



FIELD ENHANCEMENT 3

Competition in a Forest

OBJECTIVES

Upon completion of this lesson, students will be able to:

- List the basic needs of a tree.
- Explain what part of a tree gathers each of the tree's basic needs.
- Give examples of how competition affects a tree meeting its basic needs.
- Identify crown layers in a forested area.

SUBJECT AREAS

Science

LESSON/ACTIVITY TIME

- Total Lesson Time: 80 minutes
- Time Breakdown:
 - Introduction.....15 minutes
 - Activity 125 minutes
 - Activity 225 minutes
 - Conclusion.....15 minutes

TEACHING SITE

This lesson requires an open area and a forest containing trees of various sizes.

CLASSROOM LESSON CONNECTIONS

This lesson ties closely with Classroom Lesson 1, *Me as a Tree*.

NUTSHELL

In this lesson, students compete for basic needs in an active game. Afterwards they observe and write about how trees compete with one another for their basic needs.

BACKGROUND INFORMATION BASIC NEEDS

In order to survive, trees need the following resources: nutrients, sunlight, water, air, and space. The availability of some basic resources can be limited, so trees compete with each other to meet their needs. Different parts of a tree play different roles in collecting these resources.

Trees use nutrients (minerals) from the soil to build the materials that make up the tree. These nutrients allow the tree to survive, grow, and reproduce. Nutrients are dissolved in water that the roots collect.

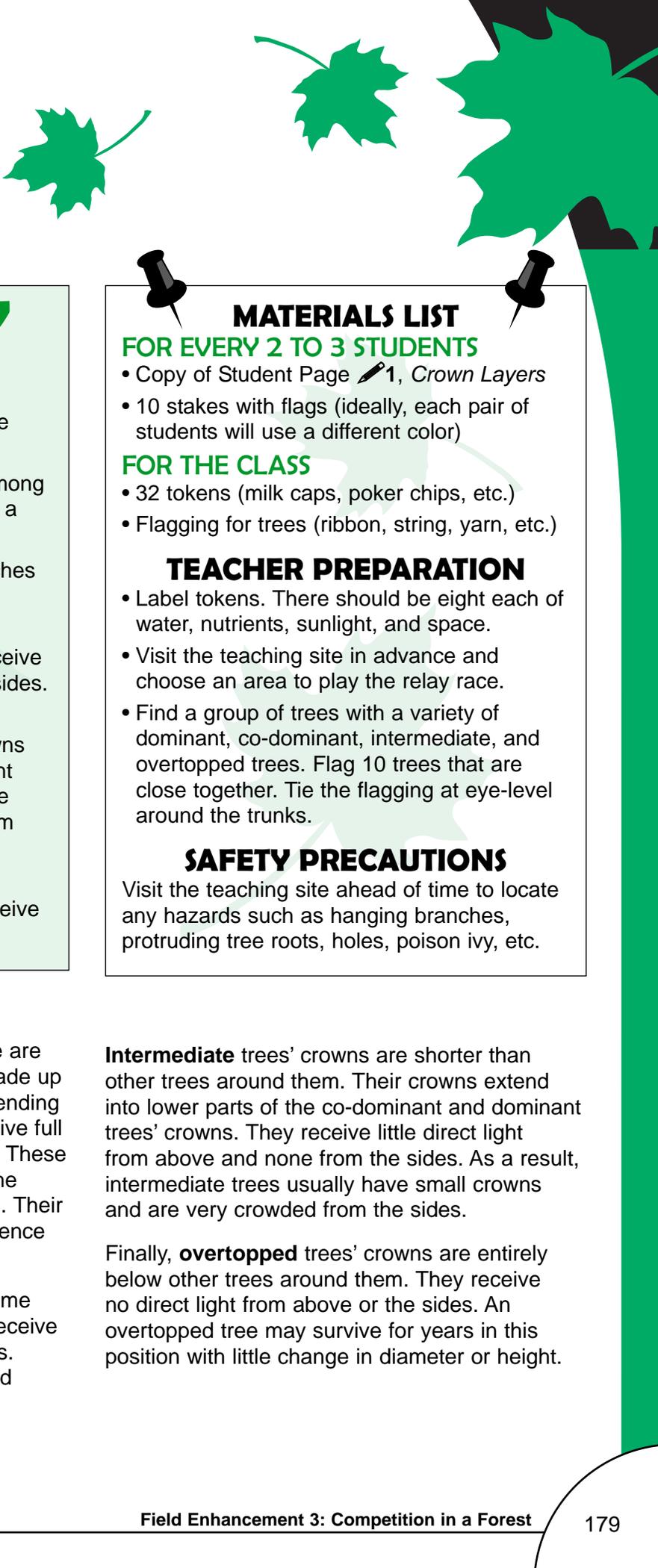
Sunlight is the form of energy that trees use to complete the process of photosynthesis. In order for a tree to convert carbon dioxide and water into sugars (and other carbohydrates), it needs energy from the sun. The **crown** of a tree collects sunlight.

