

Ecosystems

Narrative Summary

Students begin the unit by setting up a terrarium in which they grow grass, mustard, and alfalfa plants. They then add crickets and isopods. They also set up an aquarium into which they introduce snails, guppies, elodea, algae, and duckweed. By connecting the terrarium and aquarium bottles to create an “ecocolumn,” students are able to observe the relationship between the two environments and the organisms living within them. Using test ecocolumns that contain only plants, students simulate the effects of pollutants—such as road salt, fertilizer, and acid rain—on an environment. Students then use a food chain wheel to make inferences about the effects these pollutants might have on their own miniature ecosystems. Later, students read about, explore, and discuss the Chesapeake Bay as a model ecosystem. They analyze this ecosystem from the viewpoint of various users—waterman, dairy farmer, land developer, recreational boater, and resident—and present their findings to the class. This activity enables students to appreciate the trade-offs that must be made to reach mutually acceptable solutions to environmental problems.

Science Content

Ecosystems helps students understand the relationships between plants and animals and the interdependence of living things within an environment. By modeling complex systems, students investigate the relationships between life and earth sciences while simultaneously exploring science in personal



and social perspectives. As students observe the structure and function of model ecosystems, they grapple with the effects of pollutants, overpopulation, and natural hazards on these systems. Working in teams, students design and test the effects of pollutants created by humans and examine the roles of people in a real-world ecosystem—the Chesapeake Bay. Unifying concepts and processes are central to this unit as students use

their models as evidence on which to base their conclusions. Extensive reading selections provide additional information on many of the organisms and concepts covered in the unit.

Assessment

Matched pre- and post-unit assessments in which students analyze relationships in a riverbank ecosystem give teachers information about what students already know about ecosystems and what they have learned by the close of the unit. Teachers are given guidance on how to assess students as they develop and perform experiments, record observations, and make presentations. Two self-assessments in the unit allow students to reflect on their own learning and examine their attitudes toward the study of ecosystems. Additional assessments at the close of the unit allow students to apply their learning to new situations. They include an activity in which students read about an environmental problem, evaluate the differing points of view, and take a stand on the issue.

Goals for *Ecosystems*

In this unit, students explore the web of relationships that link organisms to each other and to their natural environment. From their experiences, they develop an understanding of the following concepts, skills, and attitudes.

Concepts

- An ecosystem is a community of organisms and its interaction with its environment.
- Organisms can be categorized by the functions they serve in an ecosystem: producers, consumers, or decomposers.
- Organisms in an ecosystem have dependent and interdependent relationships, which can be illustrated by food webs.
- Factors that affect growth and reproduction of organisms in an ecosystem include light, water, temperature, and soil.
- Natural and human-made events can “disturb” an ecosystem.
- A pollutant is anything that can harm living organisms when too much of it is released into an ecosystem. Pollution is the condition that results when pollutants interact with the environment.
- Pollutants can affect the stability of an ecosystem; solutions can be developed to minimize or alleviate the effects of pollutants.
- Model ecosystems can be used to learn more about the complex relationships that exist on earth.

Skills

- Using a hand lens, pH paper, measuring devices, and other testing equipment appropriately.
- Conducting, recording, and organizing daily observations.
- Planning, implementing, and analyzing experiments and drawing conclusions from the results.
- Making and testing predictions.
- Identifying ecosystems as stable or disturbed and recognizing whether the causes of a disturbed ecosystem are natural or human-made.
- Reading for more information about ecosystems and pollution.
- Communicating information through writing, drawing, and discussion.
- Applying previously learned information to analyze a problem and suggest solutions.

Attitudes

- Developing sensitivity toward living things and understanding that human behavior can positively or negatively affect them.
- Respecting evidence from an experiment and recognizing that evidence can inform a decision.
- Developing an interest in investigating ecosystems.
- Recognizing the importance of repeating experiments to get valid test results.



Ecosystems

Fundamental Concepts and Principles Addressed (5–8)

Science as Inquiry

Abilities necessary to do scientific inquiry

- Identify questions that can be answered through scientific investigations.
- Design and conduct a scientific investigation.
- Use appropriate tools and techniques to gather, analyze, and interpret data.
- Develop descriptions, explanations, predictions, and models using evidence.
- Think critically and logically to make the relationships between evidence and explanations.
- Recognize and analyze alternative explanations and predictions.
- Communicate scientific procedures and explanations.
- Use mathematics in all aspects of scientific inquiry.

