevant hypothesis based on observations and questions.
- Identify a saguaro cactus, mesquite tree, prickly pear cactus, agave, barrel cactus, ocotillo, palo verde, and creosote bush.

Background Knowledge

These are concepts the educator should understand and that can be found in the glossary.

Condensation
Hypothesis
Inquiry Process
Observation
Precipitation
Prediction
Transpiration

TEACHER'S GUIDE FOR SIXTH GRADE–
INQUIRY IN THE GARDEN – STAGE 1
Transpiration

Ocotillo

Activity Procedures

1. Introduction.

Explain to students that they will be visiting the Desert Botanical Garden where they will be studying desert plants. Through an inquiry discussion, review with students the name of our desert (the Sonoran Desert) and the characteristics of deserts in general (hot, dry, high evaporation, low rainfall, and extreme temperature fluctuations).

2. Introduce transpiration.

During the field trip, the class will be investigating the **transpiration** process in desert plants. Specifically, they will be investigating the role that different plant parts play in the process. Commence a class review of transpiration by asking students the following questions:

How does water cycle through plants in the transpiration process?

How does water get into plants?

Through what plant parts does water move?

Where does water go when it transpires out of plants?

3. Review and discuss transpiration using *The Water Cycle and Transpiration Process* graphic.

Bring out the graphic image, *The Water Cycle and Transpiration Process,* and call on students to review the different parts of the cycle. Be sure students understand that the transpiration process is part of the larger water cycle. The process involves the movement of water in plants from the soil into the roots, up through the stems, and up and out through the leaves into the air. While transpiration is specifically the evaporative loss of water through the leaves, the process involves the entire plant. An important part of the cycle is **precipitation** which occurs when water vapor in the air condenses (**condensation**) then falls back to the earth as rain, sleet, or snow. Water is then available in the soil to again be a part of the transpiration process in plants.

continued…

Palo Verde

Activity Procedures

4. Consider transpiration in desert conditions.

Point out that water is the key factor in the transpiration process. Without water, plants' cells dry up. Plants would not be able to hold their shape and they would not be able to photosynthesize. Simply put, without water, plants die. Ask students to again consider our desert and the conditions of a desert environment (hot, dry, high evaporation, low rainfall, and extreme temperature fluctuations). With this in mind, might desert plants have certain challenges to deal with as they transpire? Ask students what these challenges might be and discuss responses.

5. Introduce and review the *Transpiration Adaptations Table.*

Display the *Student Worksheet – Transpiration Adaptations Table* on the overhead transparency or smartboard and hand out one copy to each student. Explain that for the rest of this activity the class will be following the scientific method to investigate transpiration in desert plants. Refer to the *Table* to explain that as a class, students will review each plant part, the role it plays, and the challenges it faces in the transpiration process. Next, they will observe some photos of desert plants which will likely provoke some questions. They will then come up with a hypothesis about how each plant part might be uniquely adapted for transpiration in the desert and make predictions based on their hypotheses. *(Note: If necessary, review the term* ***adaptation*** *– physical or behavioral characteristics that help a plant or animal survive in its environment.)*

continued…

Mesquite

Activity Procedures

6. Review the scientific method if necessary.

If necessary, review the scientific method with students and reinforce the steps used in the process. You may use the following as a guide in your discussion:

The scientific method follows a series of logical steps to help explain the world around us. The steps are:

Make observations – The first step in the process is to observe the world around us and to take note of the natural phenomena that occur.

Ask questions – When something is observed, it usually provokes a question. Asking questions gets our attention and guides our focus.

Form a hypothesis – A hypothesis is a possible explanation that answers the questions provoked by the observations.

Make a prediction – A prediction is made to test the hypothesis. A prediction states what will happen when the hypothesis is tested through some kind of experiment or investigation. A prediction is an "if" "then" statement: "*If* (the hypothesis) is true, *then* (the prediction) should happen.

Conduct an investigation – The next step in the process is to perform an experiment to test the prediction.

Record results – The data gathered during an experiment or investigation are the results.

State conclusions – A conclusion states whether or not the hypothesis is true based on the results of the experiment.

Share your knowledge – Allow others to gain knowledge from your findings.

continued…

Creosote

Activity Procedures

7. Complete the *Transpiration Adaptations Table.*

With the entire class participating, go through the *Transpiration Adaptations Table* row by row beginning with the "roots" row. For each plant part, first complete the *"Role in Transpiration Process"* and *"Challenges in a Desert Environment"* columns. Then, bring out the photos associated with that plant part and give students time to carefully observe the photos, state their observations, and come up with a question. Use the *Teacher Reference* as a guide to help direct student responses. As students respond, fill in the table on the transparency or smartboard and give them time to fill in the table on their own *Student Worksheets.* Next, have students come up with a hypothesis – possible explanations for their observations – and write that in the table.

8. Save *Student Worksheets – Transpiration Adaptations Table.*

Explain that students will continue their investigation at the Desert Botanical Garden. There, they will have the opportunity to answer some of their questions by making and testing predictions based on their hypotheses. Remind students that in the scientific process, one does not always arrive at the right answer all the time. An important part of the process is revising questions and hypotheses based on test results. At the Botanical Garden, you may or may not test your hypotheses exactly as stated, but you will likely come up with answers to your questions!

DESERT BOTANICAL garden

TRANSPIRATION ADAPTATIONS TABLE

Name _____

Plant Part	Role in Transpiration Process	Challenges in a Desert Environment	Observations	Question
Roots				
Stems				
Leaves				

DESERT BOTANICAL garden

TRANSPIRATION ADAPTATIONS TABLE

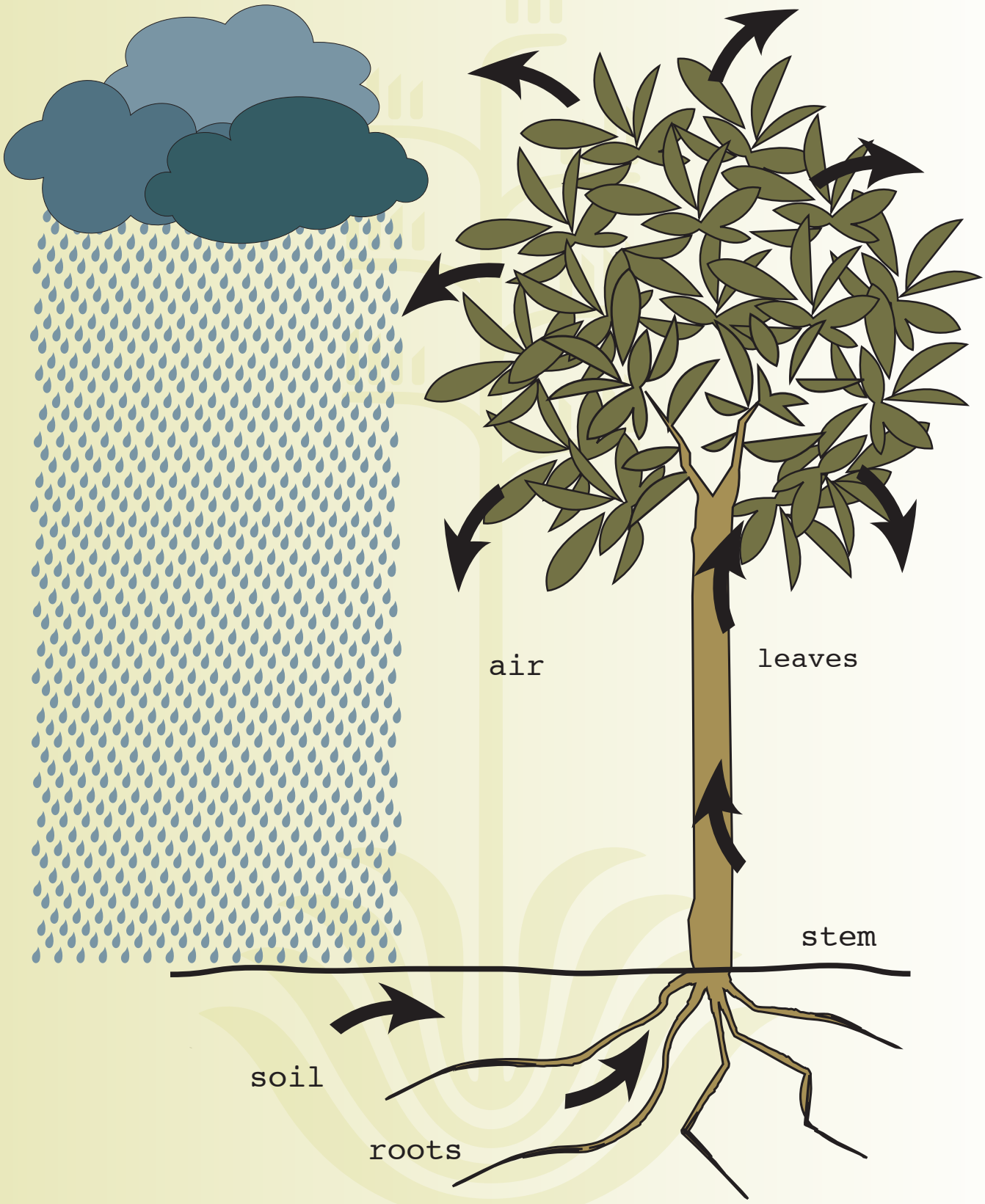
(Teacher Copy with Answers for Use as a Discussion Guide)

Plant Part	Role in Transpiration Process	Challenges in a Desert Environment	Observations	Question
Roots	Roots move water from the soil into the plant.	Limited rainfall makes it difficult to collect water.	Plants need water and there is very little water in the desert.	How do plants collect water?
Stems	Stems move water from a plant's roots to its leaves.	Limited rainfall and dry conditions. Plants need to conserve water.	Some saguaro stems appear fat. Some saguaro stems appear skinny.	Why are some saguaro stems fat and some skinny?
Leaves	Water transpires into the air through the leaves.	Limited rainfall and dry conditions. Plants need to conserve water.	Some desert leaves are small.	Why are desert leaves small?

DESERT BOTANICAL garden

INQUIRY IN THE GARDEN

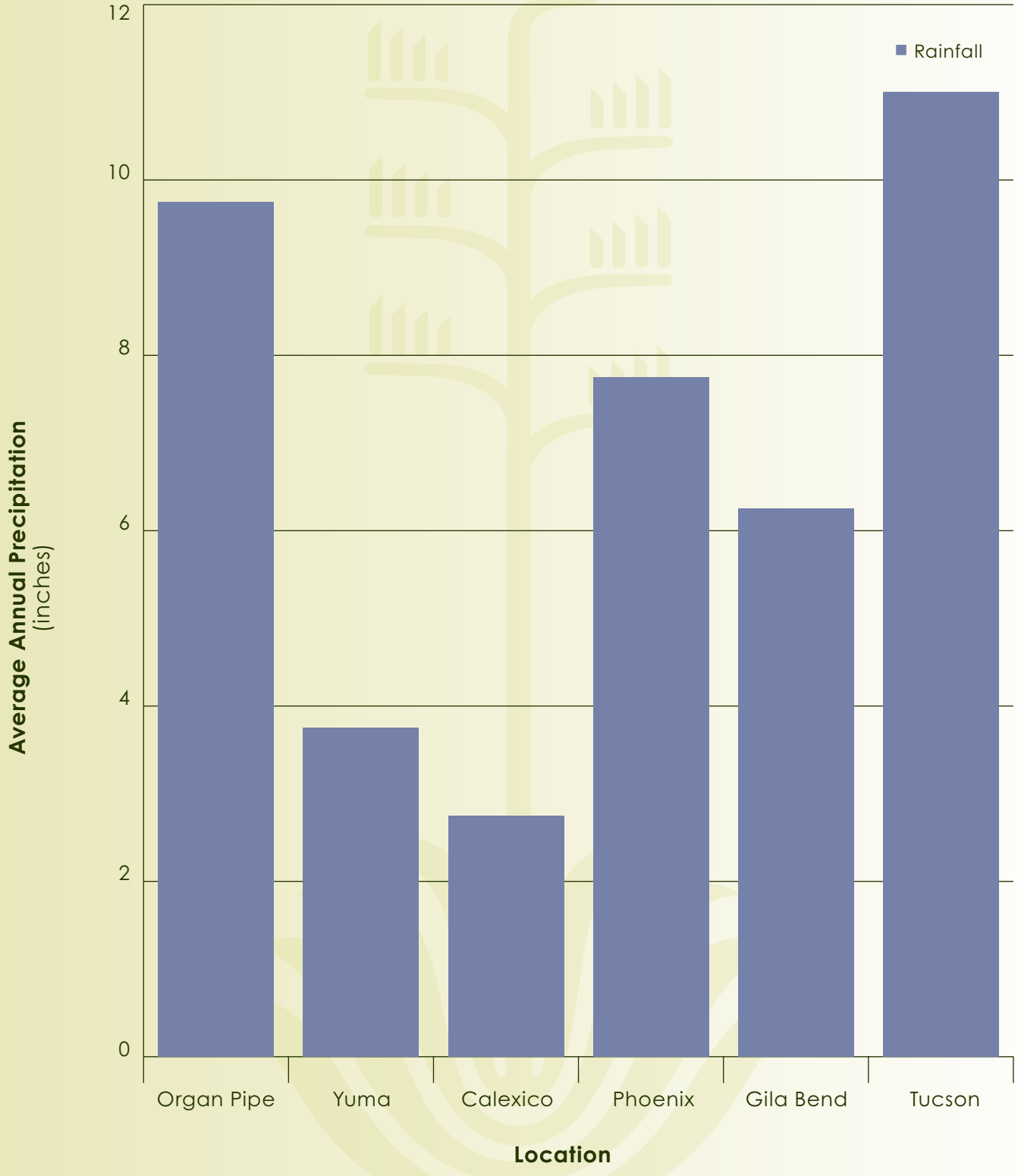
Water Cycle and Transpiration Process



DESERT BOTANICAL garden

INQUIRY IN THE GARDEN

Desert Rainfall Data



DESERT BOTANICAL garden

INQUIRY IN THE GARDEN

Transpiration

Desert Scene 1

DESERT BOTANICAL garden

INQUIRY IN THE GARDEN

Transpiration

Mesquite Tree

DESERT BOTANICAL garden

INQUIRY IN THE GARDEN

Transpiration

Saguaro

DESERT BOTANICAL garden

INQUIRY IN THE GARDEN

Transpiration

Desert Scene 2

DESERT BOTANICAL garden

INQUIRY IN THE GARDEN

Transpiration

Prickly Pear

DESERT BOTANICAL garden

INQUIRY IN THE GARDEN

Transpiration

Saguaro

DESERT BOTANICAL garden

INQUIRY IN THE GARDEN

Transpiration

Agave

DESERT BOTANICAL garden

INQUIRY IN THE GARDEN

Transpiration

Barrel Cactus

DESERT BOTANICAL garden

INQUIRY IN THE GARDEN

Transpiration

Desert Scene 3

DESERT BOTANICAL garden

INQUIRY IN THE GARDEN

Transpiration

Ocotillo

DESERT BOTANICAL garden

INQUIRY IN THE GARDEN

Transpiration

Palo Verde

DESERT BOTANICAL garden

INQUIRY IN THE GARDEN

Transpiration

Mesquite

DESERT BOTANICAL garden

INQUIRY IN THE GARDEN

Transpiration

Creosote

Related ADE Standards:

Writing Strand 1: Writing Process

Concept 1: Prewriting	Performance Objective
Prewriting includes using strategies to generate, plan, and organize ideas for specific purposes.	PO 1. Generate ideas through a variety of activities (e.g., prior knowledge, discussion with others, printed material or other sources). PO 6. Maintain a record (e.g., lists, journal, folder, notebook) of writing ideas.

Writing Strand 3: Writing Applications

Concept 2: Expository	Performance Objective
Expository writing includes nonfiction writing that describes, explains, informs, or summarizes ideas and content. The writing supports a thesis based on research, observation, and/or experience.	PO 1. Record information (e.g., observations, notes, lists, charts, map labels and legends) related to the topic.

Language Arts Strand 3: Listening and Speaking

Standard 3: Listening and Speaking	Performance Objective
Students effectively listen and speak in situations that serve different purposes and involve a variety of audiences.	LS–E3. Interpret and respond to questions and evaluate responses both as interviewer and interviewee.

continued…

Related ADE Standards:

Science Strand 1: Inquiry Process

Concept 1: Observations, Questions, and Hypotheses	Performance Objective
Formulate predictions, questions, or hypotheses based on observations. Locate appropriate resources.	PO 1. Differentiate among a question, hypothesis, and prediction. PO 2. Formulate questions based on observations that lead to the development of a hypothesis.

Science Strand 4: Life Science

Concept 1: Structure and Function in Living Systems	Performance Objective
Understand the relationships between structures and functions of organisms.	PO 1. Explain the importance of water to organisms. PO 6. Relate the following structures of living organisms to their functions: Plants • transpiration – roots • absorption – roots PO 7. Describe how the various systems of living organisms work together to perform a vital function

DESERT BOTANICAL garden

TEACHER'S GUIDE FOR 1ST GRADE–
INQUIRY STAGE 1 – INTRODUCTORY ACTIVITY
Plants and Animals are Buddies

Squirrel

Oak Tree

Bee

Desert Flower

Activity Overview

In preparation for their visit to the Desert Botanical Garden, students first explore what it means to be a "buddy" as they consider their relationships with their own buddies. Students then consider different ways that plants and animals can be buddies and play a game in which they partner up with their correct animal or plant buddy. Students next look at photographs of some plants and animals they will see at the Desert Botanical Garden and make predictions about the relationships these plants and animals may have with each other.

To support the Inquiry in the Garden lesson plans, you may also use the tutorials and Virtual Habitat in DBG's Digital Desert. These interactive activities will prepare students for their investigations by teaching them about the characteristics of deserts and the Sonoran Desert habitat.

Materials

(Note: All of the following materials are provided as downloadable graphics.)

Plant and Animal Buddy Example Cards:

Squirrel
Bat
Bee
Oak Tree (with acorn inset)
Columnar Cactus Flower
Desert Flower

DBG Buddy Cards:

Saguaro Cactus
Creosote Bush
Paloverde Tree
Gila Woodpecker
Ground Squirrel
Pocket Mouse
Guide to DBG Buddy Cards

Learning Objectives

Upon completion of this activity, students will be able to…:

– describe at least two ways that plants and animals help each other.
– list at least two different plant and animals in "buddy" relationships.
– identify and say the name of the saguaro, Gila woodpecker, paloverde tree, pocket mouse, creosote bush and ground squirrel.
– make predictions about possible "buddy" relationships based on life history information of an organism.

continued

DESERT BOTANICAL garden

TEACHER'S GUIDE FOR 1ST GRADE–
INQUIRY STAGE 1 – INTRODUCTORY ACTIVITY
Plants and Animals are Buddies

Sonoran Desert

Background Knowledge:

These are concepts the educator should understand and can be found in the glossary.

Burrow	Nectar	Pollination
Hibernate	Pollen	Seed Dispersal

Activity Procedures:

1. Introduction.

Explain to students that they will be visiting the Desert Botanical Garden where they will be learning about some interesting desert plants *and* animals. This class lesson will help them prepare for that field trip. Point out that the Botanical Garden is called the Desert Botanical Garden because it is located in the desert and focuses on desert plants. Ask students if they know the name of the desert in which the Garden is located?" *The Sonoran Desert!* Ask students if anyone can describe a desert. What makes a desert a desert? Help students understand that a desert is typically *hot* and *dry*.

2. What is a buddy?

Tell students that during their trip, they will specifically be learning about desert plants and animals that are buddies. Ask students:

"What is a buddy?"

As students come up with answers to the question, acknowledge responses and help them explore the concept of buddies. Other questions you might ask to help guide their thinking include the following:

– *What does it mean to be a buddy?*

– *What are some signs of buddies?*

– *How can you tell if two people are buddies?*

As you discuss responses, emphasize the following:

– *A buddy is someone you do things for and they do things for you.*

– *Buddies often hang out together.*

– *Buddies help each other.*

continued

TEACHER'S GUIDE FOR 1ST GRADE–
INQUIRY STAGE 1 – INTRODUCTORY ACTIVITY
Plants and Animals are Buddies

Gila Woodpecker

Saguaro Cactus

3. Discuss buddies.

Ask students the following questions and discuss their answers:

– *Who here has a buddy?*

– *What do you do for your buddy?*

– *What does your buddy do for you?*

Acknowledge responses and point out that an important thing about buddies is that both buddies benefit from the relationship; each in some way does something that helps the other. Next ask:

Do you think plants and animals have buddies?

As students respond, ask them the following:

– *Can anyone think of an example of plant or animal buddies?*

– *What are some ways a plant might help an animal or an animal might help a plant?*

Students will likely have a variety of answers. Acknowledge the responses and point out that some plants and animals are indeed buddies. (If any students gave appropriate responses, use those as good examples.)

4. Discover some plant and animal buddies.

Explain that you are going to hand out some pictures of some plant and animal buddies. The pictures are examples of some common plants and animals that have "buddy" relationships with other plants or animals. Call on six students to participate and have them spread out around the room. Hand out one picture to each student and tell them not to show anyone until instructed to do so. (Try to give the buddy pictures to students not standing near one another so they will have to walk around to find their buddy.) Tell them that the object of the activity is for the correct "buddies" to find each other. Tell the buddies they can now hold their pictures up high for all to see. They should now look for and go to their buddy. The rest of the class may verbally help guide buddies to each other.

continued

TEACHER'S GUIDE FOR 1ST GRADE–
INQUIRY STAGE 1 – INTRODUCTORY ACTIVITY
Plants and Animals are Buddies

Bat

Cactus flower

5. Discuss the example buddies.

Give students time to move around the room and find each other. Once all buddies are paired, discuss each buddy pair, one at a time. Ask the following questions to help guide the discussion:

What kind of plant is this?

What kind of animal is this?

What does the _____(plant) do for the _____(animal)?

What does the _____(animal) do for the _____(plant)?

Are these two buddies?

Use the following information to aid your discussion:

Squirrel and acorn: The acorn (which is the seed of an oak tree), provides food for the squirrel.

The squirrel often buries acorns to save them for later. Many of the acorns are not recovered by the squirrel and may grow into a tree. In this way, the squirrel helps the oak tree by dispersing and planting its seeds.

Bat and cactus flower: The cactus flower (which is white and blooms at night) provides nectar (food) for the bat.

The bat helps the cactus by pollinating the flower. Flowers must be pollinated in order to produce fruit that are full of seeds. Thus, more cactus can grow.

Bee and flower: This flower (which is colorful and blooms during the day) provides nectar and pollen for the bee.

The bee helps the plant by pollinating the flower. Again, plant flowers must be pollinated in order to produce the fruit that are full of seeds. Thus, more plants can grow.

Wrap up this activity by pointing out that each of these pairs are good examples of buddies. Each helps the other. Thank your buddies and allow them to return to their seats.

