Instructor Notes

How Toxic Is It?

Participants expose Wisconsin Fast Plants™ seeds to toxic solutions of increasing concentrations to develop a better understanding of toxicity. The activity covers a wide range of topics, including the scientific method and seed germination. Participants also sharpen writing, graphing, and metric measuring skills.

➤ *The activity is written for workshop participants and may need modification for classroom use.*

Suggested Background Reading

- An Introduction to Toxicology

National Science Education Standards for Grades 5–12

Science as Inquiry

- Abilities Necessary to Do Scientific Inquiry
  Identify questions and concepts that guide scientific investigations. Students formulate a testable hypothesis for a toxicity investigation to demonstrate conceptual understanding of scientific investigations.

  Conduct scientific investigations. Students expose Wisconsin Fast Plants seeds to toxic household substances of various concentrations to determine the relative toxicity of these substances.

  Use mathematics to improve investigations and communications. Students measure seed germination, record and graph data, and calculate the lethal dose of each toxic substance.

- Understanding about Scientific Inquiry
  Mathematics is essential in scientific inquiry. Students use mathematical tools like metric rulers, graphs, and formulas to gather data, construct explanations, and communicate results.

Science in Personal and Social Perspectives

- Natural and Human-Induced Hazards
  Natural and human-induced hazards present the need for humans to assess potential danger and risk. Students learn that cleaners, fertilizers, and pesticides offer benefits to society, but also cause health and environmental risks.

Safety

As the instructor, you are expected to provide participants with the necessary safety equipment (including personal protective equipment such as goggles, gloves, aprons, etc.) and appropriate safety instruction to allow them to work safely in the laboratory. Always follow local, state, and school policies. Read and follow all precautions on labels and MSDSs provided by the manufacturer for all chemicals used.

Read labels and follow directions for use of household and garden products. Do NOT allow any of the test chemicals or their solutions to mix with each other—very dangerous, highly toxic materials can result. For example, highly toxic Cl_2 gas is formed when mixing ammonia-based products with chlorine-based products such as bleach.

Materials

Per student

- waterproof marker
- 11 microcentrifuge tubes with caps
- disposable pipet
- solutions of different household or garden supply test substances such as bleach, household ammonia, household cleaners, table salt, Epsom salt, urea, fertilizers, or pesticides
- dropper bottle of distilled water
- filter paper
- scissors
- forceps
- 2-inch x 10-inch piece of Styrofoam®, 1-inch thick
- transparent metric ruler
- 22 RCBr seeds (Wisconsin Fast Plants)
  Wisconsin Fast Plants seeds are available from Carolina Biological Supply Company, 2700 York Road, Burlington, NC 27215; 800/334-5551.

Procedure Notes and Outcomes

The entire class can use the same substance or each participant can test a different substance. Have participants record the initial concentration of their test solution, if known. Otherwise, refer to the concentration as "straight" if used from the original bottle without dilution. Solutions that are diluted with water can be referred to as, for example, 1:1 or 1:2 dilutions.

Participants set up the experiment as described in the Procedure. The next day, or over a two-day period, participants measure any growth of their seeds. Participants then record and graph the data to determine the lethal dose of the test substance.

Answers to the questions will vary based on participants' opinions and experience.

Activity Instructions

How Toxic Is It?

In this activity, you will test the toxicity of a household substance by measuring the effects of varying concentrations on the germination of Wisconsin Fast Plants seeds.

Safety

In a laboratory setting, you are ultimately responsible for your own safety and for the safety of those around you. It is your responsibility to specifically follow the standard operating procedures (SOPs) which apply to you, including all local, state, and national guidelines on safe handling, storage, and disposal of all chemicals and equipment you may use in the labs. This includes determining and using the appropriate personal protective equipment (e.g., goggles, gloves, apron). If you are at any time unsure about an SOP or other regulation, check with the course instructor.

Procedure

1. Using the waterproof marker, label the caps and the sides of the microcentrifuge tubes to indicate the various test concentrations. Use "100," "90," "80," "70," "60," "50," "40," "30," "20," "10," and "0" to represent the percentage of test solution in each tube. The tube labeled "0" has no test solution and is therefore considered to be the control.
2. Prepare each of the microcentrifuge tubes using your test solution and distilled water according to the following table.

Prepare the Tubes		
Label	Test Solution	Distilled Water
100	10 drops	0 drops
90	9 drops	1 drop
80	8 drops	2 drops
70	7 drops	3 drops
60	6 drops	4 drops
50	5 drops	5 drops
40	4 drops	6 drops
30	3 drops	7 drops
20	2 drops	8 drops
10	1 drop	9 drops
0	0 drops	10 drops

3. Cut a filter paper "wick" approximately the same size as the microcentrifuge tube. Place this wick into the tube labeled "100." The purpose of the wick is to soak up the water and keep the seeds damp but not so wet they drown while inside the tubes. Push the wick down so it forms a flat place for the seeds to rest above the level of any remaining liquid in the tube.
4. Cut and place wicks in all the other microcentrifuge tubes by following the procedure in step 3.
5. With the forceps, carefully place two seeds near the top, flattened part of each wick in each tube. Do not let the seeds fall off the wick and into the solutions where they could drown. Close the caps to the microcentrifuge tubes.
6. Carefully insert the narrow end of each microcentrifuge tube into the Styrofoam. Push the microcentrifuge tubes down into the foam far enough so they stand upright.
7. Label the block of Styrofoam with your name and the name of your test substance and place it where instructed by the teacher.
8. Formulate a hypothesis for this experiment.
9. After one or two days, indicate the extent of germination by measuring and recording each seed's length of growth in millimeters. A seed that did not germinate has a length of 0 millimeters. Record your results in the data table.

Data Table

Tube	Seed One Length	Seed Two Length
100		
90		
80		
70		
60		
50		
40		
30		
20		
10		
0		

Questions

1. Using your data table, graph the results by showing seed germination length at each concentration.
2. Make a conclusion regarding the effects of your test substance on RCBr seed germination. Based on your findings, what is the lethal dose of the test substance?
3. Does your conclusion allow you to support or reject your hypothesis?