Grade 7 Science, Quarter 1, Unit 1.1

Processes Within an Ecosystem

Overview

Number of instructional days: 23 (1 day = 50 minutes)

Content to be learned

- Identify which biotic and abiotic factors affect a given ecosystem.
- Analyze how biotic and abiotic factors affect a given ecosystem.
- Predict the outcome of a given change in biotic and abiotic factors in an ecosystem.
- Use visual models to track population changes in an ecosystem.
- Explain the transfer of the sun's energy through living systems.
- Explain the effect of the transfer of the sun's energy on living systems.
- Diagram and sequence a series of steps to show how matter cycles among and between organisms and the physical environment.
- Develop a model for a food web of local aquatic and terrestrial environments.
- Conduct controlled investigations that show the total amount of matter is conserved when its form and location change as a result of the transfer of matter among and between organisms and the physical environment.

Processes to be used

- Make observations.
- Analyze data.
- Make predictions.
- Use, develop, and interpret models.
- Examine the flow of energy through systems.
- Analyze scenarios.
- Create diagrams.
- Conduct controlled investigations.

Essential questions

- How do biotic and abiotic factors affect an ecosystem?
- How could the impact of change in either biotic or abiotic factors in an ecosystem be predicted?
- How can population changes in ecosystems be tracked?
- What steps are involved in the cycling of matter among and between organisms and the physical environment?
- What kind of evidence from an investigation can be used to show that matter is conserved and then it cycles among and between organisms and the physical environment?

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 (7-8) –5 Students demonstrate an understanding of equilibrium in an ecosystem by …

5a identifying which biotic (e.g., bacteria, fungi, plants, animals) and abiotic (e.g., weather, climate, light, water, temperature, soil composition, catastrophic events) factors affect a given ecosystem.

5b analyzing how biotic and abiotic factors affect a given ecosystem.

5c predicting the outcome of a given change in biotic and abiotic factors in an ecosystem.

5d using a visual model (e.g., graph) to track population changes in 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 (7-8) –6 Students demonstrate an understanding of energy flow in an ecosystem by …

6a explaining the transfer of the sun's energy through living systems and its effect upon them.

6d creating or interpreting a model that traces the flow of energy in a food web.

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 (7-8)-7 Students demonstrate an understanding of recycling in an ecosystem by …

7a diagramming or sequencing a series of steps showing how matter cycles among and between organisms and the physical environment.

7b developing a model for a food web of local aquatic and local terrestrial environments.

7d conducting a controlled investigation that shows that the total amount of matter remains constant, even though its form and location change as matter is transferred among and between organisms and the physical environment (e.g., bottle biology, mass of a closed system over time).

Clarifying the Standards

Prior Learning

In grades K–2, students diagrammed and used information from a food web to determine basic needs within each food web. They distinguished between living and nonliving things and identified the sun as a source of heat. In grades 3 and 4, students identified sources of energy for the survival of organisms such as light or food as well as demonstrated that all animals' food sources begin with the sun as the basis of the energy source. In grades 5 and 6, students defined an ecosystem and identified the sun as the major source of energy. They sequenced energy flow in an ecosystem and completed a food web for a given ecosystem.

Current Learning

The reinforcement level of instruction is used for this unit of study. This unit reinforces the importance of photosynthesis and how energy flows through an ecosystem.

Students explain how matter cycles and energy flows through an ecosystem. Using data and observations, students predict outcomes when abiotic/biotic factors are changed in an ecosystem. Students demonstrate an understanding of equilibrium in an ecosystem by identifying which biotic (e.g., bacteria, fungi, plants, animals) and abiotic (e.g., weather, climate, light, water, temperature, soil composition, catastrophic events) factors affect a given ecosystem. Students analyze how biotic and abiotic factors affect a given ecosystem and predict the outcome of a given change in biotic and abiotic factors in an ecosystem. Students use a visual model (e.g., graph) to track population changes in an ecosystem.

Given a scenario, students 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). Students demonstrate an understanding of energy flow in an ecosystem by explaining the transfer of the sun's energy through living systems and its effect on them and by creating or interpreting a model that traces the flow of energy in a food web.

Given an ecosystem, students trace how matter cycles among and between organisms and the physical environment (includes water, oxygen, food web, decomposition, and recycling but not carbon cycle or nitrogen cycle). Students demonstrate an understanding of recycling in an ecosystem by diagramming or sequencing a series of steps showing how matter cycles among and between organisms and the physical environment. Students develop a model for a food web of local aquatic and terrestrial environments and conduct a controlled investigation that shows that the total amount of matter remains constant, even though its form and location change as matter is transferred among and between organisms and the physical environment (e.g., bottle biology, mass of a closed system over time).

Students must be able to analyze the slower processes and the effects of weathering, erosion, and mountain building. They analyze the rapid processes and effects of erosion, volcanoes, and earthquakes. Students investigate the effect of flowing water on landforms using a model or local environment.