6. Discovering buddies at the Desert Botanical Garden.

Commend students for their success at finding their buddies in the previous activity. Remind students that they will be going to a field trip to the Desert Botanical Garden and ask if they think they might see any of the plants or animals they just discussed. Yes, they might! Explain that you are now going to show them pictures of some more plants and animals

continued


Paloverde Tree

that are also buddies in some way. This time however, instead of pairing up the buddies, the class will ask questions and make predictions as to which plants and animals are buddies and how they might help each other. Once at the Botanical Garden, students will find out exactly how these plants and animals are buddies as they experience them up close and personal!

7. Review DBG buddy cards.

Bring out and one by one, share each of the DBG buddy cards. As you bring out each card, hold it high for all to see and read the associated information about it from the *Guide to DBG Buddy Cards*. Tell students to listen quietly as you read about each plant or animal. Each has important information you will need for the next part of this activity. Explain that when you are done, you will all come up with some questions about each plant or animal and make predictions as to which two might be buddies with each other. Ask students to hold off comments until you are done reading all the cards. The information for each card follows:

Saguaro Cactus: This is a saguaro cactus. It lives in the Sonoran Desert. In the spring, it produces large, white flowers that become succulent, red fruits after pollination. It can grow to over 40 feet tall and live around 250 years. Its body tissues are full of water. It can heal itself with a scab-like crust if it gets cut or scraped.

Creosote Bush: This is a creosote bush. It lives in the Sonoran Desert. Its leaves have a waxy coating which help it to hold water and protect it from the sun. Even when it's real hot and dry, the creosote bush survives, shading the ground with its bushy branches.

Paloverde Tree: This is a paloverde tree. Paloverdes live in the Sonoran Desert and their name means "green stick." Their stems are green because like their leaves, they can make food in their stems. Paloverde trees bloom bright yellow in the spring and produce hundreds of bean pods. Inside the bean pods are many hard seeds which are eaten by a variety of desert animals.

Pocket Mouse: This is a pocket mouse. Pocket mice are found in the Sonoran Desert where they eat lots of seeds and live in underground burrows. They are called pocket mice because they carry their seeds in their cheek pouches. They are active mostly at night. Pocket mice are hunted by many predators such as hawks, owls, and coyotes.

continued

TEACHER'S GUIDE FOR 1ST GRADE–
INQUIRY STAGE 1 – INTRODUCTORY ACTIVITY
Plants and Animals are Buddies

Ground Squirrel

Ground Squirrel: This is a ground squirrel. It is also known as the round-tailed ground squirrel and it lives in the Sonoran Desert. Ground squirrels live in underground burrows, usually at the base of small bushes. Ground squirrels eat seeds and green plants. Ground squirrels will hibernated during the coldest part of winter and will stay underground during the hottest, driest days of summer.

Gila Woodpecker: This is the Gila woodpecker. It lives in the Sonoran Desert. Like other woodpeckers, this bird uses its strong beak to dig insects out of the bark of plants. The Gila woodpecker prefers a certain desert plant in which it carves out a hole to serve as its home. Gila woodpeckers eat insects, berries, and cactus fruit.

8. Discuss DBG buddies.

Once all cards have been read and displayed, point to each plant or animal and have students say its name and ask what they recall about it. Next lead an inquiry discussion about the plants and animals. The goal of this discussion it to make predictions as to which plant/animal pairs might be buddies. Students will also generate questions that might be answered during your field trip to the Desert Botanical Garden. Use the following questions to help guide your discussion:

Which of these might possibly be buddies with one another?

In what way could they be buddies?

What else do we need to know in order to figure out which plants and animals are buddies?

Might some of these animals be buddies with more than one other plant?

How might this _____ *(plant) help this* _____ *(animal)?*

How might this _____ *(animal) help this* _____ *(plant)?*

9. Making buddy predictions and generating questions.

Prepare a table on the board using the table below as a guide (it is best to have this prepared in advance). Use the table to summarize student responses about how each plant or animal might help each other *if they were buddies.* In each cell, write how each might help the other and include questions that might need to be answered to help students better understand the possible relationships. The first cell is completed as an example:

continued

	Pocket Mouse	Ground Squirrel	Gila Woodpecker
Pocket Mouse	**Why buddies?** *The paloverde could provide food for the pocket mouse since it eats seeds. The pocket mouse might help the paloverde with protection, pollination, or seed planting.* **Questions:** *Does the pocket mouse eat all the seeds it collects? Does the pocket mouse do something to protect or pollinate the paloverde?*	**Why buddies?** **Questions:**	**Why buddies?** **Questions:**
Saguaro	**Why buddies?** **Questions:**	**Why buddies?** **Questions:**	**Why buddies?** **Questions:**
Creosote Bush	**Why buddies?** **Questions:**	**Why buddies?** **Questions:**	**Why buddies?** **Questions:**

Once the table is completed with students, review each possible buddy pairing and ask students to come up with their predictions as to which plant/animals pairings are the most likely buddies. Circle the predicted pairs where they intersect on the table.

10. Review your predictions and wrap up the activity.

Commend students for their good predictions and questions. Remind them to remember their predictions and questions in order to share these with their guide during their field trip. (It is a good idea to copy your table on paper to review with students the day of their field trip.) Remind students that they will discover the answers for themselves at the Desert Botanical Garden!

Acorn

Squirrel

Bat

Columnar Cactus Flower

Bee

Desert Flower

Saguaro Cactus

Gila Woodpecker

Creosote Bush

Ground Squirrel

Paloverde Tree

Pocket Mouse

TEACHER'S GUIDE FOR 1ST GRADE-
INQUIRY STAGE 1 - INTRODUCTORY ACTIVITY
Plants and Animals are Buddies

Related ADE Standards:

Comprehensive Health Strand 5

Concept	Performance Objective
5CH-F2. Describe characteristics needed to be a responsible friend and family member	PO 1. Explain what it means to care and be a friend

Reading Strand 3: Comprehending Informational Text

Concept 1: Expository Text	Performance Objective
Identify, analyze, and apply knowledge of the purpose, structures, and elements of expository text.	PO 2. Answer questions (e.g., who, what, where, when, why, how) about expository text, heard or read.

Writing Strand 1: Writing Process

Concept 1: Prewriting	Performance Objective
Prewriting includes using strategies to generate, plan, and organize ideas for specific purposes.	PO 1. Generate ideas through prewriting activities (e.g., brainstorming, **webbing**, drawing, writer's notebook, group discussion).

Writing Strand 3: Writing Applications

Concept 2: Expository	Performance Objective
Expository writing includes non-fiction writing that describes, explains, informs, or summarizes ideas and content. The writing supports a thesis based on research, observation, and/or experience.	PO 2. Participate in creating simple summaries from informational texts, graphs, tables, or maps. (See M01-S2C1)

Language Arts Strand 3: Listening and Speaking

Standard 3: Listening and Speaking	Performance Objective
Students effectively listen and speak in situations that serve different purposes and involve a variety of audiences.	LS-F1. Use effective vocabulary and logical organization to relate or summarize ideas, events and other information

Language Arts Strand 4: Viewing and Presenting

Standard 4: Viewing and Presenting	Performance Objective
Students use a variety of visual media and resources to gather, evaluate and synthesize information and to communicate with others.	VP-F3. Access, view and respond to visual forms such as computer programs, videos, artifacts, drawings, pictures and collages

TEACHER'S GUIDE FOR 1ST GRADE–
INQUIRY STAGE 1 - INTRODUCTORY ACTIVITY
Plants and Animals are Buddies

Related ADE Standards:

Science Strand 1: Inquiry Process

Concept 1: Observations, Questions, and Hypotheses	Performance Objective
Observe, ask questions, and make predictions.	PO 1. Compare common objects using multiple senses. PO 2. Ask questions based on experiences with objects, organisms, and events in the environment. (See M01-S2C1-01) PO 3. Predict results of an investigation based on life, physical, and Earth and space sciences (e.g., animal life cycles, physical properties, Earth materials).

Science Strand 4: Life Science

Concept 3: Organisms and Environments	Performance Objective
Understand the relationships among various organisms and their environment.	PO 1. Identify some plants and animals that exist in the local environment. PO 3. Describe how plants and animals within a habitat are dependent on each other.

Workplace Skills Strand 1

Standard 1: Students use principles of effective oral, written and listening communication skills to make decisions and solve workplace problems.	Performance Objective
1WP-F2. Respond to oral presentations by formulating relevant questions and opinions and summarizing accurately	PO 1. Recognize the content of an oral presentation PO 2. Ask questions relating to content PO 3. State opinions relating to content PO 4. Develop summary of relevant content
1WP-F3. Apply critical listening skills (e.g., listening for content, long-term contexts, emotional meaning, following directions)	PO 1. Listen effectively PO 2. Analyze/evaluate orally received information PO 3. Respond appropriately
1WP-F4. Listen to an oral presentation, evaluate, and express an opinion orally	PO 1. Recognize the content of an oral presentation PO 2. Develop summary of relevant content

Workplace Skills Strand 3

Standard 3: Students apply critical and creative thinking skills to make decisions and solve workplace problems.	Performance Objective
3WP-F2. Identify methods for initiating change	PO 1. Give examples of methods to initiate change

DESERT BOTANICAL garden

TEACHER'S GUIDE FOR SECOND GRADE-
INQUIRY IN THE GARDEN - INTRODUCTION
Desert Detectives

Monarch butterfly

What is Inquiry in the Garden?

The Desert Botanical Garden Inquiry in the Garden and on-site programs move students through different stages of the inquiry process as they learn about the Sonoran Desert. Each stage involves students in the scientific method as they observe, ask questions, make predictions, conduct field investigations, test hypotheses, analyze results and state conclusions. These lesson plans meet Arizona Department of Education Academic Standards.

- **Stage 1** – Classroom Introductory Activity- introduces students to specific concepts and vocabulary. Students will make observations leading them to ask questions which may be answered during their field investigations in the next stage of the program.
- **Stage 2** – Field Investigation- involves students in outdoor observations and actual field investigations. For most students, the field investigation is part of a fun and exciting tour at the Desert Botanical Garden. For classes not able to visit the Garden, an alternative field investigation is suggested. In both options, students conduct simple investigations and test and hypotheses they may have made.
- **Stage 3** – Final Classroom Activity- leads students through a guided discussion of their field investigation. Students will complete the inquiry process by analyzing the data and drawing conclusions from their investigations. Suggestions for student assessment are also provided.

continued…

TEACHER'S GUIDE FOR SECOND GRADE-
INQUIRY IN THE GARDEN - INTRODUCTION
Desert Detectives

Gambel's quail adult

Adult toad

Mesquite tree

What is Inquiry in the Garden?

Learning Objectives

Upon completion of this activity, students will be able to…

- list and describe the primary stages in the cycle of life.
- describe the life cycles of the butterfly, Gambel's quail, red spotted toad, and mesquite tree.
- describe at least two ways to conduct an investigation.
- identify and name a cactus wren, agave, and saguaro.
- participate in a scientific investigation using the inquiry process.

Background Knowledge:

These are concepts the educator should understand and can be found in the glossary.

Decompose **Lifecycle** **Metamorphosis**

Pups **Vegetative reproduction**

TEACHER'S GUIDE FOR SECOND GRADE-
INQUIRY IN THE GARDEN - STAGE 1
Desert Detectives

Monarch butterfly

Activity Overview

In preparation for their visit to the Desert Botanical Garden, students will first examine the concept of the life cycle using the common butterfly as an example. Students will then play a game in which they become part of the life cycle of a certain plant or animal and must find the other students who represent different stages of the same life cycle. Following a discussion about investigations, students will be introduced to three plants and animals they will be investigating during their visit to the Desert Botanical Garden. Based on their discussion, they will develop questions which may be answered during their field trip.

To support the Inquiry in the Garden lesson plans, you may also use the tutorials and Virtual Habitat in DBG's Digital Desert. These interactive activities will prepare students for their investigations by teaching them about the characteristics of deserts and the Sonoran Desert habitat.

