



Plant's Subway System

Week 1

Plants pick up nutrients and water through their roots. They move up the stem through xylem and phloem, then transpiration releases water through the leaf's stomata.

How do plants transport nutrients from their roots to their leaves?

What chemical makes plants green?

What is photosynthesis?

Introduction

Plants produce food through **photosynthesis**. Large amounts of water, with its dissolved minerals, are needed for this chemical process. For this to happen, plants must have a way to get the water all the way up to their leaves.

Food and **water** are transported through the plant through structures called **xylem** and **phloem**. A plant doesn't have a heart to pump liquids as we do. Our heart *pushes* the blood through our body. In plants, water is *pulled* up from the roots to the leaves. The two processes that make this happen are **transpiration** and **cohesion**.

Transpiration: water escapes through tiny openings on the bottom of the leaves, called **stomata**. This creates a difference in pressure in the **xylem** cells. When one molecule is lost, another is pulled up to replace it. A similar thing happens when you remove water from the top of a straw—other water molecules must come up the straw to replace them. Leaves constantly release water through **transpiration**.

Cohesion: cohesion is the force that cause water molecules to stick to one another—the reason drops gather together. Because xylem vessels are very small, cohesion causes water molecules to be pulled along in a process called **capillary action**.

Xylem vessels connect straight from the roots to the leaves for the speediest transport possible. The rings you see when you cut down a tree are old xylem tissue. In fact, the word *xylem* comes from the Greek word *xylem*, meaning “wood.”

Supplies

- **Celery**—one stalk per student in class; stalks can be cut to half height.
- **White carnations or daisies**
- Scientific method **Lab Report sheet**—one per student (in Appendix)
- **1 clear glass** or jar of water to demonstrate lab setup
- Red and blue **liquid food color**
- **Paper towels**
- **Pencils**
- **Colored pencils**

Teacher Prep

The night before class:

- Place celery in colored water. Having some leaves attached is dramatic.
- Split the stem of a carnation or daisy. Place one end in red water, place the other end in blue water.
- Keep one celery stalk and one flower uncolored for class.

Procedure

- Beginning with guidelines will help you to set the tone for a stress-free environment.
Go over the rules in the front of this book on the To the Teacher page and share them with the students. Using humor and animation will make class more fun—giggles are always OK! Especially when you discuss no eating in science lab—ask them if it will be OK to eat the celery—NO! Drink the water? No, that is so silly!
- In science class today, we will learn about the scientific method while studying how nutrients flow through plants.
- Explain the steps of the scientific method: question, hypothesis, experiment, observation, analysis, and conclusion.
- Show an uncolored stalk of celery and a carnation to the class. “Can you see the xylem in these plants?” (probably not)
- “Let’s devise an experiment that will allow us to observe the xylem.”
- After brainstorming for a while, lead students to the idea that because xylem transport water, if we put dye in water, it might make the xylem visible. Perhaps a hint about how medical dye is used to make our blood vessels visible to medical scans such as an MRI.
- Record the question, “How does water travel through plants?” Students may write or draw according to their abilities.
- After the procedure is decided, bring out cup of water, add food coloring, place celery in cup.
- Have students explain or draw the lab set-up under procedure.
- “We would normally have to wait for the water to be transported. I put one in water last night so we could observe our results right away like in a cooking show!”
- Bring out changed celery in colored water. Remove stalks from water, pat dry on paper towel and pass to students for observation.
- Make sure students observe the dots on the bottom of stalks—these are the ends of the xylem.
- Observe the leaves also. Do you see any xylem in the middle? Why? (perhaps it is beneath the outer “skin.”)
- “Is the xylem branching, like our circulatory system, or does it go straight up the stalk?” (straight, no branching)
- “Can anyone think of a way we could test this?” (Split the stem, and see where the color goes.)
- After discussion, bring out the carnation with the split stalk. The carnation should be half red and half blue.
- “What is your conclusion?” (The color goes straight up, no horizontal mixing. Xylem vessels are straight, not branching like our circulatory system. If you cut into the trunk of a tree beyond its xylem, the part of the tree above the injury will die.) Complete lab sheets by filling in conclusion.



“We cannot
create observers
by saying
'observe',
but by giving
them the power
and the means
for this
observation and
these means are
procured
through
education of the
senses.”

Maria Montessori