STREAM *LŌKAHI*

How is *lōkahi* (balance, harmony) evident in the cycles of matter and energy in a stream community?

HAWAIʻI DOE STANDARD BENCHMARKS

Science 3: Life and Environmental Sciences - ORGANISMS AND THE ENVIRONMENT

- **SC.5.3.1** Describe the cycle of energy among producers, consumers, and decomposers.
- **SC.5.3.2** Describe the interdependent relationships among producers, consumers, and decomposers in an ecosystem in terms of the cycles of matter.

KEY CONCEPTS

- Energy from the sun flows through the stream food web from the plants through the animals that consume them.
- Matter is cycled within the stream food web through the exchange of oxygen and carbon dioxide and the recycling of nutrients through the action of decomposers that break down dead and decaying organisms.

ACTIVITY AT A GLANCE

Students classify stream life cards according to the role that organisms play in a food chain. They then use the cards in a game to reinforce how energy flows through the food chain.

ASSESSMENT

Students:

- Diagram and describe the flow of energy among producers, consumers, and decomposers (food chains, food webs).
- Illustrate the relationships (carbon dioxide and oxygen exchange) among producers, consumers, and decomposers in a stream ecosystem.

TIME

3 class periods

SKILLS

classify, diagram, synthesize

MATERIALS

Provided:

- ✓ stream life cards (both color and black and white sets are provided in Unit Resources)
- ✓ Learning Log 2
- ✓ game instructions

Needed:

- ✓ box to hold stream life cards
- ✓ scissors
- ✓ paper clips
- ✓ tape

VOCABULARY

carnivore – an animal that eats other animals
decomposer – an organism that feeds on dead plants and animals and helps break them down into nutrients to be used again by plants
diadromous - migratory between fresh and salt water
endemic – unique to an area; naturally occurring only in that place
endangered – in danger of becoming extinct
hapawai and *hīhīwai* – native snails found in Hawaiʻi streams
herbivore – an animal that eats plants
indigenous – naturally occurring in one area, but not unique to that area
larvae – early stages of an animal that must undergo metamorphosis to mature
lōkahi – balance, harmony
nutrient – any matter that promotes growth and provides energy
omnivore – an organism that eats both plants and animals
ʻoʻopu – native stream fishes; gobies
ʻōpae kalaʻole – native shrimp that live in fast-moving riffles in streams
ʻōpae oehaʻa – native prawn
plankton – tiny plants and animals that float or drift in aquatic environments
photosynthesis – the production of carbohydrates using sunlight energy to combine carbon dioxide and water in the presence of chlorophyll
producer – plant that makes its own food using energy from the sun
riffles – fast-moving areas of water in a stream

