

FOREST ECOLOGY

Overview

Forests are dynamic communities dominated by trees. The type of forest capable of growing on a site is directly related to factors of soil, sunlight, water and climate. In this class, students will learn about the life cycle of a forest, how site factors affect tree growth and how to predict animal species present in certain forest types.



Background

A forest is a biological community dominated by trees and other woody vegetation. Ecology is the scientific study of the relationships of living things to one another and to their environment. Forest ecology is concerned with the forest as a biological community, with the relationships between the various trees and all other organisms within the community, and with the relationships between these organisms and the physical environment. By understanding and studying these relationships, it is possible to predict what plants and animals will appear in a given environment and the order of their appearance.

Like all other living organisms, trees have a complex set of habitat requirements. These factors, often called site factors, are climate, soil composition, location and animal interactions. The most important factor in determining the presence of a particular tree species is light. A plant's ability to survive in the absence of full sunlight is called *tolerance*. A plant is said to be tolerant if it can survive in full shade.

Trees have life cycles that include birth, growth, injury, disease, aging and death. As trees go through their lifecycles, the major process that provides the water, nutrients and energy necessary to grow and survive is photosynthesis. As a tree grows, it burns sugars and takes in carbon dioxide from the air, or respire. The roots of a tree absorb nutrients from the soil by taking in nutrient-laden water and transporting the nutrients to xylem cells in the trunk, branches and leaves. In the leaves, these minerals participate in the formation of chlorophyll, the green pigment in leaves that absorbs light particles. The absorption of light causes the hydrogen and oxygen molecules in water to break apart. The oxygen is then re-

leased into the atmosphere through a process known as transpiration. The hydrogen that is left combines with carbon to form the carbohydrates that the plant uses as food. Without sufficient sunlight and water, photosynthesis slows down or halts.

Since all animals depend on plants, knowledge of plant succession can be used to predict animal succession. If you study an abandoned field or clearcut, you can record when certain plants and animals appear and when they go away. In the first years, the field is dominated by annual plants that after a few years are replaced by perennials. During this time, birds, rabbits and rodents are present. Within seven years, pine seedlings begin to appear and within ten years become the dominant vegetation. As the pine trees shade out the grasses and weeds, the small animals are replaced by larger browsing animals such as deer. Pines will remain the dominant vegetation for many years, with hardwood species such as oaks and hickories appearing in the understory where pine seedlings cannot grow. After the pines mature, they begin to die from storms, insects and disease. Dead or dying trees decompose and become home to the many bugs and animals that aid in this decaying process. As pines die, the understory hardwoods receive more light and fill in the canopy. Over time and without interference, the stand converts from pine to hardwood. The animals present include squirrels, woodpeckers, racoons, foxes and deer. As hardwoods die, they are replaced by hardwoods in the understory. The stand remains hardwood until it is destroyed by a natural disaster or harvesting. Afterward, the entire process begins again.

Biological diversity refers to the full range of living organisms in a forest at a given time, including variety and complexity of species present, and relative abun-

Subjects

Science, language arts

Concepts

Biological diversity results from the interaction of living and nonliving environmental components such as air, water, climate and geologic features.

Forests and other ecosystems, contain numerous habitats that support diverse populations of organisms.

Organisms are interdependent and depend on nonliving components of the Earth.

The structure and scale of an ecosystem are influenced by factors such as soil type, climate, availability of water and human activities.

Ecosystems change over time through patterns of growth and succession, and are affected by other phenomena such as disease, insects, fire, weather and human intervention.

Altering the environment affects all life forms, including humans, and the interrelationships that link them.

Plant and animal populations exhibit interrelated cycles of growth and decline.

Objectives

Students will develop: (1) a basic knowledge of the structure of a tree and how it grows, (2) a basic knowledge of factors that determine the type of forest that will grow on a site and (3) an understanding of succession.

Materials Needed

A shelter for classroom activities, flip chart, markers, tree cross section and twigs to demonstrate how a tree grows.

A wooded area with a variety of forest types, soil conditions, moisture conditions and varying past human activities within a reasonable walking distance of the shelter.

Time Required

Write important concepts and definitions on a flip chart and plan the field trip before class begins.

Class can be taught in 1 hour.

dance of each. Different forest types occur during different successional stages and support different levels of diversity. A forest consisting of one tree species is less diverse biologically than one of comparable size with an variety of tree species. Young stands have a greater variety of plants and animals than old stands. Without diversity among plant and animal species, interdependent food webs may break down.

It is important to remember that forestry is much more than managing just trees. The plant and animal populations that depend on a forest must be considered whenever decisions are being made about a forest's use. When any component of a forest is altered, many environmental benefits, such as oxygen production and rainfall, may be affected. A strong knowledge and understanding of these interrelationships will enable you to make informed decisions concerning forestry.

Vocabulary

- **Biodiversity:** The variety and complexity of species that are present and interact in a community, plus the relative abundance of each.
- **Decomposition:** The process by which organic material such as leaves and branches are broken down by bacteria, fungi, protozoans and the many different kinds of animals that live in the soil. The process produces the rich loam referred to as topsoil.
- **Ecology:** The science or study of the relationships between organisms and their environment.
- **Ecological succession:** The gradual change of plant and animal communities over time.
- **Environment:** The sum of all external conditions and influences, living and nonliving, that affect the development and survival of an organism.
- **Photosynthesis:** The process by which a plant or tree combines water and carbon dioxide with energy from the sun to make high-energy sugar compounds and oxygen.
- **Transpiration:** The loss of water through the leaves.

Doing the Activity

1. Review the background information above and discuss competition (dominant, intermediate, suppressed and snag) and forest life zones (emergent, canopy, understory, forest floor).

2. Next take the students on an interactive field trip through nearby woods, creeks, fields, etc., if the weather allows. Ask the students to describe the ecological processes or other conditions that are present at each stop. Questions to consider include:

- What are the site conditions? (i.e. slope, soil, moisture, etc.)
- Is this a relatively old forest or new, ie. what stage of succession? How can you tell?
- What animals do you expect to be present here? Is there any evidence of their presence?
- Are there signs of natural or human disturbances to the forest, such as tree damage or evidence of fires?
- Would you think that this area is biologically diverse?

Helpful Hints

Keep topics brief.

Ask questions and involve the students.

Make sure that you have an assistant to help keep the students moving and together during the field trip or you'll waste a lot of time waiting on stragglers.

