Green Shield: The Forest Ecosystem





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Introduction

Trees cover almost one-third of the land on Earth. A tree can be a home, or **habitat**, for many kinds of animals and insects. Because it can provide several habitats at once, a single tree can also be an **ecosystem**—a community of living things in a shared environment. An ecosystem is like a neighborhood. Plants and animals in an ecosystem provide food for each other in **food chains** and **webs**.

A forest creates a bigger kind of ecosystem. A **forest** is a group of trees growing close together covering a large area, with smaller trees, plants, and animals living under them. A **biome** is an even bigger region of the Earth with a certain climate, landscape, and certain living things. Forests are a kind of biome (along with deserts, grasslands, and tundra).

The three general types of forests are **boreal**, **tropical**, and **temperate**. The evergreen trees of a boreal forest, also known as **taiga**, are found across Siberia, Scandinavia, Alaska, and Canada. Broad-leaved **deciduous** trees (trees that lose their leaves) are found in temperate forests, mostly in the Northern Hemisphere in regions with changing seasons. Tropical forests are found near the equator, and are full of **biodiversity**. The Amazon Rainforest is the largest forest in the world and is home to more living things than any other place on Earth.

In forests, **mycorrhizal networks** help trees find and absorb nutrients and water. These networks are made up of **fungi** that form a relationship with plant roots that benefit both the plant and the fungi. This **symbiosis** significantly expands the root system's surface area so that vast amounts of soil can be explored for water and nutrients. This allows trees far, far greater access to resources that just their root systems alone could reach. In return, the fungi get **photosynthate**, or the sugar that plants make, from the root tissue.

Forests are complex natural systems where different species work together. In doing so, the forest and trees provide a variety of benefits that help keep the Earth healthy, too. Tree Trekkers learn more about what these benefits mean as they explore the important role trees and forests play in providing homes for other plants and animals and protecting our planet.



Questions to guide explorations and experiments

- What is a forest?
- D What is an ecosystem?
- What role do trees play in forest ecosystems?
- D How do trees help each other? How do they help others in the forest ecosystem?
- How can change in one part of an ecosystem affect change in other parts of the ecosystem?
- How do the things trees do for their own growth (photosynthesis) and survival of trees affect the planet?

Helpful "tree-sources" for this topic

Explore different tree-based ecosystems in your neighborhood and around the world:



Forest Ecosystem Guide: Boreal vs Deciduous vs Coniferous vs Temperate 8billiontrees.com/trees/forestecosystem



The State of the World's Forests fao.org/state-of-forests/en



Biomes kids.britannica.com/kids/article/ biome/403913



Understanding Habitats, Ecosystems and Biomes wildernessclassroom.org/ understanding-habitatsecosystems-biomes



Biomes, Ecosystems, and Habitats education.nationalgeogra phic.org/resource/biomesecosystems-and-habitats



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Helpful "tree-sources" for this topic (cont.)



We Depend on Trees Song Celebrate the benefits of trees with song youtu.be/TB6ycNTZwzw



Heat Islands from NASA Learn why cities may experience much warmer temperatures than nearby rural areas climatekids.nasa.gov/heat-islands



Climate Heroes: The Power of Trees from the Nature Conservancy Illustrates the role of trees in the quest to tackle climate change youtu.be/ilXeGlybjJQ

Children's Books

FICTION

- Everyone Starts Small by Liz Garton Scanlon (ages 4-8)
- The Great Kapok Tree by Lynne Cherry (ages 4-8)
- *Little Sap: The Magical Story of a Forest Family* by Jan Hughes (ages 4-8)
- *Little Tree and the Wood Wide Web* by Lucy Brownridge (ages 4-7)
- The Lumberjack's Beard by Duncan Beedie (ages 4-8)

POETRY

- A Forest Song by Kirsten Hall (ages 4-8)
- The Wisdom of Trees: How Trees Work Together To Form a Natural Kingdom by Lita Judge (ages 7-10)

- My Dad Is a Tree by Jon Agee (ages 3-6)
- Redwoods by Jason Chin (ages 6-9)
- *Slowly Slowly* by Toni Yuly (ages 3-6)
- *Slowly, Slowly, Slowly Said the Sloth* by Eric Carle (ages 4-8)
- *Walking Trees* by Marie-Louise Gay (ages 4-8)



