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…
Alternate Field Investigation

2.

**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*
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…
Alternate Field Investigation

**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…*
Alternate Field Investigation

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.
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…
Alternate Field Investigation

**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.
Alternate Field Investigation

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…
Alternate Field Investigation

**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…**
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.
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:
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:
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:
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?
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

<table>
<thead>
<tr>
<th>Concept</th>
<th>Performance Objective</th>
</tr>
</thead>
<tbody>
<tr>
<td>C1: Prewriting</td>
<td>PO 1: Generate ideas through a variety of activities (e.g., brainstorming, graphic organizers, drawing, writer’s notebook, group discussion, printed material).</td>
</tr>
</tbody>
</table>

### Writing Strand 3: Writing Applications

<table>
<thead>
<tr>
<th>Concept</th>
<th>Performance Objective</th>
</tr>
</thead>
<tbody>
<tr>
<td>C2: Expository</td>
<td>PO 1: Record information (e.g., observations, notes, lists, charts, map labels and legends) related to the topic.</td>
</tr>
</tbody>
</table>

### Language Arts Strand 4: Viewing and Presenting

<table>
<thead>
<tr>
<th>Standard</th>
<th>Performance Objective</th>
</tr>
</thead>
<tbody>
<tr>
<td>Students use a variety of visual media and resources to gather, evaluate and synthesize information and to communicate with others.</td>
<td>VP–E1: Analyze visual media for language, subject matter and visual techniques used to influence opinions, decision making and cultural perceptions</td>
</tr>
</tbody>
</table>
**Related ADE Standards:**

**Science Strand 1: Inquiry Process**

<table>
<thead>
<tr>
<th>Concept</th>
<th>Performance Objective</th>
</tr>
</thead>
</table>
| 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. |
Related ADE Standards:

Educational Technology Strand 2: Communication and Collaboration

<table>
<thead>
<tr>
<th>Concept</th>
<th>Performance Objective</th>
</tr>
</thead>
<tbody>
<tr>
<td>C1: Effective Communications and Digital Interactions</td>
<td>PO1: Communicate digitally with others by selecting and using a variety of appropriate communication tools.</td>
</tr>
<tr>
<td>C2: Digital Solutions</td>
<td>PO1: Contribute to a cooperative learning project and demonstrate effective group behaviors while using digital collaborative resources.</td>
</tr>
</tbody>
</table>

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

<table>
<thead>
<tr>
<th>Standard</th>
<th>Performance Objective</th>
</tr>
</thead>
</table>
| IWP–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. |