Mercury In Your School and the Community: A National Issue

is a participatory curriculum that was adapted from
“Mercury In Your Community and the Environment”
(A Wisconsin Curriculum)

by the
Mercury in Schools Education Team
Steve Brachman, Waste Reduction Specialist, University of Wisconsin - Extension
Benjamen Jones, Project Assistant, University of Wisconsin - Extension
Steve Skavroneck, Environmental Consultant
Al Stenstrup, Environmental Educator, Wisconsin Department of Natural Resources
Mary Thiry, Youth Development Educator, University of Wisconsin - Extension

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Introduction

Why Mercury Education

Mercury is a naturally occurring element that can cause health and ecological problems when released to the environment through human activities. Though a national, and even international issue, the mercury problem is best understood when studied at the local level. Use this guide to help your students learn about the health and environmental concerns associated with mercury, find out where it is in their school and homes, and help school officials and family members do something about it.

This curriculum contains background information on mercury and youth-based activities. To obtain the most out of the curriculum, teachers should read over the general information and have the students conduct their mercury I.Q. Teachers do not need to use all of the activities, they can then proceed to any section, according to their curriculum needs, and review the scientific information provided and assign to their students the corresponding activity. However, it is usually a good idea to do Activity 2, the case study, before doing any of the Activities 3 through 10. Activities were designed for High School classes, however many are appropriate for 6th through 8th grade use.

Correlations to National Standards

The teaching activities included in the Mercury In Your School and the Community: A National Issue are interdisciplinary and have been correlated to the National Science Education Standards, the Curriculum Standards for Social Studies, and the U.S. Education Standards for Physical Education and Health Standards.

Only Grade 12 standards were considered. For the Social Studies and Physical Education and Health Standards the Content Standard is listed first and refers to what students should know and be able to do. The Performance Standard is then listed and tells how students will show they are meeting a standard. For the Science Standards only the Content Standard is listed. Only direct relationships are listed and apply only to the main activity the students are involved with.

Social Studies Standards

II. Time, Continuity, & Change

Social studies programs should include experiences that provide for the study of the ways human beings view themselves in and over time, so that the learner can:

c. apply key concepts such as time, chronology, causality, change, conflict, and complexity to explain, analyze, and show connections among patterns of historical change and continuity;

Activity 8

III. People, Places, & Environments

Social Studies programs should include experiences that provide for the study of people, places, and environments, so the learner can:
b. create, interpret, use, and synthesize information from various representations of the earth, such as maps, globes, and photographs;

Activity 7

k. propose, compare, and evaluate alternative policies for the use of land and other resources in communities, regions, nations, and the world.

Activities 9, 10

VI. Power; Authority, & Governance

Social studies programs should include experiences that provide for the study of how people create and change structures of power, authority, and governance, so that the learner can:

j. prepare a public policy paper and present and defend it before an appropriate forum in school and community

Activity 10

X. Civic Ideals & Practices

j. participate in activities to strengthen the “common good” based upon careful evaluation of possible options for citizen action.

Activities 9, 10

U.S. Education Standards – Physical Education and Health Standards

NPH-H.9-12.1 Health Promotion and Disease Prevention

Students will comprehend concepts related to health promotion and disease prevention—

- Analyze how behavior can impact health maintenance and disease prevention. Activity 2
- Explain the impact of personal health behaviors on the functioning of body systems. Activity 2
- Analyze how the environment influences the health of the community. Activities 6, 10
- Analyze how public health policies and government regulations influence health promotion and disease prevention. Activities 9, 10

NPH-H.9-12.3 Reducing Health Risks

Students will demonstrate the ability to practice health-enhancing behaviors and reduce health risks—

- Evaluate a personal health assessment to determine strategies for health enhancement and risk reduction. Activities 3, 4
- Analyze the short-term and long-term consequences of safe, risky and harmful behaviors. Activity 2

NPH-H.9-12.4 Influences on Health

- Analyze how information from the community influences health. Activity 9

NPH-H.9-12.7 Health Advocacy

- Evaluate the effectiveness of communication methods for accurately expressing
health information and ideas. Activities 9, 10
- Express information and opinions about health issues. Activities 9, 10
- Demonstrate the ability to work cooperatively when advocating for healthy communities. Activities 9, 10

**Science Standards**

**Content Standard A: Science as Inquiry**

As a result of activities in grades 9-12, all students should develop
- Abilities necessary to do scientific inquiry. Activities 3, 4, 5

**Content Standard B: Physical Science**

As a result of activities in grades 9-12, all students should develop an understanding of
- Structure and properties of matter. Activities 2, 8

**Content Standard C: Life Science**

As a result of activities in grades 9-12, all students should develop an understanding of
- Interdependence of organisms. Activities 7, 8

**Content Standard F: Science in Personal and Social Perspectives**

As a result of activities in grades 9-12, all students should develop an understanding of
- Personal and community health. Activity 2
- Natural Resources. Activities 8, 9
- Environmental Quality. Activities 6, 7
- Natural and human-induced hazards. Activities 2, 9
- Science and technology in local, national, and global challenges. Activities 8, 9
Focus On Mercury – General Information

Mercury In Our World

(Excerpted by permission from “Mercury: Get Mad Now, Not Later,” a 1994 fact sheet by the Western Lake Superior Sanitary District)

Mercury, also known as quicksilver because it is a silver-colored liquid at room temperature, is an element that does not break down. It occurs naturally and is found in very small amounts in oceans, rocks and soils. It becomes airborne when rocks erode, volcanoes erupt and soil decomposes. It then circulates in the atmosphere and is redistributed throughout the environment. (See page 9 for a listing of the unique and interesting properties of mercury.)

Large amounts of mercury also become airborne when coal, oil or natural gas are burned as fuel or mercury-containing garbage is incinerated. Once in the air, mercury can fall to the ground with rain and snow, landing on soils or water bodies, causing contamination.

Lakes and rivers are also contaminated when there is a direct discharge of mercury-laden industrial waste or municipal sewage. Once present in these water bodies, mercury accumulates in fish and may ultimately reach the dinner table.

Although mercury has been a very useful element, due to its unique properties, it poses a very real health risk—from direct exposure to mercury, as well as from eating contaminated fish. We can minimize this risk by reducing our use of mercury-containing products and properly disposing of mercury-containing waste.

Mercury has been used for thousands of years for a wide variety of purposes. Historical uses, which are no longer prevalent, include: preparing felt for hats, controlling mildew in paints, killing weeds as a component of herbicides, and various medical uses—teething powder, antiseptic ointments and syphilis treatment. Its toxic effects on workers in hat factories in the late 1800’s led to the term “mad as a hatter.” Mercury is still used for folk medicine and ceremonial purposes in several cultures.

Today, mercury is released to the environment from many sources. It is used in household and commercial products, as well as industrial processes. Coal-fired power plants, incinerators, some manufacturing plants, hospitals, dental offices, schools and even homes have all been found to release mercury. In the home, mercury can be found in fluorescent lights, thermostats, thermometers, and even some children’s toys. At school, mercury may be in science and chemistry classrooms, the nurse’s office and electrical systems. School and home mercury audit activities in this package
provide more detailed information on where to find it and what to do about it.

**Mercury Health Issues**

Two different forms of mercury are of human health concern. Elemental mercury, which is most toxic in its gas form, slowly vaporizes at room temperature and more quickly when heated. Children playing with elemental mercury can be seriously poisoned by breathing the invisible vapor from mercury spilled in carpeting, furniture or other surfaces.

Elemental and inorganic mercury can be transformed into organic mercury by the bacteria in the bottom mud in water bodies. Unlike elemental mercury, organic mercury (often referred to as “methylmercury”) can be readily absorbed in humans. The most likely source of methylmercury exposure is eating contaminated fish, which can result in long-term damage to the kidney, liver and central nervous system. Young children and developing fetuses are most at risk.

Organic mercury tends to increase up the food chain, particularly in lakes. The mud at the bottom of a lake may have 100 or 1000 times the amount of mercury than is in the water. Worms and insects in the mud extract and concentrate the organic mercury. Small fish that eat these critters further concentrate the mercury in their bodies. This concentration process, known as “bioaccumulation”, continues as larger fish eat smaller fish until the top predator fish in the lake may have methylmercury levels in their tissues that are up to 1,000,000 times the methylmercury level in the water in which they live.

Most states advise anglers and their families to reduce their consumption of certain types and sizes of fish either statewide or for individual water bodies. Certain types of store bought fish also have elevated mercury levels. The US Food and Drug Administration has issued consumption advisories relating to mercury for mackerel, swordfish, tilefish, and tuna.

**Mercury and Children’s Health**

The greatest risk of mercury poisoning is for fetuses and young children because their nervous systems are still developing. They are four or five times more sensitive to mercury than adults. Damage occurring before birth or in infancy can cause a child to be late in beginning to walk and talk, and may cause lifelong learning problems. Unborn children can be seriously affected even though the methylmercury causes no symptoms in their mothers.
Mercury Exposure from Cultural and Religious Practices

In the United States, certain Afro-Caribbean and Latin American traditions, including: Santeria, Palo, voodoo, and Espiritismo incorporate the use of elemental mercury in folk medicine and religious practice. Mercury is sold in most botanicas—stores specializing in herbal remedies and religious items used in these traditions. Its use, normally in small, enclosed spaces, combined with the fact that small amounts of mercury can remain for long periods of time, create the potential for very high direct exposures to individuals. Although these religious traditions have been well studied by anthropologists and sociologists, and many medical anthropologists have documented the use of potentially toxic remedies in folk medicine, little attention has been focused on the health implications of toxic substances used in religious rituals and spells.

Availability and extent of use
Several surveys have attempted to characterize mercury use in Latino/a and Afro Caribbean communities. Metallic mercury is available at botanicas in New York, New Jersey, and Pennsylvania, but botanica personnel often deny having mercury for sale when approached by outsiders to these religious and cultural traditions. Actions by public health authorities have driven the mercury trade underground in some locations. In a survey of New York City botanicas, 93% reported selling elemental mercury (about one to four capsules per day). A survey of 115 botanicas in 13 cities in the United States and Puerto Rico found that 99 sold mercury. Another survey of 203 Caribbean and Latin American adults in the New York City area found that 44% of Caribbean and 27% of Latin American respondents reported using mercury.

Uses
Mercury is typically sold in capsules that contain, on average, about 8 or 9 g (0.3 oz.) mercury. The most common method of use reported by botanica personnel was to carry mercury on the person in a sealed pouch (49%) or in a pocket (32%) as an amulet; sprinkling mercury in the home was mentioned by 29%. Proprietors reported that family members, friends, spiritualists, and card readers recommend mercury to store patrons to bring luck in love, money, or health and to ward off evil. A survey of Latin American and Caribbean New York residents found that burning mercury in a candle, mixing it with perfume, and sprinkling it in the car were also frequently reported uses. Of 28 New York botanicas visited during another survey, 13 prescribed sprinkling mercury on the floor. Mercury poisoning has also been documented in Mexican-American infants fed mercury as a folk
remedy for gastroenteritis. Medical anthropologist Robert Trotter identified the use of mercury, as well as lead oxides, for the treatment of empacho, a digestive illness.

**Impact**

As a result of these practices, living spaces may become contaminated with mercury. Removal of elemental mercury from floorboards and carpets is difficult, if not completely impractical. These mercury practices can be a direct source of contamination not only in the users, but also in their families, people living in adjacent apartments, and any future residents of the premises. The potential liability to present and future landlords is significant, because current and prospective homeowners may raise concerns about health risks related to prior mercury use on the premises. In addition, much of the mercury used in folk medicine and religious practice may be disposed of improperly. One survey found that 64% of mercury users in a study reported throwing mercury in the garbage, 27% flushed it down the toilet, and 9% threw it outdoors. Preliminary interviews with mercury users indicated a lack of knowledge about the inhalation pathway as the primary route of mercury exposure. People seem to know that mercury is toxic and avoid touching or eating it in most cases, but they do not seem to know about how quickly it turns into vapor (gas form) and the inhalation exposure risks associated with that. Several local and national education efforts have been undertaken in the past.

**Community involvement, outreach, and education**

Because botanicas represent a critical link to health care services in Latino/a and Afro Caribbean communities, it is important to recognize the role of botanicas in providing culturally congruent health interventions in their communities. Botanicas are the first place many turn for general health care services in Latino/a and Caribbean communities; any public health interventions to reduce mercury exposure must work with spiritualists, Santeros, and botanica proprietors. Working cooperatively with botanicas to promote effective substitutes and institute labeling for mercury is more likely to be effective than an adversarial enforcement approach that essentially criminalizes cultural practices. Outreach in Afro-Caribbean and Latino/a communities is a must. Such outreach and education will be most effective if they are coordinated with an effort to characterize the ways mercury use and its hazards are understood in the communities, so that communications can address any gaps in knowledge and provide the most important information to mercury users.

*Previous information taken from “Assessing Elemental Mercury Vapor Exposure from Cultural and Religious Practices,” by Donna M. Riley, C. Alison Newby, Tomas O. Leal-Almeraz, Valerie M. Thomas
* -article published in Environmental Health Perspectives – Volume 109, Number 8, August 2001

July 4, 2001 Posted: 5:51 AM EDT

**Thai diners told steer clear of 'toxic' shark fin**

**BANGKOK, Thailand** – The health ministry in Thailand is urging diners to stay away from shark fin soup following reports that the increasingly popular delicacy may contain dangerously high levels of mercury.

