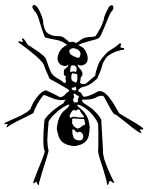


Activity #3

Ecosystem Engineers I: Strawberry Guava

Length:
Two class periods with two-week lab in between

Prerequisite Activity:
None

Objectives:
- Identify how an invasive plant species might alter soil or other habitat conditions to affect the surrounding ecosystem.
- Explore how invasive plants can affect native seedling germination and growth.
- Formulate a hypothesis and design and conduct a lab to observe effects caused by invasive species.
- Create a poster presentation of lab results.

Vocabulary:

bioactive
control
ecosystem engineer
endemic
germination
hypothesis
invasive
mean number
median
scientific method
variable

● ● ● Class Period One: *Designing Labs*

In Advance

Acquire 30-60 Petri dishes, 1 package of lettuce seeds, 1 head of lettuce (same species as seeds), and enough strawberry guava leaves to fill a regular sized grocery bag. (You can find strawberry guava trees in Iao Valley, or along Hana Highway.) Set aside a place in your classroom for the dishes. It should be easily accessible and under a light table or window.

Materials & Setup

For Group Discussion and Lab Activity
- Scientific method chart
- Blender
- Water
- 3 spray bottles
- Petri dishes (3 per group)
- Paper towels cut into circles the size of Petri dish
- Lettuce seeds (30 seeds per group)
- Lettuce

- Strawberry guava leaves
- Labels for Petri dishes and indelible markers
- Rulers
- Teacher Background "Scientific Method Chart" p 97 and Copy Master "Station Instructions" p 99 (You may want to display the latter with a projector
- Student Page "Ecosystem Engineers" p 101-103

For each group of students
- Student Pages "Ecosystem Engineers Lab Report" p 105 and"Daily Data Sheet" p 107-111

Instructions

NOTE: you can prepare the lab stations yourself or assign a few students to set up and "man" each station.

1. Blend two handfuls of lettuce leaves with 1-3 cups of water until little or no plant material is visible. Pour into spray bottle. Repeat with strawberry guava leaves. Fill one spray bottle with plain water. Label spray bottles.

   Cut paper towels into circles that fit inside the Petri dishes. Print out Copy Master "Station Instructions." Cut into sections and place each instruction at its appropriate station.

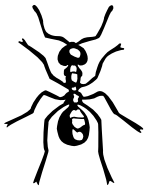
2. Set up five stations for students to visit in order.
   Station #1: Petri dishes, paper towel circles, labels, and indelible markers
   Station #2: Lettuce seeds (10 seeds per dish)
   Station #3: 3 spray bottles - one filled with water, one with strawberry guava mixture, and one with lettuce mixture
   Station #4: Student Page "Ecosystem Engineers"
   Station #5: Student Pages "Ecosystem Engineers Lab Report" and "Daily Data Sheet" (one each per group)

3. Lead a discussion on the scientific method, using Teacher Background "Scientific Method Chart."

   Question: What are the steps of the scientific method?
   Answer: The scientific method begins when you 1) ask a general question and 2) conduct some background research. Next, you 3) develop a hypothesis and 4) test the hypothesis in a controlled experiment. 5) Collect and analyze results. 6) Determine whether your hypothesis is true or false, based on your results. 7) Report your results and conclusion. If your hypothesis is false, you can begin the process again with a different hypothesis.

   Writing a hypothesis as an "if... then" statement is a prediction of the results you need to support the hypothesis.

   For example:
   If strawberry guava compounds stifle plant growth, then seeds receiving the compounds should grow 20 percent shorter than the control.



4. Tell students that they will be replicating the 2010 experiment of a University of Hawai‘i student, Kelly Bongolan. Explain that scientists repeat one other's experiments in order to verify results. When the same results can be demonstrated time after time, a hypothesis moves from a guess to an accepted scientific fact.

