Grade 7
Science
Unit 8: Food Webs and Cycles

Time Frame: Approximately two weeks

Unit Description

This unit focuses on food webs in ecosystems, with an emphasis on understanding the energy movement through food webs. Ecosystem cycles are included, with a particular emphasis on the nitrogen and carbon cycles.

Student Understandings

Students will exhibit an understanding of food webs as complex, illustrative models of energy transfers in a relatively closed system of living and nonliving components by using arrows to show the transfer of energy. A working knowledge of the various cycles associated with living systems (i.e., water, carbon, carbon dioxide/oxygen, and nitrogen) helps students understand the complexities of food webs. Students will demonstrate knowledge of the cycles by creating illustrative models and writing balanced chemical equations.

Guiding Questions

1. Can students construct a food web for an ecosystem and trace and describe the energy flow through the system?
2. Can students explain the importance of the nitrogen cycle to the survival of living organisms?
3. Can students describe the carbon cycle?
4. Can students describe the role of photosynthesis?
5. Can students explain the importance of water as a resource?

Unit 8 Grade-Level Expectations (GLEs)

GLE #	GLE Text and Benchmarks
Science as Inquiry	
Note: The following Science as Inquiry GLEs are embedded in the suggested activities for this unit. Other activities incorporated by teachers may result in additional SI GLEs being addressed during instruction on the Food Webs and Cycles unit.	
3.	Use a variety of sources to answer questions (SI-M-A1)
11.	Construct, use, and interpret appropriate graphical representations to collect, record, and report data (e.g., tables, charts, circle graphs, bar and line graphs, diagrams, scatter plots, symbols) (SI-M-A4)
16.	Use evidence to make inferences and predict trends (SI-M-A5)
19.	Communicate ideas in a variety of ways (e.g., symbols, illustrations, graphs, charts, spreadsheets, concept maps, oral and written reports, equations) (SI-M-A7)
37.	Critique and analyze their own inquiries and the inquiries of others (SI-M-B5)
Life Science	
7.	Construct a word equation that illustrates the processes of photosynthesis and respiration (LS-M-A4)
24.	Analyze food webs to determine energy transfer among organisms (LS-M-C2)
34.	Explain how environmental factors impact survival of a population (LS-M-D2)
Science and the Environment	
35.	Identify resources humans derive from ecosystems (SE-M-D2)
39.	Analyze the consequences of human activities on ecosystems (SE-M-A4)
40.	Construct or draw food webs for various ecosystems (SE-M-A5)
41.	Describe the nitrogen cycle and explain why it is important for the survival of organisms (SE-M-A7)
42.	Describe how photosynthesis and respiration relate to the carbon cycle (SE-M-A7)

Sample Activities

Activity 1: Food Webs (SI GLEs: 11, 19, 37; LS GLE: 24; SE GLEs: 40)

Materials List: Internet access, pictures of organisms, glue or tape, science learning logs, Feeding Relationships BLM (one per student), chart paper

Ask students to list and identify both the foods and their sources that they have eaten in the past twenty-four hours and to create a food chain with this information in their science *learning logs* (view literacy strategy descriptions). Science *learning logs* are student-created booklets wherein

students can record information. The science *learning logs* created for this activity can be used throughout this unit as the activities relate to each other. Explain that a food chain shows direct feeding relationships of organisms, beginning with plant life and ending with an animal. Students should correctly draw the arrows, illustrating the direction of the flow of energy from one organism to another. Allow students to compare their food chains and discuss any misconceptions that they may have.

Activate students' prior knowledge about food webs by asking them to identify organisms that live in their region and place this list on the board. Explain that types of consumers are described by words derived from Latin, such as the following: *vorare* means to devour, *omnis* means all, *herba* means grass, *caro* means flesh. Using this information, explain the terms *omnivore, herbivore,* and *carnivore*.

After presenting this information to students, provide them with a copy of the Feeding Relationships BLM and allow them to further classify their list identifying each type of consumer as an omnivore, herbivore, or carnivore. Discuss the general feeding relationships of the organisms identified and draw lines illustrating the direction of the flow of energy from one organism to another. Explain that most animals are interconnected because they are part of more than one food chain.

Provide students with a visual illustration of a food chain and food web (one is available online at http://www.sciencebob.com/lab/webchainpics.html) to (1) show the interaction of different producers and consumers in an ecosystem, (2) emphasize how they are good visual organizers that illustrate the different flows of energy among organisms, and (3) demonstrate how each organism is important to the survival of the ecosystem. Help students to see that a food web illustration shows much more than just "who is eaten by whom." Following the discussion, ask students to list in their *learning logs* what information is learned from looking at a food web that is not available on a food chain. Afterwards, fill in any blanks or clear up any confusing relationships. Explain that organisms in every environment are part of a food web.

