

Lesson 4

What Are Forests Like?

Objectives

Students will

- identify major characteristics of a tree
- identify three types of trees
- discuss features of three basic types of forests
- describe the importance of forests for all of creation

Vocabulary

bark—the outer protective layer of a tree's trunk

canopy—the ceiling formed over a forest by interlocking tree branches

conifer—a tree that produces its seeds in cones

deciduous (duh-SID-joo-uhs) *tree*—a broadleaf tree that loses its leaves in the autumn

forest—a large area of land that is covered with trees and other plants

temperate (TEM-per-uht) *climate*—a climate that has four distinct seasons and temperature changes

tropical rainforests—dense, warm, wet forests near the equator

trunk—the woody stem of a tree

Structuring the Curriculum

The five activities in the Discover section are designed to be done together during an extended outdoor class session. You may need to use another class period to complete the indoor activities and discussions. After the students have completed the activities, have them compare their results. Discuss the expected outcomes and background information with the class. Having the class discussion in the wooded area is usually best.

General Forest Safety Precautions:

- ✓ Follow deer tick precautions when entering woodlands. Wear long pants and shirts with long sleeves, long socks pulled up over pant legs, light-colored clothing (to better spot ticks), and a hat.
- ✓ Check carefully for ticks after leaving the forest, and wash all clothes when you get home.
- ✓ Know how to identify poison ivy, sumac, and other poisonous plants in your area before entering woodland areas.
- ✓ Never approach wild animals, especially mammals. Nocturnal mammals seen resting or traveling during the day often have a rabies infection.

If time allows, show students the preparation steps for the Making Paper demonstration.

Preparation/Materials

Activity: Determining Forest Temperatures

- ✓ thermometer, one per team

Try This: Tree Canopy Percentages

- ✓ cardboard tissue paper rolls, one per team

Activity: Tree Identification

- ✓ activity sheet 1, one per student
- ✓ field guide to trees, one per team
- ✓ Before class, identify six trees of different species (both deciduous and conifer), and tack sheets of colored paper labeled 1–6 to these trees.

Activity: Estimating Tree Heights

- ✓ activity sheet 2, one per student
- ✓ meter sticks, one per team
- ✓ calculators, one per team

Activity: Exploring Dead Log Ecosystems

- ✓ field guides to insects, one per team
- ✓ field guides to spiders, one per team

Demonstration: Making Paper

- ✓ several sheets of used paper, including newspaper, construction paper, tissue paper, white paper, and paper towels
- ✓ wire hanger
- ✓ nylon stocking
- ✓ stapler
- ✓ 2-gallon tubs, two
- ✓ warm water
- ✓ blender
- ✓ scraps of construction paper (optional)
- ✓ herbs (optional)
- ✓ flower petals (optional)
- ✓ 4-cm threads (optional)
- ✓ wooden spoon
- ✓ two pieces of cloth
- ✓ rolling pin
- ✓ iron (optional)

Background

Trees are complex organisms. A tree's trunk carries food and water to other parts of the tree using vascular tissues called xylem and phloem. Xylem tissues transport water and minerals from the tree's roots to the branches, leaves, flowers, fruit, and seeds. Phloem carries food produced by photosynthesis in the leaves to the roots, and other plant parts. The outer layer of the trunk is the bark, which protects the trunk's woody tissues from bacteria, fungi, and insects.

Although scientists have classified about 20,000 species of trees, some botanists believe that the total number may approach 50,000. Only 700 species of trees are found in North America.

Forests grow in regions that have sufficient rainfall and relatively moderate temperatures. The three basic types of forests—temperate deciduous, conifer, and tropical—are determined by temperature and rainfall.

Temperate deciduous forests consist of deciduous trees, which lose their leaves in the autumn after some put on a dazzling display of color as the dominant chlorophyll pigment breaks down in response to lower temperatures and dwindling daylight hours. Leaf loss helps deciduous trees conserve water. They don't photosynthesize in the winter and must have at least four months of growing season to manufacture enough food to sustain themselves through the year. Deciduous trees grow in temperate climates of the middle latitudes; the types of deciduous trees that dominate a forest vary from region to region. Temperate deciduous forests once spread across eastern North America, most of Europe, and parts of Japan and Australia, but centuries of deforestation has cleared all but scattered patches of these forests away.