Materials

(Note: All of the following materials are provided as downloadable graphics.)

- Life Cycle Stages Example Cards:
  - Butterfly Life Cycle Stages
  - Red Spotted Toad Life Cycle Stages
  - Gambel's Quail Life Cycle Stages
  - Mesquite Tree Life Cycle Stages
  - Desert Cottontail Life Cycle Stages

- Pictures of the following plants and animal:
  - Cactus Wren
  - Agave
  - Saguaro Cactus

continued…

TEACHER'S GUIDE FOR SECOND GRADE-
INQUIRY IN THE GARDEN - STAGE 1
Desert Detectives

Saguaro Cactus

Learning Objectives

Upon completion of this activity, students will be able to…

- list and describe the primary stages in the cycle of life.
- describe the life cycles of the butterfly, Gambel's quail, red spotted toad, and mesquite tree.
- describe at least two ways to conduct an investigation.
- identify and name a cactus wren, agave, and saguaro.

Background Knowledge:

These are concepts the educator should understand and can be found in the glossary.

Decompose **Lifecycle** **Metamorphosis**

Pups **Vegetative reproduction**

Activity Procedures

1. Introduction.

Explain to students that they will be visiting the Desert Botanical Garden where they will be seeing some very interesting desert plants. Remind them that often where there are lots of plants, there are lots of animals, too! During their field trip, they will be "detectives" as they **investigate** the life cycles of some very interesting desert plants and animals. This class lesson will help them prepare for that field trip.

2. Review characteristics of a desert.

Point out that the Botanical Garden is called the Desert Botanical Garden because it is located in the desert and focuses on desert plants. Ask students if they know the name of the desert in which the Garden is located?" *The Sonoran Desert!* Ask students if anyone can describe a desert. What makes a desert a desert? Help students understand that a desert is typically *hot* and *dry* and has *very little rainfall.*

continued…

Monarch egg

Monarch larva

Monarch pupa

Monarch butterfly

Activity Procedures

3. Discuss life cycles.

Since the trip will be focusing on life cycles, ask students:

*What is the **life cycle?***

Who (or what) has a life cycle?

Why is it called a "life cycle?"

Can someone give an example of a life cycle?

Entertain answers to the life cycle questions and lead a discussion based on students' answers. Some points to make in the discussion include:

The life cycle describes the different stages of life including birth (live or as an egg), childhood, adulthood, and reproduction (a new birth).

It is called the life "cycle" because it has no beginning and no end (cycle = circle).

It is also called a cycle because it repeats itself.

Although death is part of the life cycle, it is the reproductive stage that keeps the cycle going.

*Even in death, the cycle continues as living things **decompose** and return to the earth as soil.*

4. Review the Life Cycle of a Butterfly

Reiterate that a life cycle has no beginning and no end. The life cycle does have an order however. As an example, ask students if they can list the order of the life cycle of a butterfly. Help students come up with the stages of egg, larva, pupa, and butterfly (if necessary use the *Example Cards* as hints). As students respond correctly, hand out a *Butterfly Life Cycle Stages Example Card* to the first student who stated the stage on the card. Have the four students with the cards come to the front of the class and hold up their cards. Ask them to get in the correct order of the butterfly's life cycle. Students will most likely stand in a line to show the order. If they do, remind them that it is a life cycle so how might they stand to demonstrate that? If they do not do so on their own, help students to stand in a circle in the correct order of egg, larva, cocoon, butterfly, and egg again. Once again point out that the circle shows that there is no beginning and no end.

continued…

Newborn cottontail

Young rabbit cottontail

Adult rabbit cottontail

Activity Procedures

5. More Plant and Animal Life Cycles

Have the first four students sit down then ask the class if they think they can figure out some other plant or animal life cycles. Bring out the other *Life Cycle Stages Example Card* (Gambel's quail, mesquite, desert cottontail, and red spotted toad) and call on 14 volunteers. Randomly hand out the *Example Cards* to the student volunteers. Tell them that they each have a life cycle stage of a particular animal or plant. For the activity, they should walk around the room and group together with others in the life cycle of their particular plant or animal. When they have found all the other stages of their life cycle, they should stand together in the correct order (again in a circle).

6. Discuss the Example Life Cycles

Give students time to find and group with the others in their life cycle. If necessary, they may ask for help from the other students in the class. Once students have found their groups and are in their circles, review each life cycle and discuss the stages. Discuss the similarities and differences of the different life cycles. Involve the entire class in the discussion. You may also explain that these are real plants and animals that live in the Sonoran Desert and like all plants and animals, they have life cycles. The groups and stages are as follows:

Mesquite tree	–	seed, seedling, tree, tree with seed pods, seed
Red spotted toad	–	egg, tadpole, tadpole with legs, adult, egg
Gambel's quail	–	egg, chick, adult, egg
Desert cottontail	–	newborn, young rabbit, adult rabbit, newborn

continued…


Mesquite seeds


Mesquite seedling


Mesquite tree


Mesquite tree with pods

Activity Procedures

7. Prepare for your field trip investigation.

During your field trip, you will learn about the life cycles of several other desert plants and animals. Each of these has something special about its life cycle, and as a class, you will investigate each of these. First, ask students the following:

What does it mean to investigate and how could we investigate a plant or animal at the Desert Botanical Garden?

Discuss student responses and help student to come up with the following:

To investigate means to find the answer to a question through a system of inquiry or research.

We can investigate the plants and animals by asking the guide good questions.

We can read information in a book, online, or on signs at the Garden.

We can investigate by observing the plant or animal in question.

We can investigate by setting up an experiment to help us answer our questions.

Ask students what kinds of investigation might be most practical during their field trip. Help students understand that observing the specific plant or animal will be one of the best ways to answer their questions. Also simply asking their guide is encouraged. However, they should be sure to be prepared with good, clear questions to ask their guide. To prepare students for their investigation they will now look at a picture of each plant or animal, learn its name, and get a hint about what it is so different and special about it. The hint will help them prepare good questions to ask their guide and will also help them focus their observations.

continued…

Cactus wren

Activity Procedures

8. Cactus wren.

Hold up the picture of the cactus wren and ask if anyone knows what kind of bird it is. Explain that this is one of the animals you will be learning about during your field trip -- and will likely see. Have everyone say its name and discuss its identifying features such as its color, markings, and size (about 7 – 9 inches long). Can students name the stages of a cactus wren's life cycle? (egg, chick, adult, egg)

Given this bird's name and what is seen in the picture, where might it be found? Near cactus! If you don't see the actual bird however, you will definitely see a special sign of the bird, likely in a cactus. Ask students:

What sign of a cactus wren do you think we might see in a cactus?

Once students come up with the correct answer of "nests," commend them and tell them that that is part of their hint for their investigation on their field trip. Here is the rest of the hint:

Hint: There is something very different and special about cactus wrens' nests.

Ask students what they think might be so special about a cactus wren's nest? As students respond, point out that you will just have to discover this during your field trip. As you all discussed before, how might they investigate the cactus wren? Remind students that as previously discussed, they should take time to observe the cactus wren and/or certain cacti during their visit to the DBG. They should also come up with some good questions to ask their guide. Ask students for examples of things they might look for or good questions they might ask. Help them come up with any or all of the following:

Where do cactus wrens build their nests?

What do cactus wrens use in their nests?

Do cactus wrens build special kinds of nests?

What might we observe if we watched a cactus wren for a long time?

What's special about a cactus wren's nest?

Ask students to remember their questions. In addition to making their own observations, they should be prepared to ask their guides their questions during the field trip.

continued…

Agave

Activity Procedures

9. Agave.

Hold up the picture of the agave and ask if anyone knows what kind of plant it is. Again, explain that this is one of the plants they will see and learn about during their field trip. Have everyone say its name and discuss its identifying features such as the shape of its leaves, its growth form, and its tall stalk. Explain that they will see many different types of agaves but they will not all have the long stalk. Ask students:

Does anyone know what the stalk is for?

As students respond, commend the correct answer which is that the stalk is actually its flower stalk -- on top of the stalk are the plant's flowers. It is part of the life cycle of the agave. Can students name the stages of an agave's life cycle? As students respond to this question, their answers will likely be seed, seedling, adult plant, seed. Point out that that is just one of the agave's life cycles! Yes! This is actually their hint for their investigation about agaves. Here is the rest of the hint:

Hint: Agaves have three different types of life cycles.

Tell students that their investigation will be about finding out the three types of life cycle of the agave. Again, how might they find this out? By observing agaves during their field trip and asking their guide good questions. Do students have some ideas about how these life cycles could be different? What are some things they might observe about agaves? What are some good questions to ask their guide? Help students come up with any or all of the following:

Do all agaves look the same?

What is different about some agaves that might mean they have a different type of life cycle?

How do agaves reproduce?

Ask students to remember their questions. In addition to making their own observations, they should be prepared to ask their guides their questions during the field trip.

continued…


Saguaro

Activity Procedures

10. Saguaro.

Hold up the picture of the saguaro and ask if anyone knows what kind of plant it is. Again, explain that this is one of the plants they will see and learn about during their field trip. Have everyone say its name and discuss its identifying features such as its growth form, spines, and appearance. Can students name the stages of the saguaro's life cycle (seed, young plant, adult plant, seed)? This plant, unlike the agave, has just one type of life cycle but there is something very interesting about how it grows that you will be investigating. Here is your hint:

Hint: There is a special "rule of thumb" about how saguaros grow.

Tell students that their investigation will be about how saguaros grow. Somehow, this will be related to their thumb! Once again, ask student how they might find this out. Again discuss the importance of making observations and asking good questions of their guide. Help students come up with the following observations to make and/or questions to ask:

How tall do saguaros grow?

How long do saguaros live?

What do young saguaros look like?

How old are saguaros when they start to grow arms?

Again, ask students to remember their questions. In addition to making their own observations, they should be prepared to ask their guides their questions during the field trip.

11. Activity wrap-up.

Wrap up this activity by reviewing some of the life cycles learned. Once more, repeat the names of the plants and animal they will investigate during their field trip and ask students if they will be able to recognize them when they are at the Garden. Have students repeat some of the questions they came up with for their investigations and remind them to remember their questions so that they can make observations and ask their guides when they are on their field trip.

Related ADE Standards:

Language Arts Strand 3: Listening and Speaking

Concept	Performance Objective
C3: Students effectively listen and speak in situations that serve different purposes and involve a variety of audiences.	LS-F1. Use effective vocabulary and logical organization to relate or summarize ideas, events and other information.

Science Strand 1: Inquiry Process

Concept	Performance Objective
C1: Observations, Questions, and Hypotheses - Observe, ask questions, and make predictions.	PO 1. Formulate relevant questions about the properties of objects, organisms, and events in the environment. (See M02-S2C1-01) PO 2. Predict the results of an investigation (e.g., in animal life cycles, phases of matter, the water cycle).

Strand 2: History and Nature of Science

Concept	Performance Objective
C2: Nature of Scientific Knowledge - Understand how science is a process for generating knowledge.	PO 1. Identify components of familiar systems (e.g., organs of the digestive system, bicycle).

Science Strand 4: Life Science

Concept	Performance Objective
C2: Life Cycles - Understand the life cycles of plants and animals.	PO 1. Describe the life cycles of various insects. PO 1. Describe the life cycles of various mammals.. PO 1. Describe the life cycles of various organisms.

