Zebra Mussel Invasion

Time: 2-4 class periods spread out over at least one week
National Benchmarks: Benchmarks 5A: Diversity of Life; 5D Interdependence of Life; 5E: Flow of Matter and Energy; 9B:Symbolic Relationships; 9D:Uncertainty; 12B:Computation and Estimation; 12D:Communication Skills; 12E:Critical-Response Skills.
National Science Content Standards: *Science as Inquiry: A*; *Life Science: C*: Biological Evolution; The Interdependence of Organisms; Matter, Energy, and Organization in Living Systems; *Science and Technology: E:* Abilities of Technological Design; Understandings about Science and Technology; *Science in Personal and Social Perspectives: F:* Population Growth; Natural Resources: Environmental Quality; Natural and Human-induced Hazards; Science and Technology in Local, National, and Global Challenges
New York State Standards: 1, 2, 4, 5, 6, 7

Objective: Students will know how to design an experiment to test how a pond ecosystem changes over time due to an invasive mollusk and be able to develop a testable hypothesis, create the experimental set-up, collect data, and carry out the experiment.

Lesson Outline:

1. Students brainstorm the effects of invasive species
2. Students design and create an experiment to test the effect of an invasive mollusk (mystery snails) on a pond microcosm
3. After one-two weeks of observations and monitoring, students report and discuss their results

Materials:

-pond water
- lab handouts for both sessions
-wide-mouth one quart mason jars
-permanent markers and tape
-tongue depressors
-water soluble plant fertilizer solution (1t Miracle Gro/qt)
- salt solution (1t table salt/qt)
- 25 or 50 ml graduated cylinders
- mystery snails

Optional: grow light and timer
Optional: filter flasks, Buchner funnels, filter paper and water aspiration set up

Preparation*:* The set up phase of this activity is relatively straightforward aside for the need to assemble all the materials. Mystery snails are readily available at most pet stores that sell aquarium fish. They come in different colors: blue, gold, etc., but any form will

do as long as they are alive. You can try this activity with zebra mussels, as long as you are comfortable collecting them yourself. Many rocks along the Hudson River are home to zebra mussels, although the animals are difficult to keep alive in an aquarium without sufficient oxygen. You also need to make sure that you dispose of the animals correctly when you are finished, by killing them with bleach. Even the water they reside in can have tiny, swimming larvae, so it is essential that all organisms in the water are dead before you dispose of the water.

You can set up this activity so that each group tests each variable (four jars per group) or so that each group tests only one variable against a control. You can also vary this activity by deciding what variable you will test for at the beginning: color change, or amount of floating plant material. Conversely, allow the students to make these decisions for a more inquiry-based experience.

Engagement: Ask students to summarize the effects of invasive species on an ecosystem. By this time, they should be able to offer several observations. If time permits and this has not done previously, show pictures of invasive species damage. Ask students to think of other types of change that may take place in a pond ecosystem.

Exploration:

Day 1: The class should be divided into groups of three or four students. Explain that there will be three variables: salt, fertilizer, and invasive species (mystery snails). Each group should set up their 'ponds' depending on whether you will test all variables in each group, or only one. Fill the jars with the pond water. If the students are using all of the variables, they should use random sampling to decide which jar will receive which treatment. This can be done using a random numbers table, or by asking students to close their eyes and choose a jar, or assigning numbers to each jar and then having students pull the treatment names out of a hat. After they have set up their ponds, encourage the students to observe them for a while and write down their observations. Discuss what they saw. Try to get them to identify trophic levels and to think of these jars as mini ecosystems. Remind them why the water might be green. The ponds may also contain *Daphnia*, which are large enough to be seen with the naked eye, floating plants (duckweed), detritus, and a few macroinvertebrates.

Next, have the students spend some time thinking about how the different treatments may affect the ecosystems. Have them write down their hypotheses on the data sheet and turn it in at the conclusion of the lab. (Optional: Before the next lab, review the hypotheses and summarize them for distribution to the students.) Allow the ponds to sit for at least one week, undisturbed.

Day 2: Distribute the ponds and return the data sheets from the previous lab to the groups and ask them to record their observations, comparing what they observed last time to the present. (Optional: Use the summary of class hypotheses to discuss how they will measure the changes they observed.) Review the concept of a control. The students need to find a way to measure the variables they identified, which included: the amount of floating vegetation, the amount of phytoplankton, the amount of brown organic matter in the bottom of the jar, and the number of macroinvertebrates. Macroinvertebrates can be counted and it is possible to estimate the percentage of the surface covered with floating plants. The students are likely to be uncomfortable with crude estimates and need reassurance in the beginning. The same technique can be used for organic material on the

bottom of the jar. One technique that seems to work well for measuring the amount of phytoplankton involves arranging the jars for the class from greenest to least green and assigning a greenness rank.

A less successful technique involves removing the floating plants and using a filter flask, Buckner funnel, filter paper and water aspiration to collect the phytoplankton. The filter paper can be arranged from greenest to least green and assigned a greenness rank. However, it is may be difficult to arrange the filter paper by color because the students are sometimes unable to remove all the floating vegetation, and because the organic material from the bottom makes the paper brown and green.

You can extend this activity for as many weeks as you would like. The longer the ponds are left alone, the more change will occur.

Explanation: When discussing the results from the experiment, talk about each artificial pond separately. Depending on what variable you measured with the students, you will get different results. Refer to the background readings on chloride and nitrates. Elevated chloride (salt) levels will reduce the ability of organisms to survive. Elevated nitrates (fertilizer) will increase the plant growth, usually seen as algae during this experiment. The alien species, depending on the amount of time spent, will reduce the amount of microorganisms in the water. Zebra mussels have dramatically changed the ecology of the Hudson river by reducing certain zooplankton, especially rotifers (one of the smaller zooplankton). They are filter feeders and filter the water of the Hudson every 1-4 days (the entire river!). They have depleted the suspended phytoplankton as well, causing damage to the native mollusk species, whose numbers have significantly decreased. Don't spend too much time on the impacts, however, as students will have a chance to view the actual data in the next lesson.

Extension: Ask the students to graph their data and the class data.

Evaluation: All students should complete a lab report.

Comments: