

LESSON:

Great Lakes—Make the Human Health Connection

Summary: Students read an extensive article on the Great Lakes' environmental problems, summarize the article's position on human health threats, then complete diagrams showing specific sources, routes of exposure, and health effects of four common pollutants.

EHP Article: "Great Lakes: Resource At Risk," *EHP Student Edition*, June 2005, p. A164
<http://ehp.niehs.nih.gov/members/2005/113-3/focus.html>

Objectives: By the end of this lesson students should be able to:

1. summarize the main environmental problems facing the Great Lakes.
2. identify four Great Lakes environmental problems that directly endanger human health, their likely sources, possible routes of exposure, and policies meant to minimize them.

Class Time: 50–60 minutes; additional research can be done as homework

Grade Level: 10–12

Subjects Addressed: Environmental Health, Biology, Health, Environmental Science

►Prepping the Lesson (30 minutes)

INSTRUCTIONS:

1. Read the article "Great Lakes: Resource At Risk" and review the Student Instructions and Assessing the Lesson.
2. Decide if students will be doing the exercise in class using the *EHP* article only, or if they will be assigned additional research. If students will be doing additional research, see the answer key for suggestions.
3. Decide if students will be doing the lesson individually or in groups.

MATERIALS (per student):

- One copy of the article "Great Lakes: Resource At Risk"
- One copy of the Student Instructions

VOCABULARY:

Algal bloom
 Atmospheric deposition
 Anoxia
 Ballast
 Bioaccumulate
 Biomagnification
 Body burden
 Cerebral palsy
 DDT
 Extirpation
 Methemoglobinemia
 Mercury
 Polybromated diphenyl ethers (PBDEs)
 Polychlorinated biphenyls (PCBs)
 Phytoplankton
 Sediments
 Sex ratio



Volatilize
Zooplankton

BACKGROUND INFORMATION:

The article “Great Lakes: Resource At Risk” is an extensive exploration of environmental issues facing the Great Lakes and the various efforts under way to restore or protect the lakes for future generations. Much of the article deals with dangers to the lakes that potentially affect their economic value to surrounding residents and industry. Other topics covered include dangers to native species and the destruction of shoreline habitat. The core of the article, however, focuses on potential dangers to human health caused by the introduction of chemical pollutants, sewage, and heavy metals into the lakes. This lesson highlights three essential elements in understanding environmental threats to human health: **sources, routes of exposure, and toxicity**. Once these are established, policies can be considered which address one (or several) parts of this dangerous equation.

The **sources** of pollutants that endanger human health are detailed in the article: industry, transportation, and development along the shoreline. **Routes of exposure** are a risk analysis concept that may be new to the students. For a pollutant to cause human health problems, it must come in contact with a person and enter the body. Common routes of exposure include through the air (breathing), through the mouth (eating or drinking), and through the skin. Preventing contact with and entry into the body of toxic agents are good ways of protecting people from environmental health problems. While the best solution is a clean environment, a good interim step is to limit human exposure. Toxicity is a measure of how harmful a toxic agent is for a person. It can refer to what body systems are affected, at what dose a toxic agent becomes deadly, or what physical effects have been established by the use of laboratory animals. For an excellent review of toxicology principles see the website “A Small Dose of Toxicology,” below.

RESOURCES:

Environmental Health Perspectives, Environews by Topic page. Choose Chemical Exposures, Climate Change/Global Warming, Drinking Water Quality, Ecological Change, Economics, Food Safety and Regulation, Hazardous Waste, Industry Issues, International Environmental Health, Mercury, Natural Resources, Polychlorinated Biphenyls (PCBs), Sustainable Development/Conservation, Water Pollution, <http://ehp.niehs.nih.gov/topic>

Great Lakes Information Network, go to “Pollution” then “Human Health,” <http://www.great-lakes.net>

ATSDR “ToxFAQs,” comprehensive toxicological information on common contaminants, <http://www.atsdr.cdc.gov/toxfaq.html>

Environmental Defense Fund “Scorecard,” a breakdown by region of common pollutants and their effects, <http://www.scorecard.org>

Society of Toxicology, <http://www.toxicology.org/publicoutreach/k12resources/k12educators.html>

CRC Press, follow the prompts to TF1691 for a complete presentation on principles of toxicology from Steven G. Gilbert, *A Small Dose of Toxicology*, CRC Press, 2004, http://www.crcpress.com/e_products/

► Implementing the Lesson

INSTRUCTIONS

1. Hand out the article to students and allow them to read it and take notes on the article’s general themes.
2. Have the students begin by summarizing the main threats to human health as cited in the article in no more than one page.
3. Next, have students complete the Human Health Connection Diagrams individually (or in groups) by closely reviewing the article and their notes. They should include facts from the article but also incorporate their own ideas, especially in the section about policy solutions. On the health effects section, students can either write the health effects or actually draw the affected body parts or systems.
4. Have students report their results to the rest of the class and summarize their findings.

NOTES & HELPFUL HINTS:

- Students should be encouraged to use logic and prior knowledge to add answers to the Human Health Connection Diagrams. The answer key reflects some of the possible answers.
- The class of chemicals known as PBDEs are a newly emerging problem. Some of the information needed to complete the Human Health Connection Diagrams is not included in the article because the issues are not yet clear. It is important to emphasize to students that science is a constantly evolving field—there is always more to learn.
- This lesson can be extended by having students research any of the following contaminants/biological agents from the article: chlordane, dioxin, microcystin, DDT, and lead. The basic lesson stresses the most widespread and familiar contaminants.



►Aligning with Standards

SKILLS USED OR DEVELOPED:

- Communication (note taking, oral, written—including summarization)
- Comprehension (listening, reading)
- Critical thinking and response
- Research
- Tables and figures (creating, reading)

SPECIFIC CONTENT ADDRESSED:

Unifying Concepts and Processes Standards

- Systems, order, and organization
- Evidence, models, and explanation
- Change, constancy, and measurement
- Evolution and equilibrium
- Form and function

Science in Personal and Social Perspectives Standards

- Personal and community health
- Population growth
- Natural resources
- Environmental quality
- Natural and human-induced hazards
- Science and technology in local, national, and global challenges

NATIONAL SCIENCE EDUCATION STANDARDS MET:

Plan an inquiry-based science program

- Develop student understanding, and nurture community of science learners
- Work within and across disciplines and grade levels

Guide and facilitate learning

- Support inquiries when interacting with students
- Model inquiry, curiosity, openness to new ideas and data, and skepticism

Ongoing assessment of teaching and student learning

- Use multiple methods, and systematically gather data about student understanding and ability
- Report student achievements and opportunities to learn

Create learning environments that provide time, space, and resources for learning science

- Structure time to allow extended investigations
- Create setting that is flexible and supportive of inquiry
- Make tools, materials, media, and resources available to students
- Use resources outside of the school
- Engage students in designing a learning environment

Develop communities of science learners that reflect the intellectual rigor of scientific inquiry, and attitudes and social values conducive to scientific learning

- Give students a voice in decisions, and require students to take responsibility for the learning of all members of the community
- Nurture collaboration among students

Actively participate in the ongoing planning and development of school science program

- Participate in decisions concerning the allocation of time and other resources to the science program



▶Assessing the Lesson

An answer key has been provided below for the completion of the Human Health Connection Diagrams based on the article. (Answers in parentheses are not included in the article but might be raised by the students.)

Pollutant	Sources	Routes of Exposure	Health Effects	Policy/Action
PCBs	Industrial use in past, sediments, abandoned sites, air	Eating fish	Sex ratio changes, difficulty conceiving, shortened menstrual cycle	Source: Discontinue use, ban, clean up old sites Exposure: Public education, limiting fishing
PBDEs	Plastics, flame retardants in consumer goods, housing	Unclear, possibly breathing, (possibly ingestion)	Unclear, possibly developmental problems, reproduction problems, thyroid problems	Source: (Limit use) Exposure: Unclear
Mercury	Coal-fired power plants, incinerators, chemical waste from industrial sites, industrial boilers	Eating fish, (drinking water)	Reproductive problems, poisoning, tremors, deafness, blindness, cerebral palsy	Source: (Control use, disposal) Exposure: Limit fishing
Sewage	Runoff of untreated sewage due to storms, septic system failures	Drinking water, (swimming)	Severe intestinal disease, gastric problems, methemoglobinemia, death	Source: Improve drainage systems, control runoff Exposure: Protect drinking water

