

LESSON 5

Climate and the Forest



This lesson can be completed in the classroom or at home. Your teacher will explain to you how to participate in assignments and group discussions if you are completing the lesson at home.

Today's Topic: Climate and the Forest

Introduction to Climate and the Forest

Watch the video, [Climate and the Forest](#), to start your exploration of how forests are connected to California's climate. As you watch, note the different aspects of climate and how the forest fits into climate conditions. Also, make note of how the forests are affected by the climate. Discuss with your class how the different spheres (atmosphere, biosphere, geosphere, and hydrosphere) interact with forests.

Read and Respond

Read the passages below about climate and the forest, then discuss with your group what you learned. Follow your teacher's instructions about how to be part of these group discussions.

What Is Climate?

Some areas of California are warmer while some are colder. Some are wetter and some are drier. **Climate** describes the typical weather conditions of an area. Coastal climates typically have mild winters, while higher-up mountain climates have cold and snowy winters. Summers in the deserts are hot and dry, while in a temperate forest summers are typically warm and humid.

Climate is different from **weather**. Weather explains the changing day-to-day conditions, such as being rainy and cold one day and sunny and warm the next.

There are many reasons why forests affect the climate. There are also many ways that the climate can affect forests. Forests also influence the climate in their local areas.

Water and Climate

Forested areas are typically cooler than non-forested areas in the summer. Not only do trees provide shade, but they also release water through their leaves. This process of releasing water through leaves is called **transpiration**. Transpiration has a cooling effect on the surrounding atmosphere.

In winters and typically cooler climates, trees can actually warm their surroundings. Forests have a low **albedo**, which means that they can absorb more heat from the sun. Snow is white and has a high albedo. This means that it reflects most of the heat from the sun back into the atmosphere. Trees are darker colors and absorb a lot more heat than snow. Transpiration also increases the amount of water vapor in the air. The amount of water in the air is called **humidity**. When the humidity of an area is high that means it has higher amounts of water vapor. Water vapor in the air helps to hold heat in the atmosphere.

