

Lesson One: MERCURY IN YOUR EVERYDAY LIFE

In the **Quicksilver Question Web Module**, students learn that gold mining is just one of many possible sources of mercury pollution. In this activity, students examine a data table that illustrates the major sources of mercury pollution from human sources in New Mexico State.

This lesson addresses the following New Mexico State Education Standards in Math for grades 5-8.

- **Number and Operations** – Understand numbers, ways of representing numbers, relationships among numbers, and number systems.
- **Number and Operations** – Understand the meaning of operations and how they relate to one another.
- **Number and Operations** – Compute fluently and make reasonable estimates.
- **Algebra** – Understand patterns, relations, and functions.
- **Algebra** – Represent and analyze situations and structures using algebraic symbols.

As the Quicksilver Web Module demonstrates, gold mining is one way that mercury can contaminate the environment and endanger human health. In the town of Quicksilver, New Mexico, an abandoned gold mine has contributed mercury to Golden Lake and contaminated the fish there, but this is not the only source of mercury in the town. As the Health Clinic's brochure, "Mercury and You," points out, there are many sources of mercury in people's daily lives.

The United States Environmental Protection Agency estimates that over 9000 pounds of mercury compounds were released into the New Mexico environment in the year 2000. Although mercury pollution can come from mining operations, the largest portion of mercury releases in New Mexico comes from coal fired electric boilers that are used to make electricity. Other sources of mercury include burning garbage and medical waste, dentist offices, wastewater treatment centers, thermometers, fluorescent light tubes and much more. Mercury discharged in the land, air or water can eventually end up in lakes, rivers and the ocean, where fish populations can become contaminated.



For a more in-depth understanding of mercury pollution, consult the following resources that were used to prepare this lesson:

- "Mercury Study Report to Congress, Volume II: An Inventory of Anthropogenic Mercury Emissions in the United States." Environmental Protection Agency. <http://www.epa.gov/oar/mercury.html>

Lesson Overview

New Mexico State Education Standards

Teacher Background

- “Mercury and P2 in the Northwest” in the Spring 2003 issue of *Pollution Prevention Northwest*. <http://www.pprc.org/pprc/pubs/newslets/news0303.html>

Teacher Preparation

Materials: (for each student)—

- Photocopies of the table, “New Mexico Mercury Sources and Estimated Annual Discharges (in pounds).”
- Optional: Computer access

Procedure



Student Assessment:

Student work can be assessed in the following ways:

Have student's score one another's data tables. Fifteen points are possible.

- Ask students to reflect on the variety of sources of mercury pollution that were identified in the **Quicksilver Question Web Module**. Create a list on the board of students' ideas of sources of mercury pollution. You may want to refer students back to the Health Clinic's “Mercury and You” brochure for more information. These documents can be accessed by using the save/print function in the module or downloading them from the “For Teachers” page of the Quicksilver website.
- Ask students to examine the data table of the major sources of mercury pollution in New Mexico State. What sources did students not include on their list of mercury pollution sources?
- Using the data table, students will calculate the percentage of the total of each source of mercury pollution.
- **Optional:** Students can be challenged to create some sort of graphic that presents the information on the sources of mercury pollution. Students may create a circle graph, a bar graph or a pictorial representation of the data table. You may want to allow students to create their graphics using computer graphing software.
- Conclude the activity with a discussion about the sources of mercury pollution. Possible discussion questions follow:
 - What are the two biggest contributors to mercury pollution?
Coal-fired power plants (32.8%) and other emissions (29.2%).

New Mexico has four coal-fired power plants, two of which are quite large and have multiple units. The two largest coal-fired power plants are near Farmington, NM and account for about 2180 pounds of mercury emissions per year. The other two, much smaller, plants are located near Grants, NM and Raton, NM. Mercury naturally occurs in coal, but varies in the amount depending on where the coal was mined and the type of coal.

