

The Environmental Impact of Mining



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Standards

Module Overview

- Lesson 1 The Effects of Mercury on Humans**
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Worksheet
Answer Sheet
Puzzle
- Lesson 2 Mercury in the Food Chain**
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Worksheet
Answer Sheet
Flow Chart
- Lesson 3 The Environmental Impact of Historic Mining**
Lesson Plan
Video Worksheet
Answer Sheet
- Lesson 4 The History of the Comstock Mines**
Lesson Plan
Website Worksheet
Answer Sheet
- Case Study Pau-Wa-Lu**
PowerPoint Presentation

Performance Objective:

- Group Debate**
- Mercury Poisoning Assessment Test**
- Mercury Poisoning Answer Sheet**

Teaching and Learning Experiences Mapped to Standards

Health effects of mercury	<p>13.8.5 Investigate and describe some changes that are reversible and some that are not.</p> <p>16.8.5 Describe how unintended consequences of technologies can cause resource depletion and environmental degradation, but technology can also increase resource availability, mitigate environmental degradation, and make new resources economical.</p> <p>20.8.5 Use a systematic approach for thinking critically about risks and benefits.</p>
Comstock mining history and environmental impact	<p>13.8.5 Investigate and describe some changes that are reversible and some that are not.</p> <p>16.8.5 Describe how unintended consequences of technologies can cause resource depletion and environmental degradation, but technology can also increase resource availability, mitigate environmental degradation, and make new resources economical.</p> <p>17.8.3 Evaluate how changes in environments can be beneficial or harmful</p>
Stream flow mapping	<p>11.8.2 Compare a variety of map types and locate Nevada and Nevada features on each.</p> <p>20.8.2 Use a model to predict change.</p>

Module Overview - Mercury

Topic: The environmental impact of the Carson River Mercury Site

Overarching Understandings:

Students will learn how mercury contamination has effected the environment along the Carson River.

Objectives:

1. Students will identify the locations of some of the superfund (mercury contaminated) sites along the Carson River.
2. Students will identify the effects of mercury contamination on wildlife and humans.
3. Students will trace the source of mercury contamination throughout the food chain.

Assessment

Performance Tasks, Projects:

Students will be expert groups. They will be given packets of information that relate to their topic. They will prepare a presentation and worksheet/information sheets for the other students to use as they present their information.

Presentations by expert groups:

1. Mapping of the sites
2. Questions about mercury and how it affects humans
3. Posters showing the effects of mercury on wildlife and humans
4. Poster tracing mercury through the food chain

Quizzes, tests, academic prompts:

- Test
- Critical thinking worksheets

Other evidence:

Debate between groups: mining interests, prospectors vs. environmental groups

Key Elements students will need to know:

1. Students will need to know the sites of contamination along the Carson River
2. Students will need to know the effects of mercury contamination on wildlife and humans.
3. Students will need to know how mercury affects the food chain.

Key skills the students will need to be able to do:

1. Students will need to be able to make a map of the contaminated sites.
2. Students will need to be able to list the effects of mercury contamination on wildlife and humans.
3. Students will need to be able to trace mercury through the food chain.

**Lesson Plan #1 -
The Effects of Mercury Contamination on Humans**

Lesson Goal:

Students will learn about the effects of mercury poisoning on humans.

Concepts to be developed:

All forms of mercury can be toxic to humans.

Skills to be developed:

1. Authentic research skills.
2. Reasoning skills.
3. Graph-reading skills.
4. Computer skills.
5. Critical thinking skills.

Objectives:

1. List the types of mercury.
2. Identify characteristics of each type of mercury.
3. Identify and list the effects of mercury on humans.