Conifer forests consist of evergreen trees with needles or small compact leaves. These needles or scaly leaves are covered by a waxy surface, which helps conserve against water loss, allowing conifer trees to keep their leaves in all seasons. Conifer forests thrive in the cold weather and poor soil of higher latitudes and altitudes. Conifer forests dominate Russia, Canada, Alaska and parts of China.

Tropical rainforests stretch across South America, Africa, and Asia near the equator. Because of constant sunlight and warmth, rainforests support the greatest biodiversity of species of any biome, including a wide diversity of trees and other plant species. As many as 100 species of trees may live in an area one-fourth the size of a soccer field. This wide diversity of plant life supports an incredible animal diversity. Many rainforest animals dwell in the forest canopy. Biologists around the world are alarmed at the current rate of tropical rainforest destruction, which is estimated to be 1 to 2 percent a year. Poor, developing countries are rapidly harvesting timber to earn fast cash to boost their flailing economies, and poor farmers are using slash-and-burn farming techniques to make a living. Much of the biosphere's biological wealth is disappearing with these forests, and scientists fear that the biological crown jewels of God's creation will be lost in a generation.

Forests are vital to the biosphere's health. Collectively, trees produce enormous quantities of food and oxygen through the process of photosynthesis, during which they remove carbon dioxide from the atmosphere; this regulates global warming gases. Tree roots hold soil to the ground, preventing erosion. (In regions of severe deforestation, heavy rains produce massive mudslides because forests no longer hold the soil back.) Forests also provide valuable resources such as timber, fruits, fibers, and medicines. For example, the cancer fighting chemical taxol is found in the bark of the yew tree. Forests also hold the majority of Earth's species; without them, this rich biological wealth would be lost, impoverishing the biosphere and causing the extinction of many living species.

Transpiration is another important contribution of forests. Trees take in an enormous quantity of water from the ground. This transpires through the leaves and evaporates. The evaporation of water requires heat energy, which comes from the surroundings. In this way trees cool the surrounding environment.

Through wise forest management programs, healthy forests can be maintained indefinitely, but this can happen only if forest health takes priority over the profit from its resources. Biologists agree that most of the world's forests, including many found in North America, are not being managed in a sustainable way.

Lesson 4

What Are Forests Like?

Can you guess the name of the largest organism that ever lived? What did you guess—an elephant? a dinosaur? a blue whale? None of these creatures gets the prize for the largest organism. The largest organism ever to live on Earth was a tree! A redwood tree named the Lindsey Creek tree weighed 3,630 metric tons (8 million pounds) when it fell in 1905. This one tree weighed the same as 600 elephants and more than 35 of the heaviest dinosaurs to ever walk the planet.

What is the longest-living organism on Earth? Did you guess the oldest human, who lived to 122 years old, or perhaps a 200-year-old tortoise? The oldest living organism is a tree! Many trees live to be hundreds of years old (far older than any animal) but a bristlecone pine tree named Methuselah is the granddaddy of them all. This tree began to grow in 2765 B.C., so it was already ancient when Jesus was born. In fact, it was over 1,700 years old when King David ruled Israel!

Botanists have identified 20,000 species of trees, but there may be as many as 50,000 species. Many undiscovered species probably grow out of sight in tropical rainforests. Trees are some of God's most impressive creations. They are the largest and oldest living things on Earth. Trees share several characteristics. Most trees grow to a height of at least 4 m (13 feet) and have a diameter of at least 8 cm (3 inches). The woody stem of a tree is called a **trunk**. The trunk supports the tree's entire weight without



Bristlecone pine.

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outside help. The outer protective layer of a tree's trunk is called **bark**. The bark protects the tree from bacteria, mold, and insects. Trees have deep roots that anchor themselves into the ground, and they have leaf- or needle-covered branches that spread out in all directions.

A large area of land that is covered with trees and other plants is called a **forest**. Forests grow in many different places around the world that have enough rainfall and warmth to support many trees. Three basic types of forests grow in the world: conifer forests, temperate deciduous forests, and tropical rainforests.

Different trees grow best in different regions. A **conifer** is a tree that produces its seeds in cones. Pines, spruces, and cedars are all conifers. Most conifers have needles or scaly leaves that stay on the tree year-round. Conifer needles have a waxy covering that prevents water loss. This allows conifer trees to keep their leaves all year, so they can photosynthesize all year and make enough food to live in harsh conditions. The tree's triangular shape allows it to shed heavy snow. This helps protect the branches and exposes the leaves so that the tree can continue photosynthesis. Conifer forests thrive in the cold weather and poor soil of northern regions and mountains. They stretch across Russia, Canada, Alaska, and parts of China.