Other emission may include both natural and non-natural sources. Mercury is a naturally occurring element that is found in rock formations and can enter the air during volcanic eruptions. Other ways that mercury may get into the environment includes when mercury-containing products are broken, crushed or burned, releasing vapors into the air. Also, landfills that hold

mercury-containing products vent mercury vapors along with methane gas. Other possible sources include pesticides, old computer parts, fertilizers, old paint, waste water treatment, forest fires and agricultural burning.

- How do you think mercury gets into the environment from each of these sources? What do you think is impacted: air, water or soil?

It is estimated that about 75% of fluorescent light tubes and compact fluorescent bulbs are sent to landfills instead of recycled. These products release mercury into the landfills and can contaminate water and air.

Home thermostats often contain mercury. They should be taken to household hazardous waste collection sites, not sent to landfills.

Some silver-colored dental fillings contain a mixture of silver, mercury and other metals. The fillings release small amounts of mercury vapor, which is inhaled by the person with the filling. Also, dentist offices may release mercury into the waste stream. In addition, cremating the bodies of people who had dental fillings can release mercury into the air.

Automotive switches and relays, such as antilock brake sensors, some headlights and trunk switches, often contain mercury. Estimates suggest that these automotive applications used 12 tons of mercury in 1995. These products should be properly disposed of instead of sent to a landfill. Many auto manufacturers are working to create new devices that do not rely on mercury.

Fever thermometers, as well as blood pressure devices used at hospitals, once used mercury because of its ability to expand and contract depending on temperature. There are now non-mercury versions of these products on the market. Mercury can be released into the air when these products are broken, or if they are sent to a landfill or incinerator.

Button cell batteries, as well as old alkaline batteries (before 1990), contain mercury and must be disposed of properly.

Power generation facilities that burn coal release elemental mercury into the air. The mercury can circumnavigate the globe for up to two years, and can fallout in areas far away from the source. For example, mercury pollution in the Arctic is the result of air pollution from industrial sources far away.

Vehicle emissions contain mercury, which pollutes the air.

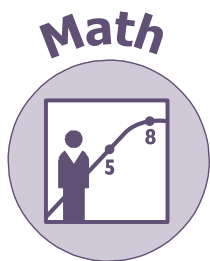
Waste incineration of both medical and municipal waste can contribute mercury into the air.

Web Module: QUICKSILVER

- For each mercury source, can you think of some ways to reduce the amount of mercury that gets into the environment?

Some ideas include:

- ***Sponsoring exchange and collection programs for consumer products***
- ***Encouraging manufacturers to redesign their products to be mercury-free***
- ***Developing effective recycling systems***
- ***Placing sales bans or requiring warning labels on mercury-containing products***
- ***Enacting disposal bans to keep specific products out of landfills***
- ***Requiring mercury-containing items to be removed from vehicles prior to crushing and recycling.***



MERCURY IN YOUR EVERYDAY LIFE

Student Handout #1



Teacher Key

The following table shows the sources of mercury pollution in New Mexico. Fill in the missing information in the table. Then answer the two questions on the next page. Round your answers to one decimal place.

**New Mexico Mercury Sources
and Estimated Annual Discharges (in pounds)**

MERCURY SOURCES	MERCURY COMPOUNDS IN POUNDS	PERCENT OF TOTAL
Fluorescent light tubes	201	2.2
Dental	64	0.7
Coal-fired Power Plants	2990	32.8
Laboratory Waste	91	1
Portland cement manufacturing	283	3.1
City garbage incinerators	1705	18.7
Copper smelting	70	0.8
Medical waste incinerators	921	10.1
Municipal solid waste (e.g. batteries)	36	0.4
Cars/mobile sources	91	1
Other emissions (industry, cremations, waste water treatment)	2666	29.2
TOTAL	9118	100%

Data was collected from the Environmental Protection Agency's "Mercury Study Report to Congress, Volume II: An Inventory of Anthropogenic Mercury Emissions in the United States" and the Toxic Release Inventory for New Mexico in the year 2000. Copper smelting emissions were estimated using an average mercury in ore/measured emissions ratio.

