



Science Unit: *Temperate Forest*

Lesson 11: *The Way a Tree Works*

School year: 2006/2007

Developed for: Lord Selkirk Annex Elementary School, Vancouver School District

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Grade level: Presented to grades 1 - 2; appropriate for grades 1-7 with age appropriate modifications

Duration of lesson: 1.25 hours

Notes: See safety note under Science Activity/Experiment 3 regarding the use of rubbing alcohol to investigate colours in leaves.

Objectives

Learn how plants take water up the stem.

Learn about transpiration.

Learn about different colours in leaves and flowers

Students will have practical experience of how to set up an experiment, obtain results and interpret those results.

Background Information

Plants such as trees need four things to make food: water, carbon dioxide, green chlorophyll and sunlight. Water is taken in by the roots and travels to the leaves in tube cells called xylem (pronounced zy-lem). The food (sugar) is made in the leaves, which contain the green chlorophyll, in a process called photosynthesis. The food travels down the stem/trunk in cells called phloem (pronounced flo-em). The waste product from this process is oxygen, which is released from the leaves during the daylight.

Since each experiment takes time to work, set up one and while waiting for the results set up the next and so on. Some results will not be ready until the next day.

Science Experiment/Activity 1: Show how water travels from the roots to the leaves

Science Experiment/Activity 2: Do trees evaporate water from the leaves?

Science Experiment/Activity 3: Separate the hidden colours in a leaf

Vocabulary

Carbon dioxide A gas in the air that plants use to make food. Animals breathe it out as a waste product.

Chlorophyll The chemical substance which gives leaves and needles a green colour and is responsible for harnessing light energy and using it for photosynthesis.

Evaporation The process of a substance changing from a liquid to a gas by exposure to the air and or heat.

Leaves The food factories of trees and plants.

Oxygen A gas in the air all animals breath in to help them obtain energy from food and green plants release into air in daytime as a waste product.



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<u>Phloem</u>	Layer of cells inside the bark, which act as tubes, carrying sugar (sap) made in leaves, to other parts of a plant.
<u>Photosynthesis</u>	The process plants use to make their own food using energy from the sun, carbon dioxide from the air and water from the soil. Chlorophyll is essential to the series of chemical reactions involved.
<u>Roots</u>	Underground part of a plant which anchors it to the ground and absorbs water and minerals from soil.
<u>Sugar</u>	Compound of hydrogen, carbon, and oxygen produced by green plants in the process of photosynthesis.
<u>Transpiration</u>	The process whereby water is lost through the leaves of a plant due to evaporation.
<u>Trunk</u>	The stem of a tree that grows by adding a new layer of wood each year. Consists of several layers: outer bark, phloem, cambium, sapwood, heartwood.
<u>Xylem</u>	Tube cells, which carry water and dissolved minerals from roots to leaves in a plant.

Materials

For experiment 1, water through the stem, each group of students will need the following

- celery stalks
- water
- glass slides or small Petri dishes for sections
- red food colouring
- hand lenses or microscopes
- glass jar
- knife/razor blade to be used by teacher only

For experiment 2, transpiration, each group of students will need the following

- access to scales
- potted plants or trees
- polythene bags
- twist ties

For experiment 3, hidden colours, each group of students will need the following

- green leaves
- coffee filter paper
- scissors)
- rubbing alcohol
- 3 pencils
- metal spoon
- 3 glass jars
- tape,
- flower petals, marker pens, as additional things to separate colours

In the Classroom

Introductory Discussion

1. Review photosynthesis. Show the interactive Nova Activity, http://www.pbs.org/wgbh/nova/methuselah/phot_flash.html



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2. Review the basic parts of the tree. What part of the tree is in the soil? What is the job of the roots? (anchoring and water uptake) What is the job of the leaves? (photosynthesis and transpiration) Transpiration is how water gets to the top of a 40 foot tree. Demo water molecules being joined together and pulled along. As water evaporates from the leaf, water is pulled from the leaf veins, which pulls it from the leaf stem, which pulls it from the twig, which pulls it from the branch etc. (for example demo, see page 72 *Forests in Focus*).

Review how to do a science activity.

- Make an observation and then ask a question OR start with a question: Do trees transpire water? How does the water get from the roots to the leaves? Why do leaves change colour in the fall?
- Set up an experiment
- Make observations.
- Collect data, record and examine results (think about why things happened the way they did).
- Make conclusions and explain results (compare results to predictions to help you think deeper).

Science Activity/Experiment 1

Experiment Title: To investigate where water travels in the stem

Purpose of Experiment: to show water traveling up xylem in the stem of a plant.

