Human Accelerated Environmental Change-Version 2

Time Period: One 90-minute session
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, 4, 5, 6, 7

Objective: Students will know some of the major changes that have taken place in the Hudson River watershed and be able to work in groups to determine what has caused these changes using graphs, tables, and maps.

Lesson Outline:

1. Students view a powerpoint of different human impacts on a global scale, taking notes and discussing questions when necessary.
2. Using the jigsaw technique, students examine one type of change more closely and then explain this to other classmates.
3. Students answer questions based on a short reading assignment.

Note: There are two different versions of this lesson, one for lower level students, and one for upper level students. Version 2 is the upper level version.

Materials:

- Power Point presentation
- Copies of HAEC Notes-one for each student; for use during Power Point
- Copies of HAEC questions-one packet for each student
- Copies of HAEC group handout-one copy for the class; can be laminated and used again (color printing is best)
- Copies of HAEC Resource Packet-one copy for the class; can be laminated and used again (color printing is best)
- Copies of HAEC Summary Graphs-one for each student
- Copies of HAEC reading-one for each student

Engage: Ask the students to brainstorm the major changes that they think have taken place over the last 20, 50, 100 years. Make a chart on the board, and add to the chart as the class progresses. You can use the aerial photos in the Land Use Change module (photos exist for Westchester and Dutchess counties) to explore these changes in more details.
Expore: Students use the Notes handout during a powerpoint presentation that explores the major global changes that have taken place as a result of humans. Encourage students to answer questions such as: Is the world overpopulated? What does overpopulated mean? How do the

different environmental changes interact globally? Locally? What changes do you think are the most important? Teacher notes for the powerpoint are found under each slide.

Now that students have spent some time thinking about global changes, they will get a chance to learn about different changes in the Hudson Valley. Divide the class into jigsaw groups, asking them to think about the major questions at the top of the handout that will frame the activity. When conducting a jigsaw activity, you first begin with the jigsaw groups. Ideally, these groups will each have five students. Then, students number off within the jigsaw groups to form expert groups. Ultimately, they return to their jigsaw groups to explain what they learned with their expert groups. If you do not have a class with multiples of five, you can have some groups that have more than five students, or determine another arrangement that works best for you.

Each expert group gets a of graphs (titled "Group Handout"), which show the 'end result' of a human-accelerated environmental change. Students spend some time looking at these graphs and brainstorming what might have caused the change, and thinking about how to test their hypotheses. Allow students about 10 minutes to learn about their topic and answer the questions on the handout. Then, students will receive a "Resource Packet". Each resource packet corresponds to a particular group. Students use this Resource Packet to find evidence to support their hypotheses. Once students have answered all the questions, they will return to their jigsaw group and answer the remaining questions.

In their jigsaw groups, students should take notes on each of the other expert groups' stories. Finally, they should complete the chart that asks them to identify which changes are responsible for the case studies discussed, and think about whether these changes are temporary or permanent.

Explain: Change is a constant theme within ecosystems, and adapting to that change is how organisms have evolved over time. However, humans have managed to create change on a dramatic, global scale by altering the landscape, polluting water, air, and land, encouraging and allowing the invasion of exotics, and decreasing biodiversity through exploitation and overuse. Compounding these factors is climate change, which promises to accelerate many of these issues, and ozone depletion as a result of pollution. The growing human population is accelerating these impacts, increasing the damage around the world and affecting ecosystems in many ways.

Scientists are just beginning to understand the ways that some of these changes are interrelated. Examples include the worldwide decline in amphibians, as well as the loss of coral reefs, the fish declines, etc. Without a clearer understanding of these interactions, it is difficult to advocate for solutions because anything that does not address the other causes will be ineffective. Policy makers also need to be made aware of these changes so that policy can account for synergistic causes.

In the Hudson Valley watershed, the major changes that have taken place are related to land use change, the introduction of exotic species, climate change, and the resulting loss of biodiversity.

Group 1: Lyme disease increases with decreases forest size, suggesting that forest fragmentation in the Northeast has played a role in the increase of this disease. There is also data that demonstrates a connection between increased rodent diversity and Lyme disease; that is, the more diverse a forest ecosystem, the lower the incidence of infected nymphs.

