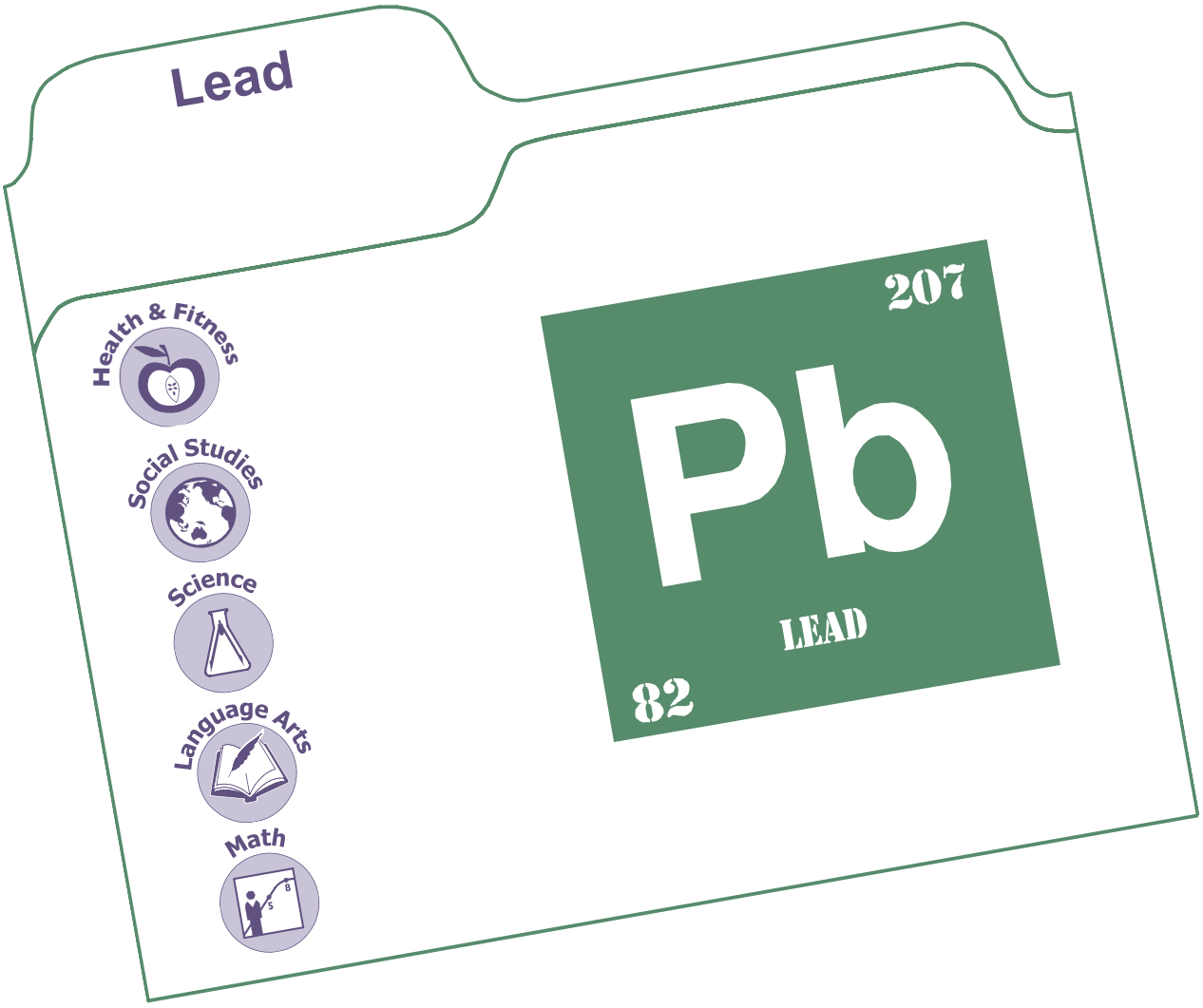
Environmental Health

Fact File



Lead

IEHMSP
INTEGRATED ENVIRONMENTAL HEALTH
MIDDLE SCHOOL PROJECT

Interdisciplinary Environmental Health Curriculum for Middle School Students

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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Master Copies of Student Handouts

Introduction to the Environmental Health Fact Files

How to Use the Fact Files

This FACT FILE was created for use by teachers participating in the Integrated Environmental Health Middle School Project (IEHMSP). The IEHMSP is funded by the National Institute of Environmental Health Sciences (NIEHS). The project 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.

Every FACT FILE produced for the project is designed to make it easy for teachers to team teach a specific environmental health-related topic. Teachers who are interested in teaching an environmental health topic across the curriculum can use these lesson plans and resources to help them integrate environmental health themes into their individual subject areas. By integrating these topics across subject areas, teaching teams demonstrate to students the interdisciplinary nature of the field of environmental health and help break down artificial barriers between subjects. Each lesson plan includes a Student Handout which encourages content-area reading. Many of the Student Handouts include Check Your Understanding questions to help assess your students' reading comprehension skills.

Each FACT FILE provides subject area specific lesson plans to teachers of social studies, science, language arts, math and health and fitness. At least two lessons are provided for each subject. Additional resource materials are also included to help school librarians who are facilitating student research projects. A companion web page is available with annotated links to related web sites (see **Resources for the Librarian** section for the website address).

In order to provide students with a foundation of knowledge about the topic, every FACT FILE includes a **Student Introduction** section that introduces the basics of environmental health and shows how the specific topic relates to the field. This page should be given to students before they embark on any of the subject specific lesson plans. It can be used across disciplines and should be distributed by the first teacher in the team to introduce the topic.

Teachers wishing to learn more background information about the topic should use the **Resources for the Librarian** section and the associated web page.

The lesson plans included in the FACT FILES are designed to be stand alone units – the only assumption is that the students will have been introduced to the information contained in the **Student Introduction** page. This allows teaching teams to mix and match lessons and present them in any order that is convenient to their particular situation and constraints.

We hope you find these lesson plans useful and that the experience of using environmental health as an integrating context for teaching is a rewarding one. Please feel free to contact us with your questions, comments, and suggestions. Contact information can be found on page 14.

Special Note: Teaching about Lead

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.

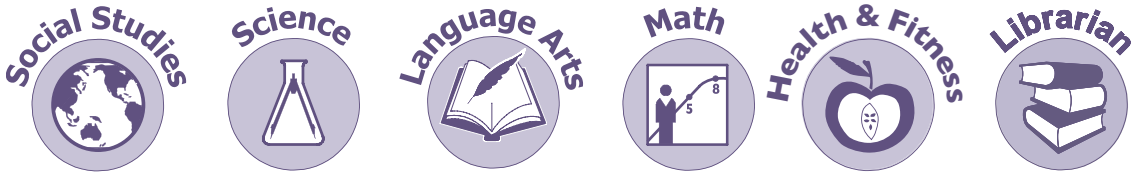
Lead poisoning is one of the most common childhood environmental health problems in the U.S. Lead can be found in drinking water, soil, air, paint and sometimes even in food. With an understanding of the sources of lead poisoning and the main routes of exposure, students can learn how to protect themselves and their family members from this health hazard. The widespread risk of lead exposure makes it an important topic for the middle school curriculum.

When teaching about a health issue such as lead exposure, it is important to keep in mind that some of the students in your class may have a higher risk of lead exposure 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, many of the lesson plans in the *EH Fact File: LEAD* relate lead poisoning as an environmental justice issue. By investigating this topic, students will find connections between lead poisoning, poverty, ethnicity, geography, 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.

Key to Symbols

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

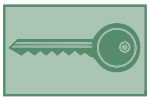


This icon in the margin indicates points in the lesson plan that provide good **Opportunities for Student Assessment**.

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

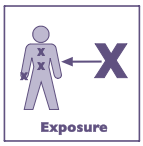
Student Handout

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.**

Lessons at a Glance

STUDENT INTRODUCTION: Environmental Health & Lead

The **Student Introduction** provides students with the background knowledge they need about environmental health and lead poisoning before proceeding with any of the discipline-specific lessons in this curriculum. 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. Enrichment activities are also provided for a more in-depth investigation of environmental health and lead poisoning.

Suggested Grade Levels: 6 – 8
Curriculum Connections: Environmental health and lead poisoning

Social Studies LESSON ONE: A Time Travel Vacation to the Roman Empire

Lesson Overview: In this lesson, students learn about the many ways that ancient Romans came in contact with lead. After reading about lead in the Roman Empire, students answer questions to check their understanding. Then, students create a travel guide for a time travel vacation to the Roman Empire. The guide includes a health advisory to educate travelers about the risks of lead poisoning.

Suggested Grade Levels: 6 & 7
Curriculum Connections: Ancient Roman culture and geography
***EALRs:** History 1.2.2 and 2.2.2; Geography 1.2.2a; Social Study Skills 1.1.2e

Social Studies LESSON TWO: The Geography of Childhood Lead Exposure

Lesson Overview: This geography lesson investigates the geography of childhood lead exposure in Washington State. Students first read about lead poisoning as an environmental justice issue. Then, students use information from a data table to create a Washington State map that plots instances of childhood lead poisoning by county.

Suggested Grade Levels: 7 & 8
Curriculum Connections: Washington State contemporary issues, Washington State geography & economics, mapping
EALRs: Geography 1.1.2b, 2.2.2 and 3.1.2b; Washington State History 1.2.2

*EALRs: Washington State Essential Academic Learning Requirements.

Materials developed by the Integrated Environmental Health Middle School Project (NIEHS Grant #ES10738 and #ES07033).

Science LESSON ONE: Toxic Candies and Dangerous Cures

Lesson Overview: Students read a short passage about folk remedies and candies from around the world that commonly contain high levels of lead. Students interview four adults to learn about different folk remedies and their origins. Students work in groups to read case studies about Hispanic children who were exposed to lead from folk remedies and imported candies. They then complete case history reports for each child, including recommended treatment options.

Suggested Grade Levels: 6 & 7
Curriculum Connections: Body systems and diseases, health, interviewing, interpreting case studies, and science/geography connections
EALRs: Science Environmental and Resource Issues 1.2; Science Communication 2.1; Science Identifying Problems 2.2; Health & Fitness 2.2 and 3.2

Science LESSON TWO: Four Lead Awareness Activities

Lesson Overview: This lesson focuses on the dangers of lead in household paint, dust, soil and drinking water. Students work in small groups to investigate four different ways that people commonly come in contact with lead in their homes. Each activity includes background reading, data collection and observation. Each group then makes a presentation to the rest of the class about its investigation.

Suggested Grade Levels: 7 & 8
Curriculum Connections: Environmental science, investigations, making predictions and observations, and collecting data
EALRs: Science Explanations 2.1; Science Communication 2.1; Science Identifying Problems 2.2

Language Arts LESSON ONE: Beethoven's Hair

Lesson Overview: Students read a biographical sketch of Beethoven, who might have suffered from lead poisoning, and a historical narrative about a lock of his hair traveling through time. Students create a timeline from the historical narrative and then choose a time period described in the reading and conduct research on the art, music, and culture of that period. Students use their research to write a piece of historical fiction.

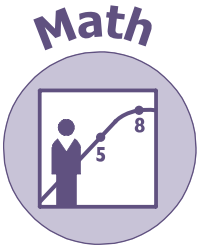
Suggested Grade Levels: 6 & 7
Curriculum Connections: Non-fiction, biographical sketch, historical narratives and creative writing
EALRs: Reading 1.2 and 3.3; Writing 1.3 and 2.3

Language Arts LESSON TWO: Eighteen Pence a Day

Lesson Overview: This lesson examines the working conditions in London's white lead mills in the mid-1800s. Students first read biographical sketches of Charles Dickens and Jack London. Next, they read excerpts from Dickens' *The Uncommerical*

Traveller. Finally, each student chooses one young factory worker, described by Jack London in *The People of the Abyss,* and writes a journal entry from her point of view.

Suggested Grade Levels: 7 & 8
Curriculum Connections: Point of view, biographical sketch, reading history, word choice, journal writing, Charles Dickens and Jack London
EALRs: Reading 1.1, 2.3 and 3.3; Writing 1.2 and 2.3



Math LESSON ONE: Trumpeter Swan Math

Lesson Overview: In this lesson, students work with data related to trumpeter swans suffering from lead poisoning in Skagit and Whatcom counties of Washington. Students first read two newspaper articles that include some statistics. They then work through calculations using those statistics. Students also work with a data chart to create a bar graph.

Suggested Grade Levels: 6 & 7
Curriculum Connections: Organizing data, percentages, bar graphs, reading for information and interpreting statistics
EALRs: Math 1.1, 1.4, 4.1, 4.3 and 5.2

Math LESSON TWO: Childhood Blood Lead Levels

Lesson Overview: This lesson uses data from a U.S. Environmental Protection Agency report on the links between childhood lead poisoning, race, and income level. Students play the role of interns at the EPA who must create a series of graphs for an important presentation. The students take information from a complicated graph and table and present the information in several different formats.

Suggested Grade Levels: 7 & 8
Curriculum Connections: Percentages, samples and populations, making predictions, bar graphs, and interpreting statistics and graphs
EALRs: Math 1.4, 4.3 and 5.2

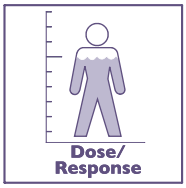
Health & Fitness Lessons

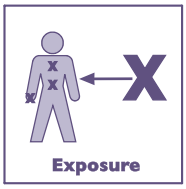
This section provides lessons, activity ideas, and resources for Health and Fitness teachers to integrate the topic of lead into their curriculum.

Suggested Grade Levels: 6 - 8
Curriculum Connections: Diseases and disorders, growth and development, air, water and soil pollution, nutrition, community health, consumer and personal products, occupational exposure.

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 *EH Fact File: Lead* your students will meet some of the overall learning outcomes for the project. These learning outcomes are aligned to the Washngton State Esssential Academic Learning Requirments (EALRs).





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

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

      EALRs: Science 1.2 and 1.3; Heath & Fitness 3.1

    - Students will understand that duration, frequency and routes of exposure are critical factors in determining whether a substance has an effect either 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)

Environmental Health Fact File: LEAD	**Introduction:** Introduction to Environmental Health	**SS Lesson 1:** A Time Travel Vacation to the Roman Empire	**SS Lesson 2**: The Geography of Childhood Lead Exposure	**Science Lesson 1:** Toxic Candies & Dangerous Cures	**Science Lesson 2**: Four Lead Awareness Activities	**LA Lesson 1**: Beethoven's Hair	**LA Lesson 2**: Eighteen Pence a Day	**Math Lesson 1**: Trumpeter Swan Math	**Math Lesson 2**: Childhood Blood Lead Levels
Social Studies: History									
1.1.2a Group events and individuals by historical eras and develop timelines.						X			
1.2.2 Identify and analyze the contributions of the Contemporary era in the development of WA. State (Washington State History).			X						
1.2.2 Compare and contrast elements of culture (World History).		X							
2.1 Investigate and research. Locate and obtain sources of information.		X				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	
Social Studies: Geography									
1.1.2b Use data and a variety of symbols and colors to create maps and graphs.		X	X						
1.2.2a Locate physical and human features and events on maps and globes.		X							
2.2.2 Use observations, maps, and other tools to identify and to compare and contrast the patterns humans make.			X						
3.1.2b Explain how the actions and interactions of human societies affect and are affected by the environment.	X	X	X						
3.2 Analyze how the environment affects people.	X			X	X				X

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Social Studies: Economics									
1.1.2a Provide examples of how groups and individuals face economic choices.		X					X		
Social Studies Skills									
1.1.2e Take notes, paraphrase, summarize and enter data.		X		X					
1.1.2f Create a product that uses social studies content to support findings.		X	X	X		X	X		
2.1.2c Interview appropriate people to gain needed information.				X					
3.1.3d Analyze and evaluate the impact of ideas, events, and/or people on groups, environments, economic systems, and/or subsequent events.		X							
3.1.3e Group human and natural events into broadly defined eras and construct related timelines.						X			
Science									
1.2 Recognize systems and the interactions within and among them.	X			X					
1.3 Explain how human societies' use of natural resources affects quality of life and the health of ecosystems.	X	X	X	X			X	X	
2.1 Communicate scientific procedures, investigations, and explanations in a variety of formats (Communication).				X	X				
2.1 Develop abilities necessary to do scientific inquiry (Explanations).					X				
2.1 Design, conduct and evaluate investigations (Investigations).					X				
2.1 Correlate and test models (Modeling).					X				
2.2 Identify common, everyday challenges or problems in which science/ technology can be or has been used to design solutions (Identifying Problems).	X			X	X				

Environmental Health Fact File: LEAD	**Introduction:** Introduction to Environmental Health	**SS Lesson 1:** A Time Travel Vacation to the Roman Empire	**SS Lesson 2**: The Geography of Childhood Lead Exposure	**Science Lesson 1:** Toxic Candies & Dangerous Cures	**Science Lesson 2** : Four Lead Awareness Activities	**LA Lesson 1**: Beethoven's Hair	**LA Lesson 2**: Eighteen Pence a Day	**Math Lesson 1**: Trumpeter Swan Math	**Math Lesson 2**: Childhood Blood Lead Levels
Health and Fitness									
2.2 Describe health care practices that result in early detection, treatment and monitoring of non-communicable diseases.				X					
2.3 Anticipate risky situations and demonstrate behavior to reduce risks.	X	X	X	X					X
3.1 Understand how environmental factors affect one's health.	X	X	X	X	X	X	X		X
3.2 Gather and analyze health information. Identify ways people make healthy and unhealthy decisions.	X	X		X	X		X		X
3.2 Distinguish between safe and unsafe use of health-care products		X		X					
4.1 Assess needs and resources.	X								
4.1 Identify workplace health and safety issues.	X	X	X				X		
Reading									
1.1 Use word recognition and word meaning skills to read and comprehend text.	X	X	X	X	X	X	X	X	X
1.3 Build vocabulary through reading.	X	X	X	X	X	X	X	X	X
2.1 Comprehend important ideas and details. Demonstrate comprehension.	X	X	X	X	X	X	X	X	X
2.4 Recognize that authors make language choices to influence an audience. Recognize the author's point of view, tone and use of persuasive devices.							X		
3.1 Read to learn new information.	X	X	X	X	X	X	X	X	X
3.4 Read for literary experience in a variety of forms.						X	X		

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Writing									
1.2 Use style appropriate to the audience and purpose.		X				X	X		
1.3 Write clearly and effectively. Apply writing conventions.	X	X				X	X		
2.1 Write in a variety of forms for different audiences and purposes.		X				X	X		
3.5 Publish. Produce a final product.						X	X		
Communication									
2.1 Communicate using different forms of oral presentations such as reports.					X				
2.3 Use effective delivery.					X				
3.2 Work cooperatively as a member of a group. Contribute to group.		X	X		X				
Math									
1.1 Demonstrate understanding of integers, fractions, decimals, percents, place value of decimals and properties of the rational number system.			X		X		X	X	X
1.4 Identify how statistics can be used to support different points of view.								X	X
4.1 Gather information. Read, listen, and observe to access and extract mathematical information.			X					X	X
4.3 Represent and share information using both everyday and mathematical language.								X	X
5.2 Use mathematical thinking and modeling in other disciplines.			X		X			X	X
5.3 Relate mathematical concepts and procedures to real-life situations.			X	X	X			X	X

About the IEHMSP

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.

About the Sponsoring Centers

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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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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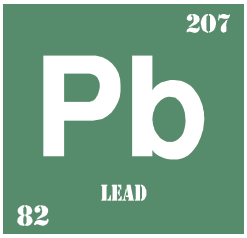


Student Introduction: ENVIRONMENTAL HEALTH & LEAD

Introduction Overview

The **Student Introduction: Environmental Health and Lead** provides students with the background knowledge they need about environmental health and lead poisoning before proceeding with any of the discipline-specific lessons in this curriculum. 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. Enrichment activities are also provided for a more in-depth investigation of environmental health and lead poisoning.

Suggested Grade Levels: 6-8
Topics: Environmental health, lead poisoning 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 environmental health concepts to your student. The PowerPoint presentation can be presented along with the student reading. You can download the presentation at http://depts.washington.edu/iehmsp/.

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 lead and environmental health before you proceed to the subject-specific lesson plans.

Student Assessment

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

25%	Did students read the **Student Introduction: Environmental Health and Lead**?
50%	Did students correctly answer the **Check Your Understanding** questions?
25%	Did students view the **PowerPoint Presentation: What is Environmental Health?**

Extension Activities

Environmental Health Collage: Using images from magazines, students create a collage of environmental hazards and environmental health-related jobs.

Lead and the Periodic Table: Locate lead on the periodic table of the elements. Compare it to other elements and describe lead's basic properties.

Classroom Speaker: Ask an environmental health professional from your community to visit your class to talk about his or her job.

Environmental Health Collage: Using images from magazines, students create a collage of environmental hazards and environmental health-related jobs.

Lead and the Periodic Table: Locate lead on the periodic table of the elements. Compare it to other elements and describe lead's basic properties.

Classroom Speaker: Ask an environmental health professional from your community to visit your class to talk about his or her job.

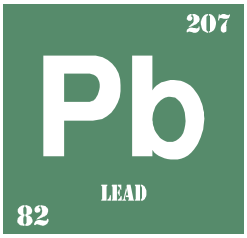
Student Assessment:
The extension activities provide for more in-depth assessment of student understanding.

Hazards in Your Community: Make a list of possible environmental hazards in your community. Discuss what students can do to protect themselves from the hazards. Explore how they might be able to reduce or eliminate the hazards.

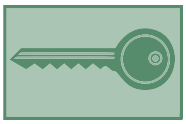
Lead Poisoning Prevention Poster: Create a poster that provides tips on how to protect young children from lead poisoning.

Lead in the Body: Draw a life-size human body mural. Draw and label the body systems and organs that are affected by lead poisoning.

Lead Card Games: Create a deck of cards with "true or false" questions related to lead poisoning. Use the cards to play a simulated version of "Hollywood Squares." You can also create cards with answers on them and play a round of "Jeopardy," where students must provide the correct question to go along with the answer on the card. A card game ("Lead Rummy") is also available commercially. This deck of cards has "true or false" questions related to lead poisoning lessons, effects, actions and dangers. Use the cards to quiz students, or to play a round of rummy. Ordering information is provided on page 140.



Student Introduction: ENVIRONMENTAL HEALTH & LEAD



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.

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.

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.

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

Toxicity: A measure of how dangerous a chemical is.

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**.

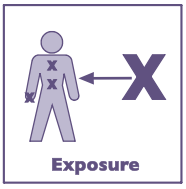
Toxicity

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.

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	

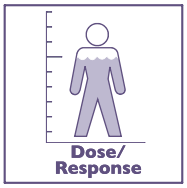
A bottle of bleach, for example, will have the word DANGER on the label, because it is highly toxic if ingested (toxicity rating = 1). Borax powdered cleaner, however, is rated as slightly toxic (toxicity rating = 3) and will have the word CAUTION on the label. This is just one example of a system used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

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.

Materials developed by the Integrated Environmental Health Middle School Project (NIEHS Grant #ES10738 and #ES07033).

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.

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).

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**.

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.

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.

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.

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).

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

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

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.***

What is Lead Poisoning?

Lead is a naturally occurring dull-grey metal that is found within the earth's crust. Lead is resistant to corrosion, has a low melting point and is easy to shape. These natural properties have made lead a popular resource for thousands of years. Today, lead can be found in drinking water, soil, air, paint and sometimes even in food. Lead is known on the periodic table of the elements as "Pb." The Latin word for lead is *plumbum.* Even today, **lead poisoning** is also known as plumbism and household plumbing in old homes is sometimes made up of lead pipes and solder.

There is no safe level of lead in the human body. Lead poisoning can occur when lead is ingested, inhaled or absorbed into the body. Lead poisoning can affect intelligence, behavior and development. Lead poisoning affects about 434,000 children younger than six years old in the U.S. Fortunately, after years of education and prevention programs, rates of childhood lead poisoning are declining in the U.S.

How do people become lead poisoned? Lead can be found in many places in our everyday environments – in some paints, drinking water, dust, soil, air and food. However, many of our problems with lead come from products that are now banned in the U.S. These banned products include leaded automobile gasoline, residential lead paint and a particular type of insecticide (chemicals used to kill insect pests). Even though these products are now banned, lead continues to pollute air, soil, and water.

Lead Poisoning:
A health condition that occurs when lead that is ingested, inhaled or absorbed into the body reaches a harmful level. Lead poisoning affects many systems in the body, particularly the kidneys, red blood cells and brain.

Today, lead is used in many industrial and hobby products. The list below includes some items that contain lead products:

- automobile batteries
- some brands of hair-dye
- night vision equipment
- fishing weights
- some types of exterior paint
- some types of shotgun pellets
- some types of folk remedies
- some types of vinyl miniblinds
- high definition televisions (HDTVs)
- old plumbing
- computer monitors
- stained glass windows
- some types of pottery glaze
- some types of candy from Mexico

What can people do to avoid lead poisoning? Children who live in homes built before 1978 have a potential risk for lead poisoning. If you live in an older home, here are a few easy things you can do to protect yourself and your family:

- Always wash your hands before eating. Frequently wash children's toys, including pacifiers (helps to keep lead dust from being ingested).
- Eat nutritious low-fat meals that are high in calcium and iron to protect yourself from absorbing lead into your body (calcium and iron can decrease how much lead your body absorbs).
- Flush water from your tap for 15-30 seconds, or until it runs cold, for drinking and cooking purposes (standing water can have more lead in it from lead pipes or solder).
- Only use cold water for drinking, cooking and mixing infant formula (hot water can have higher levels of lead than cold water).
- Frequently wipe dust from counters, tables, floors and windowsills with a wet cloth or mop (helps keep lead dust from being ingested or inhaled).
- Use a doormat to wipe your feet, or remove shoes before entering your house (helps keep you from tracking lead contaminatd soil into the house).

What are the effects of lead poisoning? Once lead enters the body, it first becomes concentrated in the blood and soft tissues, then much of it is excreted in the urine. Of the lead that stays in the body, 95% of it will become concentrated in the body's leg bones

and teeth, since lead acts just like calcium within the body. The lead that is stored in the bones can slowly move back into the blood stream during times of body stress, such as a broken bone, pregnancy or old age. Lead poisoning can harm practically every system in the body, especially the kidneys, blood cells, heart, reproductive organs and the central nervous system.

Lead poisoning is most harmful to children under six years old and unborn babies. While an adult will absorb 10% of the lead that he or she ingests, a child will absorb 50% of the lead into his or her body. Young children absorb more lead into their growing bodies, excrete less lead from their bodies, and suffer from greater impacts to their organs. When a growing child ingests lead, the lead acts just like calcium. Growing bodies need a lot of calcium, so young children absorb more lead than adults. Lead poisoning impacts young children by interfering with brain development, impacting the nervous system, causing hearing and vision problems, and damaging the kidneys. Lead poisoning can also decrease IQ and cause behavior problems, hyperactivity and learning disabilities. At high levels, lead poisoning can cause seizures, comas and even death.

The symptoms of lead poisoning include loss of appetite, tiredness, stomachaches and crankiness. Parents and doctors often do not suspect that a child is suffering from lead poisoning because their symptoms may point toward some other illness, such as the flu.

Adults who suffer from lead poisoning may have increased blood pressure, fertility problems, digestive problems, nerve disorders, and memory and concentration problems.

Blood Lead Level (BLL):
A measurement of the amount of lead in a person's blood. BLL shows the individual's exposure to lead over the past 2-3 weeks. After that time, lead is concentrated in the long bones. A BLL test provides a snapshot view of the individual's lead exposure. A BLL of over 10 µg/dL is considered elevated. "Micrograms per deciliter" (or µg/dL) is a measurement of the amount of lead in a person's blood. The Greek symbol **µ** is pronounced "mew".

Lead poisoning is usually detected using a blood test. The test gives the doctor the patient's **blood lead level (BLL)**, or the amount of lead in the patient's bloodstream. A blood lead level test only tells the doctor about the patient's recent exposure to lead. When a person stops being exposed to lead, their blood lead level will slowly decline. A blood lead level of over 10 micrograms per deciliter (µg/dL) causes concern, although some scientists believe that even this small level is too much for a young child. A doctor can determine a person's past exposure to lead, also called their body burden, by using a special x-ray to analyze lead levels in bone. Since lead stays in bone for many years after exposure to lead, a bone test can tell a doctor more about the person's history of lead poisoning. Similarly, some scientists also look at a child's baby teeth to test lead levels. Hair analysis can also be used to show very recent exposure to lead.

A child who is diagnosed with lead poisoning may require a special kind of medicine called chelation therapy. This medicine chemically binds to the lead in the child's body and helps the child to get rid of the lead through urination. This medicine can help lower the amount of lead in the child's body, but there is no way to completely remove all of the lead. The most important thing is to find the source of lead and get rid of it to protect the child from further exposure.

Some important facts about lead poisoning:

- About one in twenty-two children in the U.S. have elevated levels of lead in their blood.
- 52% of U.S. homes still contain lead paint, even though the sale of residential lead paint was banned in 1977.
- Children from lower income families are eight times more likely to be poisoned than those from higher income families.
- African-American children are more than five times more likely to have potentially harmful levels of lead in their bodies than Caucasian children. Nationwide, about 22% of African American children living in older housing have elevated lead levels.
- In 1979, cars released 94.6 million kilograms (kg) of lead into the air in the United States. In contrast, after leaded gasoline was banned, in 1989 cars released only 2.2 million kg into the air.

Check Your Understanding

1. Your four-year old cousin was just diagnosed with mild lead poisoning. What body systems and organs may be affected? ***Answers may include: kidneys, brain development, and nervous system (hearing and vision).***

2. List five possible ways that a young child may come in contact with lead. ***Answers may include: eating paint dust or paint chips; ingesting contaminated soil; parents bringing home lead particles from work; parent's hobbies including lead-based products; drinking water from old plumbing; and polluted air.***

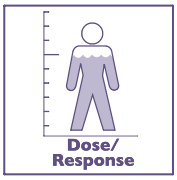
Acute Lead Poisoning: When a person comes in contact with a large amount of lead in a short period of time and absorbs enough to become ill.

Chronic Lead Poisoning: When a person repeatedly comes in contact with a small amount of lead over a long period of time.

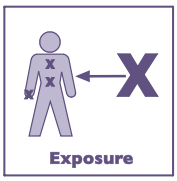
Secondary Lead Poisoning: When an animal becomes lead poisoned from eating another lead poisoned animal.

What Does Lead Have to Do with Environmental Health?

- **What does DOSE have to do with lead poisoning?** People can suffer from acute or chronic lead poisoning. **Acute lead poisoning** occurs when a person comes in contact with a large amount of lead in a short period of time, such as ingesting a folk remedy that has a high lead content. **Chronic lead poisoning** occurs when a person repeatedly comes in contact with a small amount of lead over a long period of time, such as drinking water that has a low level of lead that comes from lead plumbing. Sometimes, animals such as eagles or coyotes suffer from **secondary lead poisoning** when they feed on the body of an animal that has died from lead poisoning.



- **What is the main ROUTE OF EXPOSURE for most cases of lead poisoning?** The most common way that children come in contact with lead is through ingesting house dust containing particles of lead from old lead paint. Occasionally, a child might eat chips of lead-based paint because it tastes sweet. Young children frequently put their fingers or toys in their mouths. If their fingers or toys touched any dust or soil that was contaminated with lead, then the child will swallow some lead. This means that the main route of exposure for lead poisoning is ingestion. Lead can also be inhaled or, during pregnancy, absorbed by the developing baby from its mother's exposure to lead.



- **What does INDIVIDUAL SUSCEPTIBILITY have to do with lead?** How old you are and how big you are has a lot to do with how susceptible you are to lead poisoning. A young child is more susceptible than an adult for several reasons. First, a young child is so small that a small exposure to lead represents a big dose. Second, the child absorbs more lead into their body because it acts just like calcium. Third, young children are more likely to swallow dust from lead paint because they frequently put their toys and fingers in their mouths and spend a lot of time crawling on the floor, where dust settles. Since children's brains and other organs are still growing and developing, they will suffer more from the impacts of lead poisoning than full-grown adults. Pregnant women are also susceptible to lead poisoning because their bodies absorb more lead, since it acts like the calcium that their bodies need. Also, developing babies can absorb lead through the placenta, which can result in brain damage, low birth weight and even miscarriage.

Risk Factor:
Something that increases and individual's chance of becoming ill, hurt, or killed.

- **What environments put people at RISK of getting lead poisoning?** Lead poisoning is often linked with poverty, although it affects people of all ethnicities and income levels. Children who live in homes built before 1978 are more likely to come in contact with lead paint. Adults who are exposed to lead at work (such as at an automobile battery factory) are more likely to suffer from lead poisoning. Also, children whose parents work with lead are more likely to suffer from lead poisoning, since their parents might bring home lead particles on their clothing, shoes or hair. Children who live in mining communities are at a higher risk. Children whose diet is low in calcium and iron and high in fat will absorb more lead into their bodies than children who eat a well-balanced diet. People who use lead-containing folk remedies are at a higher risk for lead poisoning. All of these things are called lead poisoning **risk factors**.

Student Assessment:
Did the students complete the reading and thoughtfully answer the questions?

Check Your Understanding

1. Michael is a forty-five year old school librarian who likes to play soccer and golf. Miyoko is a twenty-nine year old woman who is pregnant with her first child. She makes and sells handmade ceramic bowls. Jasper is a two-year old boy whose family lives in an older home that was just remodeled. Which two people do you think are more susceptible to lead poisoning? Why?

Miyoko and Jasper are more susceptible to lead poisoning because age and pregnancy are two important factors in individual susceptibility. Miyoko is pregnant, which may cause her to absorb more lead into her body. She also works with ceramics and may come in contact with lead-containing glazes, which increases her risk. Since Jasper is a young child, he is more susceptible to lead poisoning because he probably puts his hands and toys in his mouth. Also, he lives in an old home that may have contained lead paint. Recent renovations could stir us lead dust that Jasper might ingest.

2. Name one thing you can do to decrease your risk of lead poisoning.

Answers may include: washing hands before eating; avoiding hobbies that involve lead-containing products; not seeking employment in an industry that uses lead products; not living in a mining community; eating a well-balanced diet; not using lead-containing folk remedies; using cold tap water for drinking and cooking; wiping feet before coming indoors; and wiping up dust at home.

Lesson One: A TIME TRAVEL VACATION TO THE ROMAN EMPIRE

Lesson Overview

In this lesson, students learn about the many ways that ancient Romans came in contact with lead. After reading about lead in the Roman Empire, students answer questions to check their understanding. Then, students create a travel guide for a time travel vacation to the Roman Empire. The guide includes a health advisory to educate travelers about the risks of lead poisoning. Extension activities are included for additional classroom work or homework assignments.

Suggested Grade Levels: 6 & 7
Curriculum Connections: Ancient Roman culture and geography

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:

- Compare and contrast elements of culture (e.g., society, government, economy, technology, arts, ideas, and beliefs) in the following context: Ancient history (prehistory - 600): River civilizations, Greece, Rome, China. (World 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 culture. (History 2.2.2)
- Locate physical and human features and events on maps and globes (Location, Place, Region). (Geography 1.2.2a)
- Take notes, paraphrase, summarize and enter data. (Social Study Skills 1.1.2e)

Teacher Background

For a more in-depth understanding of lead poisoning and the Roman Empire, consult the following resources that were used to prepare this lesson:

- Time Traveler's Guide to the Roman Empire, a website written as a guidebook with information on culture, health, politics and more. The "Sex" section, however, is not appropriate for students.
  http://www.channel4.com/history/microsites/H/history/guide03/index.html

- Examples of travel advisories and health warnings are available at:
  - National Center for Infectious Disease Traveler's Health
    http://www.cdc.gov/travel/
  - World Health Organization International Travel and Health
    http://www.who.int/ith/preface.html
  - U.S. Department of State Travel Warning Information Sheets
    http://travel.state.gov/

Materials developed by the Integrated Environmental Health Middle School Project (NIEHS Grant #ES10738 and #ES07033).

Teacher Preparation

MATERIALS: Copies of **Student Handout**
Art Supplies

- Make enough copies of the **Student Handout** for each student or group to have one. Master copies of the handouts are included at the back of this book.
- You may want to print out some examples of travel health warning sheets from the government web sites listed under **Teacher Background**. This will provide students with an understanding of the type of information that is conveyed in these publications.
- If you are the first teacher in your team to use this FACT FILE, make copies of the student handout entitled, **Student Introduction: Environmental Health and Lead**. Ensure that students have read the handout and mastered the content and vocabulary.

Procedure

- Distribute the **Student Handout** as an introduction to this lesson. The reading, entitled **The Time Traveler's Guide to the Roman Empire**, is divided into four major sections. Each section is followed by brief questions to help the students check their understanding of what they have read. The reading can be done in class in small groups, or individually as homework. One or more sections can be assigned at a time.
- Students can work in small groups or individually to conduct research on the daily life of ancient Romans. They then design a travel guide to ancient Rome that includes a map, must see tourist spots and general information. Students also include a health advisory on lead poisoning, that warns travelers about the many ways that they might come in contact with lead during their vacation to the Empire (e.g. drinking water, wine, preserved fruits, going on a mine tour, cookware and tableware). Students can use real government travel and health warnings as an example for their own health advisories.
- Each travel guide must include a map of the Roman Empire with major landmarks or travel destinations marked (such as major cities and must-see tourist spots). Students should include a key to their map. Travel guides should also include information about at least five of the following aspects of Roman culture:

  - Must see tourist spots
  - Money
  - Hygiene and Health
  - Religion
  - Politics
  - Social Class System
  - Technology
  - Entertainment
  - Art and Music
  - Celebrations
  - Fashion
  - Weather and Climate
  - Important Latin Words to Know

Student Assessment

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

10%	Did students complete the **Student Handout** and correctly answer the **Check Your Understanding** questions?
20%	Did students **conduct research** on life in the Roman Empire?
70%	Did students create **travel guides** that include the required elements? • 20% **Health advisory** that includes the following topics: sources of lead, ways to avoid getting sick, what you need to bring with you, after you have returned home. • 10% **Map** with major landmarks, must-see tourist spot, and a key. • 30% **Cultural information** that includes at least five aspects of Roman culture. • 5% Did students use **neatness** and **creativity** in producing their travel guides? • 5% Did students **cite their sources** in proper bibliography format?

Extension Activities

Alternate Format Presentation: Instead of a travel brochure, challenge students to present their information in a variety of media including: a play, a news broadcast, a website, a newspaper, a speech, a travel scrapbook, or a mural.

A Roman Feast: Host an ancient Roman Empire feast! The following websites provide recipe ideas:

- Ancient Roman Recipes Website
  http://www.mit.edu:8001/people/wchuang/cooking/recipes/Roman/Ancient_Roman.html
- Ancient Roman Cuisine Website
  http://www.realm-of-shade.com/sweetlady/cuisine/cookbook.html
- Social Position and Food in the Roman Empire
  http://www2.carthage.edu/outis/food.html

It's How You Play the Game: Play some ball games and board games from the Roman Empire. Instructions are available on these two websites:

- Roman Ball Games Website
  http://www.personal.psu.edu/users/w/x/wxk116/romeball.html
- Roman Board Games Website
  http://www.personal.psu.edu/users/w/x/wxk116/roma/rbgames.html

Student Assessment:
The extension activities provide for more in-depth assessment of student understanding.

A TIME TRAVEL VACATION TO THE ROMAN EMPIRE

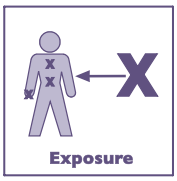
Student Handout #1

Teacher Key

Welcome!

Welcome to the Roman Empire in the year 85 A.D. You've come a long way during your travels here to the great Roman Empire, the strongest and most glorious empire in the world. During your stay, you are sure to enjoy yourself, for the Romans truly know how to have a good time. We have festivals and celebrations for almost every day of the year, and all of them include great feasts overflowing with food and wine. In fact, you are probably thirsty from all of your traveling. Here, I've laid out a goblet of wine for you and some preserved fruits. Feast, and when you have rested, we will begin our tour — I have some wonderful sites for us to visit over the next few days — a gladiator tournament at the great Colosseum, a visit to the public bathhouse, a tour of our largest lead mine, and so much more.

Aristocrats:
The upper class in ancient Rome, made up of the senators and the equestrians.

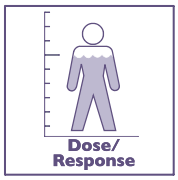


Those Drunken Romans

If there is one thing we Romans enjoy, it is a party. It seems like there is always some reason to celebrate and, at least for the **aristocrats**, the food is abundant and the wine is always flowing. We value our Emperor's ability to throw lavish parties — and you should see how much he eats and drinks all day long. The average Roman ingests about 1-5 liters of wine per day.

Sapa:
A grape syrup used to sweeten and preserve sour wine. It was made by boiling grapes in a lead kettle. Scientists believe that one teaspoon of the syrup would have been more than enough to cause lead poisoning. Sapa was also used to preserve fruit.

In order to keep up with our demand for wine, there are winemakers all over the Empire. We have one problem with our wine, though. We haven't figured out how to stop the fermentation process, so often our wine becomes quite sour. We do know how to compensate for the sourness, however. We add a sweet syrup made from grapes called **sapa**. We follow a special recipe for creating sapa. The grapes are simmered slowly in a lead pot or lead-lined copper kettle until they turn into a thick syrup. The use of the leaden kettle results in "sugared lead," or lead acetate, which seems to sweeten the wine and helps to preserve it. It's not all that surprising that wine consumption counts for 50-60% of the daily lead intake by the aristocrats.



While the aristocrats enjoy our most superior kinds of wine, the lower classes – **plebians** and **slaves** – drink an inferior kind of wine that isn't usually sweetened with sapa. The difference between lead intake by the aristocrats and the lower classes is significant. An average aristocrat probably consumes about 250 µg of lead each day, while the average plebian absorbs about 36 µg and a slave 15 µg per day.

Plebians:
The urban poor of ancient Rome.

Slaves:
The lowest class in ancient Rome. Slaves often worked in the lead mines and had short, hard lives.

Check Your Understanding

1. Describe the three social classes mentioned: aristocrats, plebians and slaves.

Aristocrats are the highest social class and include the emperor, the senators and the equestrians. Plebians and slaves are from the lower class. Plebeians are the urban poor. Slaves mostly work in the mines and often have short, hard lives.

Materials developed by the Integrated Environmental Health Middle School Project (NIEHS Grant #ES10738 and #ES07033).

Student Assessment:
Have students answer these questions individually or in pairs.

2. What was sapa and how was it made?

Sapa was a sweet syrup added to sour wine. It helped sweeten the wine and also acted as a preservative. Sapa was made by boiling grapes in a lead kettle until it formed a thick syrup.

Gouty Aristocrats

Gout:
A painful condition where the joints become swollen. Gout often affects the foot, leaving the patient unable to walk. It is often a symptom of lead poisoning.

Colic:
An extremely painful stomachache, often caused by chronic lead poisoning.

Senator:
The highest class in ancient Rome. Senators held government positions and were either appointed by the emperor or inherited their position.

Dropsies:
A condition caused by lead poisoning that makes the hands hang useless from the wrists.

Dry Gripe:
A particularly painful stomachache that feels like the bowels are being pinched. It is often a symptom of lead poisoning.

Some of our physicians have noticed some common health problems among the aristocrats. Strangely, these health problems don't seem to be affecting the lower classes. Many of our aristocrats are plagued by **gout** and **colic**.

We've noticed that married aristocrats are having a hard time having children and that many women are having miscarriages. There used to be a law that prohibited women from drinking wine, but now it is legally acceptable. These reproductive troubles are becoming a major problem because the aristocrats need to have heirs to inherit their property and fortunes, as well as to keep their blood lines going. This has been a particular problem among the **senators**, who need an heir to inherit their position in the government.

A Roman Wine Jug

In some ways, it seems our emperors might suffer the worst. While many of our leaders through history have been known for their gluttony, many have also suffered from health problems such as gout, colic and **dropsies**. For example, one of our former emperors, Claudius, who reigned from 41-54 A.D. had all sorts of health problems. Some poets and actors of the time liked to mimic his disturbed speech, weak limbs, tremors and the strange way he walked. They also poked fun at Claudius' quick fits of temper and his often inappropriate fits of laughter. Claudius was known for being a bit absent-minded and dim-witted. He often complained of **dry gripe**, a terrible kind of stomachache. He even sometimes slobbered – in public! Our current emperor, Domitian, also enjoys wine in excess. I have heard rumors that he drinks from fountains that flow with wine.

A few people seem to think that the wine has something to do with these strange health problems. I don't know for sure. Domitian certainly drinks excessive amounts of wine, and so did Claudius. Even if the lead is causing these problems, there is no way the aristocrats will give up their wine.

Some Lead with your Water?

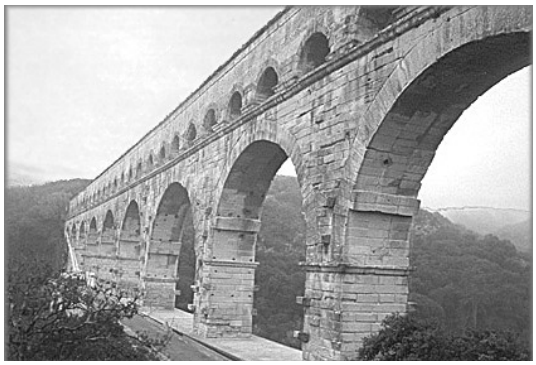
Aqueduct:
A structure for carrying a large amount of water over long distances. The water pipes in aqueducts were either lead or earthenware. Lead pipes were more popular in the city while earthenware was more common in rural areas.

We Romans are known throughout the world for our innovations in science and technology. See, look over there against the horizon. That stone structure stretching as far as you can see is part of our **aqueduct** system. The aqueducts bring fresh water from its source to the city of Rome and neighboring towns. Our water is fresh, sweet and clean. Some aristocrats even have indoor plumbing, but most people fill their water pitchers at the fountain in the town square. The public bathhouses are also filled with water from the aqueducts.

The aqueducts are tall structures with lead-lined pipes that carry the water. Some aqueducts in rural areas have earthenware pipes; these are less expensive and easier

to repair, but our engineers still prefer lead pipes. In fact, the word *plumbing* comes from the Latin word for lead, *plumbum.*

The architect and writer Vitruvius, who lived from 70-25 B.C., was critical of using lead pipes. He thought that earthenware pipes produce more "wholesome" water while water from lead pipes is "harmful to the human body." He seemed to think that lead pipes were a health risk. He might have been right, but at least in the city of Rome, lead is still the choice for water pipes.



A Roman Aqueduct

Risks & Benefits

Check Your Understanding

1. What were some of Claudius' symptoms that might be attributed to lead poisoning? ***Claudius was dim-witted and absent-minded. He suffered from disturbed speech, weak limbs, tremors, drooling, dry gripe and difficulty walking. He often acted inappropriately, was given to sudden fits of laughter, and had a short temper.***

2. The word *plumbism* means lead poisoning. How is this word linked to the aqueducts in ancient Rome? ***The Latin word for lead is plumbum, from which the words "plumbing" and "plumbism" are derived.***

Student Assessment:
Have students answer these questions individually or in pairs.

The Father of Metals

You seemed to really enjoy the preserved fruits I gave you! One of our favorite snacks is preserved fruits like grapes, apples, figs, plums, pears and cherries. We preserve the fruit by using sapa as a preservative.

I'm glad that you noticed the tableware. Not only are they handmade by artisans, but the artwork is very important to us. The designs and borders on our plates, goblets, vases and other tableware depict scenes of everyday life in the Empire. Earthenware plates and goblets are painted with a lead-based glaze and then fired. Most of our cookware is made from lead. It is such a soft, malleable metal that we find so many different uses for it. Some cook pots are made from copper or bronze, but most people prefer lead or lead-lined copper pots.

Lead really is our most useful metal. We consider lead to be the father of all metals and associate it with the god Saturn. We use lead as an ingredient in some medicines, to make our metal coins, and for roofing, coffins, even writing tablets and toys. Our favorite paint color is a deep red called Pompeian red which is made with **minium**, a lead salt.

Minium:
A lead salt, often used as a pigment to create red paint.

Women use many lead-containing products. It is a main ingredient in many cosmetics, including face powders and hair dyes.

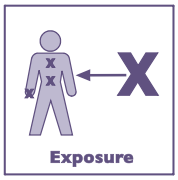
Vase painting of a Roman woman looking in a mirror

The Great Roman Mines

I thought you might enjoy a tour of one of our largest lead mines. When the Romans first began using lead, it was a by-product of silver production. Now we've found so many uses for lead, that we mine specifically for it. Lead has such a low melting point that it is easy to **smelt**. The lead mines are worked by slaves. It is hard work in the lead mines, and there are many dangers associated with it. Oftentimes, the slaves don't live long.

Smelt:
To melt an ore in order to separate a particular metal. In ancient Rome, the ore galena was smelted to produce lead and silver.

A long time ago, the scientist and writer Pliny the Elder explained how white lead (used as a pigment) was created. "For medicinal purposes lead is melted in earthen vessels, a layer of finely powdered sulphur being put underneath it; on this thin plates are laid and covered with sulphur and stirred with an iron rod. Whilst it is being melted, the breathing passages should be protected...otherwise the noxious and deadly vapour of the lead furnace is inhaled."



We used to have lead smelting forges in every part of the city. The noxious fumes that come from the lead smelting forges are overwhelming, so now most forges seem to be located farther out from the cities in smaller towns.

Student Assessment:
Have students answer these questions individually or in pairs.

Check Your Understanding

1. Name five ancient Roman household items that contained lead.

Answers may include: dinnerware, cookware, medicines, coins, roofing material, coffins, writing tablets, toys, paint, and cosmetics.

2. Why did Pliny the Elder believe that the lead mines and smelters were dangerous?

He believed that the noxious odors that came from the process of smelting lead could be deadly to those who inhaled them.

Pliny's Thoughts on Lead Poisoning

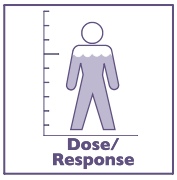
Pliny the Elder, who lived from 23-79 A.D., sometimes wrote about the impacts of lead on people's health. I thought you might enjoy talking with his nephew, Pliny the Younger, who has studied many of his uncle's manuscripts. Since you seem so interested in how we use lead here in the Empire, I asked him to describe his uncle's opinions on the dangers of consuming lead. Here's what Pliny the Younger has to say:

Greetings, Time Traveler! My uncle noticed that colic from lead poisoning was a new disease that became widespread during his own days. He thought that it was interesting that while the wealthy suffer from many common health problems, the lower classes seem to almost completely avoid these troubles. While it is true that the slaves that work in the lead mines and forges often become sick or even die from the noxious fumes, most of the poor people do not seem to be as affected as the wealthy.

For one reason, the lower classes eat a simple diet, mostly a grain-based porridge. They cannot afford delicacies like preserved fruit or expensive wine. My uncle once wrote that the practice of adding lead in one form or another to wine is so prevalent that 'genuine, unadulterated wine is not to be had now, not even by the nobility.' He noticed a connection between consumption of leaden wine and health issues, writing that 'from the excessive use of such wines arises dangling...paralytic hands.' Large doses of lead from food and wine seem to make people sick!

The poor have cookware and tableware made from earthenware instead of expensive lead kettles and pots. Also, the poor do not have luxuries like lead-containing cosmetics or paints. Finally, many of the lower classes live farther out from the cities, where the aqueducts have earthenware instead of lead pipes. Ironically, this makes the poor less at risk of getting sick from lead exposure.

TEACHER NOTE:
Pliny the Elder's writings on lead poisoning are paraphrased here in order to make them more accessible to students.



Well, Pliny the Younger certainly had a lot to say about the possible dangers of lead. Between you and me, I think there is probably some truth to these ideas. However, lead is such a popular metal, and the aristocrats so love their wine, I cannot imagine that there will be any changes in the way we use lead, at least not anytime soon.

We have certainly seen a lot today. You look a little tired. Let me take you to one of Rome's grandest bathhouses, The Baths of Caracalla, so that you can have a massage and take a dip in the pools there. Tomorrow, we'll see a gladiator tournament at the Colesseum – you'll want to be well rested for that event!

Check Your Understanding

1. How did the diet of the lower classes differ from that of the aristocrats? ***The lower classes had a simple diet mostly comprised of a grain-based porridge. They could not afford delicacies such as preserved fruit or leaden wine.***

2. Why did Pliny the Elder believe that the lower classes suffered less from lead poisoning than the aristocrats? ***Pliny the Elder believed that the lower classes had fewer opportunities to come in contact with lead than the aristocrats, since the lower classes couldn't afford luxuries like preserved fruit, leaden wine, and lead cookware and dinnerware. He noticed that the health problems that he attributed to lead poisoning, such as gout, colic and dropsies, plagued the aristocrats, but not the lower classes.***

Student Assessment:
Have students answer these questions individually or in pairs.

Travel Guide Activity

Student Assessment:
Did the students' travel guides include the required elements?

Now that you have had a guided tour of the Roman Empire, it's time to create a travel guide that includes some general information about the Roman Empire as well as what you have learned about the dangers of lead poisoning. You should include a health advisory on lead poisoning that warns travelers about the many ways that they might come in contact with lead during their vacation to the Empire. Your health advisory should include the following sections:

- Sources of Lead (provide at least four).
- To Avoid Getting Sick (provide at least four).
- What You Need to Bring With You (provide at least one).
- After You Have Returned Home (provide at least one).

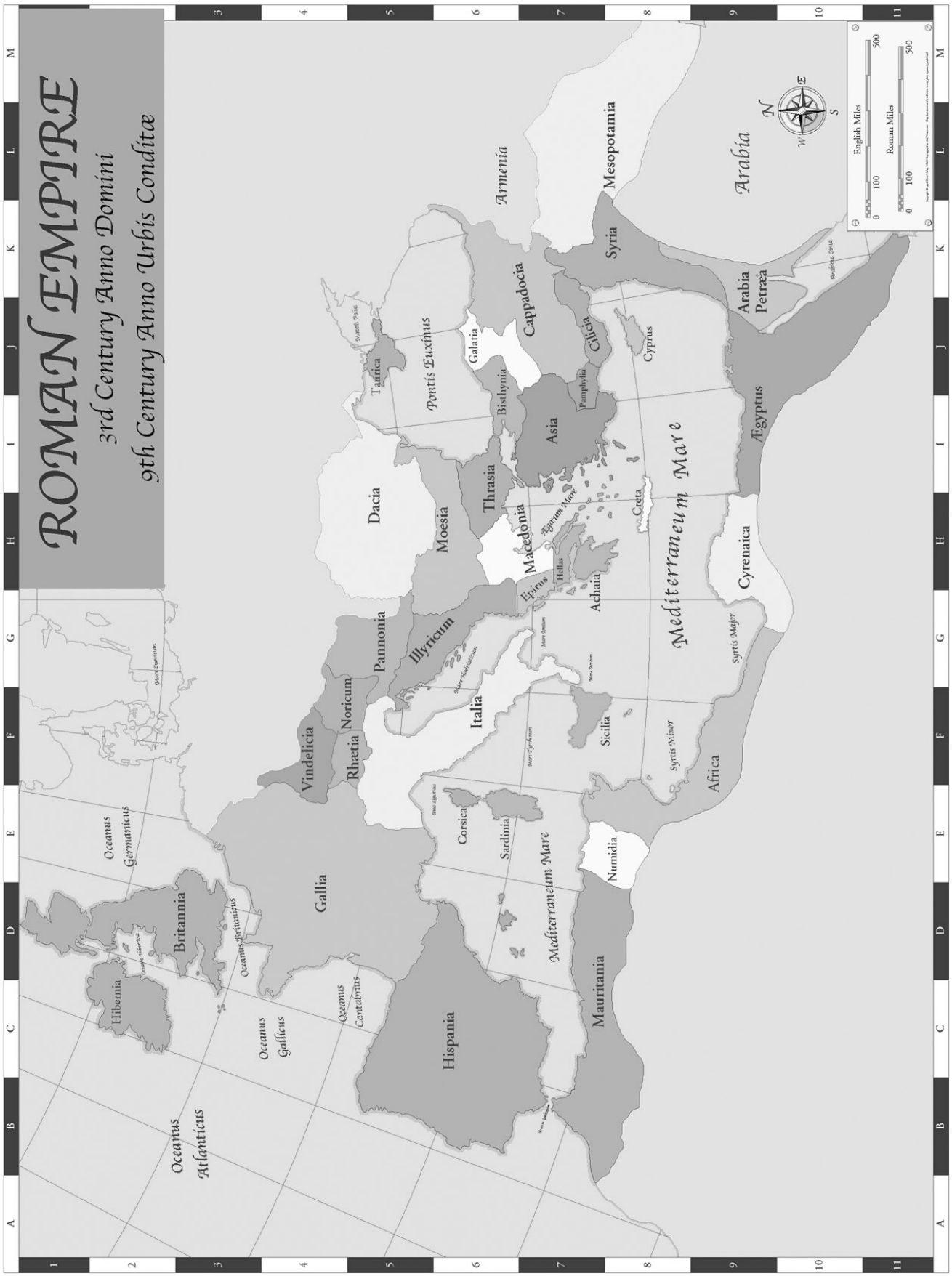
It's a good idea to use real government travel and health warnings as examples when working on this project. Examples can be found at:

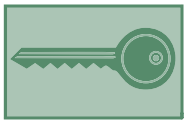
- **National Center for Infectious Disease Traveler's Health Pages**
  http://www.cdc.gov/travel/
- **World Health Organization International Travel and Health Pages**
  http://www.who.int/ith/preface.html
- **U.S. Department of State Travel Warning Information Sheets**
  http://travel.state.gov/

In addition to a health advisory on lead poisoning, your travel guide should include a map of the Roman Empire with major landmarks or travel destinations marked (such as major cities and must-see tourist spots). The map of the Roman Empire included in this lesson can be used as a starting point for your travel guide.

Your travel guide should also include information about at least five of the following aspects of Roman culture:

- Must-see tourist spots
- Money
- Hygiene and Health
- Religion
- Politics
- Social Class System
- Technology
- Entertainment
- Art and Music
- Celebrations
- Fashion
- Weather and Climate
- Important Latin Words to Know





Teacher Key

Sample Student Travel Health Warning for Lead Poisoning in the Roman Empire

Time travelers visiting the ancient Roman Empire are advised to take caution against lead poisoning. Lead is a heavy metal which can be toxic at any level, especially to young children and unborn babies. Lead can be ingested, inhaled or absorbed. Lead is one of the most popular metals in use in the Roman Empire. It can be found in food, water and many common household products. While it may be difficult to completely avoid this prevalent metal, travelers can exercise some precautions to help safeguard their health.

Student Assessment:
This sample is provided to help you evaluate student work. This is the kind of information that students might include in the Travel Health Warning section of their Travel Guide.

