GRADES
6–8
VARIATION 3–5

Students conduct a field study of three different environments as they focus on sunlight, soil moisture, temperature, wind, water flow, plants, and animals in each environment. By comparing different environments, students will learn how nonliving elements influence living elements in an ecosystem.

FIELD, FOREST, AND STREAM

SUBJECTS
Science, English Language Arts, Math

PLT CONCEPTS
3.1, 3.2, 3.4

STEM SKILLS
Collaboration, Investigation, Organization

DIFFERENTIATED INSTRUCTION
Cooperative Learning, Literacy Skills, Personal Connections

MATERIALS
Chart paper, marking pens, paper for recording observations, trowel or stick for digging, phones with light meter app, thermometer, small strip of paper, compass or smartphones with compass app, bottle of tap water. Optional: Topographical map of area.

TIME CONSIDERATIONS
Preparation: 60 minutes

Activity: One or more 50-minute periods

OBJECTIVES

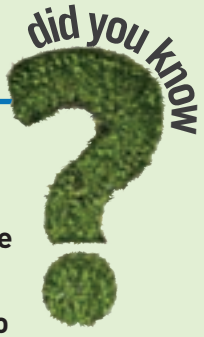
Students will

- **Describe similarities and differences they observe in the nonliving (abiotic) and living (biotic) components of three ecosystems.**
- **Identify ways that abiotic components of an ecosystem affect the biotic components.**

BACKGROUND

An **ecosystem** is a community of different species interacting with each other, and with chemical and physical factors that compose its nonliving environment. It is a system of interrelationships among organisms and between organisms and the physical environment.

FOREST FACT



The leaf shape of any tree species can vary with elevation and temperature. At cooler temperatures and higher elevation, red maple leaves tend to have more teeth and dissected lobes, which allow for more photosynthesis to occur along the leaf margins.

Plants and animals in an environment interact with each other in various ways. For example, plants may depend on insects or birds to pollinate flowers and on earthworms to aerate the soil; animals may depend on plants for food or shelter.

Plants and animals also interact with the nonliving elements of their environment. Physical factors such as sunlight, moisture, temperature, wind, and water flow influence the suitability of a local area for particular organisms. Those factors determine the kinds of plants and animals that live there.

Physical attributes of the environment are determined by factors such as topography, proximity to water, elevation, or geological features. In addition, the resident organisms (particularly plants) may affect the sunlight, moisture, temperature, and wind of the area. For example, the tall trees of a redwood forest tend to block sunlight and thus create a dark, moist environment, or microclimate, on the forest floor that is suitable for shade-loving plants but is too shady for other kinds of plants. **Microclimate** refers to special conditions of light, moisture, and temperature that occur in a narrowly restricted area within an ecosystem, such as under a bush or in a small woodland opening.

HOW TO MEASURE WIND DIRECTION

The amount and direction of wind in an ecosystem can affect soil moisture levels and the ability of organisms to grow and thrive.

Wind direction tells you where the wind is coming from. A northerly wind blows from the north to the south. To measure wind direction using a compass or smartphone compass app:

- Turn your body so that you are facing into the wind.
- Hold the compass or smartphone in the palm of your hand, at waist level, so that the white pointer is facing away from your body. The white pointer and the bearing below indicate the direction from which the wind is coming.

To measure direction of water flow, follow the same procedure so that you face in the same direction the water is flowing.

GETTING READY

- Find three study sites that are somewhat different from each other in terms of sunlight, air temperature, soil moisture, wind, topography, and number and types of plants and animals living there. If possible, select one site that is open, like a field or lawn; one that has trees; and one that contains water. Possible study sites include a lawn; a park, playground, or other area with many trees; a flowerbed or vegetable garden; a vacant lot; a pond, stream, or marsh; an open field; and a forest.
- Plan to visit the sites on the same day or on different days (at about the same time each day). Obtain any necessary permission to take students to visit the sites you have chosen.

SAFETY CHECK! Check the sites beforehand to identify any safety hazards such as deep holes, sharp objects, or poisonous or irritating plants.

- Arrange to have at least one parent volunteer, aide, or older student help supervise students during outdoor investigations. This person will help the activity go more smoothly, ensure students' safety, and prevent damage to the sites.
- Make copies of the student page for each team to record their observations. Using chart paper and marking pens, prepare a large chart for compiling team data, or plan to use spreadsheet software.
- Have students practice using equipment like thermometers and light meter and compass apps (see the box *How to Measure Wind Direction* for information on reading a compass).

