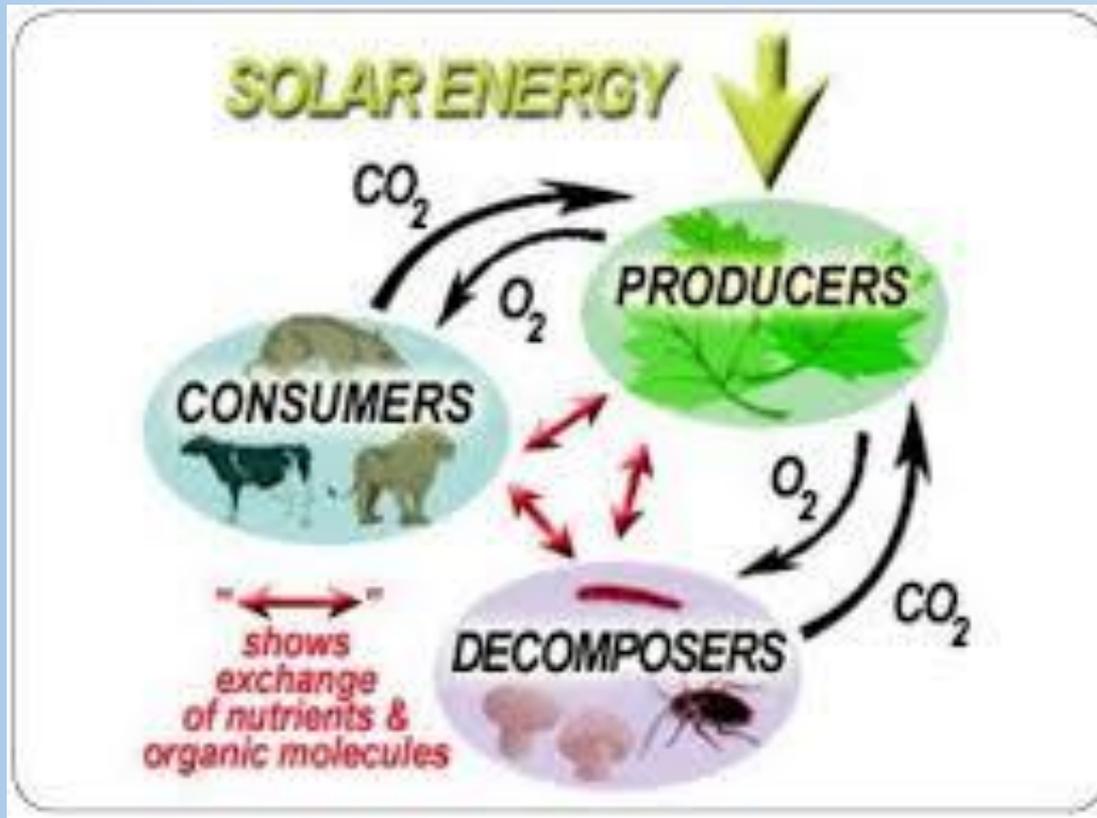
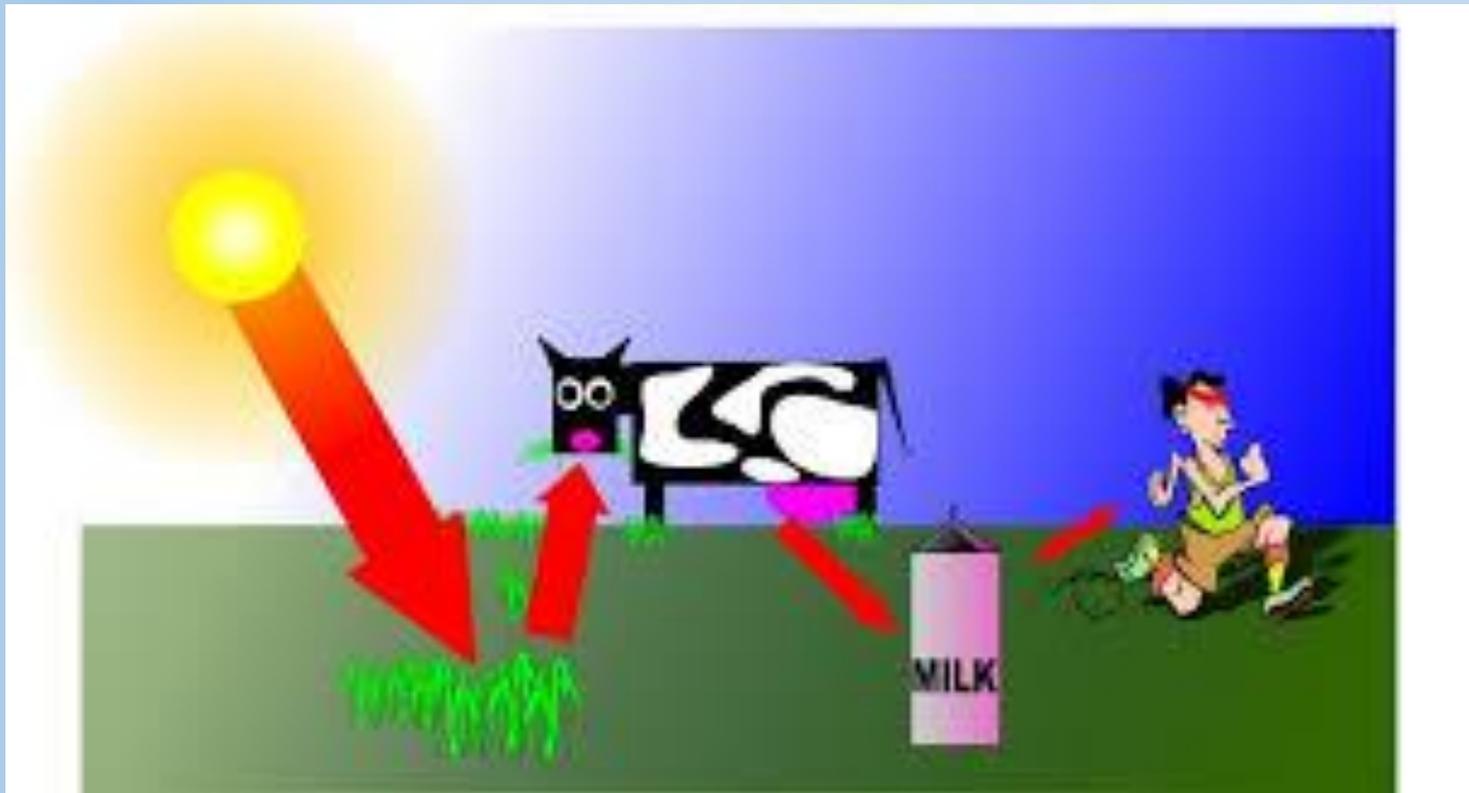


