

# Chapter Two - Looking at an Old Forest Ecosystem

## Introduction to the Chapter

*"An ecosystem consists of living things interacting with each other and their surroundings. "*

In the complete Old Forest Study Unit, this chapter leads students into an examination of the *surroundings* in an old forest ecosystem. They will study the physical make-up of an old forest, and the way the appearance and characteristics of a forest change with time after a major disturbance.

A field trip is recommended as part of this chapter. Detailed descriptions of field trip activities and worksheets are provided.

The mature Cedar-Hemlock forest, a characteristic forest of the Interior Cedar-Hemlock Biogeoclimatic Zone, is chosen as the example ecosystem. However, many of the principles taught here are applicable to other forest types.

## Objectives of Chapter Two

1. Students will recognize that a forest has a physical structure that includes the forest floor, the understorey and the tree canopy.
2. Students will understand that after a disturbance, an ecosystem progresses through a characteristic series of forest communities, until it reaches the status of mature forest.
3. Students will understand that a mature forest is self-perpetuating and contains trees of all ages.
4. Students will understand that the presence of old trees gives a particular set of features, which create a variety of habitats for plants and animals to exploit.
5. In a field trip situation, students will investigate how forest structure can affect living conditions within the forest.

**The complete version of the study unit contains these four lesson plans:**

Lesson One Forest Structure  
Lesson Two How a Mature Forest Develops  
Lesson Three What Features Make Old Forests Special?  
Lesson Four Forest Field Trip

*This abridged version of the study unit contains Lessons One and Three.*

# Lesson One - Forest Structure

## Objectives of Lesson

1. Students will be able to recognize the forest floor, understory and canopy of a forest.
2. Students will understand that forest structure affects the types of habitats available in the forest.

## Materials Needed

1. Class set of worksheet titled "Forest Structure" (two pages).
2. Overhead transparency of worksheet titled "Forest Structure".

## Teaching the Lesson

1. Using the overhead transparency provided, explain the words:

**Structure** is the physical appearance of the forest. It doesn't refer to the *kinds* of plants in the forest; rather, it refers to the *size and arrangement* of plants.

**Forest floor** is the ground cover in the forest. It might include old leaves, tree needles, moss, lichens, fungus, as well as herbs such as flowers and grass, and small shrubs such as Bunchberry. Rotting logs are common in older forests.

**Understorey** is the layer of plants reaching above the forest floor but not reaching up to the tops of the trees. The understorey usually includes large shrubs and young trees.

**Canopy** is formed by the tops of the trees. A closed canopy occurs when the tops of the trees meet and the plants below are in the shade. An open canopy occurs when the trees are widely spaced, and do not completely shade out the plants below.

2. Explain the following concept:  
Every forest in BC's major ecosystems exhibits the canopy/ understory/ forest floor type of forest structure to some degree. But each type and age of forest community has its peculiarities. Can the students think of types of forests that do not exhibit this kind of structure?

Some examples of forest types that do not show this classic type of structure are:

- A young forest newly replanted after logging, or re-growing after a severe forest fire, may have no tree canopy because the trees are too small.
- The Alpine Tundra zone has no forest canopy, because it has no trees!

3. Have the students complete the worksheet titled "Forest Structure".
4. Define habitat as:

**"The natural surroundings needed by an animal or plant, including everything it needs for reproduction, food, water, and a place to live".**

5. Cover these points:
  - How might the forest structure affect habitats? Forest structure defines the living conditions under the tree tops: temperature, shade/sunlight, wind, amount of snow or rain reaching the forest floor, etc.
  - The forest structure has a big influence on the types of habitats found in the forest, and therefore on the types of plants and animals that make up the whole of the forest community.
  - As a forest progresses through the different stages leading to a mature forest, the forest structure changes. Different habitats become available at each stage, and therefore the groups of species living in the forest community change at each stage.
  - In an old forest, there are frequent openings in the forest canopy, usually caused by downed trees or spaces between the big trees. This allows pools of light to reach the forest floor. This additional light supports pockets of lush understorey growth.
6. Distribute the worksheets titled "Forest Structure".

Name \_\_\_\_\_

# Forest Structure

1. Using the following definitions to guide you, label the diagram of the forest below.  
Colour the forest if you have spare time after completing the rest of this worksheet.

