

Walch Hands-on Science Series



Plants

by Joel Beller and Carl Raab

illustrated by Lloyd Birmingham

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Which Trees Are Allelopathic?

TEACHER RESOURCE PAGE

INSTRUCTIONAL OBJECTIVES

Students will be able to

- germinate seeds in petri dishes.
- draw conclusions based upon observations.
- compare and contrast germination rates.
- use a mortar and pestle.
- state and test hypotheses related to allelopathy.

NATIONAL SCIENCE STANDARDS ADDRESSED

Students demonstrate an understanding of

- competition of organisms in an ecosystem.
- behavioral responses.
- big ideas and unifying concepts, such as cause and effect.

Students demonstrate scientific inquiry and problem-solving skills by

- identifying a problem and evaluating the outcomes of the investigation.
- working individually and in teams to collect and share information and ideas.
- controlling variables in an experimental research setting.

Students demonstrate competence with the tools and technologies of science by

- using tools to observe phenomena.

Students demonstrate scientific competence by

- completing a controlled experiment.

MATERIALS

- Field guide to local trees
- Sealable plastic bags
- Labels
- Pen or pencil
- Water
- Mortar and pestle
- Plain white paper towels
- Petri dishes
- Scissors
- Medicine dropper
- Cabbage seeds
- Marking crayon
- Hand lens



HELPFUL HINTS AND DISCUSSION

Time frame: Two weeks

Structure: Individuals or cooperative learning groups

Location: In class and in the field

In this activity, students conduct an investigation of allelopathy (direct or indirect harmful effects of one plant upon another caused by chemical compounds the plant secretes into the environment). Specifically, they will study how trees produce harmful chemicals that prevent competition from other plants.

Emphasize that the paper in the petri dishes should be kept consistently moist with the various mixtures of leaves and water. Germinating seeds should not be chilled but kept at room temperature.

ADAPTATIONS FOR HIGH AND LOW ACHIEVERS

High Achievers: Have these students carry out all follow-up investigations. They should also help the low achievers use the field guide to identify trees.

Low Achievers: Encourage these students to work in cooperative learning groups. They may need help in distinguishing which seeds have germinated. They also should be shown how to use the field guide to identify particular trees.

SCORING RUBRIC

Full credit should be given to students who record their observations accurately on the data table and who answer the Analysis questions correctly. Extra credit should be given to students who complete the follow-up activities.

INTERNET TIE-INS

<http://www.umbc7.umbc.edu/~farabaug/transport.html>

<http://www.tau.ac.il/botany/USR/aloni/>

<http://www.muohio.edu/dragonfly/hi/two.htmix>

QUIZ

Why do few, if any, plants grow under pine trees?

Which Trees Are Allelopathic?

STUDENT ACTIVITY PAGE

BEFORE YOU BEGIN

Some trees give off chemicals that prevent other plants from growing near them. This process is called *allelopathy*. Decomposing pine tree needles produce an acid that is absorbed into the soil. This makes the soil too acidic for other seedlings to grow. If you see a tree that has very few or no plants growing under its canopy of leaves, there is a good chance that that tree is allelopathic. Walk around your neighborhood or a park and look for trees that fit this description. In this activity, you are going to search your neighborhood to determine whether there are any allelopathic trees in the area.

MATERIALS

- Field guide to local trees
- Sealable plastic bags
- Labels
- Pen or pencil
- Water
- Mortar and pestle
- Plain white paper towels
- Petri dishes
- Scissors
- Medicine dropper
- Cabbage seeds
- Marking crayon
- Hand lens

PROCEDURE

1. Take a tour of your neighborhood or a nearby park. Take your field guide along with you as well as plastic bags, labels, and a writing implement. Search for trees that have little or no undergrowth (plants growing under the tree). Black pine and Japanese pine trees are good choices.
2. Use your field guide to identify the trees. Write the tree's name on the plastic bag, or insert a label in the bag. Collect three healthy leaves from the tree. In the case of a pine tree, collect a dozen green needles. Place them in the labeled plastic bag.
3. Continue to identify trees and collect leaves until you have three or four plastic bags with leaves from different trees.
4. Keep the bags in the refrigerator until you take them to school.
5. In school, take the leaves from one of the trees and place them with a little water in a mortar. Grind them thoroughly with the pestle.
6. Pour the mixture (there should be more plant material than water) back into its plastic bag. Add some more water—no more than 50 drops. Mix well.
7. Fold a paper towel in half, then in half again. Place the folded towel on a tabletop. Place the bottom half of a petri dish on the folded towel. With a pencil, trace around the outside of the petri dish. Use the scissors to cut out the circle.
8. Put all four paper circles inside the bottom half of the petri dish.
9. Using a medicine dropper, saturate the paper circles in the petri dish with the leaf-water mixture you have prepared. If there is a small amount of excess fluid, keep it to replace any that evaporates.

(continued)



Which Trees Are Allelopathic? (continued) STUDENT ACTIVITY PAGE

10. Next, sprinkle 25 cabbage seeds onto the moist paper. Replace the cover on the petri dish. On the cover, write the name of the tree that the leaves in the mixture came from. Put this petri dish in a warm place for three days. Examine it daily for seven days with the hand lens. Look for signs of cabbage seed germination. If necessary, add more of the leaf-water mixture. Enter your data on the table in the Data Collection and Analysis section.
11. Repeat steps 7 through 10 for each plastic bag of leaves you have collected.
12. As a control, prepare a petri dish with paper circles as before, but add only pure water. Sprinkle 25 cabbage seeds on top of the water-soaked paper circles. Place the control dish in a warm place for three days. Examine it daily for seed germination for seven days. Enter the data in the table below.

DATA COLLECTION AND ANALYSIS

Number of Seeds Germinated

Day	Tree _____ Number of Cabbage Seeds Germinated	Tree _____ Number of Cabbage Seeds Germinated	Tree _____ Number of Cabbage Seeds Germinated	Control Number of Cabbage Seeds Germinated
3				
4				
5				
6				
7				
8				
9				
10				

1. Which trees were allelopathic? _____
2. Which trees were not allelopathic? _____
3. Why was a control important for carrying out this activity? _____

(continued)

Which Trees Are Allelopathic? *(continued)*

STUDENT ACTIVITY PAGE

CONCLUDING QUESTIONS

1. What evidence do you have to support your answers to questions 1 and 2? _____

2. Why are cabbage seeds a better choice for this activity than lettuce seeds, which germinate in only two days? _____

FOLLOW-UP ACTIVITIES

1. Repeat this investigation using seeds other than cabbage. Are your observations and conclusions the same?
2. Use pH paper to determine the acidity of decomposing pine needles. Then repeat this experiment by merely soaking the paper circles with acid that has the same pH as decomposing pine needles.
3. Coffee beans contain an allelopathic chemical. Design and carry out an experiment to test its effect upon a vegetable seed of your choice.
4. Could decomposing pine needles be used to replace dangerous herbicides that destroy weeds? Explain your reasoning.