# Energy Transfer in Ecosystems



# Where does the energy for life come from?

- The sun begins the process of energy transfer within the ecosystem



# Solar energy enters the biosphere through photosynthesis and cellular respiration.

**Table 4.4** Comparing Photosynthesis and Cellular Respiration

	Photosynthesis
1. What is it?	A series of chemical changes in which green plants capture the Sun's light energy and transform it into chemical energy that is stored in energy-rich food compounds such as sugars
2. Which living things use it?	Green plants and certain kinds of single-celled organisms
3. How is energy changed?	Light energy is changed to chemical energy
4. What substances does it use?	<ul style="list-style-type: none"><li>• carbon dioxide (CO<sub>2</sub>)</li><li>• water (H<sub>2</sub>O)</li></ul>
5. What substances does it produce?	<ul style="list-style-type: none"><li>• glucose (C<sub>6</sub>H<sub>12</sub>O<sub>6</sub>)</li><li>• oxygen (O<sub>2</sub>)</li></ul>
6. How can it be represented?	light energy + carbon dioxide + water → glucose + oxygen light energy from the Sun + CO <sub>2</sub> + H <sub>2</sub> O → C <sub>6</sub> H <sub>12</sub> O <sub>6</sub> + O <sub>2</sub>
7. Why is it important?	<ul style="list-style-type: none"><li>• Photosynthesis transforms the Sun's energy into a form that living things can use to survive</li><li>• Photosynthesis produces the oxygen that most living things need to survive</li></ul>