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NONFICTION

- Be Thankful for Trees by Harriet Ziefert (ages 4-8)
- The Boreal Forest: A Year in the World's Largest Land Biome by L. E. Carmichael (ages 8-12)
- Branching Out: How Trees are Part of Our World by Joan Marie Galat (ages 8-12)
- Deep Roots: How Trees Sustain Our Planet by Nikki Tate (ages 8-12)
- DKFindOut! Forest by Cat Hickey (ages 6-9)
- Footsteps in the Forest by Laura Perdew (ages 5-8)
- The Forest in the Trees by Connie McLennan (ages 4-8)
- The Gentle Genius of Trees by Philip Bunting (ages 4-8)
- Incredible Stars of the Plant World by Benjamin Flouw (ages 5-10)
- Let's Save Our Planet: Forests by Jess French (ages 8-10)

- Listen to the Language of the Trees: A Story of How Forests Communicate Underground by Tera Kelley (ages 6-10)
- Look What I Found in the Woods by Moira Butterfield (ages 5-10)
- The Magic and Mystery of Trees by Jen Green (ages 4-10)
- The Magic of Forests: A Fascinating Guide to Forests Around the World by Vicky Woodgate (ages 6-10)
- The Story of an Oak Tree Ecosystem by Henry Cole (ages 4-9)
- *Tell Me, Tree: All About Trees for Kids* by Gail Gibbons (ages 4-8)
- A Tree Is a Community by David L. Harrison (ages 4-8)
- A Tree Is a Home by Pamela Hickman (ages 4-8)
- A Walk in the Deciduous Forest by Rebecca L. Johnson (ages 8-12)
- Welcome to the Tree Stump by Alix Wood (ages 5-9)



At Home in the Ecosystem

Introduction

Trees provide habitats for many animals, plants, and insects. A tree can be both a **habitat** and a small **ecosystem**. Forests are ecosystems with many different kinds of habitats. There are even habitats in each layer of a forest. And under the forest floor, plants and trees, with the help of **fungi**, gain greater access to water and nutrients.

Ecosystems can occur on their own. But what happens when people build a park or garden? Those places create habitats for plants, animals, insects, and fungi, too. Central Park, in New York City, is 2.5 miles long and half a mile wide, and is home to more than 500 plants and animals. Forest and park rangers and arborists care for naturally occurring and man-made ecosystems and protect the things that live there.

Kids can learn more about habitats, ecosystems, and the crucial role trees play in both by creating their own forest ecosystem in a diorama that shows others what they look like and how they work.

Supplies

- Tree Trekker Journals (or notebooks)
- Writing tools
- Books about trees
- Computer and printer (optional)
- Internet access to research kid-friendly sites (optional)

- Drawing tools, painting materials, clay
- Colored construction and/or tissue paper
- Shoe boxes (one per kid or team of kids), scrap cardstock, paperboard (cereal boxes, paper towel tubes), cardboard, and other materials from the recycling bin
- Scissors, glue, and tape



Get kids thinking

Talk with kids about what an ecosystem is. If you think about an ecosystem as a neighborhood, you see how the different plants and animals in it work together to live and grow. If you drew a picture of your neighborhood, it might show where you and your friends live, where you buy food and go to school, where you like to play, who you play with, and how you help each other.



A picture of a forest ecosystem would show the same things. It would show who lives there and where, where they get their food, and how the things that live there interact. Ask Tree Trekkers to think about ecosystems they are familiar with including woods, forests, or parks they know about or have visited. What plants, animals, or insects lived there?

To help kids understand the complexity of ecosystems, help them visualize the different layers of forests. Using the Layers of the Forest graphic (page 45) as a guide, have kids interpret and act out the layers of different types of forest.

Kids can stand on risers, benches, or rocks to create the top layers and crouch, kneel or even lie on the ground to create the lower levels. Take a picture of the kids acting out each kind of forest and then show them the photos so they can compare and discuss:

- Boreal: canopy and undergrowth
- **Temperate:** tall tree, sapling or small tree, shrub, herb, ground
- **Tropical:** emergent layer, canopy, understory, forest floor



Ask kids what they know about the habitat and homes of plants and animals that live in these types of forest ecosystems. Can they describe a food chain in one of the levels?

