



Botanical Garden Programs: Reading Plants

MAKING COMMUNITY MEASUREMENTS: WHICH PLANT PART?



Grades 3–6

I. Introduction

Plants, like all other 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).

In this lesson, students will identify a plant in a given community and make a variety of measurements, preferably during two different seasons. Students will determine how a plant meets its basic needs. In addition to identifying plant parts, students will observe seasonal change (growth, leafing out, flowering, etc.) and make comparisons between plants within a community.

II. Objectives

- ◆ This series of activities enables students to explore the concept of plant communities and their processes.
- ◆ In this activity, students will learn how to look at plant parts during different seasons in order to gain a better understanding of environmental effects on plants.
- ◆ By comparisons and analysis of results, students can learn valuable skills in how to transform an observation into concrete data.

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).
- ◆ Plants have structures for gas exchange (photosynthesis and respiration) and transport of materials (5.2.a).

Investigation and Experimentation

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

- ◆ Scientific progress is made by asking meaningful questions and conducting careful investigations. As a basis for understanding this concept . . . students should develop their own questions and perform investigations (3.5, 4.6, 5.6).

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).
- ◆ Plant cells have chloroplasts, in which photosynthesis takes place, as well as cell walls (7-1.b).
- ◆ Mitochondria liberate energy for the work that cells do and that chloroplasts capture light energy for photosynthesis (7-1.d).

Investigation and Experimentation

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

- ◆ Scientific progress is made by asking meaningful questions and conducting careful investigations. As a basis for understanding this concept... students should develop their own questions and perform investigations (6.7, 7.7, 8.9).

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. This activity links the basic needs of plants with plant parts.

Review the parts of a plant and their main functions:

Basic Plant Parts	Functions
Roots	anchorage; uptake of water, minerals, and other nutrients
Stems	support; transport of water and nutrients; photosynthesis in some stems
Leaves	photosynthesis (plants are able to make sugar inside the green chloroplasts found in leaves and some stems)
Flowers or cones	reproduction

Guidelines for discussion about basic needs of living things (including both plants and animals): What does an organism need in order to survive and grow?

◆ Light and warmth

How does the organism use light? Does it use light for photosynthesis? Does it use light for warmth? Does it live only within a range of temperatures? How does it deal with temperature extremes?

◆ Air

How does the organism obtain oxygen in order to respire (assume aerobic respiration, in which oxygen is used to break down glucose into carbon dioxide and ATP= energy)? Does it use carbon dioxide for photosynthesis? How does it get air?

- o Stomata?
- o Absorption through surface cells or other modified body parts?
- o Lungs with nasal openings?
- o Gills?
- o Spiracles?

◆ Water

How does the organism get water? Water serves as a medium for nutrient transfer within the body, as a medium for metabolic reactions, and provides structural support for individual cells.

◆ Nutrition or food

How does the organism get nutrition or food? Nutrients are used to construct living tissue and to carry on metabolic processes. Which body parts are used?

- o Can it make sugar and actively take up other nutrients?
- o Does it see its food?
- o Does it move towards its food?
- o Does it catch its food? With what part of the body?
- o Does it eat with same part as it catches food or a different part?

V. Materials

- ◆ suitable site for study suggestions:
 - o schoolyard (lawn, **shrubs**, trees)
 - o community garden
 - o park
 - o field
 - o natural plant community
- ◆ magnifiers (one for each student is ideal)
- ◆ plastic bags for collecting samples
- ◆ marking pens
- ◆ data sheets (see below)
- ◆ rulers and measuring tapes
- ◆ weatherproof marking tags

VI. Procedure

Guide your students through a discussion of the plant parts and the needs of living things. Then take the students to the chosen study site. To become familiar with the plants inhabiting the community, each pair of students should be assigned to investigate either one plant or one area. Students will describe a plant in detail during two seasons (they should return to the same plant during the second season and make the same measurements again), followed by examining the plant and determining which plant part is used to obtain which basic plant need.

First scenario—students investigating one plant

1. Select a plant you would like to investigate in detail. You will return to make similar measurements of this plant at a different season.

2. Use the **Plant Data Sheet** at the end of this lesson plan to measure, de-scribe, and draw the various parts of your plant.
3. Use the **Plant Needs** data sheet at the end of this lesson plan to explore how you think the plant obtains each of its basic needs. Be sure to notice the subtleties that are evident in plants every day. Examples:
 - o Notice which parts are green due to **chlorophyll**. All have the capacity to make sugar.
 - o Some trees lose their leaves in fall. If measurements are being made in winter, then the plant may not be carrying out photosynthesis at all during that time.

Second scenario—students investigating an area
(use this only if the area seems homogenous, such as a lawn or field)

1. Pairs of students should be assigned to investigate different locations within an environment (a grid in a lawn, for instance). Within that small location, students should pick one plant to investigate in detail. Then follow directions 2 and 3 as above.

For both scenarios, a class chart could be then made that summarizes the student data. For instance, number of different trees, shrubs, **herbaceous** flowering plants (including grasses) can be graphed, along with height of plant. Another chart can be made for number of total plants with leaves or flowers at that season. Other possibilities include leaf size, shape, etc.

Sample Class Chart

Date: 12/5/2002	Team 1	Team 2	Team 3	Etc.	Total	Average
# tree species (types)	4	6	1		11	3.67
# shrub species (types)	8	4	7		19	6.33
# herbaceous flowering plants	15	12	21		48	16
# ferns	0	1	0		1	0.33
Other	1 moss	0	1 moss		2	0.66
# trees with leaves, etc.	3	3	0		6	2
# plants with flowers	2	1	1		4	1.33
# plants using leaves for photosynthesis	18	19	27		64	21.33
# plants using stems for photosynthesis	2	1	3		6	2

Use summary discussion with students to arrive at the following synopsis:

Plants Needs—which body part?