# Cellular Respiration

Cellular Respiration	
A series of chemical changes that let living things release the energy stored in energy-rich food compounds such as sugars to fuel all life functions	1. What is it?
Nearly all living things on Earth	2. Which living things use it?
Chemical energy is changed to other forms of energy such as kinetic (motion) energy and heat	3. How is energy changed?
<ul style="list-style-type: none"> <li>glucose (C<sub>6</sub>H<sub>12</sub>O<sub>6</sub>)</li> <li>oxygen (O<sub>2</sub>)</li> </ul>	4. What substances does it use?
<ul style="list-style-type: none"> <li>carbon dioxide (CO<sub>2</sub>)</li> <li>water (H<sub>2</sub>O)</li> </ul>	5. What substances does it produce?
glucose + oxygen → carbon dioxide + water + usable energy $C_6H_{12}O_6 + O_2 \rightarrow CO_2 + H_2O + \text{usable energy}$	6. How can it be represented?
<ul style="list-style-type: none"> <li>Cellular respiration releases the energy that living things use to survive</li> <li>Cellular respiration produces the carbon dioxide that green plants need to carry out photosynthesis</li> </ul>	7. Why is it important?

# Photosynthesis and Cellular Respiration Balance Each Other

Photosynthesis and cellular respiration balance each other

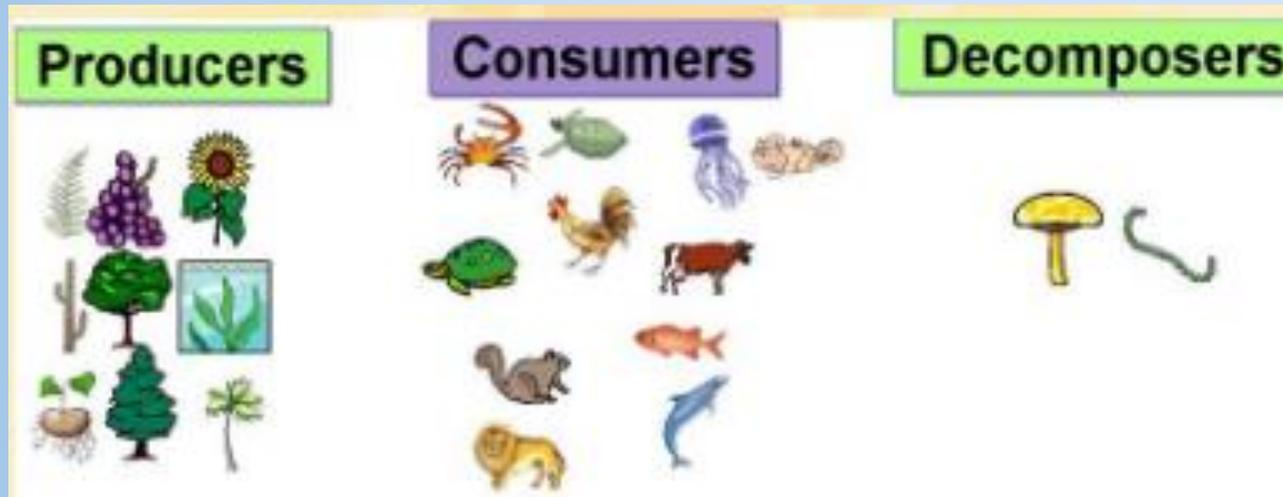
- Each process makes the raw materials that the other processes needs to store or release energy:
  - Photosynthesis stores energy; Cellular respiration releases energy
  - Photosynthesis uses carbon dioxide and water, and produces glucose and oxygen
  - Cellular respiration uses glucose and oxygen, and produces carbon dioxide and water

## Discussion Questions

1. What forms of energy are transformed during photosynthesis and cellular respiration?
2. Which substances are used and produced by photosynthesis and by cellular respiration?

# Producers transfer energy to consumers and decomposers.

- **Producers:** Living things that make their own food to get the energy they need
- **Consumers:** Living things that eat producers or other consumers to get the energy they need
- **Decomposers:** living things that break down dead organic material to get the energy they need



