

**Lesson Objectives:**

- Define herbaceous, hardwood, and softwood plant species and their differences
- Describe photosynthesis and the cell layers of a tree trunk
- Compare the xylem cells of softwoods and hardwoods

**SC Science Standards:**

- Grade Five: 5.S.1A.1-8, 5.E.3A.1, 5.E.3B.3-4, 5.L.4A.1-2, 5.L.4B.1,
- Grade Six: 6.S.1A.1-8, 6.E.2A.3, 6.L.4A.1, 6.L.4B.1, 6.L.5B.1-5
- Grade Seven: 7.S.1A.1-8, 7.L.3A.1-3, 7.L.3B.1, 7.EC.5A.1
- Grade Eight: 8.S.1A.1-8, 8.E.6B.1
- Biology 1: H.B.6A.1-4, H.B.2B.2, H.B.6C.1, H.B.3A.2

**Safety Tips:**

- Some people are allergic to food dyes, so be sure to only put some in the cup of water that will be absorbed by the paper towel. The sole purpose of using the dye is to highlight the water absorption into the paper towel. The water the participant will be drinking through a straw does not need to be dyed.

**Worksheet Answers:**

1. Trees have woody tissues, can be very tall, and have the general makeup of roots, stems, and leaves. Secondary answer is dependent on your surroundings.
2. Plants need sunlight, water, and carbon dioxide to conduct photosynthesis. They absorb sunlight with their leaves (chlorophyll), pull up water from the ground by their roots, and “breathe in” carbon dioxide from the atmosphere through the stomata (located on their leaves).
3. Xylem; phloem
4. Vessels; tracheids
5. General organization of answers:
  - a. Vessels
    - i. Found in hardwood tree species
    - ii. Short, wide cells
    - iii. Full of perforations
  - b. Tracheids
    - i. Found in softwood tree species
    - ii. Long, skinny cells
    - iii. Thick cell walls
  - c. Similarities
    - i. Move water throughout the tree
    - ii. Pull water up from the roots to the leaves
    - iii. Help with the process of photosynthesis
6. The Champion Longleaf Pine is located in Aiken, SC, measuring in at a trunk circumference of 140in, a height of 105ft, and a crown spread of 56ft. (Source: <https://www.americanforests.org/big-trees/longleaf-pine-pinus-palustris-2/>)

**Assessment Ideas:**

- **PRESENT:** Students could create a poster of their findings and how the absorption rates differed between “trees”. They could practice generating data tables and graphs to compare the absorption rates and their averages.
- **ANALYZE:** Students critique the demonstration, and have a discussion answering:
  - Did the demonstration work for you? If not, what went wrong?
  - Does this demonstration accurately portray how the trees are different? (One is passive transport; one is active transport...)
  - What are some other analogies that could be used to discuss the differences shown in hardwood and softwood xylem cells?
- **CHALLENGE:** Split students into two sides and have four students off in their own group as a “judges panel. Each side represents either softwood or hardwood trees (or smaller groups could debate for individual tree species), and students have to investigate into their differences further to create an argument that they have the “superior” tree type. Topics to investigate are:
  - Photosynthetic rates
  - Water retention (leaves) and collection (roots)
  - Growth rates
  - Germination rates (seeds)
  - Nutrient/space/sunlight requirements
  - Shade tolerance
  - Timber quality

**How to Explore Further:**

- Students could continue to research different tree species and write a paper or prepare a short presentation on a different type of tree. Tree species representative of different ecosystems could be selected so students are tasked with exploring more about a specific tree species but also a different ecosystem type/biome.
- Students could dive deeper into the other morphological differences in softwood trees. Another straightforward comparison would be between the leaves. Needles could go in one plastic bag, and deciduous leaves could go in another. Leave both bags in the sunlight for a half hour. This would test how much the different leaves transpire and lose water to the atmosphere. The findings would (probably; depending on tree species choices) show that the bag with the needles would have less condensation than the bag with deciduous leaves, due to the fact that softwood needles generally have waxy coating. This small experiment could be expanded upon even further and used as a segue to learning about deserts/CAM plants by adding cacti spines to a bag to have as another comparison.