- ◆ **Light:** Solar radiation (light energy) is the source of energy for photosynthesis; the sun also heats the plant to a level in which metabolic activity can take place; sun heats the soil which allows for root growth
- ◆ **Air:** CO₂ enters through leaf and stem stomata, used to make glucose; O₂ as byproduct of photosynthesis, enters through leaf and stem stomata and also through roots, used for respiration
- ◆ **Water:** Roots absorb; stems and leaves can store water (succulence); leaves can be modified to slow water loss
- ◆ **Nutrition:** Leaves are the center of photosynthesis for most plants, a process in which glucose is made; other nutrients are absorbed by the roots from the soil; stems hold leaves in an optimal place for light absorption

VII. Discussion Questions

1. How would you characterize the community you are studying? Do trees, shrubs, or grasses dominate it?
2. What was the most striking observation you made about your plant? For example, what was the first thing you noticed about it?
3. How does your plant obtain water? Do you think the roots are deep or shallow? Why?
4. How does your plant obtain air? Which parts need air? (*All parts do for respiration, leaves or stems need carbon dioxide from air for photosynthesis.*)
5. How does your plant utilize sunlight? Which parts are used for photosynthesis?
6. What is the plant able to obtain from the soil? What measurements do you think you could make to verify this?
7. What changes do you expect to observe when you return to investigate your plant further in ___ months?

When returning for second investigation in a different season:

1. Compare your plant between the two seasons. What things are the same about your plant during the two seasons? What things are different?
2. Does the plant continue to obtain its needs in the same way?

VIII. Discussion Questions Related to *Reading Plants*

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

1. Compare the plants from your study site with the plants in each of these gardens. Do the plants in the Jungle Garden use the same body parts to obtain their needs as the plants at your study site? (*For instance, epiphytes may be observed in the Jungle Garden; epiphytes' roots are still utilized for obtaining water, but students may have to think about this to draw this conclusion.*)
2. Do the plants in the Desert Garden use the same body parts to obtain their needs as the plants at your study site? (*For instance, cacti and other stem succulents use stems for photosynthesis, and usually not leaves.*)
3. Do the plants in the Lily Ponds use the same body parts to obtain their needs as the plants at your study site? (*For instance, lotus and papyrus use spongy stem tissue (aerenchyma) that occurs above the water level to obtain and transport oxygen to the roots.*)

IX. Extension Activities and Web Links

See the lesson plans **Making Community Measurements: Abiotic Factors** and **Making Community Measurements: Biotic Factors**.

Great Plant Escape (University of Illinois at Urbana-Champaign)

“Plantenstein is the Suspect” and “Mysterious Parts that Surprise!”

Online “cases” to solve involving plant parts.

< <http://www.urbanext.uiuc.edu/gpe/case4/case4.html>> (online mysteries)

< <http://www.urbanext.uiuc.edu/gpe/tg>> (teacher guide)

Smithsonian in Your Classroom(Smithsonian Institution)

“Plants and Animals: Partners in Pollination”

Lessons showing the relationships between plant parts and pollinators.

< <http://educate.si.edu/resources/lessons/siyc/pollen/start.html>>

DiscoverySchool.com (The Discovery Channel)

“Plant Pollination”

Lesson on flower structure and pollination.

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

Vocabulary

<i>community</i>	all the organisms living together in a common environment and interacting with one another
<i>herbaceous</i>	a plant with little or no wood
<i>nutrient</i>	a necessary ingredient for a plant's growth and survival, such as nitrogen or potassium
<i>shrub</i>	multibranched plant which remains under 20 feet in height at maturity
<i>succulence</i>	having water-storing tissue

Making Community Measurements: Plant Parts Plant Data Sheet

Name: _____ Date: _____

Describe the community you are investigating:

Name of plant (if known):

Plant Description

◆ **Average height & width of mature plant**

Shape (*draw on the back of this paper*)

Look at the outline of the **entire plant** (its profile). What is its overall shape? Describe or draw. Are **roots** visible? If so, describe them and/or draw them. Describe the **stems** of this plant (one trunk, many trunks, intricately branching, thorny, etc.). All plants have stems, so look carefully (hint: leaves are always attached to the stem).

Height _____

Measure and write down the height of this plant, if possible.

Width _____

Describe the **stems** of this plant (one trunk, many trunks, intricately branching, thorny, etc.). All plants have stems, so look carefully (hint: leaves are always attached to the stem). If a trunk is present, obtain the diameter at breast height (this is often referred to as dbh) as follows: Measure the circumference of the tree 4 feet above the ground. Diameter at breast height can then be calculated by using the following formula (diameter = circumference/p).

Making Community Measurements: Plant Parts Plant Data Sheet

◆ **Leaves**

Shape _____

Size _____

Color _____

Pattern of attachment? (one per node, two per node, etc.)

◆ **Flowers (if present):**

Shape _____

Size _____

Color _____

Number of flowers per stem: _____

Where are flowers located on the plant? _____

◆ **Fruits or cones (if present):**

Shape _____

Size _____

Where are fruits/cones located on the plant? _____

◆ **Other diagnostic features:**

Making Community Measurements: Plant Parts Plant Data Sheet

Name: _____ Date: _____

Name of plant (if known): _____

Plant community: _____

Which part of the plant is used to obtain the given resource? Describe for both winter and summer.

	Roots		Stems		Leaves		Flowers / Fruits	
	Winter	Summer	Winter	Summer	Winter	Summer	Winter	Summer
Light								
Air								
Water								
Nutrients								