# Food Chains Chart the Flow of Energy from Producers to Consumers

**Food chain:** A model that describes how food energy is passed from one living thing to another

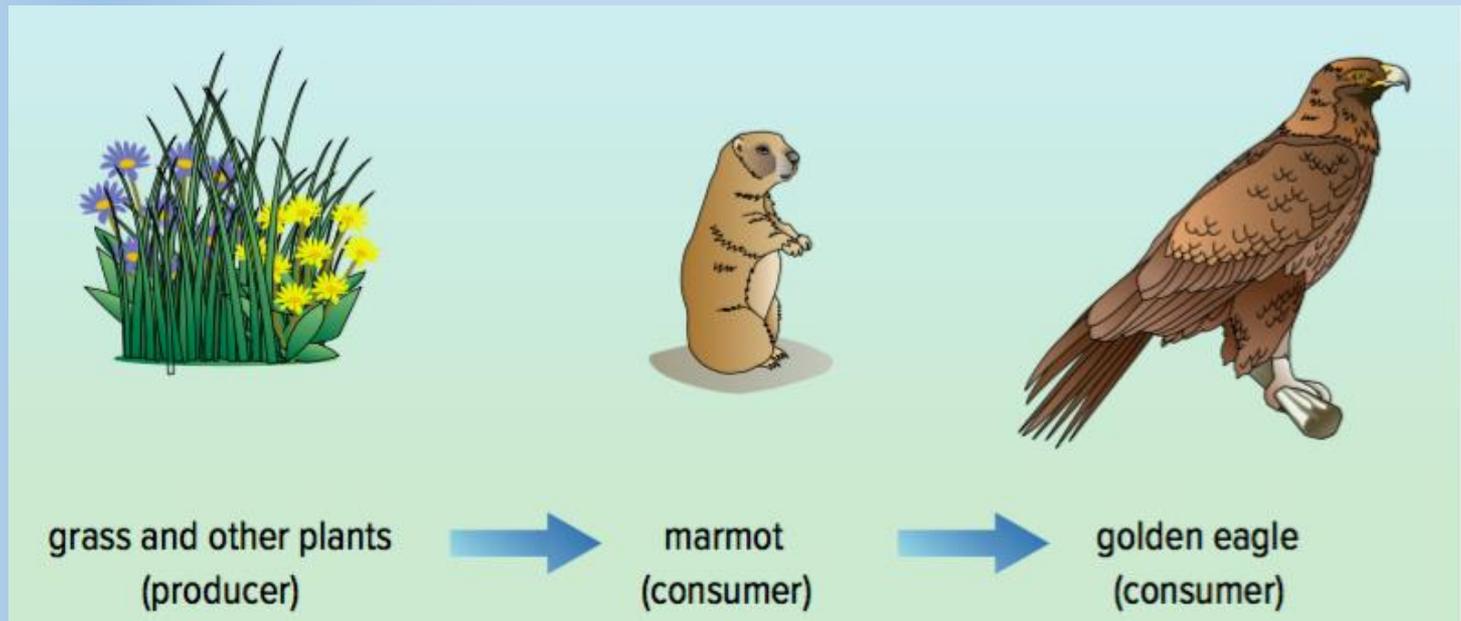


Figure 4.12: The terrestrial mountain ecosystem food chain has three links, with one producer and two consumers.

# Food Webs Show How Food Chains Are Connected

**Food web:** A model of feeding relationships shows a network of interacting and overlapping food chains

- A change in the number of one organism could affect several food chains in the food web
- All organisms in an ecosystem are connected and depend on each other for survival