Broadleaf trees have wide leaves instead of needles or scaly leaves. Most broadleaf trees grow flowers for reproduction. This group includes deciduous trees and tropical trees. A **deciduous** (duh-SID-joo-uhs) **tree** is a broadleaf tree that loses its leaves in the autumn. Maples, oaks, and elms are deciduous trees. Deciduous

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Discover

Review the following safety precautions with students before these activities.

- ✓ Follow deer tick precautions. (These are outlined in the beginning of the lesson.)
- ✓ Always turn logs toward you to prevent snakebites. (The snakes will crawl out away from you instead of toward you.)
- ✓ Never approach or touch wild animals, especially nocturnal animals not normally seen during daylight hours, such as bats and possums.

1. **Activity: Determining Forest Temperatures.** Provide each student team with a thermometer. Have students lay the thermometer in the sun on asphalt or concrete, wait two minutes, and record the temperature in their science journals. Have them repeat this procedure to determine the temperature of a sunny patch of grass and of the forest floor. On a sunny day the temperature difference between the shade of a forest canopy and concrete in the sun can reach 16 °C (30 °F) or more. This activity demonstrates the remarkable cooling effect of a forest canopy.

Extension. Have students dig 15-cm holes in the forest floor to test forest soil temperatures. Have students record the temperature at ground level and at 1 m height.

2. Have students complete **Try This: Tree Canopy Percentages** (page 168) in the student text. In the center of a forest or woods the canopy should cover 100 percent of the sky.



trees live in temperate climates. (A **temperate** [TEM-per-uh] **climate** is a climate that has four distinct seasons and temperature changes.) Deciduous trees put on a dazzling display of color in the autumn, and then they lose their leaves. Leaf loss helps the trees conserve water. During the winter in temperate climates there isn't enough sunlight for these trees to produce enough sugar to keep healthy. So photosynthesis stops, the trees drop their leaves, and the trees become dormant (inactive) until spring. Temperate deciduous forests once covered eastern North America, most of Europe, and parts of Japan and Australia. Today only small sections remain.

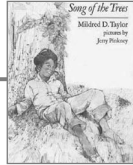
Tropical trees grow near the equator and keep their leaves all year. Palm trees, for example, are tropical trees. **Tropical rainforests**—dense, warm, wet forests near the equator—circle around the equator through South America, Africa, and Asia. Because they receive constant sunlight and warmth, tropical rainforests support a much greater variety of trees and other plants than any other place on Earth. This wide variety of plant life in turn supports an incredible variety of animals. Tropical rainforests are disappearing quickly because of logging, farming, and ranching. Many of God's creatures are becoming extinct as these forests disappear.

Forests give us countless products. From the forests

Read On

Song of the Trees

To read about how a family tries to keep a dishonest man from cutting down the forest on their land during the Depression, read *Song of the Trees* by Mildred D. Taylor.



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Try This



Tree Canopy Percentages

A **canopy** is the ceiling formed over a forest by interlocking tree branches. Tree canopies provide habitats for wildlife and shade for the forest floor. How much of the sky does a tree canopy cover? Try this activity to find out.

Take a cardboard tissue paper roll with you as you walk into a forest or patch of woods. Look through the roll toward the sky. Estimate the percentage of the circle covered by trees. If you can't see any sky, the canopy covers 100 percent of the sky. If half of the circle is filled, the canopy covers 50 percent.

Record the location where you are standing, and write down the percentage of sky the canopy covers. Estimate the percentage of canopy cover at other locations, such as the edge of the woods and places where sunlight is shining through. Write a paragraph in your science journal explaining why planting dense trees around houses might be more helpful than planting grass.

Safety notes:

- ✓ Follow deer tick precautions when entering woodlands—wear long pants and shirts with long sleeves, long socks pulled up over your pant legs, light-colored clothing (to better spot ticks), and a hat. Check yourself carefully for ticks after leaving the forest, and wash your clothes when you get home.
- ✓ Know how to identify poison ivy, sumac, and other poisonous plants in your area before entering woodland areas.
- ✓ Never approach wild animals, especially mammals. Wild mammals may have rabies.



