

Unit A: Introduction to Forestry

Lesson 2: Understanding Forest Ecology

Student Learning Objectives: Instruction in this lesson should result in students achieving the following objectives:

1. Define forest ecology.
2. Identify the components of forest ecosystems.
3. Explain the processes and relationships of natural ecosystems.
4. Describe the interrelationships between trees and environmental factors.

Recommended Teaching Time: 2 hours

Recommended Resources: The following resources may be useful in teaching this lesson:

- A PowerPoint has also been developed with use of this lesson plan
- http://en.wikipedia.org/wiki/Forest_ecology
- <http://www.usoe.k12.ut.us/CURR/science/sciber00/8th/energy/sciber/ecosys.htm>

List of Equipment, Tools, Supplies, and Facilities

Writing surface

PowerPoint Projector

PowerPoint slides

Transparency Masters

Picture of a forest

Colored pencils, markers, or crayons

Plain paper

Terms: The following terms are presented in this lesson (shown in bold italics and on PowerPoint Slide #2):

- **Bole**
- **Ecology**
- **Ecosystem**
- **Forest ecology**
- **Hardening-off**
- **Hardiness**
- **Material cycle**
- **Mycorrhizae**
- **Overstory**
- **Photoperiod**
- **Stratification**
- **Succession**
- **Understory**

Interest Approach: Use an interest approach that will prepare the students for the lesson. Teachers often develop approaches for their unique class and student situations. A possible approach is included here.

Have the students recall when you asked them to identify “things” that they may find in a forest from the previous lesson. Show them the pictures of the forest if they need to see them again. From this list, have students explain the relationship between the “things” they listed. Direct the class discussion towards the introduction of the lesson.

Summary of Content and Teaching Strategies

**** Give each student 2 pieces of paper. Tell them to fold them in half to create a small booklet. On the front cover tell them to title the book “Understanding Forest Ecology” Then have them draw a picture of whatever they think of when they think of forests.**

Objective 1: Define forest ecology.

(PowerPoint Slide #3)

I. **Ecology** is the science that deals with the relation of plants and animals to their environment and to the site factors that operate in controlling their distribution. An **ecosystem** is the interacting of a biological community with its nonliving environment.

(PowerPoint Slide #4)

A. **Forest ecology** is the study of the forest ecosystem.

1. Forest ecology deals with the interrelationships between various trees, plants, and other living organisms that make up the community and with the interrelationships between those organisms and the physical environment in which they exist.

(PowerPoint Slide #5)

2. Ecosystems can vary in size from a few hundred hectares to thousands of hectares. Forest ecosystems are generally classified into types based on the dominant tree species.

(PowerPoint Slide #6)

3. Some ecosystems are simple, while others can be very complex.
 - a. Apple orchards or pine plantations are simple ecosystems because they have only one species of plant.

(PowerPoint Slide #7)

- b. True pine-hardwood forests, an oak-hickory forest, or a beech-maple forest, are complex ecosystems because they have more than one species.
 1. The more complex an ecosystem, the more resistant it is to either change or damage by insects, diseases, ice storms, fire and other disasters.

(PowerPoint Slide #8)

2. When an ecosystem contains many different plant species, the plants are not all affected if the ecosystem suffers from one of the damaging factors.

(PowerPoint Slide #9)

In a mixed hardwood ecosystem, one species of tree may be killed out by a disease, yet other trees will take its place; there will not be a total loss in the timber resource and the ecosystem will continue to function.

- a. A simple ecosystem can be destroyed because it is susceptible to a single damaging factor.

****Have students draw a picture of an ecosystem and of forest ecology in their booklet. They should be able to take both of these definitions and draw one picture on the next page. Allow them to share their ecosystem drawings when they are finished.**

Objective 2: Identify the characteristics of forest ecosystems.

(PowerPoint Slide #10)

II. There are various characteristics and processes typical of the forest environment.

(PowerPoint Slide #11)

- A. Characteristics included stratification, zonation, diversity and stability.
 1. **Stratification** refers to the various layers that can be observed in the forest.
 - a. The upper canopy of trees, trees just below the main canopy, saplings, seedlings, and small herbaceous plants near the forest floor are typical layers.

(PowerPoint Slide #12)

2. Various kinds of trees in the forest have similar needs for moisture and nutrients and are often found in the same zone. The wet area near a stream turns to a dry area farther away. Several zones comprising different groups of tree species are located between them.

(PowerPoint Slide #13)

3. Natural forest ecosystems are very diverse, with many kinds of trees and plants. The various layers in a forest provide a variety of habitats for both plants and animals, allowing many different kinds to develop.