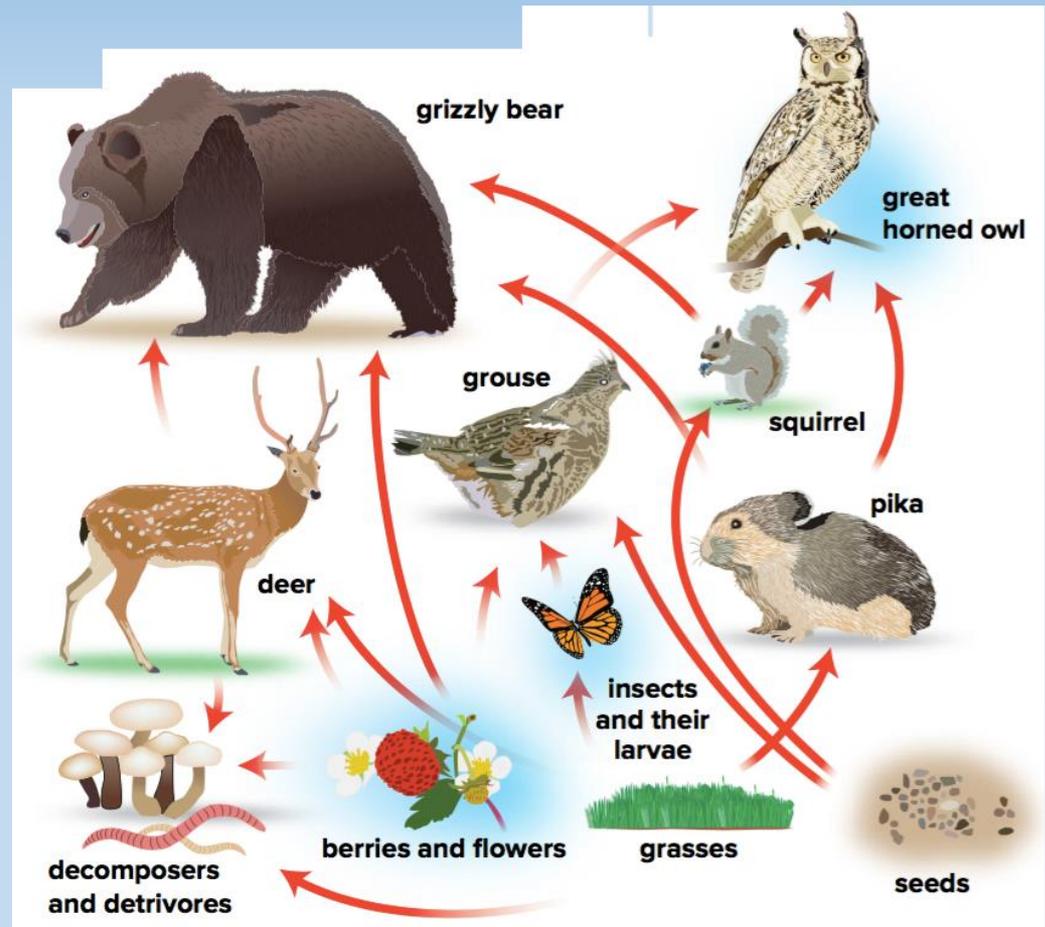


Figure 4.13: An food web that might be found in B.C.'s alpine regions

## Discussion Questions

1. Compare and contrast producers, consumers, and decomposers.
2. A food web is a more realistic model for feeding relationships in an ecosystem than a food chain. Explain why.

# Interactions are needed to provide a constant flow of energy to sustain the biosphere.

Why are there limits to the length of a food chain?

- Most of the energy transferred from one organism to another is lost to the environment as unusable heat
- Some energy has already been used to support life functions (growth, cellular respiration)
- Some energy is stored in wastes that are excreted
- Less and less energy is available to each organism in the food chain