Now have Tree Trekkers brainstorm what lives in the different layers of a forest. Remind them that some animals can move from layer to layer, but some stay in the same layer for their whole lives. And plants can live in different layers. You can suggest some different organisms to get them going, such as tree sloths, koalas, owls, orchids, fungi, etc. Take some time to talk about how the climate in each forest ecosystem impacts the things that live there.

Let's get started!

Start with a book! Share books about tree habitats and forest ecosystems such as *A Tree Is a Community* by David L. Harrison, *The Forest in the Trees* by Connie McLennan, *The Lumberjack's Beard* by Duncan Beedie, *Redwoods* by Jason Chin, or *The Great Kapok Tree* by Lynne Cherry.

Ask kids to point out ways plants and animals use trees as their homes or food sources and how the trees and other living things depend on each other. Challenge them to identify what kind of tree or forest is depicted in the book and which levels of the forest they see.

Repeat this exercise a couple of times with books, or sections of books, that explore



different kinds of forests. Encourage kids to compare and contrast the different kinds of forests and write down their findings in their Tree Trekker Journals. Then invite your Tree Trekkers to choose a forest or tree ecosystem to further research and create a diorama that brings it to life.

Working on their own or in pairs, invite kids to choose a kind of tree or forest ecosystem to research in depth. Using books and information they've collected in their Tree Trekker Journals, have Tree Trekkers gather information about their ecosystem to inform the diorama they will make.



They'll need to know:

- what kind of tree or forest (boreal, temperate, or tropical) it is
- where it can be found on Earth
- what levels it has

- what seasons it experiences
- the kinds of trees, plants, animals, and insects that live there

Provide a shoebox and a variety of art supplies. Kids could also use natural materials such as twigs and rocks that they find on the ground to create a more realistic effect. Encourage adding 3D elements using scrap paperboard or other materials to build out the tree trunk and branches or plants and animals. Have them add labels that identify the different trees, plants, animals, and insects in their ecosystem diorama.

When the Tree Trekkers have completed their tree or forest ecosystem, ask them to share their creations with others. Have those who chose similar ecosystems talk with each other about the choices they made about what to include and how their unique pieces of art emphasize different aspects of the same ecosystem.



BRANCH OUT!

Explore ecosystems in your neighborhood. Branch Out! and have Tree Trekkers look for evidence of animals and plants using trees as their homes.



This "Who has been in the forest?" handout from Green Schoolyards America can help frame and guide searches: <u>greenschoolyards.org/s/</u> 08_10-Who_s-Been-in-the-Forest.pdf

Diagram: Layers of the Forest









Ecosystem Services of Trees: Carbon Capture Superheroes

Introduction

Forests act as huge air filters and coolers for the Earth. To the benefit of our ecosystem, when a tree makes its own food through **photosynthesis**, it takes **carbon dioxide** out of the **atmosphere**, trapping it inside the tree, and releases **oxygen** and water into the atmosphere. Carbon dioxide, a **greenhouse gas**, traps heat from the sun and makes the planet warm up. But when a tree turns carbon dioxide into oxygen and glucose, it acts as a **carbon sink**, trapping the carbon inside and removing it from the atmosphere. That's called **sequestration** and helps keep our planet cooler. The more wood in a tree (trunk, roots, and branches), the more carbon it can trap. Older trees can even trap carbon in their leaves.

This significantly impacts the ecosystem and the living conditions for all plants and animals. Kids can explore connections between forests and climate and learn more about how the benefits trees provide are the foundation for a cooler planet and healthy environment.

Supplies

- Outdoor thermometer
- An empty paper towel tube
- A straw, cut in half
- Masking tape

- Sand (enough to fill the paper towel tube and the straw)
- A rimmed baking sheet or tray
- Tree Trekker Journals (or notebooks)
- Writing and drawing materials

Get kids thinking

Talk about **climate** and the climate where you live. Climate, or the average weather patterns over the years, is different from **weather**, which is the state or condition of the atmosphere. Spark discussion about weather and climate by heading outside and having kids place a thermometer in a sunny location.



