



# Tree's Dream

Accompanying Lesson:  
Tree Growth & Products

GRADES

6-8

# I. OVERVIEW

## A. Title

In this lesson, students will learn about a tree's anatomy and how each part helps it grow and function. They will explore products that trees offer us and map how they are manufactured. Finally, they will calculate the value of environmental and economic benefits that trees provide.

## B. Learner Objectives

Activity 1: Students will understand the structure of a tree and how the different parts of a tree help it function.

Activity 2: Students will gain insight to the process by which natural resources are turned into products and the energy needed to make the products we use.

Activity 3: Students will research a specific tree product to find out the sources of its various components.

Activity 4: Students will explore how we all depend on trees in our daily lives, and the value of trees to communities and our environment. Students will learn to calculate the annual dollar value of ecosystem services of trees in a study site using the online i-Tree tool.

### NEXT GENERATION SCIENCE STANDARDS

[MS-LS1-6 From Molecules to Organisms: Structures and Processes](#). Construct a scientific explanation based on evidence for the role of photosynthesis in the cycling of matter and flow of energy into and out of organisms.

[MS-LS2-3 Ecosystems: Interactions, Energy, and Dynamics](#). Develop a model to describe the cycling of matter and flow of energy among living and nonliving parts of an ecosystem.

[MS-ESS3-3 Earth and Human Activity](#). Apply scientific principles to design a method for monitoring and minimizing a human impact on the environment.

[MS-LS2-5 Ecosystems: Interactions, Energy, and Dynamics](#). Evaluate competing design solutions for maintaining biodiversity and ecosystem services.

[MS-ETS1-3 Engineering Design](#). Analyze data from tests to determine similarities and differences among several design solutions to identify the best characteristics of each that can be combined into a new solution to better meet the criteria for success.

## C. Materials

“A Tree’s Dream” video, tree cookies, “Resources Go Round” student page, tree ID guides or tree ID app, Diameter at Breast Height (DBH) tapes or measuring tapes, “Tree Identification” student page, “Tree Value” student page, access to computers or tablets with wi-fi

## D. Time Considerations

Activity 1: Tree growth - One 60 minute classroom session

Activity 2: A pencil’s life cycle – One 30 minute classroom session

Activity 3: Tree products and their life cycles – One 30 minute classroom session

Activity 4: Tree’s environmental benefits – Four to five 60 minute classroom sessions

## E. Getting Ready

Activity 1: Obtain a large tree cookie (cross section of a tree) and a class set of smaller tree cookies. Follow these basic [directions](#) to create your own tree cookies.

Activity 2: Print or display [Project Learning Tree's "Resources-Go-Round" Student Page](#)

Activity 3: If you would prefer students to choose a tree product from a preselected list, research items and choose a variety that originate from all around the world.

Activity 4: Download and get familiar with Project Learning Tree's [Teaching with i-Tree](#) Activity Guide. Print "Tree Identification" and "Tree Value" student pages.

## F. Key Vocabulary

**Early wood** - Wood in a growth ring of a tree that is produced early in the growing season and is lighter in color and typically wider than late wood.

**Late wood** - Wood in a growth ring of a tree that is produced later in the growing season and is darker in color and typically narrower than early wood.

**Photosynthesis** - The process by which green plants manufacture simple sugars in the presence of sunlight, carbon dioxide, and water.

**Heartwood** - The older, harder, nonliving central portion of wood of some trees that is usually darker, denser, less permeable, and more durable than the surrounding sapwood.

**Xylem** - The complex woody tissue of higher plants that includes systems for transporting water, storing nutrients, and providing structural support. Also called the sapwood.

**Cambium** - Thin layer of living, dividing cells just under the bark of trees. This layer gives rise to the tree's secondary growth.

**Phloem** - Plant tissue that transports dissolved nutrients from the leaves to the other parts of the plant. Also called the inner bark.

**Cellulose** - Complex carbohydrate that constitutes the chief part of the cell walls of higher plants and yields fiber for many products.

**Renewable natural resource** - A naturally occurring raw material or form of energy which has the capacity to replenish itself through ecological cycles and sound management practices.

**Non-renewable natural resource** - A naturally occurring raw material or form of energy which once used, cannot be replaced in this geological age, such as oil, gas, coal, copper, and gold.

**Diameter at breast height (DBH)** - The diameter of a tree as measured at breast height. Standard DBH is measured at 4.5 feet above the ground.