DESERT BOTANICAL garden

INQUIRY IN THE GARDEN

Desert Detectives

DESERT BOTANICAL garden

INQUIRY IN THE GARDEN

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Desert Detectives

DESERT BOTANICAL garden

TEACHER'S GUIDE FOR THIRD GRADE–
INQUIRY IN THE GARDEN – STAGE 1
Secrets of Desert Plants

Monarch butterfly

Activity Overview

In preparation for their visit to the Desert Botanical Garden, students first review the definition of adaptation and discuss some examples of plant and animal adaptations to the environments in which they live. Students then describe the specific environmental conditions of a desert and consider ways that the roots, stems, and leaves of desert plants are adapted to life in the desert environment. Students then read the provided *Mesquite or Saguaro? Adaptation Cards* and decide whether the adaptation described is that of a mesquite or a saguaro. Based on this initial inquiry of desert plants, students develop a list of questions to ask their guides and observations to make during their field trip.

To support the Inquiry in the Garden lesson plans, you may also use the tutorials and Virtual Habitat in DBG's Digital Desert. These interactive activities will prepare students for their investigations by teaching them about the characteristics of deserts and the Sonoran Desert habitat.

Materials

(Note: All of the following materials are provided as downloadable graphics.)

- Pictures of the following plants:

  Mesquite tree

  Saguaro

- Mesquite or Saguaro Adaptation Cards (5 cards in all)

continued…

TEACHER'S GUIDE FOR THIRD GRADE-
INQUIRY IN THE GARDEN - STAGE 1
Secrets of Desert Plants

Saguaro Cactus

Learning Objectives

Upon completion of this activity, students will be able to…

- define adaptation and give examples of plant and animal adaptations to their environment.
- describe the environmental conditions of at least two different environments.
- explain the difference between physical and behavioral adaptations and provide examples of each.
- list and describe at least three environmental conditions of a desert environment.
- list and describe the functions of plant roots, stems, and leaves.
- describe at least three adaptations of desert plants.

Background Knowledge

These are concepts the educator should understand and can be found in the glossary.

Behavioral adaptation

Environment

Environmental conditions

Investigate

Physical adaptation

TEACHER'S GUIDE FOR THIRD GRADE-
INQUIRY IN THE GARDEN - STAGE 1
Secrets of Desert Plants

Monarch butterfly

Activity Procedures

1. Introduction.

Explain to students that they will be visiting the Desert Botanical Garden where they will be discovering some fun and amazing "secrets" about desert plants. The secrets have to do with how some plants adapt to the desert environment. The following activity will help the class prepare for the field trip.

2. Review adaptations.

Since the focus of the field trip is plant adaptations, begin this activity by discussing the definition of **adaptation** and reviewing examples of adaptations to different **environments**. Some questions to help guide your discussion could include:

What is an adaptation?

Can anyone give an example of an animal's adaptation to its environment?

Can anyone give an example of a plant's adaptation to its environment?

As students respond to the questions, be sure the following points are covered as part of the discussion:

1. An adaptation is a physical or behavioral characteristic of a plant or animal that help it survive in its environment.

2. There are many examples of animals adapting to their environment including a duck's webbed feet to help it swim, a hummingbird's long bill to help it reach nectar, or a jackrabbit's long ears to help it keep cool in the hot desert.

3. There are many examples of plants adapting to their environment including a cactus's spines for protection or trees losing their leaves during the freezing winter.

4. Every environment presents specific challenges for the plants and animals that live there.

continued…

Ocean

Arctic

Rain Forest

Activity Procedures

3. As a class, complete the environmental conditions and adaptations table.

Make a table on the board using the example below as your guide. Include the headings and listings of *ocean, Arctic,* and *rainforest.* Leave the rest of the cells blank to start. Reiterate that different environments present different survival challenges for plants and animals depending on the environmental conditions. Ask students the following questions:

What are "environmental conditions?"

What are the specific environmental conditions of an ocean environment?

Environment	Environmental Conditions / Survival Challenges	Adaptations for survival
Ocean	*wet, watery environment, no free oxygen, wave action, salty, water pressure, limited visibility*	*fins for swimming, gills for breathing, some sea plants and animals attach to ocean floor, ability to extract or otherwise deal with salt, swim bladders in fish, use of sonar to detect prey*
Arctic	*extreme cold, snow, ice, no sun in winter*	*thick, warm fur, fat storage, white fur, migrate during extreme cold*
Rain Forest	*wet, warm, shady (under the canopy), wet and dry seasons, shallow soil*	*large leaves for gathering sunlight, timed blossoming (with the seasons), aerial roots, plants grow on plants (epiphytes), leaves that channel water*

Refer to the table above to help guide student's responses. Write their answers in the correct cell of the table on the board. After students have described the ocean environment, ask them to brainstorm ways that plants and animals adapt to living in the ocean environment. Write their responses in the table on the board, again using the table as a guide. Complete the rest of the table in the same manner, first considering the environmental conditions and then the adaptations for survival in that environment. (Note that the answers may be brief, with just a few adaptations for each environment to serve as examples.) Discuss environmental conditions and adaptations using the table as a guide.

continued…

Mesquite seedling

Activity Procedures

4. Behavioral and physical adaptations.

Refer to the completed table and ask students to consider which of the listed adaptations are physical and which are behavioral. Explain that a **physical adaptation** is a specific structural feature of a plant or animal's body (such as webbed feet). A **behavioral adaptation** is an action or behavior (such as migration) that helps an animal survive. Discuss student responses.

5. The desert environment.

Ask students if they can remember of the name of the botanical garden the class will be visiting. *The Desert Botanical Garden!* So what kind of environment should be expected there? *A desert environment!* Ask students to think of the **environmental conditions** associated with a desert and list those on the board. Students should at least come up with the following:

hot

dry

sunny

Lead a discussion on the desert environment. If students live in the desert, ask them to explain ways that they deal with living in the desert. *What do students do to stay cool in the summer? Do they drink more in the summer? Why?* Explain that many of the things people do to stay cool and hydrated in the desert are behavioral adaptations. During the field trip, the class will be investigating how plants adapt to our hot, dry, sunny desert environment. Do students think that these adaptations will be *behavioral* or *physical?*

Explain that the plant adaptations you will be investigating will be primarily physical, that is, they will be specific structural characteristics of the plants that help them survive and even thrive in the desert. Unlike humans, who can move into the shade, turn on an air conditioner, or pour a glass of water, plants are rooted in one place and must rely on their physical attributes to survive. Fortunately for desert plants, they have developed some amazing adaptations to deal with desert conditions!

continued…

Mesquite tree with pods

Activity Procedures

6. Plant parts.

Ask students:

What are the main structures (or parts) of plants?

Students should come up with roots, stems, leaves, and flowers. Point out that the investigations will mainly focus on the structural adaptations of plant roots, stems, and leaves. Conduct a class discussion on the purposes of each of these plant parts. To begin the discussion, ask the students, *"What is the purpose of plant roots?"* Repeat this question for each plant part and discuss student responses. Help students come up with the following:

- Roots provide support for plants (help them to stay up).
- Roots collect (or drink) water for plants.
- Stems provide structure and support for plants (hold plants up and give them their shape).
- Leaves make food for plants.
- Flowers produce seeds for plant reproduction.

continued…

Mesquite

Saguaro

Activity Procedures

7. Mesquite or Saguaro? Adaptation Cards.

Point out that the class will be focusing mainly on two desert plant species and their roots, stems, and/or leaves. These desert plants have developed some very interesting adaptations for living in the desert which the class will investigate during their field trip. Display the picture of the saguaro cactus. Ask students if anyone knows the name of this plant. Have the entire class say, "saguaro cactus." Display the picture of the mesquite tree. Ask students if anyone knows the name of this plant. Have the entire class say, "mesquite tree."

Ask students to study the two pictures and specifically consider the roots, stems, and leaves of each of the plants. Ask students to also consider the environment (desert) that these plants live in and the conditions they must deal with.

Call on five students and as they come up, hand each student one of the Mesquite or Saguaro? Adaptation Cards. Explain that one at a time, they should read their card to the class. Allow all five students to read their cards (without comments from the class) before beginning a class discussion on the mesquite and saguaro adaptations. The Adaptation Cards read as follows:

Mesquite or Saguaro? I have very deep roots that seek out water deep in the ground.

Mesquite or Saguaro? I have long, shallow roots that can quickly drink up water after a rainstorm.

Mesquite or Saguaro? I have special stems that can expand to store water.

Mesquite or Saguaro? I have tiny leaves that help conserve water.

Mesquite or Saguaro? I have no leaves but have many spines which provide protection and shade.

After all the students have read their cards, conduct a discussion by first reviewing each card and discussing the possibilities of it being an adaptation of the mesquite or saguaro. Some of the adaptations are more obvious than others. However, to find out the answers for certain, the class will be conducting an investigation at the Desert Botanical Garden. At the Garden, students will get to see desert plants up close and personal and discover their adaptations, specifically, the adaptations just discussed for saguaro and mesquite.

continued…

Saguaro

Activity Procedures

8. Prepare for your field trip investigation.

Remind students that during the field trip, they will be investigating the saguaro, mesquite and other desert plants to discover their secrets to adapting in the desert environment. Ask students the following:

What does it mean to investigate and how could we investigate plant adaptations at the Desert Botanical Garden?

Discuss student responses and help student to come up with the following:

To investigate means to find the answer to a question through a system of inquiry or research.

We can investigate by asking the guide good questions.

We can read information in a book, online, or on signs at the Garden.

We can investigate by observing the plant in question.

We can investigate by setting up an experiment to help us answer our questions.

Ask students what kinds of investigation might be most practical during their field trip – especially considering the adaptations of mesquite and saguaro just discussed. Help students understand that observing the specific plants will be one of the best ways to discover their adaptations. Also, simply asking their guide good questions is encouraged. Students should however, be sure to be prepared with good, clear questions to ask.

To help the class prepare for their field trip, have students come up with a list of at least five questions to ask their guide and at least five specific things they will look for (or observations they will make) that suggest a plant's adaptation to life in the desert environment. They should think of the *Mesquite or Saguaro?* activity as they make their lists. Write their responses on the board and consider having students copy the list or designating several students to be "keepers of the questions and observations." Be sure the class brings their lists of questions and observations on their field trip!

DESERT BOTANICAL garden

INQUIRY IN THE GARDEN

Secrets of Desert Plants

DESERT BOTANICAL garden

INQUIRY IN THE GARDEN

Secrets of Desert Plants

Mesquite or Saguaro?

I have very deep roots that seek out water deep in the ground.

Mesquite or Saguaro?

I have long, shallow roots that can quickly drink up water after a rainstorm.

Mesquite or Saguaro?

I have special stems that can expand to store water.

Mesquite or Saguaro?

I have tiny leaves that help conserve water.

Mesquite or Saguaro?

I have no leaves but have many spines which provide protection and shade.

Related ADE Standards:

Reading Strand 1: Reading Process

Concept 3: Phonics	Performance Objective
Decode words, using knowledge of phonics, syllabication, and word parts.	PO 1. Read multi- syllabic words fluently, using letter-sound knowledge. PO 2. Apply knowledge of basic syllabication rules when decoding four- or five-syllable written words.

Reading Strand 3: Comprehending Informational Text

Concept 1: Expository Text	Performance Objective
Identify, analyze, and apply knowledge of the purpose, structures, and elements of expository text.	PO 1. Identify the main idea and supporting details in expository text. PO 5. Interpret information from graphic features (e.g., charts, maps, diagrams, illustrations, tables, timelines) of expository text.

Writing Strand 1: Writing Process

Concept 1: Prewriting	Performance Objective
Prewriting includes using strategies to generate, plan, and organize ideas for specific purposes.	PO 1. Generate ideas through a variety of activities (e.g., brainstorming, graphic organizers, drawing, writer's notebook, group discussion, printed material).

Language Arts Strand 3: Listening and Speaking

Standard 3: Listening and Speaking	Performance Objective
Students effectively listen and speak in situations that serve different purposes and involve a variety of audiences.	LS-F1. Use effective vocabulary and logical organization to relate or summarize ideas, events and other information.