DOING THE ACTIVITY

1 **PERSONAL CONNECTION** Ask students to think of a place they enjoy visiting. It might be a park, a grandparent's house, or the library. Invite them to consider:

- What do you particularly enjoy about the place? Is it the people? The physical space?
- What living things make the place enjoyable?
- What nonliving things make the place enjoyable?

2 Help students see that any place has both living and nonliving parts that work together to make an ecosystem. Explain that students will investigate ecosystems at three different study sites to find out how living and nonliving elements affect each other. Ask students what they might look for and what tools they might use to investigate.

3 **COOPERATIVE LEARNING** Divide your group into teams. Explain that each team will investigate and record observations of a different component at three different study sites. (If you have a large group, have two teams study each component and then average their data.) Be sure to discuss appropriate outdoor behavior with students. All living things, including plants, are to be respected and not injured in any way. Talk with students about following the rule: look, learn, leave alone. (See Appendix B: Tips for Teaching Outdoors.)

4 Give students instructions, a copy of the student page, and materials as described below, or have them plan their own investigations.

TEAM 1: SOIL

This team will determine the soil moisture and soil characteristics at each study site. Students can use a trowel or stick to scrape the surface of the ground and obtain a small sample of soil from underneath the surface. By feeling the soil, they should be able to tell whether it is wet, moist, or dry. (Moist soil will stick together.) They should examine the soil for other characteristics, such as texture, color, and smell. They should also note plant material or organisms in the soil. (See the activity Soil Builders [in Grades 3–5] for more information.)

TEAM 2: WIND AND SUN

This team will determine wind movement and measure how much sunlight reaches the ground at each study site. To assess the amount of wind, one student can hold a small strip of paper away from the body, while the others observe whether it hangs straight down or blows at an angle. They can use the compass or compass app to determine the direction from which the wind seems to be blowing. To determine sunlight intensity, students may use a photographic light meter or photosensitive paper. If these items are not available, they can describe the site in relative terms, such as shady, dark, medium light, or bright, or they can note "Site 1 is brighter than site 2, and site 2 is brighter than site 3."

TEAM 3: TEMPERATURE

This team will measure each site's temperature at ground level, 1" (2.5 cm) deep in the soil, and 1 yard (.9 m) above ground. If one site is a pond, stream, or lake, have the team measure the temperature at just above the water, at 1" (2.5 cm) deep, and at 1 yard (.9 m) above the surface of the water.

TEAM 4: LAY OF THE LAND

This team will determine whether each site is flat or sloped and will record any other land features that affect the study site (such as tall buildings or cliffs adjacent to it). The team will also determine which direction water flows from the site. They can do so by slowly pouring water onto the ground and observing where it goes. They can use the compass to determine the direction of flow. If possible, also have them study a topographic map to locate the site and determine the body of water into which the site drains.

TEAM 5: PLANT LIFE

This team will observe the various kinds of plants at each site (large trees, small trees, shrubs, small plants, grasses—no need to identify species). Students should record the most common kinds of plants found in each location and note especially where each grows relative to the others.

TEAM 6: ANIMAL LIFE

This team will record the various kinds of animals at each site (insects, birds, reptiles, fish, frogs, or tadpoles). Students should include evidence of animals such as scat, tracks, burrows, or leaves that have been chewed.

5 After teams have had sufficient time to investigate each location, have them all come together to present their findings and share what they have learned.

6 Each team should listen to the reports of the other teams and use the information to complete their team chart.

7 Ask teams to enter their data on the large chart you prepared or into a spreadsheet. Use this chart or spreadsheet as a basis for discussing differences between the locations and any interactions students observed among the elements. Discuss:

- Which ecosystem has the greatest number of plants? Animals? Which has the least number of each? How do you explain this difference?
- What plants and animals are found at more than one site? How are the plants and animals the same and how are they different at different sites?
- Which site had the highest air temperature? The lowest? The most wind? The least?
- What has the wettest soil? The driest?
- How are the number and type of plants in an area affected by light intensity, air temperature, and soil temperature?
- How does water influence the soil temperature, air temperature, and soil moisture?
- What relationship does light have with air temperature? With soil moisture? With plants?
- How might water flow affect soil moisture and plants?
- Which of the elements we studied seems most important for determining the diversity or number of plants and animals at each site? What makes you say so?

TAKE IT OUTSIDE

Take a hike! Invite students to join you on a walk near your site. On the way, encourage them to look for places where moisture, temperature, sunlight, wind, and other factors are higher or lower, and to note differences in vegetation. You might use an app such as AllTrails, which can help you find places to hike, bike, fish, and more.

