

# Flow of Energy in Ecosystems

## Reflect

Animals, including humans, get their **energy** by eating other organisms. For example, you may have eaten an apple at breakfast that provided your body with energy later in the day. Where did the energy stored in the apple come from? We know that energy cannot be created or destroyed, so where does the source of energy in living systems begin, and how does it move through these systems?



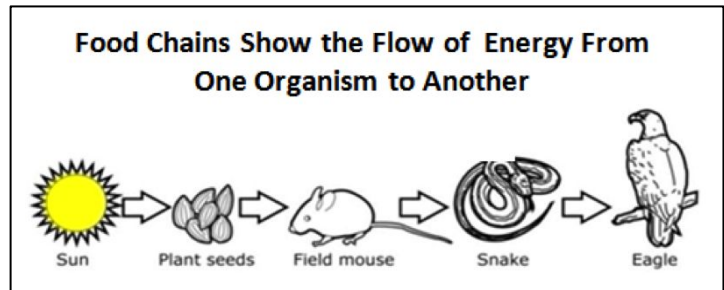
**energy** – the ability to do work or cause change



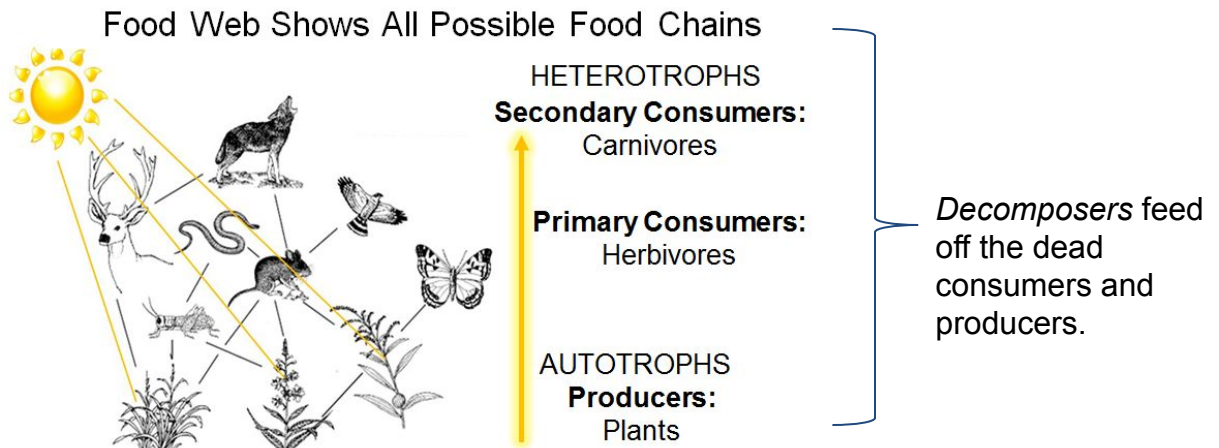
### Energy flows through ecosystems.

When you push on the first of a series of lined-up dominoes, the energy from your push is transmitted from one domino to the next. Your push represents the energy that started the movement. This energy moves along the line as each domino topples into the next.

Energy also moves from a starting point through living systems in a one-way direction shown in a *food chain*. This movement is described as a flow of energy. The sun is the major starting point for most of the living things on Earth.



*Food webs* are models that demonstrate how matter and energy are transferred between producers, consumers, and decomposers as the three groups interact within the connected food chains in an ecosystem. Transfers of matter into and out of the physical environment occur at every level. Eventually, decomposers recycle nutrients from dead plant or animal matter back to the soil in terrestrial environments or to the water in aquatic environments. The atoms that make up the organisms in an ecosystem are cycled repeatedly between the living and nonliving parts of the ecosystem.



# Flow of Energy in Ecosystems

## Trophic Levels in an Ecosystem

Energy flows in an ecosystem from one trophic level (feeding level) to the next. All organisms can also be classified as either autotrophs or heterotrophs.

- **Autotrophs**

- **Producers:** The first trophic level includes organisms that are called producers, or autotrophs, because they produce their own food. *Auto-* refers to “self,” and *troph-* refers to “feeding,” so autotrophs are self-feeders. Producers include plants, algae, and some bacteria that use photosynthesis to make their own food.