Related ADE Standards:

Science Strand 1: Inquiry Process

Concept 1: Observations, Questions, and Hypotheses	Performance Objective
Observe, ask questions, and make predictions.	PO 1. Formulate relevant questions about the properties of objects, organisms, and events of the environment using observations and prior knowledge. PO 2. Predict the results of an investigation based on observed patterns, not random guessing.

Science Strand 4: Life Science

Concept 1: Characteristics of Organisms	Performance Objective
Understand that basic structures in plants and animals serve a function.	PO 1. Describe the function of the following plant structures: • roots – absorb nutrients • stems – provide support • leaves – synthesize food • flowers – attract pollinators and produce seeds for reproduction

Science Strand 4: Life Science

Concept 4: Diversity, Adaptation, and Behavior	Performance Objective
Identify plant and animal adaptations in specific environments.	PO 1. Identify adaptations of plants and animals that allow them to live.

Workplace Skills Strand 1

Standard 1: Students use principles of effective oral, written and listening communication skills to make decisions and solve workplace problems.	Performance Objective
1WP-F3. Apply critical listening skills (e.g., listening for content, long-term contexts, emotional meaning, following directions)	PO 1. Listen effectively PO 2. Analyze/evaluate orally received information PO 3. Respond appropriately

DESERT BOTANICAL garden

TEACHER'S GUIDE FOR KINDERGARTEN– INQUIRY IN THE GARDEN – STAGE 2

Alternate Field Investigation

Saguaro Cactus

Activity Overview

In this investigation, students venture outside for a teacher–led, plant discovery walk in their own schoolyard. This activity is offered as an alternative field investigation for classes unable to visit the Desert Botanical Garden. The purpose of this activity is to get students outside and involved in real, hands–on field investigations about plants. It is suggested that classes first conduct the *The Magic of Desert Plants, Inquiry Stage 1– Introductory Activity* in preparation for this investigation. Although that introductory activity is primarily for classes visiting the Desert Botanical Garden, it provides foundational concepts and vocabulary which are further explored in this investigation.

Teacher Preparation

The purpose of the plant discovery walk is for students to see plants in nature that exhibit a variety of roots, stems, and leaves. It is suggested that teachers first scout the school grounds before taking the students outside. Decide on a route which would be good for a plant discovery walk. The route should include a variety of plants including trees, shrubs, and smaller forbs or grasses. It is recommended that at least three specific places or "stops" be identified along the route that would serve as focal points to discuss plant roots, stems, or leaves. The teaching stops should include a focal plant or plants that allow for the conveyance of the *Teaching Points* presented for each of the plant parts. Teachers should feel free to use more than one stop for each plant part if they are unable to find examples for all the teaching points at one stop.

TEACHER'S GUIDE FOR KINDERGARTEN-
INQUIRY IN THE GARDEN - STAGE 2
Alternate Field Investigation

Roots: Saguaro Cactus

General Procedures

Guide students on an outdoor walk following your pre–planned route. At each stop, conduct an inquiry to convey the *Teaching Points* presented for that stop. Following each discussion, conduct one or more of the suggested activities. Wrap up your walk by discussing students' discoveries and reviewing the *General Teaching Points*. When the class is back inside, review the entire investigation by walking students through the *Concluding Activity*, which replaces *Inquiry in the Garden- Stage 3*.

Note: Be sure to discuss safety issues with students prior to your walk. If there are plants that should not be touched (dues to spines or other safety reasons), be sure students are made aware of those in advance.

Plant Discovery Walk – General Teaching Points

- Plants exhibit a variety of sizes, colors, textures, and shapes.
- Three main parts of plants are the roots, stems, and leaves.
- Roots, stems, and leaves come in a variety of forms.
- Some plants have roots, stems, or leaves with special characteristics (magic).

Roots Stop

Description

The roots stop is best located near a large tree. It would be ideal (though not necessary) if there were some large tree roots exposed above ground. It is also preferable for there to be other types of plants (such as smaller shrubs and/or grasses) nearby for comparison.

Teaching Points

- Roots differ in form but provide the same function for plants.
- Roots provide support and obtain water for plants.
- Roots are like our feet and keep trees from falling down.
- The roots of plants are usually hidden underground.
- In many plants, the roots are at least as deep and wide as the part of the plant above ground.
- Some tree roots, like mesquite and cottonwood grow very, very deep into the ground.

continued…

TEACHER'S GUIDE FOR KINDERGARTEN–
INQUIRY IN THE GARDEN – STAGE 2
Alternate Field Investigation

Roots: Agave

General Procedures

Discussion and Activity Suggestions

At the roots stop, conduct an inquiry using the teaching points as your guide. Questions to help students arrive at the key points for this stop could include the following:

Does this tree have roots?

Where are this tree's roots?

What do roots do for this tree?

How are this tree's roots similar to/different from other nearby plants?

Can you point to the part of your body that is similar to this tree's roots?

After students have had a chance to discuss roots, choose and conduct one or more of the following suggested activities.

Have students…

- Stand up with feet together and arms spread wide. Tell them to keep their feet together but move their upper bodies as if they were trees swaying in the wind. Then have students spread their feet apart about shoulder width and "sway" around some more. Ask students which feels more stable, feet apart or together? How might a tree's roots be underground to give it more stability, apart or together?
- Pick a plant and draw both what they see above ground and what they think its roots look like underground.
- Find a plant that likely has small roots.
- Find a plant that likely has large roots.

continued…

Stems: Saguaro Cactus

General Procedures

Stems Stop

Description

The stems stop should offer a variety of plants with different kinds of stems. Including a cactus (if your schoolyard has any) in the stem stop would be useful. A tree at or near this stop offers the opportunity to point out its trunk and branches.

Teaching Points

- Plant stems differ in form but provide the same basic function for plants.
- Plant stems provide support and structure for plants.
- A tree's stem includes its trunk and branches.
- Some stems have special characteristics (magic) such as cactus stems which hold lots of water.

Discussion and Activity Suggestions

At the stems stop, conduct an inquiry using the teaching points as your guide. Questions to help students arrive at the key points for this stop, could include the following:

Can you point to this tree's stems?

Are all these stems alike?

How are this plant's stems similar to/different from that plant's stems?

What do these stems do for this plant?

What is different about this cactus's stems?

After students have had a chance to discuss stems, choose and conduct one or more of the following suggested activities.

continued…

TEACHER'S GUIDE FOR KINDERGARTEN-
INQUIRY IN THE GARDEN - STAGE 2
Alternate Field Investigation

Leaves: Saguaro Cactus

General Procedures

Have students…

- Find a stem they can wrap one hand around.
- Find a stem they can wrap their arms around.
- Find the largest stem (tree trunk) in the schoolyard.
- See how many children it takes to hold hands and encircle the school's largest tree.
- Find a least two stems with different textures.
- Find two different colors of stems.
- Pick a plant and draw its stems.

Leaves Stop

Description

Locate an area near which are a variety of plants with different types of leaves. Students will venture from this stop to discover the variety of leaves nearby. Look for plants that have leaves that are small, large, round, pointed, very tiny, different colored, odd shaped, etc. If there are any agave in your schoolyard discuss the point that agave have fiber in their leaves.

Teaching Points

- Plant leaves differ in form but provide the same basic function for plants.
- Leaves make food for plants.
- Some leaves have very special characteristics (magic) such as being succulent (full of water) or containing fiber.
- Some plants lose their leaves during the winter or during times of little rain.
- Some plants are evergreen and keep their leaves year–around.

continued…

Leaves: Agave

General Procedures

Discussion and Activity Suggestions

At the leaves stop, conduct an inquiry using the teaching points as your guide. Questions to help students arrive at the key points for this stop could include the following:

From where we are, how many different kinds of leaves do you see?

Can you name some ways that leaves are different/similar?

Do any of the leaves we see have special characteristics (or magic)?

Do some plants have more leaves than others?

What do leaves do for a plant?

Are there any plants with no leaves at all? Why?

After students have had a chance to discuss leaves, choose and conduct one or more of the following suggested activities.

Have students…

- Find and draw at least three different types of leaves.
- Find, draw and color at least two different colors of leaves.
- Find, feel and describe at least two different leaf textures.
- See how many different types of leaves they can find.
- Find the schoolyard plant that has the largest/smallest leaves.

continued…

TEACHER'S GUIDE FOR KINDERGARTEN-
INQUIRY IN THE GARDEN - STAGE 2
Alternate Field Investigation

Saguaro Cactus

Concluding Activity

Procedures

1. Review and discuss the students' experiences during their Introductory Activity (Stage 1).
2. Review main concepts and terms and how they applied to the *Plant Discovery Walk* (the investigation).
3. They should then consider the discoveries they made during the investigation and review their findings. What did students discover during their investigation?
4. Explain to students that an important part of science is sharing your findings with others. Discuss the value of sharing scientific information (so that others may learn from the work and to expand everyone's understanding of the subject). Scientists typically publish their work in scientific journals. Students will prepare a final presentation of their investigation to share with others, both in class and by posting online on the *DBG Journal of Student Findings*.
5. Give students time to prepare a final presentation display of their investigation. Using the information from their investigation, they may choose to create a poster, draw pictures, and/or include photographs taken during their investigation or acquired from the internet. Write a song, poem, skit or story reflecting their experience. Encourage student creativity in the display of their work. (Note: For more ideas on art projects that tie into Garden themes, go to the *Additional Resources* section of the Digital Learning website.)
6. Have students share their displays and compare their findings with the rest of the class.

Post Your Findings on the Internet!

Students may share their findings online by visiting the DBG *Journal of Student Findings* at *http://www.dbg.org/index.php/digital/students/journal*. Here, students can submit investigation findings or original art inspired by their *Inquiry in the Garden*.

TEACHER'S GUIDE FOR KINDERGARTEN– INQUIRY IN THE GARDEN – STAGE 2

Alternate Field Investigation

Related ADE Standards:

Language Arts Strand 4: Viewing and Presenting

Concept	Performance Objective
Students use a variety of visual media and resources to gather, evaluate and synthesize information and to communicate with others.	VP–R3. Create visual representations of personal experiences through media such as drawing, painting, acting and puppeteering

Science Strand 1: Inquiry Process

Concept	Performance Objective
C1: Observations, Questions, and Hypotheses – Observe, ask questions, and make predictions.	PO 1. Observe common objects using multiple senses. PO 2. Ask questions based on experiences with objects, organisms, and events in the environment.
C2: Scientific Testing (Investigating and Modeling) – Participate in planning and conducting investigations, and recording data.	PO 1. Demonstrate safe behavior and appropriate procedures (e.g., use of instruments, materials, organisms) in all science inquiry. PO 2. Participate in guided investigations in life, physical, and Earth and space sciences. PO 3. Perform simple measurements using non–standard units of measure to collect data.
C3: Analysis and Conclusions – Organize and analyze data; compare to predictions.	PO 1. Organize (e.g., compare, classify, and sequence) objects, organisms, and events according to various characteristics. PO 2. Compare objects according to their measurable characteristics (e.g., longer/shorter, lighter/heavier).
C4: Communication	PO1. Communicate observations with pictographs, pictures, models, and/or words PO2. Communicate with other groups to describe the results of an investigation.

continued…

Related ADE Standards:

Science Strand 4: Life Science

Concept	Performance Objective
C3: Organisms and Environments – Understand the relationships among various organisms and their environment	PO 1. Identify some plants and animals that exist in the local environment. PO 2. Identify that plants and animals need the following to grow and survive: • food • water • air • space

Science Strand 5: Physical Science

Concept	Performance Objective
C1: Properties of Objects and Materials – Classify objects and materials by their observable properties.	PO 1. Identify the following observable properties of objects using the senses: • shape • size PO 2. Compare objects by the following observable properties: • size

Educational Technology Strand 2: Communication and Collaboration

Concept	Performance Objective
C1: Effective Communications and Digital Interactions	PO1. Communicate with others as a whole class using digital tools.
C2: Digital Solutions	PO1. Participate in a classroom learning project using digital collaborative resources.