Strange Truth

Record Leaves

The South American bamboo palm tree has the largest leaves in the world. The leaves of this tree can measure up to 20 m (65 feet) long!

we get timber for building materials, utility poles, furniture and other wooden items, firewood, and paper. Many forest trees and other plants give us medicines. We get fruits such as pineapples and bananas, spices such as cinnamon and vanilla, nuts such as cashews and macadamias, and other foods such as mushrooms, berries, cocoa, cola, sugar, and sweet potatoes from forests. Rubber, bamboo, and jute (used for rope and burlap) are also forest products. So are Christmas trees.

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Near the edge of the forest the canopy probably covers about 50 percent. Stress to students that thick canopies provide wildlife habitats and shade for forest soil, conserving water.

A dense forest of trees surrounding homes would provide more habitat for wildlife, moderate summer and winter temperatures reducing energy use, reduce landscaping costs, and conserve water that would be otherwise used on lawns. Disadvantages would include an increased risk of damage from falling trees and an increased population of deer ticks that cause Lyme disease.

3. **Activity: Tree Identification.** Distribute **activity sheet 1**. Have student teams use field guides to trees to identify several trees near your school. Before class, identify six trees of different species (both deciduous and conifer), and mark these trees with sheets of colored paper labeled 1–6. Stress that a wide variety of trees in a forest creates the highest biodiversity of plant and animal species.
4. **Activity: Estimating Tree Heights.** Give each team a meter stick and a calculator, and give each student a copy of **activity sheet 2**. Have students follow the steps on the activity sheet to estimate the height of a tree. Be certain that students hold the meter stick at arm's length at all times. It could help them to close one eye when doing their measurements.

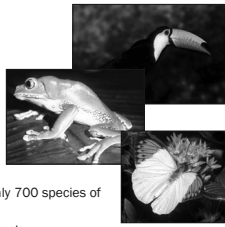


Amazing Creations

Packed Forests

Rainforests cover only 6 percent of Earth's land, but between 50 and 85 percent of all Earth's species live there.

- About 170,000 of the 250,000 known plant species live in rainforests.
- A survey in Brazil's rainforest found 487 tree species in just 2.5 acres. In comparison, all of North America has only 700 species of trees.
- One-third of all bird species live in South American rainforests.
- One small rainforest park in Peru supports 1,300 butterfly species. In comparison, all of Europe has 321 species of butterflies.
- In a rainforest location in Peru scientists collected 80 species of frogs in just one day. In comparison, the United States has only 81 species of frogs.
- Madagascar, a country smaller than Texas, has 300 species of frogs, 297 of which are found nowhere else in the world.



Are forests important only because they give us so many products? No. Forests are also important for Earth's health. Forests take in large quantities of carbon dioxide and release oxygen. Tree roots hold soil in the ground, preventing erosion. In areas where forests have been cut down, heavy rains produce large mudslides because forests no longer hold the soil back. These mudslides can destroy buildings, kill many people, and muddy clear mountain streams. Forests also provide homes for most of Earth's animal species. Without forests, most of God's creatures, including you, couldn't live.

It's important to balance a forest's value as timber and other resources with its value as a habitat. When we get resources from the forest, we must make sure that we aren't destroying the environment and its beauty. We must also make sure that we are leaving enough resources for the years to come. This requires careful management of forests. Many of the world's forests—including

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Intersection with History

A Beautiful World

Christopher Columbus was amazed at the beauty of the rainforests he saw in the New World. He wrote, "I never beheld so fair a thing: trees beautiful and green, and different from ours, with flowers and fruit each according to their kind, many birds and little birds which sing very sweetly."



Amazing Creations

Natural Air Conditioners

Think about how much cooler it is to stand under a tree than in a parking lot on a hot day. Trees act as air conditioners for the outdoors. How do they do this? Like other plants, trees take in water through the ground. This water is drawn up through the plant and is eventually released by the leaves, where it evaporates. The process of evaporation takes in heat energy from the surrounding environment—as water evaporates, then, the surrounding air becomes cooler. In this way trees are God's natural air conditioners. Planting trees around houses and other buildings cuts down on the need for artificial air conditioning.

some in North America—are not being managed in healthy ways. Scientists are learning more and more about how to use forest resources in a way that will allow the forests to be healthy for many generations. If we use forests carefully, we can always have healthy forests.

Think Back

1. Why might trees be considered some of God's most remarkable creations?
2. What characteristics do all trees share?
3. Describe the major difference among the three types of forests.
4. Why do you think that deciduous trees grow mainly in temperate climates?
5. Why are tropical rainforests home to such a wide variety of living things?