Sources of Lead

- Wine treated with sapa, a sweet grape syrup. Also called “leaden wine.”
- Preserved fruits such as grapes, apples, figs, plums, pears and cherries.
- Any food cooked or stored in solid lead, or lead-lined copper or bronze cookware.
- Any food or beverage cooked, stored or served in lead glazed earthenware.
- Water that has flowed through lead pipes in the aqueduct.
- Lead-containing cosmetics, especially face powders and hair dyes.
- Some common household objects contain lead, such as coins, roofing, writing tablets and toys.
- Pompeian red paint.
- Noxious fumes from lead smelting forges.
- Dust from lead mines or water coming from lead mines.

To Avoid Getting Sick

- Avoid drinking wine.
- Avoid eating preserved fruits.
- Wash your hands before eating.
- Avoid eating foods cooked in lead pots as much as possible.
- Avoid consuming foods or beverages served or stored on glazed earthenware.
- Avoid using Roman cosmetics or medicines.
- Pass on the opportunity to tour a lead mine or lead smelting forge. There are many other safer tourist opportunities.

What You Need To Bring With You

- If your type of time travel allows, bring your own bottled water, especially if your visit will be within a major city.
- If you are planning to purchase souvenirs such as tableware, vases or toys, you might want to pack a lead test kit that uses a swab to test a surface for the presence of lead. By using the simple test kit, you’ll be able to know if the item contains any lead.

After You Have Returned Home

Ask your doctor to test your blood lead level. Even by following the suggested precautions, it is likely that you will come in contact with lead during your visit. A simple blood lead test can help you determine if you need to take any medical action to treat your lead exposure.

Lesson Two: THE GEOGRAPHY OF CHILDHOOD LEAD EXPOSURE

Lesson Overview

This geography lesson investigates the geography of childhood lead exposure in Washington State. Students first read about lead poisoning as an environmental justice issue. Then, students use information from a data table to create a Washington State map that plots instances of childhood lead poisoning by county. Extension activities are included for additional classroom work or homework assignments.

Suggested Grade Levels: 7 & 8
Curriculum Connections: Washington State contemporary issues, Washington State geography & economics, mapping

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:

- 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)
- Use observation, maps, and other tools to identify and to compare and contrast the patterns humans make on places and regions (Location, Region, Place, Human/Environment Interaction). (Geography 2.2.2)
- 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)
- Identify and analyze the contributions of the following eras in the development of Washington State: Contemporary Washington (1980-present). (Washington State History 1.2.2)

Teacher Background

For a more in-depth understanding of childhood lead poisoning in Washington State, consult the following resources that were used to prepare this lesson:

- Washington State Department of Health report, "Washington State Childhood Blood Lead Screening Recommendations," November 2000
  http://www.doh.wa.gov/Topics/WALeadScreenRecommend.doc
- Washington State Department of Health's Childhood Lead Poisoning Prevention Program
  http://www.doh.wa.gov/EHSPHL/Epidemiology/NICE/Lead/default.htm

This lesson deals with several sensitive issues of the environmental justice movement, including links between income level, ethnicity and environmental health. Environmental justice is a social movement that began in the early 1980s. Environmental justice

activists believes that all people — regardless of race, country of origin, income level or education — have a right to clean air, water, and soil. The environmental justice movement looks at patterns between socioeconomic and environmental issues, such as placing an incinerator in a low-income neighborhood. While environmental justice is an important issue to teach young adults, it takes sensitivity when presenting information so as to not alienate students. Lead poisoning is considered an environmental justice issue since low-income, populations of color are at a greater risk of becoming lead poisoned than higher income, Caucasian populations. Environmental justice can bring up issues of race and class in a way that empowers students by focusing on awareness and action as instruments of social and environmental change. For a more in-depth understanding of the environmental justice movement, consult the following resources:

- **Community Coalition for Environmental Justice**
  http://www.ccej.org/

- **Northwest Environmental and Economic Justice Alliance**
  http://www.nejanw.org/

It is important to note that Washington State has very low rates of childhood lead poisoning compared to the United States as a whole. Instances of childhood lead poisoning have dropped considerably over time since leaded gasoline was banned in the early 1980s. With continued work in lead poisoning prevention education and lead abatement, these rates will hopefully continue to drop.

Teacher Preparation

MATERIALS: Copies of **Student Handouts** #1 and #2
Colored pencils or pens

- Make enough copies of the **Student Handouts** for each student or group to have a set. Master copies of the handouts are included at the back of this book.

- If you are the first teacher in your team to use this FACT FILE, make copies of the student handout entitled, **Student Introduction: Environmental Health and Lead**. Ensure that students have read the handout and mastered the content and vocabulary.

Procedure

- Distribute **Student Handout #1** as an introduction to this lesson. The reading can be assigned as homework or read as a class activity.

- Distribute **Student Handout #2**. Ask each student to neatly label his/her Washington map with the names of the forty counties. You can use this part of the activity to test student's knowledge of Washington State counties, if you have already been studying this in class.

- Ask students to examine the data chart, "Elevated Blood Lead Levels in Children, 1993-1998."

- Students will develop their own color and/or symbol key for representing the different percentages of children with elevated blood lead levels. Students should use the following data categories to make grading easier:

- The percentage of children with elevated blood lead levels can be grouped into the following categories: 0-1.9%, 2.0-3.9%, 4.0-5.9%, and 6.0-10.9%.

- Students then plot the information from the data chart onto the Washington State map. Students should include a key for their maps.

Student Assessment

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

10%	Did students complete the **Student Handout** and correctly answer the **Check Your Understanding** questions?
90%	Did students create a **map** including the required elements? • 40% Correctly **labeled** with the county names. • 5% Includes a **key** to the map. • 5% Appropriate **symbols** or **colors** are marked on the Data Chart. • 35% **Data** is correctly entered for each county. • 5% **Neatness**

Extension Activities

County Investigation: Choose one of the Washington counties with the highest rates of childhood lead poisoning. Use a variety of resources to research why that county may have higher rates than the rest of the state. Try to identify the potential risk factors for lead poisoning in that county. Potential risk factors may include: geography, industry, poverty, and ethnicity. Students can report on their findings in any of the following formats:

- A written presentation to the county's council members
- An op-ed article for the county's local newspaper
- An oral presentation to the class
- A web page to inform residents of the county about the risks of lead exposure
- A video-taped news segment

Student Assessment: The extension activities provide for more in-depth assessment of student understanding.

Environmental Justice Speaker: Have a speaker come to your class to discuss the environmental justice movement and links to your own community. The Northwest Environmental and Economic Justice Alliance and the Community Coalition for Environmental Justice both have speakers bureau programs. Both programs are based in Seattle (see **Teacher Background** section for contact information).

Lead Poisoning Awareness

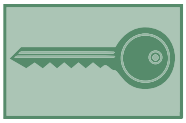
Students are challenged to prepare a lead poisoning awareness campaign for use in Washington. Each student should identify who their audience is (adults, parents, young children, schools, etc.) and design their materials accordingly. Some possible ideas include: posters, news articles, bumper stickers, web pages, ads, or radio segments. The materials should include a description of what lead poisoning is, identify risk factors, describe how it is treated and how it can be prevented. The campaign should be visually appealing and make people want to learn more.

Leaded Gasoline Around the World

The phase-out of leaded gasoline in the U.S. began in the 1970s, at a time when 88.2% of children age 1-5 had elevated blood lead levels. The phase-out of leaded gasoline is often called one of the most successful public health campaigns in the U.S. However, leaded gasoline is still used in most countries around the world. Most

African countries, in particular, use gasoline that has the highest concentration of lead in the world. Ask students to investigate both the success story of the U.S. and the challenges and health effects faced by countries that still use leaded gasoline. Check out the Global Lead Network, available at:
http://www.globalleadnet.org/
Also, Princeton Environmental Institute's website, Leaded Gasoline Phase-Out, is a good starting place, available at: http://www.princeton.edu/~vmthomas/pbgas.html

THE GEOGRAPHY OF CHILDHOOD LEAD EXPOSURE
Student Handout #1



Teacher Key

Background

Childhood lead poisoning is an important environmental health problem that affects children across America. The Centers for Disease Control estimate that about 434,000 American children, ages 1-5, each year suffer from lead poisoning. That means about 2.2 percent of all children ages 1-5 are affected by lead poisoning. Ever since leaded gasoline and lead-based paint were banned over twenty years ago, rates of childhood lead poisoning have been declining across the country.

Blood Lead Level (BLL): A measurement of the amount of lead in a person's blood. A BLL of over 10 µg/dL is considered dangerous.

Compared to the United States as a whole, Washington State has low levels of childhood lead poisoning. The Washington State Department of Health keeps records of all children who have been tested for lead poisoning. Since the levels of lead poisoning across the State are quite low, most children are never even tested for lead poisoning. In fact, only about 3 percent of children ages 1-5 ever have a blood test for lead. Of the 3 percent of children who are tested, only about 4 percent of them have an elevated **blood lead level** (higher than 10 **ug/dL**). Compare this to 28 percent of children in Philadelphia!

µg/dL: Micrograms per deciliter. A measurement of the amount of lead in a person's blood. The Greek symbol "µ" is pronounced "mew.".

Childhood lead poisoning is considered to be an **environmental justice** issue. Environmental justice is a social and political movement that believes that all people – regardless of race, country of origin, income level or education – have a right to a clean environment, including clean air, water, and soil. Childhood lead poisoning is an environmental justice issue because certain groups of children are more likely to suffer from lead poisoning than the rest of the population. If we look at the United States as a whole, a child's risk of lead poisoning increases if he or she:

Environmental Justice: The belief that all people — regardless of race, country of origin, income level, or education — have a right to clean air, water, and soil.

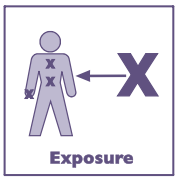
- Lives in a high risk community (geography)
- Comes from a low-income family (poverty)
- Is Black or Hispanic (ethnicity)

Other types of environmental justice issues include air pollution, water pollution, solid waste disposal, transportation, industry, human health and disease. "Environmental classism" refers to the fact that low-income people often live in less healthy environments than middle and high income people. "Environmental racism" refers to the fact that people of color are also more likely to live in neighborhoods where environmental health hazards are located, such as factories and hazardous waste sites.

In Washington State, public health officials have examined many statistics to learn about the **risk factors** for childhood lead poisoning that are specific to this region. The more the health department understands about lead poisoning risk factors, the better they can educate families of young children. The risk factors that increase a child's risk of having elevated blood lead levels include age of housing, poverty, geography, Hispanic ethnicity and parents' occupation.

Risk Factor: Something that increases an individual's chance of becoming ill, getting hurt, or being killed.

Age of Housing: Lead-based interior house paint was banned in 1977, but many old homes still have paint that contains lead. In Washington, there are 1.5 million homes that were built before 1978 and 80% of them probably still have some lead-based paint. Young children may ingest paint dust that gets on their hands, food or toys. Also, old homes may have lead plumbing, which can contaminate drinking water with lead.



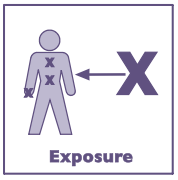
Poverty: Children who come from low-income families are more likely to live in older homes, which may have lead-based paint. Also, low-income children may not receive a proper, well-balanced diet. Children whose diets are high-fat and low in calcium are more susceptible to lead poisoning. In a child's body, lead acts just like calcium. A child with a poor diet will absorb more lead than a child with a well-balanced diet.

Geography: There is a higher rate of childhood lead poisoning in Central Washington than the rest of the state. There are several possible reasons for this risk factor. First of all, some counties in these regions might have industries that use lead products, such as a factory that releases lead-rich ash from its smokestacks. Even if the factory is now shut down, the soil downwind of the factory's location may still have high levels of lead.

Central Washington is known for its agriculture. Between 1905 and 1947, many Washington fruit orchards used a pesticide that contained lead arsenate, a combination of lead and arsenic. Most orchard soils still have elevated levels of lead and arsenic today. Some communities have built developments on land that used to be orchards. A sub-division, school or playground may now be located on soil that still contains lead and arsenic. People come in contact with the contaminated soil by tracking soil into their homes on their shoes, playing in the dirt, or eating vegetables grown in the contaminated soil.

Hispanic Ethnicity: In Washington State, Hispanic children have a higher rate of lead poisoning than do non-Hispanic children. About 0.9% of all children between the ages of one and two in Washington have elevated blood levels. If you look at Hispanic children between the ages of one and two, however, about 3.8% have elevated blood levels.

Many farm workers in Central Washington are Hispanic. Farm workers that work in areas with contaminated orchard soil may bring home lead particles on their clothing, shoes and hair. Many farm workers and their families live near agriculture fields and orchards. Their children may ingest lead dust when it gets on their hands, toys or food. In addition, several Mexican folk remedies and some types of Mexican candy sometimes contain lead. Two common folk remedies given to children to treat stomachaches, *greta* and *azarcon*, can contain up to 97% lead.



Rates of childhood lead poisoning continue to drop over time as people become more aware of the risks of lead poisoning. As a whole, lead poisoning rates have dropped considerably since household lead-based paint and leaded gasoline were banned. Hopefully in the future lead poisoning will rarely affect children.

Check Your Understanding

1. How do rates of childhood lead poisoning in Washington State compare to those across the rest of the United States? ***Washington has relatively low rates of childhood lead poisoning.***

2. The banning of what two products had a tremendous impact on lowering rates of childhood lead poisoning across the United States? ***The banning of leaded gasoline and household lead-based paint.***

3. Why is lead poisoning an environmental justice issue? ***Lead poisoning is an environmental justice issue because certain children (e.g. children of color and children living in poverty) are more likely to be exposed to lead than other children.***

Student Assessment:
Did the students complete the reading and thoughtfully answer the questions?

THE GEOGRAPHY OF CHILDHOOD LEAD EXPOSURE
Student Handout #2

Teacher Key

Data Mapping Activity

Examine the data chart below. This chart shows the percentage of children in various counties of Washington State who have elevated levels of lead in their bodies.

Elevated Blood Lead Levels in Children in Washington State, 1993-1998*

County	% of Children with BLLs above 10 µg/dL	Symbol or Color
Adams	4.2	
Benton	1.0	
Chelan	9.1	
Clark	1.7	
Cowlitz	1.9	
Franklin	0.8	
Grant	1.6	
Island	1.7	
King	4.0	
Kitsap	5.0	
Lewis	3.8	
Okanogan	3.7	
Pierce	4.7	
Skagit	2.1	
Snohomish	2.8	
Spokane	3.4	
Stevens	0.0	
Thurston	2.6	
Walla Walla	10.8	
Whatcom	2.8	
Whitman	1.6	
Yakima	5.3	

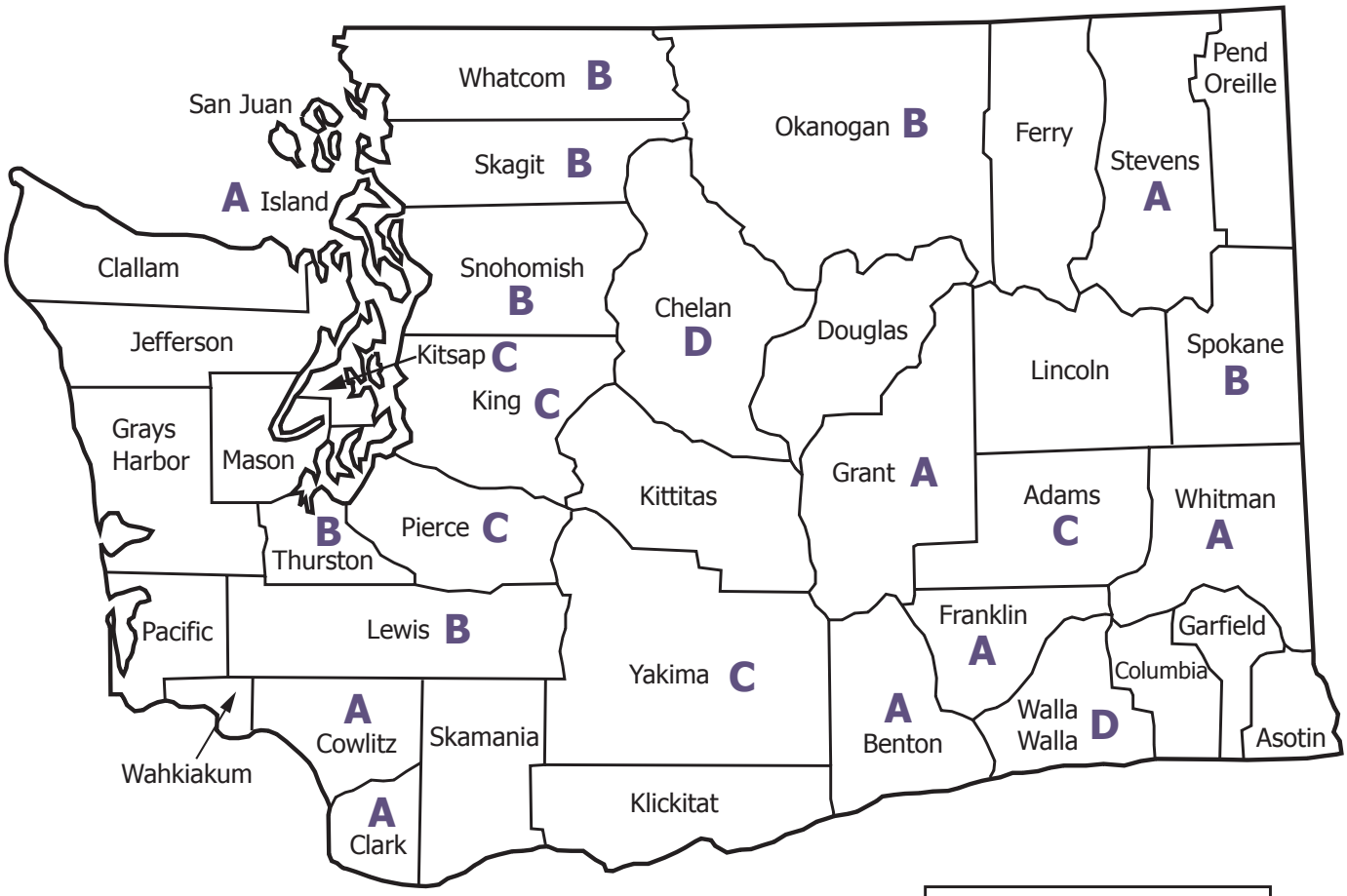
* Source: Washington State Department of Health, Office of Epidemiology, 2000.

Student Assessment:
Did the students' maps include the required elements?

TEACHER NOTE:
The sample map was completed using letters instead of colors because this guide is not printed in full color. Your students' maps will look different.

Now, it's time to put the data set on a map to make it easier to visualize what is happening. Do the following:

- Fill in the name of each county on the Washington state map below.
- Using colored pencils or pens, decide on a combination of symbols or colors to represent the range of data shown in the data key on the map below. For example, you might use green for counties where 0-1.9% of children have BLLs above 10 µg/dL, and blue for counties where 2.0-3.9% of children have BLLs above 10 µg/dL. Fill in the key below to show what colors or symbols you have chosen.
- On the data chart, complete the last column by indicating what symbol or color applies to that county.
- Locate the counties included in the data chart and color code each one based on the colors you have assigned on your data chart.



% of Children above 10µg/dL BLL
A = 0-1.9%
B = 2.0-3.9%
C = 4.0-5.9%
D = 6.0-10.9%

Lesson One: TOXIC CANDIES AND DANGEROUS CURES

Lesson Overview

Students read a short passage about folk remedies and candies from around the world that commonly contain high levels of lead. Students interview four adults to learn about different folk remedies and their origins. Students work in groups to read case studies about Hispanic children who were exposed to lead from folk remedies and imported candies. They then complete case history reports for each child, including recommended treatment options. Extension activities are also included for additional classroom work or homework assignments.

Suggested Grade Levels: 6 & 7
Curriculum Connections: Body systems and diseases, health, interviewing, interpreting case studies, and science/geography connections

EALRs Addressed

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

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 (Environmental and Resource Issues). (Science 1.2)
- Communicate scientific procedures, investigations, and explanations orally, in writing, with computer-based technology, and in the language of mathematics (Communication). (Science 2.1)
- Identify and examine common, everyday challenges or problems in which science/technology can be or has been used to design solutions (Identifying Problems). (Science 2.2)
- Describe personal and health care practices that result in prevention, detecting, and treatment of non-communicable diseases. (Health and Fitness 2.2)
- Distinguish between safe and unsafe use of health-care products. Identify ways people encourage health and unhealthy decisions, plan how to resist unhealthy messages, and create healthy messages. (Health and Fitness 3.2)

Teacher Background

For the purposes of this lesson, we are defining a folk remedy as any method of treating injury or illness that is passed down through tradition and is related to a specific region or culture.

A variety of resources (in English and Spanish) about Toxic Candies, including articles, posters, and a Toxic Treats Index can be found on the Orange County Register's Special Investigation website (see below).

Materials developed by the Integrated Environmental Health Middle School Project (NIEHS Grant #ES10738 and #ES07033).

For a more in-depth understanding of the risks of folk remedies and imported candies, consult the following resources that were used to prepare this lesson:

- Centers for Disease Control and Prevention, "Childhood Lead Poisoning Associated with Tamarind Candy and Folk Remedies, California 1999-2000." http://www.cdc.gov/mmwr/preview/mmwrhtml/mm5131a3.htm
- Washington State Department of Health News Release, "State Department Warns About Dangers of Mexican Folk Remedies." http://www.doh.wa.gov/Publicat/2000_News/00-59.html
- Orange County Register, "Special Investigation: Toxic Treats." http://www.ocregister.com/investigations/2004/lead/index.shtml

Teacher Preparation

MATERIALS: Copies of **Student Handouts**
Copies of **Case Study Cards**

- Make enough copies of the two **Student Handouts** for each student or group to have a set. Each student will need four copies of the **Folk Remedy Interview Sheet**. Master copies of the handouts are included at the back of this book.
- Make one copy of each of the **Case Study Cards**, and enough copies of the **Blood Lead Level Chart** and **Patient Case History Sheet** so that each group of students will have one.
- Optional: Print articles, slideshow, graphics, and a poster from the Orange County Register's Toxic Treats website.
- If you are the first teacher in your team to use this FACT FILE, make copies of the student handout entitled, **Student Introduction: Environmental Health and Lead**. Ensure that students have read the handout and mastered the content and vocabulary.

Procedure

- Distribute **Student Handout #1: Toxic Candies and Dangerous Cures** as an introduction to this lesson.
- **Interview Activity:** This activity provides a good introduction to the origins of folk remedies. Students interview four adults to learn about different folk remedies for common ailments. Students should interview at least one family member, but seek out adults of different generations and different ethnic backgrounds. Students should use the **Folk Remedy Interview Sheet** to record their answers.
- Once the interviews are complete, compile a class list of all of the different remedies suggested by the interview subjects. You may want to have students work together to group the different remedies into categories. Categories might include country of origin and type of remedy (exfoliant, massage, astringent, etc.). Students can also look for connections between folk remedies and current medical treatments for the same condition.
- Explain that different cultures around the world have their own remedies for illnesses that may differ from those on the students' list. Some of these remedies may contain high levels of lead, which makes the remedy actually hazardous to human health, especially for young children. Many people in the U.S. also use folk remedies imported from other countries. Distribute **Student Handout #2: Lead Levels in Folk Remedies**. Review the information on the handout with the students.

- **Case Study Activity**: Divide students into small groups and distribute one **Case Study Card**, one **Blood Lead Level Chart** and one **Patient Case History Sheet** per group. Each group should read the case study and BLL chart and use that information to fill out their case history sheet, as if they were the physician treating the child. Then, each group should present their case study to the class, including reporting on what the likely sources of lead were and what treatment they recommended. An example case history sheet has been provided.

Student Assessment

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

10%	Did students complete **Student Handouts #1** and **#2** and correctly answer the **Check Your Understanding** questions?
40%	Did students interview four adults and fill out one **Folk Remedy Interview Sheet** per person?
5%	Did students participate in compiling a **class list** of folk remedies?
35%	Did students work in a group to evaluate one **Case Study Card** and complete one **Patient Case History Sheet**?
10%	Did students make **effective group presentations** about their case study?

Extension Activities

Mapping Activity: Using **Student Handout #2: Lead Levels in Folk Remedies**, ask students to group the folk remedies by region of origin. Using a world map, students can plot the origin of the folk remedies by assigning a different color to each region or country and marking it on the map. Students should create a key to the colors at the bottom of the map. In addition, students should create a key on the student handout by marking a color or symbol for each remedy on the list.

Health Warning: The students all work for the Washington State Department of Health, which has issued health warnings on the Mexican folk remedies *greta* and *azarcon* and certain imported candies. The students are challenged to create a media campaign designed to educate Hispanic populations about the dangers of these products. The students should consider:

- Who is their targeted audience? What language or cultural barriers might they need to consider?
- Where are the best places to reach the intended audience? (Cultural community centers, community newspapers, ethnic grocery stores, etc.).
- What form of media will be used? (Radio, television, newspaper articles, posters, etc.).
- For an example of a Washington State Department of Health news release, see the bulletin entitled “State Department Warns About Dangers of Mexican Folk Remedies.”
  http://www.doh.wa.gov/Publicat/2000_News/00-59.html

Medicine Bags: Students explore medicine bags from different cultures and time periods. A medicine bag reflects the culture, climate, biology and medical knowledge of a particular place and time. Students consider what ingredients would be included in medicine bags from a variety of cultures (an Ancient Roman physician, a Native American medicine man at the time of Lewis and Clark, a Hispanic immigrant to

Student Assessment:
The extension activities provide for more in-depth assessment of student understanding.

the United States, etc.). Students will need to conduct some research on the specific culture and time period. In addition, students can create their own medicine bags including ingredients from their families' own home remedies. For the lesson plan "Chemistry of Folk Remedies," go to the AEL Rural and Urban Images Project's website. http://www.ael.org/nsf/voices/curric/folk.htm

TOXIC CANDIES AND DANGEROUS CURES
Student Handout #1

Teacher Key

Toxic Candies

Mexican candies—sweet and spicy lollipops, powders, jellies, wafers, rolls, suckers and chewing gum—are imported into the United States and sold in supermarkets, candy stores and on ice cream trucks. Many of these brightly wrapped sweets are actually toxic treats. Children in Washington, Oregon and California have suffered from lead poisoning traced to eating certain types of imported Mexican candy.

Risks & Benefits

Candies that are manufactured in Mexico often do not meet the same food safety laws that candies manufactured in the United States must meet. When Mexican candies are imported into the United States, they are rarely inspected by regulators or tested by health officials. Candies are often brought over the border in suitcases and car trunks, to be shared with family members. This makes the challenge of regulating the flow of Mexican candies into the U.S. even more difficult.

The California Department of Health Services has conducted over 1,500 tests on Mexican candy since 1993, finding that one out of four candies tested high for lead. In the past decade, over 112 brands of imported candy—mostly from Mexico—have been found to contain dangerous levels of lead. Some candies contain enough lead that a child could exceed the daily allowable lead limit by eating just one piece of candy.

These candies can become contaminated with lead from several different sources. Some candy wrappers and lollipop sticks are printed with ink that contains lead. The ink on the wrapper can be transferred onto the sticky candy. Children also ingest lead when they lick and chew the wrappers and sticks.

Many popular Mexican candies contain spicy chili powder or sticky **tamarind** pulp. When chili peppers are processed, they are harvested from the field, dried and ground up into powder. Usually, the peppers are not cleaned before drying, so soil, fertilizers and pesticides (all of which may contain lead) that are stuck to the peppers get ground up into the chili powder. Likewise, these contaminants also stick to tamarind pods and are not removed during processing.

Tamarind candy from Mexico can contain high levels of lead

Tamarind:
A bean-like fruit from the tamarind tree, often made into candies in Mexico.

Some Mexican candies are packaged in tiny handmade clay pots. In order to make the pots shiny, a pottery glaze is applied to them. Many of these pots are made with a traditional glaze called *greta* that contains lead. The lead in the glaze can then get into the sticky candy jelly. The candy is made from a spicy-sweet mixture of tamarind pulp and chili powder. Mexican candy in handmade pots has three possible sources of lead contamination: the glaze on the pot, the tamarind pulp, and the chili powder.

Exposure

The Mexican government, while aware of the problem with the contaminated candies, has been unsuccessful in stopping the manufacture and export of these toxic treats.

While some health officials have worked toward regulating candy makers, their resources are limited. Many candy manufacturers say that they do not believe that there is a problem with their candy. However, some candy manufactures have made changes to their manufacturing and packing processes in an effort to reduce lead contamination.

Health advisories have been issued by health departments in Washington, Oregon and California warning about lead in imported candies. So far, the federal government has not taken serious action toward Mexican candy manufacturers or strengthened import regulations. The U.S. Food and Drug Administration regulates the importation of candies while the Consumer Product Safety Commission regulates the candy wrappers.

Dangerous Cures

Folk remedies, also known as home remedies, are used to help treat a sickness or injury. You probably know of many folk remedies that your own family uses. For example, have you ever eaten chicken soup for a cold, gargled with salt water for a sore throat, or drank ginger ale or mint tea for a stomach ache? Folk remedies tend to be passed down through generations and many have their origins in other cultures.

Some folk remedies have been proven to work, while others are ineffective. Some folk remedies can even be harmful since they include dangerous ingredients, like lead. Some ancient folk remedies seem silly nowadays, such as treatments used by the Ancient Romans for lead poisoning. Ancient Roman physicians had some strange prescriptions for the stomach aches and cramps that went along with lead poisoning. For example, they might have the patient get a puppy to lie across his or her stomach. The thinking was that because dogs are such empathetic creatures, they would take the patient's pain onto themselves. Another remedy involved placing buttered toast onto a sore stomach.