Students perform investigations that demonstrate understand weathering and erosion. They conduct research and read articles that detail the effects of volcanic and earthquake activity. Students build/use models to better understand the effects of flowing water over landforms.

Students examine more comprehensive data from their investigations to make decisions about what they observe. Students use models and diagrams to understand the difference between fast and slow processes that shape the earth.

Future Learning

In grades and courses after grade 7, students will describe and predict how humans and natural events affect the equilibrium of ecosystems. They will explain how chemical elements and compounds cycle through all trophic levels. Students will evaluate evidence from multiple sources and then apply that information to environmental issues.

Additional Research Findings

According to *Benchmarks for Science Literacy*, by the end of grade 5, students should know that some source of "energy" is needed for all organisms to stay alive and grow (p. 119). By the end of grade 8, students should know that almost all food energy comes originally from sunlight. They should also know that matter remains constant, even though its form and location change (p. 120).

According to the *Atlas of Science Literacy*, students think organisms and materials in the environment are very different types of matter, see these substances are not transformable into each other, and tend to think that energy transformations involve only one form of energy at a time. Students do not realize that matter from dead organisms is converted into other materials in the environment. They seem to know that some kind of cyclical process takes place in an ecosystem (pp. 76, 78).

Notes About Resources and Materials

Books

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

  Chapter 1, Section 1, Living Things and the Environment, pp. 16–21 (Good information for students)

  Exploring Salt as an Abiotic Factor, p. 18

  Energy Flow in an Ecosystem, pp. 44–50

  Chapter 2, Section 2, Recycling of Matter through an Ecosystem, pp. 51–54 (Student information on cycles of matter)

Websites

- Biotic and Abiotic, background information on factors
  http://library.thinkquest.org/CR0210243/Science%20Station/How%20living%20things%20interact%20with%20their%20environment/relationship%20of%20biotic%20and%20abiotic%20factors.htm
- Analysis of Biotic and Abiotic Factors in Human-Altered Environments: Rice Fields, Cattle Grazed Marsh, and Marsh Cattle Exclusionary Zone—a completed study on factors in an environment
  http://library.thinkquest.org/CR0210243/Science%20Station/How%20living%20things%20interact%20with%20their%20environment/relationship%20of%20biotic%20and%20abiotic%20factors.htm
- Identifying Factors in the Environment (a short activity)
  http://library.thinkquest.org/CR0210243/Science%20Station/How%20living%20things%20interact%20with%20their%20environment/relationship%20of%20biotic%20and%20abiotic%20factors.htm
- Population Change: "Oh Deer"—a group simulation that shows how limiting factors affect population growth
  http://seplessons.ucsf.edu/node/140

- Tracing the energy flow through an ecosystem (an online activity that will have students use images to trace energy flow and create a map.)

  www.racerocks.com/racerock/education/curricula/projects/energyflow/odumrr.htm

- Developing a model for aquatic environments—developing a model of a food web (an interactive game and background information that should be applicable to local aquatic food webs)

  www.teachersdomain.org/resource/lsps07.sci.life.eco.oceanfoodweb

- Conducting a controlled investigation that shows the total amount of matter remains constant. (This should be done early in the unit, and data should be recorded daily.)

  http://www.eduref.org/cgi-bin/printlessons.cgi/Virtual/Lessons/Science/Ecology/ECL0014.html

Grade 7 Science, Quarter 1, Unit 1.2

Energy

Overview

Number of instructional days: 7 (1 day = 50 minutes)

Content to be learned

- Understand that energy is necessary for change to occur.
- Use data to draw conclusions about how heat can be transferred through radiation, conduction, and convection.
- Explain the difference among conduction, convection, and radiation.
- Create a diagram to explain how heat energy travels in different directions and through different materials by conduction, convection, and radiation.

Processes to be used

- Design diagrams, models, and analogies.
- Examine cause-and-effect relationships.
- Make scientific comparisons.
- Make scientific explanations.
- Identify patterns of change.
- Describe energy changes within a system.

Essential questions

- Why do conduction and radiation result in the transfer of energy?
- How is the motion of molecules in cool substances different from the motion of molecules in warmer substances?
- How is the movement of heat by convection different from heat transfer by conduction radiation?
- Why does the type of materials determine if energy travels by conduction, convection, and radiation?
- What determines the direction in which heat energy travels?
- What patterns of motion can be observed as heat travels from a heating element through a pot of boiling water and to the air near the heating element?

Written Curriculum

Grade Span Expectations

PS 2 - Energy is necessary for change to occur in matter. Energy can be stored, transferred, and transformed, but cannot be destroyed.

PS2 (5-8) INQ+SAE+POC – 7

Use data to draw conclusions about how heat can be transferred (convection, conduction, radiation).

7a designing a diagram, model, or analogy to show or describe the motion of molecules for a material in a warmer and cooler state.

7b explaining the difference among conduction, convection and radiation and creating a diagram to explain how heat energy travels in different directions and through different materials by each of these methods.