Materials:

1. Packets of information sheets from web sites, the newspaper, and OSHA fact sheets for expert groups (standard group)
2. Overheads with questions and diagrams (standard group)
Questions on PowerPoint (technology enhanced)
3. Poster paper
4. Markers, rulers
5. Computer – (technology enhanced)
6. Projector – (technology enhanced)
7. Internet if available or web whacker with web site loaded –
see attached page (technology enhanced)
8. Puzzle
9. Internet permission slips (verify) (technology enhanced)
10. PowerPoint Presentation (technology enhanced)

Safety Precautions

Technology Enhanced

Supervise use of Internet

Secure computer, projector and cords

Procedure -

Foundation:

The Carson River near the old Comstock area has been declared a Superfund Site due to mercury contamination. People can be affected by mercury contamination through contact with waterways, sediments, fish and wildlife. Children who come into direct contact with highly contaminated soils found in tailing piles or at former mill sites from mines are at the greatest risk. Families are also at risk by eating fish and wildlife caught at contaminated sites. This unit's focus is to inform students, through an environmental education unit, about the properties of mercury, what the effects of mercury contamination are to humans and wildlife and how mercury can be passed through the food chain. It also advises students of the location of the superfund site as they trace the sources of contamination.

Concept Development

1. A PowerPoint Presentation will be given as an overview of the effects of mercury. Teacher led discussion during presentation.
2. Students will be placed in expert groups to research and answer specific questions about mercury using the worksheet Mercury Poisoning. Students will use packet from web sites (standard group) or actual web sites to obtain information (technology enhanced). (See sheet for technology enhanced.)
3. Each group will make a diagram or poster to illustrate their information.
4. Groups will share their information, in order of the worksheet questions.
5. Students will complete a puzzle about mercury poisoning while teacher conferences with each group about their grade.

Technology Integration Component (See attached sheet for web sites)

Students will use websites to research questions.

Students will use links to access vocabulary and additional information.

The computer and projector will be used to present information to the large group.

The overhead or computer will be used for questions.

A PowerPoint presentation will be used as an overview and to stimulate discussion.

Evaluation

Student's research and answers will be used for evaluation for this lesson.

Group posters or diagrams will be used to evaluate conceptual understanding of the question.

A test will be given at the conclusion of the unit.

Attachments -

Handouts:

Packets for expert groups showing the effects of mercury poisoning or access to web sites

Worksheet-Mercury Poisoning

Sheet showing web sites

Puzzle

Group assignment sheet

**Group Instructions -
The Effects of Mercury Contamination on Humans**

Technology Enhanced

1. A PowerPoint presentation will be shown.
2. Each group will fill out their question worksheets from the group assignment sheet using these web sites.
3. Each group will define words using the interactive vocabulary at each web site. Definitions are to be placed in their journals.

<http://danpatch.ecn.purdue.edu/~epados/mercbuild/src/poison.htm> - What is Mercury Poisoning

www.mercurypoisoningfyi.com/mercury_poisoning_exposure.html - Mercury PoisoningFYI.com - Do You Suffer From Mercury Poisoning?

www.lirpdic.org/mercurypoisoning.htm - Mercury Poisoning - Long Island Regional Poison & Drug Information Center

Standard Instruction

1. Information about the health effects of mercury will be given orally and visually using the overhead.
2. Print out copies of above web sites. Give each group one packet and assign questions on assignment sheet for groups.
3. Each group will share their questions and answers information with the class and present their posters.
4. Write out definitions on the board or overhead, have students copy in their journals.

Worksheet

Name _____
Date _____
Period _____

Mercury Poisoning - Lesson # 1

1. What is mercury?

2. List facts about the forms of mercury:

Elemental

Inorganic

Organic

2. What are the harmful effects to humans from mercury?

Elemental

Inorganic

Organic

3. Which type of mercury is the most likely to cause adverse health because of its tendency to build up within the body?

4. Describe symptoms of the types of mercury poisoning:

Acute

Chronic

Other

5. Who is at risk from mercury exposure?

6. How are humans exposed to Mercury?

1.

2.

3.

Mercury Poisoning - Lesson # 1

1. What is mercury?

Mercury is a heavy silver-white metallic element; liquid at room temperature that is a neurotoxin. It is a common substance found in nature and used as a raw material is used in many industries.

2. List facts about the forms of mercury:

Elemental

Used in thermometers, barometers, button batteries, dental amalgam, paints, electrical equipment, gold mining and ore extractions. It can be dangerous if inhaled.

Inorganic

Was used as a teething powder, laxative and ammoniated mercury ointments, disinfectants, explosive and stool specimen preservatives. Mercury is part of a compound with other elements (chlorine, oxygen, or sulfur). It is usually found in powdered form.

Organic

Used in pesticides and fungicides, by embalmers, as wood preservatives, as antiseptics, vaccines as a preservative, Asian medicines and is in the food chain from industrial runoff. Organic mercury compounds are often produced by microorganisms in the soil or in water. Methyl mercury is often found in fish.

2. What are the harmful effects to humans from mercury?

Elemental

Inhalation causes irritation of the eyes and skin, coughing, weakness, fever, and upset stomach. Can lead to brain and nerve damage. It is the purest form of mercury and can be dangerous to breath if it evaporates.

Inorganic

Has similar effects as elemental exposure. Can also cause kidney damage and Acrodynia, primarily seen in infants and young children. Symptoms include profuse sweating, skin rash, painful, pink/red palms or soles, poor muscle tone, fever and irregular heart rhythms.

Organic

Skin irritation and burns. Can cause brain and nerve damage as well as confusion, delirium, memory loss, slurred speech, hallucinations, coma and death. It forms a compound with carbon and is called methymercury. Methylmercury is often found in fish. Builds up in the body through bioaccumulation.

3. Which type of mercury is the most likely to cause adverse health because of its tendency to build up within the body?

Organic is the most likely to cause adverse health.

4. Describe symptoms of the types of mercury poisoning:

Acute

Cough, chest tightness, trouble with breathing, and upset stomach. Pneumonia can develop which can be fatal.

Chronic

1. Gingivitis - gums become soft and spongy, teeth get loose, sores may develop, and there may be increased salivation.
2. Mood and mental changes
3. Nerve damage

Other

Mercury can cause kidney damage, which includes increased protein in the urine and may result in kidney failure at high dose exposure. Mercury has been known to affect the development of prenatal life and infants. Skin allergies may develop with repeated exposure causing rash and itching. Exposure to mercury vapor can cause the lens of the eye to discolor; some of the inorganic mercury compounds can cause burns or severe irritation of the skin and eyes on contact.

5. Who is at risk from mercury exposure?

Developing fetuses, premature babies, infants and young children, adults and wildlife.

6. How are humans exposed to mercury?

1. Inhaled
2. Through the food chain, eating fish or wildlife
3. Direct skin contact

Mercury Contamination



H W R I X S E Q P C C S W Q F I N O P S
D H Q O J W N O L I I U F X D W I C V S
K E X P F T L Q N N J B H R O Q X K R W
P H T C H L W A N O P S P N Q Q O P E T
B O K A U A G W Y R Q T U F T H T G T O
A W I T N R R R Y H D A Y M G C O S K T
X N E S O I U M N C X N D E S E R A Q K
K D J N O C M E F F E C T S C R U M S L
A S I W R N O A C U D E S O P X E P Q V
D F I E J O I P T I L E L E M E N T A L
V Q M R A J A N H N N C I X O T R F T E
E T P C U X N V G V O A U F D D P T U M
R O U U Y M O E F A L C G K V A Y W D N
S T K O W Z F V G R C U W R L V I E Z H
E F Y R O N C N L C X O C U O D F C F W

ACUTE
CONTAMINATED
EXPOSED
MERCURY
POISONING
SUBSTANCE

ADVERSE
EFFECTS
HARMFUL
NEUROTOXIN
POLLUTED
TOXIC

CHRONIC
ELEMENTAL
INORGANIC
ORGANIC
RISK

- 5.7.2 Explain a specific constraint on a physical environment that impacts human activity.
- 5.8.2 Compare and contrast the opportunities and constraints that the physical environment places on human activity.
- 5.12.2 Constraints of the Physical Environment Evaluate strategies to respond to constraints placed on human systems by the physical environment.

