

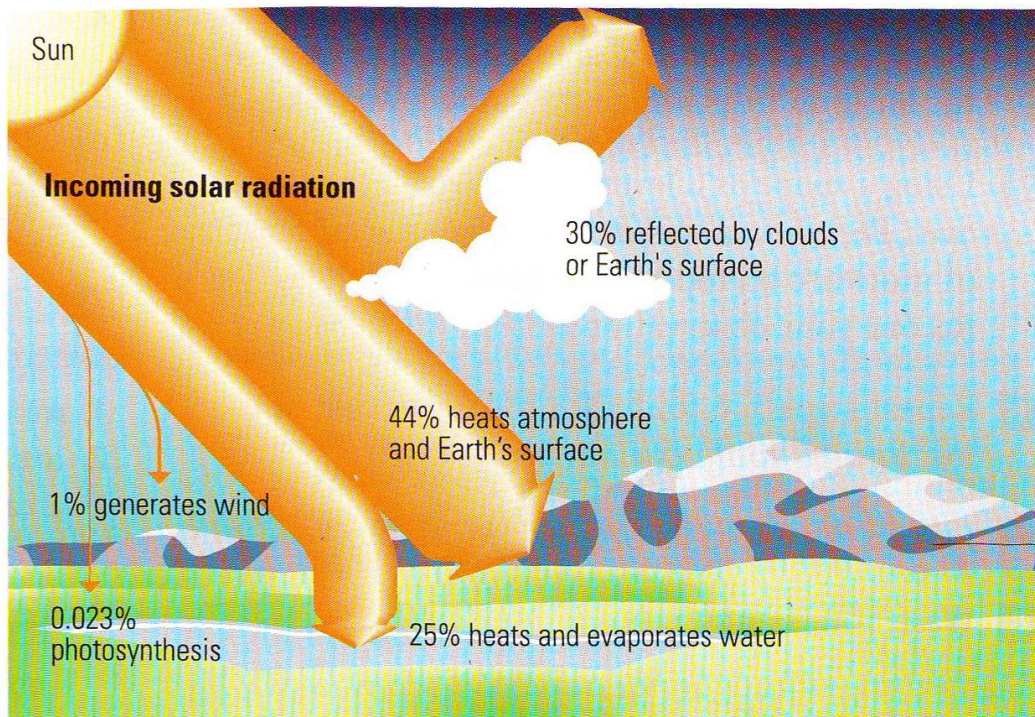
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## 1.3 Energy in Ecosystems

### Energy from the Sun

The Sun is the major source of energy for our planet. It causes evaporation of water from the oceans and lakes. Sunlight also provides the energy used by green plants to make their own food. These green plants then provide food for all organisms on Earth.

Much of the energy that comes from the Sun never reaches the Earth's surface. It is either reflected or absorbed by the gases in the upper atmosphere. Of the energy that reaches the lower atmosphere, 30% is reflected by clouds or the Earth's surface. The remaining 70% warms the surface of the planet, causes water to evaporate, and provides energy for the water cycle and weather. Only a tiny portion, approximately 0.023%, is actually used by green plants to produce food.



Many gases found in the atmosphere actually reflect heat energy escaping from Earth's surface back to Earth. These gases act like the glass of a greenhouse in that they allow energy from the Sun to enter but prevent energy from leaving. They are therefore called **greenhouse gases**.

When sunlight strikes an object, some of the energy is absorbed and some is reflected. The amount reflected depends on the surface. For example, snow reflects most of the energy from the Sun. It is one of the reasons why it is colder during the winter. Dark-coloured surfaces, such as dark soil or forest, absorb more energy and help warm the surrounding air.

