

OVERVIEW

Forests support a diversity of plants and animals that vary according to the geographic location of the forest. In this activity, students will identify a section of a local forest or wooded area to study and investigate the types of plants and animals that live there. Through this investigation, students will identify the biological and structural diversity within a forest ecosystem.

BACKGROUND

Forest Types in Pennsylvania

Understanding a forest ecosystem means understanding all the many biotic (living) and abiotic (non-living) components of that ecosystem and how they are related. Forest ecosystems are complex and the relationships within them are difficult to describe and to qualify. Today's focus on ecosystem management is a critical need for a better understanding of forest ecosystems and how they function.

There are numerous terms that are used to describe and categorize both trees and forests. What follows is a review and clarification of some of these terms.

Trees can be either **angiosperms** (plants that flower and protect their seeds in a fruit) or **gymnosperms** (plants that do not flower and produce "naked" seeds, not enclosed in a fruit). If a plant's seeds are produced in a cone, then it is referred to as **coniferous**. Trees can be either **broadleaf** trees (having wide-bladed leaves) or **needleleaf** trees (having narrow, needle-like leaves). Trees can be deciduous (meaning they lose all of their leaves seasonally) or **evergreen** (meaning they retain their leaves or needles year-round). Finally, trees can be considered **hardwood** (which refers to broadleaf, deciduous trees that often have harder wood) or **softwood** (which refers to needleleaf, evergreen trees that often have softer wood).

A tree that is an **angiosperm** is usually a **broadleaf, deciduous** species that is a **hardwood** (e.g., oak and maple). A tree that is a **gymnosperm**, is usually a **coniferous, needleleaf, evergreen** species that is a **softwood** (e.g., pine and hemlock). Of course, there are exceptions to all of nature's rules. For example, the larch or tamarack is a needleleaf, conifer that loses all of its needles seasonally, making it a rare example of a deciduous conifer. Also, there are some softwoods

that actually have harder wood than some hardwoods, and vice versa. But in general, these terms hold.

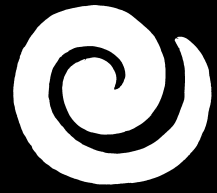
Pennsylvania is located in what is called the **temperate forest biome**. The **temperate forest biome** is characterized by having long-growing seasons, mild winters and regular rainfall (most of it occurring during the spring and summer months). Although the temperate forest biome is considered a single biome, it is comprised of several different communities. One of these communities is called the eastern deciduous forest. As you might guess from the name, the tree species in the eastern deciduous forest are primarily deciduous, but some conifer species grow throughout the forest as well.

Within the eastern deciduous forest, forests have been classified even further into forest-type groups. "Each forest-type group is composed of a diverse collection of specific forest types. For example, the oak/hickory types range from pure stands of chestnut oak to stands containing a mixture of oaks and other deciduous species where not one species dominates the composition. The actual distribution of specific forest types depends on terrain position, soil depth, climate and other factors" (Penn's Woods Today, p.2).

Two major forest-type groups in Pennsylvania are the oak/hickory forest-type group (which covers 47 percent of Pennsylvania) and the northern hardwoods forest-type group (which covers 38 percent of the state). There are several other forest-type groups interspersed across Pennsylvania, including oak/pine (2 percent), elm/ash/red maple (4 percent), white/red pine (5 percent), and a mixture of others (4 percent).

Oak/Hickory

The oak/hickory forest-type group covers 47 percent of the state, primarily in the central and southern part of Pennsylvania. Some of the tree species



GRADE LEVELS:

Grades 7–10

OBJECTIVES: Students will (1) select an area of forest and develop a scientific methodology to study it, (2) learn about the ecological relationships in their adopted forest, and (3) explore the biological and structural diversity of their forest.

PENNSYLVANIA PROPOSED ENVIRONMENT & ECOLOGY STANDARDS ADDRESSED:

4.6.7

- A. Explain the flows of energy and matter from organism to organism within an ecosystem.
- B. Explain the concepts of cycles.
- C. Explain how ecosystems change over time.

4.7.7

- B. Explain how species of living organisms adapt to their environment.

4.6.10

- A. Explain the biotic and abiotic components of an ecosystem and their interaction.
- B. Explain how cycles affect the balance in an ecosystem.
- C. Analyze how ecosystems change over time.

4.7.10

- B. Explain how structure, function and behavior of plants and animals affect their ability to survive.

ESTIMATED DURATION: Preparation: Part A – 30 minutes; Part B – 30 minutes; Activity: Part A – two 50-minute periods; Part B – three to four 50-minute periods or one field trip; Part C – two to three 50-minute periods.

MATERIALS NEEDED: Copies of Student Pages "Adopt-a-Forest Profile," "A Look at Competition," "Forest Stratification and Life Zones," "Forest Inventory Chart," "Diagram of a Rotting Log," notebooks; field guides for local tree plant, and animal identification; maps of your adopted forest (optional—your district forester may be able to supply forest type maps); magnifying lenses; binoculars; and camera (optional); "Sample Nature Guides" (optional)

that typify the oak/hickory forest include: northern red oak (*Quercus rubra*), black oak (*Quercus velutina*), scarlet oak (*Quercus coccinea*), white oak (*Quercus alba*), chestnut oak (*Quercus prinus*), pignut hickory (*Caarya glabra*), mockernut hickory (*Carya tomentosa*), bitternut hickory (*Carya cordiformis*), American chestnut (*Castanea dentata*; understory only, but formerly a canopy tree), flowering dogwood (*Cornus florida*), sassafras (*Sassafras albidum*) and hophornbeam (*Ostrya virginiana*).

Northern Hardwoods

The northern hardwood forest-type group covers 38 percent of Pennsylvania primarily in the north and northwestern part of the state. Some of the tree species that typify the northern hardwoods include: yellow birch (*Betula alleghaniensis*), sugar maple (*Acer saccharum*), American beech (*Fagus grnadifolia*), black cherry (*Prunus serotina*), eastern hemlock (*Tsuga canadensis*), white pine (*Pinus strobus*), red pine (*Pinus resinosa*), sweet birch (*Betula lent*), pin cherry (*Prunus pensylvanica*), white ash (*Fraxinus americana*), red maple (*Acer rubrum*), American basswood (*Tilia sp.*), aspen (*Populus spp.*), northern red oak (*Quercus rubra*) and white oak (*Quercus alba*).

PART A ADOPTING A FOREST

GETTING READY

Make copies of these Student Pages: "Adopt-a-Forest Profile," "A Look at Competition," "Forest Stratification and Life Zones" and "Forest Inventory Charts." Gather field guides for trees, wildflowers, birds, and wildlife for your students' reference. You may want to have an idea of forested areas that may be suitable. The forested area does not have to be a large forest. It can be simply a plot of trees on the school grounds, a nearby urban park or a privately owned forest.

PROCEDURES

1. Interest your students in studying forest ecology by asking them to think about the variety of benefits and products that come from forests. Divide the class into pairs or small groups, giving them about 15 minutes to write their list. Then combine all their responses into one list for

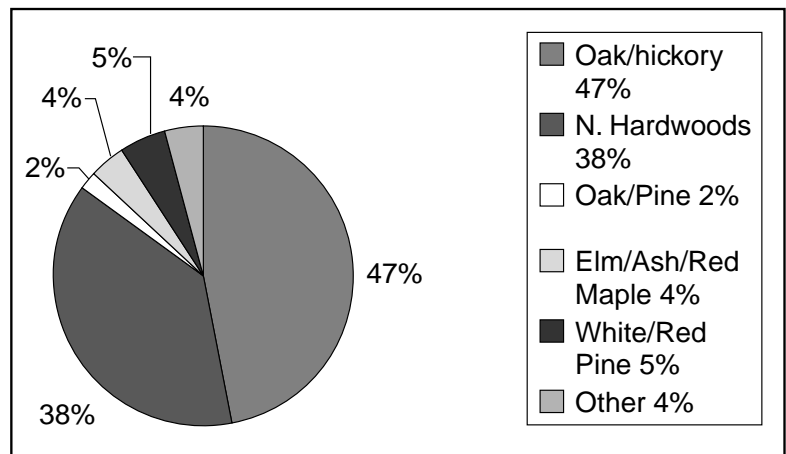


Figure 1. Percentage of timberland area, by major forest-type group, Pennsylvania, 1989 (From Widman, 1995, p.12)

discussion and review. Next, have students brainstorm a list of forests they have visited or know, such as city parks, local forests or national parks.