- **Heterotrophs**

- **Consumers:** The second trophic level of organisms get energy by eating other organisms. Consumers are further classified by the type of food eaten and by how many trophic levels of energy are involved.

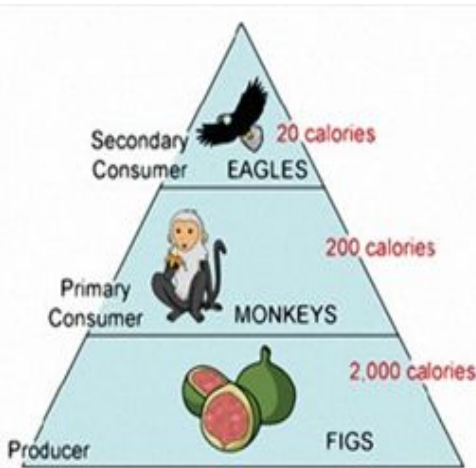
Herbivore	Carnivore	Omnivore
<ul style="list-style-type: none"><li>● It only eats producers (the root word <i>herb</i> refers to plants).</li><li>● They are also called <i>primary consumers</i>, because they are the first level in a food chain.</li><li>● Examples are rabbits, squirrels, and cows.</li></ul>	<ul style="list-style-type: none"><li>● It only eats other animals (the root word <i>carn</i> refers to meat).</li><li>● They can be <i>secondary consumers</i> (if they eat primary consumers) or <i>tertiary consumers</i> (if they eat secondary consumers).</li><li>● Examples are snakes, hawks, and lions.</li></ul>	<ul style="list-style-type: none"><li>● It eats both plants and animals.</li><li>● They can be primary consumers or secondary consumers, depending on what they choose to eat in a particular situation.</li><li>● Examples are raccoons, brown bears, and humans.</li></ul>

- **Decomposers:** Decomposers break down dead or decaying consumers and producers via chemical reactions and use the energy released from rearranging those molecules for growth and development. Decomposers can be fungi or bacteria.

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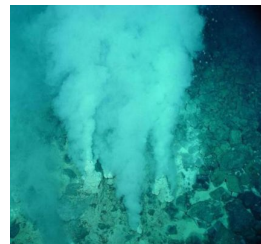
## Look Out!

Remember these important concepts about the flow of energy in ecosystems:



- Not all trophic levels of a food chain receive the same amount of energy. Only about 10% of the sun's energy absorbed by plants is transferred to the consumers at the next trophic level. Where does 90% of the energy go? Some of it is used to fuel body processes such as growth, repair, and reproduction. Most of it is transferred to the atmosphere as heat. We can represent the energy flow of an ecosystem in an energy pyramid. The different levels of the pyramid represent the different groups of a food chain or food web. The producers are found at the bottom of the pyramid. The more levels there are in a pyramid, the less energy is available to the organism at the top.

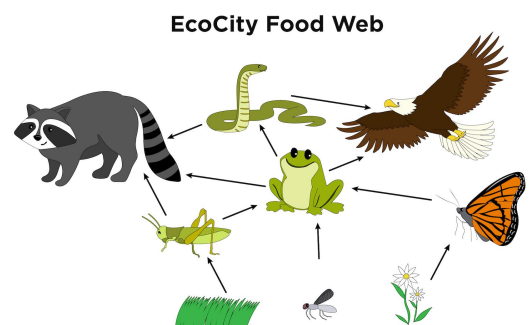
- Energy moves through an ecosystem in a single direction. First it flows from the sun to autotrophs, or *producers*. Then it flows from producers to *consumers*. Energy never flows backward from consumers to producers.
- When you draw a food chain, always begin with energy from the sun to a producer. Don't forget that the arrows should point to the organism receiving the energy.
- A small percentage of organisms use sulfur compounds from volcanic sea vents deep in the ocean as their source of energy. Instead of using sunlight in photosynthesis, these organisms use chemicals to aid in chemosynthesis. They make their own food, just like in photosynthesis.