Water is another key to photosynthesis. It is also important to the tree for transportation of nutrients. Water makes up most of the tree's sap and the sap carries nutrients and sugars. Water is collected by a tree's roots.

Air around the tree and in the soil allows the exchange of oxygen and carbon dioxide that all parts of a tree need to grow. Trees use carbon dioxide in the process of photosynthesis. Air is collected by the leaves of a tree.

Space seems to be the least tangible of the basic needs. It is important for students to know that trees can't grow when they are crowded.

Root systems need room to grow, as do branches, leaves, and trunks.



VOCABULARY

Co-dominant: Trees with crowns at the same height as other trees around them. They receive full light from above but little from the sides.

Competition: The struggle that exists among plants or trees to acquire resources from a limited pool.

Crown: The part of a tree with live branches and leaves.

Dominant: Trees with crowns extending above other trees around them. They receive full light from above and partly from the sides.

Intermediate: Trees with crowns shorter than other trees around them. Their crowns extend into lower parts of the co-dominant and dominant trees' crowns. They receive little direct light from above and none from the sides.

Overtopped: Trees with crowns entirely below other trees around them. They receive no direct light from above or the sides.

CROWN LAYERS

Just as there are layers in the forest, there are also layers of tree crowns. One layer is made up of **dominant** trees. They have crowns extending above other trees around them. They receive full light from above and partly from the sides. These trees are taller than the average trees in the stand and their crowns are well-developed. Their crown form or shape is mostly free of influence from neighboring trees.

Co-dominant trees have crowns at the same height as other trees around them. They receive full light from above but little from the sides. Usually they have medium-size crowns and are somewhat crowded from the sides.

MATERIALS LIST FOR EVERY 2 TO 3 STUDENTS

- Copy of Student Page 1, *Crown Layers*
- 10 stakes with flags (ideally, each pair of students will use a different color)

FOR THE CLASS

- 32 tokens (milk caps, poker chips, etc.)
- Flagging for trees (ribbon, string, yarn, etc.)

TEACHER PREPARATION

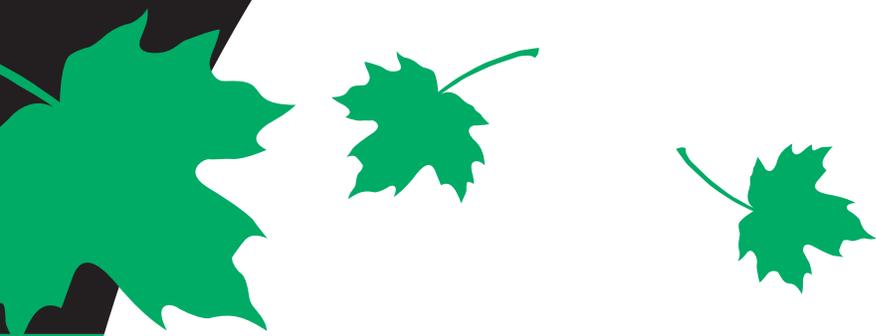
- Label tokens. There should be eight each of water, nutrients, sunlight, and space.
- Visit the teaching site in advance and choose an area to play the relay race.
- Find a group of trees with a variety of dominant, co-dominant, intermediate, and overtopped trees. Flag 10 trees that are close together. Tie the flagging at eye-level around the trunks.