On Tuesday a report by environmental pressure group Wild Aid said shark fins found on sale in Thailand contained...
levels of the heavy metal as much as 42 times the level considered safe for human consumption. Responding to the report, Deputy Public Health Minister Surapong Suebwonglee told Thai television Wednesday that officials were collecting samples of the soup from various restaurants and would be conducting tests over the coming days. He said that until safety tests had been completed diners should avoid eating the dish. Pressure groups have been calling for a halt to the growing trade in shark fins across Asia which they say is cruel, wasteful and having a devastating effect on the shark population. Shark fin soup has been growing in popularity across East Asia where, because of its high price, it is considered a prestigious dish to order at business occasions, weddings and other banquets.

**Soaring demand**
In Hong Kong, a world center for the shark fin trade, a single bowl of soup can cost more than US$100. To feed this demand environmentalists say millions of sharks are killed each year for the fin trade, most of them taken from waters in the Asia-Pacific region. Wild Aid says that between 1980 and 1997 trade in shark fins more than doubled to 7,000 tons annually. The majority of the sharks are pulled from the sea, have their fins hacked off, and are then thrown back into the water where -- unable to swim without their fins -- they drown. Environmentalists say sharks perform a vital function at the head of the food chain and dwindling shark populations will have a serious effect on the marine eco-system.

**Bulked out**
In conducting its survey Wild Aid said it had tested samples from 10 fins bought from three dealers in Bangkok's Chinatown. It said all contained dangerously high levels of mercury and were also pumped full of as yet unidentified chemicals. The report said that the need to bulk out fins in this way was a further sign that the shark numbers were decreasing. News that fins may contain dangerously high levels of toxins is being seen as adding further weight to environmentalists' campaigns to stem the trade. Already pressure from such groups had persuaded a number of Asian airlines to stop serving the soup to their business and first class passengers, and last year Taiwanese officials vowed to ban dishes made with shark fins from official banquets. In any case, campaigners say, the fins contain no nutritional value and have little themselves in the way of taste. They say that basically what diners are eating is cartilage, the same material that makes up fingernails or hair.

Even though they are considered a prestigious dish, shark fin consumption pose threat to consumers and to shark population.

*previous article taken from cnn.com*
What Is Special About Mercury

Even though mercury looks like something from outer space, it is a naturally occurring element that can be found on a periodic table. (Periodic symbol: \textbf{Hg})

<table>
<thead>
<tr>
<th>Special or Unique Properties of Mercury</th>
<th>So What?</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Only metal that is liquid at room temperature.</td>
<td>• Holds fascination for people of all ages. Special uses in several different cultures.</td>
</tr>
<tr>
<td>• Easily evaporates into the air.</td>
<td>• A blob of mercury sitting on the table will eventually disappear. The mercury vapors can be extremely dangerous to breathe.</td>
</tr>
<tr>
<td>• Very dense, yet fluid. Density = 13.546 g/cm(^3) (Density of water = 1.00 g/cm(^3))</td>
<td>• Just a little bit weighs a lot, yet moves around easily. This is useful in certain medical procedures.</td>
</tr>
<tr>
<td>• Good conductor of electricity.</td>
<td>• Used in electrical “tilt” switches and other electrical devices.</td>
</tr>
<tr>
<td>• Expands or contracts uniformly with changes in temperature.</td>
<td>• Used in thermometers and thermostats.</td>
</tr>
<tr>
<td>• Readily combines (amalgamates) with other metals.</td>
<td>• Dentists use a combination of mercury and silver, called “amalgam,” which is used to fill cavities in teeth.</td>
</tr>
<tr>
<td>• Kills bacteria and fungi.</td>
<td>• Previously used in pesticides, paints and on people to kill germs!</td>
</tr>
</tbody>
</table>
Activity 1 – Mercury I.Q.

Handout to students to test their mercury I.Q.

1. What is mercury?
   a. A type of tree found in the rainforest
   b. An element on the periodic table (symbol: Hg)
   c. A liquid aliens like to put on their hamburgers

2. What is another common name for mercury?
   a. Quicksilver
   b. Space goo
   c. There are no other names for mercury

3. What can mercury be found in?
   a. Switches
   b. Thermostats
   c. Thermometers
   d. All of the above

4. What animals are most likely to have elevated mercury levels in tissues?
   a. Large fish
   b. Snakes
   c. Birds that live in a rainforest

5. Mercury is used in:
   a. Dental fillings for cavities
   b. Fluorescent lamps
   c. Cars
   d. All of the above

6. Mercury is mined today in what countries? (Mark all that apply)
   a. U.S.
   b. Spain
   c. Mexico
   d. Russia

7. Some states or local governments have passed bans on the sales of:
   a. Mercury thermostats
   b. Mercury thermometers
   c. Fluorescent lights
   d. All of the above

8. Mercury is the only known metal that is liquid at 72 degrees: True or False
9. Mercury can be very dangerous: True or False

**Answer Sheet for activity 1**

1. b
2. a
3. d
4. a
5. d
6. b
7. b
8. True
9. True
School Information
Mercury Awareness for School Teachers

**WHAT IS MERCURY?**

Mercury is a silvery liquid metal at room temperature. Mercury conducts electricity, expands uniformly with temperature and easily forms alloys with other metals. For these reasons, it is used in many products found in homes and schools. Mercury is also an element that occurs naturally in the earth’s surface. It does not degrade and is not destroyed by combustion. Instead, mercury changes into a vapor that can travel long distances when volatilized. Mercury cycles between soils, the atmosphere and surface waters. Its toxicity can endanger living organisms and produce adverse health effects in humans.

**WHY IS MERCURY A CONCERN?**

There have been many incidents involving mercury spilled in schools, school buses or school property that cause alarm and require cleanup. Sometimes mercury comes from inside the school, and sometimes mercury is brought into the school from the community. Mercury that is spilled or spread through a school creates an immediate health issue, and may require expensive cleanup and monitoring.

Spilled mercury can evaporate at room temperature and easily be inhaled by the room occupants. Spilled mercury can spread long distances and settle in cracks and porous materials like cloth, carpet or wood, slowly emitting vapors over a long period of time. Mercury vapor is colorless, odorless and tasteless. Short-term exposure to a high concentration of mercury or mercury vapors can lead to nausea, shortness of breath, bronchitis, migraine headaches, and fatigue. Long-term exposure to mercury can result in damage to the nervous system, kidneys and liver. Symptoms include tremors, numbness in the fingers and toes, loss of muscle control, memory loss and kidney disease. Children, fetuses, and women of childbearing age are the most at risk for mercury poisoning. Mercury should be handled carefully, especially around children.

Mercury is also a concern in the environment. Improper disposal of mercury-containing products is one way that mercury is released into the air, land and water. Mercury easily enters its vapor form, and can travel long distances. Mercury that reaches lakes, rivers and streams can be converted into methylmercury by bacteria in the water. Methylmercury builds up in wildlife tissue, especially in fish. As larger fish eat smaller fish, the mercury concentrates travels up the food chain. Methylmercury can move up the food chain and create a risk for people who eat fish.

It does not take a lot of mercury to have negative environmental consequences. Researchers estimate that if one gram of mercury—one-seventieth of a teaspoon enters a 20-acre lake every year from the atmosphere, that minute amount is enough to raise the mercury levels in the fish. Methylmercury in large fish can be thousands of times greater than levels in the surrounding water.
Mercury Awareness for School Teachers

What can schools and teachers do to reduce the presence of mercury in schools?

Help educate students, other teachers and administrators about the health hazards and environmental fate of mercury; promote proper management and recycling of mercury and mercury-containing products; eliminate the use of mercury wherever possible at schools; prevent mercury spills and know what to do if a spill occurs; promote the use of alternative products that do not contain mercury; and promote energy efficiency.

Learn more about mercury

Teachers can educate students about mercury by including it as part of their lesson plans. One of the best resources is the Mercury in Schools Pollution Prevention project, located at http://www.mercuryinschools.uwex.edu

Reduce the use of mercury and mercury-containing products

To reduce the presence of mercury at school, you have to know where to find it. Interestingly, mercury can be found in a lot of places, some obvious and some you would not expect. You would expect to find mercury in science classrooms and the laboratory, but you can also find it throughout the school, in the cafeteria and in the nurse’s office. It is worthwhile for schools to replace mercury-containing equipment or choose to purchase products that contain less mercury to reduce the long-term impact on the environment.

Pollution prevention examines the causes of waste and pollution to figure out the best way to reduce it. Pollution prevention avoids generating pollution at the source rather than trying to control it afterwards. This is also called “source reduction.” Always reduce waste before recycling. Avoid products containing mercury if substitutes are available.

Classrooms, facilities and grounds

School classrooms and facilities may have mercury containing thermostats, thermometers, barometers and silent wall switches. It is simple and economical to find mercury-free alternatives for these. Approximately 75 percent of thermostats currently in use contain mercury. Electronic devices are often excellent alternatives, though many digital devices may have mercury-containing batteries, so it is best to use devices that allow you to replace the batteries with batteries free of mercury.

The lamps in the gymnasium and parking lot are generally referred to as high intensity discharge (HID) lamps, and they contain mercury. Even fluorescent and neon lamps have some mercury. However, greater energy efficiency of fluorescent lamps reduces the amount of mercury discharged by power plants generating electricity. There are also low-mercury alternatives that contain less mercury than older lamps.

Other items that contain mercury include button cell batteries and old microwave ovens that could be in the school’s cafeteria. Newer microwaves do not contain mercury. Batteries now contain much less mercury, but the mercury content is still worth considering. Button
batteries may contain up to 25 milligrams of mercury per battery. Some lithium button batteries may be free of mercury. It is always best to send old lamps and batteries to a recycling facility.

The janitorial and grounds staff also need to be aware of the materials they are using. Old latex paint produced before 1992 may contain mercury to act as a fungicide. Pesticides produced before 1994 may also contain mercury. If old mercury containing paints or pesticides are still at the school, dispose of them properly as hazardous waste. Newer paints and pesticides do not contain mercury.

Laboratories
Unlike other classrooms, laboratories may have a lot of thermometers, air pressure gauges, mercury compounds and elemental mercury for use by the students. Mercury may have been used historically in a school’s laboratory, and the laboratory may still have containers of mercury or mercury compounds in storage.

There are several mercury-free thermometers available, including red alcohol and digital thermometers. Generally, alcohol or electronic thermometers are sufficiently accurate and readily available. If mercury is used in experiments, often it is possible to use other chemicals to illustrate the same chemistry principles, or do microscale experiments to reduce the amount of materials necessary and reduce the need to have large quantities of mercury at the school. If mercury is used as part of the curriculum, make sure to have a mercury spill kit available, and that staff are trained in its use.

Nurse’s Office
The nurse’s office may have the most elemental mercury in the school, including thermometers and blood pressure measuring devices. Blood pressure gauges or sphygmomanometers may contain several pounds of mercury. Aneroid blood pressure devices and digital thermometers are available, and are as accurate as mercury-containing ones. There are also nasal sprays and contact lens solutions that contain thimerosal, phenylmercuric acetate or phenylmercuric nitrate. These compounds all have mercury in them, and have mercury free alternatives.

**Energy Efficiency**

Electricity generation is currently the largest source of mercury emissions in the United States. Practicing energy conservation by using energy efficient products and practices reduces the amount of mercury released by power plants and reduces the amounts of other pollutants released as well. Energy efficiency also reduces carbon dioxide, sulphur oxide and nitrogen oxide releases, and makes good economic sense.

**Proper Management and Retirement of Mercury-Containing Devices**

Many mercury-containing products can be recycled. Mercury metal, thermostats, batteries, thermometers and fluorescent lights are some products that can and should be safely recycled.
Mercury Awareness for School Teachers

In Case of a Spill

By being aware of, and by properly maintaining and replacing mercury products with mercury-free alternatives, the risk of a mercury spill is greatly reduced. If a spill does occur, it is important to have a plan to address it. The safest and best way to clean up a mercury spill is by hiring a licensed professional contractor. When mercury spills or an item containing mercury breaks, carefully evacuate the area around the spill and move students to a different room. Mercury and its vapors are very difficult to remove from clothes, carpet, floors, walls, and furniture. Keep everyone away from the area to prevent them from inhaling the mercury, since it can evaporate quickly. Never wear shoes or clothing that are contaminated with mercury, since it is absorbed in cloth and easily spread from one place to another. If possible, open windows to ventilate the spill area to the outdoors. Close the doors and place signs prohibiting entry on the entrances to the impacted rooms. Contact the school maintenance personnel to turn off heating, air-conditioning systems and fans. This will help avoid circulating contaminated air to other rooms. NEVER clean up a spill with a vacuum cleaner. This contaminates the vacuum and circulates mercury into the air. Do not use brooms or paintbrushes to clean up, since mercury will disperse into smaller beads and be harder to collect.

*information taken from Ohio EPA, Office of Pollution Prevention
http://www.epa.state.oh.us/opp/schoolt1.pdf
Purpose
To create an awareness within students that mercury exposure in schools is occurring and can cause health risks.

Objective
Students will demonstrate their understanding of mercury issues in schools by discussing a news story.

Materials
✓ Article from the Detroit Free Press, “Teacher placed on paid leave after toxic science experiment”
 patrols. *Note that state-specific case studies are available by clicking on your state on the national map on the Mercury in Schools web site at www.mercuryinschools.uwex.edu

Procedure
Assign the above article and press release to be read prior to class. Assign different students to lead the discussion of any or all of the following questions (and/or questions that you develop for this activity). This involves preparing a brief introduction for the topic and facilitating discussion of the question among the other students.

