LESSON 43

Getting Control of the Weed Problem

Grade level: 6-8
Subject Areas: Life science
Duration: Several sessions as a class, plus up to 8 weeks for experiments
Setting: Indoors/Outdoors
Season: Fall, Spring
Conceptual Framework Topics: Integrated weed management, weed control, plant ecology, plant life cycle

OBJECTIVES

The students will: know how plants reproduce; be able to explain chemical, mechanical, fire and biological weed control methods; be able to design and conduct an experiment to simulate a weed control method; understand the problem with applying only one control method; and be able to explain what is meant by Integrated Weed Management.

METHOD

Students investigate weed control methods through individual or small group experiments.

MATERIALS

- ✎ A variety of living invasive plants and/or their seeds from schoolyard or local area.
- ✎ A plant that regenerates vegetatively and planting materials (see ***Procedure*** for details)
- ✎ A set-up with grow lights, small greenhouse, or sunny south-facing window location.
- ✎ kNOweeds Journal or a notebook for recording information.
- ✎ Copies of the following forms which are included in this lesson:
  - **Teacher's Outline for a Student Inquiry**
  - **Design-An-Experiment Form**
  - **Creating a Record of Your Weed Control Experiment**

Students will be designing their own experiments, so the materials they will use will vary. Complete materials and procedures outlines are important to experimental design and should be approved by the teacher.

BACKGROUND

The need to control weeds persists unless restoration of a healthy environment also becomes part of the solution. Pulling weeds may slow their spread, but it does not alter the conditions that first favored the invasion. Non-native weed species have the advantage of few natural enemies and an ability to persist in a wide range of habitat and environmental conditions. For these reasons, it is rare that a single method of control is effective. Land managers have a variety of means for controlling invasive weeds – chemical, biological, mechanical and fire. In this activity, students will become familiar with the process of experimental design as they create innovative solutions to controlling invasive weed species. Land managers often use a combination of several methods. Many questions remain about how best to control weeds, and there are probably as many solutions as invasive plants have adaptations to thwart our efforts. Students

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will have the opportunity to explore and invent some possible solutions… who knows, maybe some of them will create solutions which will be adopted by land managers, and thus turn their education into a meaningful contribution as citizen scientists.

In this activity students will perform basic research on what is currently known about the invasive weed of their choice, and then design a hypothesis and experiment that will allow them to investigate their own ideas. The activity begins with an "I wonder…" statement; for example, "If cheatgrass isn't killed by a forest fire, I wonder if freezing it would work?" You can allow ideas as broad and as wild as students can create, as long as consideration is given to safety and what resources are readily available.

After the "I wonder…" statement the students should be guided through the **Experiment Design Form**. Doing research on the question is often helpful in refining the question. The *independent variable* (the thing being manipulated, e.g. temperature), the *dependent variable* (the thing you believe will respond to the independent variable, e.g. germination rate), the *controlled variables* (those things you hold constant, e.g. humidity) and the *control* (the "normal" situation without manipulating variables so you have something to compare your results against) are part of the experiment design. Students must do a certain amount of research before they can start imagining the variables. The more refined their question, the easier it will be to determine, and limit, the variables. The fewer the variables in an experiment, the less chance for error, and the more reliable the data.

PROCEDURE

1. Obtain a plant for a class demonstration. Select a plant that naturally regenerates from rhizomes, stem sections and tap roots. Canada thistle, bindweed, or leafy spurge are some weeds that may be locally available, or you can use a house plant such as a geranium for demonstration purposes. Make sure the plant is alive and planted in a garden pot, displayed prominently at the beginning of class. Hidden from view, have a tray of moist potting soil that has been "spiked" with a small amount of fertilizer and rooting hormone. Ask your students for suggestions on how you might kill the plant and list their (appropriate) suggestions on the board. After making the list, jerk the plant out of the pot and ask how many of the students think you just killed the plant. Break a few limbs off and tear up some leaves. Do any students think it is dead yet? Pull out some scissors and snip the limbs and roots into 2-3" sections and ask the students if they think the plant is dead. At this point pull out the tray of soil, bury all the plant parts about ½" deep, mist the surface thoroughly with

water, and as you walk it over to the growing station remark, "Well, it might look dead, but I sure don't think it's dead." (In a few days, after maintaining moisture and 24 hours a day of light, you should have new sprouts from the segments of the original plant).

2. The students will design an experiment to "kill" an invasive weed species. Some suggested ways to kill a weed might be:

- Applying chemical treatment (herbicides, fungicides or pesticides)
- Simulate a wildfire
- Mechanical destruction (chopping, grinding, etc.)
- Defoliation
- Biological control
- Grazing (have a pet goat at school!)
- Compost or bury
- Cover (e.g. black plastic)
- Other?

Live plants may be transplanted from the field or started from seed, depending upon availability and time constraints. Students should record important information concerning their plant in their journals or notebook, including:

- Species name
- Date collected or planted
- Drawings of their plant
- Identification of plant parts
- Measurement of plant
- Other observations while caring for them pre-experiment

While caring for their plants the students should be conducting research about their plant and the control methods they are planning to investigate. Assist them with filling out the Experiment Design Form. Once they have most of the elements decided, they should begin writing a detailed procedure for their experiment. It is difficult for them to do this because they need to visualize an entire process that they have not yet done and are only just inventing. Explain that scientists are continually changing or modifying their procedures.