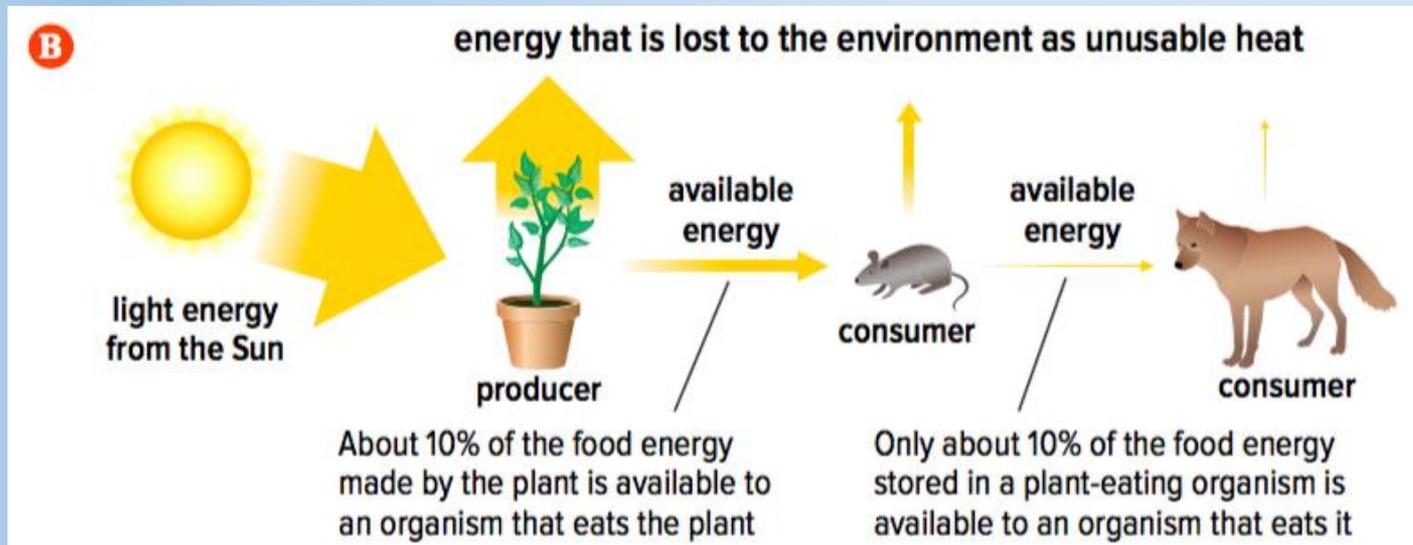
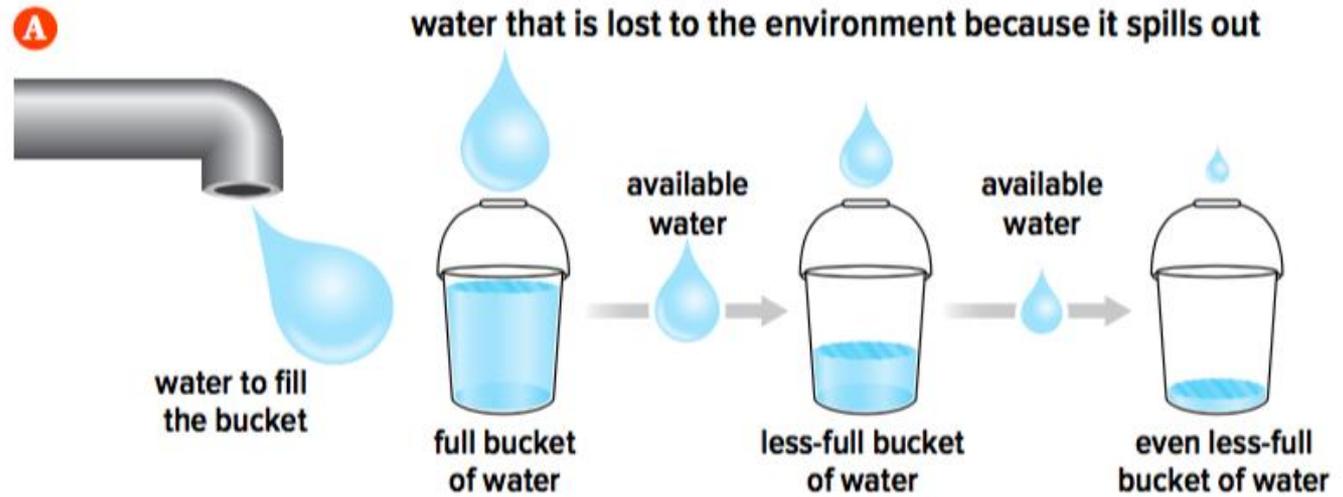
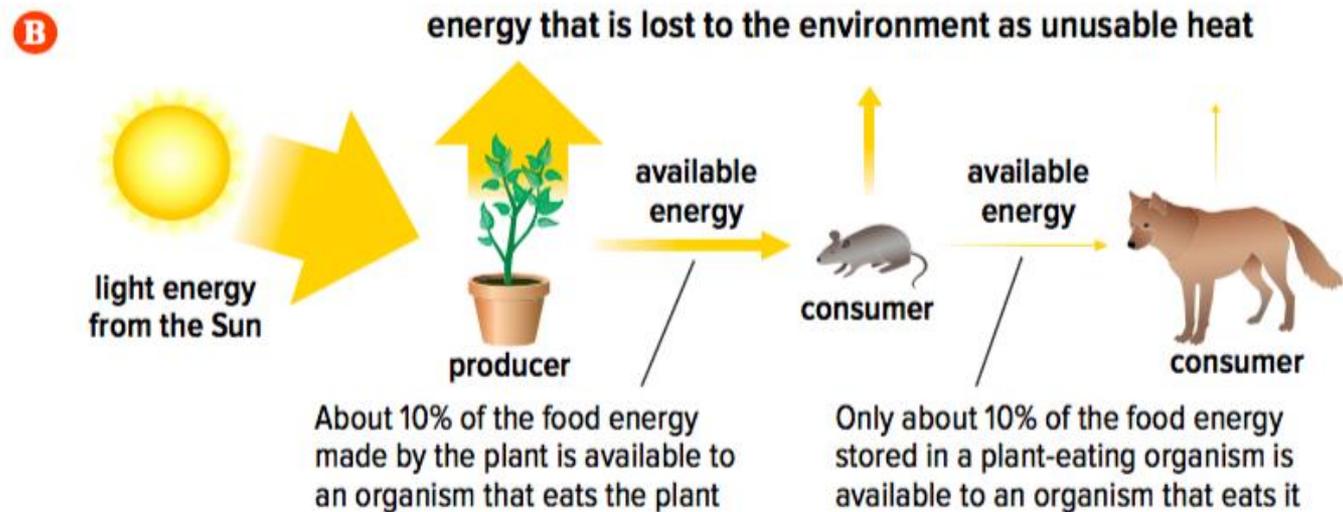