Objective 2: Learn about and describe the variety of plants that grow in the Carson River Watershed to support many wildlife species.

Identify three plants found in rangeland, riparian or forest habitats. Explain similarities and differences in their use and identify living species that thrive on these different habitats. What is the name of the habitat type that is found in the lower end of the watershed that is very dry or salty.

Big sagebrush habitat

Riparian habitat

Salt desert shrub habitat

High mountain habitat

- 2c. Vegetation along the river channel helps to make water cleaner by . . .
(circle all that apply) Holding the soil in place Filtering and taking up pollutants
Cooling the water Scrubbing the water

Grade 8

Environmental Science—*Students will demonstrate an understanding that ecosystems display patterns of organization, change, and stability as a result of the interactions and interdependencies among the life forms and the physical components of the Earth.*

- 15.8.1 Ecosystems: Stability and Change in Ecosystems. Investigate and describe how living and non-living components of ecosystems interact in various ways.

Objective 3: Describe (understand) how historical and present environmental impacts have resulted in the present landscape of Carson River watershed.

Grades 8-12

Earth & Space Science—*Students understand that the Earth is composed of interrelated systems of rocks, water, air, and life.*

- 10.8.2 Earth Structures and Composition. (Landforms) Investigate and describe how the combination of constructive and destructive forces result in the formation of landforms.

Geography: Human Systems—*Students understand how economic, political, and cultural processes interact to shape patterns of human migration and settlement, influence and interdependence, and conflict and cooperation.*

- 4.8.2 Migration and Settlement. Define the reasons for human migration and settlement and explain the effects on places and cultures.
- 4.12.2 Evaluate the impact of migration and settlement on physical and human systems.

Objective 4: Identify the mountain ranges that surround portions of the Carson River.

Circle all that apply.

- Cascade Mountain Range
- Sierra Nevada Range
- Pinenut Mountains
- Rocky Mountains
- Virginia Range
- Dead Camel Range

Where is the Carson River Watershed in relation to the Sierra Nevada mountain range?

East West North South

What is the name of the canal that brings water from the Truckee River Watershed over to the Carson River Watershed?

Bypass Canal

Lahontan Canal

Truckee Canal

Derby Canal

Grade 8

Earth & Space Science—*Students understand that the Earth is composed of interrelated systems of rocks, water, air, and life.*

11.8.2 Earth Models. Compare a variety of map types, and locate Nevada and Nevada features on each.

Objective 5: Name six attractions our watershed offers. Describe their location in relation to water bodies, communities, accessibility, or other influencing factors. Describe any contribution and influence the attraction may have upon water quality.

5a. Where does water go after it runs down your street into a ditch or storm drain?

Storage tanks

Lakes and rivers

A water treatment plant

All of these

I don't know

5b. Circle actions that help watersheds; draw a line through actions that harm watersheds.

- Plant trees or shrubs
- Plant flowers and grasses
- Rake leaves into the street
- Put chemicals down the storm drain when finished with them
- Wash cars in the street
- Pick up litter
- Tell people that streets flow to rivers
- Ride your bike
- Keep fertilizers off driveways and streets
- Mulch and compost leaves
- Pick up after your pet

Grade 12

Environmental Science—*Students will demonstrate an understanding that ecosystems display patterns of organization, change, and stability as a result of the interactions and interdependencies among the life forms and the physical components of the Earth.*

15.12.1 Ecosystems–Relationships and Interactions in Ecosystems. Investigate and describe how ecosystems change or remain the same in response to different kinds of influences.

Objective 6: Two-part question. 1. In what way am I part of the Carson River? 2. How do I impact the water of the Carson River?

Grades 8-12

Geography Content: Places and Regions—*Students understand the physical and human features and cultural characteristics of places and use this information to define and study regions and their patterns of changes.*

2.8.1 Describe the relationship between physical and human features, such as landforms and political boundaries.

2.12.1 Characteristics of Places and Regions. Determine how relationships between humans and the physical environment lead to the development of and connections among places and regions.