Discussion Questions
? Why should we be concerned about mercury?
? What are some of the symptoms of exposure to mercury?
? Why are young children and fetuses more vulnerable to mercury exposure than adults?
? What are some of the different ways that we can be exposed to mercury?
? How does mercury move around in the environment?
? What would you advise your parents to do if they discovered a broken mercury thermometer in the house? What would you do if you came across a jar of mercury in someone’s garbage or in an abandoned lot?
? What dangers are associated with the use of mercury as folk medicine or for religious practices?
? What are some of the special properties of mercury that make it different from other materials?
? Do you think there is mercury in this school? Where?
? Do you think there is mercury in your home? Where?
? Why is it so hard to clean up mercury after it has spilled?
**“Teacher placed on paid leave after toxic science experiment”**

December 4, 2001 1:56 P.M.

**GRAND LEDGE, Mich.** (AP) — A middle school teacher is on paid leave while district officials investigate why he allowed students to touch mercury during an experiment.

Up to 27 sixth-grade science students at Hayes Middle School were directly exposed to the toxic liquid metal while doing a physical science experiment in teacher Paul Cherry’s class last week, district spokesman Steve Krumm told the Lansing State Journal for a story Tuesday.

Officials in the Eaton County district about 10 miles west of Lansing became aware of the exposure Friday and brought in health officials to assess the health risks.

On Monday, Cherry’s classroom was blocked off from use. Superintendent Marsha Wells issued a news release on the incident but refused to answer specific questions.

Cherry has declined comment.

Three Barry-Eaton District Health Department employees worked about 16 hours Friday and Saturday to test for mercury and advise school officials about what to do, said Jim Rutherford, Barry-Eaton director of the environmental health division.

Health officials also visited the homes of the teacher and students to make sure the mercury wasn’t spread, he said. A few book bags and clothing items were collected. “All in all, it’s a fairly contained situation,” Rutherford said.

There were two bottles containing mercury in the classroom, each with less than two tablespoons of mercury, Rutherford said.

“Any amount of mercury can become very harmful if it is vaporized,” he said.

High levels of mercury -- found in old glass thermometers and fluorescent lights -- can cause kidney failure, central nervous system damage and even death.

Grand Ledge High School junior Alicia Arritt said Cherry let her class touch mercury five years ago in a sixth-grade science class at Grand Ledge’s Beagle Middle School.

Cherry held the mercury and told the students then they could touch it if they wanted to, Alicia said. “He didn’t make it seem dangerous at all,” she said. Alicia didn’t handle the mercury.

The district hired Marine Pollution Control, a Detroit-based environmental health consulting firm, to do the cleanup at Hayes. Mercury traces were found in the classroom and lockers of five students, according to the news release. Equipment and furniture are being replaced in the affected classroom.

Barry-Eaton District Health Department will write its report on the incident and provide copies for the Michigan Department of Community Health and Grand Ledge Public Schools, Rutherford said.

By Dec. 31, 2004, Michigan school districts must remove all instruments containing mercury that are handled by children, according to recent state law.

“This is great information to go out in the school system and tell people why we want mercury out of the schools system,” Rutherford said. “It does happen and it will happen.”
ATSDR and EPA Warn the Public about Continuing Patterns of Elemental Mercury Exposure

Elemental (or metallic) mercury is a hazardous chemical that can cause serious health problems. Children (especially very young children) and fetuses are most vulnerable. The Agency for Toxic Substances and Disease Registry (ATSDR), part of the U.S. Public Health Service, and the Environmental Protection Agency (EPA) are jointly issuing an alert to the general public. There is a continuing pattern of elemental mercury exposure in children and teenagers and in persons using certain folk medicines or participating in certain ethnic or religious practices.

ATSDR and EPA strongly advise against the use of uncontained elemental liquid mercury (that is, mercury not properly enclosed in glass as it is in thermometers) in homes, automobiles, day care centers, schools, offices, and other public buildings.

It is important for the general public to understand that either short-term or long-term exposures to elemental mercury can lead to serious health problems. Human exposure to elemental mercury occurs primarily from breathing contaminated air. Other forms of mercury can be absorbed by drinking contaminated water, eating food (usually fish containing mercury), and from skin contact. At high levels, elemental mercury can effect the nervous system and may harm the developing fetus. Other forms of mercury can damage other organs. Even at low levels, elemental mercury can cause health problems.

Elemental mercury exposure can cause harm before symptoms become evident. Once released into the environment, mercury is very hard to clean up. If it is left unattended where exposures can occur, it can have dangerous effects on human health.

Incidents involving Schoolchildren

? In recent years, increasing numbers of elemental mercury spills and contamination involving schoolchildren have been reported.

? In August 1994, more than 500 students in Belle Glade, Florida, were contaminated with elemental mercury after three children found 4 jars (totaling 55 pounds) of mercury in an abandoned van. The local hazardous waste materials team decontaminated the children (removed contaminated clothing and washed the elemental mercury from their skin). More than 20 families had to be evacuated while their homes were decontaminated.

? In November 1994, college students at Florida Atlantic University in Boca Raton, Florida, removed elemental mercury from one of the school’s laboratories. Students living in the dormitory were evacuated and housed in a local hotel while the dormitory was decontaminated.

? In June 1996, elemental mercury was taken from a middle school in St. Joseph, Missouri, and used in and outside of school by a group of teenagers. Approximately 200 children were tested for mercury exposure; one child was hospitalized and another five underwent outpatient treatment to remove the mercury from their systems; 20 other children had mildly elevated mercury levels. Two homes and a car required extensive decontamination.
? In October 1996, a high school in Oskaloosa, Kansas and a convalescent home in Johnson County, Kansas, were contaminated with elemental mercury; 52 students and an unknown number of residents of the home were tested. On the basis of ATSDR recommendations, the school was closed for a week until indoor air levels were safe. A month later, sampling at the school identified an increase in air mercury concentrations. ATSDR re-evaluated the school and did additional cleanup.

? In November 1996, ATSDR again assisted state health officials and EPA in evaluating contamination at a high school and a home in Dallas, Pennsylvania, near Wilkes-Barre. Four areas in the school had levels of elemental mercury contamination that required cleanup.

? In March 1997, a middle school student on his way to school found elemental mercury on the street in front of his home in Montgomery County, Pennsylvania. The student took the mercury to school and shared it with three to four classmates. Also, in March 1997 a broken mercury thermometer was discovered after school on the floor of a bathroom stall in the boys’ bathroom. One thermometer was confirmed missing from the science department’s inventory. The school was found to be clear of contamination with the exception of one science laboratory and the carpet in a classroom. Two homes required decontamination.

Schoolteachers, particularly science teachers, and administrators need to be aware of students’ interest in mercury, especially elemental mercury, and take steps to ensure that children are aware of its dangers and that any mercury kept in school is safely and securely contained.

Incidents involving religious practices

Persons who use elemental mercury in ethnic folk medicine and for religious practices are at risk. Elemental mercury is sold under the name “azogue” in stores (sometimes called botanicas), which specialize in religious items used in Esperitismo (a spiritual belief system native to Puerto Rico), Santeria (a Cuban-based religion that venerates both African deities and Catholic saints), and voodoo.

The use of azogue in religious practices is recommended in some Hispanic communities by family members, spiritualists, card readers, and santeros. Typically, azogue is carried on one’s person in a sealed pouch prepared by a spiritual leader or sprinkled in the home or automobile. Some botanica owners suggest mixing it in bath water or perfume and placing it in devotional candles.

General facts

The following are general facts about elemental mercury and its risks, as well as information about how people can protect themselves from exposure and resulting health effects.

What is mercury and how is it used?

Mercury occurs naturally in the environment in several forms. Elemental mercury is the liquid form used in thermometers. Mercury is also used in other common consumer products such as fluorescent light bulbs, barometers, medical equipment such as blood pressure measurement instruments, and mercury switches in children’s sneakers that light up. This alert concentrates on elemental mercury, but hazards are also associated with other types. Of these, the most common is methylmercury contamination of fish.
How could I be exposed to mercury?

In the previously described school-associated cases, children were unaware of the dangers involved in exposing themselves and their families to this deadly poison. Adults are also often unaware of the hazards associated with mercury; some have even brought it home from work for children to play with. Just one-half teaspoon of mercury spilled in the home can be dangerous.

Adults using certain folk medicines or participating in certain religious or ethnic practices may also expose themselves and their families to elemental mercury’s effects. Because elemental mercury vaporizes into the air at room temperatures, it presents an immediate health risk to anyone spending a significant amount of time in a room where elemental mercury is sprinkled or spilled onto the floor, or where opened containers of elemental mercury are present. Very small amounts of elemental mercury (for example, a few drops) can raise air concentrations to levels that may be harmful to health.

How does mercury affect health?

At high levels, elemental mercury can cause effects on the nervous system and the developing fetus. Other forms of mercury can damage other organs. Even at low levels, elemental mercury can cause health problems. Mercury exposure can begin to cause harm before symptoms become evident. Once symptoms do arise, health problems related to elemental mercury poisoning can include tremors, changes in vision or hearing, insomnia, weakness, difficulty with memory, headache, irritability, shyness and nervousness, and a health condition called acrodynia. Acrodynia, which results from acute and/or intermediate duration dermal exposures to elemental mercury, is characterized by itching, swelling, and flushing; pink-colored palms and soles of the feet; excessive perspiration; rashes; irritability; fretfulness; sleeplessness; joint pains and weakness. Children exposed to elemental mercury for long periods may have trouble learning in school. Exposure to mercury can result in communication and learning disabilities that may be irreversible.

Pregnant women and their fetuses and women of childbearing age are especially vulnerable to the toxic effects of elemental mercury because it readily passes from the mother to the fetus. Mercury may accumulate in higher concentrations in the unborn baby than in the mother. Young children, who often play on the floor where metallic mercury may have been spilled, are particularly at risk for effects on the central nervous system. Mercury vapors are readily absorbed into the bloodstream from the lungs, and the human central nervous system, which is still developing during the first few years of life, may be damaged.

Health effects can result from short-term or long-term exposure. The body gets rid of mercury through the urine and feces. Removal of this substance from the body can take up to several months after exposure. When mercury levels in the body are extremely high, “chelation” therapy is necessary. Chelation therapy is an unpleasant treatment that involves putting a chemical into the bloodstream; the chemical combines with the mercury to aid in its removal from the body. Prevention is the key to avoiding poisoning in homes, schools, and families.

What is mercury contamination and how can I prevent it?

Mercury contamination results from exposure through the air, water, food, soil, or direct contact. Exposure to elemental mercury occurs when it is not stored in a closed container. Contamination may include the spilling of elemental mercury on clothes, furniture, carpet, floors, walls, the natural environment, and even the human body. Elemental mercury and its vapors are extremely difficult to remove from such items as clothes, furniture, carpet, floors, and walls. The vapors will also accumulate in walls and other structures in contaminated rooms. The contamination can remain for months or years, posing a risk to exposed individuals. The use of elemental mercury in a home or apartment not only poses a threat to persons currently
residing in that structure, but also to those who subsequently occupy that dwelling and are unaware of the past mercury use. Avoid using elemental mercury. Appropriate substitutes are available for nearly all uses of elemental mercury. Therefore, be sure you need to use it. If substitutes are not available, make arrangements to safely dispose of whatever elemental mercury you might have by calling your local poison control center. If you do need to use elemental mercury, make sure it is safely stored in a leakproof container. Keep it in a secure space (e.g., a locked closet) so that others cannot easily get it. Use of elemental mercury in a controlled environment helps to reduce the risk that contamination will occur.

Can I clean up mercury with a vacuum cleaner?

Never use a vacuum cleaner. Using a vacuum cleaner causes elemental mercury to vaporize in the air, creating greater health risks. It also ruins the vacuum cleaner.

Can electronic equipment collect mercury vapors?

Elemental mercury vapors can accumulate in electronic equipment, especially computers. When the computer is turned on, the mercury revaporizes. This cycle of elemental mercury collecting and vaporizing from computers has been seen in several incidents in schools.

Mercury vapors are very dangerous and are virtually undetectable. Avoid breathing mercury dust, vapor, mist, or gas. Avoid contact with eyes, skin, and clothing. If you feel you have been exposed directly to elemental mercury, wash thoroughly after handling. Remove contaminated clothing and wash before reuse. If someone has breathed in mercury, provide as much clean air as possible.

What should I do to keep my home safe?

Care must be taken in handling and disposing of all items in the home that contain elemental mercury. Elemental mercury is used in a variety of household and industrial items including thermostats, fluorescent light bulbs, barometers, glass thermometers, and some blood pressure machines.

Example

If a thermometer breaks, remove children from the area. Clean up the bead of elemental mercury by carefully rolling it onto a sheet of paper or sucking it up with an eye dropper. After picking up the mercury, put it into a jar or airtight container. Do not wash it down the drain or throw it outside. The paper or eye dropper should also be bagged and disposed of properly according to guidance provided by environmental officials or your local health department. Try to ventilate the room to the outside and close off from the rest of the home. Use fans for a minimum of one hour to speed the ventilation. If larger amounts of elemental mercury are found (for example, a jar), make sure that the mercury is in an airtight container and call your local health department for instructions in how to safely dispose of it. If a larger amount is spilled, leave the area and contact your local health department and fire authorities. Do not simply throw it away, but instead seek professional guidance from environmental officials or your local health department.

**Important Telephone Numbers**

- Agency for Toxic Substances and Disease Registry (ATSDR) Emergency Response
  - Hotline (24 hours): (404) 639-0615
- National Response Center
  - 1-800-424-8802
- Superfund Information Hotline:
  - 1-800-424-9346
- You may also call your local health department
Activity 3 - School Mercury Audit

Now it is time to conduct a Hg school audit!!

Purpose

Schools are places where mercury and children may come together. They are also places where we can model appropriate health and environmental protection behaviors. Lastly, schools can also be catalysts for reducing mercury in homes of their students (and staff.)

Objectives

• Involve students in a meaningful, real-life opportunity to do something about an environmental problem at their school.
• Reduce or eliminate opportunities for students and staff to come in contact with mercury.
• Prevent the release of mercury into the environment from mercury or mercury-containing devices at school, by properly disposing of Hg.

Materials

✓ “Mercury At School: Where To Look And What To Look For”, information about conducting a school mercury audit.
✓ Copies of Mercury Audit Checklist (one per team)

Procedure

• Obtain approval from your principal.
• Discuss the audit with your school’s engineering and/or janitorial staff.
• Introduce the topic of mercury to the class, using any or all of the materials included in the Focus on Mercury section of this package (pages 1-11).
• Hand out copies of “Mercury at School: Where To Look And What To Look For” to students and ask them to review it ahead of time.
• Divide your school or classroom up and assign research teams to cover specific areas. (Obtaining the building blueprint would be very helpful but is not necessary.)
• Now have the students develop an audit “plan,” i.e. what will they look for, who will they talk to, and what will they ask? They may wish to map the locations of mercury or suspected locations.
• Conduct the audit using the mercury audit form or a form designed by the students.
• Have students discuss the results with the principal, science teachers, school nurse, and engineering and/or janitorial staff. Make recommendations for safely recycling mercury and replacing mercury-containing products or equipment, as appropriate.
Mercury at School: Where to Look and What to Look For

Science, Chemistry, Physics and Biology Classrooms

Check for: pure mercury, mercury compounds, thermometers, barometers, or other devices that may contain mercury

Why?: Mercury and mercury compounds were used in various experiments. They may or may not be used now, but they may still be in the cabinet or chemical closet. Mercury thermometers, barometers, or other mercury containing devices may be used in science, chemistry, biology and physics classes.

Alternatives: Other chemicals can be used in class experiments to illustrate science or chemistry principles. Alcohol or electronic thermometers are readily available and sufficiently accurate.

Who to Talk to: Chemistry and other science teachers

Questions to Ask:
(1) Are mercury or mercury compounds currently used in class?
(2) If they are being used, could other chemicals replace them?
(3) Do you know if these have been used in the past in science classes in this school?
(4) Are these being stored in a closet, cabinet or elsewhere?
(5) How many mercury thermometers or other mercury devices are in the classroom?
(6) Have you ever experienced a spill of mercury or a broken thermometer in your classroom?
(7) Is a spill kit readily available, if a spill occurs?
(8) Are you familiar with the proper spill control procedures for mercury?

Possible Actions: Make sure any mercury, mercury compounds, or thermometers are in non-breakable containers. These should all be collected by school engineering and/or janitorial staff, held in a safe, secured area prior to recycling them.

Your school should not wait for mercury thermometers to break before replacing them with non-mercury alternatives. If a barometer is to be retained, make sure it is protected by a Plexiglas or similar enclosure. If mercury thermometers or barometers will not be replaced at this time, obtain spill kits for the science classrooms and storage rooms. Make sure that at least several staff people are trained in proper spill control procedures.
Mercury at School: Where to Look and What to Look For

Nurse’s Office

Check for: thermometers, blood pressure measuring device (sphygmomanometer), nasal spray and contact lens solution

Why?: Mercury thermometers are used to check for fever. Sphygmomanometers can contain up to several pounds of mercury. Nasal spray and contact lens solution may contain thimerosal (an ingredient that has mercury in it), phenylmercuric acetate or phenylmercuric nitrate.

Alternatives: Alcohol or electronic thermometers are readily available. Aneroid blood pressure devices are just as effective as the mercury versions. Many brands of nasal spray and contact lens solution do not contain mercury, however the labels do not always indicate which ones are mercury free.

Who to Talk to: School Nurse

Questions to Ask:
(1) How many mercury thermometers are in the nurse’s office?
(2) Have you ever experienced a broken thermometer?
(3) Is a spill kit readily available, if a spill occurs?
(4) Are you familiar with the proper spill control procedures for mercury?
(5) Do you use a sphygmomanometer? If yes, have you considered replacing it with an aneroid blood pressure device that does not contain mercury?
(6) Do you stock nasal spray or contact lens solution? If yes, have you contacted the manufacturer to make sure they do not contain mercury?

Possible Actions:
Make sure mercury thermometers are in non-breakable containers. These should all be collected by school engineering or janitorial staff and held in a safe, secured area prior to recycling them. Do not wait for mercury thermometers to break before replacing them with alcohol or electronic alternatives. Replace sphygmomanometers with aneroid blood pressure devices.
If mercury thermometers or sphygmomanometers will not be replaced at this time, obtain a spill kit for the nurse’s office. Make sure that the nurse(s) are trained in proper spill control procedures. Use up existing stock of nasal spray or contact lens solution containing mercury and then purchase mercury-free alternatives.
Mercury at School: Where to Look and What to Look For

**Electrical And Heating Equipment**

**Check for:** thermostats, “silent” light switches and recycling of fluorescent light bulbs

**Why?:** Thermostats are used to control the temperature in buildings. Approximately 75% of thermostats in use today contain mercury. Many “silent” light switches contain mercury. Each fluorescent tube in overhead lighting fixtures contains a minute amount of mercury. However, your school probably uses a large number of these fluorescent bulbs throughout the building, so the total amount of mercury can be significant.

**Alternatives:** Electronic thermostats and non-mercury switches are widely available. Fluorescent bulbs should be recycled, rather than thrown out.

**Who to Talk to:** School engineering or janitorial staff

**Questions to Ask:**
(1) How many thermostats and “silent” light switches are there in your school building?
(2) How many of these contain mercury?
(3) How are used fluorescent bulbs managed? Are they recycled or thrown out in the trash?

(4) If they are recycled, how and where are they stored before they are taken from the building for recycling? How are they protected to avoid breaking them?

**Possible Actions:**
Place stickers (designed by the students) on any mercury thermostats or silent switches that indicate:
(1) This device contains mercury.
(2) When this device is disposed of, the mercury should be recycled.
(3) When purchasing a replacement, a mercury-free model should be chosen.

Notify the purchasing department to try to get mercury-free thermostats or light switches when purchasing replacements. Many HVAC contractors will recycle mercury thermostats.

Your school should recycle used fluorescent bulbs by replacing them in their original box in a safe, secure storage area until they are picked up by a recycling contractor.
Mercury at School: Where to Look and What to Look For

Fluorescent & High-Intensity Discharge (HID) Lamps

Which Lamps Contain Mercury?
• fluorescent lamps
• mercury vapor lamps
• metal halide lamps
• high-pressure sodium lamps
• neon lamps

Why Use Fluorescent and HID Lighting?
Fluorescent and HID lighting is an excellent business and environmental choice because it can use up to 50 percent less electricity than incandescent lighting. However, used fluorescent and HID lamps must be managed properly because they contain mercury.

How Do I Dispose of the Lamps?
• Store lamps in an area and in a way that will prevent them from breaking, such as in boxes the lamps came in or boxes supplied by lamp recyclers.
• Mark the lamp storage area with the words “Fluorescent lamps for recycling.”
• Do not break or crush lamps because mercury may be released.
• If lamps are accidentally broken, store them in a sealed container. Pick up spilled powder and add it to the sealed container.
• Take lamps to a consolidation site* or arrange with a lamp transporter to pick them up. Contact your city, county or state environmental office or solid waste office for services available in your area. To protect yourself from future liability, save the invoices that track your used lamps and include the following information:
  • the date of shipment
  • the number of lamps
  • the location from where the lamps are being shipped
  • the destination of the shipment

*These services may not be available in your area.
## Mercury Audit: Assessment Checklist for Schools

### Science, Chemistry, Physics, Biology Rooms

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<thead>
<tr>
<th>Item</th>
<th>No</th>
<th>Yes</th>
<th>Use?</th>
<th>How Many/How Much?</th>
<th>Location?</th>
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<tbody>
<tr>
<td>Elemental Mercury</td>
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<tr>
<td>Mercury Thermometers</td>
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<td>Mercury Barometers</td>
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<td>Mercury Vacuum Gauges</td>
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<td>Hg Spectral Tubes</td>
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<td>Mercury Molecular Motion Device</td>
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<td>Mercury Sling Psychrometer</td>
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<td>Mercury Compounds</td>
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<td>Mercury oxide</td>
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<td>Mercury (II) chloride</td>
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<td>Mercury (II) sulfate</td>
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<td>Mercury nitrate</td>
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<td>Mercury iodine</td>
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<tr>
<td>Zenker's Solution</td>
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<tr>
<td>Other Mercury Materials</td>
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### Nurse’s Office/Medical

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<tr>
<th>Item</th>
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<th>Yes</th>
<th>Use?</th>
<th>How Many/How Much?</th>
<th>Location?</th>
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<tbody>
<tr>
<td>Mercury Fever Thermometers</td>
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<tr>
<td>Sphygmomanometers (Blood Pressure Devices) - with silver liquid</td>
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<tr>
<td>Nasal Spray</td>
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<tr>
<td>Contact lens solution</td>
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### Facilities

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<th>Use?</th>
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<tr>
<td>Fluorescent Lamps</td>
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<tr>
<td>Mercury Thermostats</td>
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<tr>
<td>Mercury Vapor Lamps, Metal Halide Lamps, High-Pressure Vapor Sodium Lamps</td>
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### Activity 3

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<th>Use?</th>
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<tr>
<td>Mercury Gauges</td>
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<tr>
<td>&quot;Silent&quot; Light Switches</td>
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<tr>
<td>Mercury Float Control Switches (e.g. on Sump Pumps)</td>
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<tr>
<td>Flow Meters with Mercury Switches</td>
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<tr>
<td>Other equipment with mercury switches (e.g. flame sensors, fire alarms, safety valves)</td>
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<tr>
<td>Older fungicides and pesticides (prior to 1991)</td>
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<tr>
<td>Mercury Cooking Thermometer</td>
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<tr>
<td>True Vermillion Paint (contains mercuric sulfide)</td>
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<tr>
<td>Cadmium Vermillion Red</td>
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<tr>
<td>Mercury Oxide/Mercury Zinc Batteries (old alkaline type, prior to 1996 and button batteries)</td>
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*form attained from newmoa.com

http://www.newmoa.org/Newmoa/htdocs/prevention/mercury/schools/checklist.cfm
Household Information
Household Mercury

The following information illustrates how the average household contributes to the use and release of mercury to the environment. The idea is to provide a sense of how our daily activities, as well as devices and products in our homes, contribute to the overall picture of mercury release and use.

Charts are provided to show percentages of where mercury is most likely found in homes, “Presence/Use of Mercury in Households,” and what contributes most to the release of mercury, “Annual Mercury Releases from Households.” Mercury “releases” are defined very broadly and include air emissions, discharges to streams, lakes or sewers, and placement in landfills. The following types of uses or releases from households have been documented:

- coal combustion to produce electricity
- fluorescent lamps
- gasoline combustion in motor vehicles
- heating oil combustion
- appliance switches
  (chest freezers, washing machines)
- automotive switches
- thermostats
- dental fillings
- wastewater discharged to sewers
- button batteries
- gas-pilot ranges
- light switches
- thermometers
Annual Mercury Releases from Households

- Thermostats: 20%
- Electricity Consumption: 35%
- Gasoline Combustion: 8%
- Oil Combustion: 9%
- Wastewater Discharges: 11%
- Thermometers: 5%
- Switches - Appliances: 1%
- Switches - Automotive: 13%
- Dental Fillings: 1%
- Fluorescent Lamps: 2%

Presence/Use of Mercury in Households

- Thermostats: 48%
- Dental Fillings: 21%
- Lighting Switches: 14%
- Switches - Automotive: 10%
- Switches - Appliances: 2%
- Thermometers: 5%

Adopted from "Mercury Source Sector Assessment for the Greater Milwaukee Area" by the Pollution Prevention Partnership and Milwaukee Metropolitan Sewage District. 1997
Activity 4 - Hunt for Mercury At Home

Purpose
Students will expand their school efforts by looking at where mercury occurs in their homes.

Objectives
• Involve students in a meaningful, real-life opportunity to do something about an environmental problem at home.
• Reduce or eliminate opportunities for students and their families to come in contact with mercury.
• Prevent the release of mercury into the environment from mercury or mercury-containing devices at home.
• Students will be able to analyze and then determine the level of threat of mercury in their home

Materials
✔ “Hunt for Mercury at Home,” information for conducting a home mercury audit.
✔ Sample letter to the parents
✔ “Hunt for Mercury at Home – Inventory Results” form

Procedure
• If appropriate, get the permission of your principal and then inform your parent organization
• Introduce the topic of mercury to the class, using any or all of the materials included in the Focus on Mercury section of this package (pages 1-11). Consider doing one or more of the other mercury related activities first.
• Try to find out the local contacts for household hazardous waste collection and add these to the bottom of the third page of “Hunt for Mercury at Home.” The sewage treatment plant or Dept. of Public Works are good places to find out if there is a household hazardous waste collection program in your area.
• Hand out copies of “Hunt for Mercury at Home” to students and allow them 3-7 days to complete the exercise.
• Have the students develop their own or use the sample letter provided to send home to each family.
• Make sure that students understand that they need to discuss this activity with their families before they do it and that it works best if they get help from family members.
• Have students compare their results and discuss safe ways of addressing the mercury in their homes.
Dear Parent,

One topic being covered at school is mercury. Mercury is an element that occurs naturally in the earth’s surface. It can be found in many household products, and products at school. Mercury presents an environmental threat because it can accumulate in animals and people, and can be toxic. Its toxicity can endanger living organisms and can produce adverse health effects in people, such as headache, weakness, memory loss, and nervousness among others. Mercury poisoning is possible just by breathing mercury vapors, which are invisible.

