**Activity: Allelopathy and Plants: Trees**

**Objectives:**

Learn the concept of allelopathy

• Demonstrate the significance of **plant** volatiles

• Recognize **plants** as a source of medicinal and other bioactive compounds

• Practice the principles of experimental design, using a control

Prepare a technical report with data collection,

**Introduction**

Adapted from: An Aromatic Adventure with Allelopathy: Using Garlic To Study Allelopathy in the Classroom. By: Shimabukuro, Mary A., Haberman, Vickie, American Biology Teacher, 00027685, Apr2006, Vol. 68, Issue 4

Allelopathy is defined as any direct or indirect harmful or beneficial effect of one **plant** (including the microbes) on another through production of compounds that escape into the environment. The most common usage of the term refers to the detrimental effect of one **plant** on another.

Allelopathic compounds can be released from **plants** in various ways including decomposition of **plant** residues, root exudation, leaching, and volatile emissions. Allelochemicals may assist **plants** by reducing competition from neighboring **plants** and providing protection from predators and pathogens. Often these chemicals inhibit seed germination and root growth of young neighboring **plants** with less effect on mature **plants** (Shimabukuro 2006).

Allelopathy is a complicated phenomenon. Reduced **plant** growth observed in many claims of allelopathy could be due to **plant** competition for water, mineral nutrients, carbon dioxide or root zone oxygen. Other factors could include pH changes or an altered osmotic potential of the soil as **plant** residues decompose. In addition, undecomposed **plant** material in soil may stunt **plant** growth due to immobilization of nitrogen.

For these reasons, much of our understanding of allelopathy comes from studies that rely on bioassays. A **bioassay** is defined as the determination of the relative potency of a substance by comparing its effect on a group of test organisms or cells using appropriate controls" (Shimabukuro, 2006).

However, allelopathy studies using bioassays are criticized because they do not approximate the conditions in natural ecosystems (Singh et al., 2001). Many of the problems described can be overcome by using a volatile allelopathic agent (airborne communication) such as garlic, or perhaps other volatiles that come from trees.

[Questions & Experiments](http://web.ebscohost.com/ehost/detail?hid=11&sid=07e7e521-3968-49a5-bb03-299126b87df3%40sessionmgr11&vid=10&bdata=JnNpdGU9ZWhvc3QtbGl2ZQ%3d%3d" \l "toc" \o "Questions & Suggested Experiments  )

Do volatiles from crushed **tree** needles inhibit seed germination & subsequent seedling growth?

[Materials](http://web.ebscohost.com/ehost/detail?hid=11&sid=07e7e521-3968-49a5-bb03-299126b87df3%40sessionmgr11&vid=10&bdata=JnNpdGU9ZWhvc3QtbGl2ZQ%3d%3d#toc)

• A sealed seed germination set-up consisting of:

 40, 9 cm petri dishes, each containing two pieces of Whatman #1 filter paper that will be moistened with 3 ml of distilled water and sealed with masking tape (after the plants are placed in them). Each of the 6 tables will have 6 petri dishes with two pieces of filter paper per petri dish

• Experimental seeds from a lettuce (Lactuca sativa L. cv. Black Seeded Simpson) seeds (25 seeds in each of the 6 petri dishes, so 200 lettuce seeds total).

• P**lant** materials listed below:

1. Douglas-fir needles (*Pseudotsuga menzeissi*) L.) 2) Ponderosa Pine needles (*Pinus ponderosa*), 3) Incense Cedar (*Libocedrus decurrens*), 4) Western Red Cedar 6) 25 lettuce seeds only as control

• Weigh boats

• 6 graters and 6 mortar and pestels

• Triple beam balance

* 6, Graduated cylinders to measure 3 ml of distilled water
* Distilled water
* Masking tape and grease pencils or sharpies to mark petri dishes
* Incubator
* 12, Mm rulers
* 6 Cutting board and knives
* 6 ph Vernier probes

**[Procedure](http://web.ebscohost.com/ehost/detail?hid=11&sid=07e7e521-3968-49a5-bb03-299126b87df3%40sessionmgr11&vid=10&bdata=JnNpdGU9ZWhvc3QtbGl2ZQ%3d%3d" \l "toc" \o "Procedure  )  Part 1 (Each table will do the following) Have fun!:**

1. Crush the **plant** material from all of the trees provided, listed above, with a grater or mortar and pestel.
2. Weigh 1.0 g samples of each crushed trees on a triple beam balance using the weigh boats.
3. Place the crushed **tree** materials in separate petri dishes, **each** containing 2 pieces of Whatman #1 filter paper, and 25 lettuce seeds. The sixth petri dish will contain only the lettuce seeds and the filter paper. This will be the control. Use the little scooper and white paper to count lettuce seeds on. They are small and hard to count.
4. Add **3 m**l of water, record the ph and seal the dishes with masking tape, label on the bottom part of the dish with your team name, date, and contents of the dish, and place back on the cart in your tub to be incubated for three days under classroom conditions. Make sure you label the bottom of the dishes. Place masking tape on edges of petri dishes.
5. The petri dishes per table should contain the following: dish 1: Douglas-fir and lettuce seeds; dish 2: Ponderosa Pine and lettuce seeds; dish 3: Incense and lettuce seeds; dish 4 Western Juniper and lettuce seeds dish 5: Just lettuce seeds

**Procedure Part 2**

1. At the start of the next class, measure lettuce seedling length and ph of each dish. A length of zero may be recorded for seeds that do not germinate.
2. Prepare a report as follows (team graphs and tables, but individual reports)

**Report (to be completed during the next class with your team):**

Create a table and graph of your results. Label this and give it a title. Explain what your results mean in at least a page. The table should include the length of lettuce seeds in each of the 7 petri dishes. You can also include labeled sketches of the petri dishes, or ones you produce using a computer program.

 Also discuss what the strengths and weaknesses of this study

 What you learned about allelopathy and plant volatiles

 **Folklore and cultural uses** of one of the trees from your research

 Why a control was necessary and what the control demonstrated

 How you might apply this knowledge to landscaping or to your life

 3 references in APA format (see our LCC library website for how to do that)

 Title for your Table (be specific) \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

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| --- | --- | --- | --- | --- | --- |
| **Petri Dish Number or Name** | **Species in Dish or Control** | **Ph before** | **Ph after** | **# lettuce seeds germinated** | **Length of lettuce seeds that did germinate in mm** |
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