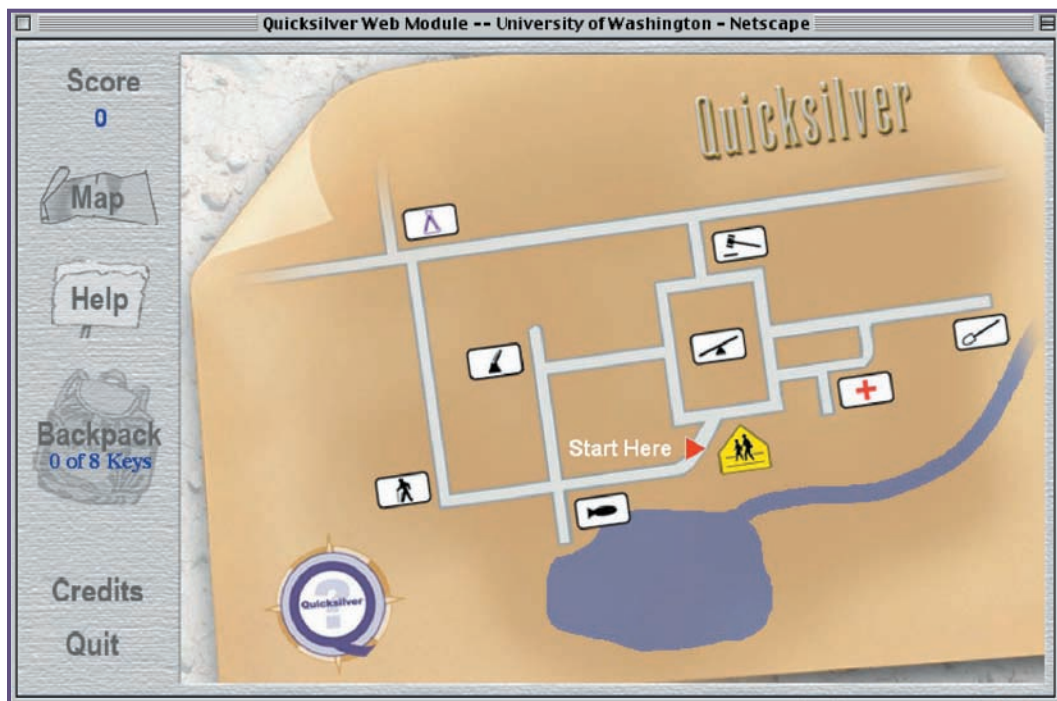


# Environmental Health

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## The Quicksilver Question Web Module



**IEHMSP**  
INTEGRATED ENVIRONMENTAL HEALTH  
MIDDLE SCHOOL PROJECT

An interactive, computer based  
environmental health curriculum for  
middle school students.

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<http://depts.washington.edu/iehmSP/>



These materials were developed by the Integrated Environmental Health Middle School Project (NIEHS Grant #ES10738 and #ES07033) at the University of Washington, Seattle.

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# IEHMSP

**INTEGRATED ENVIRONMENTAL HEALTH  
MIDDLE SCHOOL PROJECT**



These materials are produced by the NIEHS Center for Ecogenetics & Environmental Health at the University of Washington, Seattle. Funding provided by the Integrated Environmental Health Middle School Project (NIEHS grant ES 10738 and ES 07033). Any opinions, findings, conclusions, or recommendations expressed in this publication are those of the authors and do not necessarily reflect the view of the funding agency.

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## Introduction



# The Quicksilver Question Web Module: Introduction

The screenshot shows the website for the Quicksilver Question Web Module. At the top, there are logos for IEHMSP (Integrated Environmental Health Middle School Project), the National Institute of Environmental Health Sciences (NIEHS), and the University of Washington Center for Ecogenetics & Environmental Health. Below the logos is a navigation menu with tabs for Introduction, Students, Teachers, and Resources. The main content area is titled "Introduction to the Quicksilver Question Web Module" and contains the following text:

**Introduction to the Quicksilver Question Web Module**

The **Quicksilver Question Web Module** was created for use by teachers participating in the Integrated Environmental Health Middle School Project (IEHMSP). The IEHMSP introduces middle school teachers and students in Washington State and New Mexico to the field of environmental health and facilitates the teaching of environmental health topics across the middle school (grades 6-8) curriculum. The Quicksilver Question Web Module introduces students to the connections between historic gold mining, mercury contamination, fish consumption and human health.

The IEHMSP is funded by the **National Institute of Environmental Health Sciences** (NIEHS Grant #ES10738 and #ES07033).

**What is a Web Module?**  
A Web Module is an innovative, interactive computer based curriculum designed to introduce your students to an environmental health topic. The Module is available to download for free from the IEHMSP website. It can be used at anytime at any computer that meets the hardware, software and Internet compatibility requirements. The Module is also available in a CD format, by special request. See the **Training Manual** for technical information and helpful hints on using the Module.

At the bottom of the page, there is a footer with navigation links: Home | About Us | Students | Teachers | Web Modules | EH Resources | Contact Us.

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The IEHMSP is funded by the **National Institute of Environmental Health Sciences** (NIEHS Grant #ES10738 and #ES07033). <http://www.niehs.nih.gov/translat/k12/k12educa.htm>

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## How do I access the Web Module?

For the Washington State version, go to <http://depts.washington.edu/iehmosp/>  
For the New Mexico version, go to <http://hsc.unm.edu/pharmacy/iehms/>



## The Quicksilver Question Web Module: For Teachers



The Quicksilver Question Web Module is designed as a student-centered problem-based learning exercise. Students navigate through the information contained in a virtual town, collecting eight key documents. Along the way, they visit interactive virtual environments such as the Department of Health, a science lab, a newspaper office, a retirement home, a museum and the local middle school. There, they obtain facts, information, perspectives and advice about how to formulate questions and evaluate health concerns.

### **Why use a Web Module to teach environmental health?**

In the Quicksilver Question Web Module, students are presented with a realistic problem and then guided through the process of acquiring the tools necessary to understand and solve that problem. The treasure hunt for key documents, along with a point-based scoring system, motivates the students to become immersed in the material and engaged in the fictional scenario. The Module is designed to interest, engage and immerse the students in the topic.

Further learning occurs when the documents are collected and the students read, understand, integrate and evaluate them. An online quiz and a companion worksheet evaluate simple verbal information, such as definitions and data.

A series of Enrichment Activities provide opportunities for deeper conceptual understanding of the information introduced in the Module. The eight Enrichment Activities are designed to be interdisciplinary, to encourage opportunities for team teaching, and to provide problem-based learning activities for students.



### Special Note: Teaching about Mercury

The most important environmental health topics to share with students are those that have a direct impact on them and the things that they have control over in their lives. By being aware of an environmental health issue in their own community, students can become empowered with that knowledge to reduce their personal risks and lessen their opportunities to come in contact with the hazard.

Many recent news stories have focused on the risks associated with eating certain types of fish that may be contaminated with mercury. While fish and seafood can be a significant source of exposure, mercury can be found in many household and consumer products, as well as in air, water and soil. With an understanding of the sources of mercury poisoning and the main routes of exposure, students can learn how to protect themselves and their family members from this health hazard. The widespread risk of mercury exposure makes it an important topic for the middle school curriculum.

When teaching about a health issue such as mercury, it is important to keep in mind that some of the students in your class may have a higher risk of mercury poisoning than other students. Middle school students often want nothing more than to fit in with the crowd. Be sensitive to this by avoiding pointing out students in your class that may have higher risk factors. Rather, let them bring their experience to the discussion, if they choose to do so.

In addition, the content of the Quicksilver Question Web Module and its related extension activities relate mercury poisoning as an environmental justice issue. By investigating this topic, students will find connections between mercury exposure, poverty, geography, diet, cultural practices and occupation. References to these issues may cause some students to feel uncomfortable at first. For this reason, in your role as the teacher it is important that you moderate activities with basic classroom rules of respect. Emphasizing mutual respect will create an atmosphere that will allow students to share experiences and ideas on topics that may have impacted them personally.

### How Do I Present the Web Module?

The Quicksilver Question Web Module incorporates multiple resources that can be integrated into an environmental health unit. These materials include an introductory student reading, student handouts, an online quiz, a list of Internet resources, and enrichment lesson plans to further explore the topic. The Module and its supporting materials are all designed to be used by teachers of social studies, language arts, science, math, health and fitness.

The Web Module can be introduced to your students using a three-step approach, as described below.

- 1. READ THE INTRODUCTION TO ENVIRONMENTAL HEALTH.** Introduce your students to some basic environmental health concepts by assigning the reading, **Introduction to Environmental Health**. Your students may already have been exposed to this reading from an *Environmental Health Fact File* or the *Health & Environment Activities Research Tool (HEART)* manual. If so, use this time to review the reading and refresh their understanding of environmental health. In

## Introduction

particular, students should be familiar with the seven key icons (Dose/Response, Exposure, Toxicity, Individual Susceptibility, Risks & Benefits, Environmental Justice and Community Resources & Action).

- 2. EXPLORE THE MODULE.** While the Module can be presented in one class period, we recommend using two class periods to give students time to fully explore the Module.

As students work through the Module, ask them to use a piece of paper to record their progress and to take notes on the pathway to finding each key document. Each time a student encounters a key document, they will be asked one of eight Pop Quiz questions. Students should keep track of the correct answers to these questions. That way, if a student wants to return to the Module after exiting it, they can use these notes to quickly move through the Module to the location where they left off. You may also want to ask students to record their final score from the Pop Quiz questions as a way for you to track their learning.

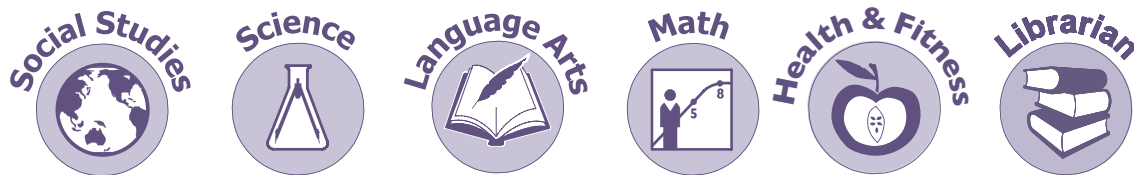
A Student Handout is provided to accompany the Module. This Handout includes ten questions that relate to the documents the students will encounter in the Module. By answering the questions on the Handout, students must be sure to carefully read the documents found throughout the Module. You can use the Handout in one of two ways. You may want to ask students to work through the Student Handout during their exploration of the Module to be sure that they are reading and understanding the documents. Please be aware that it will be difficult for students to complete both the Module and the Student Handout during one class period. You may also use the Student Handout as a way to assess student understanding of the concepts after they have finished the Module. Both the Student Handout and the Pop Quiz score can be used for assigning points for students' participation in the Module.

- 3. PRESENT AN ENRICHMENT ACTIVITY.** Discover how modern day discoveries can unravel historic mysteries! Write a letter that can travel back in time! You can deepen students' understanding of mercury and environmental health by presenting one or more of the Enrichment Activities. These Enrichment Activities relate directly to concepts and ideas brought up in the Module. The integrated nature of the lesson plans provide a opportunity for team teachers to work together. Each Enrichment Activity will take several class periods to complete.

We hope you find this Module to be useful and that the experience of using environmental health as an integrating context for teaching is a rewarding one.

# Key to Symbols

Each FACT FILE contains six sections. Icons clearly indicate the SUBJECT AREA for which the lesson plan was created:



## Key to Symbols

This icon in the margin indicates points in the lesson plan that provide good **Opportunities for Student Assessment**.



This icon in the margin indicates a handout that should be **Copied and Distributed to Students**.



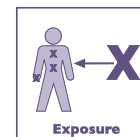
Student Handout

This icon in the margin indicates a **Teacher's Answer Key for a Student Handout**.



Teacher Key

This icon in the margin indicates content that relates to the core environmental health concept of **Exposure**.



This icon in the margin indicates content that relates to the core environmental health concept of **Toxicity**.



This icon in the margin indicates content that relates to the core environmental health concept of **Dose/Response**.



This icon in the margin indicates content that relates to the core environmental health concept of **Individual Susceptibility**.



This icon in the margin indicates content that relates to the core environmental health concept of **Risks and Benefits**.



This icon in the margin indicates content that relates to **Environmental Justice**.



This icon in the margin indicates content that relates to **Community Resources and Action**.





## *Middle School Students Exploring Environmental Health Across the Disciplines*

# **The Quicksilver Question Web Module: Lessons At a Glance**

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### **Social Studies: Expedition Medicine**

**Lesson Overview:** Students learn about the state of medical knowledge during the time of the Lewis and Clark Expedition. They develop a list of medicines and equipment to bring on a wilderness journey, then compare their lists to items compiled by Lewis. The use of mercury-containing medicines has enabled archeologists to use privy pits as a way to locate the expedition's famous camps.

**Suggested Grades:** Grades 7-8

**Curriculum Connections:** U.S. History, Lewis and Clark, medical history

**EALRs:** History 1.2.2, and 2.2.2



### **Social Studies: Gold Mining in South America**

**Lesson Overview:** In this activity, students learn about artisanal gold mining operations in South America, a source of mercury poisoning for young children. Then, students create a map that illustrates the distribution of artisanal gold mining operations across South America.

**Suggested Grades:** Grades 6-7

**Curriculum Connections:** South America, geography, mapping skills

**EALRs:** Geography 1.1.2a; Geography 1.1.2b and 3.1.2b

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### **Science: Up the Food Chain**

**Lesson Overview:** In this lesson, students play two simulation games to understand how biomagnification and bioaccumulation of mercury can affect aquatic ecosystems—and harm people.

**Suggested Grade Levels:** Grades 7-8

**Curriculum Connections:** Food chains, aquatic ecosystems, pollution

**EALRs:** Science 1.3

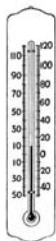
### **Science: Mercury Rising**

**Lesson Overview:** Students learn how mercury thermometers work. Then they build their own working thermometer models. Students can calibrate their water thermometers and/or create a graph that shows temperature throughout the day. Students also learn about non-toxic alternatives and how to dispose of a broken mercury thermometer.

**Suggested Grade Levels:** Grade 6-7

**Curriculum Connections:** Thermometers, temperature, graphing, calibration, building models

**EALRs:** Science 1.3 and 2.1



\*EALRs: Washington State Essential Academic Learning Requirements (EALRs).

## Language Arts: The Mercury Message

**Lesson Overview:** Students have the opportunity to send a persuasive letter that can travel back in time, reaching a group of Arkansas teenagers the day before they discover a barrel of abandoned mercury. In the letter, the students warn the teens about the dangers of mercury to human health and the environment.

**Suggested Grade Levels:** Grade 7-8

**Curriculum Connections:** Persuasive writing, letter writing, human health

**EALRs:** Writing 2.1 and 2.2



## Language Arts: Toxic Tales

**Lesson Overview:** Students learn about a historical case of mercury poisoning in Iraq caused by eating imported wheat seeds. Students learn about the use of symbols as a form of communication. They also learn about the international symbols for hazardous chemicals and design a label that could have been used to warn the Iraqi people about eating the wheat seeds.

**Suggested Grade Levels:** Grade 6-7

**Curriculum Connections:** Communication, symbols, cultural assumptions

**EALRs:** Communication 3.1 and Reading 3.1



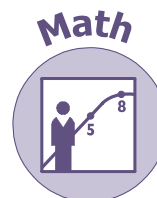
## Math: Mercury in Your Everyday Life

**Lesson Overview:** In this activity, students recognize the many sources of mercury in our daily lives. They examine a data table that illustrates the major sources of mercury pollution from human sources in Washington State.

**Suggested Grade Levels:** Grade 6-7

**Curriculum Connections:** Reading data tables, calculating percentages

**EALRs:** Mathematics 1.1 and 4.3



## Math: Cookie Mining

**Lesson Overview:** In this lesson, students become miners who need to purchase a piece of land (cookie). Students make money by mining chocolate chips. The activity introduces some basic mining economics, as well as considering the cost of environmental damage.

**Suggested Grade Levels:** Grade 7-8

**Curriculum Connections:** Economics, profit and loss, environmental damage

**EALRs:** Mathematics 5.3



This section provides lessons, activity ideas, and resources for Health and Fitness teachers to integrate the topic of mercury into their curriculum.



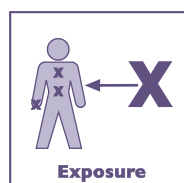
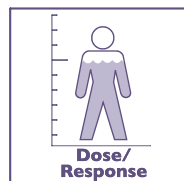
### Integrated Environmental Health Middle School Project

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**Website:** <http://depts.washington.edu/iehmstp/> **Department phone:** (206) 616-7557

# IEHMSP Student Learning Outcomes



The Student Learning Outcomes are provided to give you a sense of the overall learning goals of the IEHMSP. By teaching the Quicksilver Question Web Module and the enrichment activities, your students will meet some of the overall learning objectives for the project. These learning outcomes are aligned to the Washington State Essential Academic Requirements (EALRs).

## 1. Students will understand the relationship between human health and the environment.

- Students will understand the inherent properties of a substance (toxicity) and overall amount of that substance that gains entry into the body (dose/response) are critical factors in determining whether the substance has an effect positive or negative on health.

**EALRs:** Science 1.2 and 1.3; Health & Fitness 3.1

- Students will understand that duration, frequency, and routes of exposure are critical factors in determining whether a substance has an effect positive or negative on health. Students will also be able to describe the three ways in which a chemical can enter the human body: by inhalation (breathing), ingestion (swallowing), and dermal absorption (contact with skin). Students will also be able to identify which body systems (respiratory, nervous system, etc.) are impacted.

**EALRs:** Science 1.2 and 1.3; Health & Fitness 3.1

- Students will understand how individual factors (for example genetics, age, gender, and body size) can affect the overall impact of environmental exposures on health.

**EALRs:** Science 1.2 and 1.3; Health & Fitness 2.3, 3.1 and 4.1

## 2. Students will investigate the roles that individuals, communities and governments play in decisions that can affect human health.

- Students will understand that we make decisions by weighing the risks and the benefits of a particular action. A student's ability to critically ask the right questions (such as 'what is the route of exposure?', 'what is the dose?' and 'are there specific individual susceptibilities to consider?') and assess these factors is fundamental.

**EALRs:** Health & Fitness 3.1, 3.2 and 4.1

- Students will acquire the skills to reduce their environmental health risks at home, school, work, and in the community.

**EALRs:** Math 5.2 and 5.3; Health & Fitness 2.3, 3.1 and 4.1

- Students will recognize that some groups of people are exposed to more environmental pollution than others are, and may suffer higher rates of health problems. These groups often have less economic and political impact on the development of public policy and decision-making.

**EALRs:** Health & Fitness 3.1; Civics 4.1 and 4.3; Geography 3.1 and 3.3

- Students will understand that it is important to consider ethical, legal and social implications of environmental health research and community health issues.

**EALRs:** Science 3.2; Health & Fitness 3.1 and 3.3; History 3.3

- Students will recognize that different groups of people have different beliefs and opinions about environmental health issues depending upon their interests (economic, cultural, spiritual, etc.).

**EALRs:** History 1.3 and 3.3; Geography 3.1, 3.2 and 3.3

- Students will be able to effectively research an environmental health issue by gathering information and data from government agencies, community groups, businesses, scientists and scientific articles, and individual citizens with relevant knowledge.

**EALRs:** Math 4.1 and 5.2; Health & Fitness 3.1 and 4.1; Geography 3.1.2a; History 2.1; Social Study Skills 1.1 and 3.1; Reading 3.1

- Students will be able to describe the information or data that already exists about an issue and identify what data or information still needs to be collected in order to address the problem.

**EALRs:** Science 2.1; Math 4.1, 4.2, 4.3 and 5.3; History 2.1; Social Study Skills 1.1 and 3.1; Reading 3.1

- Students will identify appropriate local civic forums (community council, newspapers, etc.) that they may approach to address issues, present findings and seek change.

**EALRs:** Civics 4.2; Social Study Skills 2.1; Communications 2.1, 2.2, 2.3, 2.4, 2.5 and 3.3

- Students will understand that problem solving and decision-making occurs at the personal, local, state, national and international level.

**EALRs:** Civics 4.1 and 4.2

- Students will be able to clearly and effectively communicate their findings to their peers and other audiences (teachers, parents, community members, etc.).

**EALRs:** Math 4.2, 4.3 and 5.3; Social Study Skills 1.1; Communications 2.1, 2.2, 2.3, 2.4 and 2.5; Writing 2.1, 2.2 and 2.3



# Connecting to the Washington State Essential Academic Learning Requirements (EALRs)

The Quicksilver Question Web Module	Introduction: Introduction to Environmental Health	SS Lesson 1: Expedition Medicine	SS Lesson 2: Gold Mining in South America	Science Lesson 1: Up the Food Chain	Science Lesson 2: Mercury Rising	LA Lesson 1: The Mercury Message	LA Lesson 2: Toxic Tales	Math Lesson 1: Mercury in Your Everyday Life	Math Lesson 2: The Cost of Childhood Asthma
<b>Social Studies- History</b>									
1.2.2 Identify and analyze major issues, people and events in U.S. history from the revolution to 1900.		X							
1.3 Examine the influence of culture on U.S., world and Washington State history.		X							
2.2.2 Interpret how changing technologies have shaped ideas and attitudes.		X							
3.3 Understand how ideas and technological developments influence people, resources and culture.		X	X				X		
<b>Social Studies-Geography</b>									
1.1.2b Use data and a variety of symbols and colors to create maps and graphs.			X						
3.1.2b Explain how the actions and interactions of human societies affect and are affected by the environment.	X	X	X					X	
3.2 Analyze how the environment affects people.	X			X				X	
<b>Social Studies-Economics</b>									
1.1.2a Provide examples of how groups and individuals face economic choices.			X						X
<b>Social Studies Skills</b>									
3.1.3d Analyze and evaluate the impact of ideas, events, and/or people on groups, environments, economic systems, and/or subsequent events.		X	X				X		
<b>Science</b>									
1.2 Identify human life functions and organ systems (Human Biology).	X								
1.3 Explain how human societies' use of natural resources affects quality of life and the health of ecosystems (Environmental & Resource Issues).	X			X	X			X	



<b>The Quicksilver Question Web Module</b>	<b>Introduction:</b> Introduction to Environmental Health	<b>SS Lesson 1:</b> Expedition Medicine	<b>SS Lesson 2:</b> Gold Mining in South America	<b>Science Lesson 1:</b> Up the Food Chain	<b>Science Lesson 2:</b> Mercury Rising	<b>LA Lesson 1:</b> The Mercury Message	<b>LA Lesson 2:</b> Toxic Tales	<b>Math Lesson 1:</b> Mercury in Your Everyday Life	<b>Math Lesson 2:</b> The Cost of Childhood Asthma
1.3 Explain how organisms interact with their environment and with other organisms to acquire energy, cycle matter, influence behavior, and establish competitive or mutually beneficial relationships (Interdependence of Life).				X					
2.1 Correlate and test models (Modeling).					X				
2.2 Identify and examine common, everyday challenges or problems in which science/ technology can be or has been used to design solutions.	X								
<b>Health and Fitness</b>									
2.3 Anticipate risky situations and demonstrate behavior to reduce risks.	X					X			
3.1 Understand how environmental factors affect one's health.	X			X		X		X	
3.2 Gather and analyze health information. Identify ways people make healthy and unhealthy decisions.	X					X	X		
3.2 Distinguish between safe and unsafe use of health-care products.		X							
4.1 Identify workplace health and safety issues.	X		X						X
<b>Reading</b>									
1.1 Use word recognition and word meaning skills to read and comprehend text.	X	X	X			X	X		
1.3 Build vocabulary through reading.	X	X	X			X	X		
2.1 Comprehend important ideas and details. Demonstrate comprehension.	X	X	X			X	X		
3.1 Read to learn new information.	X	X	X			X	X		
<b>Writing</b>									
1.2 Use style appropriate to the audience.						X			

## Introduction

<b>The Quicksilver Question Web Module</b>	<b>Introduction:</b> Introduction to Environmental Health	<b>SS Lesson 1:</b> Expedition Medicine	<b>SS Lesson 2:</b> Gold Mining in South America	<b>Science Lesson 1:</b> Up the Food Chain	<b>Science Lesson 2:</b> Mercury Rising	<b>LA Lesson 1:</b> The Mercury Message	<b>LA Lesson 2:</b> Toxic Tales	<b>Math Lesson 1:</b> Mercury in Your Everyday Life	<b>Math Lesson 2:</b> The Cost of Childhood Asthma
1.3 Explain how organisms interact with their environment and with other organisms to acquire energy, cycle matter, influence behavior, and establish competitive or mutually beneficial relationships (Interdependence of Life).				X					
2.1 Correlate and test models (Modeling).					X				
2.2 Identify and examine common, everyday challenges or problems in which science/ technology can be or has been used to design solutions.	X								
<b>Communication</b>									
3.1 Use language to interact effectively with others. Identify cultural assumptions and perspectives.							X		
3.2 Work cooperatively as a member of a group. Contribute to group.		X							
<b>Math</b>									
1.1 Demonstrate understanding of integers, fractions, decimals, percents, place value of decimals and properties of the rational number system (Number and Numeration).			X					X	X
1.4 Identify how statistics can be used to support different points of view (Statistics).			X						
4.3 Represent and share information using both everyday and mathematical language (Represent and Share Information).								X	
5.3 Relate mathematical concepts and procedures to real-life situations.			X					X	X

### About the IEHMSP

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The Center for Ecogenetics and Environmental Health (CEEH) at the University of Washington, along with the New Mexico Center for Environmental Health Sciences at the University of New Mexico, received funding from the National Institute of Environmental Health Sciences (NIEHS) for a collaborative seven-year project. The Integrated Environmental Health Middle School Project (IEHMSP) trains middle school teachers in environmental health, giving them the expertise to help students identify and research environmental health issues in their communities. The IEHMSP is part of a national Environmental Health Sciences as an Integrating Context (EHSIC) program funded by the NIEHS. The IEHMSP involves teachers from a variety of subjects, as well as school librarians and technology coordinators. Students and teachers from several districts in Washington and from several schools in New Mexico are participating.

Participants complete a training workshop and are given a set of detailed materials and resources to help them integrate environmental health topics into their teaching. A variety of web-based teaching modules are also being developed to help teachers introduce environmental health to their students. All materials are being developed and evaluated with regional and cultural diversity in mind.

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The University of Washington (UW) **NIEHS Center for Ecogenetics and Environmental Health** strives to understand and communicate how genetic factors influence human susceptibility to environmental health risks. Center researchers study the biochemical and molecular mechanisms underlying human variability in response to environmental exposures. The Center's more than 50 core investigators hold appointments in 15 departments within the UW Schools of Medicine, Public Health and Community Medicine, Law, and Pharmacy, as well as the Fred Hutchinson Cancer Research Center. The Center's organizational structure encourages collaboration among these distinguished scientists.

For more information, go to: <http://depts.washington.edu/ceeh/>

**The New Mexico Center for Environmental Health Sciences** is an NIEHS funded center at the University of New Mexico (UNM) Health Sciences Center and Lovelace Respiratory Research Institute. The Center addresses the needs and concerns of Southwestern communities relating to environmental health issues and conducts basic and transnational research on regionally-relevant environmental public health issues. Many New Mexico and Tribal communities in the Southwest have historically borne a disproportionate share of exposure to a wide variety of environmental toxicants in the air, water and soil, and recent evidence raises concerns that members of many communities are suffering adverse health effects from environmental exposures. The theme of this NIEHS Center is "Environmental Disease and Health Promotion in Susceptible Southwestern Populations."

For more information, go to: <http://hsc.unm.edu/pharmacy/iehms/>

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A special thanks to the many teachers and students who volunteered their time to test the web module and gave us their ideas for improvements along the way.

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### How to Contact Us

As the organizers of the IEHMSP, we are here to serve as resources for students and teachers involved in the project. Please feel free to contact us with any questions, concerns, or comments you have about this Fact File.

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# THE QUICKSILVER QUESTION WEB MODULE Student Handout

Name \_\_\_\_\_

Date \_\_\_\_\_



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## QUICKSILVER GAZETTE OFFICE

1. According to the Editorial article in the *Gazette*, what part of the gold mining process might the Golden Creek Mine, the California Sierra Nevadas, and areas around gold mines in South America have in common?

## GOLDEN CREEK MINING MUSEUM

2. As part of the mining process, mercury was added to sluice boxes to help capture the small gold particles. What did the miners do to separate the gold from the gold-mercury mixture?

## GOLDEN YEARS RETIREMENT HOME

3. When Eli and Mary talked about the Golden Creek Mine, they had different viewpoints on what impact the mine had on the town's residents.
  - a. What is one benefit of the mine, as pointed out by Eli?
  
  
  
  
  
  
  
  
  
  
  - b. What is one risk, as pointed out by Mary?



Risks & Benefits

## HEALTH CLINIC

4. Name three ways that mercury can harm the human body.

## Introduction



5. If you are younger than 18 years old, why should you be especially careful about mercury exposure?

### TOXICOLOGIST'S HOUSE

6. Why might bigger fish tend to contain more methylmercury than smaller fish?

### DEPARTMENT OF FISH AND WILDLIFE

7. How do scientists test fish for mercury levels?



### DEPARTMENT OF HEALTH

8. According to the press release and the new fish advisory posted at the lake, who should be careful about what fish species they eat from Golden Lake? Why?

### SPECIAL EDITION OF THE GAZETTE

9. In the town of Quicksilver, how was important information communicated to the residents?



10. Name three resources (people or places) in your own community you could go to if you were researching an environmental health issue.



# THE QUICKSILVER QUESTION WEB MODULE Student Handout



Teacher Key

## QUICKSILVER GAZETTE OFFICE

1. According to the Editorial article in the *Gazette*, what part of the gold mining process might the Golden Creek Mine, the California Sierra Nevadas, and areas around gold mines in South America have in common?

***At all three areas, mercury was used to help separate gold particles from dirt and rock.***

## GOLDEN CREEK MINING MUSEUM

2. As part of the mining process, mercury was added to sluice boxes to help capture the small gold particles. What did the miners do to separate the gold from the gold-mercury mixture?

***The gold-mercury mixture was heated to evaporate the mercury, leaving behind pure gold.***

## GOLDEN YEARS RETIREMENT HOME

3. When Eli and Mary talked about the Golden Creek Mine, they had different viewpoints on what impact the mine had on the town's residents.
  - a. What is one benefit of the mine, as pointed out by Eli?

***Benefits:***

- ***The miners were able to get valuable gold from plain dirt.***
- ***The town of Quicksilver was founded because of the mine.***
- ***The mine helped support the townspeople.***

- b. What is one risk, as pointed out by Mary?

***Risks:***

- ***Miners sometimes became sick from the mercury vapors.***
- ***Some babies living closest to the mine were born with health problems.***

## HEALTH CLINIC

4. Name three ways that mercury can harm the human body.

***Answers may include: Mercury can damage the brain, kidneys and developing fetus. Mercury exposure can cause decreased IQ, slowed reflexes, irritability, shyness, tremors, change in vision, or hearing or memory problems.***



**Student Assessment:**  
You can score this worksheet by awarding one point for every correct answer. 10 points are possible.



Risks &amp; Benefits



5. If you are younger than 18 years old, why should you be especially careful about mercury exposure?

***Your brain and nervous system may still be forming. Mercury exposure could cause neurological problems like decreased IQ and slowed reflexes.***

### TOXICOLOGIST'S HOUSE

6. Why might bigger fish tend to contain more methylmercury than smaller fish?

***Older fish have more time to accumulate toxic chemicals in their bodies (biomagnification). Bigger fish accumulate toxic chemicals when they eat large amounts of smaller fish that have been contaminated. The more fish they eat, the more toxic chemicals they accumulate (bioaccumulation).***

### DEPARTMENT OF FISH & WILDLIFE

7. How do scientists test fish for mercury levels?

***Scientists conduct a test called Total Mercury Analysis. They prepare the fish, as if for dinner. Then they put them in a blender. The mixture is then tested for mercury content. Then, they compare that to the weight of the fish to determine how much mercury is in the fish.***

### DEPARTMENT OF HEALTH

8. According to the press release and the new fish advisory posted at the lake, who should be careful about what fish species they eat from Golden Lake? Why?

***Pregnant women and children should not eat any smallmouth bass or yellow perch from Golden Lake and should limit their overall consumption of the other fish species.***

***Pregnant women should be careful because small amounts of mercury could damage their baby's brain and nervous system. Children and fetuses have a greater response to mercury because of their small size and because their bodies are still developing.***

### SPECIAL EDITION OF THE GAZETTE

9. In the town of Quicksilver, how was important information communicated to the residents?

***Newspaper and signs at the lake.***

10. Name three resources (people or places) in your own community you could go to if you were researching an environmental health issue.

***Answers will vary, but may include: library, newspaper office, department of health, teachers, parents, etc.***







# Student Introduction: ENVIRONMENTAL HEALTH

## Introduction Overview

The **Student Introduction** provides students with the background knowledge they need about environmental health before proceeding with the Quicksilver Question Web Module or the enrichment activities. The **Student Introduction** should be presented by the first teacher in the team to introduce the topic. The reading is divided into three sections that are accompanied by **Check Your Understanding** questions that can be used to assess student understanding of the material.

**Suggested Grade Levels:** 6-8

**Topics:** Environmental health and human biology

## Procedure

The **Student Introduction** is divided into three sections along with **Check Your Understanding** questions. You can assign the entire reading and the questions, or assign one section at a time. The questions will help guide students' reading and will help you to evaluate student understanding of the materials. The **Teacher Key** provides sample answers to all of the questions.

You may want to assign the **Student Introduction** as homework or as an in-class reading. Additionally, students can work in small groups to read aloud and discuss the questions. Alternatively, you may ask for student volunteers to each read aloud a short section of the reading to the entire class. You may want to approach the **Check Your Understanding** questions as a written assignment or a class discussion. Students may be able to check their own work after the class discusses the answers.

A PowerPoint presentation is available for introducing key environmental health concepts to your students. The PowerPoint presentation can be presented along with the student reading. You can download the presentation at:  
<http://depts.washington.edu/iehmosp/>

If you have time, you may want to involve students in one or more short activities related to the **Student Introduction**. A list of suggested activities is provided below. These activities will help your students to deepen their general understanding of environmental health before you proceed to the enrichment lesson plans.

## Student Assessment



### QUICKSILVER SCORING RUBRICS

#### What is Environmental Health?

Student work can be assessed in the following ways, for a total of 100%.

25%	Did students read the <b>Student Introduction: Environmental Health?</b>
50%	Did students correctly answer the <b>Check Your Understanding</b> questions?
25%	Did students view the <b>PowerPoint Presentation: What is Environmental Health?</b>

## Introduction



# Student Introduction: ENVIRONMENTAL HEALTH



Teacher Key

## What is Environmental Health?

Your health depends on the environment around you. **Environmental health** is the study of how the environment affects human health. It differs from the study of how humans affect the environment, because it focuses on people's health. An environmental scientist might study how water pollution is hurting fish. An environmental health scientist would study what happens to the health of people when they catch and eat those fish. Environmental health is not just about the health of the environment – it always comes back to you and whether the environment you are part of is helping you stay healthy, or making you sick.

Every day, you come in contact with things in your environment that can help you or hurt you. Some of these things are important for keeping you healthy, such as oxygen or medications. However, some of these things may be harmful to your health, such as tobacco smoke or snake venom. Things in the environment that are harmful are called **hazards** and include things like **chemicals**, disease-causing bacteria, loud noises and even stress. Hazards can be natural or human-made.

People working in the fields of environmental health do many different jobs. They work to identify environmental hazards, and prevent people from being harmed by them. Some are scientists working in laboratories. Some work for the government writing regulations and studying pollution. Some work for corporations to help make sure that workplaces are safe and that the environment is kept as clean as possible. Most of these jobs require a solid understanding of science and math, knowledge about history and the law, and good communication skills.

To understand the field of environmental health, you need to understand seven core concepts: **Toxicity, Exposure, Dose/Response, Individual Susceptibility, Risks & Benefits, Environmental Justice, and Community Resources & Action.**



## Toxicity

Most people working in environmental health-related jobs have taken classes in the science of **toxicology**. Toxicology is the study of how environmental hazards, such as natural and human-made chemicals, can enter our bodies and make us sick.

When scientists study different chemicals in the environment to see if they might be dangerous to humans, they are trying to understand the **toxicity** of those chemicals. Toxicity is a measure of how dangerous a chemical is. The greater a chemical's toxicity, the less it takes to make a person sick or even kill them. The Environmental Protection Agency, for example, uses the following scale to rate the toxicity of products commonly used in the home.

**Environmental Health:**  
How the environment affects human health.

**Hazard:**  
Something that can harm the health of humans or the environment.

**Chemical:**  
Any substance that is made from elements combined into molecules.

**Toxicology:**  
The study of the harmful effects of chemicals on living things.

**Toxicity:**  
A measure of how dangerous a chemical is.

## Introduction

### Source of Exposure:

A hazard's point of origin, such as cars, industry, or a volcanic eruption.

### Environmental Pathways:

How a hazard travels from its source to humans. These include air, water, food, and soil.

### Exposure:

The total amount of a chemical that comes into direct contact with the body.

### Inhalation:

Breathing. When chemicals enter the body through this route of exposure, they can get stuck in the lungs and/or be taken up into the bloodstream.

### Ingestion:

Swallowing (usually by eating or drinking). When chemicals enter the body through this route of exposure, they can easily be taken up into the bloodstream.

### Dermal Absorption:

Absorbing a chemical through any part of the skin, including the eyes. When chemicals come in contact with the skin, they can sometimes enter the bloodstream through this route of exposure. However, for many chemicals the skin provides good protection of your body.

### Routes of Exposure:

The ways in which a chemical can enter the human body. The three main routes of exposure are inhalation, ingestion, and dermal absorption.

### Dose:



The total amount of a chemical that gets into a human or other living thing, relative to the individual's body weight.

### Duration of Exposure:

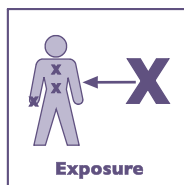
The length of time you are in direct contact with a hazard.

### Frequency of Exposure:

How often you are in direct contact with a hazard.

Toxicity Rating	Word and symbols that appear on product's label	Approximate amount need to kill an average size adult
1 – Highly Toxic	DANGER or POISON 	A few drops to one teaspoon
2 – Moderately Toxic	WARNING 	One teaspoon to one ounce
3 – Slightly Toxic	CAUTION	More than one ounce
4 – Not Toxic	none	

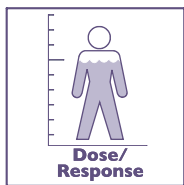
A bottle of bleach, for example, will have the word DANGER on the label, because it is highly toxic if ingested (toxicity rating = 1). Borax powdered cleaner, however, is rated as slightly toxic (toxicity rating = 3) and will have the word CAUTION on the label. This is just one example of a system used to measure the toxicity of hazards.



## Exposure

We all know what it means to be “exposed” to something like a cold or a flu. Everyday our bodies are exposed to all sorts of environmental hazards, such as bacteria, viruses, and the sun's ultra-violet (UV) rays. Some of these hazards exist naturally and some of them are the result of human activities. There are many possible **sources** of hazards, such as cars, industry, even volcanic eruptions. In order for us to be exposed, however, the hazard has to get from the source to us. To do this, it travels along an **environmental pathway**. Pathways include the air we breathe, the water we drink, the food we eat, and even the soil we work in, play in, and use to grow much of our food.

Environmental health scientists use the term **exposure** to describe the total amount of a hazard that comes in direct contact with your body. Once you have come into contact with a hazard, it can get into your body through different routes. You can breathe it in (**inhalation**). You can eat or drink it (**ingestion**). You can get it directly on your skin or in your eyes (**dermal absorption**). You can also get it directly into your body through an injection. Inhalation, ingestion, and dermal absorption are the three main **routes of exposure**. Things that help us stay healthy, like vitamins, nutrients, and medications, enter the body through these routes of exposure, but hazards can use these same routes to enter the body and make us sick.

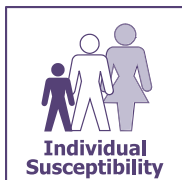


## Dose/Response

Imagine that someone has been exposed to a hazardous chemical through one of the three possible routes of exposure. They have now received a **dose** of that chemical. Dose is the amount of the hazard that actually enters your body. The amount someone gets into their body (their dose) depends on many factors, including how long you are exposed, how often you are exposed, and how big or small you are. For instance, if someone is exposed over a long period of time to a hazard, their dose will be larger. For example, 30 minutes spent under the bright summer sun would give you a much smaller dose of UV rays than 4 hours spent under the sun. This is called the **duration of exposure**. The **frequency of exposure** can also influence the dose. If someone works in a factory and is exposed to a chemical every day at work, their dose might be larger than someone who is only exposed once.

Dose can also depend on how big or small you are. When a doctor prescribes a medication for you, he or she calculates the amount of the medicine you should have based on your body size. The doctor can then give you the correct dose of the medicine for your body weight. While a teaspoon of medicine might be right for an adult, it may be far too large of a dose for an infant.

The dose you receive can influence how your body responds to a hazard. For most hazards, the larger the dose, the more extreme the **response** will be. The smaller the dose, the more mild the response will be. Drinking one can of a caffeinated soda might be fine. Drinking three cans in a row may make you jittery. Drinking five cans of soda might make you feel light-headed and sick.



### Individual Susceptibility

Some people are more likely than others to get sick when they are exposed to environmental hazards. This might be because of their **genetics**, body size, age, gender or general health. This is called their **individual susceptibility**.

For example, some people are more likely than others to get sick when they are exposed to certain kinds of pesticides, just because of their genes. We all know that genes help determine things like hair color and eye color, but they also lead to some important (and invisible) differences in the way bodies work. It turns out that some people have a more extreme response to certain pesticides because of their genes. These people are said to be more “individually susceptible” to pesticide poisoning. Someone who lives or works on a farm where pesticides are sprayed might want to know how susceptible he or she is in order to avoid exposure and stay healthy.



### Risks and Benefits

We live in an industrial society that depends on the use of both natural and human-made chemicals to function. The use of these chemicals results in **benefits** to society as well as **risks**. Pesticides, for example, make it easier to grow fruit. Unfortunately, in some cases, pesticides can make people sick. Most of us have heard that

we can reduce the risk of getting sick without giving up the health benefits that fruit offers by washing or peeling the fruit before we eat it.

Scientific researchers and government officials measure the risks and benefits that we face when we manufacture or use certain products. They work to explain what they have learned to the public and create safety standards that help people protect themselves from unnecessary risk. Their goal is simple – to help us enjoy the greatest benefits from the products that we manufacture, while exposing ourselves to the least possible risk. By understanding the risks and benefits that we face each day, we can make decisions that reduce our risk and keep us as safe and healthy as possible.



### Environmental Justice

Everyone has the right to live in an environment that does not make them sick, regardless of their race, culture, or income. This is called **environmental justice (EJ)**.

Unfortunately, some neighborhoods or communities are exposed to more environmental hazards than others, and may suffer higher rates of health problems. These communities often have less economic or political power in society when decisions are made. For

#### Response:

The reaction to an exposure or dose of a hazard. A response can be anywhere from mild (e.g. headaches, a rash) to severe (e.g. brain damage, cancer).

#### Genetics:

Information that is contained in the genes (DNA) of a person's cells. Genetic information is passed down from parents to their children.

#### Individual Susceptibility:

Differences in the ways that individuals react after exposure to the same amount of a hazardous chemical. Differences in susceptibility can be caused by differences in body size, age, genetics, gender and general health.

#### Benefit:

Something that results in increased well-being or good health.

#### Risk:

The likelihood that a harmful consequence will occur as a result of exposure to a hazard.

#### Environmental Justice:

The fair treatment of people regarding the development of environmental laws, regulations and policies.

## Introduction

example, toxic waste dumps, polluting factories, and busy highways are often built in lower-income neighborhoods or communities of color. Communities recognize this as an environmental health issue and work to seek environmental justice.

### Community Resources and Action:

An individual's ability to access resources and act on new information in order to create positive change in their own community.



### Community Resources and Action

Where can you go in your own community to collect information about an environmental health issue? You can learn more about specific issues, understand environmental laws or seek environmental justice by using community resources. Community resources include places like the library and city hall. You could search the Internet for local, state, or federal agencies that can give you information about your issue. You can also talk to environmental health scientists at local universities or health departments, and ask your teachers and family members what they know about the issue.

Once you have gathered your resources and studied the issue carefully, it is time to take action! First, ask yourself what you as an individual can do to help solve the problem. If you are concerned about air pollution, for example, you might decide to walk to school instead of getting a ride in a car. Next, ask yourself how you can share what you have learned with others so that they can help too. Maybe you could write a letter to the editor of your local newspaper or speak to your community council or school board. Maybe you could create a flyer to hand out in your neighborhood. There are many great ways to get the word out and make positive changes in the world – use your imagination and be creative!

### Check Your Understanding

1. Name one product that can be found in your home that might be considered to be highly or moderately toxic. **Answers will vary, but may include bleach, ammonia, furniture polish, nail polish remover, weed killer, rat poison, motor oil, antifreeze, etc.**
2. List the three routes of exposure. For each one, give an example of an environmental hazard to which you could be exposed through that route. **Inhalation (e.g. tobacco smoke), ingestion (e.g. drug overdose), dermal absorption (e.g. acid).**
3. Explain how the concept of “exposure” is different from the concept of “dose.” **Exposure is a measurement of how much of a hazard your body comes in contact with, while dose is a measurement of how much of the hazard actually enters your body.**
4. Pick four vocabulary words from the margin on the previous pages and use each one in a complete sentence. **Answers will vary.**



# Student Introduction: ENVIRONMENTAL HEALTH

Name \_\_\_\_\_

Date \_\_\_\_\_



Student Handout

## What is Environmental Health?

Your health depends on the environment around you. **Environmental health** is the study of how the environment affects human health. It differs from the study of how humans affect the environment, because it focuses on people's health. An environmental scientist might study how water pollution is hurting fish. An environmental health scientist would study what happens to the health of people when they catch and eat those fish. Environmental health is not just about the health of the environment – it always comes back to you and whether the environment you are part of is helping you stay healthy, or making you sick.

