Grade 6 Science, Quarter 1, Unit 1.1

Processes Within an Ecosystem

Overview

Number of instructional days: 16 (1 day = 45 minutes)

Content to be learned

- Use data and observations to identify the variety of relationships within an ecosystem, including predator/prey, consumer/producer/decomposer, and host/parasite relationship.
- Use data and observations to identify and define the relationship between catastrophic events and organisms in the environment.
- Complete a food web for a given ecosystem to demonstrate an understanding of recycling in ecosystems.
- Trace how matter cycles among and between organisms and the environment.

Processes to be used

- Identify and define relationships in systems.
- Make observations and collect qualitative data.
- Define relationships between processes and structures in a system.
- Analyze relationships within a system.

Essential questions

- What are the various relationships that exist in an ecosystem? How can they be identified?
- How do energy and matter recycle within ecosystems?
- How do food webs demonstrate the recycling of matter between organisms and the environment in ecosystems?
- How can catastrophic events affect the equilibrium in an ecosystem?

Written Curriculum

Grade Span Expectations

LS2 - Matter cycles and energy flows through an ecosystem.

LS2 (5-8) INQ+SAE -5

Using data and observations, predict outcomes when abiotic/biotic factors are changed in an ecosystem.

LS2 (5-6) –5 Students demonstrate an understanding of equilibrium in an ecosystem by …

5a identifying and defining an ecosystem and the variety of relationships within it (e.g., predator/prey, consumer/ producer/decomposer, host/parasite, catastrophic events).

LS2 (5-8) SAE-7

*Given an ecosystem, trace how matter cycles among and between organisms and the physical environment (includes water, oxygen, food web, decomposition, recycling but **not** carbon cycle or nitrogen cycle).*

LS2 (5-6)-7 Students demonstrate an understanding of recycling in an ecosystem by …

7b completing a basic food web for a given ecosystem.

Clarifying the Standards

Prior Learning

In grades K–2, students cared for plants and animals, thereby identifying the survival needs of those organisms. They experimented with growing plants in varying conditions, such as light versus no light.

In grades 3 and 4, students began to identify sources of energy with regard to organism survival. They have discussed characteristics of living organisms since kindergarten, but the terms *biotic* and *abiotic* were not introduced until the fourth quarter of grade 5 in the Heredity and Human Development unit of study. It is important to reinforce these definitions as they relate to the ecosystem.

In grade 5, students discussed the ecosystem components, the sun's energy flow, as well as the water cycle flow through an ecosystem. Even though the concept of ecosystem is being taught, the terms of *produce*, *consumer*, and *decomposer* may have not been introduced.

Current Learning

The instructional level falls between developmental and reinforcement. Demonstrating an understanding of equilibrium in an ecosystem is a new concept for students in grade 6. Students identify and define an ecosystem as well as the various relationships (predator/prey, consumer/producer/decomposer, and host/parasite). Students should be able to make perditions about how catastrophic events affect an ecosystem. They trace the flow of matter in an ecosystem.

Given an ecosystem, students use food webs to trace how matter cycles among and between organisms and the physical environment. Students use models or diagram a scenario where they trace the flow of matter through an ecosystem. They are able to show that organic matter generated by producers directly

or indirectly sustains consumer organisms that cannot make their own food. Students show that consumers use, rearrange, and ultimately decompose the materials built up by the producers.

Students identify relationships within an ecosystem. Since the movement of organic matter and energy from the producer level through various consumer levels makes up a food chain and interlocking food chains make up a food web, tracing the cycling of matter can be used as a way to approach this learning. Students can show producer/consumer/decomposer and predator/prey relationships by identifying the feeding patterns in a food web. For example, a typical food chain in a grassland might be grass (producer), mouse (primary consumer), snake (secondary consumer), and hawk (tertiary consumer). By following the overlap between the food chains of the ecosystem (food webs), students can show that the final link in all food chains is made up of decomposers, those heterotrophs that break down dead organisms and organic wastes. By understanding that this matter then returns to the food web, students can show the cycling of matter.

Students recognize how substances within an ecosystem change when affected by catastrophic events such as pollution, deforestation, or geological processes.

Future Learning

As students enter grades 7 and 8, they will develop understanding by analyzing the biotic and abiotic factors that affect an ecosystem, and they will predict the outcome of a change in biotic and abiotic factors. As they enter high school, students will begin to describe ways that humans and natural events can modify an ecosystem. By the end of high school, students should be able to define and give an example of equilibrium in an ecosystem.