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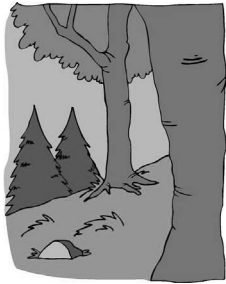
5. **Activity: Exploring Dead Log Ecosystems.** Give students this background on dead log ecosystems: Dead trees recycle nutrients from trees back into the forest soil through a process called decomposition. This process creates especially rich soil in deciduous forests, where seasonal leaf litter contributes an enormous source of nutrients for forest decomposers. There are three different stages of decomposition.

- **Stage 1: Invaders.** Once a tree dies, wood-eating insects bore holes into the tree, allowing places for fungi and bacteria to enter and start the decomposition process. Decayed wood lets moisture in, making the wood a suitable habitat for lichen, moss, and decomposing plants. Egg-laying insects invade the log as it begins to break apart. Invading organisms include bacteria, fungi, beetles, and termites.
- **Stage 2: Consumers.** Insects move into the soft, decaying wood to build nests and feed on fungi and bacteria. Many more plants, insects, and animals soon take up residence in the log and further the decay process. Consumers include daddy longlegs, ferns, mosses, centipedes, woodpeckers, ants, and small mammals. Eventually, the wood-eating insects start leaving the log to search for newly fallen logs.
- **Stage 3: Scavengers.** At the end of the decomposition process, scavengers eat the dead plant and animal material found in the log. Snails and slugs eventually break down the log until it disintegrates back into rich soil. Plant debris covers the remains of the log, allowing new plant seedlings to grow, using the nutrients left behind from the decay process.

Tree Identification

Use a field guide to trees to identify the trees that your teacher has marked.

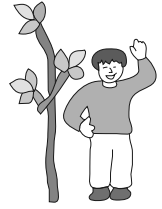
- Tree 1 _____
- Tree 2 _____
- Tree 3 _____
- Tree 4 _____
- Tree 5 _____
- Tree 6 _____



Unit 5, Lesson 4/1

Estimating Tree Heights

Have you ever wondered how tall a tree is? Here's a way to find out without climbing it with a long measuring tape.



1. Measure a team member. Record the team member's height in centimeters. _____
2. Have that team member stand against a tree that you want to measure.
3. Have another team member stand about 15 m (50 feet) away from the tree and hold the meter stick at arm's length toward the tree and the team member. Record how many centimeters tall the team member next to the tree appears to be. _____
4. Record how many centimeters tall the tree appears to be. _____
5. Determine the real tree height with the following formula. Use centimeters for units.

Formula:

$$\frac{\text{actual student height}}{\text{apparent student height}} = \frac{\text{actual tree height}}{\text{apparent tree height}}$$

Hint:

Multiply the actual student height by the apparent tree height. _____

Then divide this number by the apparent student height. This is the actual height of the tree in centimeters. _____

6. Convert the centimeters to meters by dividing by 100. This is the height of the tree in meters. _____

Unit 5, Lesson 4/2

Have students turn over dead logs and use field guides to insects and spiders to identify the types of organisms living there. Have students try to determine which stage of decomposition the log is in.

Develop

1. **Discussion: Intersection with Meteorology: Forest Climates.** Discuss the climates required by each of the three different types of forests. Explain that a particular type of forest or other biome dominates a region because of the region's climate. Use the information below for your discussion.

Temperate Deciduous Forest:

- Average annual rainfall: 75–125 cm (29.5–49 inches)
- Average summer temperature: 28 °C (82.4 °F)
- Average winter temperature: 6 °C (42.8 °F)
- Global location: Once dominated eastern North America, north and central Europe, parts of Japan and Australia, and the tip of South America.

Conifer Forest:

- Average annual rainfall: 35–75 cm (14–29.5 inches)
- Average summer temperature: 14 °C (57.2 °F)
- Average winter temperature: -10 °C (14 °F)

- Global location: Much of Canada and Alaska; Russia; Scandinavia; portions of China, and at one time a large portion of the Middle East.

Tropical Rainforest:

- Average annual rainfall: more than 250 cm (100 inches)
- Average daytime temperature: 34 °C (93 °F)
- Average nighttime temperature: 20 °C (68 °F)
- Global location: The countries of South America, Africa, and Asia located along the equator.

