Earthworm Observatory

Lesson Author: Sarah Hamilton
School or Agency: St. Anne's Wetland Education Outreach Program
Grade Level(s): 5-12
Science Topic(s): Invasive Species, Nutrient Cycling

Summary: Making an earthworm observatory is a way to show students what earthworms do and how they have the potential to alter ecosystems which they invade. Students will construct an earthworm observatory and observe and record the changes they see occurring in the soil layers. They will become familiar with the effects earthworms have on ecosystems and nutrient cycling.

Core Content: Biological Science, Unifying Concepts, more specifically: Biological Change, Energy Transformation (nutrient cycling), and Interdependence.

Objectives: Students will learn about invasive earthworms and their effects on ecosystems (and wetlands) in the Earthworm Extraction lesson plan. That knowledge will be built upon here, with the construction of an earthworm observatory which will enable students to see, first-hand, the effects earthworms have on soil layers and leaf litter. Students will draw conclusions and make inferences about the consequences of species invasions, and gain a better understanding of matter and energy flow through different organizational levels.

Materials: 5gal aquarium, impenetrable tank divider (cut to fit snugly), caulk or epoxy, sand (bottom two inches of aquarium- for drainage), loamy soil (4-6in light colored soil so black worm cast material will be evident), leaf litter (3in layer of crushed, dried leaves- preferably hardwood), worms (anecic worms will give very dramatic results, use about 10), pH testing kit.

Procedures:

1. Have the students perform the earthworm extraction lesson plan prior to attempting the earthworm observatory. This will familiarize them with the topic of earthworms as an invasive species.

2. Divide the tank into two equal halves, ensuring the divider is tightly fitted and sealed (with caulk or epoxy) to prevent the movement of earthworms from one side of the tank to the other. Be sure the lid fits snugly down on the divider to prevent the worms from crawling over.

3. As a related math exercise, have the students calculate how much of each material you will need based on the volume of the container and the desired thickness of each layer. Then build the layers of soil from the bottom up, smoothing each as you go so they are level and equal on both sides. Sand goes on the bottom, primarily for drainage so the upper layers do not get overly saturated. Loamy soil simulates the thickest and deepest layer of soil found in hardwood forests, often called mineral soil.

4. The leaf litter will simulate the litter on the forest floor. Inform the students that most nitrogen in a forest remains locked up in this kind of vegetation and is released through the gradual decomposition of organic matter. Because only a small amount of nitrogen is available in healthy forests, weedy vegetation requiring large amounts of nitrogen is deterred. Earthworms quickly release nitrogen into the soil by rapidly consuming the organic materials containing it. Ask the students to consider what kind of effects this could have on the forest.

5. If the soil and litter are dry, slowly sprinkle water over the demonstration to moisten the upper layers. Maintain moisture layers throughout the experiment because earthworms will become inactive when conditions are too extreme. Make pH measurements of the layers prior to the addition of the worms, and inform the students that plants and forests are very sensitive to soil pH levels.

6. Use tape or string to mark the top of each layer on the outside of the aquarium. These layers will change throughout the experiment and if they are not marked the change will not be as obvious. Next, place the worms on top of the leaf litter on one side of the aquarium. Record the number of worms in the aquarium and the date.

7. Record observations. If using anecic worms (night crawlers), activity should be apparent within a few days or weeks. After a month, the differences

between the two sides should be obvious. Suggestions on observations: Measuring changes in thickness of layers. Noting any color or texture changes of the soil. After two months, record the pH of the layers again.

8. Explain to the students that the worm-free side is the example of an experimental control, whereas the side with worms is the example of an experimental treatment. The control is required to understand what would have happened if the worms weren't present.

Assessment Techniques: Have the students discuss the implications of their findings. Why is a change in pH detrimental to the flora in a forest? What are the ramifications of interfering with the nitrogen cycle?

Resources: Method adapted from: Making a Worm Observatory, Great Lakes Worm Watch http://www.nrri.umn.edu/worms/educator/activities_observatory.html

Extensions: Using the same layers as in the demonstration above, you can use clear 2 liter bottles to make small observatories, ideal for small experiments because you can make replicates for different treatments. This is a great way to see the different effects different types of worms have on the layers.