Once Upon a Life Science Book

12 Interdisciplinary Activities to Create Confident Readers

Once Upon a Life Science Book

12 Interdisciplinary Activities to Create Confident Readers

Jodi Wheeler-Toppen

NSTA press
National Science Teachers Association
Arlington, VA

NSTA press®
National Science Teachers Association

Claire Reinburg, Director
Jennifer Horak, Managing Editor
Andrew Cocke, Senior Editor
Judy Cusick, Senior Editor
Wendy Rubin, Associate Editor
Amy America, Book Acquisitions Coordinator

Art and Design
Will Thomas, Jr., Director—Cover and Interior Design
All superhero art on pages 1, 9, 21, 27, 41, 53, 61, 71, 81, 93, 103, 113 , 123, 135, and 145 courtesy istockphoto.

Printing and Production
Catherine Lorrain, Director

SciLinks
Tyson Brown, Director
Virginie L. Chokouanga, Customer Service and Database Coordinator

National Science Teachers Association
Francis Q. Eberle, PhD, Executive Director
David Beacom, Publisher

12 11 10 4 3 2 1

Library of Congress Cataloging-in-Publication Data
Wheeler-Toppen, Jodi.
Once upon a life science book : 12 interdisciplinary activities to create confident readers / Jodi Lyn Wheeler-Toppen.
p. cm.
Includes bibliographical references and index.
ISBN 978-1-935155-09-6
1. Science--Study and teaching (Secondary)--Activity programs. 2. Reading. 3. Interdisciplinary approach in education. I. Title.
LB1585.W448 2010
507.1--dc22
2009053311
eISBN 978-1-936137-73-2

Table of Contents

Table of Contents

Acknowledgments

For Jon, Natalie, and Zachary

With thanks to

Tammy Moncel
Lac Courte Oreilles Ojibwe Middle School
Hayward, WI

and

Scott Parrish
William Ellis Middle School
Advance, NC

for field testing some of the activities in their classrooms.

And to the following individuals who provided expert reviews of the science content:

Aaron Wheeler
Department of Chemistry
University of Toronto

Peggy Brickman
Division of Biological Sciences
University of Georgia

Norris Armstrong
Division of Biological Sciences
University of Georgia

Lawrence J. Davenport
Department of Biology
Samford University

Acknowledgments

Darold Batzer
Department of Entomology
University of Georgia

David Goldman
National Institute on Alcohol Abuse and Alcoholism
National Institutes of Health

John Heller
Metropolitan Urology Clinic
Minneapolis, MN

Richard Lee
Skidaway Institute of Oceanography
Savannah,GA

Mark Farmer
Department of Cellular Biology
University of Georgia

Jean Pennycook
Education Division
The Penguin Science Project

Wendy Dustman
Department of Microbiology
University of Georgia

J. G. M. "Hans" Thewissen
Department of Anatomy and Neurobiology
Northeastern Ohio Universities College of Medicine

Chapter 8

The Case of the Tree Hit Man

Topics

- Plant structure and function (roots, stems, and leaves)
- Vascular tissue in plants (xylem and phloem)

NSES Content Standards (For Grades 5–8, Life Science)

- Living systems at all levels of organization demonstrate the complementary nature of structure and function. Important levels of organization for structure and function include cells, organs, tissues, organ systems, whole organisms, and ecosystems.
- Specialized cells perform specialized functions in multicellular organisms. Groups of specialized cells cooperate to form a tissue, such as a muscle. Different tissues are in turn grouped together to form larger functional units, called organs. Each type of cell, tissue, and organ has a distinct structure and set of functions that serve the organism as a whole. (NRC 1996, p. 156)

Reading Strategy

Previewing diagrams and illustrations

Background

The topic of plants does not excite many middle school students. Learning about the inner workings of xylem and phloem feels far removed from any practical applications in their lives. This chapter uses a (true life!) crime scenario to frame the study of water and sugar movement in plants.

First, students will do a few basic explorations to make sure that they have an underlying understanding of water and sugar movement in plants. Although it may seem like students should know these basic ideas, many students have never observed plants closely and are confused by these topics. However, once students observe water movement in a plant, they will be ready to learn about xylem and phloem.

