Module 3
Water as a Resource

45 – 90 minutes

Purpose of this lesson

- Introduce students to some of the water quality issues affecting the planet
- Students will research one issue and share information

Materials

Copy of the lesson
Computers with internet access

Background and discussion

The Earth's surface is covered approximately by 75% water, however only 1% of the water is available for human use at any given time. And there are ever increasing pressures on the 1%.

Water resource management will become one of the most heated, local and global-scale debates in the 21st century. Threats to water quality and quantity as a result of man-made and environmental changes at local and global scales have already emerged as a major social and ecological concern.

Increasing population, geological factors, rapid urbanization, agricultural developments, global markets, industrial development, and poor wastewater regulation continue to impact the quantity and the quality of water services.

These developments represent a multi-layered complex process affecting the environment-human activities, food production and human health, thereby placing human health and their environment at risk.

Furthermore, water's multidimensionality—the fact that it is used for drinking, shipping, power, generation, irrigation, recreation, ecological functions, economic development, and cultural uses—and its ability to freely transgress political boundaries has tested the limits of both science and technology to assess the impacts of changes to water services on the health and well-being of particular social groups.

Recent changes to watershed services associated with global climate change, such as, increased and more intense flooding, droughts, and the rapid melting of glaciers and ice caps, and growing details about water pollution and human health have all heightened the need to reconsider our current understanding between water, risk and vulnerability.

However, at the same time as the magnitude and complexity of water problems has increased and the need to "adapt" and "change" social behaviors are stressed, the scientific awareness

and understanding of how these changes in watersheds and their services affect particular communities social relations and environmental problems has not kept pace. In fact, while known to be important, much of the social consequences associated with changing water patterns and services are often ignored because of the difficulties involved in systematically linking watershed services and human well-being.

Furthermore, even when social issues are taken into account, they are reduced to the language of probability or other technical advices, such as in discussions about income distribution, instead of examining the broader social relations of climate change and other human-induced changes to water and watershed services.

Recent scholarship, however, has pointed to the fact that changes in watershed and other ecosystem services are particularly discriminatory towards the **poor**, **minority communities**, and **women**.

- 84% of water-related deaths are in children ages 0 - 14.
- 98% of water-related deaths occur in the developing world.
- Every 15 seconds, a child dies from a water-related disease.
- People living in the slums often pay 5-10 times more per liter of water than wealthy people living in the same city.
- At any one time, more than half of the poor in the developing world are ill from causes related to hygiene, sanitation and water supply.
- The daily requirement for sanitation, bathing, and cooking needs, as well as for assuring survival, is about 13.2 gallons per person.
- An American taking a five-minute shower uses more water than the typical person living in a developing country slum uses in an entire day.

And locally on the Hudson River, the pressures of an increasing number of people who live near the river are taking their toll. For example, the 10 counties along the river added 360,000 new residents from 1980 to 2006, growing 50 percent faster than the rest of the state.

Due to the population increase, there is increasing pressure to draw more water from the Hudson for drinking water purposes and a greater reliance on aging sewer systems that are overwhelmed when it rains, spilling untreated sewage into the river. CSOs or "combined sewer overflows," are an issue in several metropolitan areas in the United States and a very large problem on the Hudson which could cost billions to fix (http://projects.nytimes.com/toxic-waters).

More people in the Hudson River watershed also means more impervious surfaces such as roads, driveways, parking lots and pervious surfaces such as lawns with liberal doses of pesticides and fertilizers, among other substances (non-point-source pollution) -- that often wash off acres of pavement and into creeks and storm drains, leading ultimately to the river.

Along the Hudson, there are more than 700 locations in which sewers can overflow during heavy rains: at least 460 are in the New York City area, where each year more than 27 billion gallons of raw sewage and polluted stormwater flow into the river. At the same time, the DEC does not have a firm understanding of exactly how much up river of the New York City area.

A combination of infrastructure changes, sensor technology development and education can make a difference. As more sensors are developed and sensor networks become more ubiquitous, the resulting data will provide us with a better understanding, in real time. Organizations like Clarkson University, the Beacon Institute, Lamont-Doherty, Cary Institute and

NY Dept. of Environmental Conservation are working to install sensor networks in the river, on the land and in the air to better understand the impact of humans on the environment.

