How Forests Affect the Environment

Nº. 55

INTERMEDIATE

Science

LESSON SUMMARY

Students will learn to appreciate that trees are complex organisms that play a vital role in the environment.

FORESTS ONTARIO

Focus on Forests

Activity Information

Grade Level: Intermediate

Estimated Duration: 1 to 3 hours

Materials:

Activity #1 — depends on experiments or demonstrations designed by students:

Activity #2 — copies of Model Ecosystem Activity Sheet (one per student or group), suitable container (e.g., terrarium, aquarium. or bottle), lid (plastic wrap works well), soil, sand, gravel, rocks, small plants (grasses, mosses. lichens, ferns, herbaceous plants, tree seedlings), small organisms (ants, spiders, sow bugs, ladybird beetles, grasshoppers, crickets, worms, slugs, etc.), decomposers ("starter" sold for composting is a good source of bacteria), organic material (vegetable matter, wood chips. peat moss, manure, etc.), chlorine-free water:

Activity #3 — copies of Water Uptake and Transpiration Activity Sheet (one per student or group), stem of leafy plant, graduated cylinder, bell jar, plastic film, rubber band, glass plate, petroleum jelly:

Activity #4 — copies of Food Chain Activity Sheet (one per student or group), leaf-eating insects (adults or larvae) carefully collected with leaf samples on a field trip.

Setting: Indoors

Key Vocabulary: Biotic, abiotic, photosynthesis, respiration, producers, consumers, decomposers, habitat, transpiration

Background

Like all ecosystems, the forest can be broken down into its living (biotic) and non-living (abiotic) parts. Non-living parts include the atmosphere, the sun, and the earth. The living parts are the plants, animals, and micro-organisms. Between these two groups run the pathways of interaction that work together to maintain a balanced and thriving environment.

The dominant living part of the forest is, of course, the trees themselves. Trees are complex organisms that play a vital role in the environment in:

- the exchange of gases,
- nutrient cycling.
- wildlife habitat,
- the water cycle.
- soil conservation.

a) The Exchange of Gases. Trees obtain the necessary energy and raw materials to build and maintain their own living tissues from the sun, soil, air, and water. Trees do this through the processes of photosynthesis and respiration. During the course of these activities, trees both consume and produce atmospheric gases. For photosynthesis, they use carbon dioxide (together with water) to manufacture simple sugars and release oxygen as a by-product. All the oxygen in the earth's atmosphere was put there by this activity of trees and other green plants. For respiration, trees use oxygen to "burn" the sugars and provide energy for their growth, releasing carbon dioxide as a waste.

b) Nutrient Cycling. Through photosynthesis, trees turn the non-living into the living; they are called the producers in the ecosystem. The material that they produce — in the form of leaves, branches, trunks, and roots —is passed on to the other living organisms in the system when parts of the tree are eaten or decomposed. The eaters, or consumers, in the system, are the animals that feed on green plants and the animals that feed on the plant-feeders. All animals, ultimately, are fed by plants, turning plant tissue into animal tissue as part of a massive cycle of nutrients. The cycle of nutrients continues when both plants and animals die. Their dead tissues are broken down by the activities of such organisms as bacteria and fungi (called decomposers). Nutrients are thereby released from the once-living matter and pass back into the soil, where they can be taken up by plants. In this way, material is constantly recycled from living to non-living and back again, from the old to the new, building up then breaking down, without ever interrupting the flow of matter and energy.

c) Wildlife Habitat. In the forest ecosystem, plants provide more than just food for the animals. They also provide building materials for homes, such as nests and beaver dams. They make perches for lookout posts and crevices for hideaways. They give shade and camouflage. In these and many other ways, the plants provide a complex habitat within which animals can carry out their life functions.

d) The Water Cycle. The branches and leaves that reach up to grab the sun's energy, exchange gases with the atmosphere, and provide food and shelter for forest animals are the visible parts of the forest. But there is another, unseen forest world. It is the vast world of roots and soil, hidden from sight beneath the forest floor. It is through the roots that the dissolved nutrients in the soil begin their pathways up into the tree. More importantly, the roots absorb water, which conducts nutrient materials to all the tree tissues. After passing through the tree, excess water evaporates from the leaves in the process of transpiration. This movement of water from the soil to the air through trees is an important part of the global water cycle. (There are more details on how this process works in trees in Tree Waterworks 1, p. 34).

e) Soil Conservation. Another important function of the roots is to anchor the tree securely into the ground, giving it the support that allows the growth of a heavy trunk and branches. Roughly speaking, the volume occupied by the roots below the ground is about equal to the volume taken up by the branches above them. The network of roots also holds the soil firmly in place, helps water penetrate deeply, and prevents soil erosion. In deciduous forests, falling leaves add their matter to the soil to create a deep, rich layer of humus.