2. **Demonstration: Making Paper.** Use this demonstration to show students one of the major resources that forests provide—paper. Explain that you are recycling paper that has already been made from trees, but the process of making paper from wood chips is similar to this process. Explain that the paper-making process was invented in China in the second century A.D. and that paper was made one sheet at a time, much like this demonstration, until 1798.

Demonstration Preparation

- Remove tape, staples, and other extra items from several sheets of used paper, including newspaper, construction paper, tissue paper, white paper, and paper towels.
- Make a wire frame by bending a wire hanger into any shape that you choose. Stretch a nylon stocking over the frame and handle, and staple it in place.
- Tear the paper into 2-cm squares, and soak it overnight in a 2-gallon tub filled with warm water.

Demonstration Steps

- Half fill a blender with warm water.
- Add a handful of the soaked paper scraps.
- Blend the mixture on medium speed until the paper scraps disappear and a “slurry” liquid forms.
- You may want to blend in small pieces of colored construction paper for color and add herbs, flower petals, or 4-cm threads for texture.
- Pour the suspension into an empty tub, and fill the tub with warm water, stirring the ingredients with a wooden spoon until they are evenly dispersed.
- Gently slide the screen into the tub, and wait for pulp to settle on the screen. Gently move the screen back and forth until the pulp is distributed evenly over the nylon.
- Lift the screen out of the water. Allow the excess water to drip into the tub. Gently press the pulp to squeeze out excess water.
- Flip the frame paper-side-down onto a cloth that is laid out flat. Gently lift the screen from the paper.
- Cover the paper with a second piece of cloth, and use a rolling pin to squeeze out excess water.
- Let the paper dry overnight.
- Gently peel the paper from the cloth.

Try this demonstration first before you use it in class. Make sure to use scrap paper to reinforce the idea of recycling paper products. The morning after your demonstration, you may want to use an iron on medium heat to finish the drying process.

Reinforce/Assess

Have student volunteers read **What Are Forests Like?** (page 165) in the student text aloud. Have students answer the **Think Back** questions (page 170) as homework.

1. *Why might trees be considered some of God's most remarkable creations? (Trees are the largest and oldest living things on Earth.)*
2. *What characteristics do all trees share? (Trees grow to a height of at least 4 m and a diameter of 8 cm. They have a trunk, bark, deep roots, and spreading branches with leaves.)*
3. *Describe the major difference among the three types of forests. (Tropical rainforests grow in tropical climates near the equator; deciduous forests grow in temperate climates; conifer forests grow in northern climates. Students may also identify the different types of trees that grow in each forest.)*
4. *Why do you think that deciduous trees grow mainly in temperate climates? (The growing season farther north is too short, and tropical trees are better adapted than deciduous trees for thriving in tropical climates.)*
5. *Why are tropical rainforests home to such a wide variety of living things? (They have constant warmth and plentiful sunlight.)*

Extend

- ▶ Have students research and debate the pros and cons of forest fires and controlled burns.
- ▶ An oak/chestnut deciduous forest once stretched from Cape Ann, Massachusetts, and the Mohawk River of New York all the way down to the southern end of the Appalachian highland. A blight wiped out most of the chestnut trees in this forest. Have students research the nature and extent of this blight. Ask students to evaluate the chestnut tree population in that region today.
- ▶ Have students identify the trees near their homes. Students can create a map of the different tree species found near their house.
- ▶ Take students to a forested area, and have them sit alone for 20–30 minutes to quietly contemplate some aspect of the forest. Encourage them to use all of their senses to experience the sights, textures, smells, and sounds of the forest and its inhabitants. Have them write about their experiences in their science journals. Encourage students to do field sketching while in the forests as well.

- ▶ Create a contour map to show the range of tropical, temperate/deciduous, and conifer forests. This could possibly be a black outlined map of the Western hemisphere that students could color to show the approximate range of the type of forests.
- ▶ Many legends, fairy tales, and other stories take place in the forest. Have students write their own stories that take place in the forest.
- ▶ Have students investigate some of the foreign species that have invaded North American forests and caused serious damage (e.g., gypsy moth, Dutch elm disease, emerald ash borer, or Asian longhorned beetle).
- ▶ Point out to students that, given how vast and full the canopy is in rainforests, most of the energy is in the plant life and very few nutrients actually reach the soil. That's why rainforest destruction to farmland is so damaging. This information makes a good extension discussion.