5. Break the students into groups of 2-3 and have them visit each station.

6. Arrange Petri dishes under a window or light table. Each group will spray their Petri dishes every day for two weeks, using the appropriate spray bottle for each dish. (Assign students to take their groups' dishes home over weekends.) They will record data for each Petri dish (control, lettuce and strawberry guava) on their Student Page "Daily Data Sheet." After the seedlings sprout, students will record the total number of sprouted seedlings, the root length of the two largest seedlings in each dish and the shoot length of the two largest seedlings in each dish.

   Dishes need to remain moist. Depending on the classroom climate, they may need to be sprayed more than once a day. Also, consider refrigerating your spray mixtures, or mix fresh batches every few days.

● ● ● Class Period Two: *Analyzing and Reporting on Results*

Materials & Set Up

For each student:

- Student page "Lab Report Guidelines" p. 113
- Graph paper or access to computer

Instructions

1) After two weeks, collect the completed Student Page "Daily Data Sheet" from each group. Summarize the entire class's data in charts and graphs. These charts and graphs can be drawn on graph paper or created as computer spreadsheets. Discuss why scientists calculate their results in a variety of ways, ie: using mean number and median.

   For example, have students calculate the mean number of days it took seeds to germinate for the control and each of the variables. Determine the median days to germination and display in a table. Do the same for seedling growth. (You can compare the class's results to those collected by University of Hawai‘i student Kelly Bongolan. Her poster is included in the Teacher Background.)

2) Hand out the "Lab Report Guidelines" worksheet and review it with the students. Have students complete their "Ecosystem Engineers Lab Report" based on the data gathered by the entire class.

3) The students will then make a poster out of their experiment to put on display for the class. The poster should include their hypothesis, a brief version of the procedure, and the results, including the graphs they made.

4) Place the posters on display in the classroom. Students can do a gallery walk, providing construc-

tive and positive comments about each poster by writing it on a sticky note and placing it on the poster.

5) Have students turn in their "Ecosystem Engineers Lab Report."

Journal Ideas

- How do invasive species alter habitats and ecosystems? Name five ways.
- Imagine a forest that contains many different species, such as trees, shrubs, mosses, ferns, and vines. Maybe you have visited one recently. How does it feel? What does it look and sound like? How does it smell? What kind of birds and insects live there? Now imagine a forest with just one or two species, such as a mountainside dominated by ironwood or strawberry guava trees. How does it feel? How is it different from the diverse forest described above? Do you think the same birds and insects live in both? Why or why not?

Assessment Tools

- Daily data sheets
- Lab reports
- Posters
- Journal entries

Further Enrichment

- Partner with Maui Digital Bus to conduct related experiments in the field and lab. The program's educators can tailor lessons to meet the teacher's goals and can provide high-tech equipment via their mobile laboratory. Teachers who work with the Digital Bus gain access to their lending library, which includes digital microscopes, GPS/GIS, temperature sensors, motion detectors, and water quality kits. www.digitalbus.org

