Workshop 6: Energy and Ecosystems

DESCRIPTION

In this program participants are shown that light energy that has been absorbed by plants during photosynthesis and transformed into chemical energy can now be transferred to other organisms. Energy is contained within food molecules such as sugar and starch made by plants, therefore when animals eat plants, or eat other animals, the energy is passed to them. However, the transfer of energy between plants and animals is inefficient and there are energy losses. Consequently, energy must constantly be put into natural systems. The source of energy for ecosystems is generally visible light energy.

Energy transfer between organisms can be described by constructing food chains and food webs for each ecosystem. In this program, we shall visit classrooms where children are learning about chains and webs. We shall also look at the interconnectedness of organisms in pond and ocean ecosystems.

Finally, the program will show that matter from the bodies of dead organisms is decomposed by bacteria, fungi and worms. The process of decomposition returns nutrients, such as minerals and carbon dioxide, to the environment for future plant growth.

This program illustrates some important aspects of our understanding of energy:

1. Energy can be transferred and transformed, but it cannot be created or destroyed.
2. Some energy will be lost to the system as it is undergoing a transformation and is generally given off as heat.

While matter in ecosystems can be recycled, energy cannot. Energy flows through ecosystems and must constantly be provided to plants for photosynthesis by the sun.

LEARNING OBJECTIVES

Participants will gain:

- An understanding that plants and animals are interconnected in ecosystems by their feeding relationships because food contains energy.
- Recognition that energy is transferred and transformed as it flows through an ecosystem from the Sun as the source to producers which make food and on to consumers which eat food.
- Recognition that because the transfer of energy between organisms is inefficient, ecosystems must receive a continuous input of light energy to sustain them.

Workshop 6 timeline

GETTING READY

30 minutes

Talking about Ecosystems

In your group discuss the following points with your colleagues:

- This series is about light energy. How does light energy impact ecosystems?
- What do you think is important for students to understand by the end of fifth grade about: ecosystems? food chains? food webs?
- What reasons might elementary students give if you asked them, "Why do all organisms on Earth depend on plants?"
- What ecosystems do you (or could you) study with your students? What would be your focus at your grade level?

Workshop 6 timeline

GOING FURTHER

30 minutes

Food Chains and Ecosystems

> *Three hundred trout are needed to support one man for a year. The trout, in turn, must consume 90,000 frogs, that must consume 27 million grasshoppers that live off of 1,000 tons of grass.*
>
> *G. Tyler Miller, Jr., American Chemist (1971)*

Program 6 has focused on the flow of energy through ecosystems, and showed that food chains are quite short because not all the energy is transferred from organism to organism at each link. You may have heard that with the world's growing population, the energy needs of more humans can be supported if they eat plants directly i.e. if humans were to eat grain directly rather than eating animals that had eaten grain. For instance: More humans could be fed from a field of soy beans, than could be fed if they ate the animals that had been fed on soy.

- Create a diagram to show how the energy flow in ecosystems explains why more humans can be fed from eating soy beans directly than can be fed from eating the animals that have fed on the soy beans.

The elephant is one of the largest mammals on earth, yet it eats 'low' on the food chain. By this we mean that the elephant's diet is exclusively made of plant material.

- Why can such a large animal exist on diet which is exclusively plant in origin?

For next time

HOMEWORK ASSIGNMENT

Thinking about Ecosystems

1. In Workshop 6 we have explored transformations of energy and described the Law of Conservation of Energy as stating that energy is neither created nor destroyed. The law of conservation of energy holds for physical systems, but also for natural systems such as ecosystems.

   - If energy is not destroyed, why then do ecosystems have to be constantly supplied with energy from the Sun?

   - Why can't the energy just be recycled over and over again in an ecosystem?

2. In Workshop 6 we developed a pyramid of numbers for a pond ecosystem.

   - Create a pyramid of numbers for an ocean ecosystem, showing the types and relative numbers of organisms found at each level of the pyramid.

   - Explain what would happen to the balance of your ecosystem if the top consumers increased in numbers.

3. Please read the description below of the light energy entering an ocean ecosystem and answer the questions that follow:

   In the ocean, photosynthesis is carried out by seaweed and phytoplankton. These organisms contain chlorophyll and absorb light energy. They take carbon dioxide from the water and use the energy of light to join carbon dioxide to hydrogen from water to make sugar and oxygen. However, sunlight only penetrates to a depth of about 110 meters in the ocean.

   The light that reaches to this depth does not contain the full range of visible light photons. The low energy photons (those we perceive as red) are absorbed by the water within about 30 meters of the surface. The photons that we perceive as yellow orange are absorbed by water just below this depth. Photons perceived as green and violet are absorbed by water by 110 meters depth. Below this there is dim blue light and finally no light at all.

   - Using this information, at what depths would you expect to find the bulk of the seaweed and phytoplankton living? Explain your answer.

   Some small animals living below 60 meters look black. But when they are in shallower water these same animals are look red.

   - Using your knowledge of absorption and reflection of light, explain why these organisms look black when they are in the ocean below 50 meters, but look red in shallower water.

Standards

National Science Education Standards

K-4 Standards: http://bob.nap.edu/html/nses/html/6c.html#csck4

All animals depend on plants. Some animals eat plants for food. Other animals eat animals that eat plants.
Content Standards: K-4: Life Science: Organisms and Their Environments

5-8 Standards: http://bob.nap.edu/html/nses/html/6d.html#csc58

Populations of organisms can be categorized by the function they serve in an ecosystem. Plants and some micro-organisms are producers – they make their own food. All animals, including humans, are consumers, which obtain food by eating other organisms. Decomposers, primarily bacteria and fungi, are consumers that use waste materials and dead organisms for food. Food webs identify the relationships among producers, consumers, and decomposers in an ecosystem.

For ecosystems, the major source of energy is sunlight. Energy entering ecosystems as sunlight is transferred by producers into chemical energy through photosynthesis. That energy then passes from organism to organism in food webs.
Content Standards: 5-8: Life Science: Population and Ecosystems

Related Sources

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The Indoor River Book (1997). Iowa: Kendall/Hunt Publishing Company

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Scott, Michael, (1995). The Young Oxford Book of Ecology. New York: Oxford University Press

Trautmann, N., & Kransy, M. (1998). Composting in the classroom. Scientific Inquiry for High School Students. Iowa: Kendall/Hunt Publishing Company

University of Wisconsin- Madison (1993), Bottle Biology. Iowa: Kendall/Hunt Publishing Company

Useful web sites providing information of books for purchase
Bottle Biology
http://fastplants.cals.wisc.edu/BottleBiology/Bott