Group 2: New research shows a warming Hudson River, along with warming air temperatures throughout the region. The decrease in certain fish species, including the Atlantic

Tomcod and Rainbow Smelt, is thought to be related to temperature. Both species are temperature sensitive and are at their upper limit of temperature in the Hudson.

Group 3: The decline of the pearly mussels in the Hudson River is similar to declines in other eastern rivers which have suffered from the zebra mussel invasion. Zebra mussels have effectively decimated the food source of the pearly mussels. Recent research indicates that these mussels may be starving to death, as their body weights have declined substantially.

Group 4: The increase of an invasive clone of a native species, the common reed (*Phragmites australis*), is an interesting story in the Hudson. While the reed has been shown to have some beneficial characteristics (see the Invasive Species lessons for a more thorough exploration of this idea), it tends to decrease bird diversity in marshes. Data from Iona Island clearly shows the increase in common reed over the last 15 years, and compares the diversity of bird data from Iona with three other marshes that do not have a large amount of common reed.

Students will learn more about each of these invaders during the Invasive Species module, but this will give them a good overview of the changes.

Group 5: Although the amount of sulfur oxides in the atmosphere has decreased since the Clean Air Act amendments, the amount of nitrous oxides has remained the same and thus the acid rain problem has not been "solved". The data shows students how a community of fish changed in a stream at Hubbard Brook, and then gives them pieces of data that demonstrates how the abiotic conditions of the northeast changed during that period as a result of air pollution.

Extend: Students could research other types of change in the Hudson Valley watershed and create a report for the class.

Evaluate: Students should submit their notes and the answers to the jigsaw activity.

Comments:

References:

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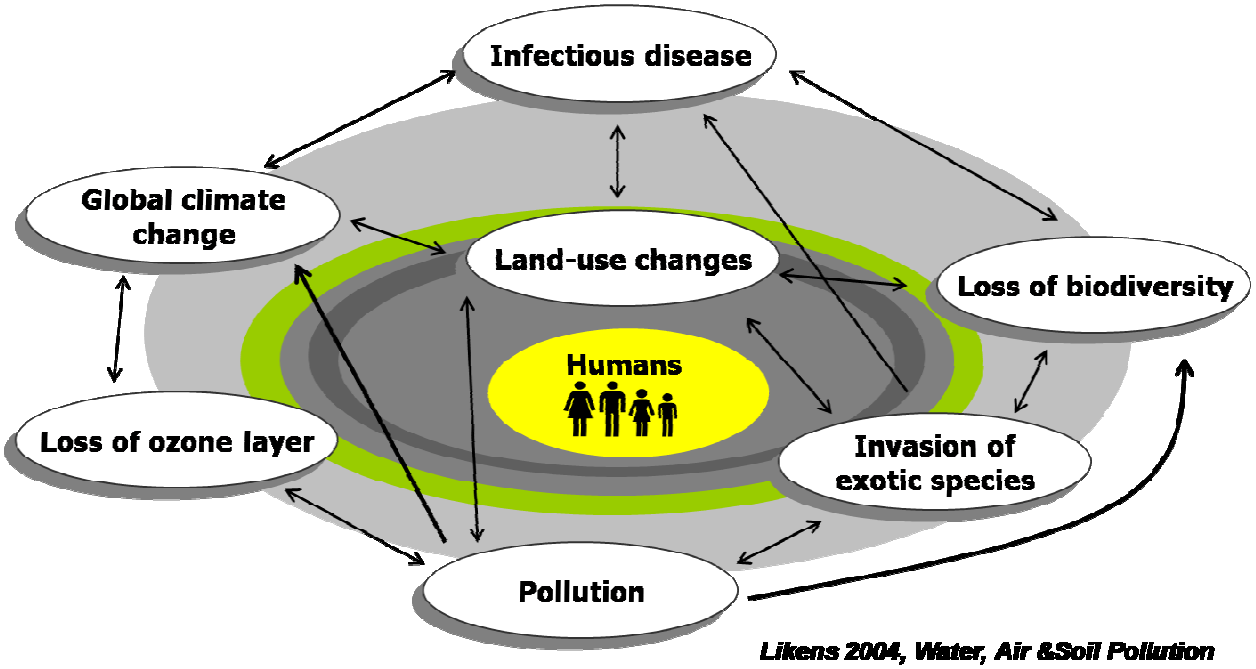

Likens 2004, Water, Air &Soil Pollution