



Grade Level

3rd - 5th Grades

Lesson Length

45-60 Minutes

STEM Careers

- Gardener/Horticulturist
- Astronomer
- Plant Scientist
- Ag Technician

Life Skills

- Critical Thinking
- Decision Making
- Planning/Organizing

Related Activities

- Plant Dissection

Learn More

- Visit Raising Nebraska raisingnebraska.unl.edu
- Visit Hastings Museum hastingsmuseum.org

Virtual Fun

- <http://solar-center.stanford.edu/activities/>

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XYLEM OR PHLOEM

Plant Science

This grab and go lesson will focus on how gravity impacts a plant's growth, specifically through the stem.

LEARNING OBJECTIVES

By the end of the lesson, students should be able to:

- Become familiar with basic parts & functions of a plant stem
- Explain the difference between xylem and phloem
- Understand how gravity impacts movement in the xylem

EDUCATIONAL STANDARDS SUPPORTED

- NE 5.3.1.b Identify how parts of plants and animals function to meet basic needs (e.g., leg of an insect helps an insect move, root of a plant helps the plant obtain water)
- NGSS 4-LS1-1 Construct an argument that plants and animals have internal and external structures that function to support survival, growth, behavior, and reproduction.

MATERIALS LIST

- All about the Stem handout
- Plant Science Journal handout
- Enough glass containers or plastic cups for each person in your group (to support a stalk of celery)
- Food coloring. Try several different colors for some added interest.
- Pitchers of water
- A bunch or two of celery. The more leaves on the bunch the better the experiment will work.
- Note: this experiment should be done in an area that will not be damaged if the food coloring get spilled.
- Knife
- Optional: plastic gloves for youth to wear to prevent food coloring on their hands

PREPARATION

- For large groups or to save time, you can add at least 5 drops of red or blue food coloring to individual cups.
- Have 2-3 pitchers or pourable containers of water ready for each table/group of students.



INTRODUCTION

Plants are able to sense the environment around them and respond accordingly. In fact, they are in constant motion as they develop, search for light and nutrients, and reproduce. Plants have mechanisms that determine up from down to produce shoots and roots in the correct orientation and also have mechanisms to measure time to know when flower at the right time of the year, become seasonally dormant and even determine night from day. Light is an important environmental cue to which plants are especially sensitive. Different levels of light will stimulate dramatic differences in growth pattern, leaf size and shape.

Plants move through tropisms which are vital to plants' survival. In general, tropisms involve cell elongation on one side of a plant, causing the plant to grow in a particular direction.

Geotropism

Movement of water, nutrients and minerals in a plant are affected by geotropism. Transportation of these critical items for survival are done through the xylem and phloem which are straw-like parts of a plant's stem that move stuff up and down. Xylem moves the water and nutrients from the roots to the stems, branches, leaves, flowers and fruit of the plant. The phloem moves the sugary sap (carbohydrates) from the leaves to the roots.

OPENING QUESTIONS

- How does a plant move water, nutrients and minerals?
- What can you tell me about a plant's stem? What are its functions?
- How would gravity impact a plant's movement of nutrients and water in the stem?

Today we are going to run an experiment and will be a lab technician (person who run experiments and records data in a lab) and explore what plants need in order to survive. You will also be deciding if gravity impacts a plant's growth. Let's get started.....

Riddle

"River flow-em
downstream."
"Phloem move thing
downstream too"

Vocabulary

Photosynthesis is the transformation of light energy into chemical energy. Green leafy plants contain a light-absorbing pigment called chlorophyll.

Fun Fact

Giant pumpkin contests held in the U.S. is caused because the farmer damages the phloem of the plant. A farmer will carefully cut the phloem of the pumpkin vine at a large branch. This will prevent sugars being transported to the roots, instead all the sugars manufactured by the plant have no place to go but into the fruit/vegetable. They also remove all other pumpkins on that vine to assure that one pumpkin will expand to many times its normal size.

ACTIVITY 1: XYLEM IN ACTION

What do you know about a plant stem? What are its functions?

Plants have a network of tubules (called the xylem) to transport water and mineral nutrients and a separate set of conduits (called phloem) to carry products of photosynthesis. Some stems provide support to the plant, but some such as the sweet potato are crucial for food storage. Stems are modified to facilitate climbing or vining in some plants and water storage in succulents. Stems of trees are reinforced over time through the development of wood and bark.

On the “All about the Stem” handout let’s discuss the differences and similarities between a xylem and phloem and fill in the missing pieces.

- Xylem - nature of tissues are hollow dead cells, at the center of the vascular bundle
- Phloem – nature of tissues are living cytoplasm but without nucleus, outer side of vascular bundle

ACTIVITY 2: XYLEM IN ACTION

Now that we’ve identified a xylem and phloem on paper, let’s watch the xylem in action on a stem!

Hold up the whole bunch of celery. Have youth identify where the roots were, the stem and leaves. Next youth will:

1. Fill a jar or plastic cup 2/3 with water.
2. Carefully add enough food coloring (at least ten drops) to the water. Green food coloring won’t be as easy to see in the green celery as red and blue.
3. Separate a celery stalk that still has leaves on it from the bunch.
4. Cut off the bottom half inch or so of the stalk and place it in the colored water.
5. For the remainder of the day, observe celery stalks. Record observations in the Plant Science Investigation

Over the rest of the day check the results. Can you see the color moving up the stalk through the xylem? What happens when it reaches the leaves?

Try this with the celery top down in the colored water. What happens in this experiment?

After allowing the celery to sit in the colored water overnight, remove one and cut through the stalk every inch or so to see the color of the stalk and the xylem. Do this with the upside down stalk and compare the difference. You can get multiple colored leaves by splitting a stalk the long way and putting half in one color and half in another.