Provide students with pictures of organisms and allow them to create a food web by gluing the pictures to chart paper and drawing lines to show the proper feeding relationships. Students should critique and analyze the food webs created by their peers. Students may also create a printable online food web at http://www.vtaide.com/png/foodchains.htm.

Activity 2: Energy Transfer (SI GLEs: 11, 19; LS GLE: 24, 34; SE GLEs: 35, 40)

Materials List: yarn, large index cards, 1 liter soft drink, 100 ml graduated cylinder, one eye dropper/pipette, clear plastic cups, science learning logs

Through a question-and-answer period, elicit student understanding of how energy flows through and sustains ecosystems in which the organisms process energy and cycle nutrients. A diagram of the energy pyramid can be found at http://www.vtaide.com/png/foodchains.htm. Students should understand that the Sun is the primary source of energy for all of Earth's organisms. Food webs begin with the first trophic (feeding) level, where primary producers create the energy-

storing molecules used by all living matter. In the second trophic level, primary consumers obtain energy by eating producers. Higher up a food web, primary and secondary consumers feed on other animals.

Explore with students how much energy is lost when it is transferred from lower levels to higher levels. Plants use only a very low percentage of the energy carried in the sunlight that reaches them. Grazing animals retrieve only about 10 percent of the energy stored in the plants they eat; the other 90 percent escapes through the animal as heat or is locked into molecules that are not easily digested and therefore eliminated as waste. Roughly 90 percent of the rest of the available energy in the food web is lost after it passes from herbivores through a series of carnivores. Students should create a model of a food pyramid showing the transfer of energy at each level and write a summary of their understanding in their science *learning logs* (view literacy strategy descriptions), including sketches/drawings as appropriate. *Learning logs* are student-created booklets wherein students can record information. An activity that models the flow of energy in a simple food chain is available online at http://www.schools.utah.gov/curr/Science/sciber00/8th/energy/sciber/ecosys.htm. Following the directions at the site, this activity can be completed as a demonstration.

Discuss with students the results of environmental factors such as habitat destruction or natural events that can limit the resources of an ecosystem as well as impact that survival of populations in those ecosystems. Describe the effect of both factors.

Stand in the center of a student circle and hold a package of yarn. Distribute hanging neck cards with the names of consumers on them. Pass the yarn to a student and allow that student to pass the yarn to something that they would consume. Continue the activity until all students have consumed something or have been consumed. At the end of the activity the yarn should resemble a food web. Students should realize that this illustrates the flow of energy from one organism to another. Ask students how humans benefit from the transfer of energy flowing through a system and discuss their responses.

Have students list several types of ecosystems found in Louisiana and to identify the major producers and consumers, in addition to the resources that humans derive from them. Research organisms found in one habitat chosen by the class to study. Explain that their research should include the animals' food habits and natural predators. Have students classify, by trophic level, several organisms in the chosen habitat

Assign student groups ecosystems to explore. Have them construct food webs using pictures and other materials as needed.

Activity 3: Cycles (SI GLEs: 11, 19; LS GLE: 7; SE GLEs: 41, 42)

Materials List: science learning logs, one empty cereal box per student, old magazines, newspaper, tape, glue, scissors, transparencies of the nitrogen and carbon cycles, long strips of paper (two per student), Cycles and More BLM (one per student), the video *Carbon: The Element of Surprise* or a similar video or program

Provide students a copy of the Cycles and More BLM, a *split-page note taking* sheet (view literacy strategy descriptions), to record information about each cycle. This literacy strategy allows students to record important information in a *two-column* format (a sample comment has been provided), with the main ideas and key vocabulary in the left column and the supporting details in the right column. Demonstrate for students how to review their notes by covering information in one column and using the other column to recall the covered information. Students should also be allowed to quiz each other over the content of their notes in preparation for tests and other class activities. (The BLM master has been started, but more information may be added as needed.)