Lesson 4

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outside help. The outer protective layer of a tree's trunk is called **bark**. The bark protects the tree from bacteria, mold, and insects. Trees have deep roots that anchor themselves into the ground, and they have leaf- or needle-covered branches that spread out in all directions.

A large area of land that is covered with trees and other plants is called a **forest**. Forests grow in many different places around the world that have enough rainfall and warmth to support many trees. Three basic types of forests grow in the world: conifer forests, temperate deciduous forests, and tropical rainforests.

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Broadleaf trees have wide leaves instead of needles or scaly leaves. Most broadleaf trees grow flowers for reproduction. This group includes deciduous trees and tropical trees. A **deciduous** (duh-SID-joo-uhs) **tree** is a broadleaf tree that loses its leaves in the autumn. Maples, oaks, and elms are deciduous trees. Deciduous



trees live in temperate climates. (A **temperate** [TEM-per-uh] **climate** is a climate that has four distinct seasons and temperature changes.) Deciduous trees put on a dazzling display of color in the autumn, and then they lose their leaves. Leaf loss helps the trees conserve water. During the winter in temperate climates there isn't enough sunlight for these trees to produce enough sugar to keep healthy. So photosynthesis stops, the trees drop their leaves, and the trees become dormant (inactive) until spring. Temperate deciduous forests once covered eastern North America, most of Europe, and parts of Japan and Australia. Today only small sections remain.

Tropical trees grow near the equator and keep their leaves all year. Palm trees, for example, are tropical trees. **Tropical rainforests**—dense, warm, wet forests near the equator—circle around the equator through South America, Africa, and Asia. Because they receive constant sunlight and warmth, tropical rainforests support a much greater variety of trees and other plants than any other place on Earth. This wide variety of plant life in turn supports an incredible variety of animals. Tropical rainforests are disappearing quickly because of logging, farming, and ranching. Many of God's creatures are becoming extinct as these forests disappear.

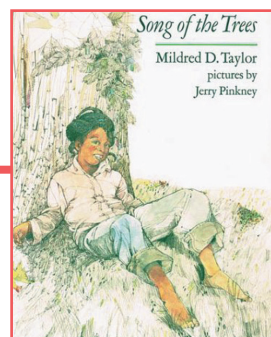
Forests give us countless products. From the forests



Read On

Song of the Trees

To read about how a family tries to keep a dishonest man from cutting down the forest on their land during the Depression, read *Song of the Trees* by Mildred D. Taylor.



Try This



Tree Canopy Percentages

A **canopy** is the ceiling formed over a forest by interlocking tree branches. Tree canopies provide habitats for wildlife and shade for the forest floor. How much of the sky does a tree canopy cover? Try this activity to find out.

Take a cardboard tissue paper roll with you as you walk into a forest or patch of woods. Look through the roll toward the sky. Estimate the percentage of the circle covered by trees. If you can't see any sky, the canopy covers 100 percent of the sky. If half of the circle is filled, the canopy covers 50 percent.

Record the location where you are standing, and write down the percentage of sky the canopy covers. Estimate the percentage of canopy cover at other locations, such as the edge of the woods and places where sunlight is shining through. Write a paragraph in your science journal explaining why planting dense trees around houses might be more helpful than planting grass.

Safety notes:

- ✓ Follow deer tick precautions when entering woodlands—wear long pants and shirts with long sleeves, long socks pulled up over your pant legs, light-colored clothing (to better spot ticks), and a hat. Check yourself carefully for ticks after leaving the forest, and wash your clothes when you get home.
- ✓ Know how to identify poison ivy, sumac, and other poisonous plants in your area before entering woodland areas.
- ✓ Never approach wild animals, especially mammals. Wild mammals may have rabies.



Strange Truth

Record Leaves

The South American bamboo palm tree has the largest leaves in the world. The leaves of this tree can measure up to 20 m (65 feet) long!

we get timber for building materials, utility poles, furniture and other wooden items, firewood, and paper. Many forest trees and other plants give us medicines. We get fruits such as pineapples and bananas, spices such as cinnamon and vanilla, nuts such as cashews and macadamias, and other foods such as mushrooms, berries, cocoa, cola, sugar, and sweet potatoes from forests. Rubber, bamboo, and jute (used for rope and burlap) are also forest products. So are Christmas trees.



Amazing Creations

Packed Forests

Rainforests cover only 6 percent of Earth's land, but between 50 and 85 percent of all Earth's species live there.