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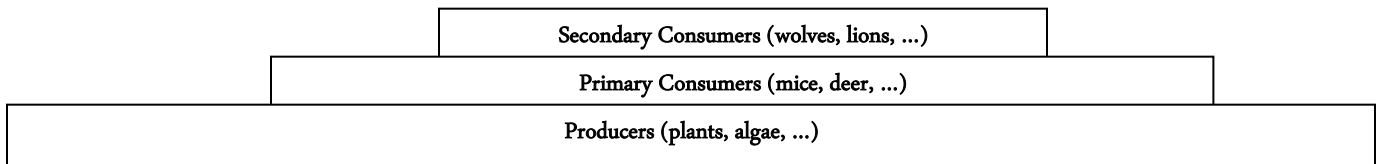
## Energy Movement in Ecosystems

Energy is transferred from one organism to another at different levels of food chains. The different levels are called **trophic levels**. Organisms that can make their own food from basic nutrients and sunlight are placed in the first trophic level and are called **producers**. Plants, algae, and some bacteria are all producers in the first trophic level.

The second trophic level contains organisms that feed directly on the producers and are called **primary consumers**. Mice, deer and most insects are primary consumers.

**Secondary consumers** are animals in the third trophic level. They rely on primary consumers for their food. Wolves, lions, and whales are secondary consumers.

