Name _____ Date _____ Class _____

Energy Flow in Ecosystems

Guide for Reading

- What energy roles do organisms play in an ecosystem?
- How does energy move through an ecosystem?
- How much energy is available at each level of an energy pyramid?

An organism's energy role is determined by how it obtains energy and how it interacts with the other living things in its ecosystem. **Each of the organisms in an ecosystem fills the energy role of producer, consumer, or decomposer.**

Plants, algae, and some bacteria can carry out photosynthesis. In this process, the organism uses the sun's energy to turn water and carbon dioxide into sugar molecules. An organism that can make its own food is a **producer.** Producers are the source of all the food in an ecosystem.

Other organisms cannot make their own food. They depend on producers for food and energy. An organism that obtains energy by feeding on other organisms is a **consumer.** Consumers are classified by what they eat. Consumers that eat only plants are called **herbivores.** Consumers that eat only animals are called **carnivores.** A consumer that eats both plants and animals is called an **omnivore.** A **scavenger** is a carnivore that feeds on the bodies of dead organisms. An organism may play more than one role in an ecosystem.

Organisms that break down wastes and dead organisms and return the raw materials to the environment are called **decomposers.** As decomposers obtain energy for their own needs, they return simple molecules to the environment to be used again by other organisms.

The movement of energy through an ecosystem can be shown in diagrams called food chains and food webs. A **food chain** is a series of events in which one organism eats another and obtains energy. The first organism in a food chain is always a producer. The second organism, called a first-level consumer, eats the producer. The next consumer, called a second-level consumer, eats the first-level consumer. A food chain shows just one possible path of energy through an ecosystem.

Most producers and consumers are part of many food chains. A more realistic way to show the flow of energy through an ecosystem is a food web. A **food web** consists of the many overlapping food chains in an ecosystem.

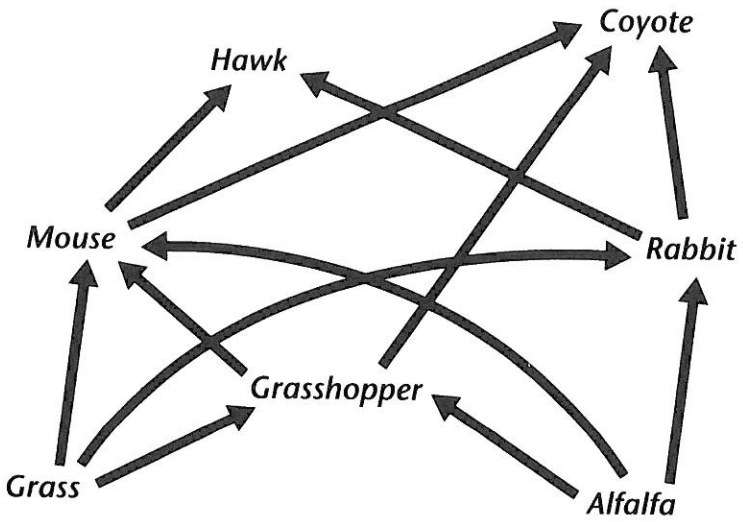
When an organism makes its own food or eats other organisms, it obtains energy. The organism uses most of this energy for its own life processes. Only some of the energy will be available to the next organism in the food web. A diagram called an **energy pyramid** shows the amount of energy that moves from one feeding level to another in a food web. **The most energy is available at the producer level of the pyramid. As you move up the pyramid, each level has less available energy than at the level below.** In general, only about 10 percent of the energy at one level of a food web is transferred to the next higher level. For this reason, most food webs have only three or four feeding levels, with few organisms at the highest level in a food web.

Name _____ Date _____ Class _____

Energy Flow in Ecosystems

Understanding Main Ideas

Answer the following questions on a separate sheet of paper.



1. Which organism in the food web above is sometimes a first-level consumer and sometimes a second-level consumer? Explain.
2. Choose one food chain in the web. Name all the organisms in that chain. Start with the producer and end with the top-level consumer.
3. Draw an energy pyramid for the food chain you chose. Label the pyramid to tell how much food energy is available at each level.

Building Vocabulary

On a separate sheet of paper, write the term that fits each definition below.