Understandings about scientific inquiry

- Different kinds of questions suggest different kinds of scientific investigations.
- Current scientific knowledge and understanding guide scientific investigations.
- Mathematics is important in all aspects of scientific inquiry.
- Scientific explanations emphasize evidence, have logically consistent arguments, and use scientific principles, models, and theories.
- Science advances through legitimate skepticism.
- Scientific investigations sometimes result in new ideas and phenomena for study, generate new methods or procedures for an investigation, or develop new technologies to improve the collection of data.

Life Science

Structure and function in living systems

- Living systems at all levels of organization demonstrate the complementary nature of structure and function, including the structure of ecosystems.
- Most organisms are single cells; other organisms are multicellular.

Reproduction and heredity

- Reproduction is characteristic of all living systems and is essential to the continuation of the species.

Regulation and behavior

- All organisms must be able to grow, reproduce, and maintain a relatively stable internal environment while living in a constantly changing external environment.
- Behavior is one kind of response an organism can make to an internal or environmental stimulus.

Populations and ecosystems

- A population consists of all individuals of a species that occur together in a given place and time. All populations living together and the physical factors with which they interact compose an ecosystem.
- Populations of organisms can be categorized by the function they serve in an ecosystem. Plants and some microorganisms are producers—they make their own food. All animals, including humans, are consumers, which obtain food by eating other organisms. Decomposers, primarily bacteria and fungi, are consumers that use waste materials and dead organisms for food. Food webs identify the relationships among producers, consumers, and decomposers in an ecosystem.
- For ecosystems, the major source of energy is sunlight, which passes from organism to organism in food webs.
- The number of organisms an ecosystem can support depends on the resources available and abiotic factors, such as quantity of light and water, range of temperatures, and soil composition.

Earth and Space Science

Structure of the earth system

- Soil consists of weathered rocks and decomposed organic material from dead plants, animals, and bacteria.
- Water is a solvent. As it passes through the water cycle, it dissolves minerals and gases and carries them to the oceans.
- Living organisms have played many roles in the earth system.

Science and Technology

Understandings about science and technology

- Perfectly designed solutions do not exist; all solutions have trade-offs.
- Technological designs have constraints.
- Technological solutions have intended benefits and unintended consequences.

Science in Personal and Social Perspectives

Personal health

- Safe living involves the development and use of safety precautions and the recognition of risk in personal decisions.
- Natural environments may contain substances that are harmful to human beings. Maintaining environmental health involves establishing or monitoring quality standards related to use of soil, water, and air.

Population, resources, and environments

- When an area becomes overpopulated, the environment will become degraded due to the increased use of resources.
- Causes of environmental degradation and resource depletion may vary.

Natural hazards

- Human activities can induce hazards through resource acquisition, urban growth, land-use decisions, and waste disposal. Such activities can accelerate many natural changes.

Risks and benefits

- Students should understand the risks associated with natural hazards, with chemical hazards (such as pollutants), and with social hazards (transportation).
- Risks and benefits relate directly to personal and social dimensions.
- Important personal and social decisions are made based on perception of benefits and risks.

Science and technology in society

- Science influences society through its knowledge and world view. Scientific knowledge and the procedures used by scientists influence the way many individuals in society think about themselves, others, and the environment.
- Societal challenges often inspire questions for scientific research.
- Science cannot answer all questions and technology cannot solve all human problems or meet all human needs.

History and Nature of Science

Science as a human endeavor

- Some scientists work in teams, and some work alone, but all communicate extensively with one another.
- Science requires different abilities, human qualities, and habits of the mind.

Nature of science

- Scientists formulate and test their explanations using observation, experiments, and models. Scientists do and have changed their ideas when led to do so by experimental evidence.
- Different scientists might publish conflicting experimental results or might draw different conclusions from the same data.
- It is part of scientific inquiry to evaluate the results of investigations, experiments, observations, models, and explanations proposed by other scientists.