Materials

- 4 small plants per class, such as geraniums, bean seedlings, pansies, or young radishes
- Dried potting soil (see Teaching Note on p. 73)
- Plastic wrap or plastic bags (or other materials requested by students)
- Watering can or spray bottle
- Celery stalks, preferably with leaves attached
- Food coloring
- Plastic cups (1 per group, plus 4 per class to use as pots for the mini-experiment)
- Knives to trim the celery (Note: Some schools do not allow students to use knives. If this is the case, the teacher should prepare the celery in advance.)
- Indirectly vented chemical splash goggles, aprons, vinyl gloves

SAFETY ALERT!

- The teacher will demonstrate safe procedures for using a knife.
- Point and push knife away from your body.
- Never use excess force when working with a knife.
- Wipe up any water on the floor when using a spray bottle, as it can be a slip or fall hazard.

Student Pages

- "The Case of the Tree Hit Man"
- Plant Police Academy
- Structure and Function in Plants

Exploration/Pre-Reading

In this exploration, students will begin with a mini-experiment to decide if roots or leaves absorb water for plants. Then they will observe the movement of water through a celery stem and compare how water and sugar move through a plant. These explorations require several days to complete, so you will need to plan ahead.

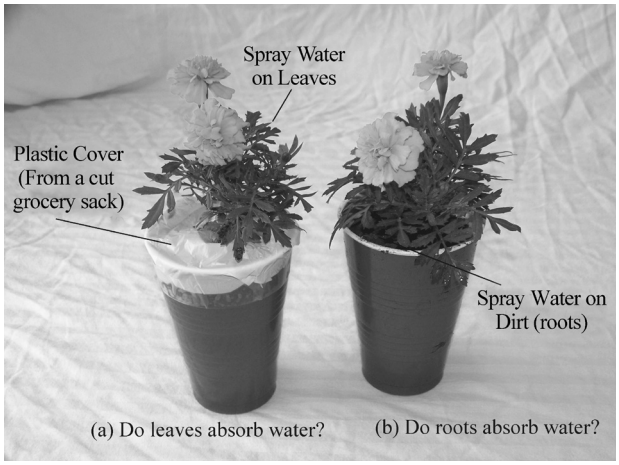
SCILINKS® THE WORLD'S A CLICK AWAY

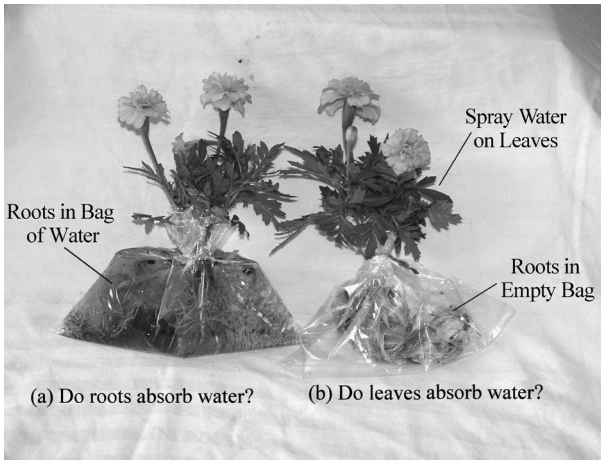
Topic: What Are the Parts of a Plant?
Go to: *www.scilinks.org*
Code: LSB012

Topic: Plant Growth
Go to: *www.scilinks.org*
Code: LSB013

Begin by telling students that a terrible crime has occurred. Over the next few days, they will be participating in Plant Police Academy to learn more about it. As their first task, students need to design an experiment that will show which part of the plant absorbs water. Show students the four plants for their class, and ask the class to design an experiment that would let them show whether leaves or roots absorb the water. After a little brainstorming, most classes will come up with something similar to one of the two experimental designs shown in the figure above. (Note that each picture shows only one plant in each condition; your classes will have two plants in each group.)

Two Possible Designs for the Mini-Experiment





Give students the handout Plant Police Academy, and have them draw the class's experimental design. Ask, "What happens to a plant when it runs out of water?" and make sure students understand that the plant will

TEACHING NOTE

If you purchase mature plants that have been well watered at the nursery, it can take up to three weeks for the plant with covered roots to wilt. You can shorten the time by using potting soil that has been thoroughly dried before planting. Place the soil on a cookie sheet and bake it at 250 degrees for two to four hours to remove the water. When you are ready to start the experiment, gently loosen the existing soil from the roots of your plants, rinse the remaining soil away with water, and then plant them in the dry soil. The plant with covered roots should then wilt in just two to four days.

wilt. They should then be able to fill in the prediction section for each experimental group.

The second activity, allowing celery to soak up colored water, may be familiar to students. This version, though, asks them to pay careful attention to where the color change takes place. The process requires at least one hour but works best when allowed to sit overnight.