Understanding where and how much water we use and water happens to wastewater is the first step in beginning to conserve one of our most precious resources.

Clarifying and characterizing the problems unique to a water body can lead to potential solutions. The first step in solving each problem is defining it:

- Is there a problem? If so, how serious?
- Does the problem afflict only a portion or the entire water body?
- Does the problem occur sporadically, seasonally, or year round?
- Is the problem a naturally occurring issue or is it caused by human activities?

A systematic and well-planned monitoring program can identify water quality problems and help to answer questions critical to the solution of these problems. Useful monitoring data accurately describes the current physical, chemicals and biological status of the water body. This type of baseline information, collected systematically over time can establish a record of water quality conditions in a water body. If reliable historical data exist for comparison, current monitoring data can also document changes in the water body from the past to the present. These data may serve as a warning flag of a developing water quality problem or on the positive side, comparison of the data may indicate improvements in water quality. The more complex a water system, the more time is required to observe and understand changes in the system.

To answer the question “is the water good or bad?” test results must be compared to some form of water quality standards and must be interpreted according to the intended use of the water.

Scientist Spotlight
Dr. Tyrone Hayes, University of California, Berkeley
Dr. Hayes is a herpetologist interested in the impacts of chemicals in the water on frogs and ultimately the impacts on humans:
http://pbskids.org/dragonflytv/scientists/scientist51.html
http://www.nationalgeographic.com/field/explorers/tyrone-hayes/
http://www.exploratorium.edu/frogs/researcher/index.html

Procedure and Assessment
1. Form small groups of 3 -4 student and select one of the water quality issues listed below. (If your group would like to select another topic (which there are several additional large issues), please get your teacher’s permission before proceeding).

2. Follow the links under the topic heading (and find additional credible resources) to answer the associated questions.

3. Prepare a report (poster, web page, etc) about the water quality topic to share with the balance of the class.

Water Consumption Calculators
Water Footprint Calculator (http://www.h2oconserve.org/home.php)
Water Footprint Network (http://www.waterfootprint.org/?page=files/home)
USGS Estimated Water Use of the United States (http://pubs.usgs.gov/fs/2009/3098/)
United Nations Water Statistics (http://www.unwater.org/statistics.html)

- What are the percentages of use of freshwater in the world?
- What is the relation between water consumption and water use?
- What is your water footprint?
- The national water footprint?
- How could the footprint be reduced?

Pharmaceuticals In Drinking Water
Drinktap.org (http://www.drinktap.org/consumerdnn/Default.aspx?tabid=73)
EPA (http://www.epa.gov/ppcp/faq.html)
CBS News (http://www.cbsnews.com/stories/2008/03/10/health/main3920454.shtml)

- What are PPCPs?
- What are some sources of PPCPs?
- What are some concerns with PPCPs in the environment?
- What can you do about PPCPs in the environment?

Arsenic in Drinking Water
EPA (http://www.epa.gov/safewater/arsenic/index.html)

World Health Organization
(http://www.who.int/water_sanitation_health/dwq/arsenic/en/index.html)

CNN – Millions in Bangladesh exposed to arsenic in drinking water
(http://edition.cnn.com/2010/WORLD/asiapcf/06/20/bangladesh.arsenic.poisoning/)

- How does arsenic get into drinking water?
- Why is arsenic in drinking water a concern?
- What are some ways to mitigate arsenic in drinking water?

Waterborne Infectious Disease
World Health Organization (http://www.who.int/water_sanitation_health/emerging/en/index.html)

Centers for Disease Control and Prevention
(http://www.cdc.gov/healthywater/statistics/index.html)

Pulitzer Gateway
(http://pulitzergateway.org/water-health/?gclid=CLTFwPbutqICFcl25Qod52ID6A)

- Name three water and sanitation related diseases, how specifically they are contracted and symptoms of the disease.
- How many people around the world contract the disease?
- What is the mortality rate caused by the disease?
- Why do women and children tend to suffer most from water related illness and issues?