

Title: Our National Flower?

Lesson Summary: Students will observe goldenrod plants with and without galls, measure differences between the plants, suggest reasons for these differences and suggest hypotheses for the cited differences.

Learning Goal: Students will examine the folly of calling a plant a weed species. The students will realize that goldenrod is an important producer in North American habitats and is intricately bound into an amazing food web. Ideally, the students will challenge the landscaping designs of their homes and examine strategies for increasing biodiversity of their yards.

Duration: This activity will take place in the first quarter of school. However, galls will be observed throughout the first semester to examine other ecological relationships. In May, students will design a landscape that promotes biodiversity.

Lesson Content Objectives:

to demonstrate the importance of biodiversity

to examine symbiosis in the local environment

to stimulate thinking regarding building a landscape that promotes biodiversity

to observe differences in botanical specimens

Process Objectives

increase observation and questioning skills

organize data into suitable data tables and graphs

propose hypotheses for further testing

collaborate with each other to strengthen the power of ideas

Prerequisite Knowledge/Skills

Scientific Method

Some knowledge of food webs

Symbiosis

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Background Information:

At one time the goldenrods were so widespread and so much of the North American landscape that in Thoreau's time there was a movement to make it the national flower of the United States. Today, because of habitat destruction through the building of suburbs many of these populations have been lost replaced instead by petunias and impatiens. The question we pose today is, what is the overall loss in biodiversity as a result of the goldenrods perceived weed status. Several species of goldenrod *Solidago* grow in the eastern United States. In the summer, these plants are often attacked by goldenrod gall flies *Eurosta solidaginis*, whose females lay their eggs in the terminal buds of goldenrod plants. After hatching from these eggs, the gall fly larvae burrow into

the stem, where they stimulate the plant to produce a gall, a structure consisting of a protective outer coat and an inner tissue of protein and starch that provides food for the growing larva. The larvae grow for about 50 weeks, after which they emerge from the gall to begin the life cycle all over again. However, the larvae are often killed before they emerge by a variety of predators and parasites, including parasitic wasps, beetles, and several species of bird.

Method: To open galls cut around its equator to a depth of a quarter of an inch, then snap the two hemispheres apart by twisting your knife blade in the cut. To keep galls for observation place in baby food jars or aquaria with screens.

### Calendar of Growth

June	Mating of Flies- Check buds for an inside look! Eggs hatch within 7-14 days. Galls are first visible at the end of the month.
Summer	The larva spends the summer feeding.
August	Open a gall and you will see a white larva.
September	Larva begins to tunnel to the outside.
October	The tunnel and a closed door have been completed but remains unused until spring.
Winter	The galls become thick and corky. The larva loses water to prevent death by ice crystal formation.
Spring	The larva pupates.
April-May	The adult fly is ready to emerge. The fly has a ptilinum, a bladder like structure it uses to ram open the pre constructed door. These openings can be seen in older galls. The adult fly hardens and its wings expand to their full size. You can observe this if you gather goldenrod at this time and place in an aquarium.

The purpose of our inquiry is to compare goldenrod stems with and without galls in an attempt to gain some understanding of the factors influencing how female gall flies choose where to lay their eggs.

### Materials:

Goldenrod with and without galls  
metric rulers  
string  
hand lens  
scalpels  
aquaria or baby food jars with screens

### Instructional Strategy

45 Minutes

When students enter room have goldenrod plants at their seats. Make sure that you have some with galls and some without. Ask them to observe them as closely as possible. Suggest that they make both qualitative and quantitative observations in their lab notebooks. After a discussion of their observations someone will remark about the galls. Lead the discussion in such a way that the galls become highlighted. Students will wonder why some have galls and others do not. Suggest that we explore this observation. You can continue the exercise the following day.

#### 1 Hour

Obtain 10 stems with galls and 10 stems without galls for each group of four students. The goldenrod species collected is Canadian goldenrod, *Solidago canadensis*. Students could collect their own galls but the teacher should have many available.

Ask the students to formulate a written report complete with qualitative and quantitative data organized into tables that analyzes factors they feel may influence female gall fly nesting sites. Students should be familiar with Data Tables and use metric units in their analyses. Have students present their data to the class. Have students listen, actively question the reports and design an hypothesis for further testing. Students will now write an experiment to test their hypothesis.

Assessment: Score student lab books. Examine them for organization of data tables, accuracy of measurement, hypothesis design and experimental protocol. Students should also answer the following discussion questions.

1. If goldenrods are eliminated from our yards what will happen to local biodiversity? Be specific.
2. Would you include goldenrod in your home garden? Why or why not?

Extension: Go to a meadow in the morning or evening and observe the number and kinds of organisms visiting these flowers. Now sit and observe any species of garden flower in your own yard and record the same data. Was there a difference? Explain the differences.

#### Works Cited:

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