
Ecosystem Comparisons

Activity Overview:

Students collect data to compare similarities and differences between two ecosystems and plant adaptation strategies for survival in each.

Objectives:

 Students will:

- Develop explanations for the connections between living and non-living things in two environments
- Observe the differences and similarities between two communities
- Discover and understand how plants adapt to environmental conditions
- Collect and compare data in prairie and woodland ecosystems

Subjects Covered: Science and Math

Grades: 3 through 12

Activity Time: 1 1/2 hours, which can be divided into 2 sessions

Season: Fall or Spring

Materials:

Elementary/Middle School Activity:

1 thermometer, 1+ soil thermometers, data sheets, clipboards and pencils, jars of bubbles, and 10' line transects



Woodland plant: Bloodroot

Background

As students begin a restoration project, they need to understand the ecology and habitat requirements of the community they are restoring. As they study and compare two ecosystem models, students develop a clear understanding of how plants adapt to their environment and what condition plants need to survive. The knowledge gained will help them to select suitable plants for their site.

The following descriptions are typical examples of how groundlayer plants adapt to light availability, wind, and moisture in woodland, prairie, and wetland ecosystems. See Earth Partnership for Schools Activity, "Adaptation Scavenger Hunt," for more information.

WOODLAND:

- Phenology: 1/2 of the groundlayer plants bloom in the spring before the canopy leaves are fully extended. Spring ephemerals appear, bloom, set seed, then die back before the canopy is full.
- Leaf shapes of groundlayer: Leaves tend to be wide, umbrella shaped (to capture light), with arching habits, and are often three parted.
- Tree biomass: 2/3 above ground, 1/3 below ground. The biomass accumulates in long-lived, above ground parts.

PRAIRIE (grasslands and meadows):

- Phenology: 1/4 of the plants bloom in spring; 1/2 in summer, in which 1/2 bloom in late summer.
- Leaf shapes: Leaves tend to be narrow to reduce water evaporation.
- Plant biomass: 1/3 above ground, 2/3 below ground. Vegetation dies back above ground each year.

WETLAND (includes wetlands such as marshes, wet meadows, wet prairies, sedge meadows, and fens):

- Phenology: less than 1/4 of the plants bloom in spring (primarily in June); over 1/2 in summer, and 1/4 bloom in the fall. Flowering in the spring is delayed because water in the soil from floods slows the warming of the ground.
- Leaf shapes: Leaves may be wide or narrow. Some woodland ground layer species will grow in a wetland. The moist soil compensates for evaporation from the direct sunlight.
- Plant biomass: 1/3 above ground, 2/3 below ground. Vegetation dies back above ground each year.

The activity includes two activity levels for comparing ecosystems. The first activity is geared to elementary and middle school students; the second activity is for high school students. Students using the elementary / middle

Ecosystem Comparisons (cont.)

(2 tent stakes, 10 feet of bright-colored rope). (Assembling the transect: Tie each end of rope to one stake. Distance between each stake should measure exactly 10 feet.)

High School Activity:

1 thermometer, 1+ soil thermometers, 1+ soil probes, data sheets, clipboards and pencils, and quadrat sticks (conduit pipe cut into four one meter length sticks, bright orange spray paint).

State Standards

Science:

Develop themes for questions (A.8.1)

Ask questions, plan investigations, make observations, predictions (C.4.2)

Find connections among living and non-living things (F.4.4)

Discuss results (C.8.10)

Group/classify objects based on properties (D.4.2)

Explain & predict changes in earth's systems (E.8.1)

Show organism's place in ecosystems (F.8.8)

Math:

Use reason and logic (A.12.1)

Organize & display data from statistical investigations (E.12.2)

Analyze information from organized & displayed data (E.12.3)



Prairie Plant: Big Blue Stem

school activity look at air and soil temperatures, soil moisture, surface litter, wind speed, the visible sky, different kinds of plants, evidence of animals, and how they feel in the ecosystem.

Students using the high school activity look at air and soil temperature, soil moisture, signs of animals, soil color and contents. They also investigate surface litter, estimate wind speed and plant heights, determine percent of sunlight reaching the ground and percent cover in a square meter, consider aesthetics, and how they feel in the ecosystem.

Activity Description

Prairies, wetlands and woodlands are natural communities that have a different set of plants, insects, animals, soils, and micro-environments. Yet, there are also similarities—each community has a basic set of requirements to survive as healthy, balanced ecosystems. Plants in each community need sun, water, space and share a myriad of interrelationships among the component parts for success.