Additional Research Findings

According to the *Atlas of Science Literacy*, upper elementary students tend to associate energy only with living things, in particular with growing, fitness, and food (p. 78). Middle school students may not realize that matter from dead organisms is converted into other materials in the environment and that a form of "recycling" occurs in the soil. (p. 70). Students may think that plants get food the same way that animals do—through eating other things in their surroundings—rather than creating it within the plant (p. 76).

Making Sense of Secondary Science states that even after traditional instruction, students have difficulty accepting that plants make food from water and air, and that this is their only source of food. Understanding that the food made by plants is very different from other nutrients such as water or minerals is a prerequisite for understanding the distinction between plants as producers and animals as consumers (Roth & Anderson, 1987; Anderson et al., 1990).

Lower elementary school students can understand simple food links involving two organisms. They often think of organisms as independent of each other, but dependent on people to supply them with food and shelter. Upper elementary school students may not believe that food is a scarce resource in ecosystems. They may think that organisms can change what they eat at will according to the availability of particular sources (Leach et al., 1992). Students of all ages think that some populations of organisms are numerous in order to fulfill a demand for food by another population (Leach et al., 1992).

With regard to decay, some middle school students think dead organisms simply rot away. They do not realize that the matter from the dead organism is converted into other materials in the environment. Some middle school students see decay as a gradual, inevitable consequence of time that does not require decomposing agents (Smith & Anderson, 1986). Some high school students believe that matter is conserved during decay, but do not know where it goes (Leach et al., 1992).

Notes About Resources and Materials

Books

- Scott Foresman Reading Street Series Leveled Readers:

  Ecosystems of the Rain Forests

  The Battle Over the Rain Forests

  Tribes of the Amazon Rain Forests

- *Science Explorer: Environmental Science*. Upper Saddle River, NJ: Prentice Hall.

  Chapter 1, Living Things in the Environment, pp. 17–19; Interactions Among Living Things, pp. 31–38

  Chapter 2, Energy Flow in Ecosystems, pp. 44–50

- *Science Explorer: Cells and Heredity*. Upper Saddle River, NJ: Prentice Hall.

  Photosynthesis pp. 50–54; Respiration pp. 55–59

Book Lists Online

- http://ricat.net/cataloging/servlet/presentbooklistform.do?listID=5149152

Cells

- www.sciencenetlinks.com/lessons.php?BenchmarkID=11&DocID=101
- www.sciencenetlinks.com/lessons.php?BenchmarkID=11&DocID=88

Ecosystems

- www.sciencenetlinks.com/lessons.php?BenchmarkID=11&DocID=275
- www.accessexcellence.org/AE/AEC/AEF/1995/sinclair_ecosystem.php
- teacher.scholastic.com/ACTIVITIES/explorer/ecosystems/be_an_explorer

Food Webs

- www.gould.edu.au/foodwebs/kids_web.htm
- www.bigelow.org/edhab/fitting_algae.html
- http://seagrant.gso.uri.edu/factsheets/foodweb.html
- www.harcourtschool.com/activity/food/meadow_activity.html
- www.vtaide.com/png/foodchains.htm
- www.pbs.org/teachers/connect/resources/2805/preview

Photosynthesis and Respiration

- www.sheppardsoftware.com/content/animals/kidscorner/foodchain/photosynthesis.htm
- www.phschool.com/science/biology_place/biocoach/photosynth/overview.html
- www.pbs.org/wgbh/nova/methuselah/photosynthesis.html
- www.pbs.org/teachers/connect/resources/5319/preview
- www.pbs.org/teachers/connect/resources/4118/preview

Grade 6 Science, Quarter 1, Unit 1.2

Processes Within an Ecosystem—Part 2

Overview

Number of instructional days: 7 (1 day = 45 minutes)

Content to be learned

- Describe the basic processes of photosynthesis and respiration.
- Recognize the substances involved in photosynthesis and respiration.
- Trace the flow of energy through an ecosystem, beginning with the sun, through organisms in the food web, and into the environment.

Processes to be used

- Recognize processes within a system.
- Examine energy flow in systems.

Essential questions

- How do the basic processes of photosynthesis and respiration compare?
- What important role(s) within an ecosystem do photosynthesis and respiration play?
- How are photosynthesis and respiration involved in the flow of energy through ecosystems?

Written Curriculum

Grade Span Expectations

LS2 - Matter cycles and energy flows through an ecosystem.

LS2 (5-8) SAE– 6

Given a scenario trace the flow of energy through an ecosystem, beginning with the sun, through organisms in the food web, and into the environment (includes photosynthesis and respiration).

LS2 (5-6) –6 Students demonstrate an understanding of energy flow in an ecosystem by …

6b describing the basic processes and recognizing the substances involved in photosynthesis and respiration.