Figure 4.14: A) Most of the water in the bucket that is transferred from one player to another in a bucket-toss relay game is lost to the environment. Less and less water is in the bucket for each player in the relay.



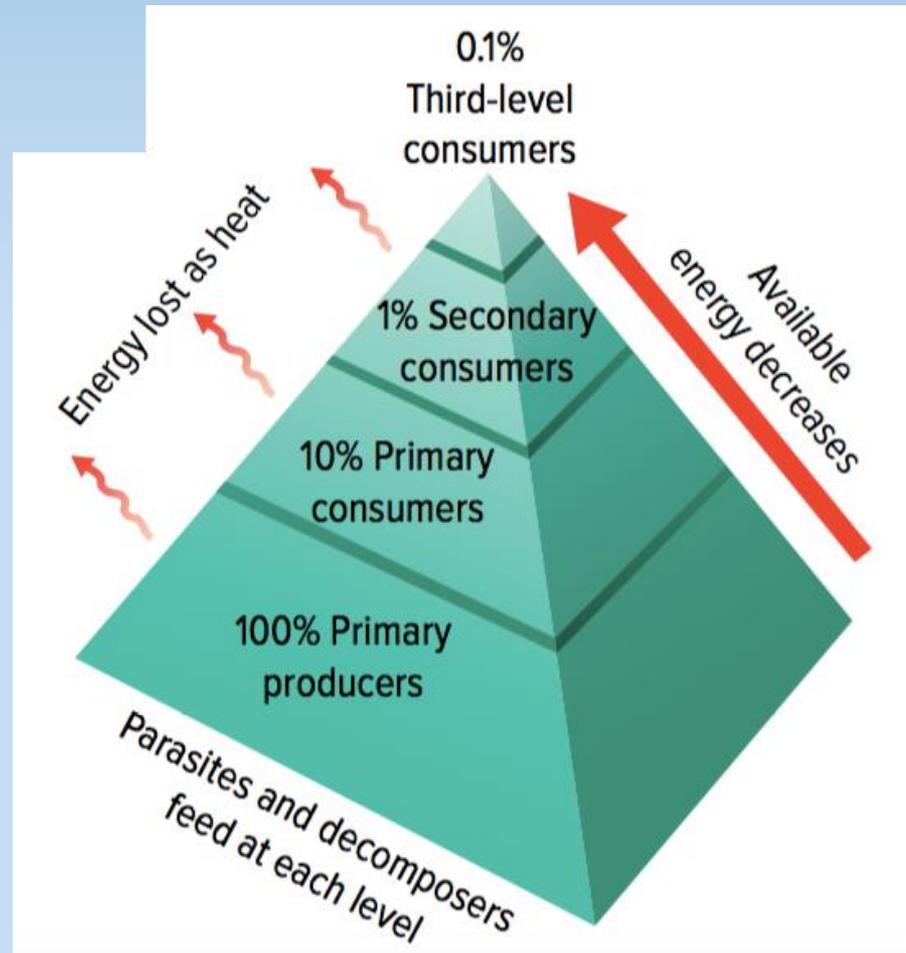
B) Most of the energy that is transferred from one organism to another in a food chain is lost to the environment as unusable heat. Less and less energy is available to each organism in the food chain.



# Energy Pyramid

**Energy pyramid:**  
A model that shows the amount of energy available in each level of a food chain

Figure 4.15: In a pyramid of energy, each level represents the amount of energy that is available to that trophic level. With each step up, there is an energy loss of 90%.



## Discussion Questions

1. When a mouse eats a plant, only about 10% of the plant's energy is transferred to the mouse. What happens to the rest of the energy?
2. In **Figure 4.14**, the analogy of a bucket-toss relay game is used to explain the transfer of energy through a food chain. Create your own analogy to explain this transfer of energy.

# Food Chain, Food Web and Food Pyramid Activity