Every day, you come in contact with things in your environment that can help you or hurt you. Some of these things are important for keeping you healthy, such as oxygen or medications. However, some of these things may be harmful to your health, such as tobacco smoke or snake venom. Things in the environment that are harmful are called **hazards** and include things like **chemicals**, disease-causing bacteria, loud noises and even stress. Hazards can be natural or human-made.

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To understand the field of environmental health, you need to understand seven core concepts: **Toxicity, Exposure, Dose/Response, Individual Susceptibility, Risks & Benefits, Environmental Justice, and Community Resources & Action.**



## Toxicity

Most people working in environmental health-related jobs have taken classes in the science of **toxicology**. Toxicology is the study of how environmental hazards, such as natural and human-made chemicals, can enter our bodies and make us sick.

When scientists study different chemicals in the environment to see if they might be dangerous to humans, they are trying to understand the **toxicity** of those chemicals. Toxicity is a measure of how dangerous a chemical is. The greater a chemical's toxicity, the less it takes to make a person sick or even kill them. The Environmental Protection Agency, for example, uses the following scale to rate the toxicity of products commonly used in the home.

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How the environment affects human health.

**Hazard:**  
Something that can harm the health of humans or the environment.

**Chemical:**  
Any substance that is made from elements combined into molecules.

**Toxicology:**  
The study of the harmful effects of chemicals on living things.

**Toxicity:**  
A measure of how dangerous a chemical is.

## Introduction

### Source of Exposure:

A hazard's point of origin, such as cars, industry, or a volcanic eruption.

### Environmental Pathways:

How a hazard travels from its source to humans. These include air, water, food, and soil.

### Exposure:

The total amount of a chemical that comes into direct contact with the body.

### Inhalation:

Breathing. When chemicals enter the body through this route of exposure, they can get stuck in the lungs and/or be taken up into the bloodstream.

### Ingestion:

Swallowing (usually by eating or drinking). When chemicals enter the body through this route of exposure, they can easily be taken up into the bloodstream.

### Dermal Absorption:

Absorbing a chemical through any part of the skin, including the eyes. When chemicals come in contact with the skin, they can sometimes enter the bloodstream through this route of exposure. However, for many chemicals the skin provides good protection of your body.

### Routes of Exposure:

The ways in which a chemical can enter the human body. The three main routes of exposure are inhalation, ingestion, and dermal absorption.

### Dose:



The total amount of a chemical that gets into a human or other living thing, relative to the individual's body weight.

### Duration of Exposure:

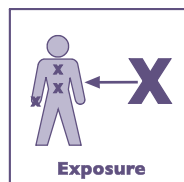
The length of time you are in direct contact with a hazard.

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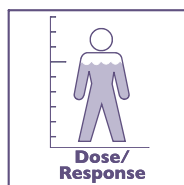


## Exposure

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hazards, such as cars, industry, even volcanic eruptions. In order for us to be exposed, however, the hazard has to get from the source to us. To do this, it travels along an **environmental pathway**. Pathways include the air we breathe, the water we drink, the food we eat, and even the soil we work in, play in, and use to grow much of our food.

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## Dose/Response

Imagine that someone has been exposed to a hazardous chemical through one of the three possible routes of exposure. They have now received a **dose** of that chemical. Dose is the amount of the hazard that actually enters your body. The amount someone gets into their body (their dose) depends on many factors, including how long you

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Dose can also depend on how big or small you are. When a doctor prescribes a medication for you, he or she calculates the amount of the medicine you should have based on your body size. The doctor can then give you the correct dose of the medicine for your body weight. While a teaspoon of medicine might be right for an adult, it may be far too large of a dose for an infant.

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### Individual Susceptibility

Some people are more likely than others to get sick when they are exposed to environmental hazards. This might be because of their **genetics**, body size, age, gender or general health. This is called their **individual susceptibility**.

For example, some people are more likely than others to get sick when they are exposed to certain kinds of pesticides, just because of their genes. We all know that genes help determine things like hair color and eye color, but they also lead to some important (and invisible) differences in the way bodies work. It turns out that some people have a more extreme response to certain pesticides because of their genes. These people are said to be more “individually susceptible” to pesticide poisoning. Someone who lives or works on a farm where pesticides are sprayed might want to know how susceptible he or she is in order to avoid exposure and stay healthy.



### Risks and Benefits

We live in an industrial society that depends on the use of both natural and human-made chemicals to function. The use of these chemicals results in **benefits** to society as well as **risks**. Pesticides, for example, make it easier to grow fruit. Unfortunately, in some cases, pesticides can make people sick. Most of us have heard that

we can reduce the risk of getting sick without giving up the health benefits that fruit offers by washing or peeling the fruit before we eat it.

Scientific researchers and government officials measure the risks and benefits that we face when we manufacture or use certain products. They work to explain what they have learned to the public and create safety standards that help people protect themselves from unnecessary risk. Their goal is simple – to help us enjoy the greatest benefits from the products that we manufacture, while exposing ourselves to the least possible risk. By understanding the risks and benefits that we face each day, we can make decisions that reduce our risk and keep us as safe and healthy as possible.



### Environmental Justice

Everyone has the right to live in an environment that does not make them sick, regardless of their race, culture, or income. This is called **environmental justice (EJ)**.

Unfortunately, some neighborhoods or communities are exposed to more environmental hazards than others, and may suffer higher rates of health problems. These communities often have less economic or political power in society when decisions are made. For

#### Response:

The reaction to an exposure or dose of a hazard. A response can be anywhere from mild (e.g. headaches, a rash) to severe (e.g. brain damage, cancer).

#### Genetics:

Information that is contained in the genes (DNA) of a person's cells. Genetic information is passed down from parents to their children.

#### Individual Susceptibility:

Differences in the ways that individuals react after exposure to the same amount of a hazardous chemical. Differences in susceptibility can be caused by differences in body size, age, genetics, gender and general health.

#### Benefit:

Something that results in increased well-being or good health.

#### Risk:

The likelihood that a harmful consequence will occur as a result of exposure to a hazard.

#### Environmental Justice:

The fair treatment of people regarding the development of environmental laws, regulations and policies.

## Introduction

example, toxic waste dumps, polluting factories, and busy highways are often built in lower-income neighborhoods or communities of color. Communities recognize this as an environmental health issue and work to seek environmental justice.

### Community Resources and Action:

An individual's ability to access resources and act on new information in order to create positive change in their own community.



### Community Resources and Action












Where can you go in your own community to collect information about an environmental health issue? You can learn more about specific issues, understand environmental laws or seek environmental justice by using community resources. Community resources include places like the library and city hall. You could search the Internet for local, state, or federal agencies that can give you information about your issue. You can also talk to environmental health scientists at local universities or health departments, and ask your teachers and family members what they know about the issue.

Once you have gathered your resources and studied the issue carefully, it is time to take action! First, ask yourself what you as an individual can do to help solve the problem. If you are concerned about air pollution, for example, you might decide to walk to school instead of getting a ride in a car. Next, ask yourself how you can share what you have learned with others so that they can help too. Maybe you could write a letter to the editor of your local newspaper or speak to your community council or school board. Maybe you could create a flyer to hand out in your neighborhood. There are many great ways to get the word out and make positive changes in the world – use your imagination and be creative!

### Check Your Understanding

1. Name one product that can be found in your home that might be considered to be highly or moderately toxic.
2. List the three routes of exposure. For each one, give an example of an environmental hazard to which you could be exposed through that route.
3. Explain how the concept of “exposure” is different from the concept of “dose.”
4. Pick four vocabulary words from the margin on the previous pages and use each one in a complete sentence.

## Exploring the Functions

<b>Score Button</b> 	Clicking on the SCORE button will give you a view of the score thermometer. Each time you answer a quiz question, you receive some points. If you answer correctly on your first try, you will receive more points than if you answer incorrectly on your first try. Bonus points are available at the end of the game. A total of 100 points is possible.
<b>Map Button</b> 	Clicking on the MAP button will bring you the map view of the town. By clicking on the icons for the different locations, you can visit different places in the town.
<b>HELP Button</b> 	Not sure where to go next? Clicking on the HELP button will provide you with a hint on what you need to do to get the next key.
<b>BACKPACK Button</b> 	Clicking on the BACKPACK button will bring you to the backpack view. As you find key documents, they get stored in your backpack. At any point, you can go to the backpack to view, save or print your key documents. Just click on the KEY ICON on the list of keys on the left side of the screen.
<b>QUIT Button</b> 	Click on the QUIT button if you want to end the game. You will receive your final score before exiting.
<b>RED ARROWS</b> 	Clicking on the RED ARROWS will move you forward or backwards by one screen. An arrow pointing left or down will bring you back while an arrow pointing to the right will move you forward.
<b>SCROLL BARS</b> 	Some characters have more to say than others. When you are looking at a dialogue box, look to see if there is a gray scroll bar on the right side of the box. You can use your mouse to scroll up or down on the bar to see all of the character's text. You'll also see blue horizontal scroll bars in the interactive timelines on the wall of the mining museum.
<b>KEY ICONS</b> 	When you find a key document, you'll see a small KEY ICON appear at the bottom of the page. Clicking on the key icon will launch a quiz question. Once you correctly answer the question, you'll receive that key document. Clicking on the key again will bring you to the BACKPACK, where you can view, save and print your key documents.
<b>HIGHLIGHTED OBJECTS In Yellow</b>	When you move your mouse over an active object in a room, the object will become highlighted in yellow. This yellow highlight alerts you that the object can be clicked on.
<b>SAVE</b> 	When you find a key document, you'll be able to save it by clicking on the red diskette icon. The document can be saved onto your computer as a Word file. You can do the same thing within the BACKPACK view by clicking on the KEY ICON.
<b>PRINT</b> 	When you find a key document, you'll be able to print it by clicking on the printer icon. You can do the same thing within the BACKPACK view by clicking on the KEY ICON.
<b>METAL DETECTOR at City Hall</b> 	You'll encounter a metal detector when you enter City Hall. First, click the red arrow to move through the detector. Then, the guard will ask you to deposit anything metallic into the tray. Click on the tray and your keys will be deposited. Click the red arrow to return to the view of the detector. Click the arrow under the detector to try to go through again. Don't worry, even though you don't see it, you do get your keys back.

## The Path of Exploration



1. **Begin at the Quicksilver Middle School.** Visit any of the teachers there and they will explain that the town is in an uproar over an article printed in yesterday's newspaper. The article questions if the town has been affected by mercury contamination as a result of historic gold mining in the area. The teacher directs you to the Quicksilver Gazette Office.
2. **Go to the Gazette Office.** A copy of yesterday's Gazette has three articles related to mercury. The editorial article, "The Legacy of Golden Creek Mine: Our Children at Risk?" (**KEY 1**) poses the Quicksilver question. The newspaper reporter suggests that you go to the Golden Creek Mining Museum.
3. **Go to the Golden Creek Mining Museum.** One of the exhibits at the mining museum is a book of local history. If you correctly click on "Hg" on the Periodic Table of the Elements, you will access three more chapters. The chapter, "Mining Golden Creek," (**KEY 2**) provides information about how mercury was used at the mine. There are also three interactive timelines on the wall. The museum docent suggests that you visit some of the residents of the Golden Years Retirement Home.
4. **Go to the Golden Years Retirement Home.** At the retirement home, you overhear a heated debate between two residents (**KEY 3**). Mary suggests you go to the Health Clinic to find out more about mercury and human health.
5. **Go to the Health Clinic.** There are two information brochures at the Health Clinic. One of them, "Mercury and You," (**KEY 4**) provides information about how mercury can harm people. The second brochure, "Toxic Tales," shares two public health stories. The Clinician suggests you visit the toxicologist for more information.
6. **Go to the Toxicologist's House.** The toxicologist, Dr. Tanagi, points out an "Introduction to Toxicology" book on the shelf and a copy of her notes sitting on the

table (**KEY 5**). She suggests that you see her friend Reed Adams who is at the lake collecting fish samples to test for mercury content.

7. **Go to Golden Lake.** When you arrive at Golden Lake, Reed Adams is there catching fish. He asks you to join him back at his Department of Fish and Wildlife lab at City Hall to help him with the testing.
8. **Go to the Department of Fish and Wildlife at City Hall.** While at Reed's lab, you help him conduct a Total Mercury Analysis. The lab report (**KEY 6**) shows that two of the fish species have high mercury content. Reed asks you to take the report over to the Department of Health.
9. **Go to the Department of Health at City Hall.** The Department of Health officer takes the report and creates a press release (**KEY 7**). She asks you to email the press release to the Gazette Office so it will be published in tomorrow's newspaper. She also asks you to head over to the lake to help post a new fish advisory sign.
10. **Go to Golden Lake.** After you click on the sign to post the new advisory, a spinning Gazette newspaper flies across the screen. There are three articles related to the discovery of mercury in the lake's fish. The top article, "Middle School Students Help Solve the Quicksilver Question," (**KEY 8**) summarizes the success of your research.
11. **Go to the Middle School.** When you return to the middle school, visit the library for access to some Internet links to conduct more research and to provide feedback on the Module. Also, visit the teachers for descriptions of enrichment activities to further your learning. You will receive bonus points for each of these actions.

## Following the Hints

If at anytime you do not know what to do next, try clicking on the HELP button. This button is located on the toolbar on the left side of the screen. The hint that will appear is specific to how far along you are in the module. Following is a list of those hints as they appear in order.

### If you have NO keys

Your goal is to collect eight key documents in your search for information about possible mercury pollution in Golden Lake. Visit one of the teachers at Quicksilver Middle School to help you get started.

### If you have Key #1 (Gazette article)

The Golden Creek Mining Museum is built on the site of the old mine. You'll find some interesting exhibits there about gold mining.

### If you have Key #2 (Mining Golden Creek)

If you need more information about the old Golden Creek mine, you might want to visit the Golden Years Retirement Home. Several of the residents there might be able to help answer some of your questions.

### If you have Key #3 (Transcript of conversation)

Looks like you've heard everything Eli and Mary have to say about the old mine. A visit to the Health Clinic might provide some information about mercury and its effects on human health.

**If you have Key #4 (Mercury & You Brochure)**

You've collected some good information about mercury and human health, but what does it all mean? You might want to visit the toxicologist—she's an expert on these kinds of issues.

**If you have Key #5 (Toxicologist's notes)**

Head over to Golden Lake. A fisheries biologist from Cascade County Department of Fish and Wildlife is collecting fish samples there right now.

**If you have Key #6 (Golden Lake fish report)**

Have you been to the Cascade County Department of Health yet? The health officers there are busy preparing a health advisory about the fish in Golden Lake.

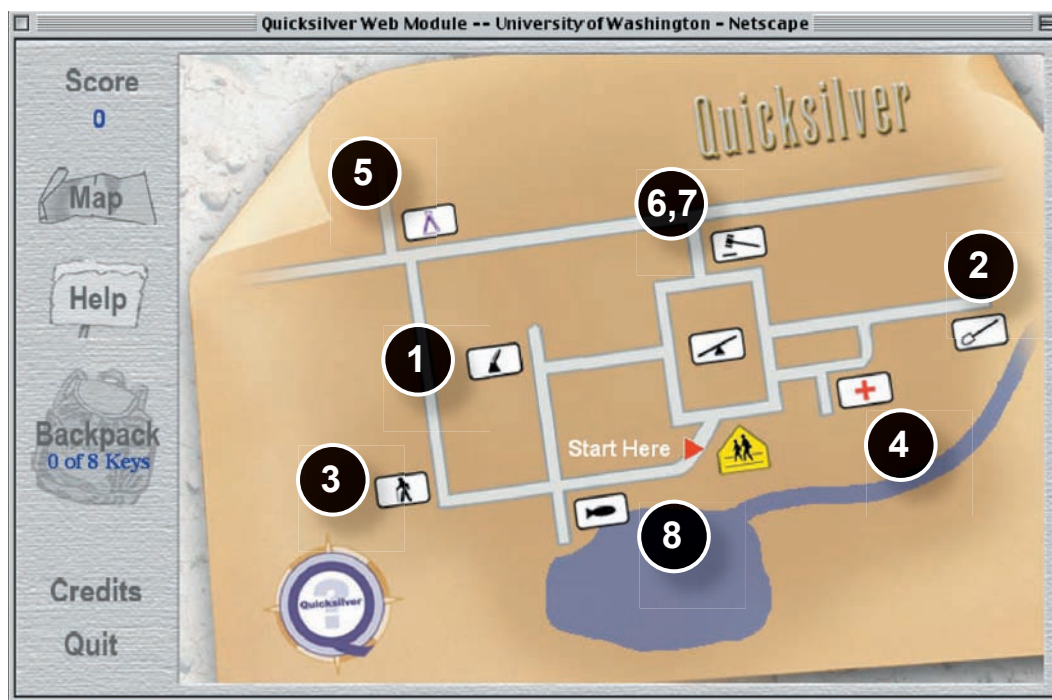
**If you have Key #7 (Department of Health news release)**

Your help is needed! Head over to Golden Lake to help post a new sign there. This sign will include a health advisory to help protect the people of Quicksilver.

**If you have Key #8 (Final Gazette issue)**

Great job! You've collected all eight key documents. Return to Quicksilver Middle School. The classroom teachers have prepared some activities about mercury and gold mining. Also, the librarian has a list of internet sites if you'd like to further explore this topic. Thank you for helping our town solve the Quicksilver Question.

## Guide to Location of Key Documents



### Number/Name of Key

### Location

#1 Gazette article

In the Gazette Office, click on the newspaper on the desk. Then, click on the top article of the newspaper.

#2 Mining Golden Creek

In the museum, click on the book on the display case. Use the red arrow pointing to the right to move through the pages. When you come to the Periodic Table, click on "Hg." Then move forward until you get to the last page.

#3 Transcript of Conversation

In the retirement home, click on the two people.

#4 Mercury and You brochure

In the Health Clinic, click on the brochure rack, where two brochures will become highlighted. One of the brochures is "Mercury & You."

#5 Toxicologist's Notes

In the toxicologist's house, click on the paper on the coffee table.

#6 Golden Lake Fish Report

Enter City Hall and go to the Department of Fish and Wildlife. In the lab, click on the lab counter. Then, beginning with the lower left fish sample, click on the fish, then the blender. Repeat for each of the four fish samples, moving toward the right. Then click the red arrow to process the data.

## QUICKSILVER Web Module

### #7 Health Department Advisory

Enter City Hall and go to the Department of Health. Click on the computer screen. Then, click the button on the screen to send the email.

### #8 Final Gazette article

At the lake, click on the sign to post the new advisory. Then click on the red arrow to launch the spinning newspaper. Click on the top article. Remember to return to the middle school once you have all eight keys.



# Pop Quiz Questions

## For Key #1

The newspaper article, “The Legacy of Golden Creek Mine,” describes how mercury can be harmful to children. Which part of a child’s body can be most damaged by mercury exposure?

- a. heart and circulatory system
- b. brain and nervous system**
- c. lungs and respiratory system
- d. stomach and digestive system

## For Key #2

How did mercury help separate the gold from dirt and mud?

- a. by sticking to the mud
- b. by floating to the top of the water
- c. by sticking to the gold particles**
- d. by casting a spell on it

## For Key #3

In what way does Mary think that the miners may have gotten sick from mercury used in the old gold mine?

- a. by being absorbed through their skin as they handled the mercury
- b. by inhaling fumes as they heated the gold-mercury mixture**
- c. by splashing in their eyes as they separated the gold
- d. by ingesting contaminated fish in nearby lakes

## For Key #4

Which of the following is true?

- a. mercury can be removed from contaminated fish by cleaning the fish
- b. if mercury gets inside your body, it remains there forever
- c. mercury is most dangerous for fetuses and babies because their nervous systems are still developing**
- d. mercury is only found in factories

## For Key #5

What question would be **most** important for a toxicologist to answer?

- a. who is most likely to be affected by eating fish with mercury?**
- b. what is the population of the town of Quicksilver?
- c. why is mercury used to extract gold?
- d. how many people in Quicksilver have mercury thermometers?

**For Key #6**

How much above the safe limit is the mercury level in yellow perch from Golden Lake?

- a. 0.20 ppm
- b. 0.35 ppm**
- c. 0.28 ppm
- d. 0.15 ppm

**For Key #7**

Which one of the following groups is **not** at a high risk for mercury poisoning?

- a. women who may become pregnant
- b. pregnant women
- c. small children
- d. adult men**

**For Key #8**

What was the action that resulted from your investigation of the Quicksilver question?

- a. the dock at Golden Lake was closed
- b. the fish in the lake were cleaned and had their mercury removed
- c. a warning notice was placed in the newspaper and at the lake**
- d. people stopped eating fish from the lake

## Technical Requirements and Information

In order to correctly view the Web Module, your computer system must meet the following requirements. If you will be using a school computer lab, you'll need to talk with your school's system administrator. Share the technical specifications with the administrator so that they can ensure that the computers have the correct browser and plug-in requirements.

We recommend that you practice loading the Module in the computer lab before your students arrive. This will give you a sense of how long it will take to load the Module. If you are using the online version of the Module, and have a slow connection, you may need to pre-load the Module onto the computers before your students arrive in the computer lab.

### Online Version:

#### Browser requirement:

Your computer must have at least one of the following browsers.

#### PC – any OS (i.e. Window 95, Window 98, Window 2000, Window XP):

- Internet Explorer (IE) version 5.5 or newer
- Netscape (NS) version 6.0 or newer

#### Mac –OS 9

- Internet Explorer (IE) version 5.2 or newer
- Netscape (NS) version 4.7 or newer

#### Mac –OS X

- Internet Explorer (IE) version 5.2 or newer
- Netscape (NS) version 6.0 or newer
- Safari version 1.0 or newer

Important! Make sure your browser is set to allow pop-ups. Most do, but some browsers such as Firefox may not, unless you change the setting. To do so find your browser's "preferences," and then go to "security" (Safari) or "web features" (Firefox).

#### Plug-in requirement:

Your computer must have both of the following plug-ins. They can be downloaded from free from the Internet.