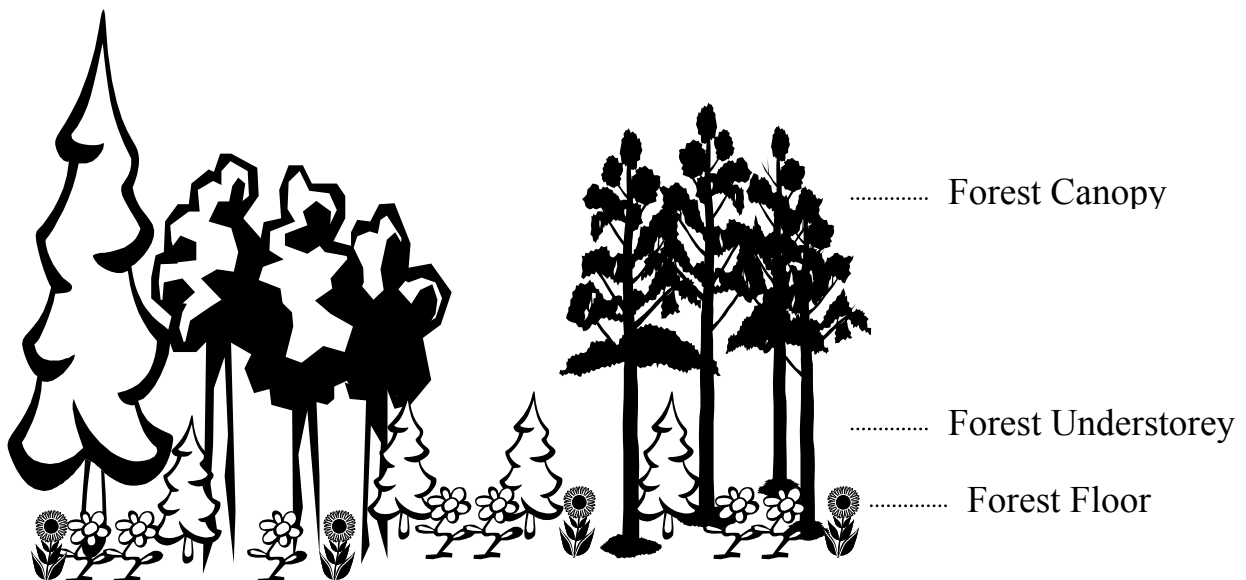
**Forest Floor** is the ground cover in the forest. It might include old leaves, tree needles, moss, lichens, fungus, as well as herbs such as flowers and grass, and small shrubs such as Bunchberry. Rotting logs are common in older forests.

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## Did you know?

A forest's canopy is never completely closed. There are often openings beside streams or swamps, next to rocky bluffs, or in places where old trees have toppled over.



2. Here is a list of plants that are growing in particular situations. Do they form part of the forest floor, the understory, or the canopy?

<b>Location</b>	<b>Plant</b>
	Black Huckleberry - a shrub about one metre tall that grows in forest openings
	Western Red Cedar Tree - a mature tree about 50 metres tall
	Bracken Fern - a fern that grows to be about one metre tall and dies back to its roots every year.
	Devil's Club - a shrub that grows about 1-2 metres in height
	Birch Tree - in this case, consider a young tree about two metres tall
	Step Moss - a moss that grows on fallen rotting logs
	Mountain Boxwood - an evergreen shrub about four feet tall
	Bunchberry - a small flower with red berries
	Western Yew - an evergreen shrub that can reach 2-3 metres in height, grows in shady damp forests
	Hemlock saplings - in this case, consider a row of hemlock trees that have sprouted on a rotting log, each sprout is about 20 cm tall.

# Lesson Three - What Features Make Old Forests Special?

## Objectives for Lesson

1. Students will be able to describe the structural characteristics resulting from old trees in a mature Cedar-Hemlock forest.
2. Students will understand that these structural characteristics create a variety of habitats for plants and animals to exploit.
3. Students will understand that these structures only develop in old trees.

## Materials Needed

1. Class set of handout titled "Old Forest Features" (three pages).
2. Assortment of library books, magazines, etc. about forests to provide a visual reference for students. Include reference books on insects, birds and mammals.
3. Poster titled "British Columbia's Ancient Coastal Temperate Rainforests" available at your resource centre as part of this study unit.

## Teaching the Lesson

1. Explain that a mature forest community that has been in place for many generations of trees has features that can't be found in younger forests.

In the interior of BC these features are best seen in the mature Western Red Cedar and Western Hemlock forests – they are in damp areas so fires are less frequent, and the forest has time to develop these old features. Many of these features will occur in other forest types, if there is enough time between disturbances.

2. Have students read the descriptions of old forest features found on the worksheet titled "Old Forest Features". Have the students generate a list on the chalkboard to summarize the old tree features mentioned in the handout. Use the teacher's reference list (following) as a check to make sure you've identified all of the features.
3. Pairs of students should each choose a different old forest feature to illustrate. They should also provide a paragraph describing the feature and why/how it develops in old forests.