Introduce the Reading. Tell students that they are now ready to read and investigate the crime. Give out the "The Case of the Tree Hit Man," and lead students to study the diagrams as described in the reading strategy section below.

Reading Strategy: Previewing Diagrams and Illustrations

Note that this strategy was first introduced in Chapter 6. If you have not used Chapter 6 with your class, tell students that in some books that they read, the pictures are extras. In science writing, however, the pictures and diagrams often carry a lot of important information. Looking at the pictures and making predictions about what they mean before reading can help make the text easier to understand.

If you have already introduced this strategy, remind students about the importance of pictures in science text. Then tell them that they are going to practice three questions that they can use to help them preview diagrams and illustrations.

Place students into their reading groups, and direct them to look at Figure 1 (p. 76). The Leaders should describe what they see in the diagram, without worrying about whether they know the correct terms. Then the Flag Flyers should predict what the diagram illustrates. Finally, the Interpreters should come up with at least one question about the diagram that might be answered in the text. Have one group share its responses with the class.

Continue to Figure 2 (p. 77), but this time the Interpreter should describe the diagram, the Leader should make the prediction, and the Flag Flyer should come up with a question. Continue this pattern until the students have discussed each diagram. Then have them proceed to reading the text as usual.

Journal Questions

When you looked at the diagrams before reading, your group discussed three questions:

- What do you see in the diagram?
- What might the diagram be illustrating?
- What question do you think the text will answer about the diagram?

Which of these three questions was most helpful for understanding the text? Why?

Application/Post-Reading

- Graphic Organizer: Structure and Function in Plants
- Pulling It Together in Writing: Give students the following prompt: *The town of Magnolia Springs has decided to prosecute the tree hit man. You are the police detective called in to explain the case to the jury. Explain how the hit man killed the tree, and include a diagram to help them understand.*
- Pulling-It-Together Focus Point: Phloem cells carry food and sugars through the plant. In a tree, the cells are located in a ring just beneath the bark. The tree hit man cut through the phloem cells and, therefore, starved the base of the tree.

References

Associated Press. *Birmingham News*. 1993. Giant oak from acorn of Columbus' day found mostly dead in Magnolia Springs. May 20.

Ball, E. *Birmingham News*. 1991. Magnolia Springs' mighty oak winning fight for life. March 31.

Mitchell, G. Associated Press. 2000. Visitors find inspiration: Remains of 500-year-old tree still park's centerpiece. November 19. *http://www2.ljworld.com/news/2000/nov/19/visitors_find_inspiration*

National Resource Council (NRC). 1996. *National science education standards*. Washington, DC: National Academies Press.

Save the Tree Committee. n.d. Inspiration Oak vital statistics (handout provided at Inspiration Oak Park).

Save the Tree Committee. n.d. Answers to frequently asked questions (handout provided at Inspiration Oak Park).

REMEMBER YOUR CODES

! This is important.
✓ I knew that.
X This is different from what I thought.
? I don't understand.

The Case of the Tree Hit Man

The assassin crept across the lawn in the dead of night. He worked quietly and efficiently. There were only a few hours until morning, and his work would need to be completed by the time the sun came up. He had been hired to kill one of Magnolia Springs' oldest and most respected residents: a 500-year-old oak tree.

The tree, named Inspiration Oak, had been growing since before the time of Christopher Columbus. It had survived the birth of the small town and the invention of the automobile. By 1990, it stood 65 feet tall, with a trunk that was almost 30 feet in diameter.

The owner of the land had decided to chop down the tree and build a gas station. The people of Magnolia Springs loved that tree, so county officials denied the permit for a gas station and collected money to buy the land instead.

The owner's plans were foiled, and all because of that tree. But what if something happened to the tree? The owner got on the phone and called a hit man.

It's not easy to kill a big tree in a hurry. Chopping it down would take time and be noisy. Neighbors would be sure to notice. Poison might work, but it would take massive amounts of poison and could take years to finish the job. But the tree hit man had a plan because he knew how trees were organized.

What the Hit Man Knew

Trees, like most plants, have three main parts: the roots, leaves, and stem. The roots hold the tree firmly in the ground so that even a strong wind will not knock it over. They grow deep into the soil and can stretch for hundreds of feet in all directions. As shown in Figure 1, the root network is as big as the trunk and the branches combined. Trees need this vast network of roots to absorb water and minerals for growth.

