

Common Misconceptions Children Have about Energy Flow in Communities

For each idea, consider why a child would be likely to believe this and what evidence might refute it.

1. Interdependencies among life forms have a predetermined purpose.

In a community, food chains are a good example of interdependencies among producers, consumers, and decomposers. Scientists would argue that energy flow is a consequence of these interdependencies rather than a predetermined purpose. This is an example of teleological thinking, where nature or natural processes are considered to have a purpose or design. Children and adults often try to attribute cause in nature in this way, often because of religious or cultural beliefs. It's more a habit of mind to be addressed during lessons than an idea to be countered by evidence.

2. Interdependencies among life forms are ultimately meant to serve the needs of people.

There are countless interdependencies in the living world that have no influence whatsoever on human beings. Think about communities in places that people have yet to explore, like parts of the deep sea or the tops of trees in tropical rain forests. This is an example of “anthropocentric” thinking — where nature or natural processes are thought to revolve around the human species. Young children especially tend to think of the natural world in human terms and, as a result, may reason about interdependencies among life forms in this way.

3. Food is defined only as those things that animals eat.

Food is *any* substance that provides energy and nutrients to an organism. All organisms require food. Animals, including human beings, are consumers and eat their food. Others technically do not “eat” their food. Producers, which include plants, make their own food and then process it internally for energy and matter. Decomposers absorb their food. The first meaning that children have for the term “food” is something that they eat. They also have experience observing pets and other animals eating food. The scientific meaning of food is something that is developed only with formal instruction.

4. Plants get their food from the soil.

Photosynthesis is the process by which plants make their own food. Using light energy from the sun, carbon dioxide from the air is combined with water from the soil to form the food sugar. Some of the first observations children make about plants are that they grow in soil and take in water through their roots. It's a natural extension to think that plants get food from the soil. This may also be reinforced by the term used for fertilizer: plant food. Even after children are introduced to photosynthesis, this idea may persist because they can't observe carbon dioxide being absorbed from the air.

5. Plants make food for the benefit of animals.

The food that plants make provides them with their own source of energy and matter. Plants were making food well before animal life evolved. And, in the absence of animals, plants still make food. Many children can't see the "point" of a plant except as a source of food for an animal. One way to get children to broaden their ideas about plant life is to engage them in plant cultivation and other activities that establish plants as life forms with their own unique and interesting habits.

6. Energy is "formed" in biological processes rather than changed or transferred.

The first law of thermodynamics states that energy is conserved in a system: it is neither created nor destroyed. It can, however, change forms. When a plant makes food through photosynthesis, it changes light energy to chemical energy. When an animal eats a plant, chemical energy is transferred to the animal. In this way, energy flows. It doesn't spontaneously appear. Energy is an abstract concept. Children can't see energy, yet they may understand that objects, like food, contain energy. It seems reasonable that they think that energy is formed within an object as it comes into being.

7. Once eaten, the energy in food disappears.

Once food is eaten, it can be "burned" to obtain energy, or it can be stored in an organism's body. In the first case, the energy is used, and most of it is changed to heat. This is an example of the second law of thermodynamics: in any energy reaction, energy tends to degrade from a higher-quality form to a lower-quality form. Although heat can't be used to fuel life processes, this energy does not simply disappear. In the second case, think about fat. Fat storage represents an excess of energy from food eaten; when we gain weight we have evidence it hasn't disappeared. Most children understand that food gives them energy, and they know that they have to eat food regularly. They may reason that as the energy in food is "used up," it disappears

8. Energy adds up through a food chain, giving top predators all of the energy.

At each link in a food chain, energy is used to fuel life processes. Most of this energy, which is stored in the chemical bonds of food, is changed into heat as it is used. For any amount of energy entering a food chain, very little is left for top predators. Children may have this idea because they think of predators as large animals that require a lot of energy. They may reason that a top predator's energy needs can only be met by "saving it up" from links lower in a food chain. This may also reflect the belief that the links before a top predator are there to serve the top predator

9. There are more individuals at the ends of food chains than at the beginning.

Think about a natural community: a forest, for example. Are there more trees, shrubs, and grasses than hawks or bears? Scientists have actually conducted studies where they've taken census of populations, and there is no doubt that in most communities, there are fewer individuals at the ends of food chains than at the beginning. This is a consequence of energy flow; so much energy is used at each link that few individuals can be supported at the end. Note that this idea applies only to producers and consumers: there can be billions of decomposers at the end of a food chain. Children may believe this because they are more familiar with animals that are top predators. Often, these are the animals that are featured in books and other media, leading children to equate this with numerical dominance. Even when challenged, children may think that these animals are hiding, otherwise more would be observed.

10. The decomposers recycle energy.

If the decomposers recycled energy, plants would be expected to be able to survive without energy input from the sun. If you isolate a plant without light, even in soil rich with decaying matter, it will eventually die. When teaching about food chains, energy and matter are often equated with one another. Children are taught that nutrients (i.e., matter) are recycled. They are also taught that the nutrients in food provide energy. It seems reasonable that they think that the nutrients recycled by decomposers provide energy.