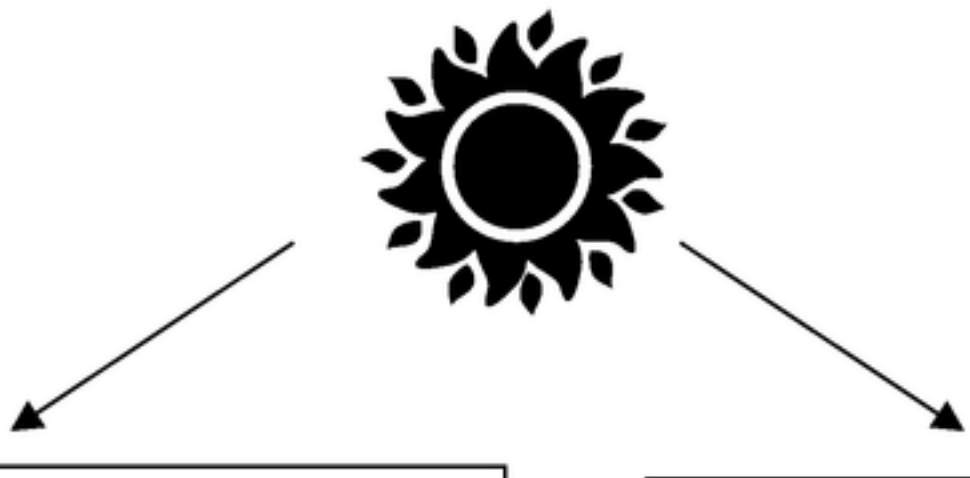
ADVANCE PREPARATION

- ☐ Copy stream life cards (3 sets of producers and 1 set of herbivores, omnivores, carnivores and decomposers. Note: the color set has producer cards; the black and white set does not).
- ☐ Laminate the cards and cut them out (without identifying labels on the front of the cards). Clip the sets together to distribute to students.
- ☐ Make a copy Learning Log 2 for each student.

TEACHER BACKGROUND INFORMATION

The Flow of Energy

The sun gives off electromagnetic radiation (e.g., visible light) that is converted into two useful forms of energy:



Thermal or Heat Energy: This energy increases the vibration of electrons resulting in heat. It can also be re-radiated back to space. Thermal energy warms the earth, heats the atmosphere, drives the water cycle and produces air and water currents.

Chemical Energy: Some special molecules convert light energy into chemical energy by storing it in their chemical bonds (for example, photosynthetic pigments in plants absorb light energy and convert and store it in the chemical bonds of sugar).

Energy flows through the stream ecosystem, beginning with the **producers** (plants). They convert light energy into chemical energy through the process of photosynthesis. Most of the energy produced by the plants is lost as heat energy. The remaining energy is stored as chemical energy in the bonds of organic molecules. This is the energy available to the herbivores and the decomposers when the plants are eaten.

Herbivores and **omnivores** consume energy stored in plants. Most of the energy consumed is used by the animals in the process of respiration. Through the process of respiration the animals convert the chemical energy stored in the bonds of organic molecules into energy that they use for life processes--growing, moving, reproducing, and finding food. The energy not respired is stored in the animals and available to the carnivores - the next level of the food chain.

Carnivores and **omnivores** obtain chemical energy from eating herbivores.
Decomposers or scavengers play a critical role by breaking down wastes and dead plants and animals. Prawns feed on small pieces of plant and animal matter, breaking it down so that bacteria can finish the job and make nutrients available for the plants.

At each level in the food chain, most of the energy consumed by plants and animals is used for maintenance, growth and reproduction. Approximately 10 percent is stored and available to the next level in the food chain.

Cycles of Matter

These feeding relationships help to maintain *lōkahi* (balance, harmony) in the stream community through the cycling of nutrients from one feeding level in the food chain to the next. Herbivores break down cellulose in plants and provide food for carnivores. Carnivores keep the herbivore and omnivore populations from getting too large. And decomposers help to recycle nutrients from wastes and from dead and decaying organisms, making the nutrients available to the plants. Decomposers consist of two groups: the larger organisms, such as the snails and prawns that help to break down matter into smaller parts, and the bacteria that feed on the wastes and make the nutrients available to plants.

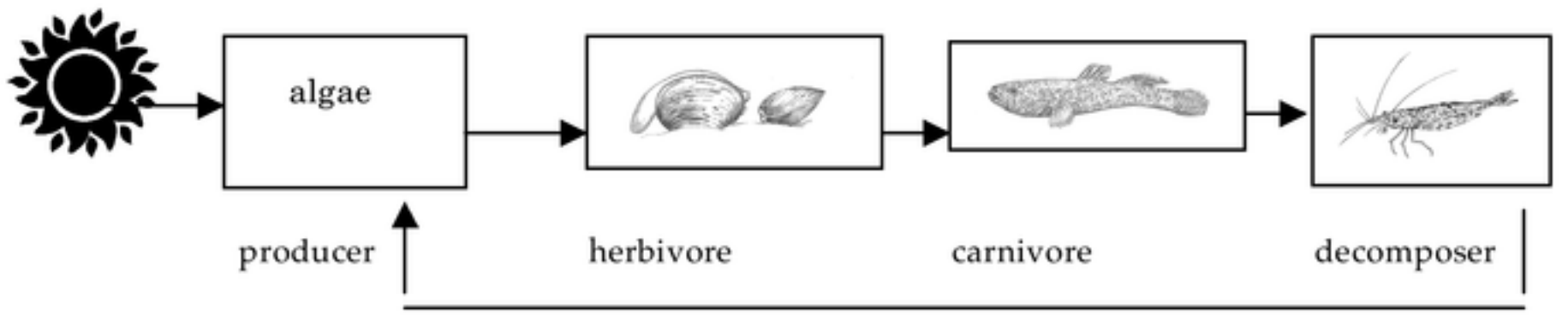
Oxygen and carbon dioxide are cycled in the stream through the processes of photosynthesis and respiration. Plants give off oxygen (O_2) in the process of photosynthesis. Through their respiration, animals take up the oxygen and release carbon dioxide, which the plants utilize. Plants absorb carbon dioxide (CO_2) through stomata (tiny openings on the underside of their leaves).