#### All platforms – PC or Mac

- Flash Media Player version 6.5 or newer
- Acrobat PDF reader version 5.0 or newer

### CD Version:

#### PC – any OS (i.e. Window 95, Window 98, Window 2000, Window XP)

- Auto Run turned ON. Please contact your system administrator for directions
- CPU: Minimum Pentium II 300 or same speed as Pentium II 300
- RAM: 32 MB
- CD-Rom: 8X speed or higher
- Browser must be installed – see browser requirements above
- Plug-ins must be installed – see plug-in requirements above

#### Mac – OS 9 and OS X (any Model)

- CPU: Minimum G3 233
- RAM: 16 MB
- CD-Rom: 8X speed or higher
- Browser must be installed – see browser requirements
- Plug-ins must be installed – see plug-in requirements

# How to Use the Web Module in a Computer Lab

## Online Version:

1. First, ask your school's system administrator to be sure that the computers meet the technical specifications described on the previous page. They can be sure that the computers meet the browser and plug-in requirements. If your students log on to the computers using student passwords, their student accounts may be set up to not allow large files, like the Module, to be downloaded from the Internet. Your system administrator will be able to check on this potential problem.
2. You will need to register on the IEHMSP website in order to download the Module. Use your Internet browser (Explorer, Netscape, Safari or Firefox) to access the following website: For the Washington version: <http://depts.washington.edu/iehmosp/>  
For the New Mexico version: <http://hsc.unm.edu/pharmacy/iehms/>

Click on the Web Module button. Then choose the "Teachers" tab. You will be directed to a log in screen. Click the "Register" button and you'll reach the registration page. Please type in your information. You'll also need to type in your email address (your userID) and a password of your own creation. We recommend a password of between 5 and 20 characters. If at anytime you forget your password, you can click on the "Forgot your password?" link on the login screen and your password will be sent to your email address within a few minutes.

3. Try downloading the Web Module onto one of the computers in the lab. This will give you a sense of how long it will take. If you have a slow connection, you may need to pre-load the Module onto all of the computers before your students arrive in the lab. Sometimes even fast connections can become painfully slow when all computers are simultaneously accessing the same website. To download the Web Module, follow the instructions below.
4. When your students arrive in the computer lab, ask them to log onto the computers (if they use student accounts). Then, ask them to open an Internet browser (Explorer, Netscape, Safari or Firefox).
5. Students should type the following address into the address bar in their Internet browser: For the Washington version: <http://depts.washington.edu/iehmosp/>  
For the New Mexico version: <http://hsc.unm.edu/pharmacy/iehms/>
6. When the IEHMSP website opens, ask students to click on the Web Module button. Then, ask them to click on the "Students" tab at the top of the center window on the screen. This will take them to an introduction screen that provides an overview of the Module.
7. At the bottom of the screen, students are asked to login. Provide students with your email address, which serves as the userID for all of your students. When students click the START button, the Module will automatically launch in a new window.

**CD Version:**

1. A CD version of the Module may be available by special request to schools that do not have Internet connections or whose computers do not meet the minimum technical specifications. To request a CD version, please call Lyle Rudensey, IEHMSP Resource Teacher, at (206) 616-7557 or email [lylecroc@u.washington.edu](mailto:lylecroc@u.washington.edu).

**Technical Support:**

If you have questions about loading or running the module, contact Kristen Bergsman, IEHMSP Curriculum Developer, at (206) 685-5378, [crowtalk@u.washington.edu](mailto:crowtalk@u.washington.edu).





## Lesson One: EXPEDITION MEDICINE

### Lesson Overview

In the **Quicksilver Question Web Module**, students learn about the connection between mercury and the Lewis and Clark Expedition.

This activity relates to the *Quicksilver Gazette* article, “Poop Helps Scientists Trace Path of Historic Lewis and Clark Expedition.” Students learn about the state of medical knowledge during the time of the Lewis and Clark Expedition. They develop a list of medicines and medical equipment to bring on an arduous wilderness journey, then compare their lists to a list of items compiled by Meriwether Lewis for his famous expedition.

### EALRs Addressed

This lesson addresses the following Washington State Essential Academic Learning Requirements (EALRs). The benchmarks listed are for grade 8 in social studies.

In this lesson, the student is asked to:

- Identify and analyze major issues, people, and events in U.S. history from the Revolution to 1900. (Social Studies History 1.2.2).
- Interpret how changing technologies have shaped ideas and attitudes, and analyze the impact of ideas and technological developments on society and



Meriwether Lewis and William Clark and their Corps of Discovery spent the winter of 1805 in a fort they constructed near present day Astoria, Oregon. Scientists are now testing soil around the site of Fort Clatsop in an attempt to locate an old privy pit, and from that information, backtrack to find the exact location of the fort. Military regulations at the time required that privy pits be located 90 paces from the fort. Using this information, scientists hope to find the exact location of Fort Clatsop.

Since mercury was one medication that was commonly administered to the members of the expedition, the privy pits should still have high levels of mercury in the soil. Mercury tends to build up in a person’s body over time. If he is exposed to small amounts of mercury, his body can get rid of these small amounts in his feces. If he consumes more mercury than his body is able to excrete, then mercury can build up in the body. By testing the soil for mercury levels, scientists hope to find the site of the old privy pit near the fort.

For a more in-depth understanding of medicine and the Lewis and Clark Expedition, consult the following resources that were used to prepare this lesson:

- **Medicine and Health on the Lewis and Clark Expedition**  
This website provides an excellent overview of medical care during the

### Teacher Background



Meriwether Lewis



William Clark

expedition, as well as quotations from journals and interesting anecdotes of illnesses and mishaps along the journey.

[http://hsc.virginia.edu/hs-library/historical/lewis\\_clark/](http://hsc.virginia.edu/hs-library/historical/lewis_clark/)

- **Lewis and Clark: The National Bicentennial Exhibition**

This website provides excellent lesson plans and resources. In particular, go to the “For Educators” link and find the lesson plans for “Preparing for the Trip” and “Plants.”

<http://www.lewisandclarkexhibit.org/>

- **Medical Supplies of the Lewis and Clark Expedition**

<http://www.nps.gov/jeff/LewisClark2/CorpsOfDiscovery/Preparing/Medicine/Medicine.htm>

- **Discovering Lewis and Clark**

<http://www.lewis-clark.org>

- **Exploring Environmental Issues: Focus on Risk**

This Project Learning Tree curriculum module focuses on risk assessment, communication, perception and management.

<http://www.plt.org>

- **Chemistry of Folk Remedies**

In this lesson, students explore medicine bags from different cultures and time periods. This lesson plan is property of the AEL Rural and Urban Project.

<http://ael.org/nsf/voices/curric/folk.htm>

The *Quicksilver Gazette* article is based on a real article titled “Poop Leads UW Team to Possible Discovery,” by Lauren Walsh. It was printed in the University of Washington’s *The Daily* on October 5, 1998. If you want to read more about this discovery, consult the following resources:

- **Poop Leads UW Team to Possible Discovery**

<http://archives.thedaily.washington.edu/1998/100598/lewis.html>

- **Hunting for Lewis and Clark’s Winter Camp**

[http://depts.washington.edu/~uweek/archives/1998.10.OCT\\_01/\\_article8.html](http://depts.washington.edu/~uweek/archives/1998.10.OCT_01/_article8.html)

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### Teacher Preparation

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#### Materials: (for entire class)

- *Quicksilver Gazette* article, “Poop Helps Scientists Trace Path of Historic Lewis and Clark Expedition”
- **Student Handout** with list of medicines and medical equipment .

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### Procedure

- Begin by asking students to read the *Quicksilver Gazette* article, “Poop Helps Scientists Trace Path of Historic Lewis and Clark Expedition.” This document can be accessed by using the save/print function in the module or downloading it from the “For Teachers” page of the Quicksilver website.
- Provide your students with a brief background on the state of medical knowledge in the early 1800s, using the information provided in the **Teacher Background** and the suggested websites.
- Students begin by working in small groups. Each group is challenged to develop a list of medicines and medical equipment they think is most important to bring along on a modern day wilderness journey. Ask students to imagine



embarking on a journey of an indeterminate length, maybe a year, maybe more. The journey will take them through wilderness that has never before been described or mapped—you have no idea what lies ahead of you. There are no trails or maps to guide you. What do you think is most important to bring in your medical kit? Students can arrange their lists of medicines and equipment in a table similar to the ones shown on the **Student Handout**.

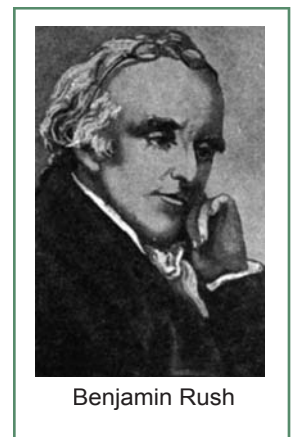
- If students have a difficult time getting started, you might want to work together to develop a list of categories for the types of medical conditions that might need treatment. For example: injuries, infections, disease, animal attacks, harsh weather, poor diet, etc. Students can also consider the risks that they will take on their journey. What are things they can control and things they cannot control? How can they be prepared for risky events?
- Ask each group to share their list with the rest of the class. What medicines and equipment were common among the groups? What were some illnesses or injuries that were not considered? What does the class think are the most crucial medicines and equipment to bring along?

- Next, share with your students the list of medicines and medical equipment that Meriwether Lewis purchased for his upcoming expedition. Ask your students to imagine the difficult task of assembling a medical kit for a wilderness expedition when Lewis did not know how long the journey would take, or what the terrain and weather would be like. The medical knowledge of the day believed in treating most ailments with blood-letting, blistering, sweating, or purging; therefore the majority of the items Lewis brought on the expedition were for these purposes.



He also brought along treatments for malaria and venereal diseases. Explain to your students how many of these treatments, in particular blood-letting, offered no relief to the patient and on many occasions did more harm than good.

- On the list of items that Lewis brought on the expedition, point out the three items that contained mercury. Relate these three medicines to the scientists' search for mercury in the privy pits at Fort Clatsop.
  - **Calomel**—mercurous chloride ( $\text{Hg}_2\text{Cl}_2$ ) used as a purgative and to treat syphilis.
  - **Mercuriale**—mercury used as an ointment or salve for the treatment of venereal diseases.
  - **Dr. Rush's Bilious Pills**—a combination of calomel (mercurous chloride used as a purgative) and jalap (a powdered purgative made from the root of a plant). The pills contained 60% mercury. The pills were used as a purgative or laxative to treat all sorts of conditions. The pills caused severe diarrhea and were called "Thunderbolt" or "Thunderclapper" pills for that reason.
- Compare the students' lists to Lewis' list. How has medical knowledge and technology changed over time? Are there differences between the hazards, illnesses and diseases that would be encountered by a modern day wilderness expedition than what Lewis and Clark encountered?



Benjamin Rush

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### Student Assessment



Student work can be assessed in the following ways, for a total of 100%.

20%	Did students read the <i>Quicksilver Gazette</i> article “ <b>Poop Helps Scientists Trace Path of Historic Lewis and Clark Expedition</b> ” and <b>Student Handout #1</b> ?
60%	Did students work in small groups to <b>develop a list</b> of medicines and medical equipment to bring on a wilderness journey?
10%	Did students <b>present</b> their list of medicines and medical equipment to the class?
10%	Did students actively participate in a <b>class discussion</b> about how medical knowledge and technology has changed over time?

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### Extension Activities

- See the **Teacher Background** section for the **Lewis and Clark: The National Bicentennial Exhibition** and the **Chemistry of Folk Remedies** websites that have additional lesson plans on Lewis and Clark’s use of medicine during their expedition.
- For more information on Fort Clatsop, see the Lewis and Clark National Historical Park website at: <http://www.nps.gov/focl/index.htm>. The Park’s Traveling Trunk Program loans out educational materials and artifacts for a fee.



# The Quicksilver Question Web Module



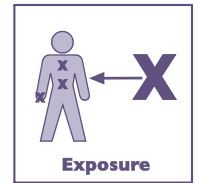
Student Handout

## Poop Helps Solve the Mystery of Historic Lewis and Clark Expedition

By Irma S. Tink

SEATTLE—Scientists are finding a new way to examine the route of the historic Lewis and Clark expedition—by digging into old privy pits (temporary toilets).

Mercury, which is now known to be toxic to humans and other animals, was given to the members of the expedition as a medicine to treat syphilis and other illnesses. Mercury is mostly eliminated from the body through feces and remains in soil for a very long time. Scientists believe that the areas around the privy pits used by the expedition may still contain high levels of mercury. Scientists are measuring mercury levels in the soil in areas likely to have been used as campsites by the expedition. This will hopefully allow them to confirm the path that the explorers took. University of Washington scientist Julie Stein is using mercury testing to pinpoint the exact location of historic Fort Clatsop, the expedition's winter residence in 1805-06. The fort was built near present-day Astoria, Oregon, but the log buildings have since been lost to decay. Stein hopes that her search for Lewis and Clark's toilets will help locate the site of the original fort.



Meriwether Lewis and William Clark were sent out by President Jefferson to explore what is now the Western United States. The four-year, 33-person expedition began shortly after much of the Western U.S. was purchased by the U.S. government from France in the Louisiana Purchase. Lewis and Clark were instructed to study the geology, plants and wildlife of the West.

Although the members of the expedition wrote in journals, collected samples and even drew maps of the areas that they explored, it is still very difficult to determine exactly where they made their camps along the journey. Scientists and historians are hoping that by tracing the mercury in the old privy pits, they will be able to determine the precise path of the expedition.

Adapted from *The University of Washington Daily*, October 5, 1998 by Lauren Walsh.





# MEDICATIONS & MEDICAL EQUIPMENT USED BY THE LEWIS & CLARK EXPEDITION

## Student Handout #1



Student Handout

Name \_\_\_\_\_

Date \_\_\_\_\_

### MEDICATIONS

Item	Description	Cost
15 lb. pulverized Cort. Peru (Peruvian Bark or Cinchona)	Quinine/fever reducer	\$30.00
1/2 lb. pulverized Jalap	Laxative/purgative	\$0.67
1/2 lb. pulverized Rhubarb	Laxative/purgative	\$1.00
4 oz. pulverized Ipecacuan	Emetic/purgative	\$1.25
2 lb. pulverized Cream Tartar	Purgative/diuretic	\$0.67
2 oz. Gum Camphor	Stimulant/diaphoretic	\$0.40
1 lb. Gum Assafoetid (Assafoetic/Assafoedita)	Purgative	\$1.00
1/2 lb. Gum Opii Turk. opt.	Opium/pain killer	\$2.50
1/4 lb. Tragacanth	Gum used to bind pills	\$0.37
6 lb. Sal Glauber	Purgative	\$0.60
2 lb. Sal Nitri (salt petre)	Treatment for fevers/gonorrhea	\$0.67
2 lb. Copperas	Metal used in making inks	\$0.10
6 oz. Sacchar, Saturn. opt. (Sugar of lead/lead acetate)	Treatment for eye problems & gonorrhea	\$0.37
4 oz. Calomel (Mercurous Chloride)	Purgative/treatment for syphilis	\$0.75
1 oz. Tartar Emetic	Emetic	\$0.10
4 oz Vitriol Alb. [White Vitriol (Zinc Sulfate)]	Treatment for eye problems	\$0.12
1/2 lb. Rad. Columbo (Root of columbo)	Tonic for indigestion and diarrhea	\$1.00
1/4 lb Elix. Vitriol [Elixir of vitriol (ethylsulfuric acid)]	Tonic for stomach problems	\$0.25

**Laxative:**

A drug that helps relieve constipation.

**Purgative:**

A drug that causes the body to purge, through diarrhea, vomiting or an increase in urine or perspiration.

**Emetic:**

A drug that causes vomiting in order to purge poisons from the body.

**Diuretic:**

A drug that increases the amount of urine.

**Stimulant:**

A drug that causes a temporary increase in energy.

**Diaphoretic:**

A drug that causes an increase in perspiration.

Continued on the next page.

**MEDICATIONS (continued)**

Item	Description	Cost
1/4 lb. Es. Ment. pip. (Essence of menthol or peppermint)	Treatment for digestive problems	\$0.50
1.4 lb. Bals. Capaiboe (balsam of Copaiba)	Treatment for rheumatism and gonorrhea	\$0.37
1/4 lb. Bals Traumat (Compound tincture of Benzoin)	Treatment for cuts and abrasions	\$0.50
2 oz. Magnesia	Purgative	\$0.20
4 oz. Laudanum (Tincture of opium)	Pain reliever	\$0.50
2 lb. Ung. Basilic (Compound of pine resin, yellow wax, and lard)	Ointment or salve	\$1.00
1 lb. Ung. Calimin	Astringent	\$0.50
1 lb. Ung. Epispastric	Blistering agent	\$1.00
1 lb Ung. Mercuriale (Mercury)	Ointment of salve for treatment of syphilis and other venereal diseases. Diaphoretic.	\$1.25
1 Emplast. Diach. S. (Diachylon simple)	Plaster or salve made of the juices of several plants	\$0.50
50 doz. Bilious Pills to order of B. Rush [Combination of calomel (mercurous chloride) and jalap]	Purgative/laxative	\$0.10 per dozen or \$5 total
2 oz Nutmegs	Flavoring for oral medicines	\$0.75
2 oz. Cloves	Flavoring for oral medicines	\$0.31
4. oz. Cinnamon	Flavoring for oral medicines	\$0.20

**Astringent:**

A drug that is used to clean and soothe the skin.

**Blistering:**

A chemical that is applied to the skin to cause blisters. Doctors at this time thought that the blisters pulled bad substances out of the patient's body.



Student Handout

## MEDICAL EQUIPMENT

Item	Description	Cost
1 Set Pocket Insts. small		\$9.50
1 Set Teeth Insts. small		\$2.25
1 Clyster Syringe	Used for administering enemas	\$2.75
4 Syringes	Used for treatment of gonorrhoea	\$1.00
3 Best Lancets	Used for bleeding or blood-letting	\$0.80 each or \$2.40 total
1 Tourniquet	For amputations	\$3.50
2 oz. Patent Lint	Linen or fleece-like material for poultices and dressing wounds	\$0.25
6 Tin Canisters		\$0.25 each or \$1.50 total
3 - 8 oz. Gd. Stopd. bottles		\$0.40 each or \$1.20 total
5 - 4 oz. Tinctures Bottles		\$1.85
6 - 4 oz. Salt Mo.		\$2.22
1 Walnut Chest		\$4.50
1 Pine Chest		\$1.20
1/4 lb Indian Ink	Black pigment in the form of sticks used for writing	\$1.50
2 oz. Gum Elastic (Rubber from the buckhorn plant)	Bark has some medicinal qualities. However, not soluble in water, and may have been used to seal containers	\$0.37

**Bleeding/Blood-letting:**  
Intentional cutting of a vein as a medical treatment.







## Lesson Two: GOLD MINING IN SOUTH AMERICA

In the **Quicksilver Question Web Module**, students learn how gold mining can impact children's health.

This activity connects to the *Quicksilver Gazette* article that explains how children in the Brazilian Amazon Basin in South America are being poisoned from nearby gold mining operations that use mercury. In this activity, students learn about artisanal gold mining and then create a map that illustrates the distribution of artisanal gold mining operations across South America.

This lesson addresses the following Washington State Essential Academic Learning Requirements (EALRs). The benchmarks listed are for grade 8 in social studies.

In this lesson, the student is asked to:

- Understand that the condition of scarcity requires people to choose among alternatives and bear the consequences of that choice. Provide examples of how groups and individuals faced choices and consider price and personal values etc., in making choices in present and in historical situations. (Opportunity cost). (Economics 1.1.2a).
- Use data and a variety of symbols and colors to create thematic maps, mental maps, and graphs depicting geographic information (Location, Place, Region). (Geography 1.1.2b).
- Explain how the actions and interactions of human societies affect and are affected by the environment with regard to air, water, and land issues (Human/Environment Interaction, Region). (Geography 3.1.2b).

Gold mining is a viable industry worldwide, with large industrial mines currently operating in Africa, North America, South America, Australia and Eastern Europe. However, there is also an underground network of small mining operations that are regionally important to their local economies. These small, informal mining operations, known as artisanal mining, are prevalent in Latin America, Asia and Africa. The gold rush in South America began in the early 1980s as a way for people to escape devastating poverty. In 1983, there were almost one million artisanal gold miners working in the Brazilian Amazon Basin.

Artisanal mining is a term that encompasses a broad range of mining operations. Artisanal mining might be small, such as an individual panning for gold, or may be a large dredging operation. The key component of artisanal mining is that the operations are low-tech, rudimentary, and often hidden and illegal. Artisanal mining is driven by individuals' need for survival—to bring home money to support their families living in impoverished regions.

### Lesson Overview

### EALRs Addressed

### Teacher Background

In artisanal mining, gold is extracted from ore using mercury. The mercury is added to the ore either in pans, sluice boxes or on the ground. Then some of the mercury is recovered using one of several different processes. One popular process is to burn the mixture in open pans, which releases much of the mercury as a dangerous vapor. During these processes, three times as much mercury may be lost to the environment as the amount of gold being produced. The mercury enters the local soil, water and air, often polluting the environment surrounding artisanal mining operations. Gold workers can inhale the dangerous mercury fumes and local water supplies can become seriously contaminated from even a small amount of mercury. People can also become exposed to mercury from eating fish from rivers or lakes near artisanal mining operations.

Some facts regarding artisanal gold mining:

- “As much as 95% of all the mercury used in artisanal gold mining is released to the environment.
- For every gram of gold produced, 2-5 grams of mercury are released into the environment.
- This equates to losses of 240-600 tons of mercury each year in the Amazon Basin alone.”

(Facts from “Mercury Migration,” The Ban Mercury Working Group.)

As the *Quicksilver Gazette* article stated, recent studies have found that children in the Brazilian Amazon Basin of South America who live near gold mines have high levels of mercury in their bodies. The mercury exposure may be the cause of nervous system damage, including learning disabilities, slowed reflexes and behavioral problems.

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

- This information is adapted from the findings of a UNIDO Expert Group Meeting from July 1997. The article, “Mercury in Artisanal Gold Mining in Latin America: Facts, Fantasies and Solutions,” can be accessed from the following website: [http://www.facome.uqam.ca/facome/pdf/veiga\\_02.pdf](http://www.facome.uqam.ca/facome/pdf/veiga_02.pdf)
- “Mercury Migration: Ending Mercury Use in Artisanal Gold Mining,” from the Ban Mercury Working Group. <http://www.ban.org/Ban-Hg-Wg/Briefing%20Papers/endingmerc.pdf>
- Blank maps can also be downloaded from the World Atlas website. <http://www.worldatlas.com/webimage/testmaps/samer.gif>

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### Teacher Preparation

#### Materials: (for each student or group)

- **Student Handout #1** with data tables
- **Student Handout #2** with a blank map of South America
- Quicksilver document “The Legacy of Golden Creek Mine.”
- Quicksilver documents “Back to the Elements: Gold and Mercury.”

## Procedure

## Mapping Activity

- Encourage students to review the *Quicksilver Gazette* article “The Legacy of Golden Creek Mine: Our Children at Risk?” The article refers to recent findings that show that children in South America who live near gold mines that use mercury may have brain and nervous system damage due to mercury exposure. Students may also want to refer to the Quicksilver documents “Back to the Elements: Gold and Mercury.”
- Share with your students the information included in the **Teacher Background**. Discuss why artisanal gold mining is popular in South America and what impacts it has on the economy, environment and human health.
- Hand out a blank South America map to each student and ask them to label the map with the country names. This is a great way to quiz your students’ knowledge of South America geography, if you have already been studying this in class. Then, ask the students to use the table, “Artisanal Gold Mining in South America” to create a key and overlay the information about the amount of gold produced each year onto their maps.
- After the students have created their maps, hold a discussion about the relationship between the number of gold workers and the amount of gold produced in each country. How many total people are involved in artisanal gold mining in South America?