Folk Remedy:
Any method of treating injury or illness that is passed down through tradition and is related to a specific region or culture.

In the Pacific Northwest, Hispanic families are at a higher risk for becoming lead poisoned from folk remedies. Two particularly dangerous folk remedies are Mexican stomach ache treatments traditionally given to Hispanic children. These powdered medicines, known as *greta* and *azarcon,* are mixed with water and then swallowed (ingested). Both remedies can contain up to 99% lead. Oftentimes, Hispanic families will bring these Mexican remedies with them to the U.S.

Student Assessment:
Did the students complete the reading?

Other Sources of Lead

Other common sources of lead poisoning include paint, miniblinds and pottery. Older homes built before 1978 may contain lead-based paint. Children are at risk from ingesting paint chips or inhaling paint dust, especially during renovations when paint is scraped or sanded. Some brands of imported vinyl miniblinds contain lead. The vinyl breaks down in sunlight, releasing lead-contaminated dust, which can be ingested or inhaled. Some types of glazes used on pottery and ceramics contain lead. When food and beverages are stored in or served on pottery or ceramic dishes treated with lead-based glazes, the lead can get into the food or beverage and be ingested.

Source: McKim, J., Sharon, K., and Heisel, W. Hidden Threat, *Orange County Register*. April 25, 2004. Available at http://www.ocregister.com/investigations/2004/lead/index.shtml.

Check Your Understanding

1. Name two sources of lead contamination found in some types of Mexican candies.
   Answers may include: lead-based ink on wrapper and/or stick; lead in chili powder; lead in tamarind pulp; lead-based glaze on clay pots.

2. How could the manufacturing process be changed to reduce how much lead gets into some types of Mexican candies?
   Answers will vary, but may include using lead-free inks, washing chili peppers before processing, using pesticides and fertilizers that are lead-free, and using lead-free pottery glazes.

3. Name one folk remedy that you or your family has used to treat an illness or injury.
   Answers will vary.

4. Through what route of exposure are children exposed to the Mexican folk remedies *greta* and *azarcon*?
   Ingestion.

Interview Activity

Folk Remedy:
Any method of treating injury or illness that is passed down through tradition and is related to a specific region or culture.

Student Assessment:
Did the students interview four adults and take appropriate interview notes?

Folk Remedy Interview Sheet

Select FOUR adults to interview for this activity. You should interview at least one family member, but seek out adults of different generations and different ethnic or cultural backgrounds. Use this page to take notes during the interview (one sheet per person interviewed).

Your Name: **Date:**

Name of Person Being Interviewed (Subject):

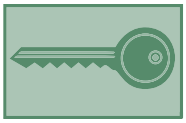
Subject's Age:

Subject's Ethnicity/Cultural Background:

Ask the interview subject what **folk remedies** he or she has used to treat the following conditions:

CONDITION	FOLK REMEDY
Acne	
Allergies	
Asthma	
Bites & Stings	
Bleeding	
Burns	
Colds	
Dandruff	
Earache	
Headache	
Heartburn	
Hiccups	
Nosebleed	
Snoring	
Sore Throat	
Sprains	
Stomach Ache	
Sunburn	
Teething & Toothache	
Other	

TOXIC CANDIES AND DANGEROUS CURES
Student Handout #2



Teacher Key

Chart of Lead Levels in Folk Remedies from Around the World*

Name of product	Region of origin	Typical Lead level	Medicinal use	Route of Exposure
Albayalde or **Albayaidle**	Mexico and Central America	93%	*Empacho* (vomiting, colic, fatigue)	Ingestion
Alarcon, Azarcon, Coral, Luiga, or **Maria Luisa**	Mexico	95%	*Empacho* (see above)	Ingestion
Alkohl	Middle East	85%	Topical medical preparation; applied to umbilical stump	Absorption
Ba Bow Sen	China	Up to 100%	Hyperactivity and nightmares in children	Ingestion
Bint al dahab, Bint or **Bent dahab**	Oman, Saudi Arabia, India	98%	Diarrhea, colic, constipation	Ingestion
Cebagin	Middle East	51%	Teething powder	Ingestion, absorption
Cordyceps	China	2%	Hypertension, diabetes, bleeding	Ingestion
Deshi Dewa	Asia, India	12%	Fertility pill	Ingestion
Ghasard	India	2%	Daily tonic	Ingestion
Greta	Mexico	97%	*Empacho*	Ingestion
Kohl, Surma, Saoott	Africa, Asia, India, Pakistan, Middle East	Up to 86%	Cosmetic, astringent for eye injuries and umbilical stump, teething powder	Absorption, Ingestion
Kushta	India, Pakistan	73%	Diseases of the heart, brain, liver, and stomach	Ingestion
Pay-loo-ah	Laos (Hmong)	90%	High fever, rash	Ingestion

*Adapted from New South Wales EPA, "Traditional Remedies Reported to Contain Lead." http://www.epa.nsw.gov.au/leadsafe/remedies.htm

Case Study Activity

Blood Lead Level Chart*

BLOOD LEAD LEVELS (BLL)	SEVERITY AND RECOMMENDED TREATMENT
LEVEL 1 Low Zone < 10 µg/dL	**Indicates a low blood lead level.** Inform parents of potential lead hazards in child's environment. **Retest child at physician's discretion or as parental concerns arise.**
LEVEL 2 Border Zone 10 – 19 µg/dL	**These children are in a border zone.** Adverse health effects will be subtle and children probably will not show symptoms. In order to identify and control the specific source of lead exposure, parents should be provided with family lead education. Conduct a home interview and environmental investigation in conjunction with local health department. **Continue retesting at 2-3 month intervals until the child's BLL has dropped below 10 µg/dL.**
LEVEL 3 Danger Zone 20 – 44 µg/dL	**While symptoms still may not be apparent, the potential for adverse health effects is greatly increased.** The source of lead in the child's environment must be indentified and controlled. A home interview and environmental investigation should be carried out in conjunction with the local health department. Other family members may also need to be tested. **Continue retesting at regular intervals (weekly or monthly) until the child's BLL drops below 10 µg/dL.**
LEVEL 4 Emergency Zone 45 µg/dL or higher	**Hospitalize the child and begin medical treatment immediately.** Serious mental or nervous system damage can result. Provide family lead education. Conduct home interview and environmental investigation in conjunction with local health department. All members of the household need to be tested. **Retest within 48 hours.**

Blood Lead Level (BLL):
A measurement of the amount of lead in a person's blood. A BLL of over 10 µg/dL is considered dangerous.

µg/dL:
Micrograms per deciliter. A measurement of the amount of lead in a person's blood. The Greek symbol "µ" is pronounced "mew".

*Adapted from Washington State Department of Health, "Medical Management of Children with Elevated Blood Lead Levels."
http://www.doh.wa.gov/Topics/MEDmgmt.doc

Patient Case History Sheet
Case Study # *1*

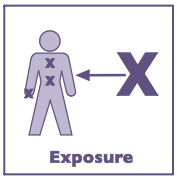
Date: *March 1999*

Patient Name: *José* **Sex:** *Male* **Age:** *4 years old*

BLL Lab Results: *88.0 µg/dL*

Diagnosis and Severity: *Lead poisoning, medical emergency*

Possible ROUTES OF EXPOSURE:



- **Inhalation:**

  – Dust on miniblinds in child's home tested positive for lead, possibly could have inhaled dust.

- **Ingestion:**

  Greta powder given as a folk remedy, tested at 770,000 ppm (or 77%).

  Imported Mexican candies, wrapper tested at 16,000 ppm (or 1.6%). Lead could have absorbed into candy or child could have licked wrapper.

- **Absorption through Skin:**

  No apparent risk

Recommended Treatment:

Because of his high BLL, José needs immediate medical therapy. He should be hospitalized and begin treatment immediately. Serious mental or nervous system damage can result from such a high BLL.

Recommended Follow-up with Family:

Family needs to be counseled to abstain from using greta powder as a home remedy. Instead, suggest safer, effective over-the-counter medications for stomachaches. Child should not be allowed to eat imported Mexican candies. All candies in the home need to be destroyed. Family can consider replacing miniblinds with PVC-free blinds, but this is of less concern. Other family members who may have eaten candy or ingested greta powder may need to be tested for lead poisoning.

Student Assessment:
This completed sample Case History Sheet is provided to help evaluate student work.

Student work can be assessed in the following ways:

Did the students correctly complete the case history sheet?

Did the student groups clearly present their case studies to the rest of the class?

Case Study Cards

Lead Poisoning Case Study #1

In March 1999, two Hispanic children residing in the Central Valley of California were identified during routine lead poisoning screening.

José, a four year-old boy, had a blood lead level of 88.0 µg/dL. His six year-old sister, Carmen had a blood lead level of 69.0 µg/dL. Neither the children nor their parents had recently traveled outside of the United States.

Folk Remedies: The children had been given *greta,* a Mexican folk remedy used to treat stomachaches. *Greta* powder collected from the family's home had a lead level of 770,000 ppm (or 77%).

Pottery: No pottery in the home tested positive for lead.

Home Environment: Tests on paint and dust from their home did not indicate high lead levels. Miniblinds on the windows of the home tested positive for lead.

Mexican Candies: Imported candies, including Dulmex-brand Bolirindo lollipops, were found in the home. Tests on imported candies collected from the home revealed a candy wrapper with a lead level of 16,000 ppm (or 1.6%).

Lead Poisoning Case Study #2

In May 2000, a four year-old Hispanic boy named Carlos was identified during routine lead screening. Carlos had a blood lead level of 26 µg/dL. His family had recently moved to Fresno County, California from Oaxaca, Mexico.

Folk Remedies: It is not known if Carlos received any folk remedies while in Mexico or the U.S.

Pottery: In Mexico, the family had used a ceramic bean pot and water jug regularly.

Home Environment: An environmental investigation did not reveal high lead levels in dust, paint, or soil.

Mexican Candies: Tests on imported candies collected from the home revealed a candy wrapper with a lead level of 16,000 ppm (or 1.6%).

Lead Poisoning Case Study #3

In June 2000, a Hispanic boy named Luis, aged 2 years, was identified through routine screening. Luis had a blood lead level of 26 µg/dL. He resides in Orange County, California.

Folk Remedies: Luis had been given *greta* and *azarcon* to treat a stomachache, Mexican folk remedies that usually contains substantial amounts of lead.

Pottery: It is not known if the family uses any imported pottery at home for cooking, serving or storing food.

Home Environment: The family's house was built in 1963 and had been renovated during early 2000. Tests on soil, paint, and dust in and around the child's home did not reveal high lead levels.

Mexican Candies: Luis had eaten various imported tamarind fruit candies purchased routinely by his family in Mexico. High lead levels were found in one of the three brands of imported candies the child had eaten. A Dulmex-brand Bolirindo lollipop had levels of 404 ppm (.04%) in the stick and 21,000 ppm (2.1%) of lead in the wrapper.

Lead Poisoning Case Study #4

In August 2000, a four year-old Hispanic boy named Daniel was identified through routine screening. Daniel, a resident of Los Angeles County, California had a blood lead level of 22 µg/dL. When the child was tested at age 1, he had an acceptable BLL of 5 µg/dL. Daniel was born in the United States and had not traveled to Mexico.

Folk Remedies: Daniel's family reported that they do not use folk remedies.

Pottery: Daniel's family said that they do not use imported pottery.

Home Environment: An environmental investigation of their apartment, which was built in 1986, did not reveal high lead levels.

Mexican Candies: Family members reported that Daniel had been eating Mexican candies regularly for 3 years. A Dulmex-brand Bolirindo lollipop found in the home had levels of 404 ppm (.04%) in the stick and 21,000 ppm (2.1%) of lead in the wrapper.

Case Study Cards

Lead Poisoning Case Study #5

In June 2000, a two year-old Hispanic girl named Marie was brought to see a doctor. The physician recognized the symptoms of lead poisoning and tested her blood lead level. Marie, a resident of Walla Walla, Washington, had a blood lead level of 124 µg/dL. This was the highest blood lead level seen in the State in seven years. Marie's family had recently moved to Washington from Mexico.

Folk Remedies: Marie's family told her physician that they had given her *greta,* a traditional Mexican folk remedy as a treatment for stomachaches. The state public health laboratory tested a sample of the remedy and found that it contained nearly 80% lead. The family had purchased the medicine in Mexico and brought it with them to Washington State.

Pottery: It is not known if Marie's family used imported pottery.

Home Environment: An environmental investigation of their apartment did not reveal high lead levels.

Mexican Candies: It is not known if Marie ate imported candies.

Case studies adapted from: "Childhood Lead Poisoning Associated with Tamarind Candy and Folk Remedies: California, 1999-2000" and Washington State Department of Health News Release, "State Department of Health Warns About Dangerous Mexican Folk Remedies," (June 15, 2000).

Lesson Two: FOUR LEAD AWARENESS ACTIVITIES

Lesson Overview

This lesson focuses on the dangers of lead in household paint, dust, soil and drinking water. Students work in small groups to investigate four different ways that people commonly come in contact with lead in their homes. Each activity includes background reading, data collection and observation. Each group then makes a presentation to the rest of the class about its investigation. Extension activities are also included for additional classroom work or homework assignments.

Suggested Grade Levels: 7 & 8
Curriculum Connections: Environmental science, investigations, making predictions and observations, and collecting data

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:

- Develop abilities necessary to do scientific inquiry. Use evidence from scientific investigations to think critically and logically to develop descriptions, explanations, and predictions. (Science Explanations 2.1)
- Communicate scientific procedures, investigations, and explanations orally, in writing, with computer-based technology, and in the language of mathematics. (Science Communication 2.1)
- Apply science knowledge and skills to solve problems or meet challenges. Identify and examine common, everyday challenges or problems in which science/technology can be or has been used to design solutions. (Science Identifying Problems 2.2)

Teacher Background

For a more in-depth understanding of lead in paint, soil, dust, and water, consult the following resources that were used to prepare this lesson:

- Seattle & King County Public Health Department Lead Information Site
  http://www.metrokc.gov/health/tsp/arseniclead.htm
- Fact Sheet on Lead produced by the EPA
  http://www.epa.gov/safewater/contaminants/dw_contamfs/lead.html
- EPA's Lead in Paint, Dust and Soil Website
  http://www.epa.gov/opptintr/lead/index.html
- Tacoma Pierce County Health Department Hand Washing Website. Includes lesson plans, kid's activities and more related to proper hand washing.
  http://www.gotsoap.net

Teacher Preparation

- Collect materials for each activity. Specific materials for each of the four different activities included in this lesson are listed in the **procedure** section below. Some materials may need to be ordered in advance.

- If you are the first teacher in your team to use this FACT FILE, make copies of the student handout entitled, **Student Introduction: Environmental Health and Lead**. Ensure that students have read the handout and mastered the content and vocabulary.

- Make enough copies of the **Student Handouts** for each student or group to have a set. Master copies of the handouts are included at the back of this book.

- Break students into at least four different work groups. Assign one activity (dust, soil, hand washing, and water) to each group.

Procedure

- There are four different activities suggested for this lesson. You may pick and choose from these activities and find your own way of setting up this lesson. One way to set up your classroom is to break your students into four groups and assign an activity to each group. Each group is responsible for conducting their own investigations using the supplied materials and their **Student Handouts**. Alternatively, you may want to focus on just one or two of the investigations.

- After completing the activities, each student group can prepare a report on what they learned during their activity. During a follow-up class period, have each group report on their findings to the rest of the class. You may want to encourage students to demonstrate a portion of their experiment or create some visual aids. For example, the group doing Activity #2 could show how much soil was tracked on the mat, demonstrate how to use a lead swab test and create a “Please Remove Your Shoes” sign to be posted by the front door in people’s homes.

Activity #1 – Lead Dust Cleanup:

- For each student group, you will need the following **MATERIALS:**

  Student Handout #1
  Baby powder, flour or cornstarch
  Rubber gloves
  Access to water
  Liquid dishwashing detergent
  Three buckets or other large containers
  Hand whisk broom or duster
  Spray bottle filled with water
  Several rags or sponges.

- In this activity, students will investigate the three-bucket cleaning technique for properly cleaning areas contaminated with lead dust. This technique is recommended by the EPA for cleaning areas that are known to be contaminated with lead dust from paint. The students will compare the effectiveness and safety of the three-bucket technique with two other cleaning methods.

Activity #2 – Lead Underfoot:

- For each student group, you will need the following **MATERIALS:**

  Student Handout #2
  A white or light colored piece of heavy fabric the size of a door mat
  Access to outside
  A sensitive lab scale
  A lead swab test kit

- If students have internet access, have them access the Public Health Department fact sheet below. If they do not have internet access, print it out and give it to them as a handout.

  King County Public Health Department, Soil Safety Guidelines
  http://www.metrokc.gov/health/tsp/guidelines.htm

- In this activity, students need access to outside so they can track dirt in on their shoes and then wipe their shoes clean on a fabric mat. The students then weigh the amount of soil collected on the mat, make observations, and use a lead swab test kit to test for the presence of lead in the soil.

- You can purchase lead swab test kits at most paint and hardware stores. One example is the "Lead Check Household Lead Test Kit," which includes two swabs and costs around $8.00. Be sure that the test kit you purchase can be used for testing soil and dust and follow the specific instructions that come with the test kit.

Activity #3 – Effective Hand Washing:

- For each student group, you will need the following **MATERIALS:**

  Student Handout #3
  Access to a sink
  A bottle of Glo Germ Gel™
  A small black light
  A bottle of antibacterial waterless hand washing gel
  A watch with a second hand
  Paper towels
  Hand soap

- In this activity, students discover the most effective method for washing hands. Proper hand washing techniques are important for protecting young children from ingesting lead paint dust.

- In this activity, the students are challenged to develop four different methods for washing hands, such as rinsing hands with water, using antibacterial hand washing gel, and scrubbing carefully with soap. They make a hypothesis about the effectiveness of each method. Then, using a special gel that glows underneath a UV light, they try out each of the four methods. Using the UV light, the students are able to see how much residue remains after washing their hands with the different methods. The students record their observations and estimate the percentage of the hand that still has gel on it.

- Glo Germ Gel™ can be purchased online. An 8 oz. bottle, good for 75-100 applications, will cost about $15.00. You can also purchase UV lights from this

website or most large hardware stores. Glo Germ Powder™ can also be used to sprinkle on floors, countertops and windowsills and see how much is picked up on your hands during daily activities. (http://www.glogerm.com or phone 1.800.842.6622)

Activity #4 – Pollution Dilution Investigation:

- For each student group, you will need the following **MATERIALS:**

  Student Handout #4
  1 bottle of water
  1 bottle of dark colored food coloring (blue works well)
  8 plastic spoons; 1 eye dropper
  Color pencils the same color as the food coloring
  1 plastic cup

- If students have internet access, have them access the EPA fact sheet below. If they do not have internet access, print it out and give it to them as a handout.

  EPA's Consumer Fact Sheet on Lead
  http://www.epa.gov/safewater/contaminants/dw_contamfs/lead.html

- In this activity, students investigate lead in drinking water from public water systems. The students first read an EPA fact sheet on lead in drinking water and answer the questions on the **Student Handout**. Then, the students investigate the measurement of parts per billion through an activity.

- If students have internet access, you can also challenge them to find the drinking water quality report for their local water supplier and investigate the local levels of lead in drinking water. For example, Seattle Public Utilities' Drinking Water Quality Annual Report has a special section devoted to lead monitoring. During a 1997 survey of 390 households, SPU found that 14% of the homes had lead levels in drinking water above the EPA action level of 15 ppb due to corrosion from lead plumbing and solder.

Student Assessment

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

40%	Did students (working in groups) **complete the investigation** as directed on the **Student Handout**, using proper lab protocol?
20%	Did students completely and carefully **record their predictions**, **observations, and data** on their **Data Chart**?
10%	Did students correctly **answer the questions** on the **Student Handout**?
20%	Did students work together in their groups to prepare an effective **group presentation** about their investigation and observations?
10%	Did students cooperate and actively participate within their groups?

Extension Activities

Student Assessment:
The extension activities provide for more in-depth assessment of student understanding

Lead in the Body: Have students create posters or 3-D models that display lead's effects on human body systems (nervous, circulatory and digestive). Students can work individually or in teams. If working in teams, each group can choose a different body system. The students' posters and models should include information on symptoms, physiology, long-term effects and information on prevention.

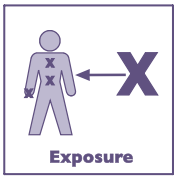
Unleaded Kids: Challenge students to create educational materials to teach people about how they can protect themselves from lead poisoning. Each student should define who their audience is (adults, parents, young children, schools, etc.) and design their materials accordingly. Some possible ideas include: a poster, article, bumper sticker, web page, or radio segment.

FOUR LEAD AWARENESS ACTIVITIES
Student Handout #1

Teacher Key

Activity #1 – Lead Dust Cleanup

Older homes and apartments that were built before 1978 may have lead-based paint in them. As this paint ages, it may chip or flake. Also, the paint might be rubbed off as dust in areas where the surface rubs against another surface, such as a door jam or a window track. This lead-contaminated dust can collect on countertops, along windowsills, in carpets and on floors. Families with young children need to be especially careful to regularly clean their homes to make sure that children do not ingest dust that gets on their toys or their hands. However, common cleaning techniques, like sweeping with a broom or dusting with a feather duster, can actually make the problem worse by scattering the dust into the air where it can be inhaled The United States Environmental Protection Agency recommends a three-bucket cleaning method for cleaning areas with lead contaminated dust.



You can use an all-purpose cleaner for cleaning up lead dust, or there are special detergents with high phosphate contents designed specifically for cleaning up lead dust.

In this activity, you will compare the effectiveness and safety of cleaning up lead contaminated dust from a household surface using three different methods. For safety purposes, you will be using either flour, cornstarch or baby powder to represent dust that is contaminated with lead. **Make sure to wear rubber gloves during your investigation in order to demonstrate proper safety techniques.**

Investigation Procedure

Do the Following:

1. First, sprinkle a fine layer of “dust” on a horizontal surface, such as a lab table or desk top.

2. You will be using three different cleaning techniques and comparing them on levels of effectiveness and safety. Make a prediction about the effectiveness and safety of each cleaning method on your data chart.

3. One person in your group should clean up the dust using a hand whisk broom or duster. Observe how well the dust is cleaned up and how much dust is scattered into the air and onto other surfaces. Write your observation on your data chart. If needed, scatter more dust for the next investigation.

4. Now, one person in your group should use the spray bottle to mist water over the dust. Then, try sweeping the dust. Write your observations on your data chart. If needed, scatter more dust for the next investigation.

5. This time, you will use a three-bucket cleaning technique. Fill one bucket with water and a small squirt of dish soap. Fill the second bucket with plain water. Leave the third bucket empty so that you can squeeze dirty water from a rag or sponge into it. Clean up the dust using the following procedure:

Materials developed by the Integrated Environmental Health Middle School Project (NIEHS Grant #ES10738 and #ES07033).

- Wet a clean rag or sponge with the cleaning mixture in Bucket 1.
- Wipe the dusty surface with the damp rag or sponge.
- Rinse the rag or sponge in the plain water in Bucket 2.
- Squeeze extra water out of the rag or sponge into the empty Bucket 3.
- Continue this process until the entire surface is clean.

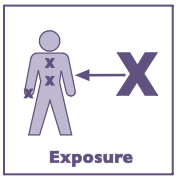
Data Chart

	Dry Sweeping or Dusting	Wet Sweeping or Dusting	Three-Bucket System
Prediction: Effectiveness			
Prediction: Safety			
Observation: Effectiveness			
Observation: Safety			

Student Assessment:
Did the students thoughtfully record their predictions, observations, and data on the data chart and then answer the follow-up questions?

1. Which cleaning method seemed to be the **most effective** at cleaning the dust?

2. Which cleaning method seemed to be the **safest** when cleaning up lead contaminated dust?



3. What are the possible **routes of exposure** that lead can get into the body when someone is cleaning up an area with lead contaminated dust?

4. What should be done with cleaning rags or sponges after they have been used to clean up lead contaminated dust?

FOUR LEAD AWARENESS ACTIVITIES
Student Handout #2

Teacher Key

Activity #2 – Lead Underfoot

Lead can occur naturally in soil. The Washington State Department of Ecology and the United States Geological Survey have determined that the natural level of lead in soil around the Puget Sound area is 24 ppm (**parts per million).** The Washington State average is 17 ppm. One of the reasons for the elevated lead levels in Puget Sound area soil is thought to be related to an old **smelter** that used to be located near Tacoma. The smelter emitted both lead and **arsenic** in the area. Depending on the direction of the wind, these heavy metals settled in soil around much of the Puget Sound area. Other parts of the state may have elevated lead levels in soil because of industry, like smelters, or in agricultural areas where pesticides containing lead and arsenic were once applied. Also, lead levels can be elevated in the soil around buildings that have lead based paint on their exterior. When the paint ages, it flakes off into the surrounding soil. When paint is sanded or scraped off during renovations, paint dust can fall into the surrounding soil.

First, read the handout entitled **Soil Safety Guidelines to Reduce Your Risk from Contaminated Soil.** Then, conduct the following investigation to learn about how much soil can be tracked into a home. You will also use a simple lead swab test kit to learn how to test for the presence of lead. It is important to note that the lead swab test kit only tells you whether or not lead is present in the soil. It does not provide any information about the amount of lead in the soil. Remember that lead can occur naturally in soil.

Parts per Million (ppm): A measurement of the amount of a substance within a solution. Represents a dilution of 1/1,000,000.

Smelter: An industrial process of using high temperatures to melt (or "smelt") a metal from an ore. Smelting processes often release hazardous substances into the air.

Arsenic: A naturally occurring chemical element that is toxic to human health. At one time, it was used as in ingredient in lead arsenate pesticides applied to orchards. Arsenic can be emitted as a by-product of copper smelting. Its chemical symbol is "Ar".

Investigation Procedure

Do the following:

1. First, weigh the clean fabric mat to determine its weight. Record this information on your data chart.

2. With your teacher's permission, one person from your group should go outside and walk around in areas where the soil is exposed. Before this person comes back inside the building, have them carefully wipe their feet on the fabric mat until their shoes are relatively clean.

3. Record some observations about the condition of the soil outside and about how you collected the soil. Some observations you might want to include: How wet was the soil? Has it rained recently? How long and how far did the person walk while collecting soil on their shoes? What kind of tread was on their shoes? Also make some observations about the soil collected on the fabric mat.

4. Then, re-weigh the mat and calculate the weight of the soil that has been collected on it.

5. Use the lead swab test kit to test a small sample of soil taken from the fabric mat. Carefully follow the directions that came with the test kit for testing soil samples. Record your findings on the data chart.

Materials developed by the Integrated Environmental Health Middle School Project (NIEHS Grant #ES10738 and #ES07033).

Data Chart

Weight of Clean Mat:

Weight of Mat with Soil:

Total Weight of Collected Soil:

Observations of Outside Soil Conditions and How Soil was Collected	
Observations of Soil Collected on Mat	
Results of Lead Swab Test	

Student Assessment:
Did the students thoughtfully record their data and observations on the data chart and answer the follow-up questions?

1. How would your results differ if the outside soil had been muddier or drier?

2. Do you think that you would get different results if you tried shoes with different kinds of treads on the soles? How would the results differ?

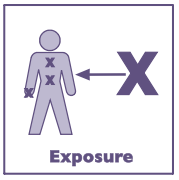
3. List three things that people can do to protect themselves from lead contaminated soil.

FOUR LEAD AWARENESS ACTIVITIES
Student Handout #3

Teacher Key

Activity #3 – Effective Handwashing

One common way that young children become exposed to lead is by getting dust from lead paint on their hands or toys. Young children naturally put their hands and toys in their mouths, which causes them to ingest the lead dust. Also, children might come in contact with lead contaminated soil when playing outside. It is important for children to learn to properly wash their hands before eating or drinking and after playing outside.



You are challenged to design an experiment to determine the best hand washing method. You will use a product called Glo Germ Gel™ to represent lead dust. This product glows when held underneath a UV light. This product only represents lead dust; it does not contain any lead. In real life, you cannot see or smell lead in dust.

Investigation Procedure

Do the following:

1. First, decide on four different hand washing methods. The methods may use soap or no soap, cold water or warm water, and differing amounts of time spent washing. You can also use antibacterial hand gel. Describe each of your four hand washing methods on the data sheet.

2. Then, come up with a hypothesis for how well each method will work. Record what percentage of the hands you think will still remain dirty after using each method.

3. Next, have one person in your group place a quarter-sized amount of Glo Germ Gel™ in their hand and rub it all around. Now, proceed to try out your first hand washing method. One person should keep track of the amount of time spent on hand washing on the data sheet.

4. When you have finished washing, hold your hands under the UV light. If there is any lead dust still remaining on your hands, it will glow brightly. Record on your data sheet an estimate of the percentage of your hands that are still dirty. You might also want to trace your hand print on another piece of paper and draw where there was lead remaining. Also record any observations.

5. When you are finished, make sure to wash your hands well until no lead dust remains (check with UV light) and dry them before starting your next trial.

6. Repeat this process for each trial, beginning with clean hands and using the same amount of gel each time.

Materials developed by the Integrated Environmental Health Middle School Project (NIEHS Grant #ES10738 and #ES07033).