During ecosystem comparisons you will examine, record, and compare the living and non-living factors that are part of each community. You will investigate the soils, surface litter, air and soil temperatures, wind speeds, light availability, plants and animals. You will also assess your perceptions and feelings in each community.

The objective is to observe the differences and similarities between the two communities, then to analyze and infer how the plants and animals have adapted to their particular habitats.

Procedure:

Elementary/Middle School Level

1. Divide into teams of three. One student records the information, two students collect the information.
2. Hang or place the air thermometer in the prairie, then insert soil thermometers to 1" and 3" depths.
3. Lay out a transect line to define an area to study. Stretch the transect line out to the full ten feet. You will look at plants and signs of animals one foot on either side of this line.
4. Using your data sheet, collect data in the first ecosystem for 30 minutes.
 - Soil moisture: Place your hand directly on the soil to feel how damp or dry the soil feels.
 - Surface litter: Examine the dead material (leaves, stems, etc.) on the surface of the soil. List what you see.
 - Soil temperature: Record the temperatures on the soil thermoeters.
 - Air temperature. Record the air temperature.

Ecosystem Comparisons (cont.)

- Wind speed scale: Estimate the wind speed on a scale of zero (no wind) to ten (strong wind), using a jar of bubbles. Bubbles will drop immediately in little or no wind; bubbles will stay up in the air and move quickly in a strong wind.
 - Sky view: Look straight up. Estimate on a scale of zero (the sky is not visible due to interference from a tree canopy, etc.) to ten (you see the entire sky from horizon to horizon.) Do not count the clouds as a visual barrier of the sky.
 - Plants: How many different kinds do you see? It is not necessary to identify the plants. Count the number of plants having three different leaf widths—grass-like (very thin), thin (less than four fingers wide), broad (wider than 4 fingers). Count the different kinds of plants with fuzzy or waxy leaves, blooming, or in seed. Plants may be counted more than once.
 - Evidence of animals: Look along your transect and list the number of insects, and spiders. Search for evidence of animals such as animal tracks, chewed leaves, and animal droppings.
5. Repeat in the second ecosystem.
 6. Return to the classroom to discuss your findings.
 7. Questions for discussion:
 - In what ways are the two communities alike? How are they different?
 - What causes the similarities and differences between the two ecosystems?
 - Did you observe connections between living and non-living things in each environment?
 - What characteristics such as leaf size, leaf shape, and blooming time did plants exhibit to adjust to their environment?
 - How can different plants affect each other?
 - In what ways are plants and animals interdependent? Consider at least three examples.

High School Level

1. Divide into teams.
2. Hang or place the air thermometer in the prairie, then insert a soil thermometers to 1” and 3” depths.
3. Lay out the four quadrat sticks to forms a square to isolate an area for study and data collection.
4. Using your data sheet, collect data in the first ecosystem for 30 minutes. The following instructions will explain how to collect your data:
 - Soil moisture: Place your hand directly on the soil to feel how damp or dry the soil is in the community.
 - Soil color and contents: Take a soil sample with a soil probe, record your observations.
 - Surface litter: Examine the dead material (leaves, stems, etc.) on the surface of the soil. Estimate the depth of litter and list what you see.
 - Air movement: Observe leaf movement to estimate air movement at canopy (in the woodland), shoulder and ankle heights. Estimate air movement on a scale of 0 (no wind) to 10 (strong wind). Leaves are motionless in little or no wind, tree branches move in a strong wind. Use jar of bubbles, if desired. See wind speed scale in elementary / middle school level.

Ecosystem Comparisons (cont.)

- Percent sunlight: Estimate how much sunlight reaches your shoulders and the ground.
 - Percent cover: Examine your quadrat and estimate the percent cover of grasses, forbs or wildflowers, mosses and lichens, fungi, and bare ground or surface litter.
 - Characteristics of plants: Describe representative plant forms, leaf size and shape, flowers or fruits.
 - Average height: Estimate the heights of the herbaceous, shrub and tree layers.
 - Evidence of animals: Look in your quadrat and list the number of insects, spiders. Search for evidence of animals such as animal tracks, chewed leaves, and animal droppings.
 - Aesthetics: Describe patterns, textures, colors and contrasts in the ecosystem.
5. Repeat activity in the second ecosystem.
 6. Return to the classroom to discuss your findings.
 7. Questions for discussion:
 - What methods did you use to estimate plant heights, percent cover, and percent sunlight?
 - In what ways are the two communities alike? Different?
 - What causes the similarities and differences between the two ecosystems?
 - What connections did you observe between living and non-living things in each environment?
 - What characteristics such as leaf size, leaf shape, and blooming time did plants exhibit to adjust to their environment?
 - Will the information you collected help you design your ecological restoration?
 - How can different plants affect each other?
 - In what ways (consider at least three) are plants and animals interdependent?