Clarifying the Standards

Prior Learning

In grades K–2, students cared for plants and animals, thereby identifying the survival needs of those organisms. They experimented with growing plants in varying conditions, such as light versus no light. In grades 3 and 4, students began to identify sources of energy with regard to organism survival. They have discussed characteristics of living organisms since kindergarten, but the terms *biotic* and *abiotic* were not introduced until the fourth quarter of grade 5 in the Heredity and Human Development unit of study. It is important to reinforce these definitions as they relate to the ecosystem.

Current Learning

Students understand from grade 5 that the sun provides energy and that energy is transferable as part of the energy cycle. (The idea of the energy cycle, starting with the sun, is at the reinforcement level.) At the developmental level, students need to describe the basic processes and recognize the substances involved in photosynthesis (taking in CO_2 and water while capturing sunlight to produce sugar [glucose] and oxygen) and plant respiration (releasing oxygen). Students also need to understand how the substances are created and used in relation with each other within the process.

Students describe and recognize the basic process and substances involved in photosynthesis and respiration. They also recognize how substances change through a process (photosynthesis and respiration). (Including water, oxygen, food web, decomposition, recycling, but not the carbon cycle and nitrogen cycle.)

Students should be able to demonstrate understanding of energy flow by describing photosynthesis and respiration as these processes relate to the survival of living organisms.

Future Learning

As students enter grades 7 and 8, they will develop understanding by analyzing the biotic and abiotic factors that affect an ecosystem, and they will predict the outcome of a change in biotic and abiotic factors. As they enter high school, students will begin to describe ways that humans and natural events can modify an ecosystem. By the end of high school, students should be able to define and give an example of equilibrium in an ecosystem.

Additional Research Findings

With regard to matter cycling, middle school students seem to know that some kind of cyclical process takes place in ecosystems (Smith & Anderson, 1986). Some students see only chains of events and pay little attention to the matter involved in processes such as plant growth or animals eating plants. They think the processes involve creating and destroying matter, rather than transforming it from one substance to another.

Other students recognize one form of recycling through soil minerals but fail to incorporate water, oxygen, and carbon dioxide into matter cycles. Even after specially designed instruction, students cling to their misinterpretations. Instruction that emphasizes the cycle of matter as it travels through the ecosystem may help correct these difficulties (Smith & Anderson, 1986).

Students tend to confuse energy and other concepts such as food, force, and temperature. As a result, students may not appreciate the uniqueness and importance of energy conversion processes like respiration and photosynthesis (Anderson et al., 1990). Although specially designed instruction does help students correct their understanding about energy exchanges, some difficulties remain (Anderson et al., 1990). Careful coordination between the *Physical Setting* and the *Living Environment* benchmarks about conservation of matter and energy and the nature of energy may help alleviate these difficulties (Anderson et al., 1990).

Grade 6 Science, Quarter 1, Unit 1.3

Characteristics of Living Organisms

Overview

Number of instructional days: 14 (1 day = 45 minutes)

Content to be learned

- Describe reproduction in terms of being essential for the continuation of a species.
- Define reproduction as a process through which organisms produce offspring.
- Recognize and illustrate the structural organization of an organism from a cell to tissue to organs to organ systems to organisms.

Processes to be used

- Describe patterns of change.
- Illustrate structural organization.
- Relate form to function.

Essential questions

- Why is reproduction essential to the survival of a species?
- What is the relationship between the structure and function of the various levels of organization in an organism?
- How can the structural organization of an organism be illustrated?

Written Curriculum

Grade Span Expectations

LS1 - All living organisms have identifiable structures and characteristics that allow for survival (organisms, populations, & species).

LS1 (5-8) POC -3

Compare and contrast sexual reproduction with asexual reproduction.

LS1 (5-6) –3 Students demonstrate an understanding of reproduction by …

3a defining reproduction as a process through which organisms produce offspring.

3b describing reproduction in terms of being essential for the continuation of a species.

LS1 (5-8) FAF –4

Explain relationships between or among the structure and function of the cells, tissues, organs, and organ systems in an organism.

LS1 (5-6) –4 Students demonstrate understanding of differentiation by…

4b recognizing and illustrating (e.g. flow chart) the structural organization of an organism from a cell to tissue to organs to organ systems to organisms.

Clarifying the Standards

Prior Learning

In grades K–2, students demonstrated understanding of an ecosystem by caring for plants and providing for their needs. Grade 1 students sequenced life cycles of plants and animals when given pictures of these organisms; however, the reproductive process was not presented.

Third-grade students demonstrated understanding of reproduction by sequencing the life cycles of plants and animals and comparing the life cycles of two organisms.