Data Chart

Trial	Hand Washing Method	Time (seconds)	Prediction: % of Hand Still Dirty	Actual Result: % of Hand Still Dirty	Observations
#1					
#2					
#3					
#4					

Student Assessment:
Did the students thoughtfully record their data and observations on the data chart and answer the follow-up questions?

1. Which hand washing method was the most effective? What percentage of the hands were still dirty after using this method?

2. Explain how you would teach a young child to wash their hands using this method.

FOUR LEAD AWARENESS ACTIVITIES
Student Handout #4

Teacher Key

Activity #4 – Pollution Dilution Investigation

The **U.S. Environmental Protection Agency** (EPA) sets the action level for lead in drinking water using the measurement **parts per billion (ppb)**. What exactly is parts per billion? In the following activity, you will use food coloring to represent a small amount of lead in a drinking water supply.

In the world of water quality testing, a pollutant is measured in **parts per million (ppm)** or **parts per billion (ppb) –** but what do these measurements really mean? In this activity, you will use food coloring to represent **lead in drinking water**, which in real life cannot be seen. At what point does the color disappear? Does this mean the pollutant is gone? Is any level of lead acceptable in your drinking water?

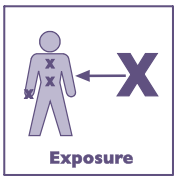
Before conducting the dilution activity, read the **EPA Consumer Fact Sheet on Lead** given to you by your teacher. Answer the following questions about the reading:

1. What is the Maximum Contaminant Level Goal (MCLG) for lead in drinking water and how is this level set? ***The MCLG for lead in drinking water is zero because EPA believes that any lead in drinking water may cause some potential health problems.***

2. What is the Action Level for lead in drinking water? How are public water supplies monitored for lead? ***The Action Level for lead in drinking water is 15 ppb. All public water supplies must follow these regulations by collecting water samples from household taps twice a year and analyzing them. If it is found to be more than 15 ppb in more than 10 percent of all homes tested, then the system must continue to monitor for lead twice per year.***

3. What are two ways that lead might get in drinking water? ***Lead can get in drinking water either from a contamination of the source water used by the system – such as from lead mining or smelting operations – or from corrosion of lead plumbing or fixtures.***

U.S. Environmental Protection Agency: Established in 1970, this government agency protects human health by safeguarding the air, water and land upon which life depends.



Parts per Million (ppm): A measurement of the amount of a substance within a solution. Represents a dilution of 1/1,000,000.

Parts per Billion (ppb): Represents a dilution of 1/1,000,000,000.

Student Assessment: Did the students correctly answer the follow-up questions?

Investigation Procedure

Now you are ready to begin your investigation activity. The dilution of the lead (represented by food coloring) is shown on the data chart, assuming that the food coloring begins with a dilution of dye-to-water of 1/10. Do the following:

1. Line up 8 plastic spoons in a row and fill the plastic cup with water. Using an eyedropper, place 9 drops of water into each of the spoons.

2. Add one drop of food coloring (dark colors work best) to the spoon on the far left (spoon #1).

3. On the data chart, in the column labelled “prediction,” record your prediction of how much lead will be in each spoon at the different concentrations. To do this, use a colored pencil to carefully shade the ovals representing each spoon. Do

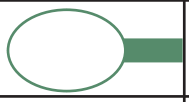
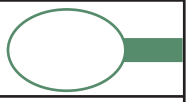
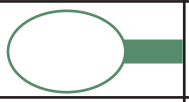
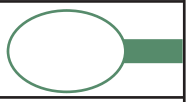
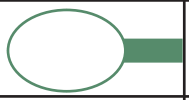
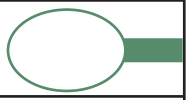
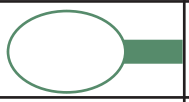
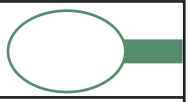
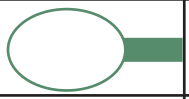
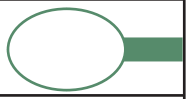
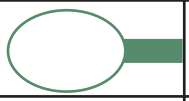
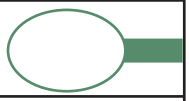
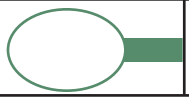
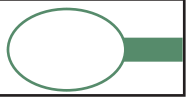
Materials developed by the Integrated Environmental Health Middle School Project (NIEHS Grant #ES10738 and #ES07033).

you think that the lead will disappear at some point? If so, by which spoon will it seem to disappear?

4. Then, use the eyedropper to pick up some water from spoon #1. Carefully add ONE drop to spoon #2. Then, empty the remaining water in the eyedropper back into spoon #1. Rinse out the eyedropper in the cup of water. Next, take one drop from Spoon #2 and add it to Spoon #3, and so on down the line of spoons, following the same procedure: pick up, one drop, empty, rinse.

5. Record on your data sheet the amount of lead in each spoon using a colored pencil to carefully shade the oval representing each spoon.

Data Chart

Spoon	Dilution	Prediction of Appearance	Actual Appearance
#1	1/100		
#2	1/1,000		
#3	1/10,000		
#4	1/100,000		
#5	1/1,000,000 **(1 ppm)**		
#6	1/10,000,000		
#7	1/100,000,000		
#8	1/1,000,000,000 **(1 ppb)**		

Student Assessment:
Did the students thoughtfully record their data and observations on the data chart and answer the follow-up questions?

1. At what point did the food coloring seem to disappear?

2. Even if you cannot see the food coloring in some of the spoons, does this mean that there is no longer any “lead” in the water? Explain your answer.

Corrode:
To weaken or destroy, usually slowly, as the result of a chemical reaction.

3. Lead often gets into drinking water when the water sits in lead pipes overnight. If the water is acidic, the lead in the pipes might **corrode** into the water. One way you can protect yourself from lead in drinking water is to flush your water before using it for drinking or cooking, especially if the water has been sitting in the pipes for six or more hours. All you have to do is flush the water until it runs cold, approximately 15-30 seconds. What is one way that you can teach your family how to flush their drinking water?

Lesson One: BEETHOVEN'S HAIR

Lesson Overview

Students read a biographical sketch of Beethoven, who may have suffered from lead poisoning, and a historical narrative about a lock of his hair traveling through time. Students create a timeline from the historical narrative and then choose a time period described in the reading and conduct research on the art, music, and culture of that period. Students use their research to write a piece of historical fiction. Extension activities are also included for additional classroom work or homework assignments.

Suggested Grade Levels: 6 & 7
Curriculum Connections: Non-fiction, biographical sketch, historical narratives and creative writing

EALRs Addressed

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:

- Build vocabulary through reading. Construct general and specialized vocabularies through reading and specific fields of academic study such as science, social studies, mathematics and the arts. (Reading 1.2)
- Read for literary experience in a variety of forms. Read, respond to and evaluate a variety of traditional and contemporary literature (poetry, essays, short stories, novels, biographies, nonfiction narratives, plays). (Reading 3.3)
- Write clearly and effectively. Apply writing conventions. (Writing 1.3)
- Write in a variety of forms including narratives, journals, poems, essays, stories, research reports and technical writing. (Writing 2.3)

Teacher Background

Review the **Student Handouts**. For a more in-depth understanding of Beethoven's life and the story of his lock of hair, consult the following resources that were used to prepare this lesson:

- ***Beethoven's Hair,*** by Russell Martin. Broadway Books, New York: 2000.
- Text from Press Conference Held by William J. Walsh, October 17, 2000 in Naperville, Illinois.
  http://www.sjsu.edu/depts/beethoven/hair/hairtestpc.html
- The Beethoven Reference Site. A great source of information, including a timeline, an extensive picture gallery, and audio files to download.
  http://www.kingsbarn.freeserve.co.uk/index.html

An interesting element of the story of Beethoven's hair is that the true cause of his illness still remains a mystery. In the book, *Beethoven's Hair,* Russell Martin chronicles how a lock of Beethoven's hair recently underwent hair analysis. The scientists determined that the hair contained over 100 times more lead than a sample of control hairs. The book concludes that Beethoven suffered from lead poisoning, which led to the numerous illnesses from which he suffered and even contributed to his early death. While the book's author is comfortable making this assertion, it has been criticized by some scientists for not being a scientifically sound conclusion.

Hair analysis only indicates short-term lead exposure during the last few months of Beethoven's life. Hair analysis does not tell us anything about Beethoven's exposure to lead over his lifetime, nor does it prove that his illnesses and death were lead related. Given current technology, the only way to accurately assess Beethoven's long-term exposure to lead and the amount of lead that was stored in his body (his "body burden") would be to conduct a special x-ray test on a piece of his bone. Since lead acts like calcium within the human body, it is absorbed and stored within the bones.

One of the scientists working on this project has announced plans to study some skull fragments that were stored after Beethoven's body was exhumed in the mid-1800s. Perhaps if the bone is analyzed for lead content, the mystery of Beethoven's history of illness – and perhaps even his untimely death – will be solved.
Scientists have different opinions about how to interpret data such as hair analysis for lead exposure. This can be a good starting point for a classroom discussion about the process of scientific inquiry and communication. Some discussion points to consider:

- How do scientists share their research findings with their peers? With the public?
- What process do scientists go through before their findings can be published in a scientific journal?
- What are some forums that scientists use to communicate their thoughts about a research finding?
- How can non-scientists evaluate the scientific validity of a source of information?

Teacher Preparation

MATERIALS: Copies of **Student Handouts**
Computer access (optional)
Research materials
Colored pencils or markers (for timeline activity)
Rulers (for timeline activity)

- Make enough copies of the **Student Handouts** for each student or group to have a set. Master copies of the handouts are included at the back of this book.
- If you are the first teacher in your team to use this FACT FILE, make copies of the student handout entitled, **Student Introduction: Environmental Health and Lead**. Ensure that students have read the handout and mastered the content and vocabulary.

Procedure

- Have students read **Handout #1: A Biography of Beethoven**. The reading can be done in class in small groups, or individually as homework. Discuss the reading as a class. Consider listening to some of Beethoven's music as a way of introducing the topic (see Extension Activities).
- Next, assign **Handout #2: Beethoven's Hair, a Historical Narrative**. The reading is divided into five major sections. Each section is followed by brief

questions to help the students check their understanding of what they have read. The reading can be done in class in small groups, or individually as homework. One or more sections can be assigned at a time.

- If computer access is available, students can explore an interactive map that places the story of Beethoven's hair in a geographical and historical context. This website features Russell Martin's book, *Beethoven's Hair,* and includes an excerpt from the book as well as information on forensic testing.
    - Interactive Map of the Journey of Beethoven's Hair
      http://www.randomhouse.com/features/beethovenshair/mapflash.html
- Ask each student to choose one moment in time that is described in the historical narrative. Students then write a piece of creative writing set in that time period. Students can write from the point of view of a particular person, real or fictional. For example, a student could write about the refugees in Denmark from the point of view of Dr. Kay Flemming or a young girl hiding in the church, or even through the eyes of a bird perched in the church rafters. The story should include some reference to Beethoven's lock of hair. You might assign a minimum length for the story, such as 500 words. As part of their assignment, students should conduct some research on the art, music, and culture of the time period, and incorporate that research into their writing.

Student Assessment

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

10%	Did students complete **Student Handout #1** and **#2** and correctly answer the **Check Your Understanding** questions?
30%	Did students correctly complete the **Timeline Activity**? • 10% Includes **events** in correct order. • 10% Includes **dates** in correct order. • 10% Uses **neatness** and **color**.
10%	Did students **conduct research** on the art, music and culture of their chosen time period and incorporate this information into their writing?
50%	Did students write a creative story that includes the required elements? • 5% Reference to **Beethoven's hair**. • 10% Information on **art, music and culture**. • 10% **Proper writing conventions**. • 10% **Point of view**. • 15% **Shows creativity**.

Extension Activities

Music Appreciation: Play some of Beethoven's musical works for the students, perhaps during class when students are working on their creative writing. You can check out CDs or audio tapes from your local library. Some of his more familiar pieces include Symphony No. 9, Fur Elise, and the Moonlight Sonata.

Newspaper Article: Have students write newspaper articles explaining new scientific studies that suggest that Beethoven suffered from lead poisoning. For example articles, see the following websites:

- **CNN Health Website**
  http://www.cnn.com/2000/HEALTH/10/17/beethoven.hair/index.html
- **Public Communications Inc. Website**
  http://www.pcipr.com/newsroom_archive/pfeiffer/20001017_beethoven.asp

Student Assessment:
The extension activities provide for more in-depth assessment of student understanding.

BEETHOVEN'S HAIR
Student Handout #1

Teacher Key

A Biography of Beethoven

Ludwig van Beethoven was a famous classical music **composer** who was considered a child genius. Born in 1770 in Bonn, Germany, he began performing publicly at the age of six and left school when he was thirteen to begin touring full-time. He went on to compose many famous works that are still widely performed today, including his *Symphony No. 9, Fur Elise* and *Moonlight Sonata.* Beethoven's compositions were passionate, dramatic and full of emotion. While his music has withstood time, he wasn't always accepted by his peers.

Composer:
A person who writes music.

While Beethoven's beautiful music seems to rise above the drudgery of daily life, he suffered greatly from physical illness and depression. Though only a teenager at the time, he took on the guardianship of his two younger brothers due to his father's alcoholism. Beethoven traveled to Vienna to study with Hayden and Bach, two other well known classical musicians. While in Vienna, Beethoven took on a paid position as a court musician to support his family back home in Bonn.

Unlucky in Love

Beethoven never married, but was often falling in and out of love. While he often fell deeply in love, the women rarely felt the same way, causing him much pain. His famous *Moonlight Sonata* is said to have been written as he sat at his piano one evening, bathed in moonlight, after his marriage proposal to Countess Giulietta had been turned down. Beethoven was a frail, sickly man, and not particularly handsome. His moodiness and violent temper often frightened away the women he loved.

Although single, Beethoven did assume the guardianship of his nine-year-old nephew, Karl, when his brother Casper Carl died. Although the boy's mother was still alive, Beethoven thought her to be unfit, and underwent a costly legal battle for custody of his nephew. Unfortunately, Beethoven did not make the best parent, and the two frequently fought. When Karl attempted suicide in 1826, Beethoven was greatly saddened to discover that his volatile relationship with Karl contributed to Karl's unhappiness.

A Lifetime of Illness

It was well known by Beethoven's friends that as time wore on, his anti-social behavior and depression deepened. Beethoven began noticing trouble with his hearing and by 1818 he was virtually deaf at age forty-eight. However, he tried to keep his hearing loss a secret at first. In an unsent letter written to his brothers in 1802, considered to be a confession of his secret deafness, Beethoven explained his self-imposed seclusion,

> "From childhood on, my heart and soul were full of the tender feeling of goodwill, and I was always inclined to accomplish great deeds. But just think, for six years now I have had an incurable condition...Though born with a fiery, lively temperament, susceptible to the diversions of society, I soon had to withdraw myself, to spend my life alone. And yet if I wished at times to ignore all this, oh how harshly was I pushed back by the doubly sad experience of my bad hearing..."

Materials developed by the Integrated Environmental Health Middle School Project (NIEHS Grant #ES10738 and #ES07033).

Beethoven made his last public performance in 1814, although he continued to compose right up until his death. As Beethoven's hearing worsened, he relied on "conversation notebooks," within which his guests wrote down their questions or thoughts for the deaf composer.

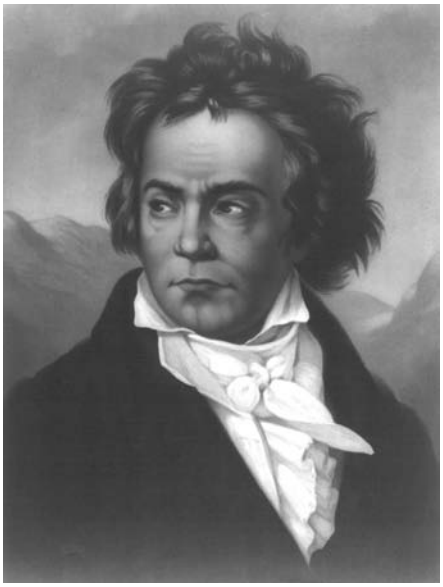
Beethoven suffered greatly from a number of physical ailments, which grew worse up until his painful death in 1827 at age fifty-six. It seemed that just when he recovered from one illness, another more painful sickness took over. Beginning in his early twenties, Beethoven was plagued with severe abdominal pain, gastrointestinal distress, persistent headaches, infections, pneumonia, bronchitis, **jaundice** and depression. He saw over thirty doctors in hope of finding relief from his constant illness. In a letter written to his brothers Carl and Johann in 1802, yet never mailed, Beethoven pleaded, "...as soon as I am dead, if Dr. Schmidt is still alive, ask him in my name to describe my disease, and attach this written document to his account of my illness, so that at least as much as possible the world may be reconciled to me after my death..."

Jaundice:
A condition in which there is yellowing of the whites of the eyes, skin, and mucous membranes, caused by bile pigments in the blood. It is a symptom of liver disease or of a blocked bile duct.

Beethoven received over 75 different medications during the months leading up to his death, however it is important to note that he refused morphine, a common pain killer at the time. Although he was in great pain from his illness, it appears that Beethoven preferred to keep his mind clear and unclouded by mind-altering drugs so that he could continue composing rather than numb his pain and be without an outlet for his creativity.

Heavy Metal Musician

Beethoven died after spending more than four painful months bedridden by a variety of illnesses. His actual death was caused by failure of his liver. Upon his death, many friends, and even some strangers, cut locks of Beethoven's hair to keep as mementos of the great composer. This was fashionable at the time, since photographs, which help people remember their loved ones, had not yet been invented. So many people took locks of hair that by the time Beethoven was buried, his head was almost completely bald. Tens of thousands of people witnessed Beethoven's funeral procession in 1827.



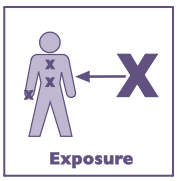
Ludwig van Beethoven, 1770–1827

In 1994, a lock of Beethoven's hair — cut from his head the day after his death by a fifteen-year-old musician — was offered for sale by Sotheby's auction house and purchased by a small group of Beethoven enthusiasts from America for $7,300. A portion of the hair underwent intense scientific experiments revealing a startling finding. Beethoven's hair showed extremely high levels of the heavy metal lead, finally offering a possible explanation for some of his chronic illnesses and strange behavioral traits. Many of Beethoven's complaints are consistent with chronic **plumbism**. Common symptoms of plumbism include severe gastrointestinal distress, jaundice, gout, headaches, irritability and erratic behavior. It is even remotely possible that Beethoven's deafness was also caused

Plumbism:
Lead poisoning.

by lead poisoning, but it is thought his deafness may have been caused by another disease, or from the frequent thrashings his father gave him as a child, which included boxing his ears.

While we will never know for sure how Beethoven came in contact with lead, it is possible that he was exposed by eating food that was prepared in lead cooking pots and served on earthenware plates with leaden glazes. He might also have been exposed to lead by drinking ever increasing amounts of wine, which at that time was often "plumbed," or treated with lead to sweeten bitter or sour flavors.



Student Assessment:
Did students read the handout? Can they summarize the content in their own words?

BEETHOVEN'S HAIR
Student Handout #2

Teacher Key

Beethoven's Hair: A Historical Narrative

(Inspired by the book *Beethoven's Hair* by Russell Martin)

A Rare Encounter

The story of Beethoven's hair begins in the spring of 1827. Johann Hummel, a well-known German musician, heard that his esteemed friend, Ludwig van Beethoven was dying. Hummel and his wife, along with a fifteen-year-old musician named Ferdinand Hiller, traveled to Vienna, Austria to see Beethoven. Ferdinand was a young musician whose talent had received much attention. As was common in that time, Hiller was living with Hummel and his wife in order to receive instruction in piano and composition.

When they arrived in Vienna, Beethoven had already been bedridden for four miserable months by a variety of illnesses. His doctors tried every treatment they knew, including prescribing over 75 different medications, but Beethoven only grew weaker. Beethoven was also completely deaf and relied on "conversation notebooks," in which his guests wrote down their side of the conversation for the deaf composer.

Over the next two weeks, Hummel and Hiller visited Beethoven four times. Hiller later wrote this description of their first encounter,

> "Through a spacious anteroom in which high cabinets were piled with thick, tied-up parcels of music, we reached — how my heart beat! — Beethoven's living room, and were not a little astonished to find the master sitting in apparent comfort at the window. He wore a long, gray sleeping-robe and high boots reaching his knees. Emaciated by long and severe illness, he seemed to me, when he arose, of tall stature; he was unshaven, his thick, half-gray hair fell in disorder over his temples."

When Hummel and Hiller heard that Beethoven had died, they hurried back to his home. Now, Beethoven lay in a coffin with a white crown of roses on his head. At the time, it was common for people to cut a lock of hair from a deceased person to remember them by. Young Hiller asked permission from his tutor to cut a lock of Beethoven's hair. By the time Beethoven was buried, so many people had cut locks from his head, that he was almost completely bald. Shortly afterwards, Hiller had a locket made for the hair. The wooden locket held the precious lock of hair between two plates of glass.

Source: Martin, R., *Beethoven's Hair.* Broadway Books, NY. (2000).

Check Your Understanding

1. Why did Ferdinand Hiller go to visit Beethoven? ***His music teacher, Johann Hummel, had heard that Beethoven was very sick and wanted to visit him one last time. Hummel brought Hiller with him to visit Beethoven.***

2. How did Beethoven, who was completely deaf, communicate with his visitors? ***Beethoven used "conversation notebooks," small notebooks that visitors could write their remarks in for Beethoven to read.***

Student Assessment:
Did students correctly answer the questions?

A Well Traveled Lock

While Beethoven had not traveled much in his lifetime, Hiller enjoyed constantly changing his surroundings as a young adult. In Hiller's possession, the lock of Beethoven's hair traveled extensively through Europe, including Germany, France, and Italy.

In May of 1883, Ferdinand Hiller began preparing for his own death. He chose to pass the lock of hair onto his son, Paul Hiller, as a 30th birthday present. Ferdinand had safeguarded the locket for 56 years and now left it in the hands of his son.

In 1911, when Paul Hiller was 58 years old, he asked an art dealer in Cologne, Germany to refurbish the locket that had held Beethoven's hair for the last 84 years. Paul wrote an inscription on a piece of paper and pasted it onto the back of the locket. The inscription read, "This hair was cut off of Beethoven's corpse by my father, Dr. Ferdinand v. Hiller on the day after Ludwig van Beethoven's death, that is on 27 March 1827, and was given to me as a birthday present in Cologne on May 1, 1883."

The locket containing Beethoven's hair (Reproduced with permission of the Ira F. Brilliant Center for Beethoven Studies, San Jose State University)

Paul Hiller died at age 81 in 1934, survived by his wife Sophie and three sons. For the next nine years, there remains no historical account of the lock of Beethoven's hair. Some people believe that Hiller may have donated the locket to a local museum, while others suspect that he may have given it to one of his sons. The most mysterious part of the story is where and when Beethoven's hair next appears in history.

Student Assessment:
Did students correctly answer the questions?

Check Your Understanding

1. How did the lock of hair come into Paul Hiller's possession? ***Paul was given the locket by his father, Ferdinand Hiller, on Paul's 30th birthday.***

2. What happened to Beethoven's hair after Paul Hiller died? ***No one knows for sure what happened to the locket. Some people believe that Paul Hiller donated it to a local museum, while others think he may have given it to one of his sons.***

Nazis:
During WWII, Germany was under the control of Adolph Hitler and his Nazi party. The Nazis took control of many neighboring countries before being defeated by Allied forces (including the United States).

Midnight in a Dark Church Loft

During World War II, the German **Nazis**, under Adolf Hitler's command, swept across Europe, invading neighboring countries and engaging in battles with Allied troops. Jewish citizens were forced to flee their homes to seek refuge in sympathetic nations. Many of those who couldn't flee were captured by the Gestapo, the Nazi's secret police

troops, and sent to **concentration camps**. In Germany and Austria, many Jews flee to Denmark in hopes of escaping the terror of the Nazis.

Concentration Camps: Camps in Europe where people, mostly of Jewish ancestry, were sent during WWII under the orders of Adolph Hitler. Many of those sent to concentration camps were tortured and killed.

In April 1940, Denmark falls under the control of Germany. Many Jews attempt to flee to Sweden in hopes of escaping the concentration camps. And so our story takes us to Gilleleje, a small fishing port in Denmark, in the chilly month of October 1943.

Word was leaked that the Gestapo were about to descend on Denmark, so Danish citizens across the country mobilized to protect their Jewish neighbors. Hospitals sent out their ambulances to pick up Jews with no place to hide, registering them as patients with changed last names to conceal their identities. Trains and buses were packed with Jews traveling throughout the night to small port towns, where fishing boats would transport them to the safety of Sweden.

On October 6, 1943, hundreds of Jews arrived by train in the small town of Gilleleje. The townspeople agreed it was their duty to help these troubled **refugees**, and hide them in their homes, attics, and the town church. The townspeople crafted a plan, convincing the captain of a large fishing vessel to allow passage for several hundred Jews across the channel to Sweden. However, while the ship was being boarded, a mass panic was caused when someone mistakenly heard a shout, "the Gestapo are here!" The ship set sail with only a handful of Jews onboard, leaving many refugees stranded on the shore. The townspeople hid the Jews in the loft of the church that night, planning to make another attempt the next day. And it is here, in the frigid, pitch-black church that the locket of Beethoven's hair mysteriously reappears.

Refugee: A person who flees to a foreign country to avoid persecution or danger.

Shortly before midnight, the town's physician, Dr. Kay Fremming, was called to the church to attend to an ill refugee. Later, he said that he had been given something special as a gift that night. Unfortunately, at midnight, the Gestapo descended on the church, arresting 120 Jews. Ultimately, most of them were sent to a concentration camp called Theresienstadt in Czechoslovakia. Due to unrelenting pressure from the Danish government, most of the Danish Jews were not transferred to the Nazi death camps, and were later released. Upon returning home, they were welcomed by their Danish neighbors, who had tended their homes and gardens in their absence.

Check Your Understanding

1. Why did Jewish refugees suddenly arrive in Gilleleje in 1943? ***The Nazis had invaded Denmark and were trying to capture Jewish people to send them to concentration camps. The refugees arrived in Gilleleje hoping to be able to get transported to nearby Sweden.***

2. How did Danish Jews fare in the concentration camps, compared to other Jews? Why? ***Danish Jews fared much better than other Jews. The Danish government put pressure on the Nazis, hoping to protect their citizens from the Nazi death camps. Most of the Danish Jews sent to concentration camps did not get sent to the death camps and were later released.***

Student Assessment: Did students correctly answer the questions?

Into the Hands of an Orphan

Sometime during that chaotic night, a stranger gave Dr. Fremming the locket of hair, perhaps as repayment for helping the Jewish refugees. But no one knows how the locket made its way to the small fishing village. Some believe that Paul Hiller had donated the locket to a museum, but that it was later stolen out of fear that it would come under control of the Nazis. Perhaps, in the fear of the night spent in the church loft, someone chose to leave it with a sympathetic doctor, hoping it would be safeguarded.

After WWII ended, a group of thirty French war orphans arrived in Denmark for adoption. A six-year-old girl named Michèle de Rybel arrived in Gilleleje and was adopted by a county administrator and his wife. Michèle felt that her adoptive parents were cruel, so one day, she planted herself on the front steps of Dr. Kay and Marta Fremming's house and asked them if she could be their daughter. Surprisingly, the childless couple agreed.

Dr. Kay Fremming died in 1969 at age 64. Upon his death, Marta showed Michèle the precious locket of Beethoven's hair, which Kay had kept secretly stashed in his desk drawer. Marta later gave the locket to Michèle in the late 1970s. Michèle was very attached to the locket, a reminder of her adoptive father.

In 1994, Michèle and her son Thomas were having some financial troubles and considered selling the locket. They inquired with Sotheby's, one of the largest auction houses in the world and decided to put it up for sale in December.

Check Your Understanding

1. Who gave Dr. Fremming the locket? Why? ***No one knows for sure who gave Dr. Fremming the locket, but it is suspected that one of the Jewish refugees gave it to him when he came to the church to treat an ill refugee. Perhaps the locket was given to him as a sign of appreciation for helping the refugees.***

2. How did Michèle come to be adopted by Kay and Marta Fremming? ***Michèle did not like her adoptive parents, whom she found to be unusually cruel. She planted herself on the front steps of the Fremming house, asking if she could be their daughter. Michèle had found the doctor and his wife to be kind. They agreed and later adopted her.***

3. What did Michèle and her son decide to do with the locket? Would you have made the same decision? Explain. ***Michèle and her son decided to sell the locket to Sotheby's. Student opinions and explanations will vary.***

Student Assessment:
Did students correctly answer the questions?

Two Americans and a Forensics Discovery

When Beethoven enthusiast Ira Brilliant spotted the listing in the Sotheby catalog in 1994, he could barely believe it. Brilliant collected first edition Beethoven compositions and other relics, but the wooden locket caught his attention. He called his friend and fellow Beethoven enthusiast Dr. Alfredo "Che" Guevera, and together with a small group of investors, they pooled together enough money to buy the hair. The locket sold for $7,300, and soon it arrived in a package mailed to Brilliant's home.