Teaching Suggestions

1. **Introduce the essential question and standard benchmarks students are working on in this lesson.**

2. **Help students discover the roles of stream organisms.**
   - Divide the class into five teams and give each team a set of one group of stream life cards (producers, herbivores, omnivores, carnivores or decomposers).
   - Explain that each team has a group of organisms that play the same role in the stream community.
   - Challenge teams to discover what role the organisms play. If they need a hint to get going, let them know that the role of the organisms have to do with getting energy.
   - Ask teams to show their organisms to the rest of the class and explain the role that they play in the stream.
   - As students define these roles, review the vocabulary introduced in the Water Words game in Lesson 1 and then add the term "producers" to the Water Words vocabulary board.

3. **Work with students to make a food chain, using a stream life card from each category.** Tape the cards to the board and discuss how the energy captured by the sun is transferred as each animal in the food chain obtains food.



4. **Draw an arrow from the decomposer back to the plant and discuss how matter is recycled in the stream through the action of decomposers.**
- Introduce the term *lōkahi* (balance, harmony) and discuss how the relationships among organisms help to maintain balance in the stream.

5. **Play a "Go Fishing" card game to reinforce students' understanding of food chains. See game directions provided at the end of the lesson.**

6. **After the game, initiate a class discussion about the flow of energy in the food chains. Chart the key ideas on the board as they are discussed.**

   Discussion Questions
   - Could the food chain exist without the plants in the stream? Explain. (No. The producers are vital since they convert the light into chemical energy and store it for animals to feed upon.)
   - What would happen if all of the carnivores were taken out of the stream? (There would be too many omnivores and carnivores, and they would not have enough food to survive. The system would be out of balance; *lōkahi* would be lost.)
   - What is another way that plants and animals depend on one another for survival? (Hint: Take a deep breath. Where does your oxygen come from?)

7. **Introduce or review the exchange of oxygen and carbon dioxide between plants and animals.**
- Write the following statement on the board and discuss the process of photosynthesis:

  6 molecules of water + 6 molecules of carbon dioxide produce
  ⟶ 1 molecule of sugar + 6 molecules of oxygen

- Discuss the process of respiration where animals breathe in the oxygen and exhale carbon dioxide that the plants need.

8. **Distribute Learning Log 2 and review it with students.**

- Challenge students to write a story that describes what is happening in the picture, including how the energy flows among the plants and animals. Ask them to use colored pencils or watercolors to add color to the picture.
- On the back of the page, ask them to draw a picture to show how plants and animals in a stream exchange carbon dioxide and oxygen.

ADAPTATIONS / EXTENSIONS

Challenge students to create a stream *lōkahi* display to share with other students in the school. Their display could include some of their poetry, papers, or illustrations.

Have students use string and tape to connect stream life cards into food chains that can be hung and displayed in the classroom.

REFERENCE

M.J. Farabee, Text © 2007. *Photosynthesis*. An excellent Web site with diagrams, enlarged pictures of plant stomata, and explanation of photosynthesis. All rights reserved. Use for educational purposes is encouraged. Retrieved May 14, from http://www.emc.maricopa.edu/faculty/farabee/BIOBK/BioBookPS.html