**Pulpwood** - Wood suitable for making into pulp for manufacturing paper products.

**Chip-n-saw** - Mid-sized trees that produce chips for pulpwood as well as small dimension lumber.

**Saw timber** - Tree or log of suitable size for sawing into lumber.

**Sustainable** - Able to be maintained at a certain rate or level.

**Forester** - A person trained in and practicing forestry.

**Volume** - The amount of space, measured in cubic units, that an object or substance occupies

## II. BACKGROUND

By counting a tree's growth rings, you can tell the age of the tree at the time it was cut. Trees put on two annual growth rings, early wood and late wood. *Early wood* grows during the wet spring season. Rings are lighter in color (larger lumen) and larger/wider (growing more). The *late wood* grows in the summer before the tree goes dormant in the winter. These growth rings are darker in color (smaller lumen) and smaller/thinner (growing less). To study a tree's growth rings without harming a tree, foresters use a tool called an increment borer. This removes a long, narrow cylinder of wood which is called a core sample. The growth rings appear as lines on the core sample and the forester is effectively able to age the tree.

All parts of a tree serve a function in helping that tree to survive. A tree's roots help anchor the tree to the ground and also absorb vital nutrients and water from the soil. The leaves capture energy from the sun in a pigment called chlorophyll, and they convert carbon dioxide and water into oxygen and sugar through a process called *photosynthesis*. The trunk of the tree may seem simple from the outside, but the inside is much more complex than most people realize. The *heartwood* forms the central core of the tree, is made up of dense dead wood, and provides strength for the tree. The *xylem* (sapwood) surrounds the heartwood and carries water and nutrients up from the roots to the leaves. The older xylem cells eventually become heartwood. The *cambium* is a thin layer of growing tissue which makes new cells that become xylem, phloem, or more cambium. *Phloem* (inner bark) carries water and sugars that are made in the leaves to the rest of the tree. The outer bark protects the tree from injury and disease.

Trees are a *renewable natural resource* that can be harvested to provide us with over 5,000 everyday products. Trees of varying maturity, size, quality, as well as species provide us with many different forest products. For example, bark, branches, and extra wood not used to make solid lumber is chipped up and used to make paper products and fuel for our mills. Small *diameter at breast height (DBH)* trees (6-9") are called *pulpwood* and used to make paper products. Medium diameter trees (10-13") are called *chip-n-saw* and can be used for smaller dimensional lumber like 2x4s. Large diameter trees (14"+) are called *sawtimber* and are used for a variety of lumber including larger products like telephone poles. In the "A Tree's Dream" video, it states that we plant 5 trees for every 1 tree that is harvested - indicating *sustainable* forestry practices. Sustainable forest management is essential not only to meet our current demand for this natural resource but to ensure forests for future generations. In the United States, we fundamentally practice sustainable forestry and have more trees than we did 100 years ago!

Take a walk through your neighborhood or around your school and look closely at the trees. You may notice an assortment of sizes, shapes, colors, and textures. Some tree species such as pines tend to be tall and straight with relatively short branches. Other species like Southern magnolia tend to be shorter with long and broad branches. The growth rate of trees depends on the species and environmental conditions where it is growing. *Foresters* measure trees to plan harvesting operations, and to make other forest management decisions. To determine the approximate wood yield of a certain forested area, foresters do a "timber cruise" in which they calculate the *volume* of lumber in a given area, examine the health of the forest, and survey the species found there. This information is used to determine how the forest should be cared for and what the economic feasibility of a harvest should be. Volume of wood can be calculated by measuring a tree's diameter at breast height (measured at 4.5 feet off the ground) and merchantable height. The volume is measured in board feet (a piece of lumber 12 inches square and 1 inch thick), cords (a stack of logs 4 ft. x 4 ft. x 8 ft.), cubic feet or

cubic meters. One giant sequoia (250 feet tall or more and over 20 feet in diameter) could yield more than 500,000 board feet, enough to make 33 houses!

### III. DOING THE ACTIVITY

#### **A. Engage - captures interest, makes connections, and provides an opportunity for students to express what they know**

Ask students, “What products come from trees?” Allow students to share different every-day items that they use, which are made from trees. Most answers will focus on paper products and items that are made from the wood of a tree.

Explain that wood is used to build the frame and structure of houses. Ask students to give examples of wooden products that can be found in the structure of their own homes. Have students guess how many total trees on average are used to build one house.

Tell students, “Now we are going to watch a video about Tim the tree who has a big dream. Make sure to pay close attention to the wood products used to build the home and their functions.” Show the video, “A Tree’s Dream” at: <https://www.youtube.com/watch?v=777wq0VIEFg&t=10s>

Follow up the video with a few questions:

- What was Tim’s big dream? (To be a house)
- How many trees were used to build that house? Is that number close to what you estimated before the video? (100)
- What were the different types of wood products mentioned that were used to build the house? What are the functions of those products? (Boards to hold the foundation/concrete of the house; Posts that support the floor beams; Beams that go sideways across the posts to carry the floorboards; Boards that go over the beams to make the floor; Studs to make the frames for the walls; OSB that is nailed to the studs to make it sturdy and strong; Headers that go over windows and doors; Trusses and rafters to hold the roof; Roof boards that are nailed to the rafters)
- What does OSB stand for? How is it made? (Oriented Strand Board – Trees are shaved into flakes, glued together, then pressed to make a sturdy and wide board.)
- Is any of the tree wasted at the sawmill? (No, small scraps can be used to make paper and even the bark can be burned for fuel)