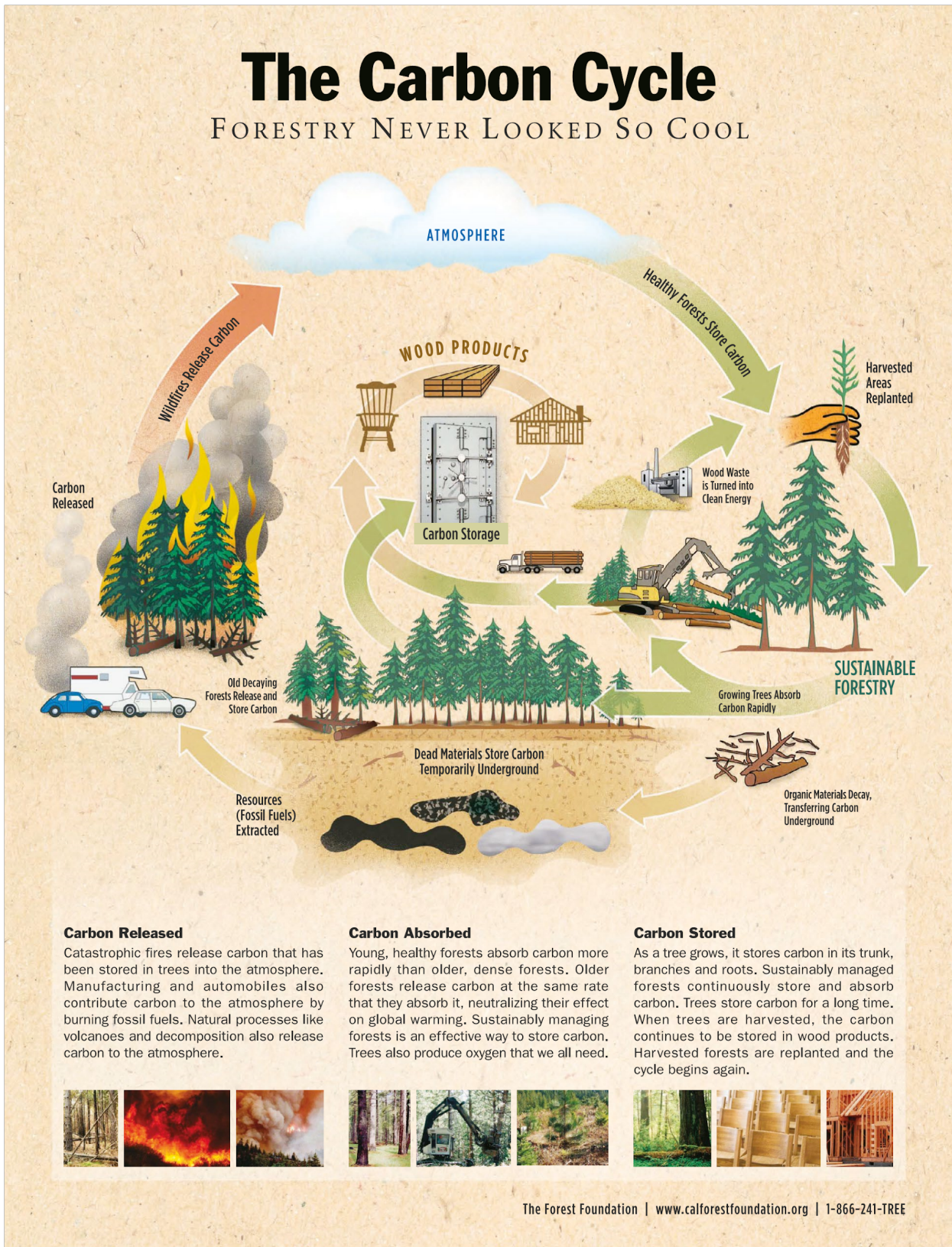
Carbon and Forests

The amount of carbon in the atmosphere has an enormous effect on climate. More carbon in the atmosphere means that more heat from the sun is held onto in the atmosphere, warming it and the surface. Less carbon in the atmosphere means that more heat is able to escape Earth's atmosphere and be released into space, keeping the climate cooler.

Forests are a major part of the carbon cycle on Earth. Like water, carbon cycles through the atmosphere, everything on land, and underneath the surface. Trees take in, or **sequester**, carbon from the atmosphere in the form of carbon dioxide to make food for themselves. The carbon is then released back into the atmosphere when the trees are decaying, dead, harvested, or burned.

The Carbon Cycle

FORESTRY NEVER LOOKED SO COOL



Carbon Released

Catastrophic fires release carbon that has been stored in trees into the atmosphere. Manufacturing and automobiles also contribute carbon to the atmosphere by burning fossil fuels. Natural processes like volcanoes and decomposition also release carbon to the atmosphere.



Carbon Absorbed

Young, healthy forests absorb carbon more rapidly than older, dense forests. Older forests release carbon at the same rate that they absorb it, neutralizing their effect on global warming. Sustainably managing forests is an effective way to store carbon. Trees also produce oxygen that we all need.



Carbon Stored

As a tree grows, it stores carbon in its trunk, branches and roots. Sustainably managed forests continuously store and absorb carbon. Trees store carbon for a long time. When trees are harvested, the carbon continues to be stored in wood products. Harvested forests are replanted and the cycle begins again.



The Forest Foundation | www.calforestfoundation.org | 1-866-241-TREE

The Carbon Cycle

Image Credit: California Forest Foundation

Large, healthy forests can sequester large amounts of carbon dioxide from the atmosphere. The trees store the carbon and release oxygen back into the atmosphere. The carbon storage of trees is called a **carbon sink**. Trees store the carbon in their trunks, roots, branches, and leaves. About half of the total weight of a tree is carbon. But not all trees take in and store carbon at an equal rate.

Older trees are able to hold much more carbon than younger trees. In fact, the redwood forests in northern California are one of the top forests in the world for carbon storage. The trees are some of the tallest in the world, growing more than 100 meters tall, and can live for around 3,000 years. This makes them able to sequester and store a great deal of carbon over their lifetimes.

The ages and distribution of the trees in the forest are very important. Older trees absorb and store a greater amount of carbon, and younger trees absorb carbon at a faster rate. This difference in old and young trees means there needs to be a balance of both in a forest. Thinning a forest helps foresters manage the oldest, largest trees while also planting new trees in cleared areas. Well-managed forests with a combination of old, tall trees and young, small trees are able to sequester more carbon than an unmanaged forest that is all the same age.