At one point in time, you could begin a journey on the shores of Hudson Bay and travel down the continent right through to the Amazon and beyond, without ever leaving the cover of forest. In Europe, also, the areas that are now fields, towns, and cities were once occupied by vast woodland. Although the extent of the world's forests has been — and continues to be — greatly reduced by human settlement, forests remain an important part of the global environment and play vital roles that reach far beyond the boundaries of the forest itself.

Model Ecosystem

Activity Sheet

Purpose

To create a model of an ecosystem in the classroom.

Materials

A suitable container (e.g., terrarium, aquarium, or bottle), lid (plastic wrap works well), charcoal, soil, sand, gravel, rocks, small plants (grasses, mosses, lichens, ferns, herbaceous plants, tree seedlings), small organisms (ants, spiders, sow bugs, ladybird beetles, grasshoppers, crickets, worms, slugs, etc.), decomposers ("starter" sold for compo sting is a good source of bacteria), organic material (vegetable matter, wood chips, peat moss, manure, etc.), chlorine-free water

Method

1. Decide what kinds of animals and vegetation you want to establish in your model ecosystem. Identify their needs and determine how to create that environment.
2. Prepare a mixture of soil, sand, gravel, mud, and other materials you think are needed in your model ecosystem.
3. Put a layer of charcoal on the bottom of the terrarium. Place the mixture of material in your container as a foundation for your ecosystem. If space permits, try to give it an interesting contour.
4. Arrange plants in a way that makes your ecosystem look as natural as possible.
5. Add a few insects, worms, slugs, or other small animals to your ecosystem. Be sure to keep the total number in proportion to the size of your ecosystem.
6. Add an appropriate amount of water to your ecosystem, and cover the container loosely to maintain humidity at an appropriate level.
7. Place your ecosystem where it will receive suitable light and temperature conditions.
8. Design your own charts and record the changes that occur in your ecosystem as you continue to observe it over a period of one to two weeks. (You may find it necessary to add water periodically.)

Questions

1. a) What aspects of an ecosystem do you think are easy to duplicate in the classroom?

   b) What aspects do you think are difficult to duplicate?

2. List the producers and consumers in your ecosystem.

3. Explain how your producers and consumers obtained the energy and gases they need to survive.

4. What happened to the wastes produced by the organisms in your ecosystem?

5. a) What habitats did you create before adding the organisms?

   b) Did any of your organisms create their own habitats? If so, describe them.

6. Could you have included much larger organisms in your ecosystem? Explain your answer.

7. If you were to repeat this activity, would you do anything differently? Explain.

*This activity has been adapted, with permission, from Hirsch, AlanJ. etal. *Science Explorations* 10. Toronto: John Wiley & Sons, 1988.

Water Uptake and Transpiration

Activity Sheet

Purpose

To observe how plants absorb and give off water.

Materials

One stem of a leafy plant, graduated cylinder, bell jar, plastic wrap, rubber band, glass plate, petroleum jelly

Method

1. Fill the graduated cylinder with water and tightly stretch a plastic wrap over the top. Fasten the wrap tightly with a rubber band.
2. Push a leafy stem carefully through the plastic wrap and into the water. Record the level of the water.
3. Place the cylinder and stem on a glass plate and seal a bell jar over them with petroleum jelly. Leave the apparatus in a sunny location.
4. Record the level of water in the cylinder at intervals of an hour. Note and record any changes in the appearance of the leaves and/or the bell jar.

Questions

1. Plot the changes in the water level on a graph.
2. How do you account for the changes in the water level? (Water level goes down as water evaporates and is absorbed by the plant.)
3. If the leaves have grown, can you draw any conclusions about the role of water in plant growth?
4. Does this experiment need a control? If so, how would you design a control?

Extension

Repeat the experiment under different conditions of temperature and light. Note differences (if any) and explain them.