## Reflect

**In terrestrial ecosystems, food webs involve organisms that live on land.**

A food chain is useful for tracing energy flow, but it only tells part of the story. A *food web* shows the complexity of interactions between the different trophic levels. The terrestrial food web on the right shows several overlapping food chains. The producers are plants. Insects such as grasshoppers and butterflies are primary consumers that eat the plants. Frogs and raccoons are secondary consumers that eat insects, and snakes and eagles are tertiary consumers (also carnivores) that eat secondary consumers.



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## What Do You Think?

Take a look at the terrestrial food web to the right. Identify each organism as one or more of the following.

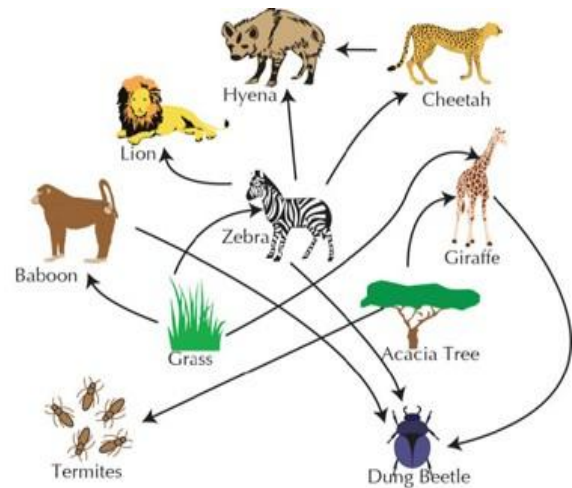
**Producer** (autotroph):

**Primary consumer** (heterotroph):

**Secondary consumer** (heterotroph):

**Tertiary consumer** (heterotroph):

Which organisms do you think would consume the dead plant and animal matter in this ecosystem?



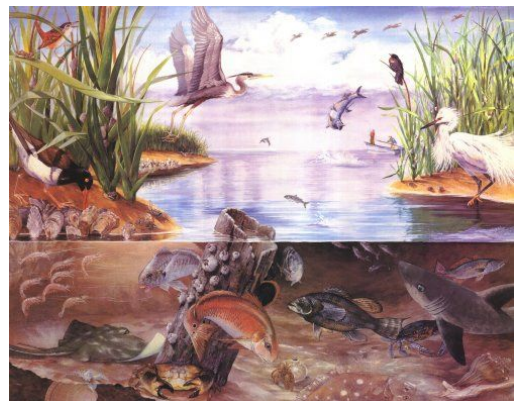
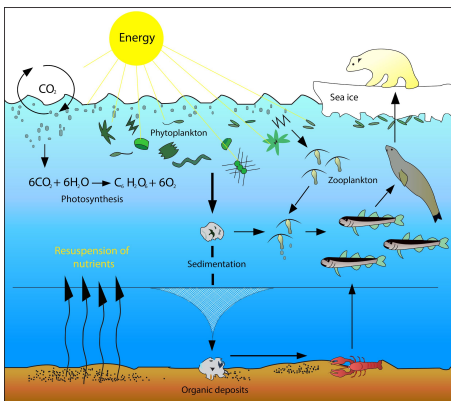
## Look Out!

In aquatic ecosystems, food webs involve organisms that live in water.

Aquatic ecosystems make up the largest part of our *biosphere*, the part of Earth that is able to support life. *Aquatic ecosystems* include marine and freshwater ecosystems.

- *Marine ecosystems* are saltwater environments such as oceans, coral reefs, and salt marshes.
- *Freshwater ecosystems* are water environments with a very low salt content and include rivers, streams, and ponds. Like all ecosystems, aquatic ecosystems consist of food webs with producers and consumers.





Tiny aquatic plants called *phytoplankton* are the main producers in aquatic ecosystems. Algae are a common type of phytoplankton. Tiny aquatic animals called *zooplankton* and small animals without backbones called *invertebrates* are primary consumers that feed on phytoplankton. Fish and larger aquatic life eat these primary consumers and make up the higher consumer levels of the food chain.



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## Try Now

Study the images below. Identify the trophic levels shown in each image. Write “producer,” “primary consumer,” “secondary consumer,” or “tertiary consumer” next to the image in the right column of the table.

Image	Trophic Level
	Squirrel:  Nut:
	Bear:  Fish:
	Caterpillars:  Leaf:
	Bird:  Insect:  Tree: