Making Community Measurements: Abiotic 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. They will make measurements of abiotic factors such as taking soil samples and making measurements of weather conditions on the day(s) of the study.

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 concepts related to environmental factors in a local environment.
- Students may then infer how these factors might affect the biological resources of the area.

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 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) factors that surround an organism. 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.

V. Materials Needed

- suitable site for study

  suggestions:
  - school yard (lawn, shrubs, trees)
  - community garden
  - park
  - field
  - natural plant community
  - vacant lot
- 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)
- clipboards
- data sheets (see below)
- field guides
- ball
- reference sources for climate data (newspapers, internet)
- air thermometer
- soil thermometer
- light meter
- altimeter

VI. Procedure

Guide students through a discussion of communities and introduce the concepts of biotic and abiotic factors. Ask students to guess how each abiotic environmental variable might affect the growth of living organisms. 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). In order to ensure that measurements characterize 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. Take a small soil sample (about 1 cup of soil) and place in labeled bag. Back in the classroom use microscopes or lenses to examine the soil—its texture and color, quantity of rocks, the amount of organic matter, presence of living organisms. Use the same procedure as in the Rooting into the Soil lesson to observe how fast water drains through the soil when placed in a coffee filter setup. (Consider repeating that activity with a timer, and then compare your sample to the known samples: sand, pumice, and potting soil.) Record the following information for soil from your community:
   a. clay, sand, loam?
   b. quantity of rocky material
   c. amount of organic matter in soil
   d. depth of leaf litter, if any (measure)
   e. how well drained does it appear to be, based on your measure-ments?
   f. other measurements possible if you have the supplies include soil pH and chemical composition
2. Climate summary—determine the following:
   a. air temperature at ground level and four feet above ground
   b. soil temperature two inches below ground and six inches below ground
   c. if a light meter is available, measure the light level in several dif-ferent locations
   d. if no light meter is available, estimate the amount of sunlight reaching the ground (full sun, partial shade, complete shade)
   e. back in the classroom, use local newspapers and websites to record the annual precipitation for the site (including monthly distribution) as well as monthly temperature extremes and averages
3. If you have an altimeter, measure the elevation of the site.

VII. Discussion Questions

1. How would you characterize the abiotic environmental factors in the community you are studying? (*For a soils example: sandy soil with 10% rocks and little organic matter, no leaf litter, well drained, neutral pH*)
2. What did you learn about soil in your community? Is it uniform throughout the site?
3. What did you learn about the temperatures measured in your community during the time of your visit? Were temperatures uniform throughout the site?

4. Are you surprised by any of the measurements? For instance, was it colder than you expected or wetter?
5. What affect do you think each variable (soil, temperatures, moisture, light level) has on the plants growing there?

When returning for second investigation in a different season:

1. How do temperatures compare between the two seasons?
2. How does precipitation levels compare between the two seasons?
3. Was there a difference in light level between the two seasons? (This would certainly be true for a deciduous forest in winter compared with late spring.)
4. Are you surprised by any of the changes?
5. Do you have any new thoughts on how the environmental variables affect plant life in your area after this visit?

VIII. Discussion Questions Related to ***Reading Plants***

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

1. Compare and contrast the abiotic environmental variables of the three gardens.
2. How do you think these variables affect the plant life of each garden?
3. How do the abiotic environmental variables of these gardens compare with your study site?

IX. Extension Activites and Web Links

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

Ask students to make rain gauges out of soda bottles and make a daily chart of precipitation for the entire school year.

Establish a classroom weather station and make daily measurements. Learn about your local climate!

Find partners in another state or country and compare findings.

Real Time Weather Information

Weather Underground	< http://wunderground.com >
The Weather Channel	< http://www.weather.com >
Interactive Weather Information Network	< http://weather.gov >
Intellicast Weather	< http://intellicast.com >
AccuWeather	< http://www.accuweather.com >

Wonderful World of Weather: CIESE Online Classroom Projects (Stevens Institute of Technology)
Lessons allowing students to describe weather in measurable terms.
< http://216.0.165.241/curriculum/weatherproj/index_NEW.html >

Weather Specially for Kids: National Weather Service (National Oceanographic and Atmospheric Administration)
Links for information and lessons on weather.
< http://www.education.noaa.gov/sweather.html >

Vocabulary

abiotic	nonliving, as opposed to biological or biotic
biotic	relating to life; the living components of an environment
climate	the temperature, humidity, precipitation, light, wind, and other weather normal in an area
community	all the organisms living together in a common environment and interacting with one another
environment	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.
habitat	the natural area in which an individual, species, or population lives
population	members of the same species living in the same place at the same time
species	a group of organisms that are able to breed together and produce offspring that can also breed with members of the same species

Making Community Measurements:

Abiotic Factors

Names:_____ Date:_____

Location:

1. Amount of sunlight (check one):

	Deep shade		Filtered shade		Direct sun

If you have a light meter, ambient light level (in foot candles):

2. Air temperature (°F or °C):

3. Air movement (check one):

	Wind		Slight wind		No wind

4. Soil texture description (check one or more):

	Clay		Loam		Sand		Rock

5. Leaf litter (check one or more):

	None		Scant		Deep (> 1 inch)
	Dry		Moist		
	Intact leaves		Decomposing leaves		

6. Water/moisture (check one):

	Standing water		Moist		Dry

7. Make a list of the living and non-living things in the environment. Look carefully and see how many you can find of each.

Living (biotic) Non-living (abiotic)