SAFETY PRECAUTIONS

Visit the teaching site ahead of time to locate any hazards such as hanging branches, protruding tree roots, holes, poison ivy, etc.

Intermediate trees' crowns are shorter than other trees around them. Their crowns extend into lower parts of the co-dominant and dominant trees' crowns. They receive little direct light from above and none from the sides. As a result, intermediate trees usually have small crowns and are very crowded from the sides.

Finally, **overtopped** trees' crowns are entirely below other trees around them. They receive no direct light from above or the sides. An overtopped tree may survive for years in this position with little change in diameter or height.



COMPETITION

Many factors affect how **competition** plays out in a forest. These factors include tree age, species, spacing, size, and disturbances. For example, trees that are the same age both support and compete with each other. When trees are young, they shelter one another from the wind. In addition, a high density of trees encourages rapid tree growth by suppressing weeds. However, as they grow older, they begin to compete with one another for their basic needs.

Tree species can affect how competition occurs over time. An oak tree is slow growing, while an aspen grows quickly. Aspens grow quickly in an area with a lot of light and soon become the dominant trees. The oaks take over as dominant trees, but only after the aspens die.

Disturbances play a role in competition. Storms, diseases, and fires that kill trees decrease competition for surviving trees. Sometimes, simply by good fortune, a tree may survive a storm or a fire, while many of the trees surrounding it die. This tree will probably have an advantage because competition has been reduced.

The spacing between trees also affects competition. Frequently the crowns of trees overlap one another in a forest. In this area of overlap, two or more trees compete for the resources available there. Depending on the amount of overlap and the size of the crowns involved, this can be a disadvantage for some trees.

PROCEDURE INTRODUCTION

1. Ask your students what they need to survive. (*Answers will vary and could include anything from parents to pets to video games.*) Now ask students what they really **need** to survive. (*Guide them to food, water, shelter, space, and air.*)

2. Now, ask your class what a tree needs to survive. (*Water, sunlight, nutrients, air, and space.*) Discuss with your class how the tree makes use of these five basic resources.

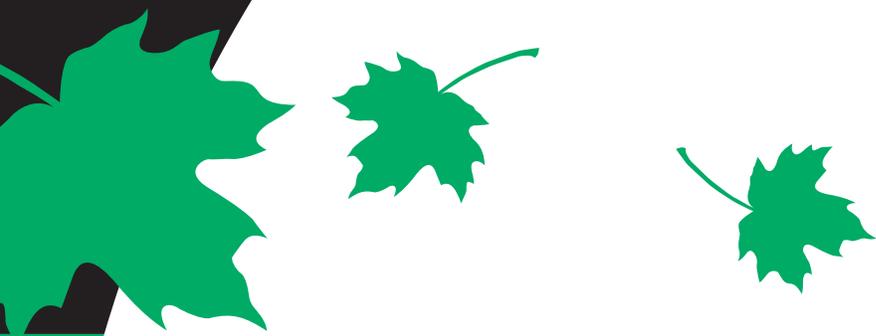
- Ask them what part of the tree is best for absorbing sunlight. (*Leaves.*) Explain that, during photosynthesis, leaves use energy from the sun to turn carbon dioxide and water into sugar. Trees use this sugar for food.
- Ask students what part of the tree collects air. (*Leaves.*) Air contains the carbon dioxide trees use in photosynthesis. Humans breathe in oxygen and give off carbon dioxide. Trees take in carbon dioxide and give off oxygen.
- Ask your students what part of the tree is best for absorbing nutrients. (*Roots.*) Explain that roots absorb nutrients (or minerals) from the soil. Trees use nutrients to grow and build the materials that make up the tree.
- Ask your students what part of the tree is best for absorbing water. (*Roots.*) Remind students that water is one of the ingredients needed for photosynthesis. In addition, water helps transport nutrients from the roots up to the top of the tree and energy from the leaves down to the roots.
- Ask students what parts of the tree need space. (*The whole tree.*) Explain that branches need space to spread out. In this way, the branches help the leaves get sunlight. Roots need space to spread out and gather water and nutrients from the soil. The trunk needs space to grow wider and taller.



