

Determining the Effects of Substances on Plants

Annotation

What materials in the environment have an effect on seed germination in plants? In this lab, students will discuss/research the pollutants that may be present in their area and choose one to bioassay on seed germination. After choosing a pollutant and having the instructor approve it, they will design an experiment to test its effects on your seeds.

Problem

What materials in the environment have an effect on seed germination in plants?

Primary learning Outcomes

At the end of this lesson, students will be able to:

- Design and carry out an experiment to test a hypothesis
- Collect data and display it in a meaningful way
- Interpret data, draw conclusions and determine follow up experiments that may be warranted.

Assessed GPS

Characteristics of Science

Habits of Mind:

SCSh2, SCSh3, SCSh4, SCSh4, SCSh5, SCSh6

Content:

SB4

Assessed Qcc's

Science, Technology and Society: 1, 3, 4.3, 5.5, 7.1

General Agriculture: 106, 117, 118, 121

Ag Environmental Science: 159, 421

Horticulture: 106, 117, 118, 121

Duration

50 minutes day one

15 to 20 minutes for the next 3days

Materials and Equipment (per group)

14 Fast plants seeds

water

permanent marker

7 clear film canisters

one 1-lb. cottage cheese container

7 wicks of absorbent fabric (1.5cm wide & 6cm long) Pellon a good type

10% solution of some environmental “pollutant” (or other concentrations)

graph paper, pencil, data collection tables

Background

Determining the effects of substances in the environment on living organisms in the environment is accomplished by bioassay. A substance found in the environment is tested at several concentrations with living organisms to determine what concentrations are beneficial or harmful to living things.

A standard measure of toxicity in organisms is LD50. **LD50** is the lethal dose of a given substance that will cause death of 50% of the population being tested. LD50 values are normally expressed as milligrams of chemical per kilogram of body weight. This means that the lower the LD50 for a given substance the more toxic it is.

At times there are visible or measurable symptoms of toxicity at levels of concentration that are below the lethal dose. In the environment, organisms that are sensitive to a particular substance can be used to determine the presence or absence of a given substance in the environment. These organisms are called **indicator species**. The environmental Protection Agency has begun to test the effects of certain chemicals on plants. A simple bioassay technique is to look at the effects of a “pollutant” on seed germination.

In this lab you will discuss/research the pollutants that may be present in your area and choose one to bioassay on seed germination. After choosing a pollutant and having your instructor approve it, you will design an experiment to test its effects on your seeds.

You will be making a series of dilutions of whatever pollutant you decide to use to determine the toxicity at different concentrations. This is done by starting with the most concentrated solution and diluting it over and over again to get $\frac{1}{2}$, $\frac{1}{4}$, $\frac{1}{8}$, $\frac{1}{16}$, and $\frac{1}{32}$ concentrations of the original solution.

You must include in your design your experimental set up and data collection tables you will use. You will also need to explain how you plan to display the results of your experiment when you have analyzed your data. A possible experimental design is enclosed. You may use it, but you must modify it to fit your particular situation. Modifications must be approved by your instructor before beginning the experiment so that you will not run into problems that may cause you to have to begin again.

Procedure:

1. Mark 7 film cans at the half full line with a permanent marker. Label one can “water” as a control. Label the other six cans with the concentrations of “pollutant” you plan to test. For example, if you plan to test a 50% solution of the chemical as your strongest dose you would mark your canisters with 50%, 25%, 12.5%, 6.25%, 3.13%, and 1, 56%.
2. Fill the water can with water to the fill mark and place the wick in the water by pushing the wick down the side of the can with a pencil.

3. Make a second mark on the six remaining can half-way between the first mark and the bottom of the can. Mark each can with the concentrations of “pollutant” you plan to test. (See # 1 above)
4. Make a solution of your “pollutant at the most concentrated amount you plan to use (about 100mls of solution should be plenty).
5. Fill the container marked with the greatest concentration of chemical to the full mark you made earlier. Pour half of the liquid into the can marked with the 2nd concentration. The first container with full strength solution can be set aside. Fill the second concentration can to the full mark with water.
6. Repeat step 5 pouring the half of the second container into the third and so on until all have half the concentration of solution of the one preceding it.
7. Insert wicks into all containers as done in step 2 above. Place two seeds at the top of each wick in all 7 cans.
8. Place the cans inside the cottage cheese container and secure the lid on the container. Place a piece of tape with your names, the date and the name of your pollutant on it.
9. Observe and take notes on your observations for the next 5 days.

Tips and Suggestions

- Get your film canisters from Wal-mart, K-mart or some other local film developing store. They are free.
- Pellon can be found in fabric stores. It must be washed prior to use to get processing chemicals out.
- Use small jars such as baby food jars with lid and more seeds could be used per rep – as many as 10.

Source of this Lab: Bioassays With Fast Plants. Wisconsin Fast Plants, University of Wisconsin-Madison, College of Agricultural and Life Sciences Dept. of Plant Pathology, 1630 Linden Drive, Madison, WI 53706