Unifying Concepts and Processes

Systems, order, and organization

Evidence, models, and explanation

Constancy, change, and measurement

Evolution and equilibrium

Form and function



Ecosystems

Fundamental Concepts and Principles Addressed (K–4)

Science as Inquiry

Abilities necessary to do scientific inquiry

- Ask a question about objects, organisms, and events in the environment.
- Plan and conduct a simple investigation.
- Employ simple equipment and tools to gather data and extend the senses.
- Use data to construct a reasonable explanation.
- Communicate investigations and explanations.

Understandings about scientific inquiry

- Scientific investigations involve asking and answering a question and comparing the answer with what scientists already know about the world.
- Scientists use different kinds of investigations depending on the questions they are trying to answer.
- Simple instruments, such as magnifiers, thermometers, and rulers, provide more information than scientists obtain using only their senses.
- Scientists develop explanations using observations (evidence) and what they already know about the world (scientific knowledge). Good explanations are based on evidence from investigations.
- Scientists make the results of their investigations public.
- Scientists review and ask questions about the results of other scientists' work.

Physical Science

Properties of objects and materials

- Objects have many observable properties, including size, weight, shape, color, temperature, and the ability to react with other substances.
- Objects are made of one or more materials and can be described by the properties from which they are made.

Life Science

The characteristics of organisms

- Organisms have basic needs. For example, animals need air, water, and food; plants require air, water, nutrients, and light.
- Each plant or animal has different structures that serve different functions in growth, survival, and reproduction.
- The behavior of individual organisms is influenced by internal cues (such as hunger) and by external cues (such as change in the environment).

Life cycles of organisms

- Plants and animals have life cycles that include being born, developing into adults, reproducing, and eventually dying.
- Plants and animals closely resemble their parents.
- Many characteristics of an organism are inherited from the parents of the organism, but other characteristics result from an individual's interactions with the environment.

Organisms and their environments

- All animals depend on plants. Some animals eat plants for food. Other animals eat animals that eat the plants.
- An organism's patterns of behavior are related to the nature of that organism's environment, including the kinds and numbers of other organisms present, the availability of food and resources, and the physical characteristics of the environment. When the environment changes, some plants and animals survive and reproduce, and others die or move to new locations.
- All organisms cause changes in the environment where they live. Some of these changes are detrimental to the organism or other organisms, whereas others are beneficial.

- Humans depend on their natural and constructed environments. Humans change environments in ways that can be either beneficial or detrimental for themselves and other organisms.

Earth and Space Science

Properties of earth materials

- Earth materials are solid rocks and soils, water, and the gases of the atmosphere; these materials have different physical properties. Earth materials provide many of the resources that humans use.
- Soils have properties of color and texture, capacity to retain water, and ability to support the growth of many kinds of plants.

Science and Technology

Abilities of technological design

- Identify a simple problem.
- Propose a solution.
- Implementing proposed solutions.
- Evaluate a product or design.
- Communicate a problem, design, and solution.

Understandings about science and technology

- Science is one way of answering questions and explaining the natural world.
- People have always had problems and invented tools and techniques (ways of doing something) to solve problems.
- Scientists and engineers often work in teams with different individuals doing different things that contribute to the results.
- Tools help scientists make better observations, measurements, and equipment for investigations.

Abilities to distinguish between natural objects and objects made by humans

- Some objects occur in nature while others have been designed by people to solve human problems.
- Objects can be categorized into two groups, natural and designed.

Science in Personal and Social Perspectives

Types of resources

- Resources are things we get from the living and nonliving environment to meet the needs and wants of a population.
- Some resources include basic materials, such as air, water, and soil; some are produced from basic resources; and some resources are nonmaterial, such as quiet places and beauty.
- The supply of many resources is limited. If used, resources can be extended through recycling and decreased use.

Changes in environments

- Environments are the space, conditions, and factors that affect an individual's and a population's ability to survive and their quality of life.
- Changes in environments can be natural or influenced by humans.
- Some environmental changes occur slowly, and others occur rapidly.

Science and technology in local challenges

- People continue inventing new ways of doing things and solving problems.

History and Nature of Science

Science as a human endeavor

- There is still much more to be understood about science.
- Many people choose science as a career. Many people derive great pleasure from doing science.

Unifying Concepts and Processes

Systems, order, and organization

Evidence, models, and explanation

Constancy, change, and measurement

Evolution and equilibrium

Form and function