Although albedo varies across Earth's surface, the planet's overall albedo is about 30 percent. In contrast, the Moon's albedo is about 11 percent; the albedo of cloud-covered Venus is about 75 percent.

An area's albedo will change when the amount of energy that is absorbed or reflected changes. Such changes can alter Earth's energy budget. For example, some areas may have a thick snow or ice cover during the winter that melts in the spring. During the winter, this area would reflect more of the Sun's energy and have a higher albedo than it would during the rest of the year.

If a green meadow is ploughed for crop planting, its albedo will change. If a forest is cut down and replaced with houses, that area will reflect more energy back into the atmosphere. If former farmland is allowed to go fallow and eventually reforests, its albedo changes as well. The alterations in the energy cycle brought about by the transformations in the landscape are further examples of how each part of the Earth system affects other parts.

The Flow of Energy in Ecosystems

All energy used by living things comes from the Sun and is passed along food chains to carnivores. This process is not very efficient; as Figure 1.5.3 shows, a great deal of energy is lost at each *trophic* (feeding) level. Much of the energy leaves the food chain through respiration.

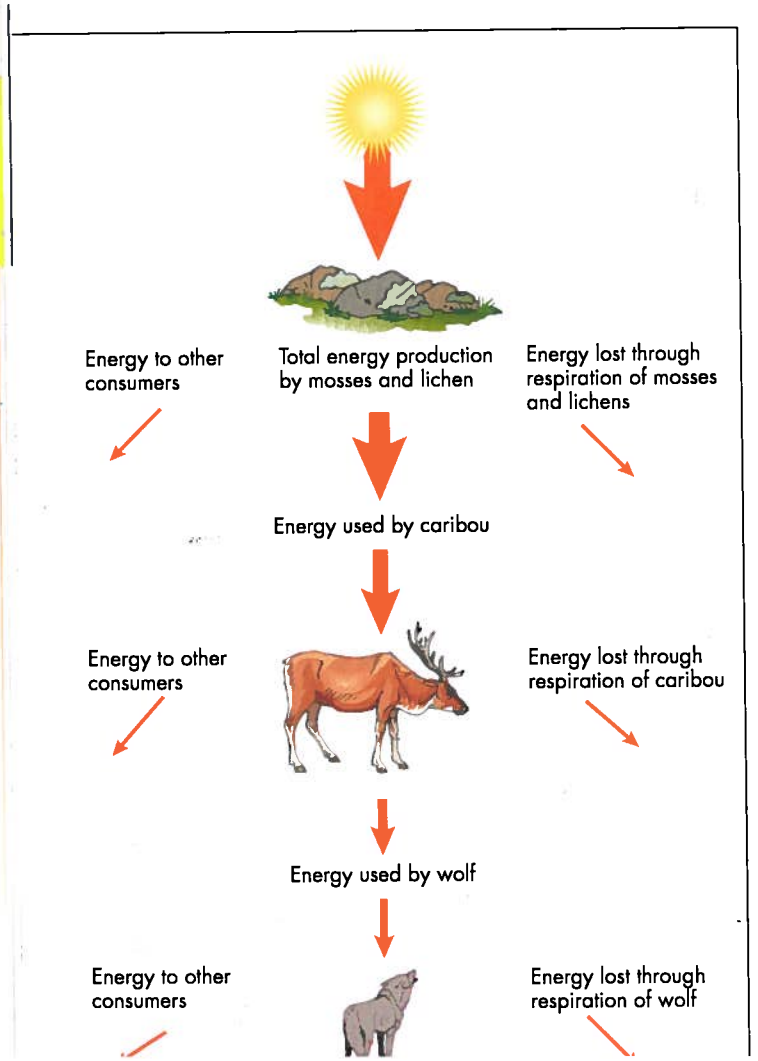

Figure 1.5.3 Flow of energy in an ecosystem. Using this diagram as a model, create your own example of energy flow along a food chain.

All energy used by living things comes from the Sun. Although energy reaches Earth continuously as sunlight, less than 0.023 percent of the total energy reaching the atmosphere each day is actually captured by living things. Through photosynthesis, producers store some of the Sun's energy in the foods that they make. They use some of this food for their own life processes; the rest is stored. Herbivores get their energy by eating producers. Carnivores get their energy by eating herbivores or other carnivores. Thus, the Sun's energy is passed along food chains to carnivores.

Depending on the types of species and ecosystem involved, there can be up to 90 percent energy loss with each transfer from one trophic level to the next. For this reason, all pyramids of energy look like the one in Figure 1.5.4: they taper off to almost nothing. The more trophic levels or steps that exist in a food chain or web, the greater the cumulative loss of usable energy.

This energy cannot be recaptured by any of the organisms in the food chain; it is lost forever to that ecosystem. Thus, energy flow is a one-way process along a food chain. For an ecosystem to keep operating, energy from the Sun must keep entering it.

The energy loss in moving to each successive trophic level explains why most food chains and food webs rarely have more than four consecutive links or energy transfers. Energy flows also demonstrate why the eating habits of people can influence how many humans planet Earth can support. If people eat at lower trophic levels by directly consuming grains, such as corn, rather than eating the grain eaters, such as pigs, they will be a part of a shorter food chain and obtain more energy than meat eaters do from the same amount of plant material.

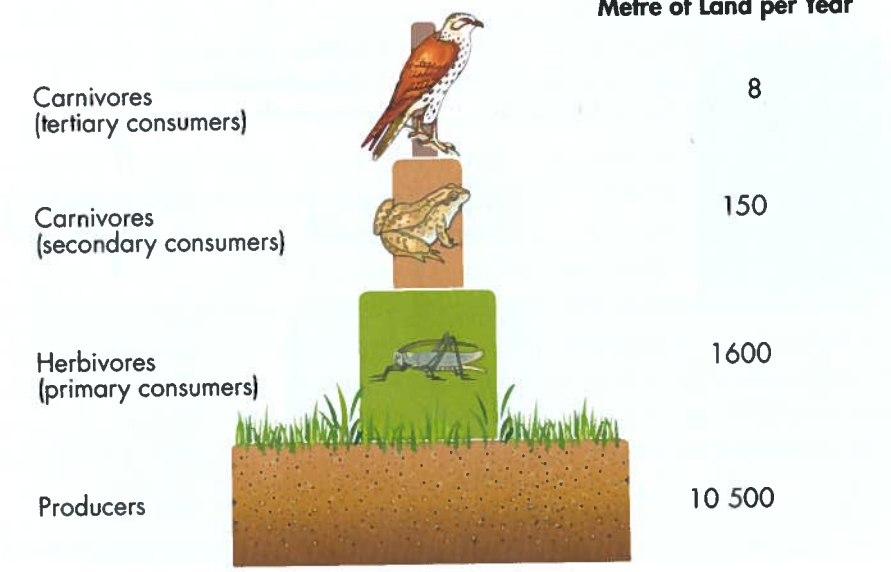

Figure 1.5.4 Pyramid of energy. If the total energy of the producers represents 100 percent of the energy in the pyramid, calculate the percentage of energy that is lost at each step.

Figure 1.5.5 How do our food choices affect the number of people that Earth can support?