## Discussion Points

- Compare the data table on the amount of artisanal gold mining in different countries with those countries’ levels of poverty and unemployment rates. Also, look at the major industries for each country. What might make people turn to artisanal gold mining? What factors might make people willing to take the risk of gold mining, even if they know it is dangerous to their health?
- Pose this question to your students: What are some possible ways to help artisanal gold mining become safer in South America? Possible ideas include:
  - Educating miners on other methods of gold reclamation that do not use mercury.
  - Educating miners on how to use mercury more safely.
  - Educating people about the dangers of mercury.
  - Educating communities about how to protect themselves from mercury if their local environment has been contaminated (such as avoiding certain fish species).
  - Encourage governments to create legislation or enforce existing legislation on worker safety and the use of mercury in small-scale mining operations.
- Mercury poisoning from artisanal gold mining disproportionately affects low-income indigenous people and their communities in developing countries. What can the world community do to help?



### Student Assessment



Student work can be assessed in the following ways, for a total of 100%.

10%	Did students read the <i>Quicksilver Gazette</i> article “ <b>The Legacy of Golden Creek Mine</b> ” and “ <b>Back to the Elements: Gold and Mercury?</b> ”
10%	Did students actively participate in a <b>class discussion</b> about artisanal gold mining in South America?
80%	Did students create a <b>map</b> using the data on <b>Student Handout #1</b> , including the required elements? <ul style="list-style-type: none"><li>• 30% Correctly <b>labeled</b> with the country and territory names.</li><li>• 5% Includes a <b>key</b> to the map.</li><li>• 40% <b>Data</b> is correctly entered for each country or territory.</li><li>• 5% <b>Neatness</b>.</li></ul>



# The Quicksilver Question Web Module

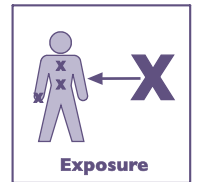


Student Handout

## The Legacy of Golden Creek Mine: Our Children at Risk?

By Elizabeth Goldman

QUICKSILVER—Mercury used at the Golden Creek Mine nearly a century ago may be causing neurological problems in the children of Quicksilver. Scientists have recently shown that children in South America who live close to gold mines that use mercury may have brain and nervous system damage due to exposure to mercury. The South American miners use mercury to help separate gold from dirt and sand. Some of the mercury is spilled or lost into nearby water and soil. People who eat fish that live in mercury contaminated water may become sick.



The Golden Creek Mine operated for many years using mercury to extract gold. Could there be a connection between the South American gold mines and the abandoned mine sitting in our backyard? Past mining operation may have contaminated Golden Creek and Golden Lake, leading to learning disabilities and other nervous system problems in our town's children.

Children in the Brazilian Amazon Basin in South America who live near gold mines that use mercury have been shown to have levels of mercury in their bodies that are high enough to cause damage to the brain and nervous system. By testing samples of hair from these children, scientists have determined that the children have been exposed to high levels of mercury. Some of these children have nervous system damage that has led to learning disabilities, slowed reflexes and behavioral problems.



Recent reports indicate that the lakes and rivers near abandoned gold mines in California are contaminated with mercury. The Sierra Nevada region of California was mined heavily for gold from 1857 until about 1900. The miners used mercury to extract small amounts of gold from huge amounts of dirt. It has been estimated that between 30 to 40 percent of the mercury used was washed into the river in the process of extracting gold. Recent studies have shown that the lake and rivers closest to the old mines have the highest levels of mercury. Similar gold mining practices were used at the Golden Creek Mine. This mercury may have contaminated our creek and lake.

It is time for the community of Quicksilver to investigate the legacy of our gold mining past. We must protect our children from the harms that have been clearly associated with mercury exposure in other mining regions.





# The Quicksilver Question Web Module



Student Handout

## Back to the Elements: Mercury

Mercury was used at Golden Creek Mine to help separate small amounts of gold from large amounts of dirt and rock. How do gold and mercury compare?

### Mercury (Hg)

The periodic symbol for mercury is Hg, which stand for the Latin “hydragyrum,” meaning *water silver*.

### Properties:

- Liquid at room temperature. Mercury is the only metal to have this property.
- Poor conductor of heat. Fair conductor of electricity.
- Mercury is a **heavy metal**. The term heavy metal refers to any metallic chemical element that has a relatively high density and is toxic at low concentrations.

### Mercury has three forms:

- elemental (metallic Hg)
- inorganic (salts such as HgS, HgCl)
- organic (including methylmercury, Hg-CH<sub>3</sub>)

### Sources

Elemental mercury is rarely found as a free element in nature. It is more common to find mercury in ores, a combination of several minerals. Methylmercury is a form of mercury found in some fish and seafood. Tiny organisms in the soil and water transform inorganic mercury into a new form. Methylmercury can get into the bodies of fish and other seafood that people eat.

### Biological Function

Mercury performs no known biological function. Mercury is toxic to humans and can cause damage to the brain, kidneys and developing fetus at low concentrations.

### Historic Uses

Humans have used mercury in: thermometers, switches, fluorescent lights, batteries, medicines, and dentistry.

### Relationship to Gold

Gold and mercury mix easily together, forming a mixture called an amalgam. At the Golden Creek Mine, mercury was used to separate gold from dirt and rock.

### **Back to the Elements: Gold**

The town of Quicksilver was built by miners who searched the hillsides for gold. Find out about gold's unique properties.

#### **Gold (Au)**

##### **Name:**

The periodic symbol for gold is **Au**, which stands for the Latin "aurum" which means gold.

##### **Properties:**

- Solid at room temperature.
- Gold is the most malleable and ductile metal, meaning that it can easily be flattened and shaped. One ounce (28 g) of gold can be beaten out to a sheet covering 100 square feet or drawn into a wire 50 miles long.
- Good conductor of heat and electricity.

##### **Sources:**

Found both as a free element in nature and associated with quartz, pyrite and other minerals in rock.

There are several minerals that are often mistaken for gold. These minerals are called Fool's Gold.

##### **Biological Function:**

Gold performs no natural biological function, but compounds containing gold are used in drugs to treat arthritis and cancer.

##### **Historic Uses:**

Humans have used gold in: jewelry, coins, computers, communications equipment, spacecraft, jet aircraft, and dentistry.

##### **Relationship to Mercury:**

Gold and mercury mix easily together, forming a mixture called an amalgam. At the Golden Creek Mine, mercury was used to separate gold from dirt and rock.





# GOLD MINING IN SOUTH AMERICA

## Student Handout #1



Student Handout

Name \_\_\_\_\_

Date \_\_\_\_\_

### Artisanal Gold Mining in South America, 1997

Country	Tons of Gold Produced per year	Number of Gold Workers
Brazil	30 - 50	200,000 - 400,000
Colombia	20 - 30	100,000 - 200,000
Peru	20 - 30	100,000 - 200,000
Ecuador	10 - 20	50,000 - 80,000
Venezuela	10 - 15	30,000 - 40,000
Suriname	5 - 10	15,000 - 30,000
Bolivia	4 - 5	10,000 - 15,000
Chile	3 - 5	6,000 - 10,000
French Guiana*	2 - 4	5,000 - 10,000
Guyana	3 - 4	6,000 - 10,000
<b>TOTAL</b>	<b>107 - 173</b>	<b>522,000 - 995,000</b>

**Ton:**  
A metric measurement for weight. One metric ton is equal to 2,240.6 pounds. To put it into context, a male African elephant can weigh about six tons.

\*French Guiana is a territory of France.  
From UNIDO Meeting Report, "Mercury in Artisanal Gold Mining in Latin America: Facts, Fantasies and Solution." 1997.

### Population Information by Country, 2003

Country	Population	Below Poverty Line	Unemployment Rate
Brazil	18,032,604	22%	6.4%
Colombia	41,662,073	55%	17.4%
Peru	28,409,897	50%	9.4% (widespread underemployment)
Ecuador	13,710,234	70%	7.7% (widespread underemployment)
Venezuela	24,654,694	47%	17%
Suriname	435,449	70%	17%
Bolivia	8,586,443	70%	7.6%
Chile	15,665,216	21%	9.2%
French Guiana	186,917	N/A	22%
Guyana	702,100	N/A	9.1%
<b>TOTAL</b>	<b>316,045,627</b>	<b>Avg. 50.6%</b>	<b>Avg. 12.3%</b>

**Below Poverty Line:**  
A country's government sets a number as the poverty threshold. If a family's total income is less than the poverty threshold, then the family is considered to be living below the poverty line, or low-income.

**Unemployment Rate:**  
A measurement of the amount of adults who do not have jobs or sources of income.

**Underemployment:**  
Someone who is underemployed may have a job, but it does not provide enough income to support his or her family. People can be considered underemployed if their jobs are part-time or seasonal work, or if their jobs do not pay enough in wages to meet their needs.

Figures from www.geographic.org 2003 statistics.

## Major Industries by Country, 2003

Country	Major Industries
Brazil	Textiles, shoes, chemicals, cement, lumber, metals, aircraft, motor vehicles and parts.
Colombia	Textiles, food processing, petroleum, clothing and footwear, chemicals, cement, gold, coal, and emeralds.
Peru	Fish, metals (including gold), petroleum, coffee, sugar, and cotton.
Ecuador	Petroleum, fish and shrimp, textiles, paper products, chemicals, plastics, lumber and food.
Venezuela	Petroleum, metal mining, food processing, textiles, motor vehicle assembly and construction materials.
Suriname	Bauxite and gold mining, lumber and food processing.
Bolivia	Mining (including gold), petroleum, food and beverage, tobacco, handicrafts and clothing.
Chile	Minerals, food and fish, wood products, cement, textiles, transport equipment and chemicals.
French Guiana	Construction materials, forestry products, rum, gold mining, shrimp processing and clothing.
Guyana	Bauxite and gold mining, timber, shrimp, textiles, sugar, rice and rum.

*Bauxite:*

A mineral mixture that is the main source of aluminum.



Student Handout

# South America

Gold Produced in 1997

**KEY**

- 30-50 tons
- 20-30 tons
- 10-20 tons
- 0-10 tons

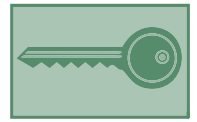
**Name the Country!**

<b>1</b> _____	<b>6</b> _____	<b>11</b> _____
<b>2</b> _____	<b>7</b> _____	<b>12</b> _____
<b>3</b> _____	<b>8</b> _____	<b>13</b> _____
<b>4</b> _____	<b>9</b> _____	<b>14</b> _____
<b>5</b> _____	<b>10</b> _____	<b>15</b> _____

**Note that #'s 13, 14 and 15 are territories of other countries**

From [www.worldatlas.com/webimage/testmap/samer.gif](http://www.worldatlas.com/webimage/testmap/samer.gif)

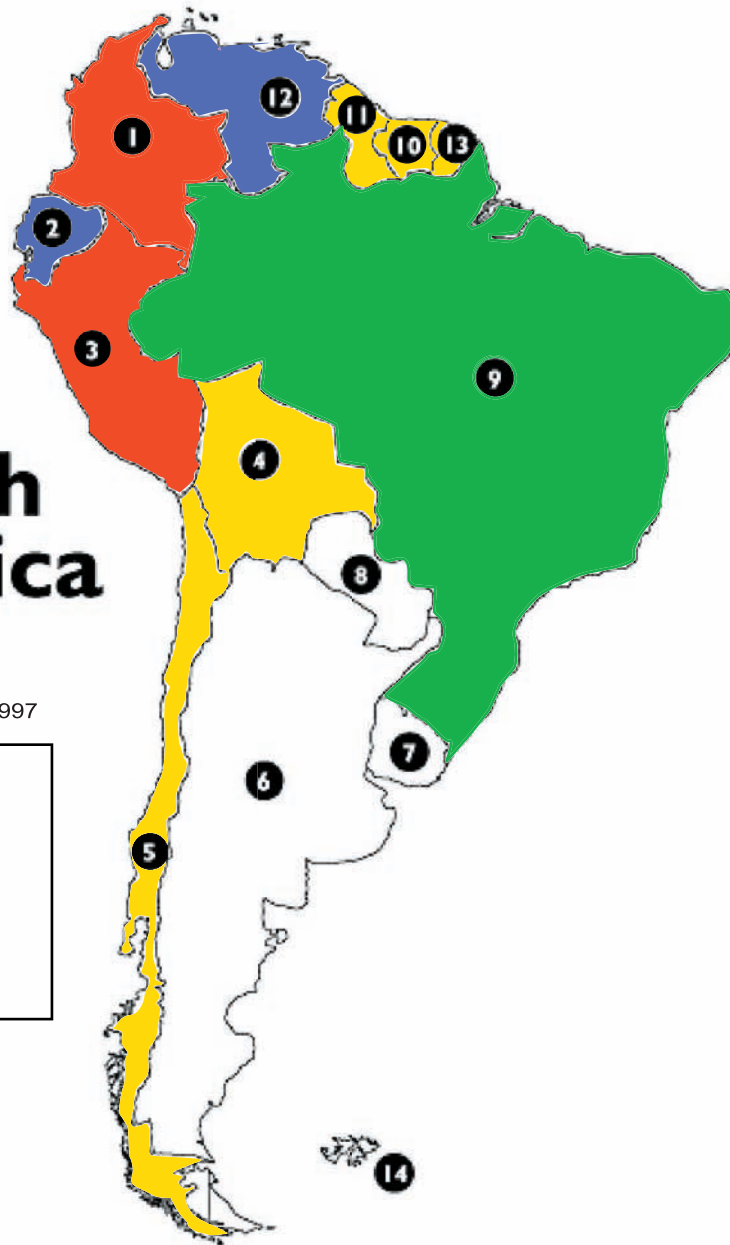
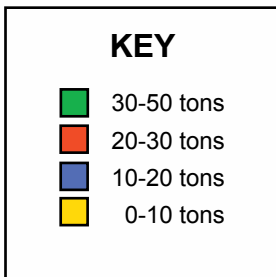




Teacher Key

# South America

Gold Produced in 1997



## Name the Country!

- |                |                 |                 |
|----------------|-----------------|-----------------|
| <b>1</b> _____ | <b>6</b> _____  | <b>11</b> _____ |
| <b>2</b> _____ | <b>7</b> _____  | <b>12</b> _____ |
| <b>3</b> _____ | <b>8</b> _____  | <b>13</b> _____ |
| <b>4</b> _____ | <b>9</b> _____  | <b>14</b> _____ |
| <b>5</b> _____ | <b>10</b> _____ | <b>15</b> _____ |

Note that #'s 13, 14 and 15 are territories of other countries

From [www.worldatlas.com/webimage/testmap/samer.gif](http://www.worldatlas.com/webimage/testmap/samer.gif)





## Lesson One: UP THE FOOD CHAIN



Teacher Key

### Lesson Overview

In the **Quicksilver Question Web Module**, students learn that mercury moves up through aquatic food chains.

In this lesson, students play two simulation games to understand how biomagnification and bioaccumulation of mercury can affect aquatic ecosystems—and harm people. Both games require either an outdoor playing field or a gymnasium with room for students to run.

This lesson addresses the following Washington State Essential Academic Learning Requirements (EALRs). The benchmarks listed are for grade 8 in science.

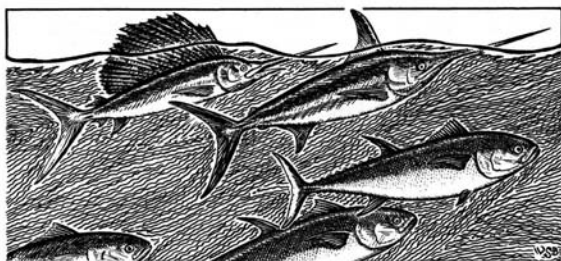
In this lesson, the student is asked to:

- Explain how organisms interact with their environment and with other organisms to acquire energy, cycle matter, influence behavior, and establish competitive or mutually beneficial relationships. (Science 1.3 Interdependence of Life).
- Explain how human societies' use of natural resources affects quality of life and the health of ecosystems. (Science 1.3 Environmental and Resource Issues).

### EALRs Addressed

### Teacher Background

As the students learned in the **Quicksilver Question Web Module**, some common fish species can have high levels of mercury. Of the four fish species in Golden Lake, Smallmouth Bass and Yellow Perch had an average mercury concentration that was



above the recommended limit of 0.15 ppm. When people consume fish that are high in mercury, they can suffer from mercury poisoning. Young children under six years old, pregnant women and women of childbearing age are especially susceptible to the dangerous effects of mercury. The Department

of Health for each state issues health advisories concerning different species of fish from different aquatic environments. For example, in a polluted bay, the bottom-feeding fish may have high mercury content, but other fish species may be safe to eat.

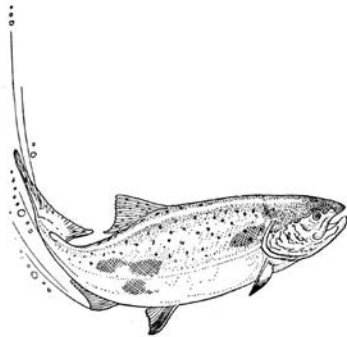


In an aquatic ecosystem, mercury passes up through the food chain to the predatory fish. Therefore, predatory fish often have higher levels of mercury and are included in state and federal fish advisories. Some saltwater fish that are regularly included in advisories include swordfish, shark, king mackerel, tilefish and tuna (both fresh and frozen steaks and canned). Mercury is stored in the flesh of the fish, not the fat, so it cannot be trimmed away before eating.

Canned tuna on average has relatively high levels of mercury. Therefore, the U.S. Environmental Protection Agency (EPA), the Food and Drug Administration (FDA), the

Centers for Disease Control and Prevention (CDC), and individual states' Departments of Health (DOH) have all issued warnings about canned tuna consumption by young children, pregnant women and women of childbearing age. All of the agencies agree that eating fish is a healthy part of a balanced diet, however certain people should limit their intake of specific fish, including canned tuna. For example, it is recommended that pregnant women should eat no more than one can of tuna per week, and young children should eat even less.

When mercury is ingested, it first enters the bloodstream and then is deposited in organ tissues like the brain and kidneys. Unlike DDT or PCBs, mercury is not stored in fat, but accumulates within the central nervous system and other organs. People excrete mercury through the feces; however it is a very slow process. If the dose received is greater than the amount the body is able to excrete, then the mercury can build up in the organs. Mercury may cause learning disorders and neurological damage. In 2000, the Centers for Disease Control and Prevention (CDC) suggested that up to ten percent of American women may have potentially hazardous levels of mercury in their bodies.



The following games introduce students to the processes of biomagnification and bioaccumulation. **Biomagnification** is the process whereby an animal eats another animal or plant, consuming the contaminants stored in the prey organism. The contaminants then magnify up the food chain, with the animals at the top levels suffering from the most contamination. **Bioaccumulation** is the natural process of growth that involves consuming nutrients. If an animal's food source is contaminated, then that animal will build up more of the contaminate in their body over time. An older animal, therefore, will have more of the contaminate stored in its body than a young animal. Mercury passes up through the food chain through both of these processes.

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

- **Environmental Protection Agency (EPA) Fish Consumption Advice**  
Fact sheets with advice on how to protect your family from mercury contamination from fish and seafood.  
<http://www.epa.gov/waterscience/fish/advisory.html>
- **Commonplace Mercury Earns Bad Reputation**  
"Mercury Rises as Health Concern," in the Spring/Summer 2003 issue of *Northwest Public Health*.  
<http://healthlinks.washington.edu/nwcpnp/nph/s2003/>

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### Teacher Preparation

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#### Materials: (for entire class)

- A large outdoor playing field or a gymnasium.
- Some kind of token, such as poker chips. About 1/3 of the tokens should be marked with an "Hg" for mercury contamination or be colored differently. You will need more tokens than you have students.
- One plastic baggie or paper bag for each student. This represents their stomachs.



- Color-coded bandanas, sashes or armbands for each group to wear.
- Have students review the Quicksilver documents “Mercury Levels in Fish from Golden Lake” and “Report on Mercury Levels in Golden Lake Fish.”

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## Procedure

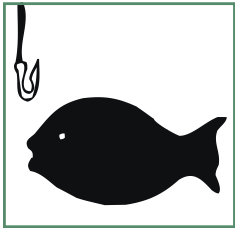
### The Biomagnification Game

**Biomagnification:** *the process whereby an animal eats another animal or plant, consuming the contaminants stored in the prey organism. The contaminants then magnify up the food chain, with the animals at the top levels suffering from the most contamination.*

- Introduce the concept of biomagnification. Tell your students that they will play a fast paced game to help them understand this concept
- Divide the students into three groups: Smallmouth Bass, Insects and Algae. You will want approximately three times as many Algae as Insects and three times as many Insects as Bass. For example, in a class of 26 students, you will have 2 Bass, 6 Insects and 18 Algae. Give each student a small plastic baggie or paper bag and a color-coded bandana to wear.
- Scatter the energy tokens randomly across the playing field. The playing field represents a lake.
- First, allow the Algae to gather as many energy tokens as they can in 30 seconds. The tokens must be placed in the bag (their stomach) to count.
- Next, allow the Insects to enter the playing field. It is the Insect’s goal to chase and tag the Algae. When an Insect tags an Algae, the Algae must empty the energy tokens from their bag into the Insect’s bag. The Algae then must sit on the sidelines.
- After a short amount of time (depending on the size of the field and the size of your group), allow the Bass to enter the field, hunting for the Insects. When a Bass tags an Insect, the Insect must empty their energy tokens into the Bass’ bag. The Insect then must sit on the sidelines.
- After a set amount of time, stop the game. Gather the group to discuss what happened. Take a vote to find out how many of the Algae and Insects were caught and eaten. Of the Algae and Insects that are still alive, have them count the total number of energy tokens in their stomach bags. Then, tell them to look at their tokens again and see if any of them have an “Hg” marked on them. The “Hg” represents a food source that has been contaminated with mercury. Have each person count his or her total number of contaminated tokens. Do the same thing for the Smallmouth Bass.
- Record the results on a large piece of chart paper. Things you may want to record and discuss:
  - Number of Algae that were eaten and number that still remain alive.



- Number of Insects that were eaten and number that still remain alive.
- Of each living Algae, how many energy tokens do they have total? How many are contaminated with mercury? What percentage of their food is contaminated?
- Of each living Insect, how many energy tokens do they have total? How many are contaminated with mercury? What percentage of their food is contaminated?
- Of each Smallmouth Bass, how many energy tokens do they have total? How many are contaminated with mercury? What percentage of their food is contaminated?



## The Bioaccumulation Game

**Bioaccumulation:** the natural process of growth that involves consuming nutrients. If an animal's food source is contaminated, then that animal will build up more of the contaminate in their body over time. An older animal, therefore, will have more of the contaminate stored in its body than a young animal.