2.8.2 Relate how places and regions are important to the expression of cultural identity.

2.12.2 Cultural Identity. Explain why places and regions are important to cultural identity and can serve as forces for both unification and fragmentation.

Objective 7: Explain the controversy over the first established human settlement in the 1860's**Grades 8-12**

History—*Students use chronology to organize and understand the sequence and relationship of events.*

1.8.2 Chronology. Create a tiered time line.

1.12.2 Chronology. Explain the sequence and relationship of events on a tiered time lines.

History—*Students will use social studies vocabulary and concepts to engage in inquiry, in research, in analysis, and in decision-making.*

2.8.1 Frame historical questions that examine multiple viewpoints.

2.12.1 Inquiry. Frame and evaluate historical questions from multiple viewpoints.

2.8.2 Evaluate sources of historical information based on: bias, credibility, cultural context, reliability, and time period.

2.12.2 Research and Analysis. Integrate, analyze, and organize historical information from a variety of sources.

Objective 8: Describe (understand) how historical and present environmental impacts have resulted in the present landscape of Carson River watershed.**Grades 8, 12**

History: 1700 to 1865—Students understand the people, events, ideas, and conflicts that led to the creation of new nations and distinctive cultures.

6.8.22. Nevada. Explain the events that led to Nevada statehood, including Comstock Lode and Election of 1864.

History: 1860 to 1920—*Students understand the importance and impact of political, economic, and social ideas.*

7.8.5 Describe the western frontier, including communication, pony express, telegraph, farming and water issues, mining, ranching, transportation.

7.8.9 Identify immigrant and native groups involved in mining, ranching, railroads, and commerce in Nevada and the United States.

7.12.5 United States and Nevada. Describe the role of farming, railroads, and mining in the settlement of the West.

Grades 8, 12

Geography: The World in Spatial Terms—*Students use maps, globes, and other geographic tools and technologies to locate and derive information about people, places, and environments.*

1.8.2 Compare and contrast the characteristics and purposes of several types of maps, map projections, and other geographic representations.

1.12.2 Map Selection. Select appropriate maps, map projections, and other representations to analyze and interpret geographic information.

Standards Correlations

Explore Your Watershed

1.8.5 Compare and contrast maps of similar areas for purpose, accuracy, content, and design.

1.12.5 Map Analysis. Analyze maps for similarities and differences in purpose, accuracy, content, and design.

Geography: Places and Regions—*Students understand the physical and human features and cultural characteristics of places and use this information to define and study regions and their patterns of changes.*

2.8.6 Describe how and why regions change over time.

2.12.6 Patterns of Change. Analyze why places and regions once characterized by one set of criteria may be defined by a different set of criteria today, and evaluate these changes.

Geography: Environment and Society—*Students understand the effects of interactions between human and physical systems and the changes in use, distribution, and importance of resources.*

5.8.4. Describe the patterns of change caused by human modification of the physical environments.

5.12.4 Human Modification. Develop possible responses to changes caused by human modification of the physical environment.

5.8.6 Identify and locate examples of renewable and non-renewable natural resources.

Renewable resource—An aspect that can be regenerated if used carefully (for example, fish, timber).

5.12.6 Earth's Resources. Analyze the patterns of use, the changing distribution, and the relative importance of Earth's resources.

5.8.7 Select a resource and evaluate different viewpoints regarding its use.

5.12.7 Management of Earth's Resources. Develop policies for the use and management of Earth's resources that consider the various interests involved.

Grades 5-8, 12

Geography: Geographic Applications—*Students apply geographic knowledge of people, places, and environments to interpret the past, understand the present, and plan for the future.*

6.5.1 Describe how people and places have influenced events in the past.

6.6.1 Identify resources that have played a role in historical events or movements.

6.7.1 Identify and discuss strategic geographic locations that have played a pivotal role in historic events.

6.8.1 Explain how different characteristics of people, places, and resources have affected events and conditions in the past.

6.12.1 Applying Geography in History. Analyze the ways in which physical features and human characteristics of places and regions have influenced the evolution of significant historical events.

Standards Correlations

Explore Your Watershed

High School Standards Correlated by Curtis Kortemeier of Carson High School

Standard Number	Standard
10.12.2	Investigate and describe how landforms are the result of a combination of constructive and destructive forces resulting from weathering, erosion, and the movement of lithosphere plates.
10.12.6	Compare and contrast the geologic features of Nevada and local geological features
10.12.6	Compare and contrast the geologic features of Nevada and local geological features
11.6.3	Investigate, design, and use various kinds of maps.
11.8.2	Compare a variety of map types, and locate Nevada and Nevada features on each.
13.12.5	Explain how large-scale, long-term equilibrium can accommodate small-scale changes.
13.12.6	Investigate and describe how elements necessary for life on Earth pass through both living and non-living cycles in a series of changes that form a global system
13.5.3	Investigate and describe the factors which affect the processes such as evaporation and condensation.
15.12.1	Investigate and describe how changes in an ecosystem can affect bio-diversity and bio-diversity contributes to an ecosystem's stability
15.12.2	Investigate and describe how ecosystems change or remain the same in response to different kinds of influences
15.12.2	Investigate and describe how ecosystems change or remain the same in response to different kinds of influences
15.12.4	Describe the unique geologic, hydrologic, climatic, and biological characteristics of Nevada's bioregions . (e.g. Northern NV cold desert, Southern low warm desert, Mountain).
15.12.4	Describe the unique geologic, hydrologic, climatic, and biological characteristics of Nevada's bioregions . (e.g. Northern NV cold desert, Southern low warm desert, Mountain).
15.8.1	Investigate and describe how living and non-living components of ecosystems interact in various ways.
15.8.1	Investigate and describe how living and non-living components of ecosystems interact in various ways.
15.8.1	Investigate and describe how living and non-living components of ecosystems interact in various ways.
16.12.1	Evaluate the consequences of changing patterns of resources use.
16.12.1	Evaluate the consequences of changing patterns of resources use.
16.12.4	Analyze and describe the limitations of the Earth's ability to respond to stresses produced by human or natural activities.
16.12.4	Analyze and describe the limitations of the Earth's ability to respond to stresses produced by human or natural activities.

Standards Correlations

Explore Your Watershed

Standard Number	Standard
16.12.4	Analyze and describe the limitations of the Earth's ability to respond to stresses produced by human or natural activities.
16.12.5	Analyze and evaluate the effects that increases in human populations can cause (e.g., resource depletion and environmental degradation).
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16.8.5	Describe how unintended consequences of technologies can cause resource depletion and environmental degradation, but technology can also increase resource availability, mitigate environmental degradation, and make new resources economical.
16.8.5	Describe how unintended consequences of technologies can cause resource depletion and environmental degradation, but technology can also increase resource availability, mitigate environmental degradation, and make new resources economical.
17.12.1	Analyze and evaluate how consumption patterns, conservation efforts, and cultural or social practices in countries have varying environmental impacts.
17.12.2	Investigate and describe how human actions may impact the dynamic equilibrium of global systems (e.g., global warming, ozone depletion).
17.12.4	Evaluate and describe actions which affect the global environment in terms of trade-offs that may have effects on local environments or economics.
17.12.4	Evaluate and describe actions which affect the global environment in terms of trade-offs that may have effects on local environments or economics.
17.12.4	Evaluate and describe actions which affect the global environment in terms of trade-offs that may have effects on local environments or economics.
18.12.4	Explain that scientists work with others to resolve differences in interpretation of observations.
19.12.3	Recognize and describe situations in which a system is qualitatively different from the parts which comprise it (e.g., how a population differs from an individual).
20.12.2	Use models to identify and predict cause-effect relationships (e.g., effect of temperature on gas volume, effect of carbon dioxide level on the greenhouse effect).
20.8.5	Use a systematic approach to thinking critically about risks and benefits.