



Botanical Garden Programs: Reading Plants

MAKING COMMUNITY MEASUREMENTS: BIOTIC FACTORS



Grades 3–6

I. Introduction

In this lesson, students will identify a local plant community and make a variety of measurements, preferably during two different seasons. Students will identify an individual organism, a species, and a population within the study community. Next, students will identify biotic factors at the site and attempt to characterize the site's species diversity. Finally, they will characterize the community as a whole based on their measurements.

II. Objectives

- ◆ This series of activities enables students to explore the concept of plant communities and their processes.
- ◆ Students will use the scientific processes of observation, classification, data collection, and analysis to explore life science concepts related to species diversity, as well as gain skills in characterizing the biological life of a given environment.

III. Standards Assessed

Grades 3–5

Life Sciences

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

- ◆ Ecosystems can be characterized by their living and nonliving components (4-3.a).

Grades 3–5 (cont.)

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).

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

- ◆ In all environments—freshwater, marine, forest, desert, grassland, mountain, and others—organisms with similar needs may compete with one another for resources, including food, space, water, air, and shelter. In any particular environment, the growth and survival of organisms depend on the physical conditions (5.D 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.

A **community** is made up of plant and animal populations living together in a common environment and interacting with each other. **Environment** includes all the living (**biotic**) and nonliving (**abiotic**) aspects. Differing plant communities have unique biological, chemical, and physical characteristics. Abiotic factors that govern plant community distribution include climate, geology and soils, shade/sunlight conditions, topographic position, elevation, latitude, and others. Biotic factors include the associated plants, animals, fungi, and microorganisms, and their interactions.

Within each community, there are many **habitats** for given organisms. These habitats range in size considerably, depending on the species and the size of its local population. A **population** is comprised of members of the same species living in the same place at the same time. A **species** is a group of organisms that are able to breed together and produce offspring that can also breed with members of the same species.

In addition, plants can be characterized by their form (or habit). Woody plants produce growth both upwards (growth from the stem tips) and outwards (increase in circumference by producing growth in rings) and include trees and shrubs. In general, **trees** have one main trunk and are over 20 feet high at maturity. **Shrubs** often have several to many main trunks and are less than 20 feet in height at maturity. **Herbaceous** plants are non-woody and include those with conspicuous flowers as well as those with inconspicuous flowers. Herbaceous plants with conspicuous flowers often have showy petals or other parts, and encompass a broad range of plants from poppies to buttercups to primroses. Herbaceous plants with inconspicuous flowers include grasses, sedges, rushes, and others. **Grasses** are very common in schoolyards and have leaves with parallel veins, jointed stems, slender sheathing leaves, and inconspicuous green flowers with unique arrangements of parts.

V. Materials Needed

- ◆ suitable site for study
 - suggestions:
 - school yard (lawn, shrubs, trees)
 - community garden
 - park
 - field
 - natural plant community
- ◆ magnifiers (one for each student is ideal)
- ◆ plastic bags for collecting samples
- ◆ small spade or shovel
- ◆ marking pens
- ◆ rulers and measuring tapes
- ◆ weatherproof marking tags
- ◆ rope (9 meters)
- ◆ paper
- ◆ pencils
- ◆ clipboards
- ◆ data sheets (see below)
- ◆ field guides
- ◆ ball or hula-hoop

VI. Procedure

Guide students through a discussion of plant communities, habitats, populations, species, and individual organisms. Introduce the concepts of biotic and abiotic factors. Explain that they will be visiting a site and making community measurements. (If the site is the schoolyard lawn, it can be called the schoolyard community.)

Students can work in teams to make a variety of measurements (see also data sheet at end). To ensure that measurements are a good characterization of the site as a whole, you can employ a couple of techniques. One is to create a grid using a measuring tape and assign students in incremental units to take measurements at a given site. The other technique is a random method: give students a hula-hoop and have them toss them from the perimeter of the site. Wherever it lands, that is where they make the measurements.

1. Ask students to work in groups in their study area to find examples of the following:
 - a. an individual plant
 - b. a population of the same plant
 - c. two different species of plants
 - d. an individual animal
 - e. a population of the same animal
 - f. a plant habitat
 - g. an animal habitat (ants, earthworms, birds, etc.)
2. Biotic characteristics of the site can be recorded in a variety of ways:
 - a. One pair (or more) of students should be assigned to record the number of different kinds of living things they observe at the site. A complete checklist can be compiled. Unknown plants can be called Unknown plant #1, Unknown plant #2, etc. Back in the classroom, students can be introduced to field guides to aid in identification. A summary can be prepared that includes the number of plant types (species) with different forms (habits) such as trees, shrubs, grasses, non-woody flowering plants, along with animals such as insects, birds, etc. This can easily be tied into a unit on classification of living things.
 - b. Introduce the term “**diversity**.” Diversity means variety, and in the context of species diversity within a plant community, it refers to the number of different types of plants and animals (species). It can also refer to the diversity of habitats as well. We will examine plant species diversity at the study site.
3. Students can be introduced to plot sampling. Explain that the goal is to measure the number of different plants in a plot, as well as their abundance. Abundance can be measured by number of individuals or by area covered.
 - a. Divide students into teams of 4.

- b. Pick a spot in the schoolyard. Each team should throw a ball out into the yard (over your head backwards might be a good way to go to ensure randomness).
 - c. After the ball has landed and is stationary, place the rope in a circle around the ball, laying it on the ground, on top of the vegetation.
 - d. Have students record the number of different plant species in each plot, along with an estimate of coverage by each species.
4. Summarize all data and ask each group to prepare a presentation to the class that describes the study community.

VII. Discussion Questions

1. How would you characterize the community you are studying? Do trees, shrubs, or grasses dominate the area?
2. How many individuals did you observe in your study site? How many populations? Species?
3. Would you characterize this site as being rich in species or poor in species? Why?
4. What plant community in the wild do you think your study site resembles? Do you think species diversity between the two communities is similar?
5. Which community (your site or the similar natural community) would most easily be disrupted by disease or pests? Why?
6. Why is diversity important? (In general the higher the species diversity at a site, the more complex the food chains and webs. Further, genetic diversity is important in species survival; the more diverse populations tend to contain some individuals with characteristics that may be essential in survival if there are changes in the environment.)

When returning for second investigation in a different season:

1. Compare the same plants between the two seasons. What changes are observed?
2. What things are the same about this community during the two seasons? What things are different?

VIII. Discussion Questions Related to *Reading Plants*

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

1. What plant forms dominate in the Jungle Garden? (*Woody plants, trees and shrubs, as well as vines.*) Why do you think this is?
2. What plant forms dominate in the Desert Garden? (*Low-growing shrubs, few*

- trees, herbaceous plants, include succulent cacti and euphorbia.) Why do you think this is?
3. What plant forms dominate in Lily Pond Garden? (Some trees by edge of pond, many herbaceous plants such as sedges including *Papyrus*, rushes, grasses, cattails, and water-lilies, and others.) Why do you think this is?
 4. Which of these environments has the greatest species diversity?

IX. Extension Activities and Web Links

Ask students to repeat this exercise in some area near home as a special project.

Have students make a plant collection, pressing specimens, and labeling them.

Ask students to research some natural communities in the wild that are similar to their study site and compare results—the dominant plant form in the communities (trees, shrubs, grasses, etc.), species diversity, rare taxa, etc.

Compare results of research on three communities studied at the Huntington (freshwater aquatic habitats, deserts, and tropical rain forests) with your study site.

Living Things: Units of Study (Franklin Institute of Science)

Nice synopsis of community ecology terms with links to other lessons.

< <http://www.fi.edu/tfi/units/life/life.html> >

Food Chains: How the World Works (BrainPOP)

Kid-friendly animations and information about science, health, & technology.

< <http://www.brainpop.com/science/ecology/foodchains> >

Growth and Development: Wisconsin Fast Plants (University of Wisconsin)

Germination experiments using Fast Plants.

< http://www.fastplants.org/resources/lifecycle/growth_development.html >

Vocabulary

| | |
|---------------------------|---|
| <i>abiotic</i> | nonliving, as opposed to biological or biotic |
| <i>biotic</i> | relating to life; the living components of an environment |
| <i>community</i> | all the organisms living together in a common environment and interacting with one another |
| <i>diversity</i> | variety; the number of different species of plants and animals or types of habitats |
| <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>grass</i> | an herbaceous plant with parallel veins, jointed stems, slender sheathing leaves, and inconspicuous green flowers |
| <i>habitat</i> | the natural area in which an individual, species, or population lives |
| <i>herbaceous</i> | non-woody plants which do not grow outwards, may or may not produce conspicuous flowers |
| <i>population</i> | members of the same species living in the same place at the same time |
| <i>shrub</i> | multibranched plant which remains under 20 feet in height at maturity |
| <i>species</i> | a group of organisms that are able to breed together and produce offspring that can also breed with members of the same species |
| <i>tree</i> | woody plant, usually with one main trunk, which reaches more than 20 feet in height at maturity |
| <i>woody</i> | plants which grow outwards, increasing in circumference |

Describe the appearance of three common plants in this habitat.

| | | |
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| Plant 1 (name, if known): | | |
| Height: | | Make a drawing of any flowering/ fruiting structures you find on this plant: |
| Width: | | |
| Leaves (size, color, shape): | | |
| Flowers: | | |
| Fruits: | | |
| Make a drawing of the profile of this plant: | | Make a drawing of a small branch of this plant, including leaves and stems: |

| | | |
|---|--|--|
| Plant 2 (name, if known): | | |
| Height: | | Make a drawing of any flowering/ fruiting structures you find on this plant: |
| Width: | | |
| Leaves (size, color, shape): | | |
| Flowers: | | |
| Fruits: | | |
| Make a drawing of the profile of this plant: | | Make a drawing of a small branch of this plant, including leaves and stems: |

| | | |
|---|--|--|
| Plant 3 (name, if known): | | |
| Height: | | Make a drawing of any flowering/ fruiting structures you find on this plant: |
| Width: | | |
| Leaves (size, color, shape): | | |
| Flowers: | | |
| Fruits: | | |
| Make a drawing of the profile of this plant: | | Make a drawing of a small branch of this plant, including leaves and stems: |