Brilliant and Guevera decide to open the locket and submit a sample of hair for scientific testing, with hopes of gaining some insight into Beethoven's life and his countless illnesses. On December 12, 1995, the locket was opened by Dr. Guevera in front of an anxious crowd at the University of Arizona Medical Center. As the surgeon used a scalpel to break the seal between the glass plates, he remarked, "Wow, could you hear that? I heard a rush of air like a vacuum when I started to separate the glass." For the first time in at least eight decades, the lock of Beethoven's hair was exposed. Among the lock of brown and gray hairs, there were 582 total hair strands. The hair was divided, with most of it being returned to the locket and given to the Ira F. Brilliant Center for Beethoven Studies at San Jose State University. The remaining hair was given to Guevera, who curled it into a petri dish and locked it in his office safe, happy to go about his daily work knowing a piece of his mentor, Beethoven, remained so close.

In May 1996, Guevera sent 20 hairs from his bundle to Los Angeles for drug analysis and then off to Illinois for further scientific analysis. After several years of careful testing by some of the world's top hair analysts and **forensic** chemists, an exciting discovery was announced in the year 2000. Beethoven's hair showed elevated levels of lead. His hair had forty-times the lead average that was contained in control hairs that were tested (hair samples taken from living people). Another separate test showed lead levels that were 100 times the lead levels found in control hairs!

Forensic:
A type of scientific analysis used to examine evidence, often from a deceased person, to solve a crime or a mystery.

Lead acts like calcium in the body and is stored in bones. Special x-rays of bones can help determine how much lead a person was exposed to during their lifetime.

Hair analysis only provides information on recent exposure to lead. The hair samples from Beethoven help tell the story of the last few months of his life. The results from the hair analysis suggest that Beethoven was suffering from lead poisoning at the time of his death. But what does this tell us about the illnesses that plagued Beethoven for most of his adult life? Unfortunately, it doesn't tell us anything for certain. The scientists who did the hair analysis suggested that since Beethoven was sick for so much of his life, it is possible that lead poisoning was the cause of his various illnesses. They believe that his illnesses were similar to the common symptoms of lead poisoning, such as severe stomachaches, jaundice, gout, headaches, irritability and moodiness.

Hair analysis only tells us for sure about Beethoven's exposure to lead during the months leading up to his death. The only way to determine Beethoven's exposure to lead over his lifetime would be to test a sample of his bone for the presence of lead. Since lead acts like calcium, the body stores lead in bones. A special x-ray of a piece of bone could determine the amount of lead that was stored in Beethoven's body over his lifetime. Fortunately, one of the scientists working on this project has announced plans to study some skull fragments that were stored after Beethoven's body was exhumed in the mid-1800s. This would give us more information about long-term lead exposure and the effects it might have had on Beethoven's health.

Over 170 years after Beethoven's death, his illness remains a mystery. Although some people believe that Beethoven's lengthy illness was due to lead poisoning, we do not know for sure. Perhaps future testing of Beethoven relics will solve this historical, scientific mystery once and for all!

Student Assessment:
Did students correctly answer the questions?

Check Your Understanding

1. What scientific discovery was made about Beethoven by testing his hair? ***Scientific analysis showed that Beethoven's hair had 100 times the level of lead in control hairs. This tells us that Beethoven was exposed to lead in the last few months of his life.***

2. What test is needed to determine Beethoven's exposure to lead over his lifetime? ***Scientists would need to test a piece of his bone, using a special x-ray, to determine the amount of lead his body stored over his lifetime.***

Timeline Activity

Student Assessment:
The location and date for each event is provided in parentheses to help you check the accuracy of your students' timelines.

The story of Beethoven's hair is an exciting scientific mystery that covers over 170 years of history. In this activity, you will create a timeline that plots important dates and events from the story. Use colored pencils or pens to create a colorful and informative timeline that plots the events in chronological order. Be sure to include the date and location for each event. Your timeline should begin with the year Beethoven died and end with the year that the forensic test results were announced. Include the following events in your timeline (they are not listed in chronological order):

- The locket is opened and the hairs are counted **(1995, USA)**
- A Jewish refugee gives the locket to Dr. Fremming in a church loft **(1943, Denmark)**
- Ferdinand Hiller cuts a lock of Beethoven's hair after his death **(1827, Austria)**
- Paul Hiller has the locket refurbished and adds an inscription **(1911, Germany)**
- Scientists announce results of forensic tests on the hair **(2000, USA)**
- After Paul Hiller dies, there is no record of the locket for 9 years **(1934-43, location unknown)**
- Ferdinand Hiller gives the locket to his son, Paul, as a birthday gift **(1883, Germany)**
- Ira Billiant, Dr. Guevara, and a group of investors buy the locket **(1994, USA)**

Creative Writing Activity

Student Assessment:
Did students write a thoughtful, creative piece set in a time period from the narrative, making mention of Beethoven's hair?

Now that you have read about Beethoven's hair, it's time to try your hand at some creative writing. Writers of historical fiction combine historical facts (people, places, events) with fictional, or made-up, elements. In this activity, you will choose a time period mentioned in the narrative of Beethoven's hair and create a short historical fiction story.

Choose a distinct time period described in the narrative above. For the period you have chosen, write a creative story set at that moment in history. You can write from the point of view of a real character mentioned in the narrative (Beethhoven, Ferdinand Hiller, Michèle de Rybel, etc.), or a character from your imagination. It doesn't have to be a person. The story could be told through the eyes of a bird perched in the rafters of the church of Gilleleje. Your story should include at least one reference to Beethoven's lock of hair. To make your story more believable, you should conduct some research on the art, music, and culture of the time period you have chosen and incorporate that research into your writing.

Lesson Two: EIGHTEEN PENCE A DAY

Lesson Overview

This lesson examines the working conditions in London's white lead mills in the mid-1800s. Students first read biographical sketches of Charles Dickens and Jack London. Next, they read excerpts from Dickens' *The Uncommercial Traveller.* Finally, each student chooses one young factory worker, described by Jack London in *The People of the Abyss*, and writes a journal entry from her point of view. Extension activities are also included for additional classroom work or homework assignments.

Suggested Grade Levels: 7 & 8
Curriculum Connections: Point of view, biographical sketch, reading history, word choice, journal writing, Charles Dickens and Jack London

EALRs Addressed

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 word recognition and word meaning skills to read and comprehend text. Interpret general and specialized vocabulary critical to the meaning of the text. (Reading 1.1)
- Recognize that authors make language choices to influence an audience. (Reading 2.3)
- Read for literary experience in a variety of forms. Read, respond to, and evaluate a variety of traditional and contemporary literature (poetry, essays, short stories, novels, biographies, nonfiction narratives, plays). (Reading 3.3)
- Use style appropriate to the audience and purpose. Choose voices appropriate to different genres and audiences. Use words appropriate to the chosen purpose. (Writing 1.2)
- Write in a variety of forms including narratives, journals, poems, essays, stories, research reports, and technical writing. (Writing 2.3)

Teacher Background

During the nineteenth century, the artificial production of lead carbonate by using the "Dutch method" was a thriving commercial enterprise in the United States and England. Lead carbonate, or white lead, was used in high-quality opaque paint. To make the white lead, earthen pots were filled with vinegar and covered with sheet lead or with cast lead waffles. The pots were stacked and then covered with a mound of tan – the bark from oak trees. The tan decomposed and heated the pots to about 180 degrees Fahrenheit. In about three months, the pots were removed along with the dense white powder into which the lead had been transformed.

Materials developed by the Integrated Environmental Health Middle School Project (NIEHS Grant #ES10738 and #ES07033).

White lead mills were very dangerous places to work. They tended to employ mostly young women, many of whom would suffer severe lead poisoning and sicken or die.

Reading the **Student Handouts** will provide a good background for this lesson. For a more in-depth understanding of the white lead industry, consult the following resources that were used to prepare this lesson:

- Some Views on Dirt and Drudgery Website. You can access excerpts of *The Uncommercial Traveller* from this website.

  http://www.st-and.ac.uk/~jfec/ge/drudgery.html

- The essays can also be found in Charles Dicken's book, *The Uncommercial Traveller and Reprinted Pieces Etc.*, originally published in 1860. See Chapter 1 "His General Line of Business," Chapter 25 "On an Amateur Beat" and Chapter 32 "A Small Star in the East."

Teacher Preparation

MATERIALS: Copies of **Student Handouts**

- Make enough copies of the two **Student Handouts** for each student or group to have a set. Master copies of the handouts are included at the back of this book.

- If you are the first teacher in your team to use this FACT FILE, make copies of the student handout entitled, **Student Introduction: Environmental Health and Lead**. Ensure that students have read the handout and mastered the content and vocabulary.

Procedure

- Distribute **Handout #1**, **Biographical Sketches of Charles Dickens and Jack London**, to students. The reading can be done in class in small groups, or individually as homework. One or both biographies can be assigned at a time. Follow-up the reading with an in-class discussion of the lives of the two authors. The handout also includes an activity in which students create a Venn diagram showing the similarities and differences between Dickens' and London's life experiences. These diagrams can be used to prompt a discussion of how the two authors' life experiences might have influenced their writing.

- Distribute **Handout #2**, **The Literature of the White Lead Mills**, to students. This reading includes excerpts from two works of literature. The first excerpt is from Dickens' *The Uncommercial Traveller* (1860). The reading is divided into two major sections. Each section is followed by short questions to help the students check their understanding of what they have read. These readings can be done in class in small groups, or individually as homework. Given the difficulty of the diction and some of the vocabulary in the selections, you might also choose to read through them aloud in class while your students follow along.

- Lead a discussion focused on Dicken's style of writing. Consider how his word choice and spelling illustrate his time period and captures the way in which his subjects used language. The speech pattern represented in the excerpt is called "cockney," a dialect of East London's working class people.

- You might also lead a brief discussion about factory labor laws in 19th century England. With the industrial revolution in full swing, the British parliament began to pass legislation regulating factories. Early factory laws were aimed at improving working conditions for children and women, limiting the number of hours worked in a day, and making factories safer for the workers.

- Assign students the second reading on **Handout #2**, the excerpt from Jack London's *People of the Abyss* (1903). This reading can be done in class in small groups, or individually as homework.

- **Journal Writing Activity**: After students have read and discussed the London and Dickens passages, they are asked to create a journal entry written from the point of view of a young woman working in one of East London's white lead factories. Students can choose one woman from the list of descriptions written by Jack London of actual women who worked in the white lead factories. Challenge students to consider the way she might talk/write (cockney dialect) and her word choice. Students may want to consider some of the following questions:

    - What is her job in the factory?
    - How much is she paid for a day's work?
    - How is the job affecting her health? What are her symptoms of lead poisoning?
    - How does her family benefit and suffer from her job at the factory?

Student Assessment

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

10%	Did students read **Student Handout #1**?
20%	Did students complete the **Venn Diagram Activity** on **Student Handout #1**, including at least four items in each section of the diagram.
10%	Did students complete **Student Handout #2** and correctly answer the **Check Your Understanding** questions?
60%	Did students create a thoughtful journal entry that includes the required elements? • 10% **Information on the character:** how much she is paid; how her job affects her health; and why she is willing to accept those risks. • 10% **Chooses words and phrasing** that reflect the character's background. • 10% **Proper writing conventions**. • 10% **Point of view**. • 20% **Shows creativity**.

Extension Activities

Journalism Activity: Students write newspaper articles or create political cartoons to be printed in an 1860 *London Times* newspaper. The articles and cartoons should focus on the health risks encountered by workers in the white lead industry.

Dramatic Interpretation: Students turn their journal entries into dramatic monologues and present them to the class. Male students can write their monologues from the perspective of the son, husband, or brother of a woman factory worker. Costumes and simple props can be used to enhance the presentations. The monologues can also be video-taped and edited as part of a technology activity.

Student Assessment:
The extension activities provide for more in-depth assessment of student understanding.

EIGHTEEN PENCE A DAY
Student Handout #1

Teacher Key

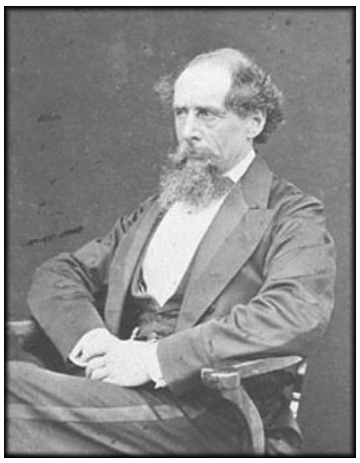
Biographical Sketches of Charles Dickens and Jack London

The Life of Charles Dickens

Charles John Huffham Dickens was born on February 7, 1812 in England. In 1814, his family moved to London and later to Chatham, England.

At age 12, he was sent to work at Warren's Blacking Factory, a shoe dye warehouse, when his father was imprisoned for debt. This was one of the worst times in Dickens' life, and he rarely spoke of it. However, his experiences in the factory influenced his later writings about working class Londoners. Dickens briefly returned to school for three years, but at age 15 was forced to work to help support the family. He worked as a clerk for a law office and then became a court reporter.

In 1833, Dickens began contributing essays and short stories to magazines and quickly acquired a large following. Dickens had a busy writing career, including publishing well known works such as: *A Christmas Carol* (1843), *David Copperfield* (1850), *Hard Times* (1854), *A Tale of Two Cities* (1859) and *Great Expectations* (1861).



Charles Dickens, 1812-1870

In 1836, Dickens married Catherine Hogarth. The couple had ten children over the next 16 years. While they were happy in the early years of their marriage, Catherine quickly became overwhelmed with the pressures of being the wife of a famous writer and the responsibility of caring for ten young children. Charles also became discontent in the marriage. Catherine and Charles were legally separated in 1858.

In 1865, Dickens survived a frightening train accident on a return trip from Paris. The train jumped a 42 foot long gap in the tracks over a bridge. All but one first-class coach, the one carrying Dickens, fell into the ravine below. As the train was being evacuated, Dickens remembered something he had left behind. He climbed back into the wrecked train to retrieve the manuscript for *Our Mutual Friend*, the novel he was writing at the time.

Through his writings and lectures, Dickens addressed important social issues such as education reform, **public health** improvements, and workers' rights. His book, ***The Uncommercial Traveller***, was a work of journalism based on his experiences traveling through the neighborhoods of East London. In two chapters of the book, he focused on the **white lead** mills in London that employed mostly poor, young women.

Dickens died in 1870 at age 58.

Public Health: The science of protecting community health by preventing illness, controlling disease, and educating people about how to lead healthier lives.

Uncommercial Traveller: Dickens uses this nickname for himself. In this book, he observes and reports on the everyday lives of the working class of East London.

White Lead: A white pigment that contains lead, marketed as a powder or paste and used as an exterior paint.

The Life of Jack London

John Griffith London was born in 1876 in San Francisco, California to an unmarried woman named Flora Wellman who came from a wealthy family. His mother was ill, so London was mostly raised by an ex-slave named Virginia Prentiss. Jack's mother married John London and the family later settled in Oakland, California.

London took on the name "Jack" as a teenager. He worked in a variety of odd jobs as a young man, including pirating oysters, being a member of a "fish patrol" to catch poachers, and sailing on a sealing ship. He even travelled around the country as a hobo.

In 1900, London married Bess Madden. The couple had two daughters. Bess and Jack later divorced, and Jack remarried in 1905.

London was a **prolific** writer, producing over fifty volumes of stories, novels and essays. He considered himself to be a **socialist** and argued in support of **women's suffrage** and **prohibition**. His novel, *The People of the Abyss* (1903), described the underworld of London and was a critique of capitalism and poverty. London traveled extensively, including a winter spent in the Yukon and a trip by small boat to Hawaii.

London's well known books include: *The Call of the Wild* (1903), *The Sea-Wolf* (1904) and *White Fang* (1906). He was one of the first writers to work with the film industry; many of his novels were made into major motion pictures.

Jack London died in 1916 at age 40 from kidney failure.

Jack London, 1876-1916

Prolific:
Producing an abundance of fruit, work, or results.

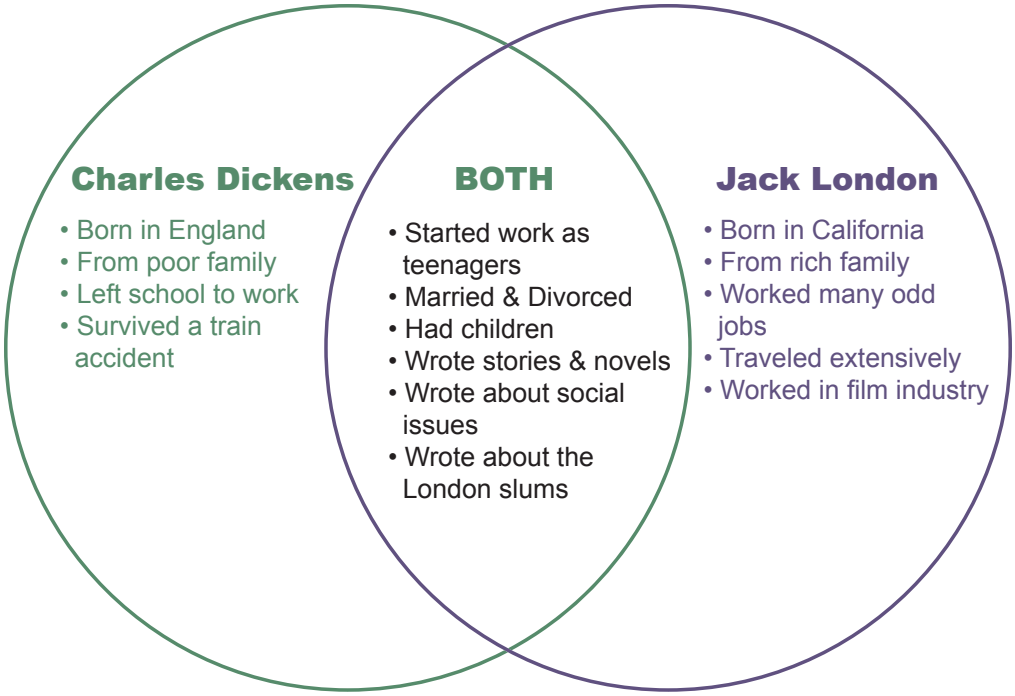
Socialist:
Belonging to the socialist party, which believed that the means of producing and distributing goods should be owned collectively or by a centralized government.

Women's Suffrage:
A movement to give women the right to vote. American women were finally granted the right to vote in 1893.

Prohibition:
The period 1920-33, during which alcoholic beverages were illegal in the United States.

Venn Diagram Activity

A Venn diagram is a great way to record information when reading about two subjects that share some similarities. On a separate piece of paper, draw two large circles that slightly overlap. Label one circle "Charles Dickens" and the other one "Jack London." After you have read the two biographical sketches about Dickens and London, record information about the two writers on your Venn diagram. Place information that is unique to only one of the writers in his circle. An example of something that is unique to Dickens might be that he was born in London. Place information that is common to both in the area where the two circles overlap. An example of a commonality between the two writers is that they both had children. Try to find at least four unique things for each writer and four things they have in common.



Student Assessment:
Student work can be assessed in the following ways:

Did students read the handout?

Did students accurately complete their Venn diagrams, including at least four items in each section of the diagram? We have included an example of a completed diagram to help you evaluate your students' work.

EIGHTEEN PENCE A DAY
Student Handout #2

Teacher Key

The Literature of the White Lead Mills

Excerpts from *The Uncommercial Traveller*, by Charles Dickens from Chapter 32, "A Small Star in the East"

... It was a dark street with a dead wall on one side. Nearly all the outer doors of the houses stood open. I took the first entry, and knocked at a parlour door. Might I come in? I might, if I plased, sur.

The woman of the room (Irish) had picked up some long strips of wood, about some wharf or barge; and they had just now been thrust into the otherwise empty grate to make two iron pots boil. There was some fish in one, and there were some potatoes in the other. The flare of the burning wood enabled me to see a table, and a broken chair or so, and some old cheap crockery ornaments about the chimney piece. It was not until I had spoken with the woman a few minutes, that I saw a horrible brown heap on the floor in the corner, which, but for previous experience in this dismal wise, I might not have suspected to be "the bed." There was something thrown upon it; and I asked what that was.

"Tis the poor craythur that stays here, sur; and 'tis very bad she is, and 'tis very bad she's been this long time, and 'tis better she'll never be, and 'tis slape she does all day, and 'tis wake she does all night, and 'tis the lead, sur."

"The what?"

"The lead, sur. Sure 'tis the lead-mills, where the women gets took on at eighteen-**pence** a day, sur, when they makes application early enough, and is lucky and wanted; and 'tis lead-pisoned she is, sur, and some of them gets lead-pisoned soon, and some of them gets lead-pisoned later, and some, but not many, niver; and 'tis all according to the **constitooshun**, sur, and **some constitooshuns is strong, and some is weak,** and her constitooshun is lead-pisoned, bad as can be, sur; and her brain is coming out at her ear, and it hurts her dreadful; and that's what it is, and niver no more, and niver no less, sur."

The sick young woman moaning here, the speaker bent over her, took a bandage from her head, and threw open a back door to let in the daylight upon it, from the smallest and most miserable back-yard I ever saw.

"That's what cooms from her, sur, being lead-pisoned; and it cooms from her night and day, the poor, sick craythur; and the pain of it is dreadful; and God he knows that my husband has walked the streets these four days, being a labourer, and is walking them now, and is ready to work, and has no work for him, and no fire and no food but the bit in the pot, and no more than ten **shillings** in a **fortnight** ..."

The woman's married daughter had by this time come down from her room on the floor above, to join in the conversation. She herself had been to the lead-mills very early

White Lead:
A white pigment that contains lead, marketed as a powder or paste and used as an exterior paint.

Uncommercial Traveller:
Dickens uses this nickname for himself. In this book, he observes and reports on the everyday lives of the working class of East London.

Pence:
A coin that was once used in England, equal to one penny.

Constitooshun:
Here, Dickens spells the word "constitution" the way it would sound in the Cockney dialect. Constitution refers to the physical makeup of a person, including his or her overall health and susceptibility to illness.

Shilling:
A coin that was once used in England, equal to twelve pence.

Fortnight:
A period of two weeks.

that morning to be “took on,” but had not succeeded. She had four children; and her husband, also a waterside-labourer, and then out seeking work, seemed in no better case as to finding it than her father. She was English, and by nature of a buxom figure and cheerful. Both in her poor dress and in her mother’s there was an effort to keep up some appearance of neatness. She knew all about the sufferings of the unfortunate invalid, and all about the lead-poisoning, and how the symptoms came on, and how they grew, – having often seen them. The very smell when you stood inside the door of the works was enough to knock you down, she said: yet she was going back again to get “took on:” What could she do? Better to be **ulcerated** and paralyzed for eighteen-pence a day, while it lasted, than see the children starve.

Ulcerated:
Covered in lesions or sores.

Student Assessment:
Did students correctly answer the “Check Your Understanding” questions?

Check Your Understanding

1. What is wrong with the young woman lying in a corner of the room? ***She has lead poisoning from working in a lead mill.***

2. What are some symptoms of lead poisoning? ***The young woman lies in a heap in the corner of the room, sleeping all day and lying awake all night. She feels like her brain is coming out of her ears and moans with pain constantly. She may be paralyzed.***

3. Why are the women willing to work at the lead mills, even though they know they will become poisoned by the lead? ***If a woman has children, she feels that it is better to work in the lead mills and bring home some money, even if it is a small amount, than to let her children starve. To a mother, it is worth the risk.***

from Chapter 35, “On an Amateur Beat”

... I found myself near to certain “Lead Mills.” Struck by the name, which was fresh in my memory, and finding, on inquiry, that these same lead-mills were identified with those same lead-mills of which I made mention when I first visited ... [the neighbourhood] as Uncommercial Traveller, I resolved to have a look at them.

Received by two very intelligent gentlemen, brothers, and partners with their father in the concern, and who testified every desire to show their works to me freely, I went over the lead-mills. The purport of such works is the conversion of pig-lead into white-lead. This conversion is brought about by the slow and gradual effecting of certain successive chemical changes in the lead itself. The processes are picturesque and interesting,--the most so, being the burying of the lead, at a certain stage of preparation, in pots, each pot containing a certain quantity of acid besides and all the pots being buried in vast numbers, in layers, under **tan**, for some ten weeks.

Tan:
The bark from oak trees which would decompose and heat the pots to about 180 degrees Fahrenheit.

Hopping up ladders, and across planks, and on elevated perches, until I was uncertain whether to liken myself to a bird or a bricklayer, I became conscious of standing on nothing particular, looking down into one of a series of large **cocklofts**, with the outer day peeping in through the chinks in the tiled roof above. A number of women were ascending to, and descending from, this cockloft, each carrying on the upward journey a pot of prepared lead and acid, for deposition under the smoking tan. When one layer of pots was completely filled, it was carefully covered with planks, and those were carefully covered with tan again, and then another layer of pots was begun above;

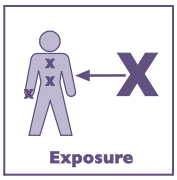
Cocklofts:
A loft or room, just under the roof of a building.

sufficient means of ventilation being preserved through wooden tubes. Going down into the cockloft then filling, I found the heat of the tan to be surprisingly great, and also the odour of the lead and acid to be not absolutely exquisite, though I believe not noxious at that stage. In other cocklofts, where the pots were being **exhumed**, the heat of the steaming tan was much greater, and the smell was penetrating and peculiar. There were cocklofts in all stages; full and empty, half filled and half emptied; strong, active women were clambering about them busily...

Exhume:
To dig up or bring to light. To remove from a grave.

As is the case with most pulps or pigments, so in the instance of this white-lead, processes of stirring, separating, washing, grinding, rolling, and pressing succeed. Some of these are unquestionably **inimical** to health, the danger arising from inhalation of particles of lead, or from contact between the lead and the touch, or both. Against these dangers, I found good respirators provided (simply made of flannel and muslin, so as to be inexpensively renewed, and in some instances washed with scented soap), and gauntlet gloves, and loose gowns. Everywhere, there was as much fresh air as windows, well placed and opened, could possibly admit. And it was explained that the precaution of frequently changing the women employed in the worst parts of the work (a precaution originating in their own experience or apprehension of its ill effects) was found salutary. They had a mysterious and singular appearance, with the mouth and nose covered, and the loose gown on...

Inimical:
Hostile or unfriendly, having harmful effects.



At last this vexed white-lead, having been buried and resuscitated, and heated and cooled and stirred, and separated and washed and ground, and rolled and pressed, is subjected to the action of intense fiery heat. A row of women, dressed as above described, stood, let us say, in a large stone bake house, passing on the baking-dishes as they were given out by the cooks, from hand to hand, into the ovens. The oven, or stove, cold as yet, looked as high as an ordinary house, and was full of men and women on temporary foot-holds, briskly passing up and stowing away the dishes. The door of another oven, or stove, about to be cooled and emptied, was opened from above, for the uncommercial **countenance** to peer down into. The uncommercial countenance withdrew itself, with expedition and a sense of suffocation, from the dull-glowing heat and the overpowering smell. On the whole, perhaps the going into these stoves to work, when they are freshly opened, may be the worst part of the occupation.

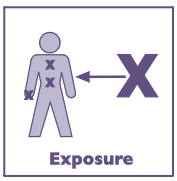
Countenance:
The face or facial features. Here Dickens refers to himself as the "uncommercial countenance".

Indubitable:
Too obvious to be doubted, unquestionable.

Sedulously:
Very carefully, painstakingly.

But I made it out to be **indubitable** that the owners of these lead-mills honestly and **sedulously** try to reduce the dangers of the occupation to the lowest point.

A washing-place is provided for the women (I thought there might have been more towels), and a room in which they hang their clothes, and take their meals, and where they have a good fire-range and fire, and a female attendant to help them, and to watch that they do not neglect the cleansing of their hands before touching their food. An experienced medical attendant is provided for them, and any **premonitory** symptoms of lead-poisoning are carefully treated. Their teapots and such things were set out on tables ready for their afternoon meal, when I saw their room; and it had a homely look. It is found that they bear the work much better than men: some few of them have been at it for years, and the great majority of those I observed were strong and active. On the other hand, it should be remembered that most of them are very **capricious** and irregular in their attendance.



Premonitory:
Warning, foreboding.

Capricious:
Unpredictable, on a whim.

American inventiveness would seem to indicate that before very long white-lead may be made entirely by machinery. The sooner, the better. In the meantime, I parted from my two frank conductors over the mills, by telling them that they had nothing there to be concealed, and nothing to be blamed for. As to the rest, the philosophy of the matter of lead-poisoning and workpeople seems to me to have been pretty fairly summed up by the Irish woman whom I quoted in my former paper: "Some of them gets lead-pisoned soon, and some of them gets lead-pisoned later, and some, but not many, niver; and

'tis all according to the constitooshun, sur; and some constitooshuns is strong and some is weak."

Student Assessment:
Did students correctly answer the "Check Your Understanding" questions?

Check Your Understanding

1. What are some of the steps in the process of creating white lead? ***The lead is placed in pots along with different kinds of acids. The pots are then buried in layers underneath smoking tan and left for about ten weeks. The layers of pots create high towers, which the workers reach from high cocklofts and ladders. Then, the pots are exhumed and the lead is heated, cooled, stirred, separated, washed, ground, rolled and pressed. Lastly, the lead is subjected to intense heat in large ovens.***

2. What are some ways that the workers come in contact with the lead? ***The workers come in contact with lead by inhaling small particles of lead in the air or inhaling the fumes from the large ovens. They also might touch the lead and absorb it through the skin, or forget to wash their hands and get lead on their food, thereby ingesting it.***

3. What are Dickens' thoughts about the safety of the lead mill? ***Dickens seems to think that this particular mill had adequate safety precautions, including flannel and muslin masks, gloves and loose gowns, as well as having workers wash their hands before eating. His reaction might be due in part to the fact that he was escorted on his tour by the two mill owners, who surely painted a favorable picture of their operation. However, Dickens seems to understand the inherent dangers of the mills, particularly from sustained work over several years or from holding some of the more dangerous jobs at the mills.***

A Description of the Effects of Lead Poisoning. An excerpt from *The People of the Abyss*, "The Precariousness of Life" by Jack London

Dissolution:
Termination, extinction, or death.