There are many efforts across the nation to educate people about mercury, its risks, and how to dispose of it. Mercury can be found in common household items such as thermometers, thermostats, fluorescent lamps, and certain types of appliance switches. An important thing to know is that the primary concern about many of these mercury-containing products is when you dispose of them, and not by just having them in your home. Most are harmless unless broken or disposed of improperly. You do not need to throw out all the mercury-containing products that you find. Any device that contains mercury needs to be recycled properly and cannot be thrown in the trash. Try to find a household hazardous waste collection, or contact the sewage treatment plant or Dept. of Public Works. When it is time to replace a mercury-containing product, use a mercury-free alternative. There are safe, dependable, and easy to use alternatives for all mercury-containing devices used in your home.

At School, your child has studied mercury and its impacts on human health and the environment, and has been given an information packet entitled, “Hunt for Mercury at Home,” along with an “Inventory Results” sheet. Please go through this with your child and fill out the “Inventory Results” sheet. Do not be alarmed if you come up with many objects in your home that contain mercury. The purpose of this is to make you aware of them, and what to do with them, and when it comes time to replace them, remember buying smart is a great way to prevent pollution.

Thank you
Hunt For Mercury At Home

Information and Checklist to Help You Inventory the Mercury in Your Home, Learn about Safe Disposal Options and Mercury-Free Products

This guide provides a list of what to look for, what to do about mercury-containing products if you find them and what mercury-free substitutes are available.

Before getting started, share information about mercury with your family and let them know why you are searching for it in your home. Family members may be able to help you identify products that contain mercury and help you decide what to do about them.

Remember, the primary concern about many of these mercury-containing products is when you dispose of them, and not necessarily contact with them in your home. You do not need to throw out all the mercury-containing products that you find.

A good example is thermostats. Many of you will find thermostats with mercury in your homes. These are designed to last a long time and are not a hazard to you and your family unless they break and spill the mercury. The best approach is to let your parents know that different types of thermostats are available and, if they replace the one they have now, they should install a mercury-free thermostat and properly recycle the old one.

This guide provides advice for what to do about each of the mercury-containing products that you may find in your home. Make sure to consider common sense, recycling, safety and pollution prevention before taking action. You can also use this guide to help you and your family buy products that do not contain mercury. If you are careful about not buying mercury-containing thermometers, toys, thermostats, etc., you won’t have to worry about mercury in your home in the future. Buying smart is a great way to prevent pollution!
<table>
<thead>
<tr>
<th>Product</th>
<th>Mercury-Free Alternative</th>
<th>What To Do</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Thermometers</td>
<td>Alcohol or digital thermometer</td>
<td>Bring to Household Hazardous Waste Facility.</td>
<td>Silver liquid in tube.</td>
</tr>
<tr>
<td>Thermostats</td>
<td>Electronic &quot;set back&quot; models can help save on energy bills.</td>
<td>When it needs replacing, recycle.</td>
<td>All non-electronic models</td>
</tr>
<tr>
<td>Fluorescent lights</td>
<td>Light bulbs in the form of long or curved tubes.</td>
<td>Continue to use these, however, recycle them at the Household Hazardous Waste Facility.</td>
<td>Bought before 1990. Check expiration date.</td>
</tr>
<tr>
<td>Shoes that Light Up or Make Noise</td>
<td>Rechargeable batteries</td>
<td>Bring to Household Hazardous Waste Facility.</td>
<td>Sneakers that don't light up.</td>
</tr>
</tbody>
</table>
## Hunt For Mercury At Home

<table>
<thead>
<tr>
<th>Product</th>
<th>Description</th>
<th>What To Do</th>
<th>Mercury-Free Alternative</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chemistry Sets</td>
<td>May contain mercury compounds.</td>
<td>Bring mercury or mercury compounds to Household Hazardous Waste Facility.</td>
<td>Other mercury-free toys.</td>
</tr>
<tr>
<td>Vials or Jars of Mercury, Sometimes on Necklaces.</td>
<td>Small containers of mercury used for ceremonial purposes. May be found in</td>
<td>Bring to Household Hazardous Waste Facility.</td>
<td>None</td>
</tr>
<tr>
<td></td>
<td>basements or garages.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Nearest Household Hazardous Waste Collection Facility:**

**Person To Call To Find Out About Household Hazardous Waste Collection In Your Community:**
Hunt For Mercury At Home

Mercury Thermometers

Some fever thermometers contain mercury and should not be thrown in the trash. A typical fever thermometer contains about 0.5 grams of mercury.

Many thermometers used to measure air and water temperature also contain mercury, and they are used by homeowners, businesses, institutions, and anglers. When these thermometers break outdoors, the mercury from them is difficult to capture.

Alcohol or digital thermometers are as accurate as mercury thermometers for most applications. Since they are mercury-free, no mercury will be released if they break or when they are thrown away. Digital thermometers last longer because they do not break. Consequently, they cost less in the long run.

Change to alcohol or digital thermometers whenever feasible. In the meantime, save old or broken mercury thermometers in a closed container. If a thermometer breaks, pick up all the mercury you can and add it to the container. Use two pieces of paper or two razor blades to scoop it up from a smooth surface. Use an eyedropper to pick up pieces of mercury from the floor or the ground. Mercury spill kits are available from safety equipment supply companies for larger mercury spills.

Homeowners can use local household hazardous waste collection programs* for broken thermometers.

Mercury-Containing Thermostats

Mercury-containing tilt switches have been used in thermostats for more than 40 years. They provide accurate and reliable temperature control, require little or no maintenance, and do not require a power source. However, each switch contains approximately 3 grams of mercury.

Mercury-free thermostats are available. Electronic thermostats for example, provide many of the same features as mercury thermostats and can be programmed to lower room temperatures at pre-set times. This results in fuel cost savings and environmental benefits from burning less fuel.

Contact your heating, ventilating, and air conditioning (HVAC) wholesaler. Thermostat manufacturers provide a special container for thermostats to each participating HVAC wholesaler. DO NOT REMOVE THE SWITCHES FROM YOUR THERMOSTATS. The wholesaler consolidates thermostats from heating contractors and mails them intact to the manufacture.

*These services may not be available in your area.
Hunt For Mercury At Home - Inventory Results

<table>
<thead>
<tr>
<th>Items Found</th>
<th>To what degree is the item found a threat?</th>
<th>Actions that were taken or will be taken</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>An immediate threat (i.e. Liquid mercury)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Potentially a threat (i.e. breaking a glass thermometer)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>A threat when discarded (Fluorescent bulbs)</td>
<td></td>
</tr>
</tbody>
</table>

1. 
2. 
3. 
4. 
5. 
6. 
7. 
8. 
9. 
10.
Mercury in Fluorescent Lights and the Environmental Impacts

The Use of Mercury in Efficient Electric Lamps - An Update
Due to the heightened concern about mercury build-up in the environment, there have been several recent legislative or regulatory actions targeted at all mercury-containing products. The general objective is to reduce or remove the mercury content of products.

Fluorescent Lamps
All efficient fluorescent lamps contain mercury. Fundamentally, these lamps are a discharge in mercury vapor. When excited, the mercury vapor discharge is an extremely efficient source of ultraviolet radiation; this is converted to visible light by the phosphor powder that coats the interior walls of the lamp.

HID Lamps
For the high-pressure sodium and metal halide lamps, mercury is used to initiate and maintain the discharge. Once started, the light output generated by the sodium, or by the metal halides, dominates the discharge.

Mercury-free developments
Mercury-free fluorescent discharges are available using Xenon. The efficiency is approximately 30% of a normal mercury-based fluorescent lamp, and therefore this technology is environmentally counterproductive for general lighting applications. Despite continuous research by the private sector, government research labs, and academia, no viable replacement has been discovered for mercury in general purpose fluorescent lamps. The search continues. There are better prospects for mercury-free HID lamps, whereas metal halide lamps without mercury present a greater challenge. The high-pressure sulfur lamp is fundamentally mercury-free, but is unstable and requires forced cooling.

Disposal
The EPA mercury report to the U.S. Congress in 1997 identified combustion sources (coal-fired utilities, waste incineration and boilers) as the three major sources of manmade mercury emissions in the U.S. Together they represent 87% of the total. By contrast, lamp disposal represented <1% each for lamp breakage and lamp recycling. It is ironic that the use of efficient mercury containing lamps is the number one choice for reducing power demand and thereby influencing utility emissions. Lamp disposal by incineration with other municipal wastes is a relatively recent phenomenon in some states. This represents the riskiest form of disposal with <90% mercury emission into the atmosphere where no controls exist on the incinerator. Recycling of large quantities of lamps, where they are shipped intact to the recycling location, represents one of the lowest environmental emissions and the least legal liability arising from the U.S. Superfund (CERCLA) legislation.

* information taken from OSRAM SYLVANIA’s website, the North American division of OSRAM GmbH
Activity 5 - Trade-offs

Purpose
One way to reduce mercury pollution from coal burning electrical plants is to use less electricity. Fluorescent light bulbs use much less energy than incandescent light bulbs, but most fluorescent bulbs contain tiny amounts of mercury. What makes sense ecologically?

Objective
Evaluate the pros and cons of two alternative technologies.
Learn how to organize data and determine the mathematical relationships needed to solve a problem.
Coherently present the results of calculations to support a recommended choice or alternative.

Materials
- Handout entitled “Trade-Offs: Your Lights, Your Environment and your Checkbook”
- Trade-offs: Question sheet and Answer sheet

Procedure
- This activity can be done as homework, or as an individual or group assignment
- Make copies and distribute “Trade-Offs: Your Lights, Your Environment and Your Checkbook,” and the “Questions” sheet to the students and ask them to prepare answers and justifications for all questions

Vs.
Fluorescent bulbs (containing mercury) vs. Incandescent bulb
"Trade-Offs: Your Lights, Your Environment and Your Checkbook"

Incandescent vs. Compact Fluorescent Bulbs -
Energy Use, Mercury Emissions and Cost

The largest source of mercury to the environment is coal-burning electric power plants. There is a very small amount of mercury in the coal that is burned to produce electricity. However, because vast amounts of coal are burned, the amount of mercury released up the smoke stacks is very significant.

One of the largest uses of the electricity produced by these power plants is for lighting homes, buildings and streets. Can the choice of light bulbs in our homes make a difference in terms of the amount of electricity used, the amount of mercury released and the amount that we pay for electricity? Let’s figure it out.

<table>
<thead>
<tr>
<th>Incandescent Bulb</th>
<th>Compact Fluorescent Bulb</th>
</tr>
</thead>
<tbody>
<tr>
<td>Energy Requirement</td>
<td>60 watts</td>
</tr>
<tr>
<td>Light Output</td>
<td>870 lumens</td>
</tr>
<tr>
<td>Average Life</td>
<td>1,000 hours</td>
</tr>
<tr>
<td>Purchase Price</td>
<td>$1.79 for 4 bulbs</td>
</tr>
</tbody>
</table>

Cost of electricity from the power plant - $0.07 per kilowatt-hour

Pounds of mercury released per kilowatt-hour of energy used =

3.69E-08 (≈ 0.0000000369)

Keep in Mind -
1 kilowatt = 1,000 watts
A lumen is a measure of brightness
A kilowatt-hour is a measure of total energy used over a period of time
1 pound = 454 grams
It takes 10 Incandescent bulbs to last as long as 1 compact fluorescent bulb

Equations to Use:

1. Efficiency = light output ÷ energy requirement

2. Amount of mercury released = hours of use x energy requirement x pounds of mercury released per kilowatt-hour of energy x 454 grams/pound of mercury ÷ 1000 watts/kilowatt

3. Electricity cost:
   = Hours of use x energy requirement x cost of electricity ÷ 1000 watts/kilowatt
Trade-offs

Questions

1. Which type of light bulb - incandescent or compact fluorescent - is more efficient? Why?
2. After 10,000 hours of use, how much mercury (in grams) is released to the environment due to use of each of these two types of light bulbs?
3. After 10,000 hours of use, what are the total costs, including purchase price and electricity, for each type of light bulb?
4. Which type of bulb would you recommend? Why?

Optional

5. Make an educated guess as to how many light bulbs are in use in your community. Based on this estimate, design a study to determine the differences in cost and in mercury released if all those bulbs were either incandescent or compact fluorescent.
Trade-offs

Answers

Which type of light bulb - incandescent or compact fluorescent - is more efficient? Why?

Efficiency, in this case, is measured by light output per amount of energy used. For the compact fluorescent bulb, this is 925 lumens/15 watts = 61.67. For the incandescent bulb, this is 870 lumens/60 watts = 14.5. Thus, the fluorescent bulb is 4.25 times more efficient.

After 10,000 hours of use, how much mercury is released to the environment due to use of each of these two types of bulbs?

The amount of mercury released due to use of the compact fluorescent bulb is:

\[
10,000 \text{ hours} \times 15 \text{ watts} \times 0.0000000369 \text{ pounds per kilowatt-hour} \times 454 \text{ grams per pound} \div 1,000 \text{ watts per kilowatt} = 0.0025 \text{ grams.}
\]

The equation for the incandescent bulb is the same, except that 60 watts is substituted for 15 watts. Thus, the amount of mercury released is 4 times greater for the incandescent bulb, or .01 grams.

After 10,000 hours of use, what are the total costs, including purchase price and electricity, for each type of light bulb?

Purchase price-
- Compact fluorescent - $13.99
- Incandescent - $1.79/4 \times 10,000/1,000 = $4.48

Electricity cost-
- Compact fluorescent
  \[
  10,000 \text{ hours} \times 15 \text{ watts} \times $0.07 \text{ per kilowatt-hour} \div 1,000 \text{ watts per kilowatt} = $10.50
  \]
- Incandescent
  \[
  10,000 \text{ hours} \times 60 \text{ watts} \times $0.07 \text{ per kilowatt-hour} \div 1,000 \text{ watts per kilowatt} = $42.00
  \]

Total cost-
- Compact fluorescent
  \[
  $13.99 \text{ (purchase)} + $10.50 \text{ (electricity)} = $24.49
  \]
- Incandescent
  \[
  $4.48 \text{ (purchase)} + $42.00 \text{ (electricity)} = $46.48
  \]

Thus, the incandescent bulb is 90% more expensive.