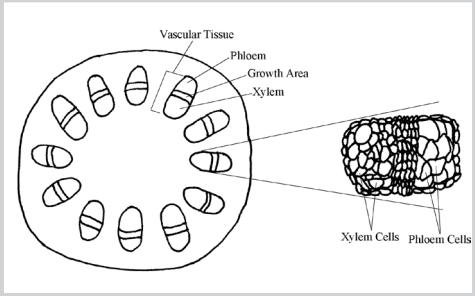
At the other end of a tree, you find the leaves. Leaves make food for the plant in a process called *photosynthesis*. The leaves get carbon dioxide from the air and water from the roots. Then they use energy from sunlight to convert the water and carbon dioxide into sugars.

The stem, or tree trunk, holds the leaves high in the air so they can get enough sunlight. The trunk also connects the roots and leaves. Inside the trunk, tubes carry water and minerals from the roots up to the

Figure 1. Tree Roots

Roots make up about half of the total size of a tree.

Figure 2. One Way That Vascular Bundles Can Be Arranged in a Stem



leaves. Another set of tubes carries sugars from the leaves to the roots.

These tubes are made of specialized plant cells that connect end to end. The cells that carry water up are called *xylem*. The cells that carry sugar down are called *phloem*. Together, the xylem and phloem are called the *vascular tissue*. Vascular tissue carries water and sugars throughout the roots, leaves, and stems.

In most plants, xylem and phloem are found in bundles throughout the stem. But in trees, the xylem grows in the center of the trunk and all of the phloem lie just below the bark on the outside.

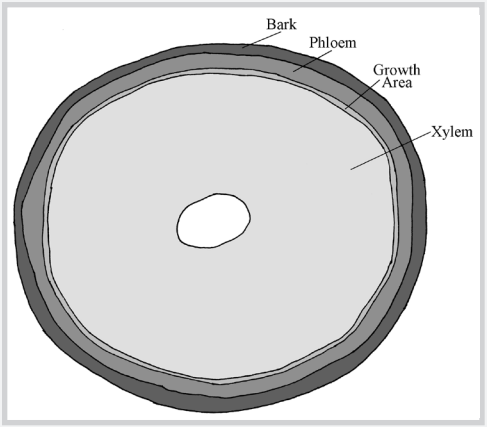
Quick and Dirty Business

The hit man worked quickly to chisel into the tree. He made a perfect ring, six inches wide and six inches deep. With each cut, he removed the bark and the phloem layer. Thick, sticky liquid oozed from the wounds. Soon the tree had no way to get sugar from its leaves to its roots. It was only a matter of time until the root cells died of starvation.

In the morning, the townspeople were horrified. They brought in tree experts from around the country, who built an elaborate intensive care unit to try to reconnect the phloem tubes. But it was too late. The tree could not be saved.

No charges were ever brought in the case of the tree hit man, but the town of Magnolia Springs came together in its effort to save the tree. They went through with their plans to buy the land and build a park. It is a beautiful, quiet picnic spot that is marked with the giant stump of Inspiration Oak.

Figure 3. Xylem and Phloem in a Tree Trunk



THE BIG QUESTION

How do water and food (sugars) move through a plant?

Plant Police Academy

A terrible crime has occurred. In a few days, you will learn more about it. But first, you need to come to plant police academy to find out more about plants.

Part 1: Which part of a plant absorbs water: roots or leaves? (mini-experiment)

Draw a diagram of your two experimental groups.

Prediction
If roots absorb water, this plant will (circle one): wilt not wilt.

If leaves absorb water, this plant will (circle one): wilt not wilt.

Results: Did the plant wilt? _____

Prediction
If roots absorb water, this plant will (circle one): wilt not wilt.

If leaves absorb water, this plant will (circle one): wilt not wilt.

Results: Did the plant wilt? _____

Claims and Evidence: Which part of the plant absorbs water? What evidence do you have from your experiment?

Part 2: Water Movement in the Stem of a Plant

Fill a cup halfway with water and add 8 to 10 drops of food coloring. Get a stalk of celery from your teacher. Cut about 2 cm from the bottom and top of the celery stalk to get rid of any dried parts. Then place the stalk in the colored water, leaf side up. Let it sit in the water for at least an hour.

a. What happened to the celery?

b. Based on these results, does water move up or down the stem of the celery plant?

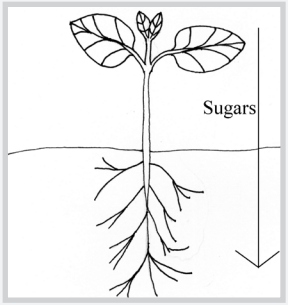
c. Chop the celery stalk in half and look at the inside with a hand lens.

