



Botanical Garden Programs: Reading Plants

LEARNING FROM LEAVES: ADAPTATION SCAVENGER HUNT



Grades 3–6

I. Introduction

All living organisms have basic needs: a source of nutrition (food), water, space in which to live, air, and optimal temperatures in order to grow and reproduce. For most plants, these needs are summarized as light, air, water, and nutrients (known by the acronym LAWN).

Plants meet their needs in different environments in a variety of ways, since the quantity or quality of different resources varies from one ecosystem type to another. This lesson enables student to apply knowledge and skills obtained in earlier lessons to a new environment.

II. Objectives

- ◆ Students will explore an environment and find an example of a variety of adaptations.
- ◆ Based on observations of leaves and prior measurements, students will make inferences about the environmental variables that might contribute to differences in leaf appearance.

III. Standards Assessed

Grades 3–5

Life Sciences

Science Content Standards K–12 (2000), California State Board of Education

- ◆ Plants have structures that serve different functions in growth, survival, and reproduction (3-3.a).
- ◆ Students know examples of diverse life forms in different environments, such as oceans, deserts, tundra, forests, grasslands, and wetlands (3-3.b).

Grades 3–5 (cont.)

- ◆ Ecosystems can be characterized by their living and nonliving components (4-3.a).
- ◆ In any particular environment, some kinds of plants and animals survive well, some survive less well, and some cannot survive at all (4-3.b).

The Living Environment

Benchmarks for Science Literacy (1993), American Association for the Advancement of Science

- ◆ In any particular environment, some kinds of plants and animals survive well, some survive less well, and some cannot survive at all (5.D. 3–5).

Grades 6–8**Life Sciences**

Science Content Standards K–12 (2000), California State Board of Education

- ◆ The number and types of organisms an ecosystem can support depends on the resources available and on abiotic factors such as quantities of light and water, a range of temperatures, and soil composition (6–5.e).

The Living Environment

Benchmarks for Science Literacy (1993), American Association for the Advancement of Science

- ◆ Animals and plants have a great variety of body plans and internal structures that contribute to their being able to make or find food and reproduce (5.A 6-8).

IV. Background

While at the Huntington Botanical Gardens, your class will visit three different gardens: the Desert Garden, Lily Ponds, and the Jungle Garden. Each of these gardens represents a distinct plant community in which plants exhibit **adaptations** to the unique conditions of their local **environment**.

Plants meet their needs in different environments in different ways, since the quantity or quality of resources varies from one ecosystem type to another. In order to appreciate the complexity of natural communities and make comparisons between them, students need to understand the basic needs of living organisms and how these resources are obtained.

As in the other **Learning From Leaves** lessons, this exercise explores leaf adaptations observed in different environments.

Leaves contain chloroplasts where photosynthesis occurs. During photosynthesis, chlorophyll (the green pigment contained in chloroplasts) captures the energy of sunlight and transfers it to other molecules within the chloroplast. There, radiant energy from sunlight, carbon dioxide from air, and water and nutrients absorbed by the roots are combined to make glucose (sugar). Oxygen is a byproduct of

photosynthesis and is used by most living things (including plants) to carry on respiration.

Adaptations to dry, hot, sunny environments:

In dry, hot, sunny environments, water is often a **limiting factor**. Adaptations to limited water availability include:

- ◆ Succulence (for water storage)
- ◆ Small leaf size or no leaves (to reduce water loss)
- ◆ Gray leaves (to reduce heat absorption; also hairs may trap moisture and increase the humidity around the **stomata**, thus slowing **transpiration**—transpiration occurs faster when the humidity of the air is low)
- ◆ Waxy leaf surfaces (helps keep moisture inside leaves and stems)
- ◆ Thorns or spines deter **herbivores** from eating stems or leaves to obtain nutrition or water
- ◆ Deep roots for obtaining water from underground reserves, or
- ◆ Shallow spreading roots to capture any available moisture

Overheating can also be a problem for many plants in dry, hot environments. Adaptations to overheating include:

- ◆ Small, narrow leaves (don't get as hot as large, wide leaves)
- ◆ White or gray leaves (to reduce heat absorption)
- ◆ Upright leaves (less surface area exposed to sun at hottest time of day, so leaves don't get as hot)

Adaptations to moist, shady environments:

In moist, shady environments, light may be a limiting factor. Adaptations to limited light availability include:

- ◆ Large, wide leaves (large surface area for absorbing any available light in order to enhance photosynthesis)
- ◆ Dark green leaves (dark pigments absorb more radiant energy used in photosynthesis)
- ◆ Horizontal leaves (arranged to capture any available sunlight)

Adaptations to wetland environments:

- ◆ Spongy tissue in stems and leaves (enables oxygen to diffuse to the roots)
- ◆ Openings in bark (allow oxygen to penetrate and diffuse to the roots)
- ◆ Floating, horizontal leaves (capturing sunlight for photosynthesis)
- ◆ Emergent leaves (capture more sunlight than submerged leaves and may be larger)

V. Materials (for each pair of students)

- ◆ *Leaf Adaptation Scavenger Hunt* sheets
- ◆ clipboards
- ◆ pencils or pens
- ◆ bags in which to place specimens

VI. Procedure

Guide your students through a discussion of the needs of living things. Discuss photosynthesis, transpiration, and limiting factors. Ask students to compare and contrast the environmental variables found in deserts, tropical rain forests, and wetlands.

1. Choose a locale with a variety of plants from different environments. This activity could be done on the schoolyard if it is adequate, or at a local park (obtain permission to collect leaves ahead of time from authorities).
2. Provide each pair of students with *Leaf Adaptation Scavenger Hunt* sheets, clipboards, pencils, and collection bags.
3. Give students a set time to obtain specimens and return for discussion (30–45 minutes recommended).
4. Sort the plants based on whether you think they came from a hot, dry, sunny environment; a moist, shady environment; a wetland environment; or another environment (depending on site selected).

VII. Discussion Questions

1. How many of the plants have adaptations to a hot, dry, sunny environments? What adaptations were observed?
2. How many of the plants have adaptations to moist, shady environments? What adaptations were observed?
3. How many of the plants have adaptations to wetland environments? What adaptations were observed?
4. What do you think the limiting factors are in each of these habitats?

VIII. Discussion Questions Related to *Reading Plants*

After your visit to the Huntington Botanical Gardens, explore the following question:

1. How do the adaptations observed on your scavenger hunt compare with those observed in each of the three gardens on the tour?

IX. Web Links

Sammy Saguaro's Scrapbook: Desert Botanical Garden

Innovative site looking at plant adaptations to arid environments

< <http://www.dbg.org/Education/sammy/>>

The Tough Cactus: AskERIC (Syracuse University)

Experiments that focus on plant adaptations to arid environments.

< <http://ericir.syr.edu/cgi-bin/printlessons.cgi/Virtual/Lessons/Science/Botany/BOT0089.html>>

Yummy Plant Parts: Discovery School (The Discovery Channel)

General look at plant parts with emphasis on adaptations.

< <http://school.discovery.com/lessonplans/programs/plantparts>>

Unique Plants of the Biomes: Discovery School (The Discovery Channel)

Lesson on biomes and plants' adaptations to specific conditions.

< <http://school.discovery.com/lessonplans/programs/plantsofthebiomes>>

Adaptation and Survival: Lessons (Schoolsnet)

Interesting activity on adaptations in different habitats (plants and animals).

< <http://www.schoolsnet.com/cgi-bin/inetcgi/schoolsnet/revision/revision.jsp?KEY=sci045>>

Vocabulary

<i>adaptation</i>	a change in plants and animals over many generations in response to environmental conditions
<i>environment</i>	conditions; all the conditions around a plant or an animal, such as, amount of space in which to live, climate, other plants and animals, etc.
<i>herbivore</i>	a living thing that eats plants
<i>limiting factor</i>	an environmental aspect that limits the success of one or more organisms in a given community or ecosystem, acting to restrict one or more of its functions.
<i>stoma (pl. stomata)</i>	a very small pore in the surface of a leaf (oxygen and carbon dioxide from the air enter through the stomata; oxygen, carbon dioxide, and water vapor leave through the stomata)
<i>succulence</i>	having water-storing tissue
<i>transpiration</i>	the loss of water vapor by plant parts that occurs mostly through pores (stomata) on the leaf surfaces

Leaf Adaptation Scavenger Hunt

Names: _____ Date: _____

Find a plant that has:

- succulent leaves
- leaves covered with white hairs
- leaves covered with a light-colored wax
- leaves that are oriented vertically
- leaves that are oriented horizontally
- small leaves
- large leaves
- no leaves
- thorns or spines
- leaves with a large length to width ratio
- leaves with a small length to width ratio
- a height greater than 20 feet
- deep roots
- shallow roots
- spongy tissue in stems or leaves