VARIATION: GRADES 3–5

1 Using index cards attached to sticks or stakes, prepare two markers for each pair of students. Write one of the following labels on each marker with suggested symbols:

- Most Sunlight [sun]
- Least Sunlight [sun covered by cloud]
- Highest Temperature [thermometer with high mercury]
- Lowest Temperature [thermometer with low mercury]
- Most Wind [fluttering flag]
- Least Wind [limp flag]
- Most Soil Moisture [faucet gushing]
- Least Soil Moisture [faucet dripping]
- Most Plants [several plants]
- Least Plants [one plant]
- Most Animals [several insects]
- Least Animals [one insect]

2 After choosing a study area such as a vacant lot, mark it off with string or rocks. Divide the group into pairs, and give each pair the "most" and "least" markers for one factor.

3 **LITERACY SKILLS** Invite teams to explore the study area and determine which location has the most and the least of each factor. For example, a team studying plants should decide which site has the most plants and which has the least. Students will indicate their choice by placing their markers in the ground.

4 After all students have marked their choices, examine the entire area to see where the markers of each type are located. According to the markers, which spot had the most or least sunlight? Heat? Moisture? At which spot did you find the most animals? Why might animals prefer that spot? Did that spot have the most or least of any other factors? At which spot did you find the most plants? Why might plants grow well at that spot?

ACADEMIC STANDARDS

SCIENCE

Practices

- Planning and carrying out investigations
- Analyzing and interpreting data

Concepts

- Interdependent relationships in ecosystems
- Patterns

ENGLISH LANGUAGE ARTS

Practices

- Speaking and listening: comprehension and collaboration
- Speaking and listening: presentation of knowledge and ideas

MATH

Practices

- Reason abstractly and quantitatively
- Use appropriate tools strategically

Concepts

- Measurement and data

ASSESSMENT

Ask students to

- Design a graphic organizer drawing connections between the elements they studied and their observations. Have students place the names of each of the elements (sunlight, soil moisture, wind, temperature, water flow, plants, animals) in large circles around the edge of the page. They should draw lines between elements that they observed to be connected. On each line, they should briefly describe the relationship. For example, students might draw a line between sunlight and soil and then write, "More sunlight = drier soil."

ENRICHMENT

- Visit each site again at a different time of year and repeat your investigations. Compare your results. How has the soil changed? The temperature? The wind? The plants and animals? What factors influenced each change?
- Bring the outdoors inside by creating a terrarium of a local ecosystem. See the box *Building a Terrarium* for tips. Discuss: what differences are there between our terrarium and the real ecosystem it represents? What can we learn about natural ecosystems from a terrarium?

BUILDING A TERRARIUM

To build a terrarium, start with a clear, uncolored glass or plastic container and cover the bottom with about ¾ inch (1.8 cm) of gravel or pebbles. Then, spread a piece of cheesecloth on the gravel and layer 2–3 inches (5–7.5 cm) of the appropriate planting mixture on top of that (see "Ecosystem Models" chart). Dig small holes for the plants and add them. Water, cover, and place the terrarium in the appropriate location, as described below.

ECOSYSTEM MODELS

Materials	Desert	Woodland	Tropical
Planting mixture	Commercial cactus plant mix or mixture of equal parts potting soil, perlite, and sand	Garden or potting soil	Garden or potting soil
Plants	Desert plants	Woodland plants	Tropical plants
Cover	Do not cover	Cover with a piece of glass or plastic	Cover with a piece of glass or plastic
Water	Spray with water until moist	Water until moist, approximately once a week	Water until moist, approximately once a week
Location and light	Location that gets about 3–4 hours of direct sunlight	Cool location with indirect light	Warm location with bright light, not too hot

STUDENT PAGE Team Chart

NAME _____ DATE _____

For each site, record observations of each ecosystem component.

Ecosystem Component	Site 1: _____	Site 2: _____	Site 3: _____
Soil • Moisture: wet, moist, or dry • Texture • Color • Smell • Animals or plant material			
Wind and Sun • Amount of wind • Direction from which wind is blowing • Amount of sunlight: shady, medium light, or bright			
Temperature • At ground level • At 1" (2.5 cm) deep into soil • At 1 yard (0.9 m) above ground			
Lay of the Land • Flat or sloped • Other land features (buildings, trees, cliffs) • Direction of water flow • Body of water into which site drains			
Plant Life • Most common kinds of plants • Where each kind grows			
Animal Life • Animals seen • Animal evidence seen (such as droppings, tracks, burrows, chewed twigs or leaves) • Where each animal or animal sign was found			

I LOVE MY GREEN JOB!

CAREER CORNER

FORESTERS manage public or private forestlands. They develop short- and long-term plans for planting, growing, and monitoring trees for healthy growth and make sure to use forest practices that comply with environmental regulations.