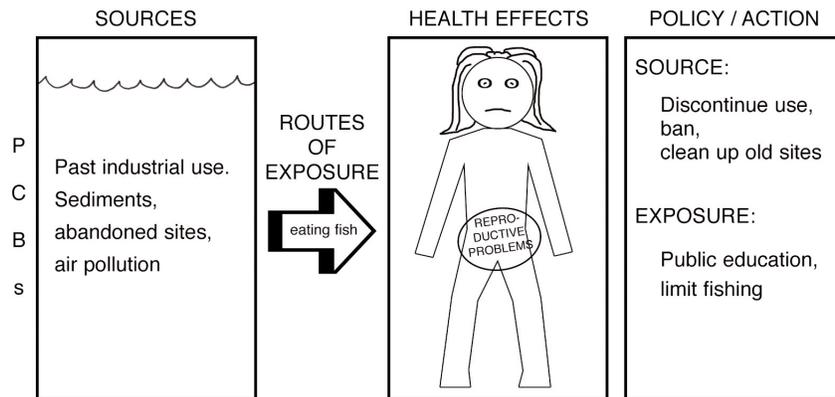
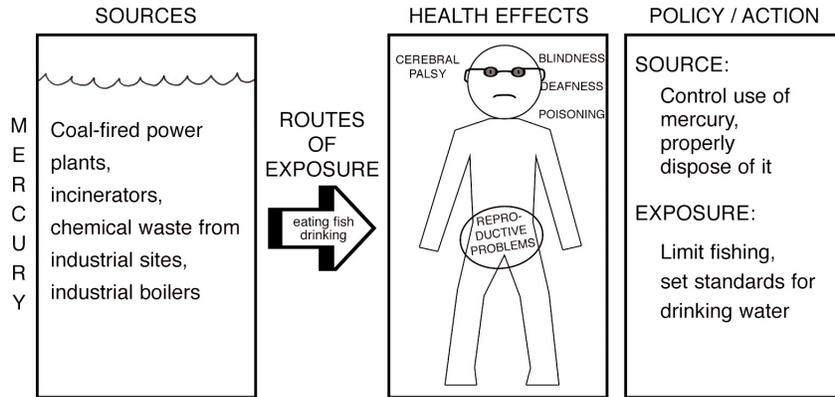
▶Authors and Reviewers

Authors: Wendy Stephan and Lisa Pitman, University of Miami Rosenstiel School of Marine and Atmospheric Science, NIEHS Marine and Freshwater Biomedical Sciences Center

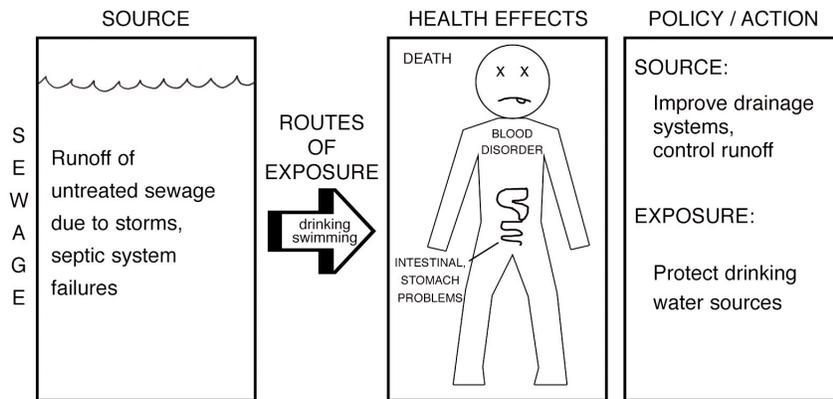
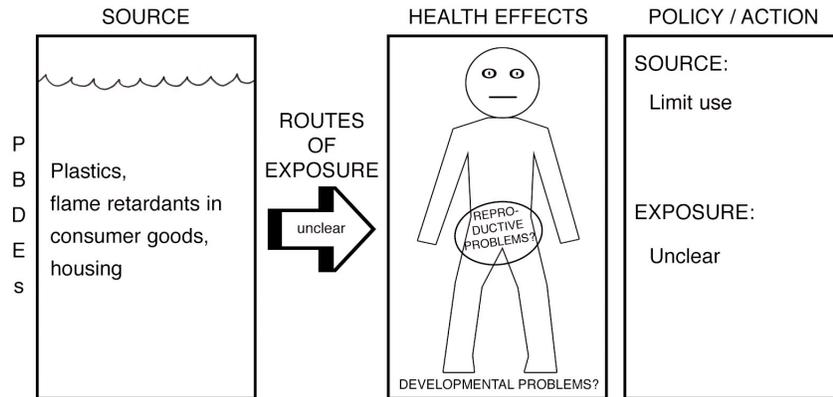
Reviewers: Susan M. Booker, Laura Hemminger, Stefani Hines, Liam O' Fallon, Barry Schlegel, Kimberly Thigpen Tart