Students will need reference materials for ideas on how to draw these features. Assemble a variety of books showing photographs and drawings of forests, plus books on insects, birds and mammals. Search your school library and ask students to bring pictures/books from home.

Browsing for "idea pictures" will also expose the students to books about the forest, which they may need for other research later in this Old Forest Ecosystems Study Unit.

*Tip: Encourage the students to show the features in lots of detail, with appropriate animals or other ecosystem components appearing in context in the sketches.*

The poster included with this kit illustrates many features and species that are found in old forests. Although the forest shown illustrates the Coastal Western Hemlock Biogeoclimatic Zone, many of the same features are found in old forests of the Interior Cedar - Hemlock Biogeoclimatic Zone.

This poster is available from:  
Western Canada Wilderness Committee  
20 Water Street  
Vancouver BC V6B 1A4

4. Close the lesson with the following concept:

Many of the features the students sketched take a lot of time to develop in nature. Only in a mature forest community that has been in place for many generations of trees, has there been enough time for these old forest features to develop.

These features add a structural diversity to the forest that is lacking in young forests. Along with the increased diversity of structure comes an increase in the types of homes and foods available for different kinds of plants and animals.

**Review the definition of *habitat*:** "the natural surroundings needed by an animal or plant, including food, water, and a place to live." Thus, **the old trees in a mature forest provide a variety of habitats.** These habitats are lacking in forests without old trees.

*(Chapter Three introduces the plants and animals of a mature Cedar-Hemlock forest, some of which can only live in old-growth forests and depend on the special habitats found in these forests.)*

**For Teacher Use - A list of old forest features that could be illustrated:**

Students should design their own illustrations after reading the handout. However, you might find this list useful for inspiring students who need an idea for their illustration.

- a) Draw lots of big cedar and hemlock trees, and have them widely spaced with a mossy forest floor and a few shrubs between the trunks.
- b) Students might want to draw a disturbance in the process of creating an opening in the old forest; for example, show a tree in the process of falling down in a windstorm.
- c) Looking at a forest as if you were walking through it, draw in the forest floor, the shrubby understorey and then a higher understorey of trees (multi-layer understorey).
- d) Show a close-up of the forest floor with lots of woody debris and rotting logs in various stages of decay.
- e) Show a rotting log as a nurse log.
- f) Show a close-up of a rotting log covered in new vegetation, perhaps with a Pine Marten hunting a vole that is scurrying into a hole in the log.
- g) Draw mushrooms growing from base of a tree, or shelf fungus growing from the side of the trunk.
- h) Sketch a woodpecker hole with a Pileated Woodpecker hanging on the side of the tree.
- i) Draw a woodpecker searching for bugs under flaking bark.
- j) Draw a tree with dead and broken branches; be sure to include lichen and moss growing on the branch.
- k) Sketch a standing dead tree (snag) with a Bald eagle nest in the top and the eagle perched nearby on a broken branch.

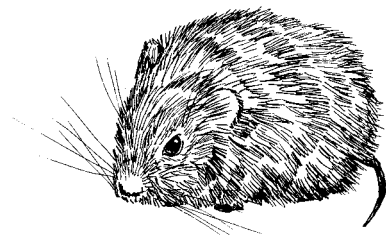
Name \_\_\_\_\_

## Old Forest Features

How do you know that you're in a forest with old growth qualities? Keep your eyes open for these features, or clues that these features exist.

The forest community has to have had more than one generation of old trees before some of these features begin to appear. For example, nurse logs won't be seen until the forest has had some big trees topple and rot on the forest floor.

- 1. Are the trees big (greater than one metre in diameter) and spaced wide apart?**  
Old Cedar and Hemlock trees can be very big. Big trees can't grow too close together or there wouldn't be enough light or soil to meet their needs.
- 2. Are there openings in the forest canopy?**  
Tree branches often meet to block out the direct sun, creating a cool and shady forest floor. But the canopy won't be entirely closed; there will be openings here and there in the forest.
- 3. Look carefully at the understorey. Is it multi-layered?**  
The understorey has the usual layer of shrubs and little trees, but there are likely young trees reaching high above the shrubby understorey. These trees will grow rapidly if an old tree topples and they suddenly receive more light.
- 4. The forest floor has lots of woody debris.**  
Look for old tree needles, cones, branches and twigs decaying on the forest floor. Some old tree forests have a continual carpet of moss. Occasionally big branches, loaded with lichen and moss, break off the old trees. This plant material becomes an important food source for several animals, including Mountain Caribou and Red-backed Voles.  
Rotting logs can be found in all stages of decay, from newly fallen to completely covered with moss, shrubs and saplings.