Extensions

- Compare other communities such as savanna, wetlands, old fields, and woodlands in different stages of succession.
- Organize and display your findings using graphs, tables, charts, and diagrams.
- Students can develop their own questions and collect related data to better understand dynamics within an ecosystem.
- Collect this information over time and through different seasons of the year to create a phenological history of the site
- Create artwork and poetry based on the aesthetic information collected about patterns, textures, colors, and contrasts observed in the various ecosystems.
- Draw inferences from the data gathered and test your hypotheses.
- Use this activity in conjunction with the Earth Partnership for Schools activity, “Winter Ecology Observations.”

Ecosystem Comparisons (cont.)

Additional Resources

- Brewer, R. (1979). *Principles of ecology*. Philadelphia: W.B. Saunders Co.
- Curtis, John T. (1959). *Vegetation of Wisconsin*. Madison, WI: University of Wisconsin Press.
- Leopold, A. (1949). *A Sand County almanac*. New York: Oxford University Press.
- Murie, Olaus J. (1982). *Animal tracks (Peterson field guide)*. Boston: Houghton Mifflin Co.
- Pearce, T. (1990). *Exploring woodlands: A cross-curricular approach to investigations of the woodland environment*. Exeter: Hampshire Books.
- Weber, Larry. (1996). *Backyard almanac*. Duluth, MN: Pfeifer-Hamilton Publishers,

Assessments

- Provide examples of differences among living and non-living things within the ecosystems. Provide possible reasons for those differences.
- Create poems or a creative writing piece about experiences in the ecosystems studied.
- Explain the various measurements taken in the ecosystems studied. Explain how the results of the measurements were similar and different.
- Create visual displays (e.g., graphs, tables) of findings and observations.

Ecosystem Comparisons

Name: _____ Date: _____ Time: _____ Weather: _____

QUESTIONS	ECOSYSTEM:	ECOSYSTEM:
Air Temperature		
Soil Temperature 1" deep		
Soil Temperature 3" deep		
Soil Moisture (wet, moist, dry)		
Soil Color (light or dark; grey, brown, black or red, etc.)		
Soil Contents		
Litter Depth and Contents		
Air Movement: Canopy Height		
Shoulder Height		
Ankle Height		
Percent Sunlight		
Percent Cover: Grass		
Flowering Plants		
Mosses and Lichens		
Fungi		
Bare ground/ litter		
Characteristics of Flowering Plants and Grasses		
Average Height: Tree Layer		
Shrub Layer		
Ground Layer		
Signs of Animals (include insects and worms)		
Aesthetics: Patterns		
Textures		
Colors		
Contrasts		
How does this ecosystem make you feel? Does it remind you of anything?		

Ecosystem Comparisons

Ecosystem Comparisons Rubric

Assessment Options:

1. Completeness of the data collection using a checklist of present/not present.
2. Analysis of data: Students use questions from #7 of the activity for the elementary/middle school section OR questions from #7 of the activity for the high school section and answer the following question:

How have the plants and animals adapted to two of the ecosystems? Be sure to give specific examples of each.

Level	Analysis and Synthesis of Information
4	<ul style="list-style-type: none"> • Reports detailed, specific data and results for both ecosystems • Explains a variety of possible relationships among various living and nonliving things found in both ecosystems • Explains how plants and animals adapt to their specific habitat • Create a hypothesis for various adaptations of plants and animals using data as supporting evidence • Has few, if any, errors in grammar/mechanics
3	<ul style="list-style-type: none"> • Reports specific data and results for both ecosystems • Explains several possible relationships among various living and nonliving things found in both ecosystems • Creates a hypothesis for plant and animal adaptations • Has few errors in grammar/ mechanics
2	<ul style="list-style-type: none"> • Summarizes results incompletely • Explains few of the relationships among living and nonliving things found in both ecosystems • Provides an explanation that is unrelated to the facts • Errors in grammar/mechanics affect content
1	<ul style="list-style-type: none"> • Omits results • Lists one or two relationships among living and nonliving things found in both ecosystems • Does not create a hypothesis • Errors in grammar/mechanics interfere with content