Blue Line:
A telltale sign of severe lead poisoning is a blue line along the gums near the teeth.

"... Worst of all is the lead dust in the white lead trades. Here is a description of the typical **dissolution** of a young, healthy, well-developed girl who goes to work in a white lead factory:

Here, after a varying degree of exposure, she becomes anemic. It may be that her gums show a very faint **blue line**, or perchance her teeth and gums are perfectly sound, and no blue line is discernible. Coincidentally with the anemia she has been getting thinner, but so gradually as scarcely to impress itself upon her or her friends. Sickness, however, ensues, and headaches, growing in intensity, are developed. These are frequently attended by obscuration of vision or temporary blindness. Such a girl passes into what appears to her friends and medical adviser as ordinary hysteria. This gradually deepens without warning, until she is suddenly seized with a convulsion, beginning in one-half of the face, then involving the arm, next the leg of the same side of the body, until the convulsion, violent and purely epileptic in character, becomes universal. This is attended by loss of consciousness, out of which she passes into a series of convulsions, gradually increasing in severity, in one of which she dies or consciousness, partial or perfect, is regained, either, it may be, for a few minutes, a few hours, or days, during which violent headache is complained of, or she is delirious and excited, as in acute mania, or dull and sullen as in melancholia, and requires to

be roused, when she is found wandering, and her speech is somewhat imperfect. Without further warning, save that the pulse, which has become soft, with nearly the normal number of beats, all at once becomes low and hard; she is suddenly seized with another convulsion, in which she dies, or passes into a state of coma from which she never rallies. In another case the convulsions will gradually subside, the headache disappears and the patient recovers, only to find that she has completely lost her eyesight, a loss that may be temporary or permanent."

Journal Writing Activity

Student Assessment:
Student work can be assessed in the following ways:

Did students create a thoughtful journal entry from the point of view of a young woman working in a white lead factory?

Did students choose words and phrasing that reflect the character's background?

After reading the excerpts from the work of Charles Dickens and Jack London, you should be very familiar with the plight of the young women who worked in the white lead mills of 19th century London. Now do the following:

- Read the short descriptions below of the lives of four real women who worked in the mines.
- Choose ONE young woman and write a journal entry as if you were that character.
- Your entry should include the following information: How much is she paid for a day's work at the lead mill? How is the job affecting her health? Why is she willing to do such terrible work?
- Write the way you imagine the character would speak. Use slang, Cockney dialect, and non-traditional spelling where appropriate, as in the reading.

Charlotte Rafferty, a fine, well-grown young woman with a splendid constitution who had never had a day's illness in her life became a white lead worker. Convulsions seized her at the foot of the ladder in the works. Dr. Oliver examined her, found the blue line along her gums, which shows that the system is under the influence of the lead. He knew that the convulsions would shortly return. They did so, and she died.

Mary Ann Toler a girl of seventeen, who had never had a fit in her life three times became ill and had to leave off work in the factory. Before she was nineteen she showed symptoms of lead poisoning had fits, frothed at the mouth, and died.

Mary A., an unusually vigorous woman, was able to work in the lead factory for twenty years, having colic once only during that time. Her eight children all died in early infancy from convulsions. One morning, whilst brushing her hair, this woman suddenly lost all power in both her wrists.

Eliza H., aged twenty-five, after five months at lead works, was seized with colic. She entered another factory (after being refused by the first one) and worked on uninterruptedly for two years. Then the former symptoms returned, she was seized with convulsions, and died in two days of acute lead poisoning.

— The above descriptions are from Jack London's *The People of the Abyss*.

Lesson One: TRUMPETER SWAN MATH

Lesson Overview

In this lesson, students work with data related to trumpeter swans suffering from lead poisoning in Skagit and Whatcom counties of Washington. Students first read two newspaper articles that include some statistics. They then work through calculations using those statistics. Students also work with a data chart to create a bar graph. Extension activities are included for additional classroom work or homework assignments.

Suggested Grade Levels: 6 & 7
Curriculum Connections: Organizing data, percentages, bar graphs, reading for information and interpreting statistics

EALRs Addressed

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:

- Understand and apply concepts and procedures from number sense, number and numeration, computation, and estimation. Demonstrate understanding of integers, fractions, decimals, percents, place value of decimals, and properties of the rational number system using pictures and symbols. (Math 1.1)
- Identify how statistics can be used to support different points of view. (Math 1.4)
- Gather information. Read, listen, and observe to access and extract mathematical information. (Math 4.1)
- Represent and share information. 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. (Math 4.3)
- Use mathematical thinking and modeling in other disciplines. (Math 5.2)

Teacher Background

Lead poisoning has posed a problem to waterfowl since the early 1900s. Waterfowl can suffer from lead poisoning when they eat lead shot. The bird species that are most commonly poisoned by lead shot are Mallards, Black Ducks, Northern Pintails, Canada Geese, Snow Geese, Trumpeter Swans and Tundra Swans.

Lead shot was used for decades for hunting waterfowl (such as ducks, geese and swans) and upland birds (such as pheasants, wild turkey and quail). Hunters use shotgun shells filled with several hundred small pellets. These pellets, or shot, shower out in a wide distribution pattern, increasing the likeliness that the hunter will hit a

bird in flight. On average, about 732 million pellets enter the environment each year in upland bird hunting. These pellets can become concentrated in certain areas, such as at a pheasant release sites or at shooting ranges. Lead shot sinks to the bottom of wetlands, which are common feeding grounds for many species of ducks, geese and swans.

Waterfowl, like trumpeter swans, ingest lead shot while feeding in lakes or ponds. They use their long necks to probe deep into the mud for food. Swans may mistake a lead shot for a seed or snail, or may purposefully swallow it along with pebbles to help grind their food. When a bird ingests lead shot, it usually becomes trapped in the gizzard, which is the muscular part of the stomach that grinds food. As the gizzard works to grind the food, it also wears down lead shot into small pieces, allowing the lead to absorb into the bird's bloodstream.

Lead accumulates in the bones and vital organs, such as the kidneys, brain and liver. If a bird swallows a small number of pellets, it will gradually become weak and die of starvation or from predation. This is called chronic lead poisoning. If a bird ingests a large number of lead shot, such as six or more pellets, it will die within a few days. This is called acute lead poisoning. Lead poisoning also affects birds of prey (eagles and hawks) and scavengers (vultures) when they eat a bird that has been lead poisoned or if they eat an animal that has lead shot embedded in its flesh (shot by a hunter). This is called secondary lead poisoning.

Humans can also be at risk for secondary lead poisoning when they consume game birds that have been hunted with lead shot. People may be exposed to lead when they ingest tissue embedded with lead pellets or fragments. There is no significant human health risk posed by eating the meat of game birds that have lead poisoning from ingesting lead objects. The liver, kidney and bone marrow of birds will contain higher levels of lead than the meat and should be avoided.

A lead poisoned bird shows characteristic symptoms, such as staggering, crash landing, or an inability to fly or walk. It eats very little and may lose up to half its body weight. The bird may have droopy wings and have green diarrhea. A bird can die from lead poisoning after ingesting only one or two pellets.

In Washington State, a ban was placed on the use of lead shot for waterfowl hunting in 1986. A U.S. ban was placed in 1991. However, lead shot is still allowed for hunting upland birds, such as pheasant, wild turkey and quail. Lead shot is also allowed for trap and skeet shooting. While many non-toxic shots are available for both upland and waterfowl hunting, some hunters prefer to use lead shot. Hunters prefer lead shot over the alternatives because it is the cheapest choice, they are most familiar with it, they fear that alternative shot will harm their guns, and they prefer the way that lead shot performs. Today, there are many lead-free shotgun shells available, including steel, tungsten, bismuth, tin and alloys. Some ammunition manufacturers believe that the new breed of lead-free shot actually improves upon the performance of lead shot. The table below offers a comparison between lead shot and some lead-free alternatives.*

Shot Material	Cost per Box of 25 Shells	Performance Comments
Lead	$5.00 per box	Lead is the standard to which all other types of shot are compared.
Bismuth	$37.50 to $62.50 per box	Very similar to lead. However, there is a limited supply of bismuth in the world.
Steel	$8.00 to $12.95 per box	Steel is lighter than lead, so hunters have to adjust. Steel may harm older guns and bullets may ricochet.
Tungsten/Iron	$62.50 per box	Very similar performance, however there is less shot in each shell as compared to lead shells. It can cause damage to older guns.

*From: "Best Management Practices for Lead at Outdoor Shooting Ranges," U.S. EPA, Region 2 http://www.epa.gov/region2/waste/leadshot

For a more in-depth understanding of the relationship between lead poisoning and local swan populations, consult the following resources that were used to prepare this lesson:

- The Washington Swan Working Group Website http://www.swansociety.org/washington.htm
- The Trumpeter Swan Society Website http://www.trumpeterswansociety.org

Teacher Preparation

MATERIALS: Copies of the **Student Handout**
Graph paper
Rulers
Colored pencils or pens
Calculators (optional)
Computer access (optional)

- Make enough copies of the **Student Handout** for each student or group to have a set. Master copies of the handouts are included at the back of this book.
- If you are the first teacher in your team to use this FACT FILE, make copies of the student handout entitled, **Student Introduction: Environmental Health and Lead**. Ensure that students have read the handout and mastered the content and vocabulary.
- The graphing activity can be done on graph paper or in a computer lab, if students have access to a spreadsheet software with graphing abilities, such as Microsoft Excel.
- If students will be doing the graphing activity by hand, distribute graphing paper, rulers and colored pencils or pens.

Procedure

- Introduce the activity by discussing the **Trumpeter Swan Distribution Map** on the **Student Handout** and pointing out the winter feeding grounds of the trumpeter swans in Whatcom and Skagit Counties in Washington State, as featured in the news articles.
- Assign the articles and related math problems to individual students or to small student groups. The readings and problems can also make a good homework assignment. The graphing activity can be done in-class or in a computer lab.

- See the **Teacher Key of the Student Handout** for correct answers and examples of how students might complete their calculations. For several problems, there is more than one correct way to solve the problem

Student Assessment

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

10%	Did student read **Article #1** and complete the **Check Your Understanding** questions?
10%	Did students read **Article #2** and complete the **Check Your Understanding** questions?
10%	Did students read **Article #3** and complete the **Check Your Understanding** questions?
15%	Did students complete the **four data tables**, rounding their answers to one decimal place?
50%	Did students create a **bar graph** that includes the required elements? • 25% **Data** is correctly represented • 5% Information on the four flyways is on the **x-axis** and information on the percentage of duck with lead shot is on the **y-axis**. • 5% Uses a different **color** to represent each duck species. • 5% Uses a **key** to the colors. • 5% Axes are **labeled** and graph is **titled**. • 5% **Neatness**.
5%	Did student complete the **Check Your Understanding** questions following the Graphing Activity?

Extension Activities

Student Assessment:
The extension activities provide for more in-depth assessment of student understanding.

Shadow A Swan: You can use swans to help teach the concepts of chance and probability using the curriculum offered at the Shadow a Swan Project website (http://www.uen.org/swan/). This program allows teachers and students to register online and have access to satellite tracking maps that track the movement of swans fitted with radio collars. The website also offers math curriculum for grades 4-6 and 10-12. This curriculum was selected by the National Science Teachers Association's SciLinks program. While some of the lessons do not require the use of a computer, the satellite map activities do require computer access.

Fly Away Home: Show students a slideshow about the fate of trumpeter swans today. The Defenders of Wildlife website offers a Trumpeter Swan Reintroduction Slideshow (http://www.defenders.org/trmpth01.html). This slideshow demonstrates how scientists are teaching some populations of swans to migrate again. Have students access the slideshow in a computer lab, or show it to the entire class using a projector.

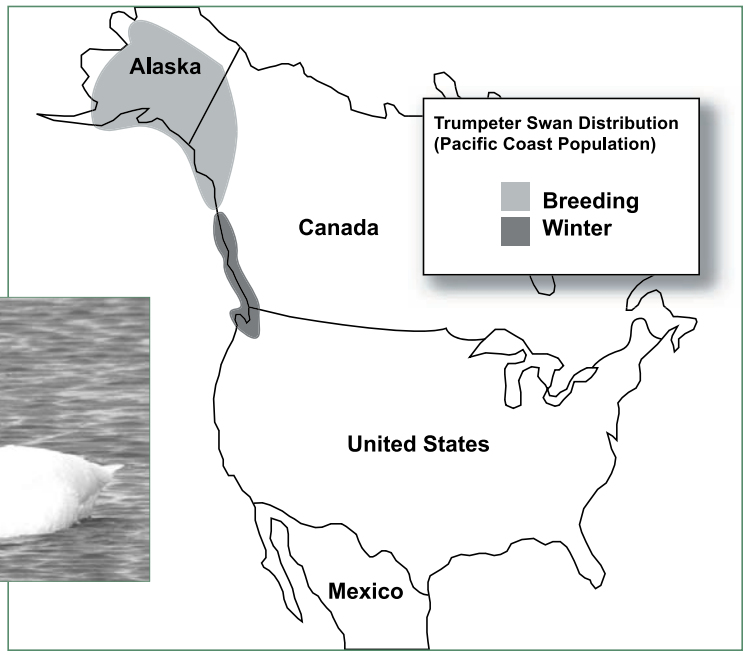
Education Campaign: Challenge students to create posters to educate a specific audience about the dangers of lead poisoning for swan populations. The posters should include statistics, charts, or graphs to illustrate information. Target audiences may include hunters, farmers, or ammunition retailers.

TRUMPETER SWAN MATH Student Handout #1

Teacher Key

Introduction

In this lesson, you will learn about how **trumpeter swans** are being poisoned by years of accumulated **lead shot** from hunting. First, look at the map below. It shows where the Pacific Coast population of trumpeter swans breeds and spends the winter.



Trumpeter Swan: A large white swan with an eight foot wing span that mates for life and returns to the same nest each year. The Pacific Coast population spends the winter in Northwestern Washington and British Columbia and has mating grounds in Alaska. Trumpeter swans have a loud call that sounds like bugling trumpets.

Lead Shot: Tiny lead pellets used in a shotgun cartridge.

In the following activities, you will read three articles about lead poisoning among trumpeter swans. Each article includes several math problems based on the information contained in the article. You will also work with a data chart to create your own bar graph with information about lead poisoning in waterfowl.

Readings

ARTICLE #1

Decades of old lead shot linked to massive swan die-offs: State biologists seek mystery site feeding decline of trumpeter population

— by M.L. Lyke, from the *Seattle Post-Intelligencer* (1/23/03)

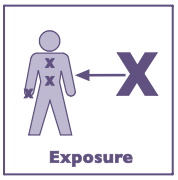
WHATCOM COUNTY – A bitter Fraser Valley wind ruffles the water of the unlikely lake, a rain-filled gravel pit surrounded by skeletal trees and heaps of excavated dirt. The dozen trumpeter swans bobbing on the water's surface add the only touch of beauty to the barren scene.

The elegant white birds shouldn't be here. This is a night **roosting area**. It's 10 a.m. The birds are supposed to be off feeding. Binoculars reveal more irregularities. Some

Roosting Area: An area in which birds settle down to rest. Oftentimes groups of birds will roost together at night.

of the birds' proud long necks hang limp. A few loners straggle off by themselves – a bad sign.

A somber Mike Davison surveys the scene from the shore. The flock at this pit lake near the tiny town of Everson is in trouble. "Ninety percent of these birds are already dead," says Davison, the Washington Department of Fish and Wildlife biologist leading an investigation into the massive die-off of trumpeter swans in Whatcom County.



Last year, 229 of the 2,400 trumpeter swans that wintered in Whatcom County died of lead poisoning, the result of birds ingesting lead pellets from hunters' spent shotgun shells. This year's unseasonably warm, dry winter seems to have delayed migration – a midwinter count on Tuesday showed roughly 827 trumpeter swans in Whatcom. The odd weather may have also delayed mass deaths seen in years prior. As of Tuesday, the department had tagged 75 dead birds.

Davison and other wildlife professionals working on the project suspect the source of the problem may be a deadly "hot spot," a body of water or agricultural field in the county containing very high levels of lead left by bird hunters. "We are pretty well convinced that this site will have a 60-year history of hunting, and this lead will have accumulated year after year after year," says Davison. The lead is likely old shot.

Use of lead shot to hunt waterfowl was outlawed in Washington in 1986, although it still is legal for shooting other game birds. However, hundreds of tons of old lead pellets have settled into lakes, marshes, wetlands, fields and other hunter haunts over the decades. But the toxic lead could also be new shot -- from hunting **scofflaws**. "Just because there's a law, doesn't mean that people are complying with it," says Davison, who has studied swan mortality in the county for 15 years.

Scofflaw:
Someone who regularly breaks the law.

He suspects the lethal site is a field with "sheet water," water that spreads across agricultural lands in wet winters. And he has a hunch crops on the hot spot may have been rotated from swan-friendly food such as corn or potatoes to undesirable strawberries, raspberries or ornamental plants during a seven-year stretch in the '90s when no swan die-offs were recorded.

Like hard-boiled street detectives with a drawerful of clues, Davison is not ruling out any possibilities in the hunt for the Whatcom County's mystery site.

Radio Transmitter Collar:
A collar that scientists attach to an animal to track its movements by satellite.

Last winter, for the first time, the Department of Fish and Wildlife captured 18 trumpeter swans and fitted them with **radio transmitter collars**. This season, crews collared another 23 swans. This has allowed researchers to track flocks, pinpoint their locations and connect the dots on a map, narrowing their focus to a central chunk of the county.

Fortunately for the search, a number of the collared birds have died of lead poisoning. Davison notes the irony. "In our business, when you go to all the expense to capture animals and put radio collars on them, the normal scenario is you want them to live forever. That's how you get information. in this scenario, for us to be successful, these birds that we collar have to die.

The death of a collared bird allows researchers to track all the areas the animal visited. If five or six of them die, investigators can determine whether the birds use particular areas in common. Such clues could break this case.

It's a staggering investigation. The county spreads across 1,356,864 acres. The majestic birds, with 8-foot wingspans, range over a large part of it. "This is a virtual needle in the haystack situation," the biologist says.

Check Your Understanding

1. In 2002, 229 of the 2,400 trumpeter swans that wintered in Whatcom County died of lead poisoning. What percentage of the total population of trumpeter swans wintering in Whatcom County died from lead poisoning in 2002?

Total number of swans = 2,400
Number of swans poisoned = 229
100 (229 / 2,400) = 9.54%
Answer: 9.54% of the Whatcom County trumpeter swans died from lead poisoning

2. Hunters use ammunition called "shells" to hunt waterfowl. Each shell contains a large number of small pellets which, when shot, scatter in a wide pattern to increase the likelihood of hitting a bird. We can assume that one shell has an average of 250 pellets. On average, a hunter shoots 6 shells for each bird that is bagged. This means that up to 732 million pellets may be fired each year to harvest the average of 488,000 upland birds (pheasants, quail, doves, etc.) that are taken annually in Washington state.

a. On average, how many pellets are shot for each bird that is actually harvested?

Solution #1:
Number of shells shot per harvested bird = 6
Number of pellets per shell = 250
250 * 6 = 1,500 pellets
Answer: 1,500 pellets are shot for each bird that is harvested

Solution #2:
Number of pellets fired = 732,000,000
Number of birds harvested = 488,000
732,000,000 / 488,000 = 1,500
Answer: 1,500 pellets are shot for each bird that is harvested

b. How many shotgun shells are shot each year, on average?

Solution #1:
Number of shells shot per harvested bird = 6
Number of birds harvested each year = 488,000
488,000 * 6 = 2,928,000
Answer: 2,928,000 shells are shot each year in upland bird hunting

Solution #2:
Number of pellets fired = 732,000,000
Number of pellets per shell = 250
732,000,000/250 = 2,928,000
Answer: 2,928,000 shells are shot each year in upland bird hunting

Student Assessment:
Did students complete the reading and provide correct answers to the math problems?

Drawn by abundant food

Miles Davis:
One of the most famous jazz trumpet players of all time.

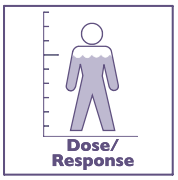
In winter, the Pacific Northwest draws an estimated 80 percent of the country's trumpeter swans, known scientifically as *Cygnus buccinator.* The handsome white birds, which look like long white arrows in flight and bugle a mean **Miles Davis** chorus overhead, mate for life and tend to return to the same nest year after year.

Estuary:
An ecosystem where a river meets an ocean so that there is a mix of fresh water and salt water.

They are drawn here by a mild climate, productive **estuaries** and rivers, and abundant agricultural lands with after-harvest pickings of corn, potatoes and grains. Flocks usually arrive in October and leave by March, heading back to Alaska and points north. The largest concentration is in the Skagit Valley, which last year had about 5,000 birds, and Snohomish County, which had close to 600.

In addition to the die-off in Whatcom County, lead deaths in Skagit and Snohomish are on the rise this year, according to Martha Jordan, a Northwest trumpeter swan expert.

Susan Murphy, with the Pilchuck Wildlife Rehabilitation Center, says some swans have been migrating from Whatcom County to Snohomish and Skagit counties to roost this year. Of the 20 dead birds picked up in Skagit County and the 26 picked up in Snohomish County so far this season, more than 50 percent apparently died of lead poisoning.



Trumpeter swan populations, which have rebounded since the species was hunted nearly to extinction for feathers and skin earlier in the century, are particularly susceptible to lead shot. With their long necks, the swans can easily reach deep into the mud, where they ingest pebbles and grit — and lethal shot pellets — to help them grind and digest their food.

Symptoms can develop as soon as 10 days after they ingest a pellet. One pellet can be a large enough dose to kill a bird. Many of the Whatcom County carcasses have contained hundreds.

Student Assessment:
Did students complete the reading and provide correct answers to the math problems?

Check Your Understanding

1. It is estimated that the total population of trumpeter swans in the U.S. is about 16,000 swans. If the Pacific Northwest draws an estimated 80% of the country's swans, how many swans can be found in this region?

Total number of swans = 16,000
Percentage of swans in Pacific Northwest = 80%
16,000 * .80 = 12,800
Answer: About 12,800 swans can be found in the Pacific Northwest.

Capturing sick swans

At the gravel pit lake, wildlife technician Erin Schneider, running a 14-foot Lund skiff, has already picked up one dead trumpeter by 10 a.m. She has also hauled in a sick juvenile, a listless lump of a bird whose gums have turned from healthy pink a telling ghostly white.

Volunteers at the site on private land -- ironically dubbed Wilder Ponds -- use a large fish net, bent from pulling dying birds from the water, to capture two more sick swans over the course of an hour. The gasping, 20-pound birds don't even struggle as Schneider and volunteer Sean Donalty put them in burlap bags, holding their heads and talking softly to them.

The birds are to be **euthanized**. No one can save them, says Davison. “There is no going back. When we get it, it’s a dead bird.” Taking sick and dying swans out of the environment quickly is critical. Eagles, coyotes and other predators could feast on the poisoned birds and themselves sicken and die.

Euthanized: When a hopelessly sick animal has been put to death in a relatively painless way as an act of mercy.

The euthanization is also an act of mercy. The lead shuts a bird’s system down, making them weak and reluctant to fly. As the poison progresses, the animals lose muscle control and coordination. Blocked organs can swell until the birds aren’t able to process food.

The swans usually die within 17 to 21 days after ingesting a pellet -- although Davison theorizes large quantities of pellets found inside Whatcom County’s swans may shorten that to as little as 10 days. “That’s a relatively short period,” he says, “unless you’re the one dying.”

‘Catastrophic die-off’

The 2002-2003 season marks the fourth consecutive year of swan mortality in Whatcom County. Davison calls the losses, the largest in North America, a “catastrophic die-off.” Last year’s midwinter death toll represented almost 10 percent of the population.

Any additional stress -- a bad hatch year or a year of reproductive failure -- could cause a serious crash in the population over time. “229 out of 2,400 -- that’s way too many birds. You can’t tolerate that level,” says Davison, known as “The Goose God.”

The statistics add urgency to the work at hand -- locating the mysterious hot spot with the toxic lead load. Davison describes the investigation as tangled, labor-intensive and costly. It relies on help from state, federal and Canadian wildlife biologists, members of the Trumpeter Swan Society and Whatcom County’s Audubon Society, the Pilchuck Valley Rehabilitation Clinic and volunteers, including waterfowl hunters.

The project’s $35,000 annual budget comes from state and federal funds. Davison says it’s already running at a slight deficit. And the work has just begun. Once wildlife investigators can narrow their search to four to six acres, intensive sampling will begin. Crews will use clam guns to pull plugs of soil from suspected sites and check these core samples for lead pellets. “One site could require thousands of core samples,” says Davison.

After the “hot spot” is located, costs could escalate dramatically. If the mystery site is a lake or slough, cleanup could involve dredging out the lead. If the site is an agricultural field, with a large amount of standing water, it could involve diking and draining the land, as well as chasing off birds with cannons and electrical alarms. That’s expensive. But so is the alternative. “If we don’t solve this soon, we’ll have to cycle through the money again next year,” says Davison as he checks other swan haunts.

He pulls up at a favorite roosting site, little Wiser Lake, southwest of Lynden. It’s a postcard-perfect suburban scene, with ducks cutting “V’s” on the lake’s silver surface in front of waterfront homes with manicured lawns.

The veteran wildlife biologist quickly spots the white hump hauled out in the lakeside brush. He gets out of the truck and moves in slowly. It raises its long neck in a tired question mark and waddles away. The sickness, says Davison, is just beginning. The bird will be dead by month’s end.

HOW TO HELP

If you find a trumpeter swan in distress in Whatcom County, call the Wildlife Rescue Network toll-free at 877-953-7377. Do not attempt to pick up or rescue the animal on your own.

The Pilchuck Wildlife Rehabilitation Center can be contacted at 360-387-8299.

P-I reporter M.L. Lyke can be reached at 425-252-2215 or m.l.lyke@seattlepi.com

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http://seattlepi.nwsource.com/local/105452_swans23.shtml

ARTICLE #2

Searching For Sources of Lead Poisoning in Swans

— by Doug Williams, from *Fish & Wildlife Magazine*

While it has been banned in the United States for more than a decade, the toxic legacy of lead birdshot continues to take a grim toll on visiting northern trumpeter and tundra swans in Skagit and Whatcom counties. “Research has shown that from the day a swan picks up lead shot, it will take about three weeks for that bird to die,” said Mike Davison, wildlife biologist for the Washington Department of Fish and Wildlife (WDFW), who is spearheading the Department’s efforts to end the poisoning of swans.

The winter of 2001-02 was the deadliest on record, with an estimated 247 swans — 95 percent of them trumpeters — dying from lead poisoning in the two counties and adjacent portions of British Columbia. About 4,000 swans over-winter in Skagit County, with another 1,000 or so in Whatcom County.

Gizzard: Part of a bird’s digestive system which has strong muscles and a tough lining to grind down food.

The birds aren’t being shot. Instead, the long-necked swans are ingesting spent lead shot that has settled onto the bottom of shallow lakes and ponds where the birds feed. The lead shot ends up in the bird’s **gizzard** where the soft metal is ground up and slowly leaches into the swan’s bloodstream.

The Department has teamed with Canadian fish and wildlife biologists, the U.S. Fish and Wildlife Service, the Trumpeter Swan Society, the Bellingham Chapter of the Audubon Society, and the Pilchuck Valley Rehabilitation Clinic to identify the places where swans are ingesting spent lead shot, and finding ways of removing the poisonous material from the environment.

The main thrust of the work has been to collect more data on the birds’ movements. A total of 26 swans — 19 in Whatcom County, plus seven in British Columbia — have been fitted with radio-transmitting collars that allow biologists and volunteers to track the birds’ movements throughout the region, and possibly pinpoint the places where they’re picking up spent shot.

Core Sampling: A cylindrical tube is inserted into the ground and the contents are examined to see what lies beneath the surface at various depths.

Davison said the 26 collared birds were tracked to 50 different sites. Two of the collared birds died from lead poisoning, and their deaths led the biologists and volunteers to focus in on about 12 specific locations. The team has done preliminary **core sampling** at some of the sites of interest, and early analysis is beginning to reveal lead shot sources, Davison said.

“Based on our early analysis, there appears to be a window of time when the birds are becoming exposed to the lead shot, so we’ll focus our future research on the locations that

the birds are visiting earlier during the time frame that they're in the area," he said. "Our goal for this coming winter is to try to get more collars on birds earlier in the season."

Davison said an intensive sampling effort of suspected lead-poisoning sites is outside WDFW's ability, given current budget and staffing levels. "We're looking to take the lead on all of the research work, while another agency or group could come in and facilitate the more-intensive core sampling effort," he said.

Non-toxic shot requirements were phased in over time, beginning in 1986, and ending in 1991 throughout the United States. Non-toxic shot has been required for all waterfowl hunting in Canada since 1999 but has been required in parts of British Columbia for almost 10 years. Non-toxic shot is also required for public hunting areas that are used for both pheasant and waterfowl hunting, and includes all of the pheasant release sites in northern Puget Sound. Hunters are encouraged to convert to non-toxic shot for all upland bird hunting.

Secondary Lead Poisoning: When a bird of prey or scavenger bird becomes lead poisoned by eating an animal or bird with lead shot embedded in its flesh.