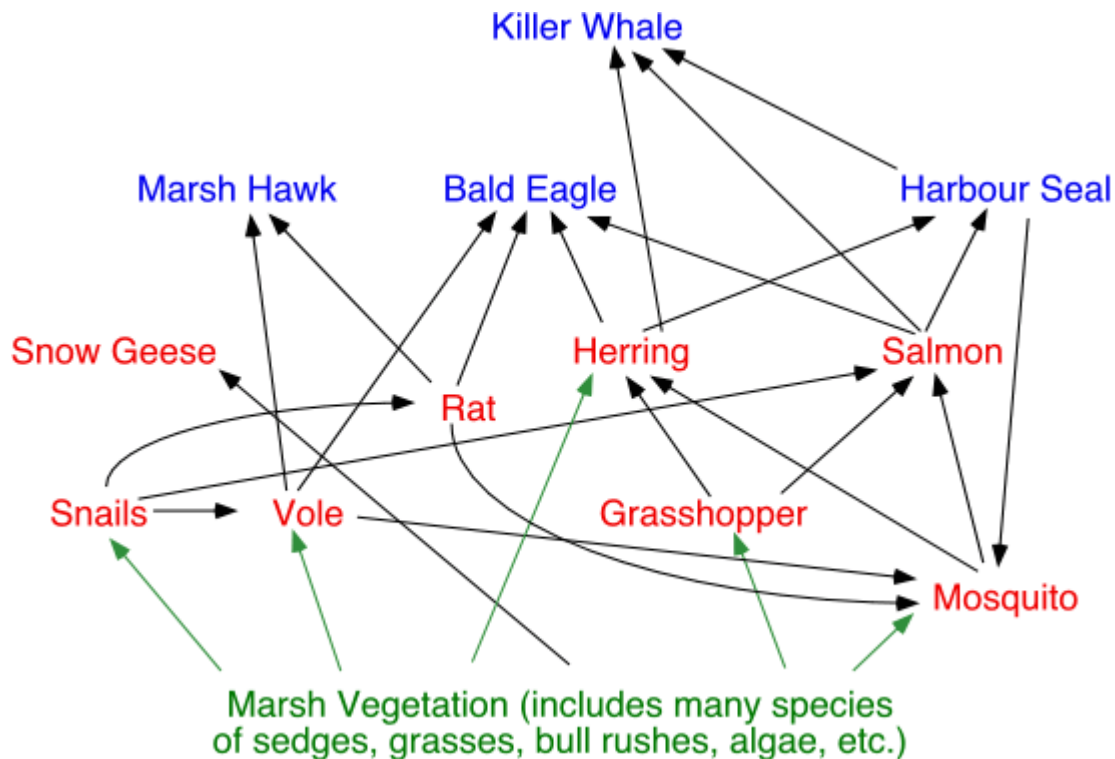
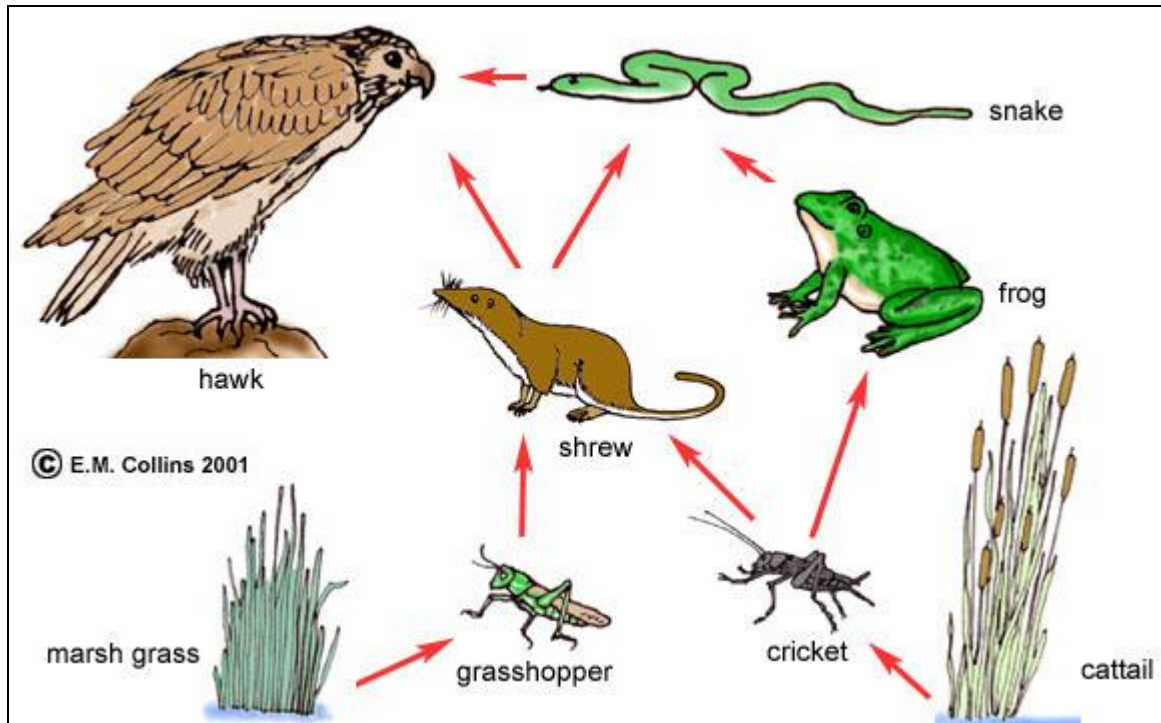
Note: Secondary consumers depend indirectly on producers, because there would be no primary consumers without them.



## Energy in Food Chains and Food Webs

Every organism within an ecosystem provides energy for other organisms. A single food chain illustrates only part of what happens in an ecosystem. Most organisms have more than one food supply, and therefore are part of several food chains. When these food chains interconnect to form a relationship, they are called a **food web**.

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### Energy Transfer

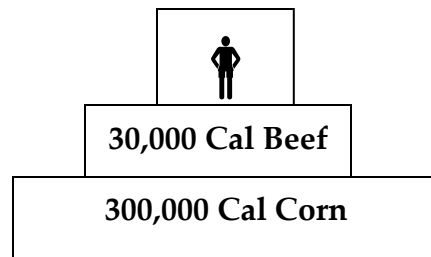
Every time energy is transferred within an ecosystem, some of the energy changes form. Not all of the energy that a plant creates can reach the animal that eats it. For example, a mouse that has eaten grass seeds cannot store all the energy from the seeds. It must use some to stay warm, to keep its cells and organs functioning, to move

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around, to feed its young, and so on. Once the energy has been used, it is not available to be transferred. The further up the food chain you go, the less energy is available. In every ecosystem, less total energy is available to secondary consumers than to primary consumers. Of course, when plants and animals die, their bodies decompose and some of the energy goes back into the ecosystem.