Forests of younger trees that are more densely planted together can take in carbon at a high rate. The young trees are much smaller than the older trees, and it takes about 250 young trees to equal a single, older redwood tree. As the trees continue to grow in tight spaces, the competition for sunlight, water, and space causes some of the trees to die, releasing carbon back into the environment. Some of the carbon is released back into the atmosphere and some is stored underground as fossil fuels.

When fossil fuels are extracted from the ground and wood from trees is burned, carbon is released into the atmosphere. Forests are able to absorb the carbon from the atmosphere in a continuing cycle.

Carbon can also be stored in wood products, such as structures for buildings, furniture, and even paper. The carbon remains in the wood until that product decays or is burned. Then, the carbon reenters the atmosphere. As you can see, carbon cycles continuously!

Climate Variations

Climates can vary and change. Sometimes climates change over many years, but it is possible for short-term changes to occur too! Changes in the climate can alter a forest.

Drought causes less water resources to be available for trees. A drought happens when there is a long period of time with little to no rainfall. If trees do not have enough water they can start to die at a faster rate. With less water available, it is also less likely that new trees will start to grow. As trees die, more carbon gets released back into the environment. This can cause the climate to continue to warm and cause the drought to continue, killing more trees. Drought can also lead to an increase in wildfires. This can kill even more trees and release even more carbon back into the environment.

Rainy conditions make for less competition for water between trees. This allows more trees to grow and the forest to spread. But too much water can cause soil erosion, especially in areas where the trees are young and their roots have not spread as much as older trees. This can cause trees and other plants that do not yet have strong roots to be washed away. An increase of water can also cause more **invasive species** to come into the environment. An invasive species is a plant or animal that is not native to the natural habitat of the forest. The invasive plants or animals compete with the native plants and animals for resources such as space, water, and food.

Healthy forests are more able to keep up and adapt to changing climate conditions than unhealthy forests. Trees help the climate of an area. For example, the natural cooling or warming properties of forests can help slow changing climate conditions. Trees even have built-in mechanisms for conserving water during periods of drought that limit the amount of water they transpire.

Earth's Spheres

Earth is made up of four spheres: the **atmosphere**, **biosphere**, **geosphere**, and **hydrosphere**. Each of these spheres works together in all aspects of nature:

- The atmosphere contains all of the air that envelops the planet.
- The biosphere contains all living things—every single type of plant and animal.
- The geosphere contains all rocky material above and beneath the surface.
- The hydrosphere contains all water on Earth—solid, liquid, and gas.



Redwood Forest with Fog Between the Trees

Image Credit: Michael Schweppe

In the image of a redwood forest in California, all four spheres can be seen. The trees are part of the biosphere. So are all of the other plants along the forest floor. The soil on the ground is part of the geosphere. The fog drifting through the trees is made of tiny water particles and is part of the hydrosphere. The atmosphere, which is invisible to our eyes, surrounds the trees and carries the fog with it.

All of Earth's spheres interact and balance each other to keep forests healthy. And healthy forests balance the carbon cycle and the climate.

Research

Who Owns and Manages California's Forests?

More than 30% of California's land is forested. California forests may be managed by the federal government, like Sequoia National Park, but they may also be run by the state, other public entities, or private organizations. There are many forests in California owned by Native American tribes. Some forests are even owned by individual people. Use the data or websites provided by your teacher to fill in how much of California's forests are owned by each group.

_____ % of California forests are national forests.

_____ % of California forests belong to the State of California.

- _____ % of California forests belong to Native American Tribes.
- _____ % of California forests belong to industry (businesses).
- _____ % of California forests belong to individual people.

National forests belong to everyone—including you! People most often use these areas for recreational activities. Hunting, hiking, fishing, and camping are all activities that people can enjoy in national forests. One-third of the national forests are designated as timberland available for harvesting. Harvesting can improve the health and resiliency of our watersheds. We remove some trees so the ones we leave can thrive. The types and number of trees that can be removed at one time is something that is controlled by the federal government. National forests are managed by the laws and practices set by Congress to “provide the greatest good, for the greatest number (of people), for the long run.”¹

California state-owned forests belong to the State of California. As with national forests, the state uses its forests to provide recreational activities like hunting, hiking, bird watching, camping, fishing, and canoeing. Harvesting can also happen in state-owned forests.