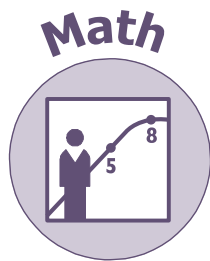
Check Your Understanding

1. Based on the estimated amount of mercury compounds discharged each year, how much mercury compounds are discharged each day in New Mexico?

$$9118 \text{ lbs}/365 \text{ days} = 25 \text{ lbs per day}$$

2. How much mercury compounds would be discharged in New Mexico in a decade, if everything stayed the same?

$$9118 \text{ lbs/year} \times 10 \text{ years} = 91,180 \text{ lbs}$$



MERCURY IN YOUR EVERYDAY LIFE

Student Handout #1



Student Handout

Name _____

Date _____

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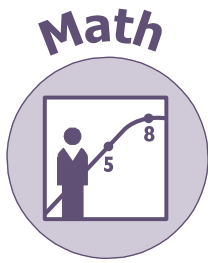
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City garbage incinerators	1705	
Copper smelting	70	
Medical waste incinerators	921	
Municipal solid waste (e.g. batteries)	36	
Cars/mobile sources	91	
Other emissions (industry, cremations, waste water treatment)	2666	
TOTAL	9118	100%

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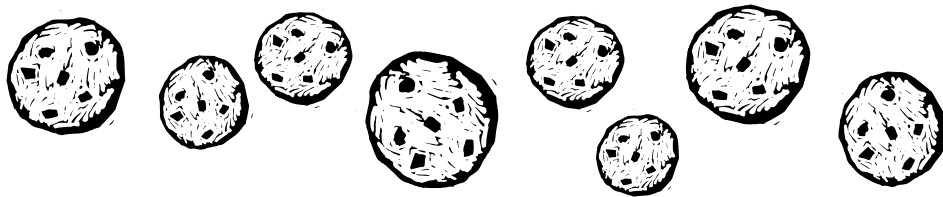
2. How much mercury compounds would be discharged in New Mexico in a decade, if everything stayed the same?



Lesson Two: COOKIE MINING

In the **Quicksilver Question Web Module**, students learn that gold mining can impact environmental and human health.

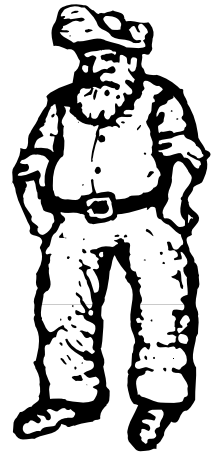
In this lesson, students become miners who need to purchase a piece of land (cookie), mining rights and mining tools (toothpicks and paper clips). They also have to pay for the time they spend mining, for environmental damage and for reclamation costs. Students make money by mining chocolate chips, but have to do some calculations to determine if they made a profit from their mining operation. The activity introduces students to some of the basics of mining economics, as well as considering the cost of environmental damage.



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- **Algebra** – Understand patterns, relations, and functions.
- **Algebra** – Represent and analyze situations and structures using algebraic symbols.
- **Social Studies: II-E** – Understand how economic, political, cultural, and social processes interact to shape patterns of human populations, and their interdependence, cooperation, and conflict.
- **Social Studies: IV-A** - Explain and describe how individuals, households, businesses, governments, and societies make decisions, are influenced by incentives (economic as well as intrinsic) and the availability and use of scarce resources, and that their choices involve costs and varying ways of allocating.

Lesson Overview



New Mexico State Education Standards

**Lesson Plan
Links**

A lesson plan for **Cookie Mining** is available from the following website. This lesson plan is the property of the Women in Mining Education Foundation.

- <http://www.womeninmining.org/cookie1.htm>