In grade 4, students demonstrated understanding of human body systems by comparing and analyzing external features and characteristics of humans and animals. Fifth-graders investigated and compared a variety of plant and animal life cycles. Students also identified cells as the building blocks of organisms.

Current Learning

Students learn about reproduction as it applies to structure and function. They may have a difficult time differentiating between sexual and asexual reproduction; therefore, it is important to emphasize how the process differs in plants and animals. This does not necessarily mean teaching human reproduction, but discussing the basic processes involved in beginning and continuing a species. Students have already demonstrated an understanding that reproduction is part of plant and animal life cycles; therefore, the reinforcement level of instruction should be used for this instruction.

Students begin by defining and describing the importance of reproduction as necessary for the survival of species. Activating students prior learning about the sequences involved in the life cycle of plants and animals is helpful in helping students make this next step in their understanding of reproduction.

Students demonstrate an understanding of differentiation by illustrating the levels of organization in an organism's cells, tissues, organs, and organ systems. They begin with cells, the building blocks of organisms. The developmental level of instruction is appropriate for this content because students have not studied this concept before. Students have already identified the cell as the building block of organisms. They now illustrate that there are many different types of cells and that the cells work together to form the next level of organization—tissues. Students learn that there are many different types of tissues that are organized into organs. They apply the same reasoning to illustrate that organs are organized into organ systems and finally the entire organism. This structural organization needs to be present in a format that shows how the levels become more and more complex and that each level has a structure that complements its function.

Future Learning

In grade 7, students will explain how cells have the same survival needs as organisms. They will observe and describe individual cells as seen through a microscope, targeting the cell membrane, cell wall, nucleus, and chloroplast. Students will observe, describe, and chart the growth, motion, and response of living organisms.

In grade 8, students will explain reproduction as a fundamental process by which a new individual receives genetic information from parent(s). Students should be able to describe forms of asexual reproduction that involve the genetic contribution of only one parent (for example, budding, vegetative propagation, etc.) and describe sexual reproduction as a process that combines the genetic material of two parents to produce a new organism (for example, sperm/egg, pollen/ova).

Eighth graders will explain that specialized cells perform specialized functions. They will also compare individual cells of tissues and recognize the similarities between cells and how they function together to perform specialized functions. Students will explain how each type of cell, tissue, and organ has a distinct structure and set of functions that serve the organism as a whole.

Additional Research Findings

According to *Benchmarks for Science Literacy*, preliminary research indicates that it may be easier for students to understand that the cell is the basic unit of structure (which they can observe) than that the cell is the basic unit of function (which has to be inferred from experiments) (Dreyfus & Jungwirth, 1989). Research also shows that high-school students may hold various misconceptions about cells after traditional instruction (Dreyfus & Jungwirth, 1988).

By the end of fifth grade, students know that babies result from the fusion of sperm and eggs. However, they often don't understand how the fusion brings new life. (Bernstein & Cowan, 1975; Goldman & Goldman, 1982).

Little has been published about students' understanding of cells or the dependence of organisms on one another and the environment or the flow of energy through the living environment. Research has focused on what students understand about the living environment at isolated points in time or on how this understanding evolves naturally in students. Research on instructional interventions that improve students understanding is limited. Reviews of research can be found in Carey (1985), Good et al. (1993), and Mintzes et al. (1991).

Notes About Resources and Materials

Books

- *Science Explorer: Human Biology and Health*. Upper Saddle River, NJ: Prentice Hall.

  Levels of Organization of the Body, pp.16–22

- *Science Explorer: Bacteria to Plants*. Upper Saddle River, NJ: Prentice Hall.

  Chapter 1, What is Life? pp. 16–33; Chapter 4, The Plant Kingdom, pp. 110–124

- *Science Explorer: Environmental Science*. Upper Saddle River, NJ: Prentice Hall.

  Chapter 1, Living Things in the Environment, pp. 17–19; Interactions Among Living Things, pp. 31–38

  Chapter 2, Energy Flow in Ecosystems, pp. 44–50

- *Science Explorer: Animals*. Upper Saddle River, NJ: Prentice Hall.

  How Cells are Organized, p. 17; Asexual Reproduction, p. 18

Sexual Reproduction

- www.factmonster.com/ce6/sci/A0860695.html

Plant Parents Lesson

- www.sciencenetlinks.com/lessons.php?DocID=91

Plant Propagation

- www.sciencenetlinks.com/lessons.php?DocID=22

Asexual Reproduction

- www.mrowen.com/sci10/biology/biology50.pdf
- http://regentsprep.org/Regents/biology/units/reproduction/asexual.cfm
- www.factmonster.com/ce6/sci/A0860694.html
- www.pbs.org/teachers/connect/resources/5690/preview