Activating prior knowledge, display transparencies of the nitrogen cycle and the carbon cycle without labels. An explanation of each cycle is available at http://www.geography4kids.com/files/cycles_carbon.html, while pictures of the carbon cycle are available at http://www.physicalgeography.net/fundamentals/9r.html and pictures of the nitrogen cycle are available at http://www.physicalgeography.net/fundamentals/9s.html.
Through probing questions, review the major components of both cycles. Provide students with two long strips of paper and instruct them to list the steps of each cycle on one of the strips and to then create a paper moebius strip for each cycle, following the instructions available online at http://mathforum.org/sum95/math_and/moebius/moebius.html *How to Make a Moebius Strip.* Upon completion of the strips, discuss how cycles are continuous, having no beginning or end, relating this to the moebius strips that the students created.

Review and define the process of photosynthesis by directing students to illustrate this process in their science *learning logs (*view literacy strategy descriptions) through the use of pictures or student drawings. *Learning logs* are student created booklets used for recording information. Allow time for students to share their illustrations. Next, instruct students to add words to their illustrations. Now, without help, students should write a word equation for *photosynthesis*. Again, allow students to share their completed equation. Discuss the proper equation and correct any misconceptions students may have encountered. Using the same process, instruct students to write the word equation for *cellular respiration* following the same process until students are able to write a balanced chemical equation for both photosynthesis and cellular respiration.

Using a think-pair-share strategy, ask students to explain why the nitrogen cycle is important to organisms and jot down questions or thoughts they may have about the topic in their science *learning log*. During the pairing session, have students refer to the diagrams of the nitrogen and carbon cycles used from above for help in developing explanations and asking their partners questions. Continue teacher questioning and student sharing until you are satisfied with their level of understanding of the nitrogen cycle. Explain to students that the nitrogen-fixing bacteria (*rhizobium*) are the only means on Earth for nitrogen gas to be converted into a compound usable by other living organisms. Without these bacteria, they would not be able to consume nitrogen compounds used in making proteins and DNA in their bodies. Following this same strategy, have students explain how photosynthesis and respiration relate to the carbon cycle.

Students should view the video, *Carbon: The Element of Surprise,* available from the LPB Cyberchannel (www.lpb.org/cyberchannel) or other similar video to help understand how carbon

cycles through a system. Explain the importance of the carbon cycle and its by-products to humans. Ask students the following questions:

- How is peat important in the formation of fossil fuels?
- How is carbon obtained?
- What types of carbon compounds are involved?
- How do photosynthesis and cellular respiration relate to the carbon cycle?

Note: There are many school libraries and teachers who have copies of the LPB Envirotacklebox™ video, *Carbon: The Element of Surprise*. The website http://www.lpb.org/education/classroom/itv/envirotacklebox/ also provides additional teacher information that could be useful for this activity.

As a review of the carbon and nitrogen cycles, instruct students to create a cycle box. This can be created using empty cereal boxes that have been covered with construction or bulletin-board paper. Students should use old magazines and newspapers, to display pictures of items that relate to the cycle they choose. Students will present their cycle boxes to the class, explaining how the pictured items relate to their displayed cycle. The discussion of other cycles, such as the water and phosphorus cycles, can be included during this lesson.

Students are to write summarizing statements of their understandings of the nitrogen and carbon cycles in their science *learning logs,* using diagrams where appropriate.

Activity 4: Let It Rain on the Sparta (SI GLEs: 3, 11, 16, 19; SE GLEs: 35, 39)

Materials List: Internet access and library resources, globe, blank strips of paper (several per student), 9-oz clear plastic cup (one per student), re-sealable plastic sandwich bag filled with ¾ cup of pea-size gravel (one per student), scissors, Importance of H_2O BLM (one per student), Water Source Cards BLM (one per group), Groundwater Fact Flash article (one per student), What is an Aquifer? BLM (one per group)

Provide students an individual copy of the Importance of H_2O BLM *graphic organizer* to complete (view literacy strategy descriptions) by identifying the ways in which living things use water. A *graphic organizer* is a way for students to arrange information to show relevance. An example has been added to the graphic organizer to stimulate student thought. Students should be encouraged to add more lines as necessary. Allow students to share this information with the class and discuss how water is an essential and necessary resource that humans derive from their ecosystem.

Review the processes of the water cycle and introduce the term *hydrosphere,* as it relates to water on Earth, by showing students a globe and leading a discussion that compares the amount of Earth's surface covered by land area to that covered by water.

Place students in groups and provide them a copy of the Water Source Cards BLM to cut and arrange (these cards can be pre-cut to expedite the process) the water locations according to the amount present in the hydrosphere, from greatest to least. Allow students to determine the

criteria for listing water sources *quantitatively* and have them first predict an ordered list of water sources from largest to smallest, then share the correct order with them. The correct order of water arranged from largest to smallest is oceans, icecaps and glaciers, groundwater, lakes, soil, moisture, and rivers. From the list, ask students to identify the most common potable water source for humans (groundwater).