#### **B. Explore - activities to explore the concept or skill**

##### **ACTIVITY 1: TREE GROWTH**

Having a good understanding of tree growth and tree anatomy will help students better understand how more complex tree products, such as ones that use cellulose, are derived from trees. Cellulose is a major component of wood and most plants. It is the main component of cell walls and helps the plant to remain stiff and strong. Cellulose is extracted from wood fiber and is used to make paper products, cellophane, viscose and rayon. It is also used as a filler and thickener in everyday products such as suntan lotion, lipstick, some brands of parmesan cheese, and even ice cream.

In this activity, students will learn about the structure and growth of a tree.

##### **PROCEDURE**

1. Discuss how to age a tree by counting a tree’s growth rings. Use a large tree cookie (cross section of a tree) as a teaching display or project an image of one for the students. Pass out smaller tree cookies to each individual student and have them practice aging trees.

2. Explain that all parts of a tree serve a function in helping that tree to survive. Teach students about the anatomy of a tree trunk using a diagram such as the one featured [here](#).
3. Discuss cellulose and how it can be extracted from wood for numerous everyday tree products. Use the suggested videos to help explain this process.
  - a. Videos: [How It's Made – How They Make Cellulose](#); [Discover Wisconsin – Cellulose Products](#); [Wood Cellulose to Textile Fibers](#)
4. Create a student page similar to [this one](#) and have students test their knowledge by completing it individually. Have students label each tree part and also describe its function.

#### **ACTIVITY 2: A PENCIL'S LIFE CYCLE**

Products are derived from all parts of a tree – wood, bark, sap, leaves, fruit, and nuts. There are over 5,000 products that are made from trees! So many of these items would surprise you like, chewing gum, crayons, cosmetics, medicines, and shoe polish. Most everyday products that we use are composed of a variety of different materials that typically come from several different countries. The cycle of producing, distributing, and disposing of these products requires *natural resources* and energy.

*Renewable resources* can be replenished through natural and/or human processes. Whereas *nonrenewable resources* are finite and cannot be replenished naturally in this geological age. The energy that is used to make products begins in the form of renewable or nonrenewable resources. We rely on numerous nonrenewable energy sources such as coal and oil to generate electricity or burn gasoline, as well as selenium and cadmium used in batteries. There is a limited supply of these minerals and elements on Earth, so we need to be cautious of how much we use these resources.

In this activity, students will examine a pencil's cycle to examine the process by which natural resources are turned into products.

#### **PROCEDURE**

1. Have students examine a pencil and list out all of the materials that make up that pencil. Have them label each material as either as a renewable or nonrenewable resource. Then have the students guess as to where each material originated from.
2. Explain to students that the cycle of any product is the course of events or operations that recur regularly and typically lead back to a starting point. Discuss the life cycle of a pencil with your students by displaying or passing out [Project Learning Tree's "Resources-Go-Round" Student Page](#).
3. Discuss the pathways of natural resources and how materials are transported that go into making a pencil. Ask your students: What type of fuel or energy is required to extract, process, manufacture, and distribute the pencil? Could any of these steps be more energy efficient? What could be done to lessen the environmental impact of each step?
4. Wrap up with a discussion on how we can use our natural resources more wisely. Cover the three R's with students – reduce, reuse and recycle. Use paper as an example and explain how the three R's can be applied to a single piece of paper.

### **C. Explain - students develop explanations for the concept or skill they have experienced**

#### **ACTIVITY 3: TREE PRODUCTS AND THEIR LIFE CYCLES**

In this activity, students will use their knowledge gained from the previous activity to research the cycle of their own favorite tree product. You can either allow students to choose their own tree products or preselect a list of products that students can choose from.

## PROCEDURE

1. Tell students that they are going to use what they learned about the life cycle of a pencil to research their own favorite tree product. They will need to make a visual representation of their tree product, showing the materials, resources, and energy that goes into making it. They will also need to write a report in which they answer the following questions.

- a. Can your item be recycled back to nature or into a new item? If so, explain that process and the new item. If not, why can't it be recycled?
- b. Can the materials that are used to make your item be found in the United States? Where does each item typically originate?
- c. Could any of the steps to extract, process, manufacture, and distribute your item be more energy efficient?
- d. What could be done to lessen the environmental impact of each step?

2. This assignment can be given on the same day as the previous activity. Allow students to select their tree product before they leave the classroom, making sure all students have a different item. Give students ample time to research and complete this project, either in the classroom or as a homework assignment.