4. Organisms that make their own food
5. Organisms that obtain energy by feeding on other organisms
6. Organisms that break down wastes and dead organisms and return the raw materials to the environment
7. Consumers that eat only animals
8. Consumers that eat only plants
9. Consumers that eat both plants and animals
10. Consumers that feed on the bodies of dead organisms

Name _____ Date _____ Class _____

Food Webs at Hydrothermal Vents

Deep below the ocean's surface are strange ecosystems called hydrothermal vents. Here, heated water rises up through cracks in the ocean floor. The water contains minerals from Earth's interior. No sunlight ever reaches these vents. No plants or algae live there. The table below lists the organisms found at hydrothermal vents.

Life at a Hydrothermal Vent

Organisms	Obtain food energy from...
Shrimp	Bacteria in the water
Crabs	Remains of other organisms
Giant clams	Bacteria in the water
Bacteria	Make their own food from chemicals in the water
Giant tube worms	Bacteria living inside their bodies

Use the information in the table to respond to the following items.

1. Which organisms are the producers at hydrothermal vents?

   _____

2. Which organisms are first-level consumers?

   _____

3. What type of consumer are the crabs?

   _____

4. In the space below, draw the food web at a hydrothermal vent. Label each organism to identify its energy role in the ecosystem.

Name _____ Date _____ Class _____

Cycles of Matter

Guide for Reading

- What three major processes make up the water cycle?
- How are carbon and oxygen recycled in ecosystems?
- What is the nitrogen cycle?

Matter is recycled in ecosystems. Matter includes water, oxygen, carbon, nitrogen, and many other substances. Three of the most important cycles of matter are the water cycle, the carbon-oxygen cycle, and the nitrogen cycle.

The **water cycle** is the continuous process by which water moves from Earth's surface to the atmosphere and back. **The processes of evaporation, condensation, and precipitation make up the water cycle. Evaporation** is the process by which molecules of liquid water absorb energy and change to the gas state. Water evaporates from Earth's surface and forms water vapor, a gas, in the atmosphere. The process by which a gas changes to a liquid is called **condensation.** When water vapor in the atmosphere cools, it turns back into tiny droplets of liquid water. As more water vapor condenses, the drops grow larger and heavier. Eventually, the heavy drops fall back to Earth as a form of **precipitation**—rain, snow, sleet, or hail.

Carbon is the building block for the matter that makes up the bodies of living things. **In the ecosystem, the processes by which carbon and oxygen are recycled are linked. Producers, consumers, and decomposers play roles in recycling carbon and oxygen.** Producers take in carbon dioxide from the atmosphere during photosynthesis. In this process, the producers use carbon from the carbon dioxide to produce other carbon-containing molecules. These molecules include sugars and starches. Consumers obtain energy from these molecules by breaking them down into simpler molecules. The consumers release water and carbon dioxide as waste products of the process. At the same time, producers release oxygen during photosynthesis. Other organisms take in oxygen from the atmosphere and use it in their life processes.

Like carbon, nitrogen is a necessary building block in the matter that makes up living things. **In the nitrogen cycle, nitrogen moves from the air to the soil, into living things, and back into the air.** Most organisms cannot use nitrogen gas in the air. Nitrogen gas is called "free" nitrogen because it is not combined with other kinds of atoms. Most organisms can use nitrogen only when it has been "fixed," or combined with other elements to form nitrogen-containing compounds. The process of changing nitrogen gas into a usable form of nitrogen is called **nitrogen fixation.** Most nitrogen fixation is performed by certain kinds of bacteria. Some of these bacteria live in bumps called nodules on the roots of certain plants. Once the nitrogen has been fixed, it can be used by organisms to build proteins and other complex substances. Decomposers break down these complex compounds. Decomposition returns simple nitrogen compounds to the soil. Certain types of bacteria break down the nitrogen compounds completely. These bacteria release free nitrogen back into the air, and the cycle starts again.