There are several Native American tribes that own and manage California forests. Some of these include the Klamath, Yurok, Karuk, and Hoopa. The ancestors of these indigenous peoples used forests as a source of food and shelter. They would also work to manage the forests to keep them healthy. They would set fires on purpose to promote new shoots on shrubs. This also kept the forest floor clear to reduce surprise attacks from other tribes. The forests remain an important part of Native American tribal heritage and culture. Today, Native American tribes continue to manage the forests using controlled burning.

Some California forests are owned by large companies. The management of these areas is up to the company. Most of the time, management of the forests is done by the owner or a board of directors. A board of directors is a group of people who help make decisions for a company. The company still has to follow rules about how they can use a forest. The California State Board of Forestry sets the rules. These rules state that companies using their forests must have a plan to make sure they do not overuse the forest resources. There are other groups that decide whether or not companies are using their forests responsibly. Companies that own forests usually manage their land for wood products, habitat conservation, water quality, and other activities.

Lastly, some of California’s forests are owned by individual people. These people own the land that has the forest on it and may even choose to build their homes there. Many people use their forests for hunting, hiking, camping, and other recreational activities. Forest owners must be aware of local and state laws that say how the land can be used. Because these areas are privately owned, they are not under the same rules as those owned by large companies.

California Forests and Earth's Spheres

Forests are a major part of all of Earth's spheres. The balance of the atmosphere, biosphere, geosphere, and hydrosphere is very important to the overall health of the forest. Use websites and/or books recommended by your teacher, such as [CalFire Forest Health](#), to find out the role each sphere plays in California forests.

- The role of the atmosphere in a forest is:
- The role of the biosphere in a forest is:
- The role of the geosphere in a forest is:
- The role of the hydrosphere in a forest is:

Each of the spheres does not exist on its own in a forest. All spheres are linked together and changes in one sphere can affect all of the other spheres. Using the resources provided by your teacher, write down at least two ways that each of the spheres interact with each other in California's forests.

Atmosphere/Biosphere Interactions

- 1.
- 2.

Atmosphere/Geosphere Interactions

- 1.
- 2.

Atmosphere/Hydrosphere Interactions

- 1.
- 2.

Biosphere/Geosphere Interactions

- 1.
- 2.

Geosphere/Hydrosphere Interactions

- 1.
- 2.

Make a Poster of Earth's Spheres

Next, use the interactions that you thought of in the research portion of the lesson to draw a picture or a poster modeling how all of Earth's spheres interact in California's forests. For example, you might include fog, a rain storm, plants and animals, etc. Use arrows and keywords in your drawing to describe parts of each sphere and the interactions between the spheres.

After completing your model (drawing or poster), display it. Then view all the posters created by your classmates. Discuss the similarities and differences between your model and the models of your classmates.

What Did You Learn?

Answer the following questions to test your knowledge.

1. What kind of forest stores the most carbon over longer periods of time?
 - a. A forest that is primarily made of old trees
 - b. A forest that is primarily made of young trees
 - c. A forest that is a combination of young and old trees
 - d. A forest that is very densely packed with any type of tree
2. Which phrase describes climate?
 - a. Day-to-day conditions of an area
 - b. Changing of conditions in an area
 - c. Typical conditions of an area
 - d. Extreme conditions of an area
3. How can forests affect the climate? Select all that apply.
 - a. Carbon sequestration
 - b. Transpiration
 - c. High albedo
 - d. Underground water

4. Write two examples of each sphere found in a forest environment.

Atmosphere _____

Biosphere _____

Geosphere _____

Hydrosphere _____

5. What is described in the carbon cycle?

- a. Storage of carbon in forests
- b. Flow of carbon throughout the atmosphere
- c. Amount of carbon trees can absorb
- d. Movement of carbon through the spheres

Apply to Real World

Group Activity: Discussion

Your teacher will assign you to a group to work on your activity.

¹ <https://www.fs.fed.us/greatestgood/press/mediakit/facts/pinchot.shtml>