HUMAN HEALTH CONNECTION DIAGRAMS 1



HUMAN HEALTH CONNECTION DIAGRAMS 2



Great Lakes—Make the Human Health Connection

Step 1: Read the article "Great Lakes: Resource At Risk," *EHP Student Edition*, June 2005, p. A164. Take notes in the box below as you read identifying the major environmental problems, why they have occurred, and how people are affected.

Step 2: Summarize in one page or less the main threats to human health identified by the article.

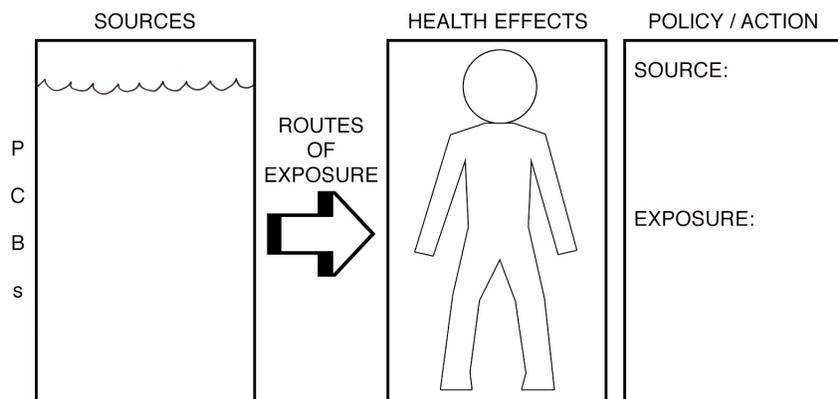
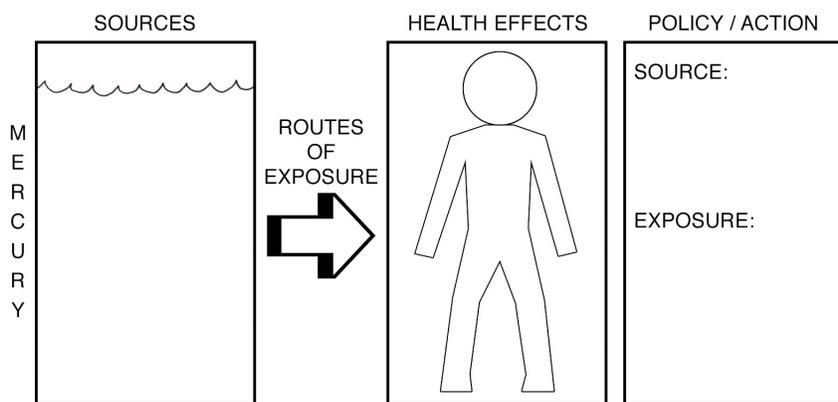
Step 3: Complete the first three sections of the Human Health Connection Diagrams with information from the article for PCBs, PBDEs, mercury, and sewage. Write the information in the boxes for Sources, Health Effects, and Routes of Exposure. For Health Effects you may also draw the organs or systems affected.

Step 4: In the Policy/Action box, identify solutions that could help control the sources of the pollution or reduce human exposure to the pollutant.

Pollutant	Sources	Routes of Exposure	Health Effects	Policy/Action
PCBs				
PBDEs				
Mercury				
Sewage				



HUMAN HEALTH CONNECTION DIAGRAMS 1



HUMAN HEALTH CONNECTION DIAGRAMS 2