Experimental Treatments:

Test treatment 1	Red food colouring
Test treatment 2	No food colouring
Test treatment 3	Alternative colour of food colouring

Methods:

Students will be divided into groups of 3-5 students per group.

1. Cut the bottom off a celery stick. This will work with celery which has its leaves still attached or not but is more dramatic with the leaves on.
2. Place the celery stick in a glass with some water to which you have added a few drops of red food colouring.
3. Leave it for half an hour.
4. Ask your teacher to cut a thin sample of the stalk.
5. View with a hand lens or put under a microscope.
6. Observe any red colour in the section.
7. Repeat with another similar celery stick in a jar with water but no food colouring.
8. Repeat with similar celery stick in a jar with water but different food colouring, such as blue.
9. Record observations.

Closure Discussion

Review what was seen in the celery stalks.



Was there any red colour or any other colour seen in the celery stalk without food colouring in the water?

Was the red colour seen across all of the stem or in just certain areas?

Did the same thing happen with the alternative food colouring?

What is the name of the tube cells which carry water?

Science Activity/Experiment 2

Experiment Title: To investigate transpiration in leaves

Purpose of Experiment: to understand the role played by leaves in getting water up to them through evaporation of water through the stomata in the leaves.

Methods:

- a. Students will be divided into groups of 3-5 students per group or this can be done as a demo especially for the younger children.
- b. Take an empty plastic bag and record its weight. If the scale is not sensitive enough to weigh one bag, the class can weigh all their bags together, or they can simply describe the appearance of the bag. Note: this activity will work best on a sunny day after the plant has been watered.
- c. Place the bag carefully over part of a potted plant. Tie the bag with a twist tie or string.
- d. Place the plant in the sunshine.
- e. Leave the plant in sunshine for 30 minutes or overnight if the sun is not available when you conduct this experiment
- f. Carefully remove the bag from the plant and weigh it again. Alternatively describe its appearance. Note any changes.
- g. Measure the amount of condensation in the bag: weight at the end of experiment – weight at the beginning.
- h. If the class has access to a microscope, look at a leaf and observe the stomata on the underside of the leaf.
- i. Record observations.

Closure Discussion

Review observations.

Needle trees have fewer stomata than broadleaved trees. Desert plants have fewer stomata than rainforest trees. Why is this adaptation important to the plant?

Adaptations for older student groups are on page 73 *Forests in Focus*.

Science Activity/Experiment 3

Experiment Title: To investigate colours in leaves

Purpose of Experiment: to show the hidden colours in leaves, relating to why trees turn colour in the fall.

Safety Note: Only adults should pour the rubbing alcohol in the jar and students should be supervised when they are using rubbing alcohol. Rubbing alcohol is poisonous if ingested and vapors may irritate



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eyes. Students should be warned to follow all safety instructions when using rubbing alcohol and notify the teacher if a spill occurs. Demonstrate how to mash the leaves in rubbing alcohol prior to having students do the experiment. Alternatively, do this activity as a demonstration.

Methods:

1. Collect green leaves from a deciduous broad-leaved tree e.g. maple. Tear the leaves into small pieces. Put them in a glass jar.
2. Add enough rubbing alcohol to each jar to cover the leaves. Mash the leaves into a soupy mixture with a spoon. Let the mixture stand for 5-10 minutes.
3. Meanwhile cut 4 cm by 9 cm strips from a coffee filter. Tape each filter strip to a pencil. Lay the pencil across the top of the jar. Adjust the strip so that the end just touches the liquid. The strip should begin to absorb the liquid.
4. When the liquid has moved halfway up the strips, remove them and lay them on clean paper to dry. Observe the green bands (chlorophyll) and the yellow or orange bands (other leaf pigments).
5. Record observations.

Closure Discussion

What colours did you see?

What colour do many broadleaved trees turn in the fall?

Where does the green chlorophyll go? [Answer: Back into the tree revealing the red colour. The red was there all the time but masked by the green.]

Scientists use this method to separate all kinds of things including the components of DNA. You can use it to separate the colours in a felt tip marker. Put a dense dot on the filter paper from a marker pen/sharpened pen about 2 cm above the top of the rubbing alcohol. As the liquid travels up the filter it separates the colours. You can try this with flower petals and different leaves. If you are doing this around or just after Christmas, Poinsettia leaves have a lot of red in them.

References

1. B.C. Ministry of Forests. 1999. Forests in Focus. ISBN 0-7726-3966-3

The Way A Tree Works

by _____

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QUESTION

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PROCEDURE

What did we do? Write and draw.

PROCEDURE

What did we do? Write and draw.

OBSERVATIONS

What did we see? Write and draw.

OBSERVATIONS

What did we see? Write and draw.

CONCLUSION

What are the answers to the questions?

What did we learn from the experiment?

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