3. Explain to students that resources are limited. Thus, trees compete with each other for these basic resources. Ask your students the following questions: “What if you were to play one-on-one basketball with an NBA player? Who would win?” (*The NBA player.*) “Why?” (*Because he would have an advantage. Students may also list specific factors like height and skill level.*) Then ask, “What if you were to play one-on-one basketball with a four-year-old? Who would win?” (*Students should respond that they would win.*) “Why?” (*Because the older, taller, and more skilled child would have an advantage.*) Then explain to your students that some trees are better able to get the resources they need to survive than others. They may have an advantage because they are older, bigger, growing on a better site, or have more space. Tree species also plays a role in how well trees compete. Explain that trees with an advantage will grow faster than trees that are less able to get the resources they need. Once a tree grows a little bigger than its neighbors, it has an even greater advantage for getting resources.

ACTIVITY 1

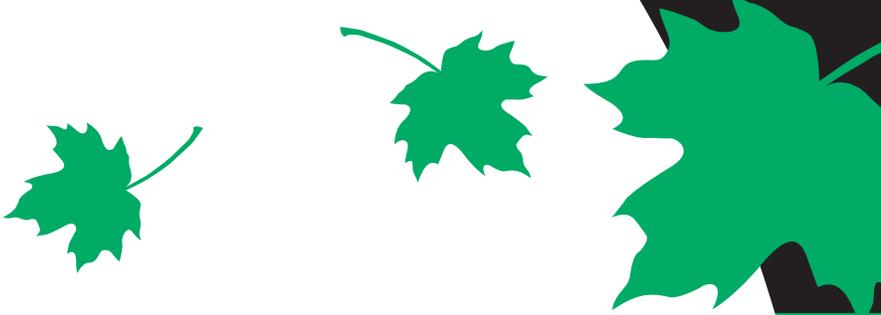
1. Take students to the open area you have chosen for playing a game.
2. Scatter the labeled tokens along one side of the playing field. Have your students stand on the opposite side of the playing area. Divide your class into teams of four students. Explain that each team represents a tree. The trees will compete in a relay race for the resources they need to survive.
 - Assign one person on each team to represent leaves. Explain that when it is the leaves’ turn, they will run to the other end, pick up a token that is labeled “sunlight,” run back to their team and tag the next team member.
 - Assign one person on each team to represent branches. Explain that the branches will bring back a token labeled “space” and then tag the next member of their team.
 - Assign two people on each team to represent roots. Ask one of the roots on each team to pick up water and the other to pick up nutrients. Each root will take a turn retrieving the appropriate token just like the other teammates.
 - Ask students why no one had to pick up air. (*Air is found almost everywhere. Trees do not need to compete for it like the other needs.*) Now tell your students about the catch: to make the competition more difficult, every player must accomplish this with only one hand and while hopping on one foot.
3. Now that you have explained the basic rules of the race, have the teams line up behind a starting line. Once everyone is ready, give the signal to go. Take note of the team that finishes first.
4. When the first round is over, congratulate the winning team. Explain that since they finished first, they represent the strongest tree and earn an advantage in the next round. The whole team gets to use both hands. The other teams, however, will still use only one hand. Collect your students’ tokens, mix them up, and scatter them on the other side of the playing field. Line the teams up for the next round and remind them that everyone still has to hop on one foot. Signal the teams to start racing.
5. Again, take note of which team finishes first. If the same team wins again, they earn the right to use both hands and both feet. If a different team wins, that team gets to use both hands. The team that won the first round still also gets to use both hands.