*Red-backed  
Vole*

**5. Big, fallen logs are very important to forest animals and insects, especially in snowy areas.** In winter, snow bridges across the logs, leaving natural tunnels along the sides of the log for voles and their predators, such as Pine Martens. Logs provide habitat for voles, which will dig into the rotten log and create a network of tunnels. A whole host of fungi and other decomposers depend on the food provided by the wood, and in turn a number of insect-eating predators, such as salamanders, depend on the residents of the rotting log.

**6. Do you see openings in the forest?**

Old trees have to die sometime. Usually rotten roots or rotten wood inside the tree trunk will weaken the tree and a strong wind will knock the trees down. Trees may fall individually or a whole group may be blown over in one storm.

But when an old tree dies, sunlight streams into the forest and fuels a flush of new growth. Seedlings of birch or aspen, which are resistant to the rots that killed the old trees, grow quickly to fill the gap. New habitats exist because of the rotting log and the different vegetation.



**7. Are there trees in various stages of death?**

Trees are very different to animals! When trees die of old age, death comes very slowly. After death, trees can stay upright as a snag for many years, and when they eventually fall to the ground, their bodies take a long time to decay.

Don't forget that even in a healthy tree, only the outside layers of the trunk and the thick roots are alive. The inside wood, or heartwood, is dead but provides the tree with strength. If a fungus or Carpenter Ants attack and begin to consume this heartwood, it doesn't directly harm the living part of the tree. It takes a long time before the tree is weakened enough to show any outward sign of damage.



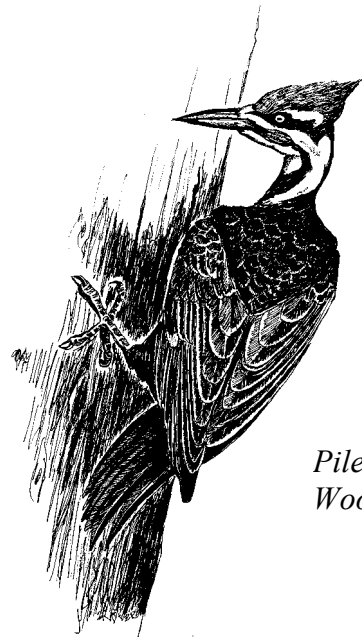
*Armillaria fungus*

**8. Are there mushrooms growing on the trees?**

If you see mushrooms growing on a tree, that's a pretty sure sign that the tree is infected with some kind of rot. The mushrooms might grow around the base of the tree or out of the tree trunk. Shelf fungi look like a hard, round shelf attached to the tree, and they add a new growth ring each year. Don't forget that the mushrooms you see are just the reproductive part of the fungus; most of the fungal body is spread throughout the tree and appears as white, cob-webby strands in the rotten wood.

**9. Are woodpeckers interested in the tree?**

As the interior wood weakens and softens, the tree becomes ideal for use by wildlife. Woodpeckers will work over a tree searching for bugs to eat, or quarry a nesting cavity from the softened inner wood. A woodpecker hole in a tree may be the first outward sign that the tree trunk is rotting.



*Pileated Woodpecker*

**10. Is the tree breaking apart?**

As the wood continues to weaken, branches may snap off, and tops of the trees break off or die. Sometimes entire, miniature ecosystems of lichens, mosses and bugs live on these old tree branches. When the branches fall to the ground, the lichens are available for voles or caribou to eat.

Broken branches and woodpecker holes can act as entry sites for other tree diseases, for other fungi, and for insects. Death and decay progresses more quickly. As the outer, living layer of the tree trunk dies, the bark begins to loosen and flake off.

Insects begin to burrow into the outer layers of wood. Bats might crawl under the loose bark for a day-time roosting site.

Sometimes the tops of cedar trees die back, and the grey, weathered top of the tree trunk stands out like a church spire.

**11. Are there snags?**

Eventually all trees dies. Some trees are pushed over by wind, but others will stand for years as a snag. Snags provide perching and nesting sites for many big birds such as ravens and eagles.

**12. Do streams have big logs lying across them?**

When a big tree falls across a stream, it acts as a dam, and water creates a pool behind the log.

Sediments settle out as the water slows down, thus creating new pockets of soil and reducing the abrasive ability of the stream's water. These pools become resting stations for fish and other aquatic organisms. Big old trees help to create aquatic habitats.

