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Studying Invasive Species Using GIS

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GIS

LESSON PLAN # 3

Name: April McGivern

Grade level(s)/Subject taught: grade 7 science, grade 8 science, Living Environment

Objectives:
Living Environment Core Curriculum
Standard 4
Key Idea 1: Living things are both similar to and different from each other and from non living things.
Performance Indicator 1.1 f : Every population is linked, directly or indirectly, with many others in an ecosystem. Disruptions in the numbers and types of species and environmental changes can upset ecosystem stability.

GOALS FOR STUDENTS:

Students will search GIS databases for information. (Guided by the teacher modeling the method and the sites, using a Smartboard or LCD projector.)

Students will use the information gathered from GIS data sites to create a GIS map. (Guided by the teacher modeling the methods needed to use the program, using a Smartboard or LCD projector.)

Students will interpret the data from the map to determine relationships between invasive species and biotic or abiotic factors in the surrounding environment.

Students will answer questions about the data they collected.

Materials: computer with GIS software, GIS website listings, Microsoft Office, Articles containing background information about the invasive species (zebra mussels).

Prompts:

1. How will you assess the prior knowledge of the student?
2. How will you begin the lesson?
3. What are the teacher and students doing every 5-10 minutes? (Teacher Actions and Student Actions
4. How will you assess the learning for the lesson?

1. Prior to this lesson students will have been studying different populations of invasive species such as purple loosestrife, leafy spurge, sea lamprey, and zebra mussels. As a "warm up" activity I will pull pre-written questions out of a bowl. Students will be asked these questions.

2. The students will be asked the questions by a format I call "popcorn". I will select the first student to answer the question. That student will then pick the next person to answer the question and so on. I expect the class to work on this lesson for three to five days. This is how we will begin the first day. Next I will introduce the topic of GIS and provide examples of it's uses. Then I will solicit input from students on what they think GIS can be used for. (Answers will be written on the whiteboard as they are given.)

3. Every 5-10 minutes teacher and students will be engaged in the steps of developing a GIS data map. The teacher will be modeling at the front of the room, as well as circulating around the room to check student work. Students will be encouraged to ask questions. (At the computers students will most likely be in pairs so I would like to also check that both students are contributing.) Class will end 5-10 minutes before the bell in order to save work and answer questions in a timely manner.

4. Student learning will be assessed by completion of the map as well as the question sheet. Information to answer the questions on the sheet will be discussed in class. A rubric will be used to grade each student's work.

ZEBRA MUSSEL INFORMATION SHEETS FOR STUDENTS TO USE:

Zebra Mussel (*Dreissena polymorpha*)

DESCRIPTION

The Zebra Mussels, *Dreissena polymorpha*, are small, fingernail-sized, freshwater mollusks, native to the Caspian and Black sea region Eurasia. They are up to 1 inch in length and have a striped pattern on their shell (thus the name "zebra" mussel). It is believed that they are accidentally introduced to North America via ballast water from a transoceanic vessel. Zebra mussels were first discovered in Lake St. Clair in the mid 1980s. They have spread very rapidly to all of the Great Lakes, inland waterways, and several states rivers (including the St. Lawrence Seaway and the Hudson, Illinois, Mississippi, Ohio, Arkansas, and Tennessee rivers). Zebra mussels colonize on docks, native mollusks, nets, water pipes and valves, etc. In 1991, another zebra mussels species, Quagga mussels (*Dreissena bugensis*), was identified in North America. These species also have found in the St. Lawrence Seaway, Lake Ontario, Lake Erie, and Saginaw Bay in Lake Huron.

IMPACTS

Zebra Mussels can have great impacts on our economy, and lakes & oceans' ecosystem. Most significantly, the mussels are extremely efficient filter-feeders, consuming large portions of the microscopic plants and animals which form the base of the food chain. Over time, this feeding behavior can affect a lake's entire ecological balance, causing significant shifts in native species populations.

In addition, one of negative effects are caused by their rapid reproduction. Zebra Mussels have clogged up water and drain pipes at municipal water supplies and at industries. They are expected to cost the US $5 billion in control efforts and reparation. Zebra Mussels have displaced native freshwater mussels of the area, and drastically altered the food web. The zebra mussel population continues to grow and no immediate end is foreseen.
(modified from http://massbay.mit.edu/exoticspecies/invaders/factsheet.html).

ORIGIN

Eurasian zebra mussels, *Dreissena polymorpha, (Pallas),* were introduced via ballast water to the Great Lakes in the mid 80s. They have spread very rapidly to all of the Great Lakes, inland waterways, and several states rivers (including the St. Lawrence Seaway and the Hudson, Illinois, Mississippi, Ohio, Arkansas, and Tennessee rivers).