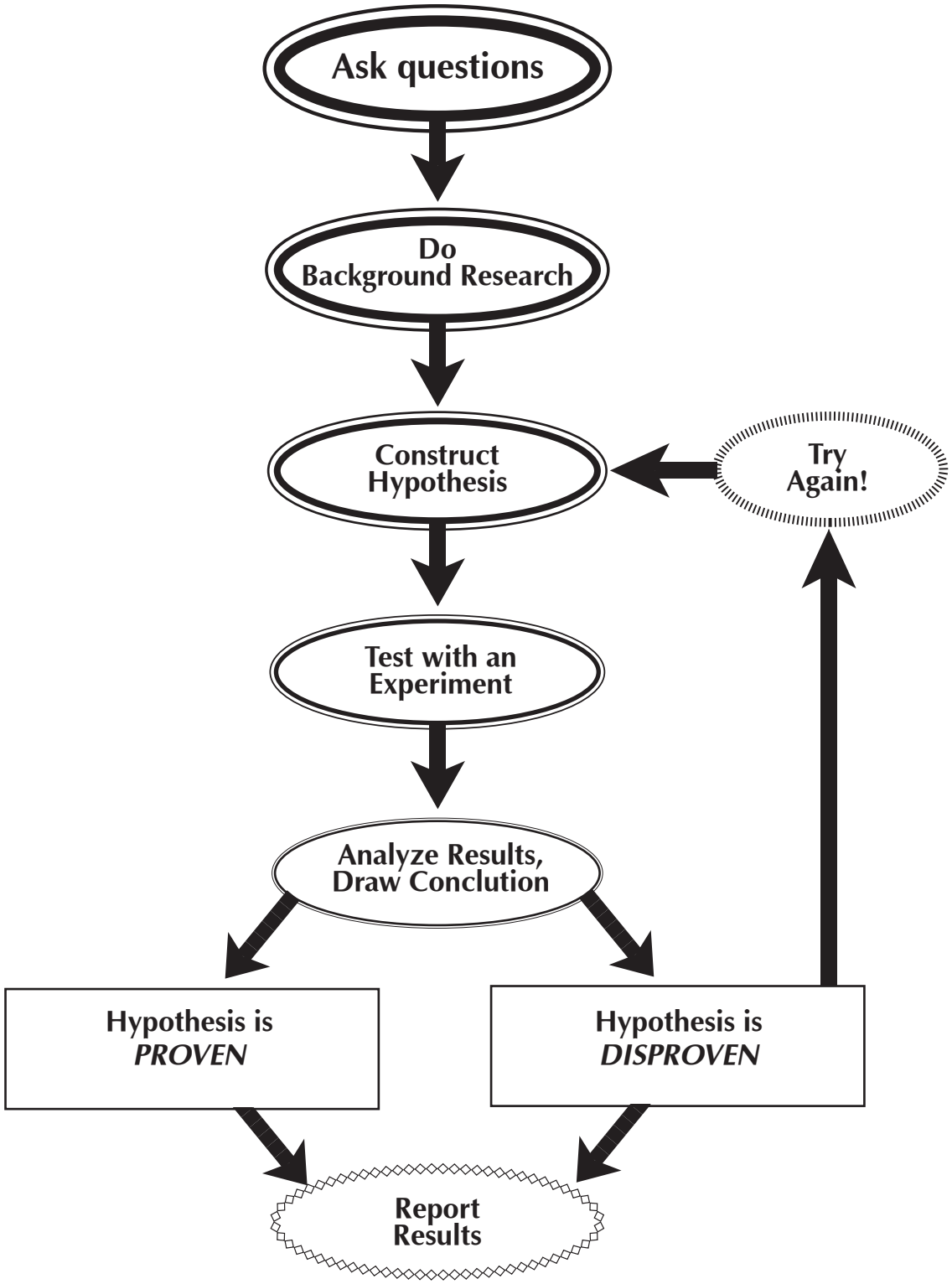
- Take a field trip to Hosmer's Grove. Contact East Maui Watershed Partnership or Haleakalā National Park staff for a guided tour of the Bird Loop. Observe and discuss with students why the forest's older *ʻōhiʻa* trees are dying while the surrounding pine trees around are thriving. Introduce the concept of "ecosystem engineers," invasive species that directly change a habitat or ecosystem.

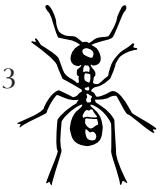
East Maui Watershed Partnership
(808) 573-6999
coordinator@eastmauiwatershed.org
www.eastmauiwatershed.org

Haleakalā National Park
(808) 572-4453
www.nps.gov/hale/forteachers

Teacher Background

Scientific Method Chart





Station Instructions

Station #1
Select three Petri dishes for your team. Fill each dish with a paper towel circle. Label one "strawberry guava," another "lettuce" and the last "control." Make sure your team name is on each dish.

Station #2
Place ten lettuce seeds in each dish.

Station #3
Spray 20-40 squirts of each mixture into the appropriate dish.

Station #4
Read "Ecosystem Engineers."

Station #5
Fill out questions 1-3 of your team's "Ecosystem Engineers Lab Report." Frame your hypothesis as an "If…Then" statement. Be specific. Example: If strawberry guava chemical compounds stifle seedling growth, the seedlings exposed to strawberry guava will show 20 percent less growth than the control.