### Energy Pyramid

Energy flow in food chains and food webs are represented by graphs called pyramids. These graphs show the relationship among the trophic levels in an ecosystem and demonstrate that not all of the energy is transferred from one level to the next. Energy is measured in joules and only about 10% of the energy of one trophic level makes it to the next level.



### Human Use of Energy in Ecosystems

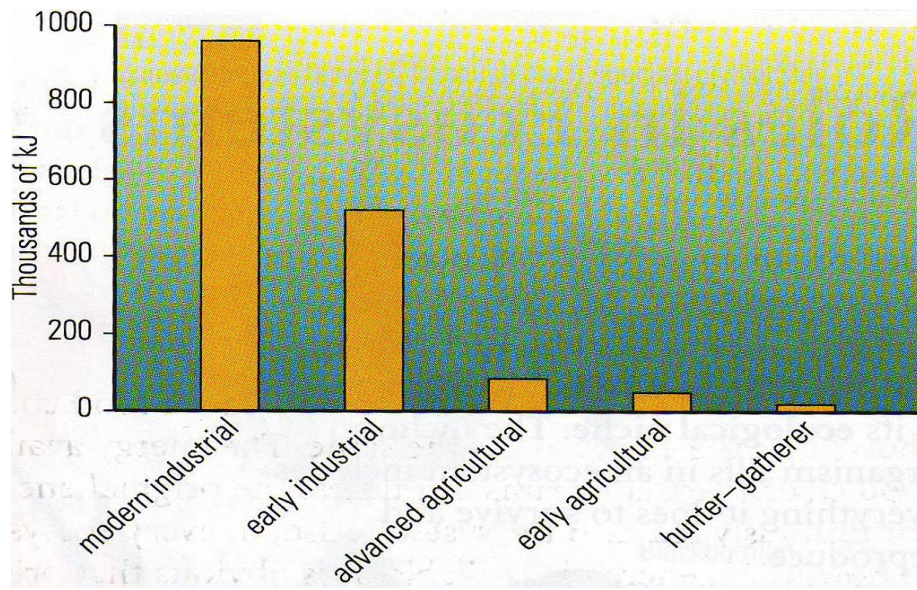
Our early ancestors survived by collecting plants and eating animals that they caught or dead animals that they found or stole from predators. Their impact on the ecosystem was very small.

Somewhere between 10 000 and 12 000 years ago, human society changed. People started to practice agriculture; they planted crops and raised animals. This allowed them to remain in one place. Trees were cut and the lumber was used to build permanent houses. The cleared land was then used for farming. The food produced by farming allowed the human population to grow, and the additional energy needed to maintain a farm had to come from the ecosystem. By changing to an agricultural society, humans were using more of the total energy available in the ecosystem.

Other changes have taken place more recently. Technological advances, such as improved plant species and modern medicines, have helped to increase food production and improve the health of humans. Again, these changes allowed the human population to grow, placing still greater demands on the ecosystem.



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### **Worksheet 1.3: Energy in Ecosystems**

1. How is sunlight important for an ecosystem?
2. In your own words, explain what is meant by the term “trophic level.”
3. What type of food would be consumed by a primary consumer? What type would be consumed by a secondary consumer?
4. Using diagrams to illustrate, distinguish between a food chain and a food web.
5. Explain why an Arctic ecosystem would be at a higher risk of imbalance than a tropical rain forest.
6. Explain how humans have changed the energy flow in ecosystems over the past 12000 years.
7. Make a pie graph showing what happens to the energy from the Sun that reaches Earth’s atmosphere. Label each piece of the pie.