Which type of bulb would you recommend?

Consider efficiency (compact fluorescent is 4.25 times more efficient), amount of mercury released (4 times less for compact fluorescent) and total cost (90% less for compact fluorescent).

Study design to determine the differences in cost and in mercury released for the community if all those bulbs were either incandescent or compact fluorescent.

The study design should include identification of the following steps:

- estimates of the number of bulbs used in lighting homes, streets and businesses
- assumptions about the frequency of bulb replacement
- determination of the total amount of energy
- application of the mercury released per kilowatt factor to determine total mercury releases
- determination of purchase and electricity costs
Mercury in the Environment
Mercury in the Environment

In this section, you will learn about the behavior of mercury in the environment and why, in addition to human health concerns relating to direct exposure, mercury is an important environmental issue. Much of the material in this lesson is from the U.S. Environmental Protection Agency’s mercury web site.

Mercury is a silvery, liquid metal at room temperature and is often referred to as one of the "heavy metals." Like water, mercury can evaporate and become airborne. Because it is an element, mercury does not break down into less toxic substances. Once mercury escapes to the environment, it circulates in and out of the atmosphere until it ends up in the bottoms of lakes and oceans. Mercury can be found as the elemental metal or in a wide variety of organic and inorganic compounds. Depending on its chemical form, mercury may travel long distances before it falls to earth with precipitation or dust.

Bacteria and chemical reactions in lakes and wetlands can change the mercury into a much more toxic form known as methylmercury. Fish become contaminated with methylmercury by eating food (plankton and smaller fish), which has absorbed methylmercury. As long as the fish continue to be exposed to mercury, mercury continually builds up in fish's bodies. Fish that eat other fish become even more highly contaminated. Thus, the largest tend to be the most contaminated.

When people eat the contaminated fish, the methylmercury can remain in their bodies for a long time. If they eat fish containing methylmercury faster than their bodies can get discharge it, the methylmercury accumulates in their bodies and can be toxic. Many states have fish consumption advisories to inform people about how many meals of fish they can safely eat over a period of time.

Where Does Mercury Come From?

Mercury is a naturally occurring element. Mercury ore - cinnabar - is mined in Spain, Algeria, Kyrgyzstan and China. Mercury is also a by-product of gold and zinc mining. Mercury enters the environment from:

- Natural sources such as volcanoes and the weathering of rocks;
- Our intentional uses of mercury;
- Our unintentional releases of mercury from burning fossil fuels and smelting metals.
**Mercury's Environmental Effects**

Fish are the main source of food for many birds and other animals, and mercury can seriously damage the health of these species. Loons, eagles, panthers, otters, mink, kingfishers and ospreys naturally eat large quantities of fish. Because these predators rely on speed and coordination to obtain food, mercury may be particularly hazardous to these animals.

Recent research in Minnesota indicates that the following environmental effects are occurring:

- Loons are accumulating so much mercury that it may be affecting their ability to reproduce;
- Elevated levels of mercury have been found in mink and otters;
- Walleye reproduction may be impaired by the fish's exposure to mercury.

Similar effects are being documented for other fish and fish-eating species around the United States and Canada. Has there always been mercury contamination, or is this a recent problem? This is a difficult question to answer, in part because of a lack of adequately preserved fish specimens of preindustrial age to compare against contemporary samples. However, several lines of evidence from recent studies on Wisconsin lakes suggest that increased emissions to the atmosphere, and subsequent higher deposition rates to lakes, likely translate into higher mercury levels in fish.
The Mercury Cycle and Bioaccumulation

There is a constant biogeochemical cycle of mercury. This cycle includes:

- release of elemental mercury as a gas from the rocks and waters (degassing);
- long-range transport of the gases in the atmosphere;
- wet and dry deposition upon land and surface water;
- absorption onto sediment particles;
- bioaccumulation (or biomagnification) in terrestrial and aquatic food chains.

Bioaccumulation means an increase in the concentration of a chemical in an organism over time, compared to the chemical’s concentration in the environment. Bioaccumulation can be a normal and essential process for the growth of any species, but the accumulation of unnecessary chemicals or toxins, or even the overaccumulation of essential substances can be detrimental. All animals, including humans, daily bioaccumulate many vital nutrients, such as vitamins A, D, and K, trace minerals, essential fats and amino acids, but unfortunately, they can also accumulate many unnecessary substances, such as lead or mercury. What concerns toxicologists is the bioaccumulation of necessary substances to levels in the body that can cause harm. With substances such as lead or mercury, any accumulation at all can be harmful. Compounds accumulate in living things any time they are taken up and stored faster than they are broken down (metabolized) or excreted.

Understanding the dynamic process of bioaccumulation is important in protecting humans and other organisms from the adverse effects of chemical exposure, and it has become a critical consideration in the regulation of chemicals.
Bioaccumulation varies among individual organisms as well as among species. Large, fat, long-lived individuals or species with low rates of metabolism or excretion of a chemical will bioaccumulate more than small, thin, short-lived organisms. Thus, an old lake trout may bioaccumulate much more than a young bluegill in the same lake.

Above is a schematic drawing of mercury cycling in an aquatic ecosystem. With the exception of isolated cases of known point sources, the source of most mercury to most aquatic ecosystems is deposition from the atmosphere, primarily associated with rainfall.

In the aquatic environment, mercury can be:
- dissolved or suspended in the water
- trapped in the sediments
- ingested by living things (biota)

Methylmercury is the form of mercury most available and most toxic to biota (including zooplankton, insects, fish, and humans). This form of mercury is easily taken up by biota and bioaccumulates in their tissues. Unlike many other fish contaminants, such as PCBs, dioxin, and DDT, mercury does not concentrate in the fat, but in the muscle tissue. Thus, there is no simple way to remove mercury-contaminated portions from fish that is to be eaten.
Activity 6 - Mercury in the Food Chain

Purpose
This activity will help the students reinforce their understanding of food webs while gaining a new understanding of bioaccumulation.

Objectives:
Students will:
1) Display a graphic understanding of an aquatic food web for a specific local body of water
2) Demonstrate an understanding of bioaccumulation

Materials:
✓ A map of your state showing waterways (a state highway map will usually work), paper and something to draw with
✓ Copies of “Example from Florida aquatic food web and mercury cycle” and information provided in Mercury in the Environment section of this curriculum package
✓ If you choose the teacher lead option you will need the following materials
   10 very small (1-2 oz.) cups
   (clear containers are the best, but use what you have).
   5 small containers (4 –5 oz)
   3 medium containers (around 8 oz)
   1 clear container (large to hold around 7-8 cups)
   Glitter (3 colors) or small beads (3 colors) or something similar that is very small and can be found in 3 distinct colors

Procedure:
1. Select a body of water or a number of water systems in your state.
2. Divide the class into study groups. Assign each group a lake, river, bay, coastal area, etc. Each group should then create a food web for their study site. Include as many of the components that they can find.
   (Use the Florida example as an idea sheet)
3. Select either student self-discovery or teacher lead and follow accordingly.
4. Students should share their findings.
Select one of the two options

Two options: (student self-discovery or teacher lead).

Student self-discovery - present each group the following scenario – the water they are in charge of has shown signs of mercury contamination. As scientists they are to demonstrate to the public what “bioaccumulation” is and why we have to be concerned about it.

1. Allow them to use a variety of materials
2. Give each group 5 minutes for their demonstration.
3. If you wish you may want to have a town board set up to judge who did the best job of demonstrating the issue.

Teacher lead:

You will need to gather the following materials: (clear containers are the best, but use what you have).

10 very small (1-2 oz.)
5 small containers (4 –5 oz)
3 medium containers (around 8 oz)
1 clear container (large to hold around 7-8 cups)

Glitter (3 colors) or small beads (3 colors) or something similar that is very small and can be found in 3 distinct colors.

1. Fill each container to 1/3 full with water.
2. Now, representing mercury, you will put a pinch of one color of glitter in each of the 10 very small (1-2 oz.), another color in the 5 small containers (4 –5 oz), and the third color in the 3 medium containers (8 oz)

Using one of the food chains the students developed, have the students label the 10 very small ones as the micro-organisms, the 5 small ones as the animal that eats the micro-organisms (small fish, insects, etc.), the medium would be the animal that eats the small ones and the clear container will represent a top predator.

Now have the students help you with the demonstration and put the food chain and bioaccumulation into action. First the 10 very small containers (they are being eaten by the primary consumer) are poured into the small containers. Some of the glitter may stay in the each container as you pour. That is OK, it represents the mercury that is excreted by the animal (not 100% of the mercury accumulates). Now the small containers will be eaten by the medium or secondary consumer. And finally the medium are eaten by the top predator (tertiary consumer).

Discuss what just happened with special emphasis on the glitter. How much of the mercury was accumulated by the top predator.

Regardless of whether you did the student self-discovery or the teacher lead one - Now hand out the: Bioaccumulation in humans chart and discuss what they have learned through the activity.
Example from Florida aquatic food web and mercury cycle
Bioaccumulation in humans
Mercury in the Environment

Activity 7 – Atmospheric Mercury

The majority of mercury entering lakes, streams, rivers, and oceans comes from the atmosphere. It is important to understand why mercury is in the atmosphere because once we understand the causes, we can concentrate on controlling the sources. In this activity, students will begin to recognize patterns and make educated guesses based on those patterns.

Objective
1. Students will demonstrate critical thinking skills
2. Students will make educated guesses (scientific inquiry) based on patterns shown in data

Materials
- Mercury Sources Factsheet
- Activity 7 sheets First, Where is Mercury?; Second, Mercury in the Air; Third, Fish Advisories
- Background information concerning fish advisories...
- Optional: EPA Fact Sheet

Procedure
1. This activity is based on critical thinking and the development of the thought process; therefore it is crucial that the different parts are given one at a time, in the prescribed order. The Activity can be done individually, in small groups, or as a large group in a discussion format.
2. Hand-out the Mercury Sources Factsheet and the Where is Mercury? sheet. Have students review data and complete the assignment.
3. Once the first assignment is complete, hand out Mercury in the Air. They will need their first assignment to complete the second.
4. Once the second assignment is complete, hand out the third, Fish Advisories. They will need the first and second to complete the third.

Optional
5. Review and discuss the EPA Fact Sheet (which can be found at the end of this Activity)
Mercury Sources Factsheet

Coal Plants are Largest Mercury Source

The majority of the mercury entering lakes, streams, rivers, and oceans comes from the atmosphere. Air deposition accounts for up to 90% of the mercury entering Lake Superior, and 80% entering the Delaware Bay.

- 85% of mercury emissions come from smokestacks, primarily power plants and municipal and medical waste incinerators
- 33% of all mercury emissions come from power plants (coal- and oil-fired), the largest unregulated source, emitting 52 tons per year

How Far does Mercury Travel in the Atmosphere?

EPA estimates 7 to 45% of mercury released from incinerators and power plants is deposited within a 30-mile radius. The stack height at each plant, the chemical species of the mercury, and the amount of rainfall at a given site all affect how much mercury is deposited around the plant. As shown in the table below, power plants with shorter stacks will have more local deposition than those with taller stacks, and more mercury is deposited locally in a humid site compared to an arid site.

The Electric Power Research Institute calculates that up to 10% of the mercury released deposits within 62 miles of a power plant, and the rest is transported regionally and globally.

<table>
<thead>
<tr>
<th>Power Plant Type</th>
<th>Average Stack Height (ft)</th>
<th>Percent of Emissions</th>
<th>Deposited within 30 miles</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>Arid Site</td>
</tr>
<tr>
<td>Oil-fired power plant</td>
<td>288</td>
<td>6</td>
<td>11</td>
</tr>
<tr>
<td>Large coal-fired power plant</td>
<td>731</td>
<td>2</td>
<td>7</td>
</tr>
<tr>
<td>Medium coal-fired power plant</td>
<td>465</td>
<td>4</td>
<td>9</td>
</tr>
<tr>
<td>Small coal-fired power plant</td>
<td>265</td>
<td>9</td>
<td>14</td>
</tr>
</tbody>
</table>

Activity 7 – *Where is Mercury?*

Which state(s) do you think have the biggest problem with atmospheric mercury (mercury that travels through the air)?
Keep in mind: Areas of large populations of people using electrical energy
General wind patterns travel from west to east

Highlight on map where you think the biggest atmospheric mercury problem would be and explain why.
Activity 7 – Mercury in the Air

How does this map compare to your highlighted map on the previous page? List similarities and differences.

How would you explain the pattern shown on this map? (What are the similarities and differences?)

After review of this map would you be more concerned about mercury if you lived in New York, Texas, or California? Does this mean the other two (that you didn’t pick) do not have to worry about mercury?
Activity 7 – Fish Advisories

How does the National Atmospheric Hg Deposition map relate to this map? (Are there similarities or patterns between the two?)

Why would a state like New Mexico (NM), that does not show any atmospheric mercury deposition, have as high or higher amounts of fish advisories than a state that is in the middle of the heavy atmospheric deposition (such as West Virginia, WV)?
Background information concerning differences in fish advisories and atmospheric deposition in New Mexico and West Virginia

The following information shows that even though West Virginia is in the area of much higher mercury deposition, New Mexico has been able to do more extensive research and is taking a more preventative stand than most states.