DESERT BOTANICAL garden

TEACHER'S GUIDE FOR KINDERGARTEN-
INQUIRY IN THE GARDEN - STAGE 3
Magic of Desert Plants

Saguaro Cactus

Activity Overview

The purpose of this activity is to move students through the completion of an investigation using the scientific process. Having previously asked questions, and made observations and comparisons, students now draw conclusions about the different parts of desert plants. After reviewing what they learned during their field investigation, students create a model of a desert plant then communicate their results with others. Students are also encouraged to submit their work for posting online at the Desert Botanical Garden website.

Materials

- Photographs and illustrations of the plants and plant parts from the Inquiry Stage 1 – Introductory Activity (saguaro, agave, mesquite and roots, stems, and leaves of each)
- Sturdy paper (construction paper, cardstock or cardboard)
- Colored paper (especially greens and browns)
- Crayons, colored markers
- Glue
- Scissors
- Items to use in model construction: string; yarn; toothpicks; fabric; pipe cleaners; straws; etc.
- Optional: *Data Collection Journal and its contents (agave fiber, cup, straw, sponge)*

TEACHER'S GUIDE FOR KINDERGARTEN-
INQUIRY IN THE GARDEN - STAGE 3
Magic of Desert Plants

Saguaro Cactus

Activity Procedures

1. Discuss the students' experiences during their trip to the Desert Botanical Garden. Tell them that in this activity, they are first going to review what they learned during their field trip. Then they are going to have fun creating one of the special desert plants they just learned about.

2. Ask students to name the three desert plants that live in the Sonoran Desert (saguaro, agave, mesquite). Show photographs of each (from the Introductory Activity). Review with students the name of the desert we live in (Sonoran Desert) and the characteristics of a desert (hot and dry).

3. Next review the three plant parts with students (roots, stems, and leaves). Show photographs of each (from the Introductory Activity).

4. Review how magic is hidden in roots. (Roots provide support for the plant. Roots collect (or drink) water for the plant.) Ask students if they remember the song "Magic of Desert Plants" from their field trip. Sing the verse about roots together. Ask students the following questions:

   "What was the magic hidden in roots?" (Roots sip water like straws!)

   "What did you collect in your magic bag to remind you of this magic?" (cup and straw)

   "How are roots different for different types of plants?" (spread out, deep, shallow)

5. Review how magic is hidden in stems. (Stems provide structure and support for plants. Cactus stems can hold water.) Ask students if they remember the song verse about stems that they learned on the field trip. Sing that verse together. Ask students the following questions:

   "What was the magic hidden in stems?" (Cactus stores water in stems!)

   "What did you collect in your magic bag to remind you of this magic?" (sponge)

   "How are stems different for different types of plants?" (thin, thick…)

continued…

Agave

Activity Procedures

6. Review how magic is hidden in leaves. (Leaves make food for plants. Some leaves contain fibers.) Ask students if they remember the song verse about leaves that they learned on the field trip. Sing that verse together. Ask students the following questions:

"What was the magic hidden in leaves?" (Agave has fiber in leaves!)

"What did you collect in your magic bag to remind you of this magic?" (agave fibers)

"How are leaves different for different types of plants?" (small, large, spiny, fibrous, succulent)

7. Instruct students to choose one of the plants they learned about: saguaro, agave, or mesquite. Explain that they will make a model of their plant and its parts using a variety of materials (review the materials available). Students should cut and glue materials onto a piece of heavy construction paper to represent the three special parts of their plant. They can also draw with crayons or markers to make their picture look like their plant. If students are able, they can write the name of their plant and label the parts. (Optional: Students can use the contents of their *Data Collection Journals* in the construction of their model.)

8. When students have finished making their plant models, divide them into small groups. Have each student share his/her picture with their group and describe which plant they chose, how each part is represented, and any other special features they included.

9. Return to a whole class discussion. Ask two students to stand in front of the class with their plant models. Call on other students to describe how the roots, stems, and leaves differ but still have similar functions. Repeat several times with different sets of students and plants.

10. Commend the class for creating such wonderful plant models, describing the three main parts of plants and their importance, and for describing differences of these parts between different plants. As a class, sing the entire "Magic of Desert Plants" song. While singing the verse about roots, stems or leaves, have students point to the correct part on their plant model.

continued…

TEACHER'S GUIDE FOR KINDERGARTEN-
INQUIRY IN THE GARDEN - STAGE 3
Magic of Desert Plants

Mesquite Tree

Activity Procedures

THEME SONG – Tune is to the song "Follow the Yellow Brick Road"

Verse 1.

Magic is hidden in plants (clap, clap)
Magic is hidden in plants (clap, clap)

La– la– la– la– la– la– la, Magic is hidden in plants. (Clap, clap)

Verse 2.

Agave has fiber in leaves (clap, clap)
Agave has fiber in leave (clap, clap)

La– la– la– la– la– la– la, Agave has fiber in leaves. (clap, clap)

Verse 3.

Cactus stores water in stems (clap, clap)
Cactus stores water in stems (clap, clap)

La– la– la– la– la– la– la, Cactus stores water in stems. (clap, clap)

Verse 4.

Roots sip water like straws (clap, clap)
Roots sip water like straws (clap, clap)

La– la– la– la– la– la– la, Roots sip water like straws (clap, clap)

Verse 5.

The Garden's a great place to learn (clap, clap)
The Garden's a great place to learn (clap, clap)

La– la– la– la– la– la– la, The Garden's a
great place to learn (clap, clap)

Post Your Findings on the Internet!

The final step of the Inquiry Process is to share your findings. One way that scientists do this is by publishing in science journals. You can share your findings by visiting the *DBG Journal of Student Findings* at *http://www.dbg.org/index.php/digital/students/journal*. Here you can submit your investigation findings or original art inspired by your Inquiry in the Garden. For more ideas on art projects that tie into Garden themes, teachers can go to the *Additional Resources* section of the Digital Learning website.

Related ADE Standards:

Language Arts Strand 3: Listening and Speaking

Concept	Performance Objective
Students effectively listen and speak in situations that serve different purposes and involve a variety of audiences.	LS–R2. Follow simple directions. LS–R3. Share ideas, information, opinions and questions. LS–R5. Participate in group discussions.

Language Arts Strand 4: Viewing and Presenting

Concept	Performance Objective
Students use a variety of visual media and resources to gather, evaluate and synthesize information and to communicate with others.	VP–R3. Create visual representations of personal experiences through media such as drawing, painting, acting and puppeteering.

Visual Arts Strand 1: Create

Concept	Performance Objective
C2: Materials, Tools, and Techniques – The student will use materials, tools, and techniques in his or her own artwork .	PO 001. Identify and experiment with materials, tools, and techniques in his or her own artwork .
C4: Meanings or Purposes • The student will express ideas to communicate meanings or purposes in artwork.	PO 001. Describe and explain his or her own artwork .

Visual Arts Strand 2: Relate

Concept	Performance Objective
C4: Meanings or Purposes – The student will interpret meanings or purposes of artwork based on contextual information.	PO 001. Interpret meanings and/or purposes of an artwork using subject matter and symbols.

continued…

Related ADE Standards:

Science Strand 1: Inquiry Process

Concept	Performance Objective
C3: Analysis and Conclusions – Organize and analyze data; compare to predictions.	PO 1. Organize (e.g., compare, classify, and sequence) objects, organisms, and events according to various characteristics. PO 2. Compare objects according to their measurable characteristics (e.g., longer/shorter, lighter/heavier).
C4: Communicate results of investigations.	PO 1. Communicate observations with pictographs, pictures, models, and/or words. PO 2. Communicate with other groups to describe the results of an investigation.

Science Strand 4: Life Science

Concept	Performance Objective
C1: Characteristics of Organisms – Understand that basic structures in plants and animals serve a function.	
C3: Organisms and Environments – Understand the relationships among various organisms and their environment	PO 1. Identify some plants and animals that exist in the local environment. PO 2. Identify that plants and animals need the following to grow and survive: · food · water · air · space

continued…

Related ADE Standards:

Science Strand 5: Physical Science

Concept	Performance Objective
C1: Properties of Objects and Materials – Classify objects and materials by their observable properties.	PO 1. Identify the following observable properties of objects using the senses: · shape · size PO 2. Compare objects by the following observable properties: · size

Workplace Skills Standard 1

Concept	Performance Objective
1WP–R1. Follow simple directions.	PO 2. Complete directed work

Workplace Skills Standard 2

Concept	Performance Objective
2M–R1. Compare and sort objects by their physical attributes.	2M-R2. Collect, organize and describe simple data.

DESERT BOTANICAL garden

TEACHER'S GUIDE FOR KINDERGARTEN-
INQUIRY IN THE GARDEN - STAGE 1
Magic of Desert Plants

Saguaro Cactus

Agave

Mesquite Tree

Activity Overview

In preparation for their trip to the Desert Botanical Gardens, students are introduced to three desert plants which they will further investigate during their field trip: the saguaro cactus, the agave, and the mesquite tree. Using graphic images, students look at and discuss the differences and similiarities of each plant's roots, stems, and leaves. Students then consider the role of roots, stems, and leaves and are introduced to the idea that during their field trip, they will learn more about the magic of these plant parts and desert plants.

Materials

Saguaro
Agave
Mesquite

Roots:

Saguaro - "Saguaro roots are very long and shallow and spread out very wide."

Agave - "Agave roots are only about as long as its leaves."

Mesquite - "Mesquite trees have many spread out roots and also have a deep "tap" root."

Stems:

Saguaro – "The stem of a saguaro is its large body and arms."

Agave – "The agave's stem is very small and mostly covered by its leaves."

Mesquite – "The mesquite's stem includes its trunk and branches."

Leaves:

Saguaro – "The saguaro is a cactus and doesn't have true leaves. Instead, it has spines."

Agave – "Agave leaves are large, and full of fibers."

Mesquite – "Mesquite leaves are very tiny."

TEACHER'S GUIDE FOR KINDERGARTEN-
INQUIRY IN THE GARDEN - STAGE 1
Magic of Desert Plants

Roots: Saguaro Cactus

Roots: Agave

Roots: Mesquite Tree

Activity Procedures:

1. Introduce students to the field trip.

Tell students that on their field trip to the Desert Botanical Garden, they are going to learn about three very special desert plants and three main plant parts. As as class, you are going to review those plants and plant parts to prepare for your trip. Encourage students to pay close attention so that when they get to the Garden, they will be able to show their guides how much they already know.

2. Review the special desert plants.

Hold up the photo of each of the special desert plants (saguaro, agave, and mesquite) one at a time. As you hold up the photo, say the plant's name then ask students to repeat the name aloud as you point out the written word. Have students make the sound of the first letter of each word. Prompt students to complete the sentence: "S is for _____!" (Repeat the process for each plant name.)

Place the pictures in a location where students can see them – preferably on a class bulletin board prepared specifically for this activity. Point out that on their field trip, they are going to learn something magic about each of these plants. The magic has to do with their special parts.

3. Review the parts of plants.

Ask students if they can name the three parts of plants (not including flowers). Encourage students to come up with "roots," "stems," and "leaves."

Call on three students to come up to the front of the class to be "roots." Tell them you are going to give each of them a picture of a special desert plant's roots and they should hold the picture up high for all to see. Hand out a "roots" picture to each student and read the cooresponding text (Note: The text is written on each of the illustrations.):

Saguaro - "Saguaro roots are very long and shallow, and spread out very wide."

Agave - "Agave roots are only about as long as its leaves."

