

## Photo Description



This photograph shows a wooden boardwalk extending over a lake during autumn. The trees surrounding the water display vibrant fall colors including orange, yellow, red, and brown leaves. Some trees appear to have lost many of their leaves already, showing the natural process of seasonal change in deciduous forests.

## Scientific Phenomena

The anchoring phenomenon represented here is seasonal leaf color change and leaf drop in deciduous trees. This occurs because as daylight hours shorten and temperatures cool, trees stop producing chlorophyll (the green pigment that captures sunlight for photosynthesis). Without chlorophyll masking them, other pigments like carotenoids (yellows and oranges) and anthocyanins (reds and purples) become visible. Eventually, trees form an abscission layer at the base of each leaf stem, cutting off nutrients and water, causing leaves to fall. This is an adaptation that helps trees conserve energy and water during winter when photosynthesis would be inefficient.

## Core Science Concepts

1. **Photosynthesis and Chlorophyll:** Trees use chlorophyll to capture sunlight and make food through photosynthesis. When chlorophyll breaks down in fall, other leaf pigments become visible.
2. **Plant Adaptations:** Deciduous trees have evolved to drop their leaves as a survival strategy for winter, reducing water loss and energy expenditure when sunlight is limited.
3. **Seasonal Patterns:** The timing of leaf color change and leaf drop follows predictable patterns based on environmental cues like temperature and daylight duration.
4. **Ecosystem Interactions:** Fallen leaves decompose and return nutrients to the soil, supporting the forest ecosystem and providing habitat for many organisms.

### Pedagogical Tip:

Use a simple experiment with green leaves and rubbing alcohol to extract chlorophyll and reveal hidden pigments. This hands-on activity helps students visualize the concept that other pigments are always present but masked by chlorophyll.

### UDL Suggestions:

Provide multiple ways for students to document observations by offering options like drawing, photographing, writing, or voice recording their observations of seasonal changes. Create a class phenology calendar where students can track and predict seasonal patterns using various representation methods.

### Zoom In / Zoom Out

1. Zoom In: At the cellular level, specialized cells form the abscission layer where the leaf stem meets the branch. These cells create a barrier that blocks the flow of water and nutrients, eventually causing the leaf to detach cleanly without damaging the tree.
2. Zoom Out: This seasonal leaf drop is part of larger biogeochemical cycles. Decomposing leaves release carbon back into the atmosphere and soil, while nutrients like nitrogen and phosphorus enrich the soil for future plant growth, connecting to global carbon and nutrient cycles.

### Discussion Questions

1. What evidence do you see that these trees are preparing for winter, and how might this help them survive? (Bloom's: Analyze | DOK: 3)
2. How do you think the fallen leaves will affect other living things in this ecosystem over the next few months? (Bloom's: Evaluate | DOK: 3)
3. What patterns do you notice in how different trees are changing colors, and what might cause these differences? (Bloom's: Analyze | DOK: 2)
4. If you returned to this same spot in winter and then again in spring, what changes would you predict and why? (Bloom's: Synthesize | DOK: 3)

### Potential Student Misconceptions

1. Misconception: Trees "make" new colors in their leaves during fall.  
Clarification: The yellow and orange pigments were always there but were hidden by the dominant green chlorophyll. Trees stop making chlorophyll, revealing the other colors.
2. Misconception: All trees lose their leaves because it gets cold.  
Clarification: Only deciduous trees lose their leaves seasonally. Evergreen trees keep their leaves/needles year-round as an adaptation to their environment.
3. Misconception: Fallen leaves are just "tree trash" or waste.  
Clarification: Fallen leaves are a vital part of the ecosystem, providing nutrients for soil, shelter for animals, and food for decomposers.

### Cross-Curricular Ideas

1. Math - Data Collection and Graphing: Have students collect fall leaf samples from different trees and measure their dimensions (length, width) using centimeters. Create bar graphs or line plots comparing leaf sizes across different tree species. Students can also calculate the percentage of trees that have changed colors in a given area, connecting to fractions and percentages.
2. ELA - Descriptive Writing and Poetry: Ask students to write detailed descriptions of the autumn landscape using sensory language (what they see, hear, smell, feel). They could also create acrostic or haiku poems about fall, using vocabulary words like "deciduous," "abscission," and "chlorophyll." Connect this to reading comprehension by having students analyze autumn-themed picture books and discuss the author's descriptive techniques.

3. Social Studies - Indigenous Knowledge and Seasonal Traditions: Explore how Native American communities used seasonal changes, including fall leaf color, to mark time, plan harvests, and prepare for winter. Discuss how different cultures around the world celebrate autumn and harvest seasons. This connects to understanding human adaptation to environmental patterns and seasonal cycles.

4. Art - Color Mixing and Nature Observation: Students can create autumn landscape paintings or collages using actual fallen leaves, exploring how artists use warm colors (reds, oranges, yellows) to convey the feeling of fall. Challenge them to mix paints to match the exact colors they observe in leaves, developing both artistic and observation skills while reinforcing the science concept of hidden pigments becoming visible.

### STEM Career Connection

1. Forest Ecologist: Forest ecologists study how forests change with seasons and how all the living and non-living things in forests interact with each other. They might track when leaves change color each year, study how animals use fallen leaves, or protect forests from disease. These scientists help us understand and take care of our forests. Average Salary: \$65,000 - \$75,000 per year

2. Botanist (Plant Scientist): Botanists study all kinds of plants, including why and how trees change colors in fall and how they survive winter. They might work in gardens, forests, or laboratories, conducting experiments to understand plant life cycles and adaptations. Some botanists help develop stronger plants that can handle climate changes. Average Salary: \$62,000 - \$72,000 per year

3. Environmental Scientist: Environmental scientists monitor ecosystems like lakes and forests to keep them healthy. They might study how seasonal changes affect water quality in lakes like the one in this photo, or how decomposing leaves impact soil and wildlife. They use science to solve problems and protect nature. Average Salary: \$68,000 - \$80,000 per year

### NGSS Connections

- Performance Expectation: 5-LS2-1 - Develop a model to describe the movement of matter among plants, animals, decomposers, and the environment
- Disciplinary Core Ideas: 5-LS1.C - Organization for Matter and Energy Flow in Organisms; 5-LS2.A - Interdependent Relationships in Ecosystems; 5-LS2.B - Cycles of Matter and Energy Transfer in Ecosystems
- Crosscutting Concepts: Patterns - Observable patterns in nature guide organization and classification; Systems and System Models - A system can be described in terms of its components and their interactions

### Science Vocabulary

- \* Deciduous: Trees and plants that lose their leaves seasonally as an adaptation to changing environmental conditions.
- \* Chlorophyll: The green pigment in plants that captures sunlight energy for photosynthesis.
- \* Abscission: The natural process by which trees shed their leaves by forming a separation layer at the leaf stem.
- \* Photosynthesis: The process plants use to make food by combining sunlight, carbon dioxide, and water.
- \* Adaptation: A special characteristic that helps a living thing survive in its environment.
- \* Decomposition: The natural process where dead plant and animal materials break down and return nutrients to the soil.

### External Resources

Children's Books:

- Why Do Leaves Change Color? by Betsy Maestro
- Red Leaf, Yellow Leaf by Lois Ehlert



## Deciduous Trees — 5th Grade Lesson Guide

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- Fletcher and the Falling Leaves by Julia Rawlinson