- Introduce the concept of bioaccumulation. Tell your students that they will play a version of tag to help them understand this concept.
- First, choose some boundaries on the play field where the game will be held. This field represents a lake brimming with fish.
- Next, choose 4-8 students to be "Humans." The rest of the students will be "Fish." Each student who is a Fish gets five tokens. Makes sure to hand out both blank tokens and tokens marked with a "Hg." Hand out a color-coded bandana to every Fish.
- Choose one or two students to represent each of the age classes of humans: Senior Citizen, Healthy Adult, Teenager and Baby. Each Human will have a different amount of time to try to catch fish. This represents the age of the human; a baby eats less fish overall than a senior citizen does.

<p><b>Fish</b> = 5 tokens each <b>Senior Citizen</b> = 3 minutes <b>Healthy Adult</b> = 2 minutes <b>Teenager</b> = 1 minute <b>Baby</b> = 30 seconds</p>
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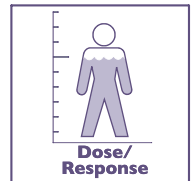
- To play the game, allow the Fish to spread out across the playing field. Then, send out the one or two students playing Senior Citizens. The Senior Citizens have three minutes to try to catch and consume as much fish as possible. When a Human tags a Fish, the Fish must give up one of their tokens to the Human.
- After the three minutes are up, ask the Senior Citizens to step to the sideline. Then, send in the Healthy Adults for two minutes. Next, the Teenagers for one minute. The Babies only have 30 seconds to try to catch some fish.

- After all of the Humans have had their chance, gather the group of students together. Ask each of the Humans to share the number of Fish (tokens) they were able to catch and how many of those were marked with an “Hg” to show that they were contaminated with mercury. Record these results on a large piece of chart paper, creating a bar graph that shows the relationship between age and amount of contamination.
- It is important to allow time to have a follow-up discussion that links the game to a broader discussion about health advisories concerning mercury in fish. Some possible discussion questions follow:
  - What is the relationship between age and the amount of contamination?

***The older an organisms is, the longer it has had for toxicants to build up in its body. This is related to the concept of bioaccumulation.***

- If a baby has only a small amount of a toxicant in its body, can that still be dangerous? How does this relate to dose?

***Even if a baby or small child has a small dose of a toxicant, it can still be dangerous. For one thing, the baby has a smaller body size, so a small amount of toxicant can have a big impact. Also, babies and small children are still growing and developing, so their organs are impacted more from some toxicants than a full grown adult.***

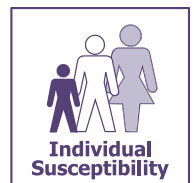


- Why are there different advisories for children and pregnant women compared to adults when it comes to mercury in fish?

***Fetuses, babies, and small children all have organs that are still developing. Therefore, mercury can have a bigger impact on their organs than those of a full grown adult. Also, they have small body sizes, so it doesn't take as much mercury to harm them as it would in a full grown adult.***

- Why are there different advisories for children and pregnant women compared to adults when it comes to mercury in fish?

***Fetuses, babies, and small children all have organs that are still developing. Therefore, mercury can have a bigger impact on their organs than those of a full grown adult. Also, they have small body sizes, so it doesn't take as much mercury to harm them as it would in a full grown adult.***



Both games are adapted from food chain games that are widely available in print and internet sources. It is difficult to ascertain the original source of the games.

### Student Assessment



Student work can be assessed in the following ways for a total of 100%.

10%	Did students read the <i>Quicksilver</i> documents, “ <b>Mercury Levels in Fish from Golden Lake: Cause for Caution</b> ” and “ <b>Report on Mercury Levels in Golden Lake Fish</b> ”?
80%	Did student actively participate in playing the <b>Biomagnification Game</b> and the <b>Bioaccumulation Game</b> , including demonstrating good sportsmanship skills?
10%	Did students participate in a <b>class discussion</b> about mercury, fish, and human health risks?



# The Quicksilver Question Web Module



Student Handout

## NEWS RELEASE

Cascade County Department of Health  
Quicksilver, WA

For Immediate Release:

### Mercury Levels in Fish from Golden Lake – Cause for Caution

QUICKSILVER—The Cascade County Department of Health has issued a health advisory for the consumption of fish caught at Golden Lake and Golden Creek. Some fish species may contain methylmercury, a toxic form of mercury that can be harmful to your health at high levels. Mercury's toxic effects are not felt evenly across the population – the developing fetus and young children are especially vulnerable because their nervous systems are still developing.



The Department of Health (DOH) recommends that children and women of childbearing age only consume fish and mercury levels less than 0.15 parts per million. The Cascade County Department of Fish & Wildlife tested the mercury levels in four species of fish caught in Golden Lake and determined these results:

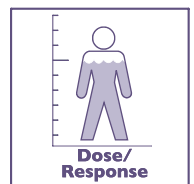
**Safe for consumption:**

- Pumpkinseed sunfish
- Kokanee

**Unsafe for sensitive populations:**

- Smallmouth bass
- Yellow perch

Women who are pregnant or may become pregnant, nursing mothers and young children should not eat smallmouth bass and yellow perch caught from Golden Lake. Also, women of childbearing age and small children should limit the amount of all freshwater fish they eat that is caught by family and friends to one meal per week on average (6 ounces cooked fish for adults and 2 ounces cooked fish for children). Other people should limit the total amount of Golden Lake fish that they eat.



For more information on fish consumption advisories, access the Environmental Protection Agency's Fish Consumption website available at:  
<http://www.epa.gov/waterscience/fish/advisory.html>

A new health advisory sign will be posted at the Golden Lake dock to educate Quicksilver residents about the recommendation.



# The Quicksilver Question Web Module

Cascade County Department of Health  
Quicksilver, WA

## REPORT ON MERCURY LEVELS IN GOLDEN LAKE FISH

Historic mining activity along Golden Creek and Golden Lake has caused concern among Quicksilver residents about mercury contamination in fish caught at Golden Lake. To address this concern, total mercury analysis tests were performed on fish from Golden Lake.

Four fish species were caught, cleaned and filleted as if preparing for dinner. The fillets were weighed and then pulverized in a blender. Mercury was then extracted from the mixture. The test was performed on 30 samples of each fish species.

The Cascade County Department of Health has set a standard of mercury levels less than 0.15 parts per million being safe for consumption. The data were reported to the Department of Health for their consideration. Below is a summary of these findings.



### Mercury Levels in Fish Populations in Golden Lake

SPECIES	NUMBER OF SAMPLES	AVERAGE Hg CONCENTRATION (parts per million)
Smallmouth Bass	30	1.20
Yellow Perch	30	0.50
Kokanee	30	0.12
Pumpkinseed Sunfish	30	0.10



## Lesson Two: Mercury Rising

### Lesson Overview

In the **Quicksilver Question Web Module**, students learn that old fever thermometers are one source of mercury contamination in the environment.

Students learn how both old mercury and new alcohol thermometers work. Then they build their own water thermometer, which models how mercury works in a thermometer. Students can calibrate their water thermometers and/or create a graph that shows temperatures changes throughout the day. Students also learn about non-toxic alternatives and how to dispose of a broken mercury thermometer.

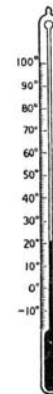
### EALRs Addressed

This lesson addresses the following Washington State Essential Academic Learning Requirements (EALRs). The benchmarks listed are for grade 8 in science.

In this lesson, the student is asked to:

- Explain how human societies' use of natural resources affects quality of life and the health of ecosystems. (Science 1.3 Environmental and Resource Issues).
- Correlate models of the behavior of objects, events, or processes to the behavior of the actual things; test models by predicting and observing actual behaviors or processes. (Science 2.1 Modeling).
- A lesson plan on **Bulb Thermometers** can be found on the How Stuff Works website. This lesson plan provides instructions on building a water thermometer
- A lesson plan on **Bulb Thermometers** can be found on the following website. This lesson plan provides instructions on building a water thermometer in a glass jar. This lesson plan is the property of How Stuff Works, Inc. <http://www.howstuffworks.com/therm.htm>
- Instructions on how to build a **thermometer** in a clear plastic film canister are available from the following website. Look under "Science," "Fourth Grade" and then for the lesson plan "Temperature." The lesson plan is posted on the Utah Education Network website and authored by Hislop and Edwards. <http://www.uen.org/curriculum/html/corelessonplans.html>
- The Environmental Protection Agency (EPA) provides information on **Mercury Fever Thermometers** on their website. This information is property of the Great Lakes Toxics Reduction Program of the U.S Environmental Protection Agency. <http://www.epa.gov/glnpo/bnsdocs/hg/thermfaq.html>

### Lesson Plan Link









## Lesson One: THE MERCURY MESSAGE

In the **Quicksilver Question Web Module**, students learn about a group of teenagers who accidentally contaminate their town with mercury.

In this activity, students respond to the *Quicksilver Gazette* article, “Arkansas Teens Poison Town with Mercury.” Students have the opportunity to send a persuasive letter that can travel back in time, reaching the Arkansas teenagers the day before they discover the abandoned mercury. In the letter, the students warn the teens about the dangers of mercury to human health and the environment.

This lesson addresses the following Washington State Essential Academic Learning Requirements (EALRs). The benchmarks listed are for grade 7 in writing.

In this lesson, the student is asked to:

- Write for different audiences. Write for distant audiences such as pen pals and community members. Identify, analyze, describe, and meet the needs of chosen audience. (Writing 2.1).
- Write for different purposes. (Writing 2.2).

This lesson is based on the article from the **Quicksilver Question Web Module** entitled “Arkansas Teens Poison Town with Mercury.” This *Quicksilver Gazette* article is based on a real article that appeared in *Time.com* on January 26, 1998. The original article was titled “The Quicksilver Mess” by S. C. Gwynne.

### Materials: (for each student or group)

- Copies of the *Quicksilver Gazette* article, “Arkansas Teens Poison Town with Mercury” and the Quicksilver document “Mercury and You.”
- Optional: art materials for creating time capsules.

- Ask students to read the *Quicksilver Gazette* article on the teenagers who poisoned their town with mercury. This article is accessed by using the save/print function in the module or downloading it from the “For Teachers” page of the Quicksilver website.
- Now, ask the students to imagine how things may have turned out differently if the teenagers had known about the dangers of mercury. How may the teenagers have reacted when they found the mercury in the abandoned factory if they knew of its dangers? What would your students do if they were in a similar situation?

### Lesson Overview

### EALRs Addressed

### Teacher Background

### Teacher Preparation

### Procedure

- Ask your students to write a persuasive letter to the teenage boys who found the mercury. Tell the students to imagine that their letters will be able to travel through time to reach the boys the day before they found the mercury in the abandoned factory. Students should use the information that they gained from the **Quicksilver Question Web Module** to warn the teenagers about the dangers of mercury. In particular, students may want to refer to the Health Clinic brochure, “Mercury and You” as well as the Toxicologist’s “Introduction to Toxicology.” These documents can be obtained by going into the module, visiting the two locations, and using the save/print features. The documents can also be downloaded directly from the “For Teachers” page of the Quicksilver website.
- Optional: Students can package their letters in some kind of container that they think will help it withstand the stresses of time travel. Students can be creative in decorating the containers.

**Student Assessment**



Student work can be assessed in the following ways, for a total of 100%:

20%	Did students read the <i>Quicksilver Gazette</i> article, “ <b>Arkansas Teens Poison Town with Mercury,</b> ” and the <i>Quicksilver</i> documents “ <b>Mercury and You</b> ” and “ <b>Introduction to Toxicology?</b> ”
80%	<p>Did students write a <b>persuasive letter</b> that includes the required elements?</p> <ul style="list-style-type: none"> <li>• 10% <b>Topic</b> of letter is clear.</li> <li>• 10% Appropriate conversational <b>tone</b>.</li> <li>• 10% <b>Position</b> is clear, compelling, and well supported with specific facts and details.</li> <li>• 10% Anticipates opposing <b>viewpoints</b>.</li> <li>• 10% Proper writing <b>conventions</b>.</li> <li>• 10% <b>Recipient</b> identified with proper salutation.</li> <li>• 10% <b>Writer</b> identified with appropriate closing.</li> <li>• 10% <b>Creativity</b>.</li> </ul>



# The Quicksilver Question Web Module



Student Handout

## Arkansas Teen Poison Town with Mercury

By I.B. Newsworthy

TEXARKANA—Today's children have grown up without mercury fever thermometers. While many adults recall being warned as children about the shiny liquid metal that puddles from a broken thermometer, many children do not know about the dangers of mercury.

Mercury is a poison, yet its unique properties make it enticing. Mercury is the only metal that is liquid at room temperature, creating shiny, liquid beads that roll and wobble. When a couple of Arkansas teens discovered a barrel of pure mercury in an abandoned factory where it had been used to make neon lights, they found it irresistible. They dipped their hands into it. They poured it in jars and handed it out to friends at school. One boy dipped a cigarette into the mercury and smoked it. An then they began to fall very ill.

The teenagers did not know that the wobbly, silver liquid was a powerful poison. Mercury evaporates at room temperature, and the invisible vapors are dangerous when inhaled. Mercury can also be absorbed during prolonged contact with the skin.

Several weeks after the teen found the abandoned mercury, they began to show symptoms of mercury poisoning. Doctors in Texarkana, a town that straddles the Texas-Arkansas border, treated six teenage boys. The boy who smoked the mercury contaminated cigarette began coughing up blood. Five other were hospitalized with symptoms that included vomiting, difficulty breathing and seizures.

The mercury crisis developed into a city-wide emergency. Two dozen federal, state and local agencies donned haz-mat suits, gloves and respirators as they tried to deal with the contamination. Authorities identified 170 people who were exposed to the mercury as it moved through the town and even to a neighboring town 15 miles away. As the teenagers passed the mercury out at school, it traveled from school lockers to bedrooms and local businesses. Eight homes had to be evacuated and decontaminated. In one home, where mercury had been spilled on the carpet, the vapors killed the family dog and caused several children to be rushed to the hospital. The carpet and floorboards had to be ripped out of the house.

In the age of digital thermometers, many households have replaced their old mercury fever thermometers with safer digital ones. Some businesses and city governments host thermometer swap programs where mercury thermometers can be traded for digital ones. While getting mercury thermometers out of the home helps reduce children's risk of coming in contact with the toxic metal, children still need to be taught about the dangers of mercury.

Adapted from time Magazine, January 26, 1998 vOL.151 No. 3.  
By S.C. Gwynne/Texarkana







# The Quicksilver Question Web Module



Student Handout

## Mercury and You

*A public service brought to you by the Cascade County Department of Health*

People have always been exposed to mercury. Small amount of mercury are released into the air by volcanoes and by burning coal. Since mercury began to be mined hundreds of years ago, mercury has become a part of many common and useful items, such as thermometers and dental filling. Mercury that is released into the environment can pollute water supplies and contaminate the fish and seafood that we eat. This pamphlet was designed to teach you about some of the way you might be exposed to mercury, the possible effects of this exposure, and how to protect yourself and your family from mercury poisoning.

### What is mercury?

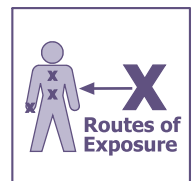
Mercury is also known by the nickname “quicksilver” and its chemical symbol, Hg. Mercury is an element with some special characteristics. Mercury is the only metal that is liquid at room temperature, forming silvery droplets that wobble and roll. Mercury can be harmful to people. Mercury can damage the brain, kidney and developing fetus.

There are three common form of mercury:

1. **Elemental Mercury**, also called metallic mercury, is the type of mercury you can see in old fever thermometers.
2. **Inorganic mercury** often occurs as salts. Historically, these inorganic salts were discovered to be the cause of mercury poisoning among hat-makers. The mercury salts were used to treat beaver skins for hats. The hat-makers became poisoned, creating the saying “mad as a hatter.”
3. **Methylmercury** is also called organic mercury. Microscopic organisms in water or soil that has been contaminated with inorganic mercury transform the mercury into another form, called methylmercury. Methylmercury can get into the bodies of fish and other seafood. If the level of methylmercury in the fish is high enough of people consume enough of it, they can become sick from eating the fish. In historic gold mining areas, oftentimes the soil and water is contaminated with elemental mercury, which can then change into inorganic mercury. This inorganic mercury is then transformed into methylmercury.

### Who is effected by mercury?

1. Mercury is dangerous for anyone exposed to it in large amounts.
2. Mercury is especially dangerous for fetuses and small children whose brains are still developing.
3. One in 12 pregnant women in the U.S. may have levels of mercury in their bodies that are potentially dangerous to their developing babies.





### How do we use mercury today?

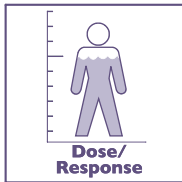
The common items listed below are sources of mercury exposure. Some of the items hold mercury within a glass or metal device. The mercury is only a health concern if the device breaks and released mercury vapors. Vapors from evaporating mercury are dangerous because a lot of the mercury can reach your brain. These items also need to be properly disposed of, not vacuumed or thrown in the garbage.

- Light switches
- Thermostats
- Fluorescent light bulbs
- Some types of thermometers
- Some types of blood pressure devices
- Mercury mixed with silver and other minerals is used in silver-colored dental fillings

Mercury is also an ingredient in thimerosal, a preservative in some vaccines. Recently the amount of thimerosal used in vaccines has been decreased due to concerns about the possible health risks of mercury. More research is being done to determine whether thimerosal should be eliminated from use in vaccines entirely.

### What happens when you are exposed to mercury?

Mercury tends to build up in our bodies over time. If you are exposed to small amounts of mercury, your body can get rid of these small amounts in our feces and urine. If you consume more mercury than your body is able to get rid of, high amounts of mercury can build up in your body.



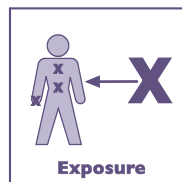
### How can mercury affect your health?

1. If you are under 18 years old:
  - Your nerves and brain may still be forming, so you could experience neurological problems like decreased IQ and slowed reflexes.
2. If you are a pregnant woman:
  - You could affect the development of your baby's brain and nervous system by being exposed to small doses of mercury.
3. People exposed to significant amount of methylmercury in fish may experience:
  - Irritability, shyness, tremors, changes in vision, or hearing and memory problems.



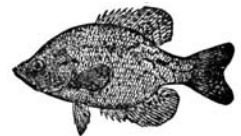
### How do you know if you've been exposed to mercury?

1. Hair sample tests can determine the amount of mercury exposure. However, such tests must be done by a qualified medical laboratory.
2. Blood or urine tests can be done to determine the amount of mercury vapor exposure.



### Should I eat fish?

Eating fish helps keep your heart healthy. Fish are low in fat and high in protein. However, some lakes, rivers and streams may be contaminated with mercury. Fish caught in these locations may be harmful to your health, especially for children and pregnant women.



Unlike some other types of contaminants, mercury cannot be removed by cooking the fish or through proper cleaning. It is therefore important to pay attention to posted fishing advisories. Depending on the advisor you may want to limit the amount of fish you eat, or avoid eating fish altogether from locations with these advisories.



# The Quicksilver Question Web Module



Student Handout

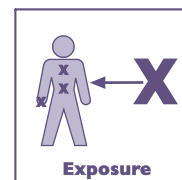
## Introduction to Toxicology

**Toxicologists** study the harmful effects of chemicals on humans and the environment. They try to understand the risks that people face when they are exposed to certain chemicals. They work to measure and explain risks to people so that decisions can be made that keep us as safe and healthy as possible, while still enjoying the benefits that modern drugs and chemicals bring to society, when properly used. The **toxicity** of a chemical is a measure of how dangerous it is.



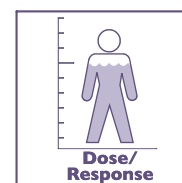
### Exposure

**Exposure** is the total amount of a chemical that comes in contact with your body. The greater the amount of the chemical that is in the air, food or water that people come in contact with, the greater the exposure for those people.



### Dose

**Dose** is the amount of the chemical that actually enters your body. Dose depends on how much exposure you have, how long that exposure take place, and how big or small you are.



Dose depends on length of time of exposure. The longer, or more frequently, you are exposed to something, the bigger your dose might be. The bigger the dose, the more extreme the response will probably be.

Dose also depends on how big or small you are. When a doctor prescribes a medication for you, he or she calculates the amount of the medicine based on how big or small you are. The doctor can then give you the correct dose of the medicine for your body weight. While a teaspoon of medicine might be right for an adult, it may be far too large of a dose for an infant.

Over four hundred years ago, a European doctor named Paracelsus established the basic belief of toxicology. He said, "All substances are poisons; there is none which is not; the dose differentiates a poison from a remedy."

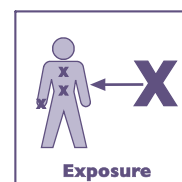
This statement says that everything can be toxic if the dose is high enough. Even water could be toxic if someone were to drink gallons and gallons of it at one time. It is the dose that makes the poison.

For some highly toxic chemicals, only a very small amount is need to cause harm. Some highly toxic chemicals you might be familiar with are bleach, gasoline, and nail polish remover. Mercury and lead are examples of highly toxic heavy metals. You could get very sick from being exposed to a relatively small amount of any of these chemicals. For other chemicals, a large amount may be necessary to produce harm. This difference in the amount of chemical needed to produce the same level of effect is called **potency**.

### Routes of Exposure

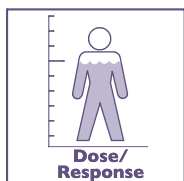
Toxic substances can enter the body through:

1. **Inhalation**
2. **Ingestion**, or swallowing a substance
3. **Dermal absorption**, or contact with the skin.



Some substances enter the body more easily by one route than another. For instance, when elemental mercury evaporates, the vapors can enter the body very easily through the lungs. Elemental mercury is particularly dangerous if it is heated because more of it evaporates. When a person inhales mercury vapors, 80% of the mercury enters the bloodstream and then moves to the brain and kidneys. The vapors can quickly affect the brain. However, if metallic mercury is swallowed, less than 0.01% will be absorbed by the gut.

Methylmercury is easily absorbed through the gut. This is one of the reasons why it is dangerous to eat fish that have high levels of methylmercury. Ninety percent of the methylmercury that is ingested will be absorbed by the gut and enter the bloodstream.



### Dose/Response

When toxicologists study dose, they look at the response that a given dose causes in an individual or in a group. Usually, the greater the dose, the greater the response in an individual. Some substances have a threshold dose that is required in order to create a response that can be observed. This means that below a given dose level there is no detectable response. The dose-response relationship of some substances like vitamins is such that they are actually beneficial at low doses, but still may be harmful at high doses.

The level of response may be different in different people. Response levels are affected by a person's age, size, gender, diet, genetics, and lifestyle. For instance, it has been found that young children and fetuses have a much greater response to mercury than adults do. Children and fetuses have a greater response because of their small size and because their bodies are still developing. Children also breathe, eat and drink more—based on their size—than adults do.