Name _____ Date _____ Class _____

Cycles of Matter

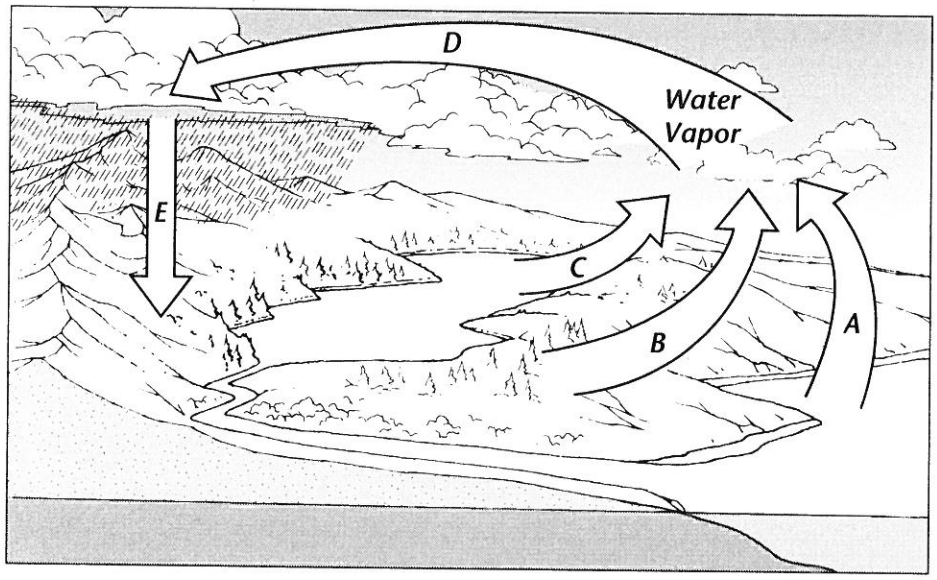
Understanding Main Ideas

Answer the following questions on a separate sheet of paper.

1. What is the source of energy for the process of evaporation?
2. What happens to rainwater that falls on land?
3. How are oxygen and carbon cycled between plants and animals?
4. Why are nitrogen-fixing bacteria so important to other organisms?

Building Vocabulary

Answer the following questions in the spaces provided.



5. Which cycle is shown in the diagram above?

_____

6. Identify each process labeled in the diagram.

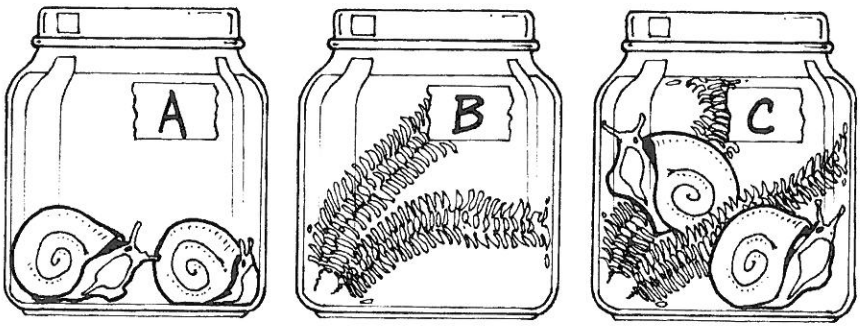
   a. _____
   b. _____
   c. _____
   d. _____
   e. _____

Name _____ Date _____ Class _____

Testing for Oxygen and Carbon Dioxide

Bromthymol blue (BTB) is a chemical that turns yellow in the presence of carbon dioxide. In the presence of oxygen, BTB stays blue. In his science class, Sanjay used BTB to test for the presence of those two gases in three situations.

Sanjay's Procedure



Sanjay labeled three small jars A, B, and C. In Jar A, he put two aquatic snails. In Jar B, he put two sprigs of *Elodea*, an aquatic plant. In Jar C, he put two snails and two sprigs of *Elodea*. Sanjay added BTB solution to the jars so the snails and *Elodea* sprigs were covered. Then he put the lids on tightly and placed the jars in a sunny place.

Sanjay's Results

Sanjay examined the jars every day for three days. These are the observations he recorded.

Jar	Observations
A	The BTB solution turned yellow.
B	The BTB solution stayed blue.
C	The BTB solution stayed blue.

Analyze and Conclude

Answer the following questions on a separate sheet of paper.

1. Why did the BTB solution in Jar A turn yellow?
2. Why did the BTB solution in Jar B stay blue?
3. Why did the BTB solution in Jar C stay blue?
4. Which jar showed what happens during the carbon and oxygen cycles in nature? Describe the process that occurred in that jar.