6. Continue racing until a team wins a round using both hands and both feet. Explain that a tree that has gotten this far represents a dominant tree in the forest, so the third time they win a round they get to grow bigger. When this happens, they will join teams with the team that was the slowest in the last round. Explain that the slow team has been out-competed by the dominant tree. Explain that everyone on that team keeps their role as leaves, roots, and branches. Each member of this team of eight must collect their assigned resource in the next round. They may continue to use both hands and both feet. Any other team that had earned an advantage in a previous round will continue to use that advantage as well.
7. It is not likely that the team of eight will win the next round. Explain that this represents the eventual decline of a dominant tree and the opportunity for a new tree to take dominance.
8. Gather your students together to discuss the game. Ask your students what happened to the trees that earned an advantage. (*They had an easier time getting resources the next round.*) Then ask your students what happened to the slowest tree. (*The slowest tree was out-competed by a dominant tree.*)

ACTIVITY 2

1. Take your students to the forested area you have chosen for observation.
2. Tell your students that they are going to see if they can observe how much the trees around them are competing. To do this, they are going to see how much the crowns of neighboring trees overlap. Demonstrate how to look straight up at the crown of a tree and locate where the perimeter of the crown is. Begin by finding a starting point directly underneath the outermost edge of the crown. Mark that point on the ground with a flag. Demonstrate how to walk around the tree directly underneath the perimeter of the crown. Make sure that you are looking straight overhead. Explain to your students that they will need to stop frequently to mark the line with flags. Tell them to continue walking and marking until the entire perimeter of the crown is marked.
3. Assign each tree you have previously marked to a pair or trio of students. Give each group 10 flags and time to work.
4. When everyone is finished and all 10 trees have been outlined, walk around with your students and take note of how much overlap exists between the trees' crowns. Explain that in the areas of overlap, there are two or more trees competing for the resources available in that space. The more overlap that exists, the more competition that exists between those trees. Ask students what the trees are competing for. (*Nutrients, sunlight, water, and space. There is enough air around them that they don't have to compete for it.*)
5. Point out how a smaller or shorter tree might receive less sunlight. Ask why this might be a disadvantage for the tree. (*It would have a harder time collecting sunlight for photosynthesis.*) Have students consider how the overlapping crowns would affect trees' need for space. Point out trees that have uneven crowns due to crowding. Ask students how competing trees' need for nutrients and water would be affected. (*If trees are closer together their roots have less area to collect nutrients and water from.*)



CONCLUSION

Remind your students that throughout a tree's lifetime, it will experience different levels of competition as its circumstances change. Give each group of students a copy of Student Page  1, *Crown Layers*. Have them look at the crown layers drawing. Point out that a tree can be labeled based on where its crown is in the canopy. Go over each of the labeled crown layers: dominant, co-dominant, intermediate, overtopped. If possible, have students try to find trees around them that fit each description.

Ask students which of the trees would have the biggest advantage for getting what it needs to survive. (*Dominant.*) Ask how one of the other trees might become dominant if it is not getting its needs met. (*If a dominant tree dies, other trees can take its place. Old age or a disturbance such as a windstorm might kill a dominant tree.*)