Clarifying the Standards

Prior Learning

Students in grades K–2 learned that the sun is a source of heat. They learned through experimentation observation and prediction that objects may change in temperature by adding and subtracting heat. Students also identified the sun as a source of energy and described observable effects of light using a variety of light sources.

Students in grades 3 and 4 described or demonstrated how heat can be produced in many ways. They used data to classify a variety of materials as conductors or insulators and predicted the observable effects of energy. Students described that heat can be produced in many and that heat moves from warm objects to cold objects until both objects are the same temperature. Students demonstrated an understanding that heat moves from one object to another causing a temperature change. They were introduced to light energy by investigating observable effects of light using a variety of light sources and predicted, described, and investigated how light rays are reflected, refracted, or absorbed. Students also demonstrated an understanding of energy by experimenting to identify and classify different pitches and volumes of sound produced by different objects.

Students in grades 5 and 6 differentiated among the different forms of energy and explained how energy may be stored. They used data to draw conclusions about how heat can be transferred. This was done by using real-world applications where heat energy is transferred showing the direction that heat energy flows. Students also identified real-world applications where heat energy is transferred and showed the direction that the heat energy flows. They differentiated among the properties of various forms of energy, explained how energy may be stored in various ways, and described sound as the transfer energy through various materials.

Current Learning

Instruction should be at the developmental level when teaching the motion of molecules. Students learn that all matter is made up of particles that are constantly in motion and that there is a direct relationship between the amounts of motion found in matter and the amount of heat that is being transferred. Students make diagrams showing that heat transfer is always in the direction from warmer to cooler and that this

transfer is a result of molecular motion. Transitioning from the unit on Properties of Matter, it is important to begin with the concept of energy and how it is needed to cause a change in matter. Determining differences among heat energy, thermal energy, and temperature is critical at this point to avoid common student misconceptions.

Students explain the differences between conduction, convection, and radiation and how heat travels through different materials through each of these methods. For example, heat causes molecules to move or vibrate faster. In conduction, the warm molecules come into contact with cooler molecules, transferring heat energy. This transfer of energy can be observed as an increase in temperature. Students can be asked to observe evidence of heat transfer by conduction and radiation by using a heat source to warm a row of chocolate chips that have been spaced along a metal strip. If the metal strip is placed slightly above the heat source, being careful not to allow the metal strip to touch the heat source, students are able to observe a pattern of heat transfer as the heat is transferred down the row of chips, causing the chips to melt starting closest to the heat source and then progressing along the row of chips. After an observation of this type of heat transfer, students could then be required to explain how the heat is transferred through radiation and conduction. Similar activities can be used to make it possible for students to observe convection and follow up their observations with scientific explanations.

Future Learning

In grade 8, students will use real-world examples to explain the transfer of kinetic to potential energy. They will explain that while energy may be stored, transferred, or transformed the total amount of energy will be conserved. Also in grade 8, students will learn about phase changes and molecular movement. In high school, students will go more in-depth into explaining the Law of Conservation of Energy and how it relates to the efficiency of a system. They will describe and diagram energy transformations that occur in different systems. They will also explain the Law of Conservation of Energy as it relates to the efficiency of a system. Students will also identify a given chemical reaction or a biological process as endothermic or exothermic based on the information provided.

Additional Research Findings

According to *Benchmarks for Science Literacy*, students tend to think energy is something needed to make things go or run, and they have difficulty distinguishing energy needs. Important ideas about energy include that all physical events involve transferring energy or changing one form of energy into another and that whenever energy is reduced in one place, it is increased somewhere else by exactly the same amount. Some of it is likely to transform into heat, which spreads around and therefore is not available for use (p. 81). Many students mistakenly think that cold spreads like heat (p. 84).

According to the *Atlas of Science Literacy*, the relation of heat energy to the disorderly motion of molecules contributes to the constant motion of molecules and a molecular explanation of changes of state (p. 58).

Middle-school students often believe liquids and gasses are not matter, or that these forms of matter are weightless. It is difficult for students of all ages to appreciate the very small size of particles as well as the intrinsic motion of particles within solids, liquids, and gasses (p. 54).

Middle-school students often attribute properties such has hotness and coldness to particles. Often there is belief that heat is produced due to the particles rubbing against each other (NSTA.org).

Notes About Resources and Materials

Websites

- National Science Teacher Association–Middle Level Resources

  www.nsta.org

Energy

- Light Pollution: This lesson investigates light pollution in the night sky.

  www.nsta.org/publications/interactive/laptop/lessons/m4.htm

- Solar Race Cars: Solar-powered cars, assembled by students, transform the school sidewalks into a mini racetrack.

  www.nsta.org/publications/interactive/laptop/lessons/m5.htm

- American Association of Physics Teachers

  www.aapt.org

- Activities around convection, conduction, and radiation

  www.PowerSleuth.org/teacher

Science Teacher Resources

- Energy transformation activities and information

  www-bioc.rice.edu/pblclass/6th%20grade/Matter%20&%20Energy/energy_transformation.htm

- Heat-transfer examples and activities

  www.nnin.org/nnin_k12energytransfer.html