Source of exotic species introduction: Ballast Water
(revised from: http://massbay.mit.edu/exoticspecies/ballast/)

What is Ballast Water? Ballast water helps maintain ship's stability during transit along coasts and on the open ocean. Therefore, most ships fill their ballast tanks with water. For example, large ships often carry millions of gallons of ballast water. This water is taken from original coastal port areas and transported with the ship to the next port of call where the water may be discharged or exchanged.

What are the Problems with Ballast Water? Coastal port areas are home to a wide variety of organisms that live in the water and bottom sediments. As a ship loads ballast it also loads many of the organisms living in that port. These organisms range in size and phyla, from microscopic plants and animals to mussels, crabs, and even schools of fish! The ballast water of shipping vessels has been a primary method of exotic species introduction throughout the world. Scientists estimate that as many as 3,000 exotic species per day are transported in ships around the world, however, not all transported species survive the trip and their new home. Some of the species that do survive the trip are able to thrive in their new environment. Therefore, zebra mussels cause disruptions in the natural ecosystem, economic troubles, and even carry human diseases.

Zebra Mussel Control

The European community, after two centuries of infestation, and the Great Lakes community, after years of infestation, haven't been able to develop a chemical toxicant for lake-wide control that isn't deadly to other aquatic life forms.

In some parts of Europe, large populations of diving ducks have actually changed their migration patterns in order to forage on beds of zebra mussels. The most extreme case occurred on Germany's Rhine River. Overwintering diving ducks and coots consumed up to 97 percent of the standing crop of mussels each year. High mussel reproduction rates, however, replenished the population each summer.

In North America, the species most likely to prey on relatively deep beds of zebra mussels are scaup, canvasbacks, and old squaws. But populations of these species are quite low; in fact, canvasbacks are so rare that they are protected. In the Great Lakes, diving ducks are migrating visitors, pausing only to feed during north-land southward migrations. However, Canadian researchers have documented increasing numbers of migrating ducks around Pt. Pelee in western Lake Erie, and these ducks were observed to be feeding heartily on zebra mussels. In southern Lake Michigan, zebra mussels encrusting an underwater power plant intake attracted flocks of lesser scaup. Unfortunately, some were pulled into the intake pipe and drowned. The stomachs of these dead scaup were full of zebra mussels. Mallard ducks also are frequently observed foraging on zebra mussels on shoreline rocks and shallow structures. In addition, freshwater drum, or sheepshead, are known to feed substantially on zebra mussels; and yellow perch have been observed feeding on juveniles, particularly when they are detached and drifting.

One novel approach to controlling zebra mussel populations is by disrupting the reproductive process. Zebra mussel eggs are fertilized externally; therefore, males and females must release their gametes (sperm and eggs) simultaneously. After release, zebra mussel sperm remain viable for only a short time-perhaps only a few minutes. Disrupting the synchronization of spawning by males and females may effectively reduce the numbers of fertilized eggs. Researchers are currently studying the environmental cues and physiological pathways that coordinate zebra mussel spawning activity .

GIS DATA SITES:

http://cugir.mannlib.cornell.edu/

http://www.nysgis.state.ny.us/

STUDENT QUESTIONS FOR GIS DATA:
(All questions will be answered on a separate sheet of paper. Questions are to be answered with complete sentences.)

1. **Are zebra mussels freshwater organisms or saltwater organisms?**
2. **Where is the density of the zebra mussels population the greatest?**
3. **Where do you think the populations of zebra mussels in the United States originated?**
4. **What is the main "method of transportation" for zebra mussels?**
5. **Why are zebra mussels called "zebra mussels"?**
6. **Explain two ways zebra mussels have impacted the environment.**
7. **What organisms might actually help control zebra mussel populations?**

GIS ASSIGNMENT RUBRIC

	1	2	3	4
Spelling and grammar	Project has multiple errors in grammar and/or spelling (4 +). Not in complete sentences.	Project minimally follows rules of grammar and/or spelling (3 -).Few complete sentences(~2)	Project somewhat follows rules of grammar and/or spelling (2 -). Some complete sentences (~4).	Project honors all rules of spelling and/or grammar. All work is written in complete sentences.
Evidence that objectives were met	No evidence that project contents support stated objectives	Little evidence that project contents support stated objectives	Some evidence that project contents support stated objectives	Clear evidence that project contents support stated objectives
Completion	Project is incomplete and contains many unfinished elements	Project is incomplete and contains several unfinished elements	Project is incomplete and contains some unfinished elements	Project is completely finished.
Timeliness	Project handed	Project handed	Project handed	Project handed

	in one week late	in 5-4 days late	in 2-3 days late	in on time
Design	Low in visual appeal. Hard to comprehend data. Little to no effort made to provide a clear picture of the data.	Some visual appeal. Generic symbols and general representation of the data.	Designs fairly clear with a few exceptions. Some evidence that effort was made to enhance layers and symbols. Clear picture of data given.	Clean design with high visual appeal. Very evident that effort was made to enhance layers and symbols. Provided an esthetically pleasing and clear picture of the data.