2. Explain to students that they are going to select and study a local forest to learn about the biological and structural diversity in a forest ecosystem. Ask your students to list what they expect to find in their local "adopted" forest. This list includes types of trees, animal and plant species, insects, and microorganisms. This activity is best done as a small group brainstorming activity with one person recording responses. Ask each group to sort the individual organisms into logical categories. Post each group's predictions.
3. Next, select a nearby parcel of forest to study. Students will generally feel more committed to the activity if they have had a voice in deciding what area should be studied. It might be helpful if you research the possibilities and offer your students several forest sites for their consideration. Students do not have to actually visit these forest sites. They can gather information on possible sites through maps, phone calls to local parks and other efforts. Try to find a site that is accessible at different times of the year. It can be on either public or private land, and might be found at a park, zoo, botanical garden or university campus in your area. Have teams of students study information on each potential site and fill out the Student Page, "Adopt-a-Forest Profile." Have students present each

forest profile to the group. After each group has presented its forest profile to the class, rate each one based on the characteristics of the site (diversity, accessibility, etc.). For example, ratings could be (a) good, (b) better or (c) best. Then students can vote for the forest they want to study.

4. Once a forest study site has been agreed upon, you and the students should (1) obtain permission, if necessary, from landowners and (2) contact appropriate government agencies for information and permission, if needed.
5. Pass out copies of these Student Pages: “A Look at Competition” and “Forest Stratification and Life Zones.” Discuss with students the elements of forest structure and give them time to study the sheets and ask questions that pertain to forest structure.
6. Now have students tailor their original forest inventory list to their adopted forest. You might ask them to do some background research by consulting field guides or contacting city or state foresters to determine the types of trees and plants typically found in the area. They can gather information on wildlife from nature centers, conservation groups or birding clubs. Local landowners that are familiar with the flora and fauna of your site are also good resources. Using the “Forest Inventory Chart,” students should list as many species as their research indicates may be there. (Students should do this in pencil so they can modify their list as needed during their site visit to their adopted forest.) As students develop their list, have them reclassify it using the following groups: woody plants such as trees, shrubs and vines; **herbaceous** plants such as grasses, ferns, wildflowers and mosses; **lichen or fungi, mammals, birds, reptiles and amphibians, and invertebrates** (insects, spiders, worms and mollusks). Ask students to compare these classifications with their original categories.
7. Ask students which life zone (canopy, understory or forest floor) they think the flora and fauna they listed may be found. Tell them they will complete this section on their forest inventory chart when they are on their site visit.

PART B SITE VISIT

GETTING READY

In preparation for the site visit to your adopted forest, you may want to ask a local forester or natural resource specialist to meet with your class before or during the field trip. These professionals may be interested in receiving a final report from the class on what the students found in their adopted forest. See the Assessment Opportunity at the end of this activity for ideas on what students might include in their final reports.

For the site visit, have students bring their copies of “A Look at Competition,” “Forest Stratification and Life Zones” and “Forest Inventory Chart.” They should also bring field guides, binoculars, hand lenses and a camera if they have them. You may make a copy for each group of the Student Page, “Diagram of a Rotting Log” for reference in the field. In addition, you may want students to bring a notebook to keep a record of their site visits. This journal could contain both written notes and sketches. Before students go on the field trip, review proper field trip etiquette and safety with them.

PROCEDURES

1. Visit your adopted forest site and ask students to look at the overall structure of the forest using the Student Page labeled “Forest Stratification and Life Zones.” Have them identify tree species using field guides and tree identification keys. Then have them decide which trees are dominant, co-dominant, intermediate, suppressed or dead (see definitions on the Student Page, “A Look at Competition”). They might want to work in small groups of two to three to decide on these ratings. Have them record their findings on their “Forest Inventory Chart,” revising their lists as necessary.
2. Have students look for the other woody plants and herbaceous plants they listed to see if such plants can be found in their adopted forest. Have students revise their lists according to what they find.
3. To help students better understand the forest ecosystem, have them locate the life zones of the forest. After locating and studying the forest floor,

the understory and the canopy, students should consider these questions:

- ◆ Are the trees mostly coniferous, deciduous or mixed?
 - ◆ Is the forest floor littered with needles, leaves, branches and logs; is it covered with grasses and herbaceous plants; or is it generally bare?
 - ◆ If leaf litter is present, what do you find in it?
 - ◆ Does leaf litter have any effect on the forest's animal life?
 - ◆ Does it inhibit or promote the growth of tree seeds?
 - ◆ Are the understory trees different from the overstory canopy? If so, do they look healthy? What would cause trees to be unhealthy? Why would some trees grow well in the understory and other trees not as well or not at all? How might the needs of the understory trees differ from those in the canopy?
 - ◆ Did you find seedlings on the forest floor?
 - ◆ Did you find any trees growing as "sprouts" from roots of parent trees (the beech is one such tree), or regenerating on the stumps of cut or fallen trees?
4. Once students have differentiated these zones, have them identify where the plants and animals listed in their inventory chart live: (a) the forest floor; (b) the understory; or (c) the canopy, using the "Forest Stratification and Life Zones" diagram. Students might need binoculars to locate animals in the canopy.
 5. Now have students try to locate and identify the birds, mammals, reptiles and amphibians, invertebrates, and lichens or fungi they noted on their inventory lists. They should not collect organisms. Please note: students can use hand lenses when examining logs or litter (leaves, twigs, and so forth, on the ground). They should take care not to break the logs apart. Besides the possibility of disturbing animals using the log for shelter or a nest, moving the log changes the micro-ecosystem that depends on it. However, you might want to use one demonstration log to show the different decomposer organisms, such as

fungi, insects and other invertebrates under the log and in the decaying wood. You can use the Student Page, "Diagram of a Rotting Log" to illustrate the different decomposers. Students will undoubtedly find organisms that are not on their lists. They can use field guides to help them identify unknown species. They should add new findings to their inventory checklist.

6. Have students observe any unusual characteristics of their forest. For example, how have human influences affected their forest?

PART C FOLLOW-UP

PROCEDURES

1. After your class has visited the forest and recorded their data, have them compile the following information:
 - ◆ species of trees observed
 - ◆ comparative characteristics of species (position within the forest structure)
 - ◆ types of other plants and fungi observed (including mosses and lichens)
 - ◆ types of animals/signs observed, including insects and other invertebrates
 - ◆ places where animals and plants were observed (canopy, understory, forest floor, soil or water)
 - ◆ number of trees that were dominant, co-dominant, intermediate, suppressed or dead
 - ◆ whether trees in the canopy and understory were of the same species.
2. Then have students answer the following questions about their forest:
 - ◆ Is their forest connected to a larger continuous forest?
 - ◆ Were there signs of natural or human-caused disturbance?
 - ◆ What unique features does the forest have?
 - ◆ What characteristics did different species share? In what ways were they different?
 - ◆ What are the interrelationships of the organisms within the forest system?
 - ◆ How can you categorize these interrelationships?

- ◆ How do humans fit into these interrelationships? (Students could try to diagram the connections.)
3. With subsequent visits to the adopted forest, have students record data uniformly, noting features at the same sites or positions.
 4. Direct the original brainstorming groups to review their forest inventory. Ask them to critique its accuracy and add items to or delete them from the chart. Groups should explain any changes to the rest of the class.

EXTENSION

- Take a field trip to a nearby forest. Bring along some field guides to the trees and spend time identifying the main tree species found there. Based on the species found, as well as your location in Pennsylvania, have students hypothesize as to which forest type they are most likely located in.
- Have students research the ranges of various animal species found in Pennsylvania to determine whether there are any species more commonly found in one forest type or the other.

ASSESSMENT

At the end of this activity, each student should prepare a final report based on the input of all teams and team members. This presentation may be an actual report or a newsletter or publication with diagrams, charts, illustrations and graphs. All students should provide personal conclusions to their reports, summarizing what they have learned about the ecological relationships within the forest system as well as their knowledge of the biological and structural diversity of the forest. Students should consider these questions when preparing their reports:

- ◆ What did I expect to find in the forest?
- ◆ How did that match up with the actual observations?
- ◆ How did I develop data to support my conclusions?
- ◆ What are the unique qualities of this forest?
- ◆ Is it a relatively old forest or mostly new growth?
- ◆ If it is fairly young, what was there before, and how do I know?
- ◆ Is it a healthy forest? How do I know that?

- ◆ What do I know about the animal life of the forest?
- ◆ What are the roles of both the forest's living and non-living elements?
- ◆ What are the effects of the local population on the forest?
- ◆ What other influences, natural or human-made, are affecting the forest?
- ◆ Of what value is the forest to my community?
- ◆ Does the forest show signs of being biologically diverse? Describe the signs.

Adapted from Project Learning Tree, *The Changing Forest: Forest Ecology*, American Forest Foundation, 1996.

Widmann, Richard H., *Forest Resources of Pennsylvania*. Forest Service Bulletin, NE-31, Radnor, PA: Northeast Forest Experiment Station, 1989.