Continuing in small groups of four, provide each member a copy of the article Groundwater Fact Flash, in addition to the What is an Aquifer? BLM, to complete during their reading. The Ground Water Fact Flash article is available online at http://epa.gov/superfund/students/clas_act/haz-ed/ff_05.htm. This article will be used to complete a *DR-TA* (view literacy strategy descriptions). This strategy is used to help students comprehend text by making predictions and then checking their predictions during and after the reading.

Introduce the article by providing a brief description that will activate the students' thoughts in order for them to generate questions that will be answered during the reading.

Form small groups and instruct students to use all available resources (Internet, textbook, and library) to acquire information, including statistics about the Sparta Aquifer. Sparta facts may be obtained at http://pubs.usgs.gov/fs/fs-111-02 or http://www.spartaaquifer.com/. The Sparta Aquifer is an underground drinking water source for north Louisiana, south Arkansas, and west Mississippi. It ranges from 50 to 700 feet thick in Louisiana, with thickness increasing toward the south and southeast. Sparta Aquifer water levels are declining at rates ranging from one to five feet per year across much of northern Louisiana and south Arkansas because of major pumping and other factors. Information about other aquifers in Louisiana may be obtained from http://www.deq.louisiana.gov/static/305b/1996/305b-f.htm.

Information obtained will be used for developing a possible plan to help reduce the problem and share with the class. To complete this task each group should list general uses of water in the aquifer, analyze the consequences of human activities to both the quality and quantity of water, and make a prediction about its continued use. Students living in an area served by the Sparta should interview city officials about projects involving the preservation of this aquifer. For students that live in an area not served by the Sparta Aquifer, they should identify their water source and investigate the status of it, along with developing measures to preserve the integrity of their water source.

Use the Importance of H_2O BLM *graphic organizer* chart to review, discuss, and add facts about the Sparta. Using this information, students can create a slogan that could be used on a bumper sticker that would promote water conservation.

Sample Assessments

General Guidelines

Assessment will be based on teacher observation/checklist notes of student participation in unit activities, the extent of successful accomplishment of tasks, and the degree of accuracy of oral and written descriptions/responses. Journal entries provide reflective assessment of class discussions. Performance-based assessment should be used to evaluate models and presentations. All student-generated work, such as drawings, data collection charts, models, etc., may be incorporated into a portfolio assessment system.

- Students should be monitored throughout the work on all activities.
- All student-developed products should be evaluated as the unit continues.
- When possible, students should assist in developing any rubrics that will be used and should be provided with the rubric during task directions.

General Assessments

- The student will trace energy through a given food web.
- The student will construct a model of a food web within a specific ecosystem.
- The student will construct a moebius strip model of a biogeochemical cycle.
- The student will enter in journals descriptions of nitrogen and carbon cycles and their importance to humans.

Activity-Specific Assessments

- Activity 1: Provided a list of organisms, students should create a food web showing the proper transfer of energy, identifying consumer relationships.

- Activity 2: Students will create an energy pyramid, displaying the proper amount of energy transferred at each level.

- Activity 3: Students will write a short paragraph, explaining the importance of the carbon cycle to life on Earth.

Resources

- *Carbon Cycle*. Available online at http://www.physicalgeography.net/fundamentals/9r.html
- *Food Chains*. Available online at http://www.arcytech.org/java/population/facts_foodchain.html
- *Food Chain Information.* Available online at *http://www.pbs.org/edens/etosha/fm_foodchain.htm*
- *GEMS: Terrarium Habitats.*
- *How to Make a Moebius Strip*. Available online at http://mathforum.org/sum95/math_and/moebius/moebius.html
- *Nitrogen Cycle.* Available online at http://www.physicalgeography.net/fundamentals/9s.html
- *Marsh Market* WOW! The Wonders of Wetlands
- *Illuminating Photosynthesis* http://www.pbs.org/wgbh/nova/methuselah/photosynthesis.html
- *The Sparta Aquifer: A Sustainable Water Resource.* Available online at *http://pubs.usgs.gov/fs/fs-111-02/#a*
- *Carbon: The Element of Surprise video.* Available through Louisiana Public Broadcasting's Cyberchannel www.lpb.org/cyberchannel
- *Exploring the Environment: Earth on Fire.* Available online at
- http://www.cotf.edu/ete/modules/carbon/efremote4.html
- What is the Carbon Cycle? Available online at *http://library.thinkquest.org/11226/why.htm*