SUMMATIVE ASSESSMENT

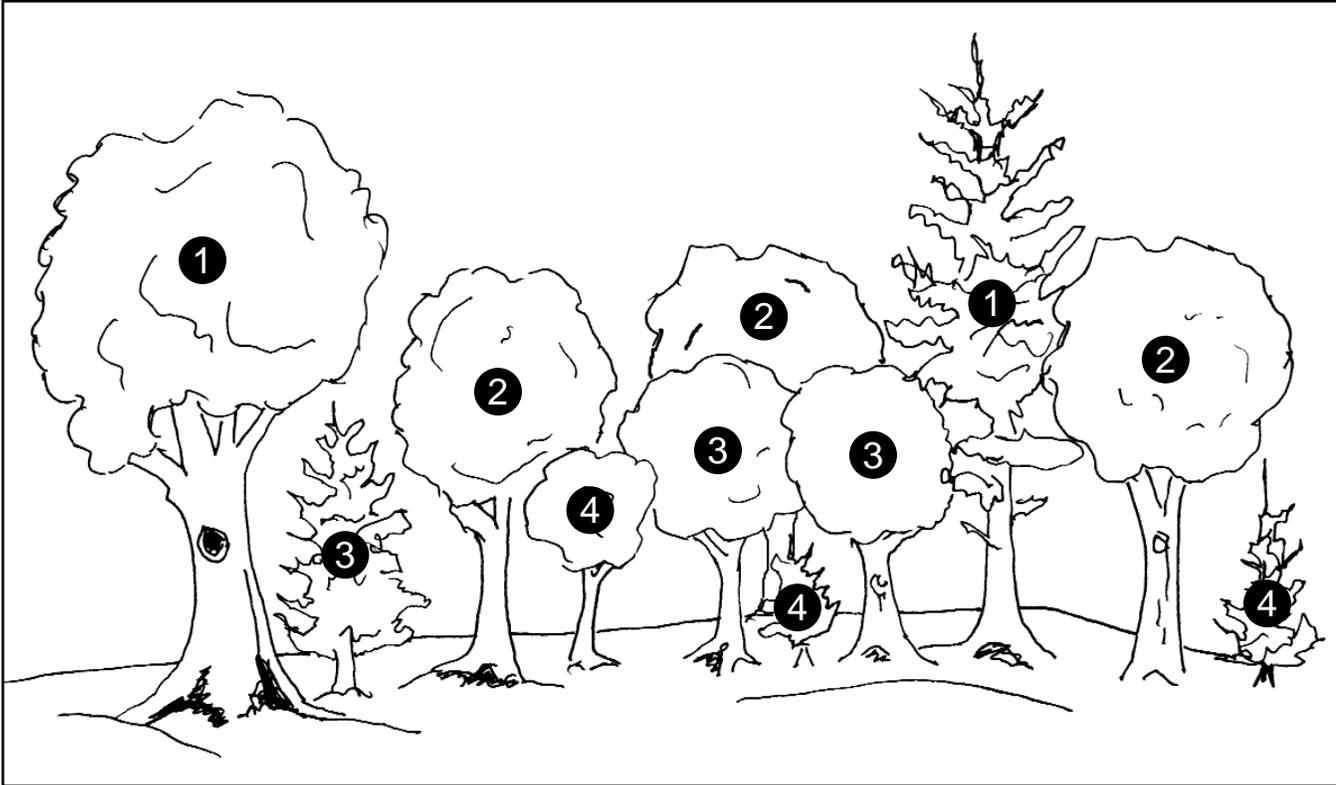
Assign students to write a story about an overtopped tree from the tree's perspective. In the story, each student should describe how competition affects this tree. They should describe periods in which competition is tough and periods in which competition is less intense. Your students should answer the following questions in their story: How does this tree's size and spacing affect how it competes with the trees around it? What disturbances affect how this tree interacts with other trees? How does this tree finally become a dominant tree?

REFERENCES

Inventory and Analysis National Core Field Guide: Volume 1. (2002). U.S. Department of Agriculture Forest Service.



CROWN LAYERS



- 1.....DominantTrees with crowns extending above other trees around them. They receive full light from above and partly from the sides.
- 2.....Co-dominant.....Trees with crowns at the same height as other trees around them. They receive full light from above but little from the sides.
- 3.....Intermediate.....Trees with crowns shorter than other trees around them. Their crowns extend into lower parts of the co-dominant and dominant trees' crowns. They receive little direct light from above and none from the sides.
- 4.....Overtopped.....Trees with crowns entirely below other trees around them. They receive no direct light from above or the sides.



OVERSTORY

**UNDERSTORY
TREE**

SHRUB

FORB

LITTER