**Excerpt taken from a release from the West Virginia Bureau for Public Health:**

The West Virginia Bureau for Public Health (BPH) encourages anglers and consumers to take notice of advisory notifications issued warning pregnant women, women of child bearing age, nursing mothers and children about the health concerns of consuming fish that may be contaminated with mercury. The warnings were issued by the United States Environmental Protection Agency and the Food and Drug Administration.

This action is being taken based on an assessment by U.S. Environmental Protection Agency (EPA) of data collected nationwide. The agencies in West Virginia that develop fish consumption advisories, the Bureau for Public Health, Division of Natural Resources and Department of Environmental Protection, agree that limited data currently available in West Virginia support this recommendation, however, additional fish sampling is required to determine more specifically the extent, level of contamination and species affected by mercury.

**A short summary of New Mexico’s efforts:**
(taken from New Mexico Environment Department)

Atmospheric deposition of mercury
With the exception of localized mineral deposits and certain industrial settings, the greatest source of mercury to the environment is atmospheric deposition. Even though the concentration in the atmosphere is very low, our watersheds provide large catchments, and mercury is carried by runoff into waterways on fine particles of soil. These particles, easily held in suspension by the force of moving water, are eventually trapped behind dams, where they settle into the poorly oxygenated region at the bottom of the reservoir. In the anoxic sediments and hypolimnetic waters above them, sulfate reducing bacteria combine some of the inorganic mercury with methane, forming the methylmercury that biomagnifies so powerfully as it is concentrated and passed from prey to predator up the food chain.

Because mercury has been found in some fish at concentrations which could lead to significant adverse human health effects, specific guidelines have been prepared. These guidelines allow those who fish and their families to make an informed decision as to what fish they can safely eat. While the occasional consumer of fish from these waters is at little risk if they are otherwise in good health, ingestion of mercury at levels found in some fish over a long period of time could result in health problems such as kidney disease and/or eye, respiratory tract, nervous system or brain damage.
How did we first discover the problem?
Some routine spot-checking by the federal government first found the problem. We verified it, and continued testing other lakes in New Mexico.

Have enough fish been tested to be really sure of the level of mercury contamination?
Yes, for the lakes for which we have issued health advisories. Mercury levels are strongly correlated with the length of the fish because longer fish are older and have had more time to accumulate mercury. Thus only four fish of different lengths from each species in a lake need to be tested in order to predict with great accuracy the levels of mercury in all the fish. However, we are testing more fish than this in order to verify our statistical models.

Where is the mercury in the fish coming from?
We don't know for sure, but we have not found any single source for it here in New Mexico so far. Studies in other areas of the U.S. and the world have found that most of the mercury appears to be coming from the air and then deposits in lakes and on soil. The mercury gets into the air from industrial processes including smelters. Another possibility is that mercury can be found naturally in different types of soils, and become washed into lakes with soil disturbances such as overgrazing, housing developments, road developments, etc.

Why would some lakes have a problem and others not?
The factors which affect the amount of mercury which gets into the fish are not fully understood. However, some of them appear to be:
1. More acid lakes lead to more conversion of mercury to methylmercury, which is taken up by the fish more easily.
2. Recently formed lakes, especially those with submerged decaying vegetation such as trees, are more likely to convert mercury to methylmercury.
3. Smaller lakes may have the mercury more concentrated.
4. Rivers with swiftly moving water will usually have less concentrated mercury.
5. Bigger fish, and species of fish which eat other fish, get larger amounts of mercury.

State/EPA mercury screening survey
In 1995 and 1996, staff of the Surface Water Quality Bureau (SWQB) conducted a screening survey for mercury covering over 2,000 miles of New Mexico's waterways. Analyses were provided, free of charge, by EPA s Environmental Monitoring Systems Laboratory (EMSL) in Cincinnati, Ohio. EMSL was able to provide a minimum detection limit of 0.7 ng/L (0.7 parts per trillion). Using ultra-clean sample handling protocols developed by SWQB staff, over two hundred stations were sampled before the EMSL project lost its funding and was terminated. This study is the most comprehensive evaluation of mercury levels in New Mexico's waters ever conducted. The Surface Water Quality Bureau has been given the use of the analytical equipment used in the State/EMSL mercury screening survey. This equipment now resides at the Scientific Laboratory Division of the New Mexico Department of Health (SLD). Staff of the SLD are currently developing a small clean room to provide a suitable laboratory environment for the analysis of mercury at low parts per trillion levels.
Survey results
The data from that study show that, with some notable exceptions, mercury levels in our rivers and streams are very low. The average concentration of mercury in New Mexico's waters is less than 2.5 ng/L (Range: 0.0 ng/L to 500.0 ng/L). No water sample drawn from any major waterway in New Mexico has been found to contain mercury at a level that could pose any degree of direct risk to humans or wildlife. While much work remains to be done, to date it appears that in all but one instance where mercury was found to exceed the current state chronic criterion of 12 ng/L (parts per trillion) its occurrence can be attributed to either mining activity or storm water runoff from Los Alamos National Laboratories (Up to >3,400 ng/L). The single exception appears to be related to a coal seam in San Juan County.

Fish tissue mercury concentrations
Despite the extremely low concentrations of mercury in the State's waters, levels in the tissues of certain fish, (usually large, predatory species), can still exceed the FDA action limit of 1.0 part per million, an increase over background of six orders of magnitude. It is this tendency of mercury to biomagnify as it is passed up the food chain that generates concern. Fish are about ten times as tolerant of mercury than are humans. This is possible because they have evolved an efficient strategy for sequestering mercury away from vital organs: they store it in muscle tissue - the portion we eat.
Update: National Listing of Fish and Wildlife Advisories

Summary
The 2000 National Listing of Fish and Wildlife Advisories is now available from the U.S. Environmental Protection Agency (EPA). States, tribes, and territories report that the number of fish consumption advisories issued in 2000 rose by 187, a 7% increase over 1999. The total number of advisories in the United States increased for four major contaminants—mercury, PCBs, dioxins, and DDT—but remained the same for chloroform. This is the third year in which the number of advisories issued for chloroform has declined or remained constant. The increase in advisories generally reflects an increase in the number of assessments performed and the improved quality of monitoring and data collection methods. The number of acres of lakes under advisory increased from 20.4% in 1999 to 23% in 2000, a total of 63,288 lakes, while the number of river miles under advisory increased from 6.8% in 1999 to 9.3% in 2000. The survey showed that 100% of the Great Lakes and their connecting waters and 71% of coastal waters of the contiguous 48 states were under advisory in 2000.

The national listing is available on the Internet at: http://www.epa.gov/waterscience/fish/

Background
The states, territories, and Native American tribes (hereafter referred to as states) have primary responsibility for protecting residents from the health risks of eating contaminated fish and wildlife. If high concentrations of chemicals, such as mercury or PCBs, are found in local fish and wildlife, then a state may issue a consumption advisory for the general population, including recreational and subsistence fishers, as well as for sensitive subpopulations (such as pregnant women, nursing mothers, and children). A consumption advisory may include recommendations to limit or avoid eating certain fish and wildlife species caught from specific waterbodies or, in some cases, from specific waterbody types (e.g., all lakes). Similarly in Canada, the provinces and territories have primary responsibility for issuing fish consumption advisories for their residents.

States typically issue five major types of advisories and bans to protect both the general population and specific subpopulations.

- **No-consumption advisory for the general population** – Issued when levels of chemical contamination in fish or wildlife pose a health risk to the general public. The general population is advised to avoid eating certain types of locally caught fish or wildlife.

- **No-consumption advisory for sensitive subpopulations** – Issued when contaminant levels in fish or wildlife pose a health risk to sensitive subpopulations (such as pregnant women and children). Sensitive subpopulations are advised to avoid eating certain types of locally caught fish or wildlife.

- **Restricted consumption advisory for the general population** – Issued when contaminant levels in fish or wildlife may pose a health risk if too much fish or wildlife is consumed. The general population is advised to limit eating certain types of locally caught fish or wildlife.

- **Restricted consumption advisory for sensitive subpopulations** – Issued when contaminant levels in fish or wildlife may pose a health risk if too much fish or wildlife is consumed. Sensitive subpopulations are advised to limit eating certain types of locally caught fish or wildlife.

- **Commercial Fishing Ban** – Issued when high levels of contamination are found in fish caught for commercial purposes. These bans prohibit the commercial harvest and sale of fish, shellfish, and/or wildlife species from a designated waterbody.

As shown in Table 1, advisories of all types increased in number from 1993 to 2000.

<table>
<thead>
<tr>
<th></th>
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<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>No Consumption – General Population</td>
<td>503</td>
<td>462</td>
<td>463</td>
<td>563</td>
<td>545</td>
<td>532</td>
<td>570</td>
<td>663</td>
</tr>
<tr>
<td>No Consumption – Sensitive Subpopulation</td>
<td>555</td>
<td>720</td>
<td>778</td>
<td>1,022</td>
<td>1,119</td>
<td>1,211</td>
<td>1,285</td>
<td>1,417</td>
</tr>
<tr>
<td>Restricted Consumption – General Population</td>
<td>993</td>
<td>1,182</td>
<td>1,372</td>
<td>1,763</td>
<td>1,843</td>
<td>2,062</td>
<td>2,213</td>
<td>2,475</td>
</tr>
<tr>
<td>Restricted Consumption – Sensitive Subpopulation</td>
<td>689</td>
<td>900</td>
<td>1,042</td>
<td>1,370</td>
<td>1,450</td>
<td>1,595</td>
<td>1,630</td>
<td>1,802</td>
</tr>
<tr>
<td>Commercial Fishing Ban</td>
<td>30</td>
<td>30</td>
<td>55</td>
<td>50</td>
<td>52</td>
<td>50</td>
<td>50</td>
<td>51</td>
</tr>
</tbody>
</table>
Mercury In Our World and Community
Mercury In Our World and Community!

To gain a clear understanding of the impact of mercury on our communities and lives, it is good to have an understanding of historical mercury uses and what is happening right now. To do this, this section has been divided into two sections-- Mercury through the Ages, which is an excellent way to work on your students’ history achievement standards and science at the same time and Mercury Right Here and Now. There are things you can do today to reduce mercury pollution in our world, giving the youth a sense of immediate success and also helping the community by reducing the possibility of mercury poisoning.

Mercury through the Ages
You will explore the historical uses of mercury, starting from ancient cultures in Egypt and China, ending with a 1950s American car classic and everything in between. You can contrast these historical uses with the current uses described in previous sections of this curriculum.

The Ancients
Mercury has been known since ancient times. The chemical symbol, Hg, is taken from the Latin, *hydrargyrus*, meaning "liquid silver". Evidence shows that the Chinese were using mercury before 2000 B.C. The ancients realized mercury was toxic and assigned the task of mining quicksilver to slaves and prisoners. The average life span of miners was 3 years from when they started this hazardous work. Ancient Egyptian tombs contain vials of mercury, demonstrating the ability to mine and refine mercury.
Virtually all mercury is derived from cinnabar, or mercury sulfide (HgS). Red cinnabar is so rich in mercury content that droplets of elemental mercury can be found in samples of the ore. The ore is heated with a reducing agent (such as oxygen, iron, and quicklime) and the mercury vapor is released into vertical columns of water where the mercury liquefies. Since mercury is quite dense, mercury collects at the bottom while most impurities float on the surface where they can be scraped away.

From the Middle Ages through the Renaissance

During the middle ages, alchemists experimented with various ways of turning metals and other substances into gold. Many used mercury in their processes and many were poisoned, although no one knew the cause at the time.

Many of the English monarchs during this period also dabbled in alchemy and some suspect that at least some of their erratic behavior can be explained by mercury poisoning! King Charles II, who became king of England in 1660, was a practicing chemist/alchemist who had his own laboratory. He experienced personality changes late in life and died of kidney failure, probably due to mercury poisoning.

Historians of science have studied the lives of several famous scientists of the period and conclude that historical accounts of certain periods of their lives, which correspond with their use of mercury, exhibit strong evidence of the symptoms of mercury poisoning.
One such notable is Sir Isaac Newton, although historians are quick to point out that the period of suspected mercury poisoning in his life did not occur while he was deriving the calculus or deducing the law of gravitation. Newton also was an alchemist who actually tasted the chemicals he worked with. At age 49, he became emotionally disturbed for a couple years. In 1979, hair strands from his corpse were tested for mercury and were found to contain 75 parts per million. (Normal levels are about 5 parts per million.)

Another scientist who worked with mercury and exhibited some erratic behaviors was chemist and physicist Sir Michael Faraday, discoverer of electricity. He used mercury in his electrical equipment and suffered from memory loss and a nervous breakdown.

Mercury in Medicine

Mercury has been used in a variety of medical remedies for a long time. One of its most important uses was for treatment of syphilis. Since syphilis was rather widespread among the ruling families of Europe and mercury was the most prominent treatment for several centuries, it is surmised that many of these rulers experienced mercury poisoning. The “common man” was also subject to this disease and the treatment was the same—mercury. The following account illustrates how knowledge of this treatment regime was put to good use in a recent archaeological study.

Archaeologists seeking the elusive remains of Fort Clasop, the winter quarters of the Lewis and Clark expedition in 1805-1806, are getting down to basics—they are looking for the camp’s privies. Researchers from the National Park Service, the Museum of the Rockies and the University of Washington are analyzing levels of mercury in the soil at the site, near Astoria Oregon. Mercury was a common Army treatment for syphilis: Meriwether Lewis dispensed it in large doses to the men of the Corps of Discovery.