While waiting to register the temperature, have kids stand in the sun and notice how it feels. Note the temperature, then move to a shady spot to take another temperature and notice how it feels. Have them record temperatures and their observations in their Tree Trekker Journals. Compare temperatures in other locations such as spots with plentiful trees, plants, or grass and in areas with concrete, bricks, or asphalt. Invite kids to share their findings and discuss.

Ask kids: Do you think trees can impact the weather or climate? If you do, how? What else can impact climate? How do human activities that release billions of tons of



carbon dioxide into the atmosphere every year impact climate? What do trees take in from the atmosphere and what do they release during photosynthesis? Have kids share their ideas for combating climate change, especially the roles that trees can play.

Let's get started!

Start with a book! The seventh, and last, section of *Be Thankful for Trees* by Harriet Ziefert, explores how trees are needed to clean the air and cool the Earth.

Share how trees impact our environment and climate with *Walking Trees* by Marie-Louise Gay, *Deep Roots: How Trees Sustain our Planet* by Nikki Tate (especially chapter 2), *Branching Out: How Trees are Part of Our World* or *The Magic of Forests* by Vicky Woodgate (especially pages 36-37). Explore reasons why some trees are extra good at taking carbon out of the atmosphere: because they grow quickly when they are young (like maple trees), are in rainforests (like pau brasil trees), or are very old and big.

Talk about what kids discovered in taking outdoor temperatures in sunny and shady places. Explain that different situations can cause "islands" of heat or cool in cities and towns. **Heat islands** are places that are hotter than other places because they have fewer trees and plants to keep things cool and more concrete or asphalt. Heat islands are found in urban or city areas that lack trees and parks. A park or tree-lined street can create a cool island in an otherwise hot city.



Connect how trees can store **carbon dioxide** to reduce **greenhouse gases** and prevent temperature rise, produce **oxygen**, and filter dust. They can also produce water that cools the surrounding area when it **evaporates**. Ask kids which is a better strategy for combating **climate change:** planting more trees or saving and protecting the trees and forests we already have? Have them share their ideas and write them in their Tree Trekker Journals. Then demonstrate:



Step 1: Show them the paper towel tube and the two pieces of a straw. Explain that these represent three tree trunks. One (the paper towel tube) is an old tree with a big trunk. The straws are new **saplings** with smaller trunks.



Step 2: Invite them to draw the three tree trunks in their journals. Then have them imagine the **branches**, the **crown** or top of the trees, the **leaves**, and the **roots**, and draw them, too.

Ask them to use what they know about these trunks to predict how much **carbon dioxide** they could trap or **sequester**. Can the saplings trap as much as the old tree? Have them write their predictions in their journals.



Step 3: Cover the bottoms of the paper towel tube and straws with masking tape. Fill each of the "trunks" with sand, explaining that the sand represents carbon dioxide that the tree can take out of the atmosphere. Once you've filled them, give your Tree Trekkers a chance to take a look at the trunks.



Step 4: Pour out the sand from each "trunk" into separate piles on the baking tray and ask kids what they see. Which held more "carbon dioxide" sand? Did they predict that the old tree trunk could hold more carbon dioxide than two (or even more) saplings? Remind kids that roots, branches, and leaves can trap carbon, too. Invite them to write about their observations and draw pictures in their journal.



Step 5: Now, revisit the question: which is a better strategy for combating **climate change:** planting more trees or saving and protecting the trees and forests we already have?



Ecosystem Services of Trees: Carbon Capture Superheroes

Talk with kids about why it doesn't have to be either/or. New trees are always needed, as old trees die, some trees are lost to fires or natural disasters, and some are harvested for wood. But it is especially important to protect forests—especially old-growth forests—from destruction. When forests are destroyed, the Earth loses its air-cleaning and cooling power, and the carbon stored in the trees gets released back into the atmosphere.

BRANCH OUT!

Scientists have figured out equations that allow us to know, based on a tree's species and age, how much carbon is stored in its trunk, branches, crown, and roots. They've also found that because young trees grow quickly, they capture carbon faster than old trees. But old trees can still capture more carbon than young ones. If you want to dig deeper, you and your Tree Trekkers can calculate how much carbon a tree can sequester.

Branch Out! to a park or arboretum to identify old, big trees and young trees growing fast in the sun or slower in the shade.



iTree has easy-to-use online tools that can guide you through the carbon capture calculation process: itreetools.org