(PowerPoint Slide #14)

4. The diversity results in a stable environment that is both resistant and resilient to change.
 - a. The location and type of habitat in which a species lives, together with its functional role in the forest ecosystem, determine the niche of a species.

****Use TM: A2-1 or PowerPoint Slide #15 as material for lecture and discussion.**

PowerPoint Slide # 16 shows you the layers of the forest. Lead into a discussion of stratification and how it might limit some of the plants. Based on what they have learned from this objective, have students draw a picture of some of the characteristics of a forest. Again you may choose to have them share these drawings.

Objective 3: Explain the processes and relationships of natural ecosystems.

(PowerPoint Slide #17)

III. There are many process and relationships of natural ecosystems.

- A. They include energy flow, decomposition, material cycling, competition, and succession.

(PowerPoint Slide #18)

1. Energy flow is an important process. Green plants, also known as the producers, combine the energy in the form of sunlight with water and minerals from the soil, with carbon dioxide from the air.

(PowerPoint Slide #19)

- a. Energy captured by green plants as sunlight is considered a flow because as it is used it is constantly converted to heat energy that goes back to outer space, not to be used again in the ecosystem.

(PowerPoint Slide #21)

- b. The nonliving materials that green plants use to survive and grow are termed the abiotic part of the ecosystem.

(PowerPoint Slide #21)

- c. Animals, or consumers in the ecosystem, survive on the green plants for food.

(PowerPoint Slide #22)

2. As waste from both plants and animals accumulate on the soil surface, decomposition becomes very important. Decomposers are the fungi and bacteria, primarily in the upper soil layer, that break down plant and animal matter to be repeatedly recycled by the green plants.

(PowerPoint Slide #23)

3. The ***material cycle*** is a circular process where materials are used over and over again.
 - a. Plants, which use materials from the environment, are eaten by animals, and as both plants and animals die, the waste is decomposed, and the decomposed materials are returned to the environment where it can be used again.

(PowerPoint Slide #24)

4. Competition for light, space, water, nutrients and other resources is a constant process in ecosystems. Throughout the processes both plants and animals are competing for the resources they need for survival.

(PowerPoint Slide #25)

5. Many forest ecosystems are constantly changing through a very slow process called ***succession***, where an individual tree dies and is replaced by other kinds of trees that were not previously present in the forest, resulting in a change in the ecosystem.
 - a. A mature forest is usually considered the climax or terminal stage, which is very stable and diverse.

****Use TM: A2-2 or PowerPoint Slide #26 as material for lecture and discussion. Based on what they have learned from this objective, have students draw a picture of the relationships of natural ecosystems.**

Objective 4: Describe the interrelationships between trees and environmental factors.

(PowerPoint Slide #27)

- IV. The total tree environment involves a complex interaction between a variety of physical and biological factors.

(PowerPoint Slide #28)

- A. An environmental change is rarely the result of a single factor. Knowledge of the nature and interrelationships of the major environmental factors is helpful in understanding how plants grow and how they respond to environmental change.

(PowerPoint Slide #29)

- 1. The physical factors include climate, soil, and pyric activity.

(PowerPoint Slide #30)

- a. Climate directly affects both the daily growth processes and the seasonal development of plants. Chemical reactions tend to speed up as temperature increases and slow down when the temperature approaches the maximum at which plants can survive.

(PowerPoint Slide #31)

- 1. The sun is the source of the visible light portion of solar radiation and is important as a source of energy for photosynthesis.
 - a. The photochemical reaction is one triggered by the sun. Sunlight is important in regulating the processes of growth, leaf fall, fruiting, flowering, reproduction and dormancy.

(PowerPoint Slide #32)

- b. The quality, intensity, and duration of light affect the photosynthetic process. The light received by the **understory**, trees growing beneath the canopies of the tallest trees, is quite different in color and intensity from the light the **overstory**, upper canopy trees, is exposed.

(PowerPoint Slide #33)

- c. **Photoperiod** or day length influences diameter growth of trees and the time of flushing or new growth in the spring and the beginning of dormancy and defoliation in the fall.

(PowerPoint Slide #34)

- d. Trees and other plants change physiologically in order to better tolerate and/or resist the extremes of environmental conditions. This change to tolerate environmental conditions is known as the **hardening-off** process.

(PowerPoint Slide #35)

- 2. Air is the principal source of carbon dioxide required for photosynthesis and oxygen used for respiration.

(PowerPoint Slide #36)

- 3. Of the environmental factors that influence the growth of trees, moisture is the most limiting element.

(PowerPoint Slide #37)

There is a wide range of annual precipitation in the forested areas around the world. Silvicultural methods retain more of the moisture available to the tree crop and generally increase tree growth more than any other practice that can alter tree growth.