High levels of the metal in specific soil samples would indicate the site of a privy. “With 33 men there for 106 days, we should be able to find some high concentrations of mercury,” said Cindy Orlando, Superintendent of the Fort Clatsop National memorial. Because Army regulations at the time stipulated that privies be locate certain distances from encampments, finding signs of one would make it easier to locate the 50-foot by 50-foot fort.
Mercury was also part of a common anti-depressive medication formulation used during the 19th century. The following article, entitled “Lincoln’s Little Blue Pill,” appearing on ABCNews.com on July 17, 2001, shows how users of this medication were probably exchanging one set of symptoms (depression) for another (mercury poisoning.) It also illustrates how the affects of mercury are reversible once the exposure is eliminated.

At one point during a debate, Lincoln reached over and picked up a man by the collar and shook him “until his teeth chattered,” according to a study that appears in the summer issue of Perspectives in Biology and Medicine. He became so angry “his voice thrilled and his whole frame shook,” the study says. Lincoln only stopped when someone, “fearing that he would shake Ficklin’s head off,” broke his grip. The study says mercury poisoning may explain Lincoln’s behavior. “We wondered how a man could be described as having the patience of a saint in his 50s when only a few years earlier he was subject to outbursts of rage and bizarre behavior,” said Dr. Norbert Hirschhorn, a retired public health physician, medical historian and lead author of the study.

The study reformulated “blue mass,” a common anti-depressive medication of the 19th century that Lincoln took. The study shows that it would have delivered a daily dose of mercury exceeding the current EPA safety standard by nearly 9,000 times. “Mercury poisoning certainly would explain Lincoln’s known neurological symptoms: insomnia, tremor and rage attacks,” said Dr. Robert G. Feldman, an expert on heavy metal poisoning and co-author of the paper. “But what is even more important, because the behavioral effects of mercury may be reversible, it also explains the composure for which he was famous during his tenure as president.

The ingredients in “blue mass,” besides mercury, included licorice root, rose water, honey, sugar and dead rose petals, according to the study. It was compounded with an old-fashioned mortar and pestle and rolled to size on a 19th-century pill tile. The vapor released by two pills in the stomach would have been 40 times the safe limit set by the U.S. National Institute for Occupational Health, the researchers found. The amount of solid mercury absorbed from two pills would have been 750 micrograms. The EPA indicates that only up to 21 micrograms of any form of mercury per day may safely be ingested. Someone who consumed the common dose of two to three little pills per day would have been at serious risk for mercury poisoning, the study says. Mercury was also used in antiseptic formulations (e.g. mercurochrome) and anti-itching compounds. (e.g. calamine lotion).
Industrial Mercury

By the 1800s, mercuric nitrate was widely used to soften fur for hats. The resulting exposure of workers lead to a classic syndrome and the phrase "mad as a hatter." In Danbury, Connecticut, a center of hat making, the effects of exposure were characterized as "Danbury Shakes." It was not until 1941 that the use of mercury nitrate in hat making was banned in most states.

One of the world's best-known mercury mines—the Almaden mine in Spain—has been in continuous operation since 400 B.C. Mercury's discovery in California predates the discovery of gold by several years. The discovery of commercial mercury ore bodies led to the development and operation of numerous mines from the 1840s to the early 1960s, from which more than 220,000,000 pounds of elemental mercury were produced. The 1848 discovery of gold in the Sierra Nevada created a ready market for mercury produced by the mines in California's Coast Ranges. Mercury forms a relatively insoluble amalgam with gold, and miners used this property to increase gold recovery. An estimated 10 to 30 percent of the mercury was lost to the environment in this process, transported into streams and reservoirs along with the discharged sediments (tailings or slickens) from the hydraulic mining operations. Mercury from hydraulic mining has been transported with sediments downstream into the San Francisco Bay/Sacramento-San Joaquin Delta estuary, where it has likely contributed to elevated mercury concentrations in fish, resulting in consumption advisories.

Mercury in the Twentieth Century

Due to its many unique properties, mercury achieved widespread use during the 1900s in industrial, commercial and residential applications. Many of these uses are still occurring today; other uses have been banned or phased out, for example mercury in latex paints, children’s sneakers that lit up and maze games.

One particularly interesting use of mercury that has since been eliminated was in cars. Up to 40 pounds of mercury were incorporated into the road leveling device on one model of late 1950s Studebaker. Who knows what happened to all that mercury and are the vintage Studebaker owners of today aware of what is in their vehicles? (Other uses of mercury in cars, such as in tilt switches which control trunk lights, have not been totally phased out as of yet.)
Activity 8 - Mercury through the ages

Using the attached, “Unique Properties of Mercury” and the Mercury though the Ages information have the students complete the following activity.

For each of the following historic uses of mercury, indicate the unique property(s) of mercury that forms the basis for this use and, if time permits, think of or research a non-mercury alternative to that use.

<table>
<thead>
<tr>
<th>Historic use</th>
<th>unique property(s)</th>
<th>non-mercury alternative</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gold mining</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Insecticides</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dental amalgam</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Batteries</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Road leveling device in cars</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mercurochrome</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Electrical tilt switches</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Anti-depressive pills</td>
<td></td>
<td></td>
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<tr>
<td>Latex paints</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Thermometers</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Children’s maze games</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Unique Properties of Mercury</strong></td>
<td><strong>Implications</strong></td>
<td></td>
</tr>
<tr>
<td>----------------------------------</td>
<td>------------------</td>
<td></td>
</tr>
<tr>
<td>♦ Only metal that is liquid at room temperature.</td>
<td>Holds fascination for people of all ages. Special ceremonial uses in several different cultures.</td>
<td></td>
</tr>
<tr>
<td>♦ Easily evaporates into the air.</td>
<td>A blob of mercury sitting on the table will eventually disappear. The mercury vapors can be extremely dangerous to breathe.</td>
<td></td>
</tr>
<tr>
<td>♦ Very dense, yet fluid.</td>
<td>Just a little bit weighs a lot, yet moves around easily. This is useful in certain medical procedures.</td>
<td></td>
</tr>
<tr>
<td>♦ Good conductor of electricity.</td>
<td>Used in electrical tilt switches and other electrical devices.</td>
<td></td>
</tr>
<tr>
<td>♦ Expands or contracts uniformly with changes in temperature.</td>
<td>Used in thermometers and thermostats.</td>
<td></td>
</tr>
<tr>
<td>♦ Readily combines (amalgamates) with other metals and materials.</td>
<td>Dentists combine it with silver to make amalgam, which is used to fill cavities in teeth.</td>
<td></td>
</tr>
<tr>
<td>♦ Kills bacteria and fungi.</td>
<td>Previously used in pesticides, paints and on people to kill germs!</td>
<td></td>
</tr>
</tbody>
</table>
You may have already started by eliminating mercury in your school and home or maybe you reduced your energy consumption. Now it is time to take even greater action. In order to take community action you need to know where your community stands. Have the students find out what people know or do not know about mercury by conducting the “Local Survey about Mercury”. Once the students have done this, have them report on their findings and the implications of those findings to the full group.

**Activity 9 - A Local Survey About Mercury**

**Objectives:**
Students will: 1) design and conduct a survey of their community on the subject of mercury; 2) evaluate the results of the survey and develop an action plan to address the survey findings.

**Materials:**
- Sample Survey

**Background:**
Are residents in your community concerned about mercury? Do any businesses use mercury in their operations? Does your community have the cleanup equipment to handle a mercury spill? Do residents in your community know about the health threats of mercury? Are any lakes in your region listed in the state fish advisory? Do anglers care?

One method of finding answers to these questions and others is to design a survey and conduct it in your community. It is an interactive process that requires preparation, involvement and interpretation. The results can lead students to take an active role in tackling an environmental problem in their community.

Several different methods can be used to study information and opinions about environmental issues. Here are 2 different methods:

- **Surveys** can be used to collect information about environmental conditions in your school and community. They focus on information about a specific problem in a certain area.
  - Example: How many mercury thermometers do you have in your home?

- **Opinionnaires** measure the beliefs or opinions of people at a specific time. They are that person’s opinion – which may or may not be accurate or correct.
  - For example:
    - I believe mercury is dangerous to human health.
    - **Strongly Agree, Agree, Neutral, Disagree, Strongly Disagree**
Before a method is selected, it is important that students carefully decide the exact information that needs to be collected, the geographic area they want to cover, and the target population that will be surveyed. A combination of methods can also be used. Accurate collection of the information is next. The students should prepare a data summary sheet to record their information.

Once the data has been collected, students will be challenged to interpret the information and suggest ways to share their results and actions that need to be taken.

A valuable book to assist you in developing and utilizing surveys is, “Investigating and Evaluating Environmental Issues and Actions: Skill Development Modules”, by Harold Hungerford and others. Stipes Publishing Company, 10-12 Chester Street, Champaign, IL 61820

Procedure:
1. Have the students use the sample survey or design a new one to conduct a community survey on the topic of mercury. Students are encouraged to add new questions especially targeted at their community.
2. Students will identify a target audience and conduct the survey. Target audiences could include: homeowners, adults, students, or teachers.
3. Tabulate and analyze the results of the survey and prepare a report. Students should then identify various action steps they could take to increase the knowledge of the target audience on the subject of mercury.
Sample Mercury Survey
Hello, my name is _______________________. I am a student at ______________School. I am doing research on mercury in our community. I would like to ask you several questions about this topic. The survey will take about 10 minutes.

Person Responding: Male ____ Female ____
Age: <20 ____ 20-40 ____ 40-60 ____ 60+ ____

1. Do you consider mercury dangerous to human health? Yes ____  No ____
2. In the last year, have you heard or read of any local or national news story that describes an incident involving mercury? Yes ____  No ____
3. Do you fish? Yes ____  No ____
   If yes, have you consulted the state fish advisory that describes the warnings for eating fish from certain bodies of water? Yes ____  No ____

For each of the following statements, tell me whether you strongly agree, agree, neutral, disagree, or strongly disagree.
4. All thermometers contain mercury. 
   Strongly Agree  Agree  Neutral  Disagree  Strongly Disagree

5. Mercury should be stored in locked cabinets if it is used at school. 
   Strongly Agree  Agree  Neutral  Disagree  Strongly Disagree

6. Switches and thermostats that contain mercury should be clearly labeled.
   Strongly Agree  Agree  Neutral  Disagree  Strongly Disagree

Please rate on a scale of 1 (not important) to 5 (very important) the following statements:
7. Mercury should be banned from use in children’s toys. 
   1  2  3  4  5

8. Non-essential uses of mercury should be phased out in our community. 
   1  2  3  4  5

9. Firefighters and emergency personnel should be trained to handle a mercury spill. 
   1  2  3  4  5
Please answer True or False to the following:

10. Mercury spills in schools have resulted in evacuations and expensive cleanups.
   T ____  F ____

11. Several different cultures use mercury for ceremonial or religious purposes.
   T ____  F ____

12. Once mercury gets into your body, it may stay there for several weeks.
   T ____  F ____

13. The burning of fossil fuels like coal releases mercury into the air.
   T ____  F ____

Please answer the following questions:

14. What would you do if you found a jar of mercury in your basement?

15. Do you read and follow the advice given in our state's Fish Consumption Advisory? Why or Why not?

16. What are the symptoms of mercury poisoning?

17. Circle the household items that may contain mercury.

   thermometers  mercurochrome  switches in old washing machines and freezers  most plastics
   kid's maze games  hair shampoo  sphygmomanometers  some nasal sprays

Thank you.
Now may be the time to take community action. Your class or a group of students may wish to develop a community action plan. This activity can be done at the beginning of the project; then you will need to revise the plan based on what the students learned from the previous activities. Or you may wish to do the plan at the end of your class mercury activities.

**Activity 10- Mercury Community Action Projects**

**Objective:**
Students will develop and implement an action plan to reduce the concerns and impacts of mercury in their community.

**Materials:**
Background materials in this set of activities.

**Background:**
Your students will be participating the “real world”! Completing a “Community Action Project” is based on the following assumptions:

- Society must solve community environmental issues with participation from its young members.
- Students need to know they can be forces for constructive change.
- Students need the opportunity to investigate and act upon a problem of their choice to increase their motivation to learn.
- The school and its community need to be connected to show relevance to the real world. The classroom is part of the community and the community is part of the classroom.

The Community Action Project will provide the students an opportunity to apply the knowledge they have acquired about mercury to improve how mercury is handled in the community. The students will use skills in research, investigation, problem-solving and working in groups.

**Procedure**
Students can undertake this activity as a class or in groups. They will brainstorm a list of recommendations for their community on mercury reduction. Based on this list, they will choose one activity and develop an action plan that will include the following:

- Identify the problem to be addressed
- List methods to address the problem
- Select the best action
- Determine the resources needed to complete the plan
- Identify possible partners for the program
- Develop a time line
- Implement the project
- Evaluate the project and suggest changes for future efforts
The class or groups will then implement their action plan.

The following are some possible activities that the students can develop for action plans:

- Organize a community outreach program about mercury; for example, display and handout(s) about mercury and take it to various public venues.

- Discuss mercury spill prevention and clean up with school janitorial staff, local fire department and/or Hazmat (hazardous materials) Team.

- Promote a mercury or household hazardous waste collection program in your community.

- Design and print labels for equipment that contains mercury and work with school janitorial staff, nursing homes and/or others to place these on mercury thermostats and other equipment;

- Check store inventories and work with store owners to ensure that no mercury-containing games (e.g. maze games or toys) are being sold to small children.

- “Adopt” a hospital, or nursing home and work with them to minimize their use of mercury and safely recycle their existing mercury.

- Work with your electric utility to promote a mercury thermostat recycling program.

- Perform mercury school audits for grade schools and middle schools in your school district.

- Determine if there are any rules pertaining to mercury in your community or state, and if not, start a campaign to establish rules.

- Investigate what popular stores in your community or state are doing concerning the selling of items that contain mercury (Walgreens, Walmart, Home Depot, etc.)

- Other ideas from the students