Draw what you see here, and label the areas where you can see food coloring.

d. Did the water move everywhere in the celery, or just in certain places?

Part 3: How Water and Sugars Move in a Plant

Sugar is made in the leaves of a plant and then travels to all the cells of the plant. In the diagram to the right, the arrow shows the direction that sugar moves.

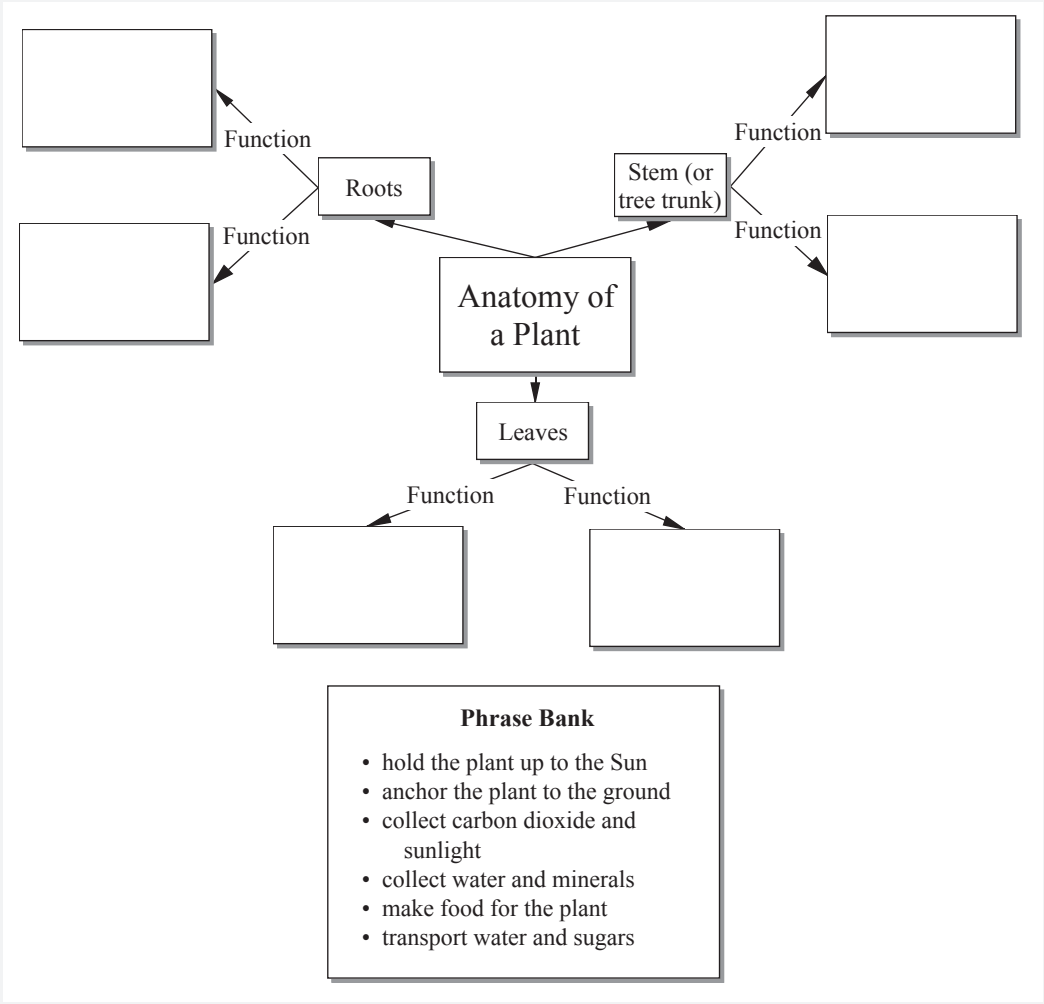


Draw a second arrow to show the direction that water moves in the plant.

Think about the direction of your arrows. Can food and water move in the same tubes inside the plant stem? Why or why not?

Congratulations! You have completed the Plant Police Academy. Now it is time to find out more about the Case of the Tree Hit Man.

Structure and Function in Plants



Phrase Bank

- hold the plant up to the Sun
- anchor the plant to the ground
- collect carbon dioxide and sunlight
- collect water and minerals
- make food for the plant
- transport water and sugars

Index

*Page numbers in **boldface** type refer to tables or figures.*

Index