### Biotransformation

**Biotransformation** is the process where your body, or other biological organisms in the environment, change the chemical structure of a substance. Often this makes the substance less toxic and easier for the body to get rid of, or excrete. Sometimes biotransformation can actually make a substance more toxic. When inorganic mercury contaminates water supplies, it is first taken up by bacteria and tiny plants and animals known as plankton. These organisms biotransform it into a different, more toxic, form called methylmercury. Once methylmercury enters the human body, it may be transformed into a different form which stays in the body for a long time. Most methylmercury leaves the body after several months as inorganic mercury in the feces.

### Bioaccumulation and Biomagnification

**Bioaccumulation** is the uptake of contaminants from the external environment and from food. **Biomagnification** occurs when the contamination level increases in organisms at higher levels in the food chain.

Once inorganic mercury has entered the water supply, it begins to bioaccumulate in the bacteria and plankton in the water. These microorganisms biotransform it into highly toxic methylmercury. The microorganisms are then eaten by small fish, which in turn are eaten by larger fish. These larger fish may accumulate high levels of methylmercury in their muscle tissues from eating large amounts of the smaller fish. Older, larger fishes have had more time to accumulate methylmercury, so they may have higher levels of methylmercury than smaller fish. The large fish are caught and eaten by humans and animals, exposing them to potentially harmful amounts of methylmercury. Human beings and marine mammals (like seals, sea lions and orca whales) living at the top of the food chain, are exposed to the greatest dose of methylmercury due to biomagnification.



### Toxic Effects

You already know that **toxicity** is the measure of how harmful a chemical is. When a toxic effect occurs at the site of the exposure, it is called a **local effect**. For example, spilling a strong acid on your skin can cause immediate damage at that site. However many toxic effects occur at a site distant from the exposure. Once a chemical enters the blood stream, it may be distributed to different organs. These are called **systemic effects** because they occur throughout the body. The toxic effects caused by methylmercury is an example of a systemic effect. Although methylmercury mainly enters the body through the digestive tract, most of the damage occurs in the brain.



Many toxic effects are **reversible**. This means that if the toxic substance is eliminated before permanent damage is done, the body returns to normal. Unfortunately certain kinds of damage are not repaired easily, and can last a long time, even a lifetime. These effects are called **irreversible**.

**Birth defects** are examples of irreversible toxic effects. Birth defects occur while the fetus is still developing inside its mother. When pregnant women ingest methylmercury (such as eating fish from mercury-contaminated water), they might not personally experience severe toxic effects. However, their infants may be born with severe, permanent damage. Birth defects caused by methylmercury include mental retardation, inability to move or speak, brain damage, blindness, and seizures.

**Reproductive problems** are toxic effects that can occur in both men and women. These effects may be reversible or irreversible depending on the chemical and dose, and may impair individuals' ability to conceive or give birth to healthy children.





## Lesson Two: TOXIC TALES

In the **Quicksilver Question Web Module**, students learn about a case of large scale mercury poisoning in Iraq.

This activity relates to the reading, *Toxic Tales*, about the poisoning in Iraq caused by eating imported wheat seeds. In this activity, students learn about the use of symbols as a form of communication both through history and in our daily lives. They also learn about the international symbols for hazardous chemicals and design a label that could have been used to warn the Iraqi people about eating the wheat seeds.

This lesson addresses the following Washington State Essential Academic Learning Requirements (EALRs). The benchmarks listed are for grade 7 in language arts.

In this lesson, the student is asked to:

- Use language to interact effectively and responsibly with others. Identify cultural assumptions and perspectives. (Communication 3.1).
- Read to learn new information. Observe and use signs, labels, and instructions. (Reading 3.1).

The **Globally Harmonized System for the Classification and Labeling of Chemicals** uses a combination of symbols, colors and words to provide information about a substance's physical, health and environmental hazards. It is used to assure safety in trade and transportation of chemicals across international borders.

The development of an international set of chemical safety symbols began as early as the 1950s. The Globally Harmonized System (GHS) was created with the input of many different nations. It has been adopted by the United Nations, which recommends it be disseminated throughout the world.

The goal of the Globally Harmonized System is as follows:

“By promoting common, consistent criteria for classifying chemicals and developing compatible labeling and safety data sheets, the Globally Harmonized System (GHS) is intended to enhance public health and environmental protection, as well as reduce barriers to trade. The purpose of the GHS is to promote common, consistent criteria for classifying chemicals according to their health, physical and environmental hazards, and to encourage the use of compatible hazard labels, material safety data sheets for workers, and other hazard communication information based on the resulting classifications.” ([www.hazmat.dot.gov](http://www.hazmat.dot.gov))

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

### Lesson Overview

### EALRs Addressed

### Teacher Background



- **Globally Harmonized System for the Classification and Labeling of Chemicals**

<http://hazmat.dot.gov/regs/intl/globharm.htm>

- **Symbols throughout the World**

Follow the links on this website to explore the use of symbols around the world and through history.

<http://www.symbols.net>

- **Hieroglyphs**

If you would like to go into more depth about the use of symbols through history, you may want to focus on Egyptian hieroglyphics.

<http://www.greatscott.com/hiero/index.html>

- **Emoticon Lesson Plans**

Your students are probably familiar with the use of symbols, or emoticons, in e-mail correspondences. The following websites include lesson plans on emoticons. There are also many websites that list symbols and abbreviations used in Instant Messaging (IM) communications.

<http://www.atacc.ab.ca/makegoodconnections/7-9emot.html>

<http://www.lessonplanspage.com/CIEmoticons68.htm>

## Teacher Preparation

### Materials (for each student)

- “Toxic Tales” reading from the **Quicksilver Question Web Module**
- **Student Handout #1** on international chemical safety symbols
- Paper and colored pens or pencils
- Optional: Overhead transparency of **Student Handout**

## Procedure

- Introduce students to a list of symbols that were used historically to aid in communication. Your students may be able to add to this list. Some examples include:
  - Morse code
  - Egyptian hieroglyphics
  - Cave paintings
  - Navigation and cartography symbols



- As a group, try to develop a list of symbols that are currently used in our everyday lives. Some examples include:
  - Weather
  - Mathematics
  - Nautical
  - Flags
  - Road signs
  - Sign language
  - Rebus—picture puzzles



- Fabric care labels on clothing
- Emoticons (or “smileys”) for email correspondences
- Computer icons
- Music
- Astrology

- Encourage students to read the *Toxic Tales* article about mercury poisoning in Iraq.

As they read, ask them to consider the following questions. How was poor communication the cause of the large scale mercury poisoning? What could have been done differently to prevent the poisoning?

- Tell students that there is an international set of symbols used to denote hazardous chemicals, called the **Globally Harmonized System for the Classification and Labeling of Chemicals**. This system was developed in order to promote safety in the transport and use of chemicals across international borders. The international system of symbols was developed in hopes of preventing poisonings and other chemical accidents from happening in the future.
- Review the **Student Handout** with your class by using an overhead transparency of the pages. Cover the definitions of the symbols with a piece of paper. See if your students can identify the meaning of each symbol before you reveal the definitions.
- Challenge the students to design a new packaging label to replace the labels that were used on the wheat seeds sent to Iraq. The label should be entirely of their own design, although they can use the chemical hazard symbols shown on the **Student Handout** for ideas.
- The label needs to clearly communicate that the wheat seeds are treated with a poisonous fungicide, should only be used for planting, and should not be eaten. The label also needs to communicate that you cannot wash the poison out from the grain. The labels cannot rely on any writing, since they need to be understood by non-English speakers. Encourage students to consider that the symbols we may readily associate with a meaning (such as the skull and crossbones representing something dangerous or poisonous) may not hold the same meaning in other cultures.
- The label needs to communicate complex information. You may want to suggest that some students design their labels to show how to use the seeds. Other students may choose to show what not to do with the seeds. These two approaches may provide an interesting comparison between students’ projects.
- Each student should create a drawing of his or her packaging label for the wheat seeds.

### Student Assessment



Student work can be assessed in the following ways, for a total of 100%.

10%	Did students participate in a <b>classroom discussion</b> about the historic and current use of symbols?
10%	Did students read the <i>Quicksilver</i> document “ <b>Toxic Tales?</b> ”
80%	Did students create a new package label that includes the required elements? <ul style="list-style-type: none"><li>• 10% Label does not include any <b>words</b>.</li><li>• 20% Label could be understood by <b>non-English</b> speaker.</li><li>• 30% Label provides <b>warning</b> that seeds are only to be planted, not eaten.</li><li>• 10% <b>Neatness</b>.</li><li>• 10% Shows <b>creativity</b>.</li></ul>



# The Quicksilver Question Web Module



Student Handout

## HealthLink

A quarterly newspaper for a healthy community  
*Brought to you by Cascade County Department of Health*

Vol. IX Issue 2.

## TOXIC TALES

### Two True Stories of Mercury and Public Health

#### The Mystery of Minamata Bay

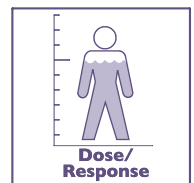
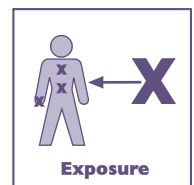
It all began with the seaweed, shellfish and fish, which began to die in record numbers. Then the cats began to act strangely, falling from the high walls bordering the sea and dying in what people began to call “cat suicide.” Next, the residents of Minamata Bay, Japan began to feel strange as well. Otherwise healthy people complained to their doctors that they stumbled while walking. They were unable to write, had trouble fastening their buttons, and suffered from other bizarre symptoms. What was happening in Minamata Bay?

In 1953, people began to see a pattern between the deaths of the cats and their own illness—both the cats and the residents of Minamata Bay ate a diet rich in fish and shellfish harvested from the bay. By the time the cause of this mysterious disease was determined to be mercury poisoning, as many as 10,000 people had become ill. The children of women exposed to mercury during pregnancy suffered some of the worst harm. These children had severe birth defects, which affected their ability to learn, think and move.

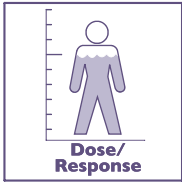
In 1963, the source of mercury was discovered to be a local company that had been dumping tons of mercury-contaminated waste into the local bay. The mercury was then transformed by tiny organisms in the water into a highly toxic form of mercury called methylmercury. These tiny organisms were eaten by small fish, which in turn were eaten by larger fish, where high levels of methylmercury accumulated in their tissues. When the people of Minamata Bay ate the fish, they received a dose of methylmercury with every meal.

Biomagnification is the process by which one animal eats another animal or plant, consuming the contaminants stored in their prey. The animal at the top of the food chain accumulates the most contamination.

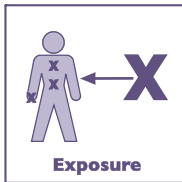
The tragedy in Minamata was the first time methylmercury in fish was recognized as a health hazard to humans. It took nearly 40 years of clean up after the company stopped dumping waste in the bay for the water to be safe for fishing and swimming.



### A Gift of Wheat



The winter of 1971 in Iraq was difficult as people could remember. There had been a poor wheat harvest the previous year, and there was not even enough wheat to eat, let alone to plant the next year's crop. Countries from around the world, including the United States and Mexico, sent wheat seeds to Iraq so that people could plant a crop to harvest the following year. Some of the wheat was colored with a red dye intended to warn people that it had been treated with a powerful mercury-containing chemical to protect the seed from mold. The wheat seeds were not safe to eat directly. Had the seed been planted, the amount of mercury in the grown plants would have been very small, resulting in a safe dose for anyone who ate the harvested wheat. The Iraqi people couldn't understand the Spanish warning labels on the wheat from Mexico. They did not know that in the United States, an image of a skull and crossbones means "poison."



The Iraqis who received the donation were very hungry, and needed food right away. They discovered that they could simply wash the red dye out of the grain, and make bread directly from the wheat. Unfortunately, mercury cannot be washed out of wheat, or fish, or any other food source that becomes contaminated. When people ate bread made from this wheat, more than 6,000 people became ill and 1,000 died as a result of mercury poisoning.

Similar to what occurred in Japan, the children who were born to the women who had eaten the bread while pregnant suffered the worst, and most permanent, damage.

### What's New at Quicksilver Health Clinic?

- Flu shots are now available at the Quicksilver Health Clinic.
- Free check-ups for seniors every other Thursday, 9:00 - 11:00 a.m.
- Help celebrate Heart Healthy Month. Come in for a low cost cholesterol screening and heart disease evaluation.





# TOXIC TALES

## Student Handout #1

Name \_\_\_\_\_

Date \_\_\_\_\_



Student Handout

### What is the Globally Harmonized System for the Classification and Labeling of Chemicals?

The Globally Harmonized System (GHS) is a series of symbols that can communicate information about chemicals without using any words. The symbols provide information about a substance's physical, health and environmental hazards. The symbols can help keep people and the environment safe when dangerous substances are sold and transported across international borders.

The GHS uses a combination of symbols, colors, patterns and numbers to communicate specific information. Here are examples of some of the GHS symbols:



Harmful to aquatic life



May cause (brain, lung, kidney, etc.) damage through prolonged or repeated exposure



Causes severe skin burns and eye damage



Toxic if swallowed, inhaled, or in contact with skin



Flammable



Explosive



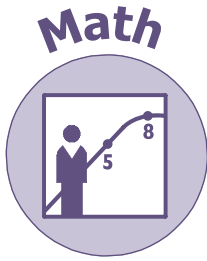
Danger

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### Design a New Label

The Globally Harmonized System can communicate important information to people who know how to read the code, such as scientists and firefighters. However, not everyone knows how to read the GHS symbols.

Can you design a label that can be understood by people from another country? First, read the Toxic Tales story about the people of Iraq who were poisoned from making bread from wheat seeds that had been treated with mercury. You are challenged to create a new label to go on the wheat seed packages. Your label needs to communicate that the seeds are safe for humans if planted but not safe to be eaten directly, even after washing. Your label can only use symbols, patterns, colors and numbers—no words. However, your label can include more than one symbol.



# Lesson One:

## MERCURY IN YOUR EVERYDAY LIFE

### Lesson Overview

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 Washington State.

This lesson addresses the following Washington State Essential Academic Learning Requirements (EALRs). The benchmarks listed are for grade 7 in mathematics.

In this lesson, the student is asked to:

- Clearly and effectively express or present ideas and situations using both everyday and mathematical language *such as models, tables, charts, graphs, written reflection, or algebraic notation*. (Mathematics 4.3).
- Demonstrate understanding of integers, fractions, decimals, percents, place value of decimals, and properties of the rational number system using pictures and symbols. (Mathematics 1.1 Number and Numeration).

### EALRs Addressed

### Teacher Background

As the **Quicksilver Question Web Module** demonstrates, gold mining is one way that mercury can contaminate the environment and endanger human health. In the town of Quicksilver, Washington, 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.

In Washington State, the Department of Ecology has estimated that currently about 3,800 to 5,000 pounds of mercury are released into Washington's environment each year from human sources within the state. Mercury pollution can come from mining operations, but it also comes from such everyday sources such as dentist offices, wastewater treatment centers, thermometers, fluorescent light tubes and so much more. Mercury discharged in the land, air or water can eventually end up in lakes, river 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 and P2 in the Northwest" in the Spring 2003 issue of *Pollution Prevention Northwest*.  
<http://www.pprc.org/pprc/pubs/newsletter/news0303.html>

#### Materials:

- Photocopies of **Student Handout #1** "Washington State Mercury Sources and Estimated Annual Discharges"
- Copies of Quicksilver document "Mercury and You"
- Optional: Computer Access

### Teacher Preparation

### Procedure

- 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 Washington State. What sources did students miss 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?  
***Other emissions (16.2%) and wastewater treatment plants (15.9%).***

***Other emissions 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 fertilizers that contain toxic waste, manure, gold mining, refineries, old computer parts, lab chemicals, old paint and steel mills that process auto parts.***

***Wastewater treatment plants use mercury as part of the chlorine production process. Each year, about 3,000 metric tons of mercury is used in outdated chlorine-production facilities that use a chlor-alkali process. As new processes are adopted, it is estimated that these plants will shut down in coming decades. Some activists and industry leaders suggest that when these plants shut down, the excess mercury should be placed in permanent storage facilities operated by the U.S. government, rather than sold or traded to other countries.***

- 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 (amalgams) 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. The Washington State Dental Association reported a study of San Francisco and Seattle waste treatment facilities showed that amalgams contribute 6-14% of the total mercury load in wastewater treatment plants. 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.***

- 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.*

**Student Assessment**



Student work can be assessed in the following ways, for a total of 100%.

10%	Did students participate in <b>brainstorming</b> a list of the sources of mercury pollution?
25%	Did students read the <i>Quicksilver</i> document “ <b>Mercury and You</b> ” and Student Handout #1?
40%	Did students correctly complete the <b>Data Table</b> , rounding the percentages to one decimal place?
15%	Did students complete the <b>Check Your Understanding</b> questions following the Data Table?
10%	Did students actively participate in a <b>classroom discussion</b> about how mercury gets into the environment and how people can reduce mercury contamination?



# The Quicksilver Question Web Module



Student Handout

## Mercury and You

*A public service brought to you by the Cascade County Department of Health*

People have always been exposed to mercury. Small amount of mercury are released into the air by volcanoes and by burning coal. Since mercury began to be mined hundreds of years ago, mercury has become a part of many common and useful items, such as thermometers and dental filling. Mercury that is released into the environment can pollute water supplies and contaminate the fish and seafood that we eat. This pamphlet was designed to teach you about some of the way you might be exposed to mercury, the possible effects of this exposure, and how to protect yourself and your family from mercury poisoning.

### What is mercury?

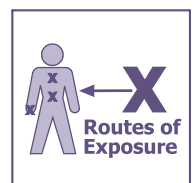
Mercury is also known by the nickname “quicksilver” and its chemical symbol, Hg. Mercury is an element with some special characteristics. Mercury is the only metal that is liquid at room temperature, forming silvery droplets that wobble and roll. Mercury can be harmful to people. Mercury can damage the brain, kidney and developing fetus.

There are three common form of mercury:

1. **Elemental Mercury**, also called metallic mercury, is the type of mercury you can see in old fever thermometers.
2. **Inorganic mercury** often occurs as salts. Historically, these inorganic salts were discovered to be the cause of mercury poisoning among hat-makers. The mercury salts were used to treat beaver skins for hats. The hat-makers became poisoned, creating the saying “mad as a hatter.”
3. **Methylmercury** is also called organic mercury. Microscopic organisms in water or soil that has been contaminated with inorganic mercury transform the mercury into another form, called methylmercury. Methylmercury can get into the bodies of fish and other seafood. If the level of methylmercury in the fish is high enough of people consume enough of it, they can become sick from eating the fish. In historic gold mining areas, oftentimes the soil and water is contaminated with elemental mercury, which can then change into inorganic mercury. This inorganic mercury is then transformed into methylmercury.

### Who is effected by mercury?

1. Mercury is dangerous for anyone exposed to it in large amounts.
2. Mercury is especially dangerous for fetuses and small children whose brains are still developing.
3. One in 12 pregnant women in the U.S. may have levels of mercury in their bodies that are potentially dangerous to their developing babies.





### How do we use mercury today?

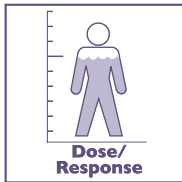
The common items listed below are sources of mercury exposure. Some of the items hold mercury within a glass or metal device. The mercury is only a health concern if the device breaks and released mercury vapors. Vapors from evaporating mercury are dangerous because a lot of the mercury can reach your brain. These items also need to be properly disposed of, not vacuumed or thrown in the garbage.

- Light switches
- Thermostats
- Fluorescent light bulbs
- Some types of thermometers
- Some types of blood pressure devices
- Mercury mixed with silver and other minerals is used in silver-colored dental fillings

Mercury is also an ingredient in thimerosal, a preservative in some vaccines. Recently the amount of thimerosal used in vaccines has been decreased due to concerns about the possible health risks of mercury. More research is being done to determine whether thimerosal should be eliminated from use in vaccines entirely.

### What happens when you are exposed to mercury?

Mercury tends to build up in our bodies over time. If you are exposed to small amounts of mercury, your body can get rid of these small amounts in our feces and urine. If you consume more mercury than your body is able to get rid of, high amounts of mercury can build up in your body.



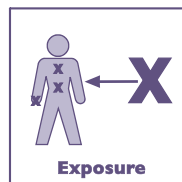
### How can mercury affect your health?

1. If you are under 18 years old:
  - Your nerves and brain may still be forming, so you could experience neurological problems like decreased IQ and slowed reflexes.
2. If you are a pregnant woman:
  - You could affect the development of your baby's brain and nervous system by being exposed to small doses of mercury.
3. People exposed to significant amount of methylmercury in fish may experience:
  - Irritability, shyness, tremors, changes in vision, or hearing and memory problems.



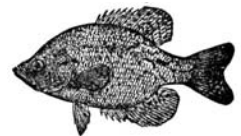
### How do you know if you've been exposed to mercury?

1. Hair sample tests can determine the amount of mercury exposure. However, such tests must be done by a qualified medical laboratory.
2. Blood or urine tests can be done to determine the amount of mercury vapor exposure.



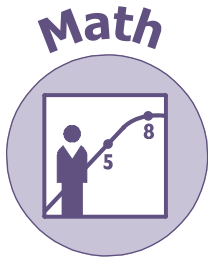
### Should I eat fish?

Eating fish helps keep your heart healthy. Fish are low in fat and high in protein. However, some lakes, rivers and streams may be contaminated with mercury. Fish caught in these locations may be harmful to your health, especially for children and pregnant women.



Unlike some other types of contaminants, mercury cannot be removed by cooking the fish or through proper cleaning. It is therefore important to pay attention to posted fishing advisories. Depending on the advisor you may want to limit the amount of fish you eat, or avoid eating fish altogether from locations with these advisories.





# MERCURY IN YOUR EVERYDAY LIFE

## Student Handout #1

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

**Washington State Mercury Sources and Estimated Annual Discharges (in pounds), 2003**

MERCURY SOURCES	MERCURY IN POUNDS	PERCENT OF TOTAL
Fluorescent light tubes	505	<b>10.6</b>
Thermostats	412	<b>8.6</b>
Dental fillings	404	<b>8.4</b>
Automotive switches	253	<b>5.3</b>
Thermometers	300	<b>6.3</b>
Button cell batteries	88	<b>1.8</b>
Power generation (coal plants or industry)	436	<b>9.1</b>
Manufacturing	337	<b>7.0</b>
Wastewater treatment plants	762	<b>15.9</b>
Fuel combustion (vehicle emissions)	331	<b>6.9</b>
Crematoria (from cremating people who had dental fillings)	57	<b>1.3</b>
Waste incineration	124	<b>2.6</b>
Other emissions	777	<b>16.2</b>
<b>TOTAL</b>	<b>4786</b>	<b>100%</b>

From "Mercury and P2 in the Northwest," *Pollution Prevention Northwest*, Spring 2003. Some of the figures were given as ranges; for the purpose of this activity, the highest number were chosen. The data range includes a total of between 3,800 and 5,000 pounds discharged annually.