Did the colored water move up the stalk through the xylem?

Vocabulary

Xylem – straw-like plant structure that move water and nutrients from the roots to the stems, branches, leaves, flowers, and fruit

Phloem –straw-like plant structure that moves the sugary sap from the leaves to the root

Did You Know?

To allow water and nutrients to move upward in the xylem is because of the evaporation of water from the surface cells (leaves) to the atmosphere. This loss of water to the atmosphere causes a negative pressure or tension to occur which “pulls” the water from the roots and soil up the plant. It works very similar to the way a drinking straw works. Xylem is composed of primarily dead plant cells.

ACTIVITY 3: WHAT HAPPENS IN ZERO GRAVITY?

We experience gravitational pull every day on Earth. Does a plant grow differently when there is no gravitational pull? Can we run a study in the classroom with zero gravity?

NASA conducted experiments on the International Space Station to record and observe how seeds germinated and grow in little to no gravity. There are 3 videos available on the NASA website (link below) that can be shared with students to show what happens in zero gravity.

https://www.nasa.gov/audience/foreducators/topnav/materials/listbytype/How_Plants_Grow_in_Space.html

https://www.nasa.gov/audience/foreducators/topnav/materials/listbytype/Evaluating_Experimental_Treatment.html



REFLECT

Let's review what we have learned so far...

How does a plant move water, nutrients and minerals?

- Xylem – straw-like plant structure that move water and nutrients from the roots to the stems, branches, leaves, flowers, and fruit
- Phloem –straw-like plant structure that moves the sugary sap from the leaves to the roots

What can you tell me about a plant's stem? What are its functions?

- To transport nutrients to the plant, provide support

How would gravity impact a plant's movement of nutrients and water in the stem?

- Possess abnormal growth habits

Describe what happened with the celery experiment. What were you able to identify?

- Xylem (food coloring/water moved up the plant to the leaves)

Fun Fact

Plants with zero gravity can mimicked by use of a clinostat which constantly rotates plants to eliminate a set direction for gravity. These experiments have shown that gravity's effect on plants prevents the hormone, auxin from accumulating on one side of the stem or roots. This causes stems or roots to develop unusual growth behaviors. For example, roots may grow toward stems and stems may grow horizontally, rather than upwards.



APPLY

Today you ran an experiment and were a lab technician (person who run experiments and records data in a lab) and explored what plants need in order to survive. How do leaves obtain their nutrients?

- The roots uptake water/nutrients and move it through the xylem to the leaves

How do you think we can grow plants in zero gravity on the international space station?

Who depends on understanding plant science research?

- All of us; in order to feed a growing population there are numerous research students and opportunities for careers related to plants.

What are other careers that relate to planting seeds other than what we have discussed?

- Plant breeder, geneticist, nursery, soil scientist, agronomist, pathologist, entomologist, etc.

We want to hear from you!

Let us know what you thought of the lesson or send us a picture of youth participating in the lesson.

#NE4HSTEM #ECLIPSE2017

ALL ABOUT THE STEM

Xylem or Phloem

NAME

DATE

What are the major functions?

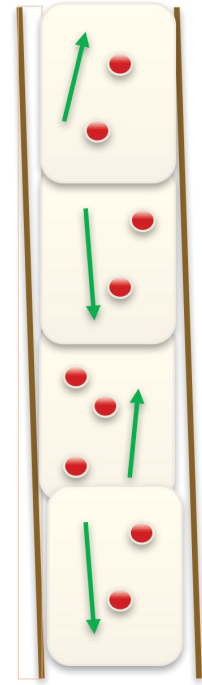
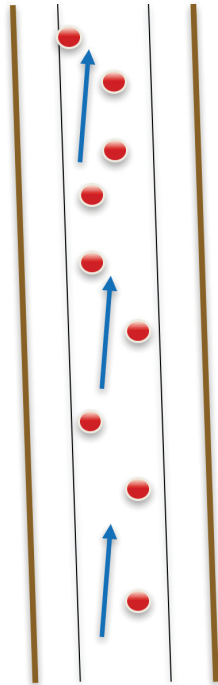
Fill in the blanks with the correct word.

One way
Thick walls with lignin

Two-way flow
Cells have end walls with perforations

Transports

Transports



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ALL ABOUT THE STEM

Xylem or Phloem

Answer Key

What are the major functions?

to transport water and mineral nutrients, provide support for the plant

Fill in the blanks with the correct word.

xylem

phloem

One way
Thick walls with lignin

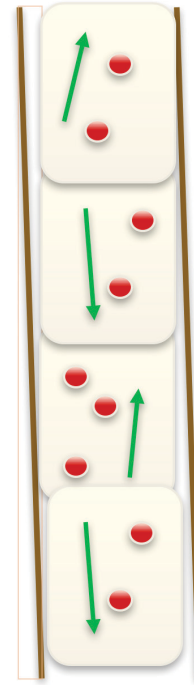
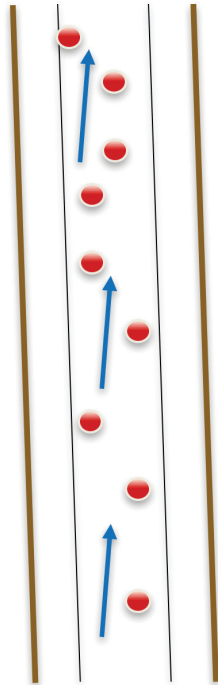
Two-way flow
Cells have end walls with perforations

Transports

water (minerals too)

Transports

food & water



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 Life up close.
HastingsMuseum

PLANT SCIENCE INVESTIGATION JOURNAL

Xylem or Phloem

NAME

DATE



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