(PowerPoint Slide #38)

- 4. Soil directly affects a tree by anchoring it and by serving as a growth medium. Besides being a reservoir for moisture, the soil provides all the essential elements for tree growth. Soil characteristics, organic matter, texture, structure, chemical

composition, depth, and position, influence tree growth by affecting the supply of available moisture and nutrients to the tree.

(PowerPoint Slide #39)

B. Certain biological factors affect tree growth. In combination with the physical factors, they make up the total forest environment. Biological factors may occur within trees, inherent or genetic considerations, or between trees.

(PowerPoint Slide #40)

1. The biological factors include the interaction between plants, animals that use the forest for food and cover. Examples are small animal life, fungi and microorganisms in the soil.

(PowerPoint Slide #41)

2. Reproduction is a vital process of every self-perpetuating tree species; however, the reproductive habits vary widely between trees.
a. Seed formation depends on the amount of reserve carbohydrates and nitrogenous materials in the tree. The amount of seed formation varies by species and certain climatic factors.

(PowerPoint Slide #42)

3. A timber tree normally directs a maximum of growth energy into the development and maintenance of one main stem or **bole**. Deviations from this typical tree form may cause a tree to take on the form of a bush or shrub.

(PowerPoint Slide #43)

a. Many tree species assume the form of a tall, pipe-like bole in moist, fertile soils but become shrub-like on dry, windy sites. Variations in tree form also occur when certain trees are overtapped by others in a forest stand.

(PowerPoint Slide #44)

4. A silvical factor related to form is a tree's tolerance or its ability to withstand unfavorable conditions.
a. Light is a major factor commonly associated with the tolerance of a tree, and tree species are often grouped or classified based on their tolerance or intolerance to shade.

(PowerPoint Slide #45)

5. Root growth is related to the inherited characteristics of a tree and root development varies considerably from species to species. Root systems are adaptive and tend to modify themselves to suit the environmental conditions in which they grow.

(PowerPoint Slide #46)

a. The presence of certain soil fungi is essential for the successful growth of many tree species. **Mycorrhizae** are certain soil fungi that enable trees to more fully utilize water, minerals, and nitrogen in the soil.

(PowerPoint Slide #47)

6. The **hardiness** of a tree is its ability to resist heat, cold, droughts, insect infestations, disease attacks, and other elements limiting survival and growth.
a. Hardiness differs between species and between individual trees within a species.
b. Hardiness is important when considering the planting of a species in an area where it normally does not grow or where it is not native.

****Use TM: A2-3 or PowerPoint Slide # 48 as material for lecture and discussion. Based on what they have learned from this objective, have students draw a picture of the interrelationships between trees and environmental factors.**

Review/Summary: In order to review the objectives, have students take notes and review the terms and anticipated questions provided. Asking questions over the objectives on PowerPoint Slide # 49 can also be used as review. Students could also write terms down under their drawing and use it as a review.

Application: Students will draw what they learned from the objectives and use it as a study aide.

Evaluation: Use the following sample test to evaluate the students' comprehension of the material covered in this lesson.

Answers to Sample Test:

Part One: Matching

1. c
2. f
3. i
4. j
5. g
6. b
7. d
8. a
9. h
10. e

Part Two: Completion

1. hardness
2. simple
3. moisture
4. sunlight
5. ecosystem
6. material
7. complex

Part Three: Short Answer

1. energy flow, decomposition, material cycling, competition, and succession
2. stratification, zonation, diversity and stability

Sample Test

Name _____

Test

Unit A Lesson 2: Understanding Forest Ecology

Part One: Matching

Instructions. Match the term with the correct response. Write the letter of the term by the definition.

- | | | |
|-------------------|----------------|-------------------|
| a. bole | e. mycorrhizae | h. stratification |
| b. ecology | f. overstory | i. succession |
| c. Forest ecology | g. photoperiod | j. understory |
| d. hardening-off | | |

- _____ 1. The study of the forest ecosystem.
- _____ 2. Upper canopy trees.
- _____ 3. Slow process where an individual tree dies and is replaced by other kinds of trees that were not previously present in the forest, resulting in a change in the ecosystem.
- _____ 4. Trees growing beneath the canopies of the tallest trees
- _____ 5. Day length.
- _____ 6. The science that deals with the relation of plants and animals to their environment and to the site factors that operate in controlling their distribution.
- _____ 7. Change to tolerate environmental conditions.
- _____ 8. One main stem.
- _____ 9. Various layers that can be observed in the forest.
- _____ 10. Soil fungi that enable trees to more fully utilize water, minerals, and nitrogen in the soil.

Part Two: Completion

Instructions. Provide the word or words to complete the following statements.

1. The _____ of a tree is its ability to resist heat, cold, droughts, insect infestations, disease attacks, and other elements limiting survival and growth.
2. A _____ ecosystem can be destroyed because it is susceptible to a single damaging factor.
3. Of the environmental factors that influence the growth of trees, _____ is the most limiting element.

4. The most important factor in regulating the processes of growth, leaf fall, fruiting, flowering, reproduction and dormancy is _____.
5. A _____ is the interacting of a biological community with its nonliving environment.
6. The _____ cycle is a circular process where materials are used over and over again.
7. The more _____ an ecosystem, the more resistant it is to either change or damage by insects, diseases, ice storms, fire and other disasters.

Part Three: Short Answer

Instructions. Provide information to answer the following questions.

1. What are the process and relationships of natural ecosystems?
2. What are the characteristics and processes of the typical forest environment?

TM: A2-1

Hardwoods – Red Oak

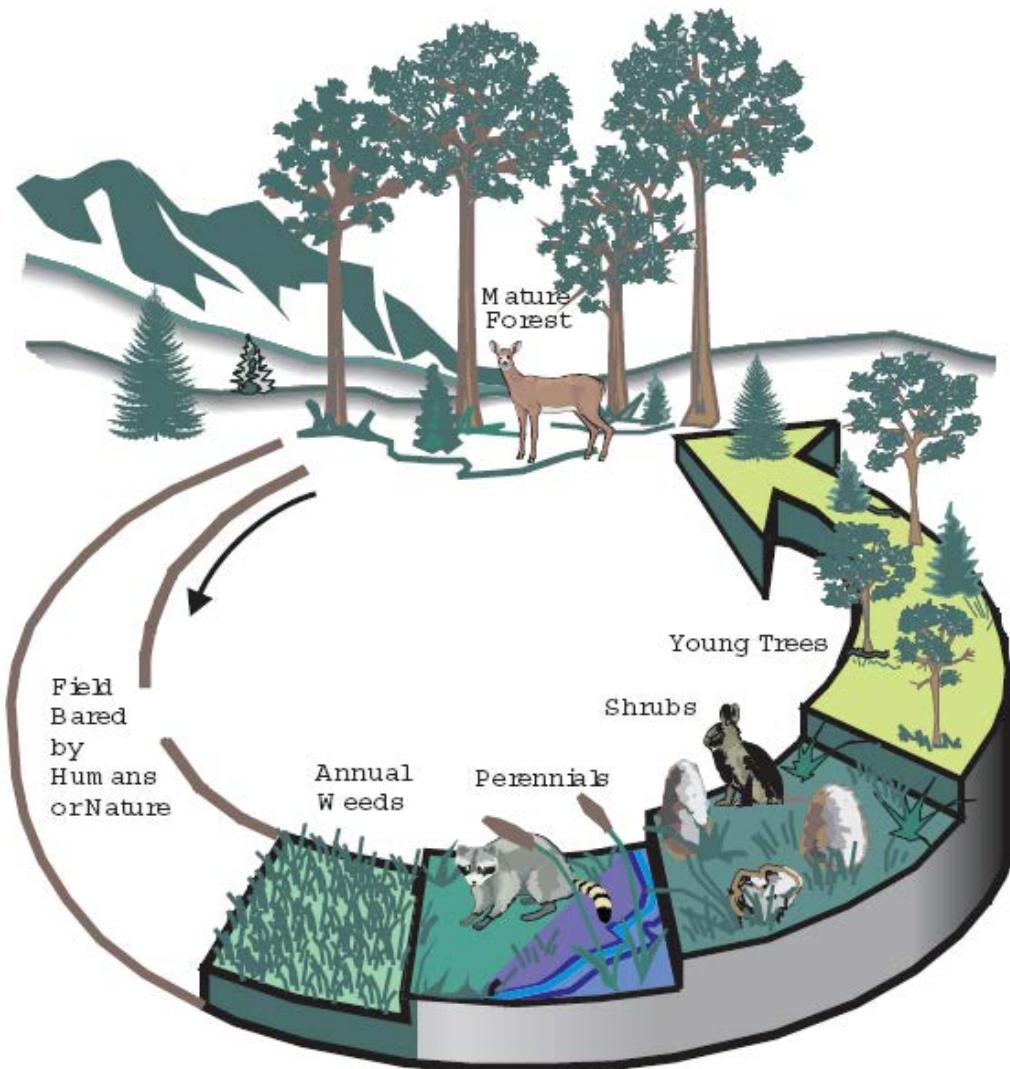


Softwoods – White Pine



TM: A2-2

TOTAL ENVIRONMENT



ECOSYSTEMS