Approve their materials list and procedural outline before allowing them to begin. The first few days will be spent gathering materials and creating their set-up. Once their experiments are up and running the time spent to monitor them is reduced. Students should be encouraged to come immediately to class, collect data, and care for their plants; 10-15 minutes is usually enough. They are 100%

responsible for all aspects of their experiment – caring for the plants, collecting and recording data, updating their journal, modifying procedures, adding to their research paper, designing data collection forms, and thinking ahead to the presentation of their findings to the "scientific community" (their peers).

3. Compare the weed control experiments as a class and discuss the effectiveness of the methods chosen for killing weeds, and discuss how methods can be combined to increase the effectiveness of weed control, also know as integrated weed management or IPM (integrated pest management). Discuss how additional experiments could be designed to study the effectiveness of combined methods of weed control.

RESOURCES

U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory (2003, June).
Fire Effects Information System (FEIS)
http://www.fs.fed.us/database/feis/

U.S. Department of Agriculture,
National Plant Data Center
http://plants.usda.gov/

TEACHER'S OUTLINE FOR STUDENT INQUIRY

Step 1: The Research Question (1 session)
1. Have the students write an "I wonder…" statement of some control method that would be effective for the invasive weed species they have selected.

2. Group the "I wonder…" questions into similar themes based upon control methods (chemical, biological, mechanical, fire or other).

3. Create scientific teams based upon the various themes and provide each team with an experiment that addresses each theme (or alternatively, students may work individually).

Step 2: Experimental Design (1 session)
Have the scientific teams identify the following elements for their experiment:
1. Independent and dependent variables
2. Controls
3. Hypothesis
4. Data Collection

Step 3: Review of the Literature (3 to 5 sessions plus homework)
Have the students conduct a review of the literature to find out what has been published about their particular topic, and prepare a report. Students will include copies of the sources of their information (not a reference list, but the actual articles… this will assist you with assessing their reports to help them with the difference between peer-reviewed scientific literature and conjecture, as well as plagiarism and paraphrasing).

Step 4: Conduct the Experiment
(6-8 weeks, 10-15 minutes/day to record data)
Students will assemble the materials and supplies for their experiment, provide a detailed procedure for the experiment, conduct the experiment, and design a data collection process.

Step 5: Reporting
Research details, procedures refinements, etc. should be updated regularly. Students will write a "scientific paper" to report the results of their experiment to the "scientific community" (the class) and provide a summary in an oral presentation. The scientific paper will include:
1. A title page with the name of the project, your name, and date

2. What you learned from the research

3. Copies of the resources you used

4. A description of the experiment you conducted, including independent and dependent variables, the control, problems with the experiment (sources of error), and the hypothesis you were testing.

5. An interpretation of the data collected from your experiment, including:
   a. how you collected the data
   b. a display of the data (charts, transparencies, etc.)
   c. what the data tells you
   d. whether or not your hypothesis was supported

6. Implications of the experiment (new questions that came up, how the information found can be used)

7. Any photos or drawings that help illustrate what you did

Name _____ **Date** _____

Design an Experiment

Research Topic (describe in as much detail as possible):

1. Identify the independent (manipulated) variable: _____

2. Identify the dependent (responding) variable: _____

3. Come up with a research question: _____

   _____

4. State your hypothesis: _____

   _____

5. Describe the materials you will need to do the experiment:

6. On the back of this form, or a separate sheet of paper, write a procedure to test your hypothesis. Remember to include safety considerations and details of set-up.

7. Identify your control:

8. Describe the variables that you will hold constant:

9. On a separate sheet of paper, design a data table to collect and display your results:

10. What kind of graph or chart will you use to present your data?

11. Be ready to graph your data on graph paper. Include a title, labels, and units for the vertical and horizontal axis.

12. Describe the results of your experiment. Did it answer your question? Did it support or disprove your hypothesis? Do you need to re-design the experiment and try again?

Name _____ **Area of Research** _____

Creating a Record of Your Weed Control Experiment

Check off each component of your experiment as it is completed.

_____ "I wonder…" question.

_____ A report of the research including:

1. A title page with the name of the project, your name, and date
2. A summary of the science you learned from the research
3. Copies of the resources you used
4. The following subjects should be addressed:
   - Botanical description
   - Life cycle of the weed species
   - Classification
   - Adaptations
   - Known control methods

You may have already written an initial report about your plant. However, as you become involved with your experiment you may learn more and add to your report.

_____ A description of the experiment you conduct, including:

1. Independent and dependent variables
2. The control
3. Problems with the experiment (sources of error)
4. Hypothesis you were testing
5. Detailed procedures
6. Examples of the data collection sheet (preferably done in table form)

The procedures should be very detailed – a step-by-step outline of everything you have done or will be doing, including a materials list. This is another part of the project that will change and need to be updated regularly as you encounter problems or changes to your experiment/research.

_____ An interpretation of the data collected from your experiment, including:

1. How you collected the data
2. The data (charts, transparencies, etc.)
3. What the data tells you
4. Whether or not your hypothesis was supported
5. Implications of the experiment (what new questions arise and how would you
6. Use the information gained from the experiment to learn more)
7. Any photos or drawings that help illustrate what you did

_____ A daily journal that details what you did each day, things you've learned, problems encountered, how you resolved those problems and/or altered the design and procedures, your feelings about the process (frustrations, confusing moments, feelings of success, etc.).

All of the above components will be included along with your final typed research report.