- About 170,000 of the 250,000 known plant species live in rainforests.
- A survey in Brazil's rainforest found 487 tree species in just 2.5 acres. In comparison, all of North America has only 700 species of trees.
- One-third of all bird species live in South American rainforests.
- One small rainforest park in Peru supports 1,300 butterfly species. In comparison, all of Europe has 321 species of butterflies.
- In a rainforest location in Peru scientists collected 80 species of frogs in just one day. In comparison, the United States has only 81 species of frogs.
- Madagascar, a country smaller than Texas, has 300 species of frogs, 297 of which are found nowhere else in the world.



Are forests important only because they give us so many products? No. Forests are also important for Earth's health. Forests take in large quantities of carbon dioxide and release oxygen. Tree roots hold soil in the ground, preventing erosion. In areas where forests have been cut down, heavy rains produce large mudslides because forests no longer hold the soil back. These mudslides can destroy buildings, kill many people, and muddy clear mountain streams. Forests also provide homes for most of Earth's animal species. Without forests, most of God's creatures, including you, couldn't live.

It's important to balance a forest's value as timber and other resources with its value as a habitat. When we get resources from the forest, we must make sure that we aren't destroying the environment and its beauty. We must also make sure that we are leaving enough resources for the years to come. This requires careful management of forests. Many of the world's forests—including



Intersection with History

A Beautiful World

Christopher Columbus was amazed at the beauty of the rainforests he saw in the New World. He wrote, “I never beheld so fair a thing: trees beautiful and green, and different from ours, with flowers and fruit each according to their kind, many birds and little birds which sing very sweetly.”



Amazing Creations

Natural Air Conditioners

Think about how much cooler it is to stand under a tree than in a parking lot on a hot day. Trees act as air conditioners for the outdoors. How do they do this? Like other plants, trees take in water through the ground. This water is drawn up through the plant and is eventually released by the leaves, where it evaporates. The process of evaporation takes in heat energy from the surrounding environment—as water evaporates, then, the surrounding air becomes cooler. In this way trees are God’s natural air conditioners. Planting trees around houses and other buildings cuts down on the need for artificial air conditioning.

some in North America—are not being managed in healthy ways. Scientists are learning more and more about how to use forest resources in a way that will allow the forests to be healthy for many generations. If we use forests carefully, we can always have healthy forests.

Think Back

1. Why might trees be considered some of God’s most remarkable creations?
2. What characteristics do all trees share?
3. Describe the major difference among the three types of forests.
4. Why do you think that deciduous trees grow mainly in temperate climates?
5. Why are tropical rainforests home to such a wide variety of living things?

Tree Identification

Use a field guide to trees to identify the trees that your teacher has marked.

Tree 1 _____

Tree 2 _____

Tree 3 _____

Tree 4 _____

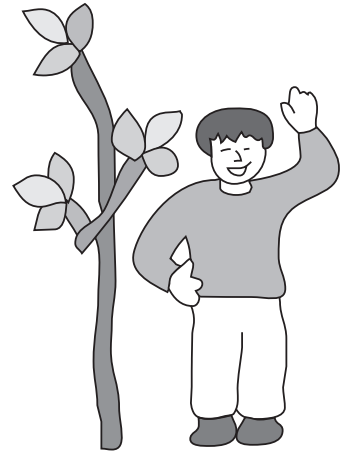
Tree 5 _____

Tree 6 _____



Estimating Tree Heights

Have you ever wondered how tall a tree is? Here's a way to find out without climbing it with a long measuring tape.



1. Measure a team member. Record the team member's height in centimeters. _____
2. Have that team member stand against a tree that you want to measure.
3. Have another team member stand about 15 m (50 feet) away from the tree and hold the meter stick at arm's length toward the tree and the team member. Record how many centimeters tall the team member next to the tree appears to be. _____
4. Record how many centimeters tall the tree appears to be. _____
5. Determine the real tree height with the following formula. Use centimeters for units.

Formula:

$$\frac{\text{actual student height}}{\text{apparent student height}} = \frac{\text{actual tree height}}{\text{apparent tree height}}$$

Hint:

Multiply the actual student height by the apparent tree height. _____

Then divide this number by the apparent student height. This is the actual height of the tree in centimeters. _____

6. Convert the centimeters to meters by dividing by 100. This is the height of the tree in meters. _____