Mesquite - "Mesquite trees have strong, wide-spread roots, and also have a deep "tap" root."

continued

Stems: Saguaro Cactus

Stems: Agave

Stems: Mesquite Tree

Ask the class, "What is the purpose of roots? What do roots do for plants?" Call on students to answer and repeat the correct answers when stated:

- Roots provide support for the plant (helps it to stay up).
- Roots collect (or drink) water for the plant.

Explain that during your visit to the Desert Botanical Garden, the class will have the opportunity to see these plant up close and learn more about the magic of their roots. Explain to students that, now that they know the purpose of roots, what other magic might they discover? Encourage students to think of some questions they could ask their guide about the magic of roots. *(Note to teachers: The purpose of this part of the activity, as with each of the following plant parts, is to guide students in asking questions as part of the inquiry process. If they are able to understand and make predictions, you could ask them to predict what the magic might be.)*

As the "roots" continue to hold up their pictures, call on three more students to come up and be "stems." Remind students to hold their pictures high as you hand them out. Hand out a "stem" picture to each student and read the cooresponding text:

Saguaro - "The stem of a saguaro is its large body and arms."

Agave - "The agave's stem is very small and mostly covered by its leaves."

Mesquite - "The mesquite's stem includes its trunk and branches."

Ask the class, "What is the purpose of stems? What do stems do for plants?" Call on students to answer and repeat the correct answers when stated:

- Stems provide structure and support for plants (hold plants up and give them their shape).

Explain that some stems also have special abilities. An example is the stem (or body) of the saguaro. You will learn about the magic of saguaro stems during your visit to the Desert Botanical Garden. Can students guess what that magic might be? (Entertain answers but smile mysteriously.) Remind students that once again, they should consider some questions they can ask their guide to learn more about the magic of stems.

continued

Leaves: Saguaro Cactus

Leaves: Agave

Leaves: Mesquite Tree

As the "roots" and "stems" continue to hold up their pictures, call on three more students to come up and be "leaves." Remind them to hold their pictures high as you hand them out. Hand out a "leaf" picture to each student and read the cooresponding text:

Saguaro - "The saguaro is a cactus and doesn't have true leaves. Instead, it has spines."

Agave - "Agave leaves are large and full of fibers."

Mesquite - "Mesquite leaves are very tiny."

Ask students if there were any words they just heard that might be new to them and need explaining. Review the word, "fiber," explaining that fibers are like threads or strings. Have students look around the room and come up with examples of fibers they see around them. Answers may include such things as clothes, shoelaces, strings, carpet, or yarn.

Ask the class, "What is the purpose of leaves? What do leaves do for plants?" Call on students to answer and repeat the correct answers when stated:

- Leaves make food for plants.

Tell students that there's also something very special (magical!) about agave leaves that they will discover during their visit to the Desert Botanical Garden. Can they guess what that magic might be? Are there some questions they can think of that will help them learn more about the magic of agave leaves at the Garden? (Again, entertain answers but smile mysteriously and explain you'll all find out on your trip.)

continued

Saguaro Cactus

Agave

Mesquite Tree

4. Group plant parts with their cooresponding special desert plants.

Ask the "roots," "stems," and "leaves" of each of the special desert plants to group together with the other plant parts from their same plant. Have each group of plant parts (the roots, stems, and leaves of each plant) go to the picture of their special desert plant (be sure you have the photos posted). Have them hold up their special desert plant parts for all to see. Ask each student point to where their plant part is on the photo of their special desert plant. (Roots can just point to the bottom of the plant.) Note: If possible, post the plant parts next to the photo of their cooresponding plant.

5. Wrap up the activity.

Review each plant and its parts. Discuss the similarities and differences of the plants and their parts. Go over the purposes of the plant parts. Remind students that during their field trip to the Desert Botanical Garden, they are going to discover something magical about each of these plants. The magic has something to do with its special parts. Do they have some good questions and/or predictions to share with their guide? Are they ready to discover the magic?

Remind students that their field trip is going to be lots of fun. It is important however, to note that just as in school, there are some rules to follow to keep everyone safe and ensure a good time for all, including others at the Garden. Review the rules with the students to help them prepare for their trip. Review the rules again on the day of your field trip.

TEACHER'S GUIDE FOR KINDERGARTEN-
INQUIRY IN THE GARDEN - STAGE 1
Magic of Desert Plants

Related ADE Standards:

Science Strand 1: Inquiry Process

Concept	Performance Objective
C 1: Observations, Questions, and Hypotheses - Observe, ask questions, and make predictions.	PO 2. Ask questions based on experiences with objects, organisms, and events in the environment.
C 3: Analysis and Conclusions - Organize and analyze data; compare to predictions.	PO 1. Organize (e.g., compare, classify, and sequence) objects, organisms, and events according to various characteristics. PO 2. Compare objects according to their measurable characteristics (e.g., longer/shorter, lighter/heavier).

Science Strand 4: Life Science

Concept	Performance Objective
C 1: Characteristics of Organisms - Understand that basic structures in plants and animals serve a function.	
C 3: Organisms and Environments - Understand the relationships among various organisms and their environment	PO 1. Identify some plants and animals that exist in the local environment. PO 2. Identify that plants and animals need the following to grow and survive: • food • air • water • space

Reading Strand 1: Reading Process

Concept	Performance Objective
C 1: Print Concepts - Demonstrate understanding of print concepts.	PO 8. Demonstrate the one-to-one correlation between a spoken word and a printed word.
C 3: Phonics - Decode words, using knowledge of phonics, syllabication, and word parts.	PO 3. Say letter sounds represented by the single-lettered consonants and vowels.
C 4: Vocabulary - Acquire and use new vocabulary in relevant contexts.	PO 1. Determine what words mean from how they are used in a sentence, heard or read.

Reading Strand 3: Comprehending Informational Text

Concept	Performance Objective
C 2: Functional Text Identify, analyze, and apply knowledge of the purpose, structures, clarity, and relevancy of functional text.	PO 1. Sequentially follow a two or three-step set of directions (e.g., recipes, center directions, classroom procedures, science experiments) using picture clues. PO 2. Identify signs, symbols, labels, and captions in the environment.

Science Strand 5: Physical Science

Concept	Performance Objective
C 1: Properties of Objects and Materials Classify objects and materials by their observable properties.	PO 1. Identify the following observable properties of objects using the senses: • shape • size PO 2. Compare objects by the following observable properties: • size

DESERT BOTANICAL garden

INQUIRY IN THE GARDEN

Magic of Desert Plants

Agave roots are only about as long as its leaves.

DESERT BOTANICAL garden

INQUIRY IN THE GARDEN

Magic of Desert Plants

The mesquite's stem includes its trunk and branches.

DESERT BOTANICAL garden

INQUIRY IN THE GARDEN

Magic of Desert Plants

Saguaro

DESERT BOTANICAL garden

INQUIRY IN THE GARDEN

Magic of Desert Plants

The saguaro is a cactus and doesn't have true leaves. Instead it has spines.

DESERT BOTANICAL garden

INQUIRY IN THE GARDEN

Magic of Desert Plants

The stem of a saguaro is its large body and arms.

DESERT BOTANICAL garden

INQUIRY IN THE GARDEN

Magic of Desert Plants

Mesquite

Mesquite leaves are very tiny.

DESERT BOTANICAL garden

INQUIRY IN THE GARDEN

Magic of Desert Plants

Agave

DESERT BOTANICAL garden

INQUIRY IN THE GARDEN

Magic of Desert Plants

The agave's stem is very small and mostly covered by its leaves.

DESERT BOTANICAL garden

INQUIRY IN THE GARDEN

Magic of Desert Plants

Mesquite trees have strong, wide spreading roots, and also have a deep ‘tap’ root.

DESERT BOTANICAL garden

INQUIRY IN THE GARDEN

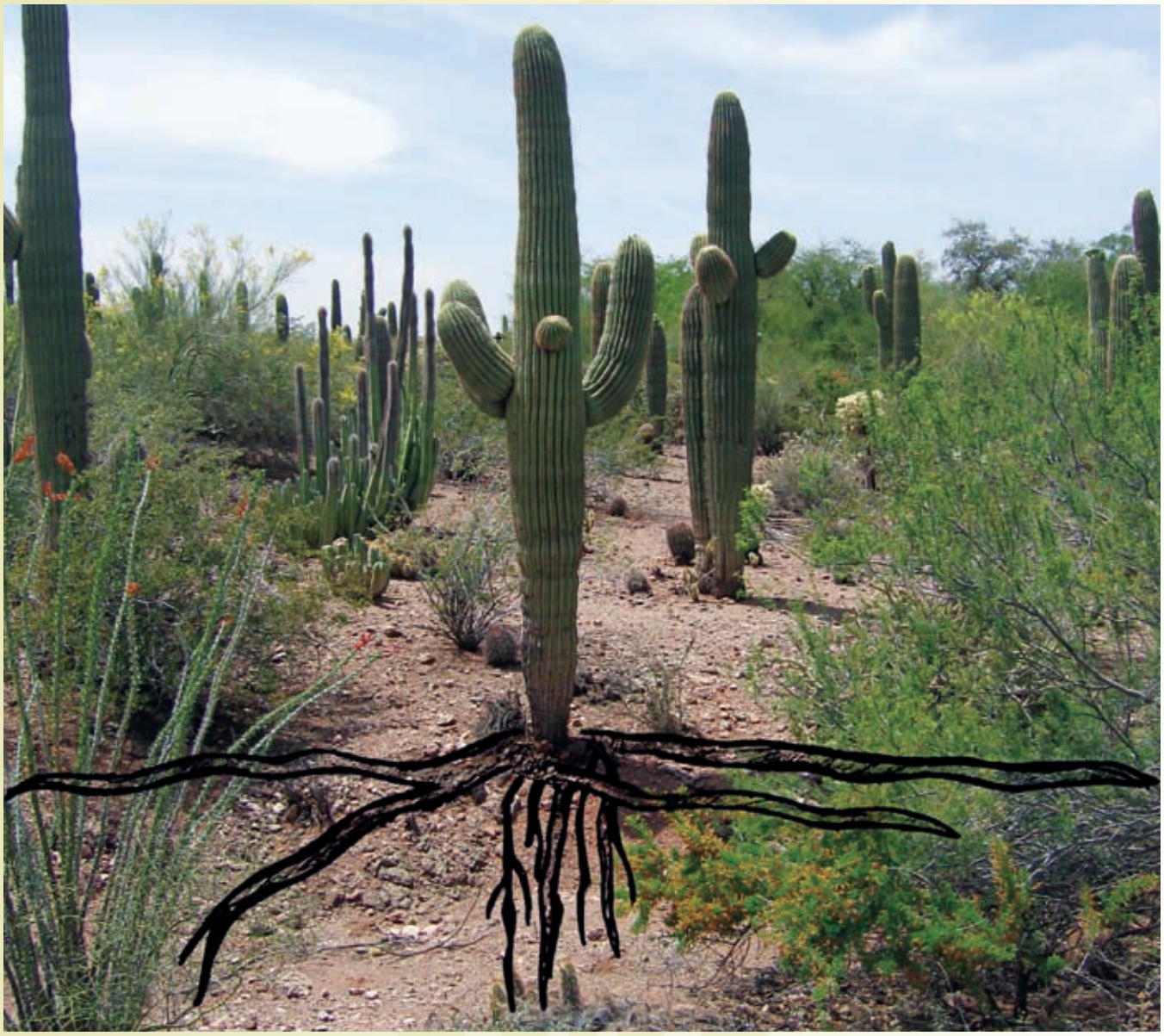
Magic of Desert Plants

Agave leaves are large and full of fibers.

DESERT BOTANICAL garden

INQUIRY IN THE GARDEN

Magic of Desert Plants



Saguaro roots are very long and shallow, and spread out very wide.