### Check Your Understanding

1. Based on the estimated amount of mercury that is discharged each year, how much mercury is discharged each day in Washington State?

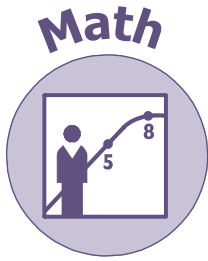
$$4786 / 365 \text{ days} = 13.1$$

**Answer: 13.1 lbs per day**

2. How much mercury would be discharged in Washington State in a decade, if everything stayed the same?

$$4786 \times 10 \text{ years}$$

**Answer: 47,860 lbs per decade**



# MERCURY IN YOUR EVERYDAY LIFE

## Student Handout #1



Student Handout

Name \_\_\_\_\_

Date \_\_\_\_\_

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

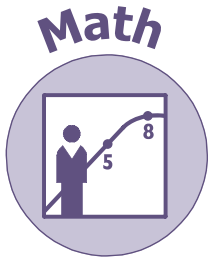
**Washington State Mercury Sources and Estimated Annual Discharges (in pounds), 2003**

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### Check Your Understanding

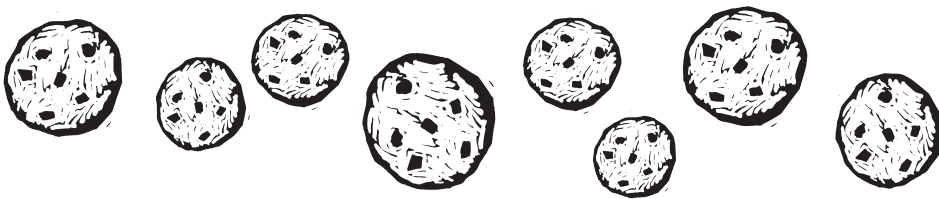
1. Based on the estimated amount of mercury that is discharged each year, how much mercury is discharged each day in Washington State?
2. How much mercury would be discharged in Washington State in a decade, if everything stayed the same?



## 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.



This lesson addresses the following Washington State Essential Academic Learning Requirements (EALRs). The benchmarks listed are for grade 7 in mathematics.

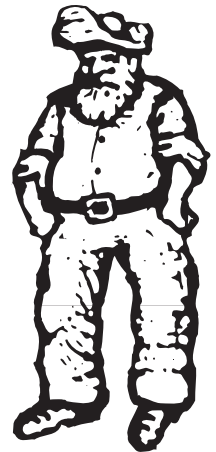
In this lesson, the student is asked to:

- Recognize the widespread use of mathematics in daily life and the extensive use of mathematics outside the classroom, *for example, in banking or sports statistic.* (Mathematics 5.3).

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>

### Lesson Overview



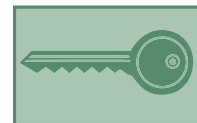
### EALRs Addressed

### Lesson Plan Links





# Mercury in your Health & Fitness Curriculum



## Why is mercury an important topic for the Health & Fitness curriculum?

The most important environmental health topics to share with students are those that have a direct impact on them and the things that they have control over in their lives. By being aware of an environmental health issue in their own community, students can become empowered with that knowledge to reduce their personal risks and lessen their opportunities to come in contact with the hazard.



Many recent news stories have focused on the risks associated with eating certain types of fish that may be contaminated with mercury. While fish and seafood can be a significant source of exposure, mercury can be found in many household and consumer products, as well as in air, water and soil. With an understanding of the sources of mercury poisoning and the main routes of exposure, students can learn how to protect themselves and their family members from this health hazard.

The topic of mercury has links to content already covered in the Health & Fitness curriculum. In addition, the topic of mercury offers many opportunities for exploring the issue from multiple angles and connecting the content to other disciplines.

The *Quicksilver Question Web Module* provides extension lesson plans, activities and resources to introduce the concept of mercury to your students. By using these resources, mercury can be taught in the context of:

- Diseases and disorders
- Growth and development
- Environmental health
- Air, water and soil pollution
- Nutrition and food safety
- Community health
- Occupational exposure

## What is Environmental Health?

Your health depends on the environment around you. Environmental health is how the environment affects human health. Every day, you come in contact with things in your environment that can help you or hurt you. While mercury is naturally occurring, people come in contact with mercury from a variety of human-made sources.

## What is mercury?

Mercury is also known by the nickname “quicksilver” and its chemical symbol, Hg. Mercury is an element with some special characteristics. Mercury is the only metal that is liquid at room temperature, forming silvery droplets that wobble and roll. Mercury can be harmful to people. Mercury can damage the brain, kidneys and developing fetus.

People have always been exposed to mercury. Small amounts of mercury are released into the air by volcanoes and by burning coal. Due to its natural properties, mercury has become a part of many common and useful items, such as thermometers and

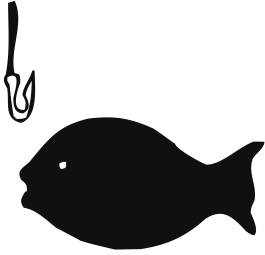
dental fillings. Mercury that is released into the environment can pollute water supplies and contaminate the fish and seafood that we eat.

There are three common forms of mercury:

1. **Elemental mercury**, also called metallic mercury, is the type of mercury you can see in old fever thermometers.

2. **Inorganic mercury** often occurs as salts. Historically, these inorganic salts were discovered to be the cause of mercury poisoning among hat-makers. The mercury salts were used to treat beaver skins for hats. The hat-makers became poisoned, creating the saying “mad as a hatter.”

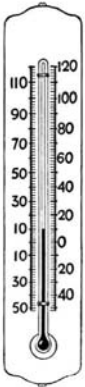
3. **Methylmercury** is also called organic mercury. Microscopic organisms in water or soil that has been contaminated with inorganic mercury transform the mercury into another form, called methylmercury. Methylmercury can get into the bodies of fish and other seafood. If the level of methylmercury in the fish is high enough or people consume enough of it, they can become sick from eating the fish. In historic gold mining areas, oftentimes the soil and water is contaminated with elemental mercury, which can then change into inorganic mercury. This inorganic mercury is then transformed into methylmercury.



### What are the sources of mercury in our everyday environment?

Some of the common items listed below hold mercury within a glass or metal device. The mercury is only a health concern if the device breaks and releases mercury vapors. These items also need to be properly disposed of, not vacuumed or thrown in the garbage.

- Light switches
- Thermostats
- Fluorescent light bulbs
- Some types of thermometers
- Some types of blood pressure devices
- Mercury mixed with silver and other minerals used in silver-colored dental fillings
- Thimerosal, a preservative used in some vaccines.



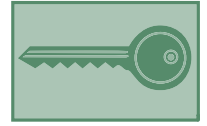
### What happens when you are exposed to mercury?

Mercury tends to build up in our bodies over time. A child’s nervous system and brain may still be forming, so exposure to mercury may cause neurological problems like decreased IQ and slowed reflexes. If a pregnant woman is exposed to even small doses of mercury, her baby’s brain and nervous system may be impacted. Adults who have significant exposure to mercury may experience irritability, shyness, tremors, changes in vision, or hearing and memory problems.





# Mercury Activities for the Health & Fitness Teacher



## Overview

This section provides lesson plans, activity ideas and resources for the Health & Fitness teacher. The topic of “environmental health and mercury” has natural connections to the Health & Fitness curriculum. Many of the lesson plans in the *Quicksilver Question Web Module*, while focused on science, math, language arts, and social studies content, are also relevant to the Health & Fitness curriculum. Through the lens of Health & Fitness, EALRs in reading, writing, math, science, and social studies can also be addressed.

The “What is Environmental Health?” Student Reading introduces key environmental health concepts and vocabulary.

The lesson plans and activity ideas in this section focus mainly on the following Washington State Essential Academic Learning Requirements for Health & Fitness:

- Recognize patterns of growth and development (2.1).
- Understand the concept of control and prevention of disease (2.2).
- Acquire skills to live safely and reduce health risks (2.3).
- Understand how environmental factors affect one’s health (air, water, noise, chemicals) (3.1).
- Gather and analyze health information (3.2).
- Use social skills to promote health and safety in a variety of settings (3.3).



## Diseases & Disorders; Growth & Development

### What is Environmental Health?

*Quicksilver Question Web Module*

This reading provides students with the background knowledge they need about environmental health and mercury poisoning before proceeding with other activities or lessons. (Quicksilver Student Introduction).

**Suggested Grade Levels:** 6-8

**Topics:** Mercury, environmental health

**Subject Links:** Health, science, reading, writing

## Nutrition and Food Safety

### Up the Food Chain

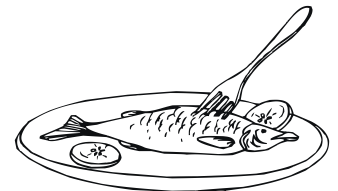
*Quicksilver Question Web Module*

In the Quicksilver Question Web Module, students learn that mercury moves up through aquatic food chains and can contaminate fish species that humans often eat. In this lesson, students play two simulation games to understand how biomagnification and bioaccumulation of mercury can affect aquatic ecosystems, and harm people who eat seafood. Both fast-paced running games require either an outdoor playing field or a gymnasium. (Quicksilver Science Lesson One).

**Suggested Grade Levels:** 6-8

**Topics:** Mercury, nutrition, food chain, pollution, aquatic ecosystems

**Subject Links:** Health, fitness, nutrition, science, environmental science



## Health Advisory

### *Quicksilver Question Web Module*

In the Quicksilver Question Web Module, students help post a health advisory at the local lake to warn residents not to eat certain fish species that may be contaminated with mercury. Challenge students to research your local water bodies and determine if any health advisories have been issued for fish in these areas. The Washington State Department of Health, the Washington State Department of Fish and Wildlife, and the Washington State Department of Ecology, as well as your county public health agency and natural resources agency, may be able to provide information on local fish advisories. In addition, information on national advisories for tuna can be obtained from the US Environmental Protection Agency and the US Food and Drug Administration. Students can investigate the methods in which these agencies communicate health information to different communities. In particular, students can examine how cultural and language differences are taken into consideration. (Quicksilver Science Lesson One extension activity).

**Suggested Grade Levels:** 6-8

**Topics:** Mercury, nutrition, health communication

**Subject Links:** Health, nutrition, communication

## Community Health and Mercury

### The Mercury Message

#### *Quicksilver Question Web Module*

In the Quicksilver Question Web Module, students learn about a group of teenagers who accidentally contaminated their town with mercury. In this activity, students respond to the Quicksilver Gazette article, “Arkansas Teens Poison Town with Mercury.” Students have the opportunity to send a persuasive letter that can travel back in time, reaching the Arkansas teenagers the day before they discover an abandoned barrel of mercury. In the letter, students warn the teens about the dangers of mercury to human health and the environment. (Quicksilver Language Arts Lesson One).

**Suggested Grade Levels:** 7-8

**Topics:** Mercury, persuasive writing, letter writing

**Subject Links:** Health, reading, writing

### Toxic Tales

#### *Quicksilver Question Web Module*

In the Quicksilver Question Web Module, students learn about a case of large-scale mercury poisoning in Iraq. This activity relates to the reading, “Toxic Tales,” about the poisoning in Iraq caused by eating imported wheat seeds treated with a mercury-based fungicide. In this activity, students learn about the importance of effective health communication in consideration of cultural and language challenges. Students discuss the use of symbols as a form of communication both through history and in our daily lives. They also learn about the international system of symbols for hazardous chemicals. Students are challenged to design a label that could have been used to warn the Iraqi people that the wheat seeds should not be eaten. (Quicksilver Language Arts Lesson Two).

**Suggested Grade Levels:** 6-7

**Topics:** Mercury, health communication, symbols, cultural assumptions

**Subject Links:** Health, reading, communication



## Mercury in Your Everyday Life

### *Quicksilver Question Web Module*

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 Washington State. Students discuss possible impacts on air, water, soil and human health. (Quicksilver Math Lesson One).

**Suggested Grade Levels:** 6-7\

**Topics:** Mercury, reading data tables, calculating percentages

**Subject Links:** Health, math

## Mercury in Schools

### *Quicksilver Question Web Module*

In many school science labs, forgotten containers of mercury can be found in the dark corners of chemical cabinets. Oftentimes, mercury can be found in unlabeled or leaking containers. Many schools still have mercury thermometers in the science lab and nurse's office. A mercury spill at school can cost tens of thousands of dollars in cleanup costs, close school doors for months, and threaten the health of students and school staff. Challenge students to research instances of mercury spills in schools around the country, and propose solutions for their own school district. Students can write persuasive papers, letters or create oral presentations based on their findings. (Quicksilver Language Arts Lesson One extension activity).

**Suggested Grade Levels:** 6-8

**Topics:** Mercury, research, persuasive writing

**Subject Links:** Health, writing, communication

## Mercury Awareness

### *Quicksilver Question Web Module*

Students are challenged to prepare a mercury awareness advertisement or commercial for use in Washington. The ad or commercial should include a description of how people can come into contact with mercury, how mercury poisoning is treated, and how it can be prevented. The campaign should be visually appealing and make people want to learn more. (Quicksilver Language Arts Lesson One extension activity).

**Suggested Grade Levels:** 6-8

**Topics:** Mercury, media studies

**Subject Links:** Health, writing, media studies

## Occupational Exposure to Mercury

### Expedition Medicine

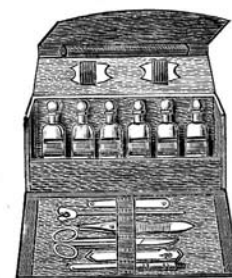
#### *Quicksilver Question Web Module*

In the Quicksilver Question Web Module, students learn about the connection between mercury and the Lewis and Clark Expedition. This activity relates to the Quicksilver Gazette article, "Poop Helps Scientists Trace Path of Historic Lewis and Clark Expedition." Students learn about the state of medical knowledge during the time of the Lewis and Clark Expedition. They develop a list of medicines and medical equipment to bring on an arduous wilderness journey, then compare their lists to a list of items compiled by Meriwether Lewis for his famous expedition. (Quicksilver Social Studies Lesson One).

**Suggested Grade Levels:** 7-8

**Topics:** Mercury, Lewis and Clark Expedition, US history, medical knowledge

**Subject Links:** Health, US history, reading



## Gold Mining in South America

### Quicksilver Question Web Module

In this activity, students learn how artisanal gold mining operations in South America can impact children's health. This activity connects to the Quicksilver Gazette article that explains how children in the Brazilian Amazon Basin in South America are being poisoned from nearby small-scale gold mining operations that use mercury in the extraction process. Then, students create a map that illustrates the distribution of artisanal gold mining operations across South America. Students use their maps to guide a discussion about the connections between artisanal gold mining, poverty and unemployment rates. Students also develop ideas for ways to make artisanal gold mining safer. (Quicksilver Social Studies Lesson Two).

**Suggested Grade Levels:** 6-7

**Topics:** Mercury, South America, geography, mapping skills, environmental justice

**Subject Links:** Health, geography, reading





# Mercury Resources for Health & Fitness Teachers



## Mercury Statistics and Facts

- According to EPA's *1999 National Emissions Inventory*, coal-fired electric power plants are the largest source of human-caused mercury air emissions in the United States (40%). Other large sources are industrial boilers (about 10% of U.S. mercury emissions), burning hazardous waste (about 5%), and chlorine production (also about 5%).

(Environmental Protection Agency. Frequent Questions about Mercury. Available at: <http://www.epa.gov/mercury/faq.htm#14>. Updated April 2005.)

- It is estimated that 3,800 - 5,000 pounds of mercury is emitted into the environment annually in Washington State.

(Pacific Northwest Pollution Prevention Resource Center. Mercury and P2 in the Northwest. *Pollution Prevention Northwest*. Spring 2003. Available at: <http://www.pprc.org/pubs/newsletter/news0303.html>.)

- According to The National Research Council's 2000 report on the toxicological effects of methylmercury, the offspring of women who consume large amounts of fish and seafood are at the highest risk of mercury exposure. The report estimated that more than 60,000 children are born each year at risk for adverse neurodevelopmental effects due to in utero exposure to methylmercury from the mother's consumption of fish and seafood.

(US Geological Survey. *Mercury in the Environment*. Fact Sheet 146-00, October 2000. Available at: <http://www.usgs.gov/themes/factsheet/146-00/>.)

- Forty States have issued fish advisories for methylmercury on selected waterbodies. Thirteen states have statewide advisories for fish from some rivers or lakes. Coastal areas along the Gulf of Mexico, Maine, and the Atlantic Ocean from Florida through North Carolina are also under advisories for certain fish.

(US Geological Survey. *Mercury in the Environment*. Fact Sheet 146-00, October 2000. Available at: <http://www.usgs.gov/themes/factsheet/146-00/>.)



## General Mercury Information



### “Mercury and P2 in the Environment.”

*Pollution Prevention Northwest*. Spring 2003.  
<http://www.pprc.org/pubs/newsletter/news0303.html>

### ToxFAQs for Mercury

From the Agency for Toxic Substances and Disease Registry (ATSDR).  
Also available in Spanish.  
<http://www.atsdr.cdc.gov/tfacts46.html>

### U.S. Environmental Protections Agency Mercury Information.

<http://www.epa.gov/mercury/>

### **EPA Mercury Laws and Regulations**

<http://www.epa.gov/mercury/regs.htm>

### **Mercury in the Environment**

U.S. Geological Survey Fact Sheet.

<http://www.usgs.gov/themes/factsheet/146-00/>

### **What You Need to Know about Mercury Kid's Page.**

U.S. Environmental Protection Agency.

[http://www.epa.gov/superfund/kids/sup\\_fact/mercury1.htm](http://www.epa.gov/superfund/kids/sup_fact/mercury1.htm)

### **Mercury Risk Assessment**

<http://www1.umn.edu/eoh/hazards/hazardssite/mercury/mercriskassess.html>

### **Environmental Health Perspectives: Measuring Mercury**

<http://ehp.niehs.nih.gov/docs/1996/104-8/focus.html>

### **NIEHS: Mercury Information**

<http://cerhr.niehs.nih.gov/genpub/topics/mercury.html>

### **Radio Segment: Mercury and the Environment**

5/24/05 A Marketplace radio story about the use of mercury in chlorine production factories and the problems with fugitive mercury emissions.

<http://marketplace.publicradio.org/shows/2005/05/24/PM200505244.html>

### **Radio Segment: Alabama Town's Streets Laden with Mercury**

3/27/05 A radio segment about the people of McIntosh, Ala., who recently learned that their streets are paved with mercury. It seems someone paved those streets with a compound that included a byproduct of chlorine production at a nearby chemical plant.

<http://www.npr.org/templates/story/story.php?storyId=4563159>

### **Radio Segment: A Look at Mercury Pollution**

3/11/05 A new study finds widespread mercury pollution in the Northeast -- in amounts greater than expected, as well as in some unexpected locations, including fish and songbirds. This radio segment focuses on the mercury pollution, which is largely attributed to Midwestern power plant emissions.

<http://www.npr.org/templates/story/story.php?storyId=4531481>



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## **Mercury Spills in Schools**

### **Mercury in Schools Program**

<http://www.mercuryinschools.uwex.edu/>

### **King County's Rehab the Lab Program**

<http://www.govlink.org/hazwaste/schoolyouth/rehab/>

## **National Alert: A Warning about Continuing Patterns of Metallic**

<http://www.atsdr.cdc.gov/alerts/970626.html>

## **Mercury Exposure**

<http://www.atsdr.cdc.gov/alerts/970626.html>

## **EPA Mercury in Schools Case Studies**

<http://www.epa.gov/mercury/casestudies.htm>

## **EPA Mercury in Schools Information**

<http://www.epa.gov/mercury/schools.htm>

## **Mercury Spill Sends Pupils to Shower**

*10/16/91 Seattle Times*

<http://seattlepi.nwsource.com/archives/1991/91110160076.asp>

## **Mercury Spill Students were not Exposed to Serious Health Threat**

*11/4/91 Seattle Times*

<http://seattlepi.nwsource.com/archives/1991/9111040020.asp>

## **Mercury Spill Shuts Detroit School**

*5/11/00 Detroit Free Press*

[http://www.freep.com/news/locway/spill9\\_20000509.htm](http://www.freep.com/news/locway/spill9_20000509.htm)

## **Cleanup of Mercury at Junior High**

*4/1/03 Connecticut Department of Environmental Protection*

<http://dep.state.ct.us/whatshap/press/2003/mf0401.htm>

## **Mercury Scare Worries Metro School Officials**

*5/24/00 Detroit News*

<http://www.detnews.com/2000/schools/0005/24/c01-62308.htm>

## **Wisconsin School Spills**

*Wisconsin Department of Natural Resources*

<http://www.dnr.state.wi.us/org/caer/cea/mercury/schoolspills.htm>

## **Mercury Contamination Plagues D.C. Schools**

3/8/05 This radio segment focuses on a team from the Environmental Protection Agency who undertakes the difficult task of cleaning up spilled mercury at Cardozo High School in Washington, D.C. Many cases of mercury spills are intentional, and officials are trying to find alternatives to prevent “toxic vandalism” and access to mercury in schools.

<http://www.npr.org/templates/story/story.php?storyId=4526345>



## Mercury In Fish

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### **National Fish Consumption Advisories**

*U.S. Environmental Protection Agency*  
<http://www.epa.gov/mercury/advisories.htm>

### **“Mercury Contamination of Aquatic Ecosystems.”**

*U.S. Geological Survey Fact Sheet, FS-216-95*  
<http://wi.water.usgs.gov/pubs/FS-216-95/>

### **FDA Advisories on Fish and Mercury.**

<http://www.cfsan.fda.gov/~lrd/pestadd.html#metals>

### **“Fish and Shellfish Consumption Advisories in Washington State Due to Chemical Contamination.”**

*Washington State Department of Health*

Includes advisories specific to mercury for Eagle Harbor, Lake Roosevelt, Lake Whatcom, Sinclair Inlet and the Duwamish River.

[http://www.doh.wa.gov/ehp/oehas/EHA\\_fish\\_adv.htm](http://www.doh.wa.gov/ehp/oehas/EHA_fish_adv.htm)

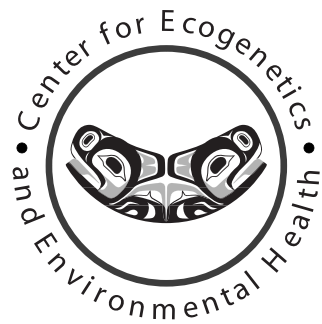
### **Commentary: Risky Food**

1/22/04 From mad cow to mercury poisoning, it's hard to tell what's safe to eat from one moment to the next. Commentator David Ropeik, communications director at the Harvard Center for Risk Analysis, advises weighing the risks and benefits before ruling out potentially healthy foods.

<http://www.npr.org/templates/story/story.php?storyId=1611069>







These materials were developed by the Integrated Environmental Health Middle School Project (NIEHS Grant #ES10738 and #ES07033) at the University of Washington, Seattle.

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