3. Have each student give a presentation on their visual representation and a summary of the research report they completed.

## **D. Elaborate & Evaluate - activities to apply learning to new situations and discuss/compare ideas with others & students review/reflect on their own learning and provide evidence for changes to their learning**

### **ACTIVITY 4: TREE'S ENVIRONMENTAL BENEFITS**

Trees provide us with so many everyday products but we also depend on trees for a number of beneficial ecosystem services. Forests help clean our water and cycle nutrients back into the soil. Trees produce oxygen and also store carbon. Forests provide wildlife habitat as well as regulate temperature and rainfall. These services we often taken for granted but we all benefit from on a daily basis.

In this activity, students will use the i-Tree online software to discover the environmental benefits provided by trees. They will calculate a dollar value to the trees around their school and their homes.

## PROCEDURE

1. Download Project Learning Tree's [Teaching with i-Tree](#) free online unit and get familiar with the i-Tree online software. For this activity, you will be leading Activity 1: Tree Benefits and Identification and Activity 2: Tree Value.

2. Lead a discussion with your students on the environmental benefits of trees and cover basic tree identification skills while in the classroom. Have students work in small groups to identify all of the trees on your campus using the "Tree Identification" student page from Activity 1. Then work through how to measure the remaining factors on the "Tree Value" student page from Activity 2 and have students collect this data for all trees on your school grounds. Note: This would be a great opportunity to invite a local forester to speak to your class or even instruct portions of this lesson.

3. Explain how to use [i-Tree Design](#) software and have the students create a map of the school. Have them incorporate the data that was collected on the existing trees on campus and generate an estimated benefits report. Discuss and analyze the many ecosystem services that trees provide for the school as well as their dollar values.

4. As a homework assignment or group project, have students collect the same data on trees around their own homes

(working individually, in pairs, or small groups) and generate an estimated benefits report. Have students research the tree species found on their properties and write a report on the products that can be made from those specific trees.

5. Once completed, have students or groups present their findings and estimated benefits reports to the class. Allow the class to give each group feedback and make suggestions for additional tree plantings.

## IV. ENRICH

**Option 1:** Have a local forester come to your classroom and help with Activity 3: Tree’s Environmental Benefits. To find a forester: Reach out to your local Extension office and ask for the Natural Resource Extension Agent; Contact your state’s forest service agency; Reach out to a nearby US Forest Service office in your state.

**Option 2:** Have students/groups take the classes’ suggestions from Activity 4, Step 5 and generate a revised report. Students will generate a management plan to plant more trees on their site that will increase environmental benefits. Use Project Learning Tree’s [Teaching with i-Tree](#) Activity 3: Land Manager Role Play to help guide this lesson. Students can use the [i-Tree Species](#) tool to select species of trees that are particularly good at the environmental benefit they would like to manage for. Have groups of students compare management plans to assess similarities, differences, and strengths to create a combined new solution.

**Option 3:** Have students/groups each develop a management plan to plant more trees on your school campus. Students can use the [i-Tree Species](#) tool to select species of trees that are particularly good at the environmental benefit they would like to manage for. Have each group present their plan and allow the class vote on a winning management plan. Then have the winning group present their findings to the school’s executive staff. Encourage administration to fund this project or have the class lead a fundraiser to help plant more trees on the school property.

## V. Additional Resources: (Links to other resources teachers and/or students could use to extend the learning. Examples: Project Learning Tree, USFS Kids, World Forestry Center, etc.)

1. Project Learning Tree – [www.plt.org](http://www.plt.org)

Project Learning Tree (PLT) is an award-winning environmental education program designed for teachers and other educators, parents, and community leaders working with youth from preschool through grade 12.

2. Teaching with i-Tree - <https://www.plt.org/curriculum/teaching-with-itree/>

PLT’s Teaching with i-Tree unit, designed for use with middle and high school students, includes three hands-on activities that engage students in discovering and analyzing the many ecosystem services that trees provide. Students use the free, online i-Tree Design software – developed by the U.S. Forest Service – to calculate the dollar value of the benefits provided by a tree or a set of trees.

3. GreenSchools Investigations - <https://shop.plt.org/Shop/ProductDetails/greenschools-investigations>

PLT’s GreenSchools program inspires students to improve the environment at their school, at home, and in their community. Student-led Green Teams apply STEM (science, technology, engineering, math) to create greener and healthier schools—and save schools money!

4. Next Generation Science Standards - <https://www.nextgenscience.org/standards/standards>

Within the Next Generation Science Standards (NGSS), there are three distinct and equally important dimensions to learning science. These dimensions are combined to form each standard—or performance expectation—and each dimension works with the other two to help students build a cohesive understanding of science over time.