Lead-poisoned swans pose a health threat to other wildlife, including bald eagles, which feed on swan carcasses and can get **secondary lead poisoning**. Davison said two dead eagles found this year in the area are being tested for lead poisoning. "Potential secondary **mortalities** point out the importance of collecting sick or dead swans as soon as possible," Davison said. "The value of the rescue and recovery work that our partners do is immense."

Mortality: A measurement of the number of deaths in a particular time or at a particular place.

Check Your Understanding

1. In 2001-2002, 247 swans died from lead poisoning in Skagit and Whatcom counties and adjacent portions of British Columbia. Ninety-five percent of these were trumpeter swans. About 4,000 swans over-wintered in Skagit county and another 1,000 over-wintered in Whatcom county and adjacent areas in B.C.

   a. What percentage of the total population of swans over-wintering in Skagit County, Whatcom County, and BC died from lead poisoning?

   Total population of overwintering swans = 5,000
   Number of swans that died = 247
   100 (247 / 5,000)= 4.94%
   Answer: 4.94% of the total swan population died from lead poisoning.

   b. How many trumpeter swans died from lead poisoning in 2001-2002? Round your answer to a whole number.
   Number of swans that died = 247
   Percentage that were trumpeter swans = 95%
   247 * .95 = 234.65
   Answer: 235 trumpeter swans died from lead poisoning.

2. A total of 26 swans--19 in Whatcom county plus 7 in British Columbia--have been fitted with radio-transmitting collars. The 26 birds were tracked to 50 different sites. Two of the collared birds died from lead poisoning.
   a. What percentage of collared birds survived during the survey?
   Solution #1
   Number of birds with collars: 26
   Number of birds that died : 2
   100 (2 / 26) = 7.69% died from poisoning
   100% - 7.69% = 92.31% survived
   Answer: 92.31% of the swans did not die from lead poisoning.

Solution #2
26 - 2 = 24 birds survived
100 (24 / 26) = 92.31% survived
Answer: 92.31% of the swans did not die from lead poisoning.

3. Before lead shot was banned, biologists were able to estimate the amount of lead pellets entering the environment each year. They call this a "distribution rate." In order to come up with this figure, they had to assume that pellets are distributed evenly across all the huntable land in Washington State. This is not true, since some areas (like shooting ranges) have a higher concentration of hunting activity than other areas. However, if we assume that the distribution of pellets on huntable land in Washington is equal, then approximately 21 pellets are distributed per acre per year.

   a. How many pellets would be deposited on one acre after 20 years?

   Amount of pellets per acre per year = 21
   21 pellets * 20 years = 420 pellets
   Answer: There would be approximately 420 pellets on the acre of land after 20 years of hunting.

   b. Lead shot was banned in Washington State in 1986 for waterfowl hunting. Hunters are now required to use non-toxic ammunition instead of lead shot. Calculate how much lead shot would have been deposited on a typical acre of huntable land in Washington state between January 1986 and January 2003 if lead shot had NOT been banned.

   Number of years between 1/1986 and 1/2003: 17 years
   Number of pellets per acre per year: 21
   21 pellets * 17 years = 357 pellets
   Answer: On one acre of land, approximately 357 lead pellets would have entered the environment if the lead shot ban had not been in effect.

ARTICLE #3

Swans Dying of Lead Poisoning in Washington State and British Columbia, Canada

— Washington Swan Working Group and The Trumpeter Swan Society

After six deadly winters, no one yet knows where the swans are getting the lead shot that is killing so many of them. The Trumpeter Swan Society has been working hard to assist Canadian and U.S. wildlife agencies with research to find the source of lead shot, so that it can be cleaned up.

As of late April 2005, the total count of swan deaths since 1999 is around 1,900 swans, with about 97% trumpeter swans and the remaining tundra swans. Most of the birds have been picked up dead or dying on the ponds they use for night roosts on the U.S. side and, to a lesser extent, in Canada. There is no way to estimate the number of additional dead birds that have escaped detection in the wintering grounds or that may have died as they tried to migrate north in the spring.

The die-off has now happened for six years in a row in the same geographical area.

During the 2004-2005 winter about 400 dead trumpeter swans were picked up, similar to winter 2003-2004, and considerably more than in previous winters.

You can help! If you choose to hunt, please use non-toxic ammunition. Tell the store why you are buying non-toxic shot and urge them to promote its use. If you allow hunters to use your land, require them to use non-toxic shot only on your property. Voluntarily switching to non-toxic shot is something we all can do—without wasting one more day—to help reduce the needless deaths of swans and other wildlife.

Reprinted with permission from the Trumpeter Swan Society. Available at: http://www.swansociety.org/washington/lead.htm.

Student Assessment:
Did students complete the reading and provide correct answers to the math problems?

Check Your Understanding

1. Between 1999 and April 2005, around 1,9000 swans have died of lead poisoning. Ninety-seven percent of those were trumpeter swans and the rest were tundra swans. How many of the dead swans were trumpeter swans and how many were tundra swans?

   Solution #1
   Number of swans that died = 1,900
   Percentage that were trumpeter swans = 97%
   1,900 * .97 = 1,843 trumpeter swans
   1,900 – 1,843 = 57 tundra swans
   Answer: 1,843 trumpeter swans and 57 tundra swans

   Solution #2
   Number of swans that died = 1,900
   Percentage that were trumpeter swans = 97%
   1,900 * .97 = 1,843 trumpeter swans
   Percentage that were tundra swans = 3%
   1,900 * .03 = 57
   Answer: 1,843 trumpeter swans and 57 tundra swans

Lead Poisoning in Waterfowl, 1973-1984

Graphing Activity

Swans are not the only birds being hurt by lead shot. Many different species of waterfowl are equally susceptible to lead poisoning, including trumpeter swans, snow geese, and many species of ducks. The birds accidentally ingest lead shot that is embedded in mud at the bottoms of lakes or ponds. The use of lead shot in hunting waterfowl was banned in the U.S. in 1991. Before the ban, biologists completed an eleven year study of ducks' susceptibility to ingesting lead shot.*

Waterfowl:
A water bird, especially a swiimming bird.

Flyway:
An established air route that migratory birds follow during their migration.

The biologists looked at the four migratory bird **flyways**, existing flight paths used by birds during their migration. During the study, the scientists examined over 95,000 ducks that had been shot by hunters. The scientists dissected the ducks' gizzards to see if they had ingested any lead shot prior to being shot. The data table below shows the results of four species of ducks that were found to have ingested one or more lead pellets.

* From: "A Review of the Problem of Lead Poisoning in Waterfowl." Northern Prairie Wildlife Research Center, 1986. http://npwrc.usgs.gov/resource/othrdata/pbpoison/abstract.htm

Directions: Fill in the missing information on the four data tables. The tables have information about the total number of ducks caught in each flyway, and the number of those caught that had ingested lead shot. Use those two numbers to calculate percentages to complete the final column. Round your answers to one decimal place.

Next, use the completed data tables to create a bar graph. Your graph should group information by the four flyways. Place information for the four flyways on the x-axis. Use a different color to represent each species of duck and include a key to the colors that you used. Make sure to label the axes and to title your graph. Once you have completed your graph, answer the **Check Your Understanding** questions.

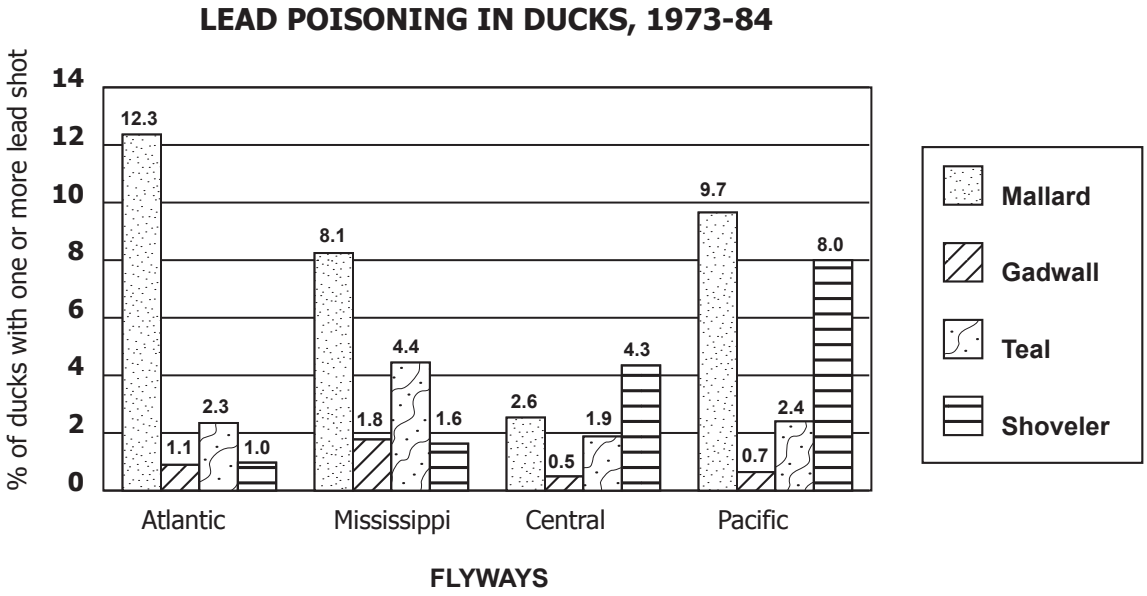
MALLARD	Flyway	Total	# w/shot	% w/shot
	Atlantic	8,602	1,058	12.3%
	Mississippi	45,448	3,681	**8.1%**
	Central	11,092	288	2.6%
	Pacific	16,338	1,585	**9.7%**
	TOTAL	**81,480**	**6,613**	**8.2%**

GADWELL	Flyway	Total	# w/shot	% w/shot
	Atlantic	469	5	**1.1%**
	Mississippi	949	17	1.8%
	Central	998	5	0.5%
	Pacific	1,223	9	**0.7%**
	TOTAL	**3,639**	**36**	**1.0%**

Blue-Winged TEAL	Flyway	Total	# w/shot	% w/shot
	Atlantic	3,084	71	**2.3%**
	Mississippi	3,428	151	4.4%
	Central	528	10	**1.9%**
	Pacific	592	14	2.4%
	TOTAL	**7,632**	**246**	**2.8%**

SHOVELER	Flyway	Total	# w/shot	% w/shot
	Atlantic	831	8	1.0%
	Mississippi	295	5	1.6%
	Central	231	10	**4.3%**
	Pacific	1,302	104	**8.0%**
	TOTAL	**2,659**	**127**	**4.8%**

Draw or attach your bar graph here:



Student Assessment:
Did students correctly complete the data tables, design a bar graph, and answer the follow-up questions?

Check Your Understanding

1. Which species of duck seems to be the most susceptible to ingesting lead shot overall? ***Mallard***

2. Which species seems to be the least susceptible to ingesting lead shot overall? ***Gadwall***

3. For each of the four species of ducks, in which flyway are they most likely to ingest shot?

   a. Mallard: ***Atlantic***

   b. Gadwall: ***Mississippi***

   c. Blue-winged Teal: ***Mississippi***

   d. Shoveler: ***Pacific***

Lesson Two: CHILDHOOD BLOOD LEAD LEVELS

Lesson Overview

This lesson uses data from a U.S. Environmental Protection Agency report on the links between childhood lead poisoning, race, and income level. Students play the role of interns at the EPA who must create a series of graphs for an important presentation. The students take information from a complicated graph and table and present the information in several different formats. An extension activity is also included for additional classroom work or homework assignments.

Suggested Grade Levels: 7 & 8
Curriculum Connections: Percentages, samples and populations, making predictions, bar graphs, and interpreting statistics and graphs

EALRs Addressed

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:

- Understand and make inferences based on analysis of experimental results, statistical data, and simple graphical representations. (Mathematics 1.4 Predictions and Inference)
- 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. Explain or represent mathematical ideas and information in ways appropriate for audience and purpose. (Mathematics 4.3 Represent and Share information)
- Relate mathematical concepts and procedures to real-life situations. Recognize the widespread use of mathematics in daily life and the extensive use of mathematics outside the classroom, for example, in banking or sports statistics. (Mathematics 5.2)

Teacher Background

For a more in-depth understanding of blood lead levels, consult the following resource that was used to prepare this lesson:

- U.S. Environmental Protection Agency, “America’s Children and the Environment, 2003.” Consult the “Body Burdens” section for information on blood lead levels in children.
  http://www.epa.gov/envirohealth/children/
- U.S. Census Bureau’s Poverty Thresholds
  http://www.census.gov/hhes/poverty/threshld.html

Teacher Preparation

MATERIALS: Copies of the **Student Handouts** in manila folders
Graph paper, rulers, and colored pencils or pens
Computer access (optional)

- Make enough copies of the **Student Handouts** for each student or group to have a set. Master copies of the handouts are included at the back of this book. If possible, place each set of **Student Handouts** into a manila folder marked "Research Notes."

- If you are the first teacher in your team to use this FACT FILE, make copies of the student handout entitled, **Student Introduction: Environmental Health and Lead**. Ensure that students have read the handout and mastered the content and vocabulary.

- The graphing activity can be done on graph paper or in a computer lab using spreadsheet software with graphing abilities, such as Microsoft Excel. If students will be doing the graphing activity by hand, collect graph paper, rulers and colored pencils or pens.

Procedure

- The activity can be done in class or assigned as homework. Students can work in small groups or individually on the activity. You can use the teacher's version of the math problems to see examples of how students might complete the calculations, answer questions and draw graphs.

  Begin the activity by reading the scenario below to the class. Then, hand out the Research File Folders containing copies of the **Student Handouts**. If students are working in groups, hand out one folder to each group to share. Encourage students to cooperatively work through the process of creating the three graphs. However, each student should create their own graphs to turn in for credit.

- **READ THE FOLLOWING ALOUD TO THE CLASS:** "You are working for the U.S. Environmental Protection Agency as part of a summer internship program. The EPA is a government agency founded in 1970 that protects human health by keeping the air, water and land safe for all living things. You have just received an urgent email from your manager, Celia Summers. She needs your help creating some graphs for an important presentation. She has given you a research file containing all the information you will need to complete the project in time for the presentation. Celia is depending on your graphs to make her presentation a success."

Student Assessment

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

10%	Did students read **Student Handout #1** and **#2** and complete the **Check Your Understanding** questions?
30%	Did students create **Graph #1** that includes the required elements? • 15% **Data** is correctly represented. • 5% Information on race is on the **x-axis** and information on median blood lead levels is on the **y-axis**. • 5% Axes are **labeled** and graph is **titled**. • 5% **Neatness** and **color.**
30%	Did students create **Graph #2** that includes the required elements? • 15% **Data** is correctly represented. • 5% Information on race is on the **x-axis** and information on median blood lead levels is on the **y-axis**. • 5% Axes are **labeled** and graph is **titled**. • 5% **Neatness** and **color.**
30%	Did students create **Graph #3** that includes the required elements? • 15% **Data** is correctly represented on the **Data Table** and the **Bar Graph**. • 5% Information on race is on the **x-axis** and information on median blood lead levels is on the **y-axis**. • 5% Axes are **labeled** and graph is **titled** and a **key** is included. • 5% **Neatness** and **color.**

Extension Activity

Press Conference: Using presentation software such as Microsoft Powerpoint, students can turn their graphs into part of a complete presentation and then hold a mock press conference in the classroom. The students can play the role of reporters. The teacher or an adult volunteer can play the role of Celia Summers, making the presentation using the students' slides. Allow time for the reporters to ask questions. Then, each student group can work together to write a brief newspaper article that reports on the findings of the EPA report. This activity would be a particularly good team teaching activity for a language arts and math teacher.

Student Assessment: The extension activity provides for more in-depth assessment of student understanding.

CHILDHOOD BLOOD LEAD LEVELS
Student Handout #1

Teacher Key

Email Sent on: Today, 9:00 AM
From: Celia Summers
Subject: Lead Poisoning Project – URGENT!

Hi. I hope you had a good weekend. I have a new project for you to begin working on right away. I just received a report from our researchers entitled "America's Children and the Environment." One section of the report focuses on childhood lead poisoning. Since I remember you saying that you studied lead poisoning in school, I could really use your help.

I have a big press conference in two days. I will be sharing the information in the report with a group of reporters from across the country. I need to be able to clearly explain to them the relationship between childhood lead poisoning, race and income.

I need you to develop three graphs for me to use during my presentation at the press conference. The graphs should demonstrate:

1. Blood lead levels by income
2. Blood lead levels by race
3. Changes in blood lead levels over time

Make sure that the graphs are clear and easy to read. Please use colors and make sure to put a title on each graph. Also, place "Blood Lead Levels" along the y-axis for each graph.

I left a research file on your desk. You should find all the information that you need for this project in the file.

Thanks!

Celia Summers
U.S. Environmental Protection Agency (EPA)

TEACHER NOTE:
This handout should be clipped or stapled to the front of a file folder that contains Student Handout #2.

Blood Lead Level (BLL):
A measurement of the amount of lead in a person's blood. A BLL of over 10 µg/dL is considered dangerous.

U.S. Environmental Protection Agency:
Established in 1970, this government agency protects human health by safeguarding the air, water and land upon which life depends.

Math

CHILDHOOD BLOOD LEAD LEVELS
Student Handout #2

Teacher Key

Background Reading

Research Notes from "America's Children and the Environment"

The United States Environmental Protection Agency (EPA) released a report in 2003 about the health of America's children. The report focused on environmental health issues affecting children, such as asthma, lead poisoning, and childhood cancer.

One important finding in the report is that childhood lead poisoning is on the decline across the country. Scientists believe that the decline can be traced to the banning of lead-based paint in the late 1970s and the banning of leaded gasoline in the early 1980s. For example, the number of U.S. homes with lead-based paint dropped from 64 million in 1990 to 38 million in 2000. Less lead in the environment means fewer instances of childhood lead poisoning.

Hi. Here is some background information for you about lead poisoning and its connections to race and income. These are some research notes that I took while reading through the full report. I plan on using these notes when I write my speech for the press conference.

- Celia

The report attempts to address this question: What are the connections between childhood lead poisoning, poverty and race?

Environmental Justice

First of all, how is poverty measured? Each year, the U.S. Census Bureau 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 level (or low-income). If the family's income is right around the poverty threshold, then they are middle-income. If the family's income is much more than the threshold, then they are high-income.

For example, the poverty threshold for the year 2000 was $17,463 for a family of four (including two adults and two children. So across the country, if a family's income was below $17,463, they were considered to be living below the poverty level. The poverty threshold changes each year to account for inflation. For example, the poverty threshold increased from $17,463 in the year 2000 to $19,157 for 2004.

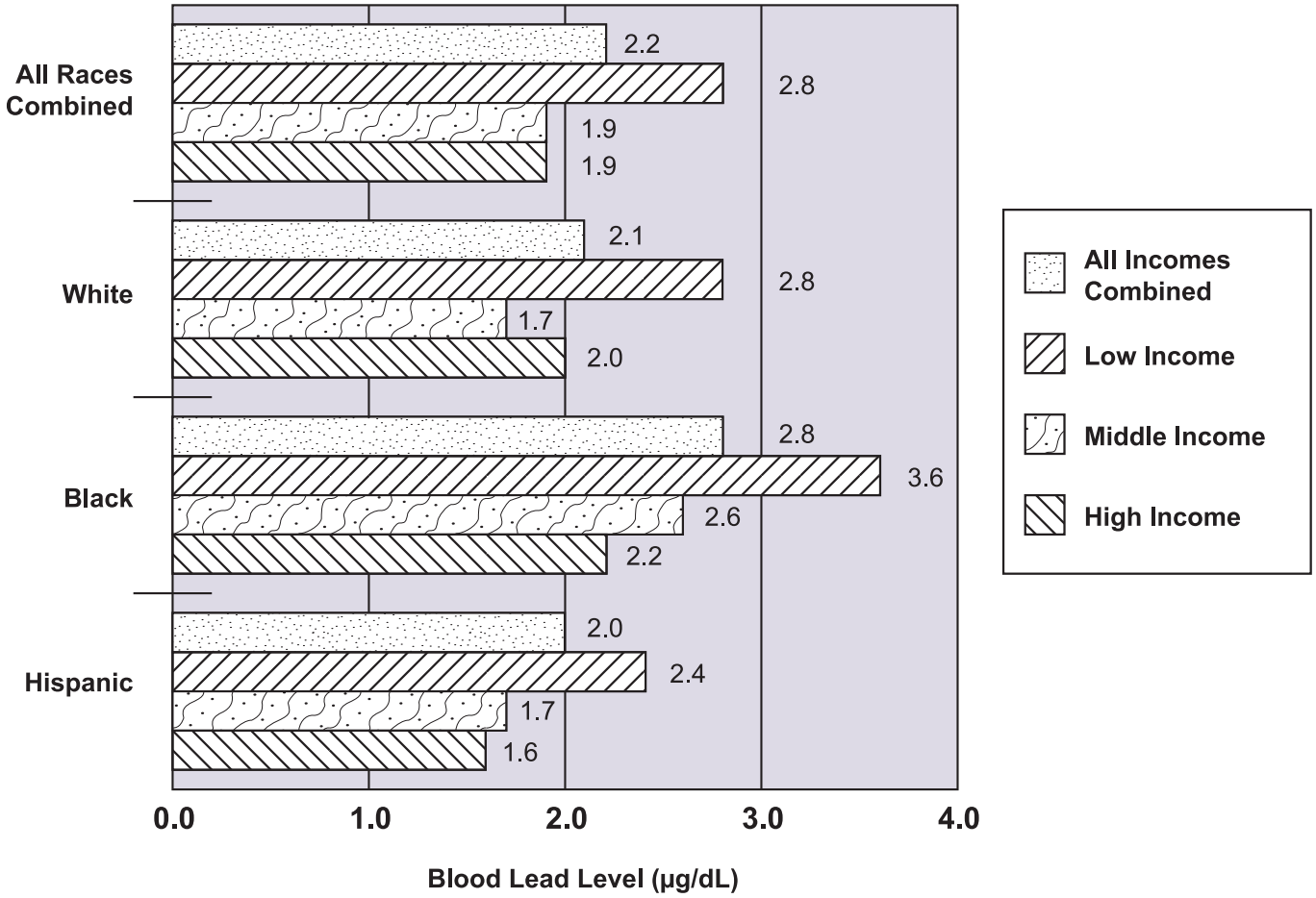
Researchers have discovered that a child's risk for lead poisoning depends on his or her race and family's income level. For instance, a black child living below the poverty level is at a higher risk for lead poisoning than a black child living well above the poverty level. One assumption is that low-income children and children of color more often live in older housing, therefore putting them at higher risk of coming in contact with lead paint or lead in drinking water.

Risks & Benefits

Measuring **blood lead level** by race and family income can help researchers identify populations that might be at greater risk for lead poisoning. This can help focus education, screening and clean-up efforts.

Blood Lead Level (BLL): A measurement of the amount of lead in a person's blood. A BLL of over 10 µg/dL is considered dangerous.

Median Concentrations of Lead in Blood of Children, Ages 1-5, 1999-2000*



*From "America's Children and the Environment." Environmental Protection Agency, 2003. http://www.epa.gov/environhealth/children/ace_2003.pdf

Median:
The middle value in a distribution of numbers.

Here's the bar graph with all the information on it. This comes from the report that I mentioned in the email. You can use this data to create the three graphs that I need for my presentation. This graph is packed with information, but it is too complicated for me to be able to use with the reporters. Your graphs need to present the data in a clearer and simpler format.

– Celia

I took this table directly from the report. This is the data that was used to make the big bar graph with all the information on it. It will help you create the three graphs I need.

– Celia

Median Concentrations of Lead in Blood of Children, Ages 1-5, 1999-2000*

Ethnicity	All Incomes	Low Income	Middle Income	High Income
All Races	2.2	2.8	1.9	1.9
White	2.1	2.8	1.7	2.0
Black	2.8	3.6	2.6	2.2
Hispanic	2.0	2.4	1.7	1.6

Numbers represent blood lead levels measured in µg/dL.

*From: *From "America's Children and the Environment." Environmental Protection Agency, 2003. http://www.epa.gov/environhealth/children/ace_2003.pdf

I found these statistics in the report. They provide information on blood lead levels during two different time periods. You will need these statistics to create one of the graphs for my presentation.

– Celia

Statistics from "America's Children and the Environment."

- In 1992-1994, Black children ages 1-5 had a median blood lead level of 3.9 µg/dL and in 1999-2000 they had a median blood lead level of 2.8 µg/dL.
- In 1992-1994, Hispanic children ages 1-5 had a median blood lead level of 2.6 µg/dL and in 1999-2000 they had a median blood lead level of 2.0 µg/dL.
- In 1999-2000, White children ages 1-5 had a median blood lead level of 2.1 µg/dL, unchanged from the level in 1992-1994.

Email Sent on: Today, 12:30 PM
From: Celia Summers
Subject: Lead Poisoning Project - Additional Questions

Hi. I know that you have been working on the lead poisoning presentation all morning. I've been writing my speech for the press conference and I thought of a few questions that I need answered. I'll use your answers as part of my presentation.

Thanks so much for all your help and hard work on this!

Celia Summers
U.S. Environmental Protection Agency (EPA)

Student Assessment:
Did students answer the Check Your Understanding questions correctly?

Check Your Understanding

1. What three income levels are represented in the graphs?
Low income, middle income and high income.

2. What three races are represented in the graphs?
Hispanic, black and white.

3. What race is at the highest risk for lead poisoning?
Black children have the highest risk for lead poisoning.

4. What income level is at the highest risk for lead poisoning?
Low income children have the highest risk for lead poisoning.

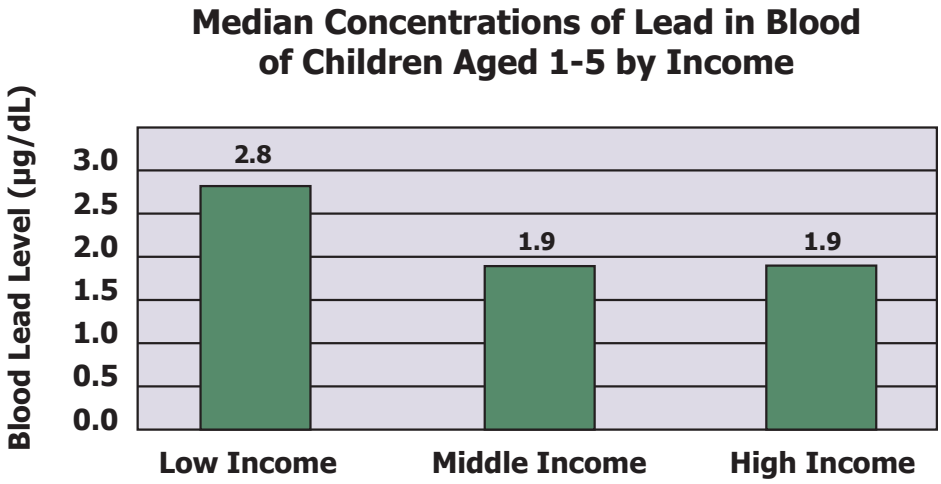
5. Between 1992-1994 and 1999-2000, which race group saw the largest decrease in blood lead levels?
The largest decrease in blood lead levels was with black children.

6. What are two possible reasons for this decrease?
Student answers will vary, but may include: increased education about childhood lead poisoning; overall decrease in the amount of lead in the environment; less lead paint in houses, drinking, water, etc.

Graphing Activity

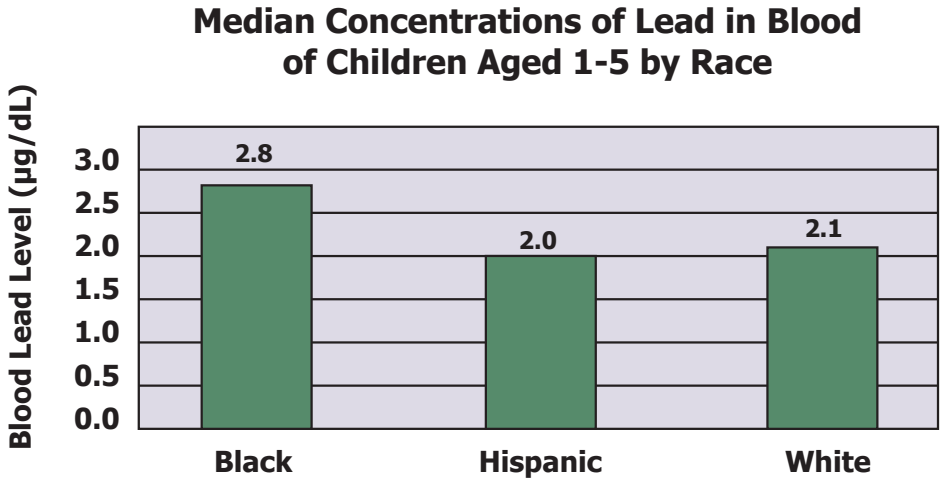
Now that you have read the background reading and answered some questions, you are ready to create the graphs that Celia needs for her presentation. You can draw the graphs below or attach them as separate pages.

GRAPH #1: Create a bar graph that shows **blood lead levels** by **income level**. Use only the information for "All Races Combined" from the data table. The x-axis should show income levels. The y-axis should show median blood lead levels. Make sure to label the axes, title your graph and use color.



GRAPH #2: Create a bar graph that shows **blood lead levels** by **race**. Use only the information for "All Incomes Combined" from the data table. The x-axis should show race. The y-axis should show median blood lead levels. Make sure to title your graph, label the axes, and use color.

Student Assessment:
Did students correctly draw their graphs, label the axes, and include titles?

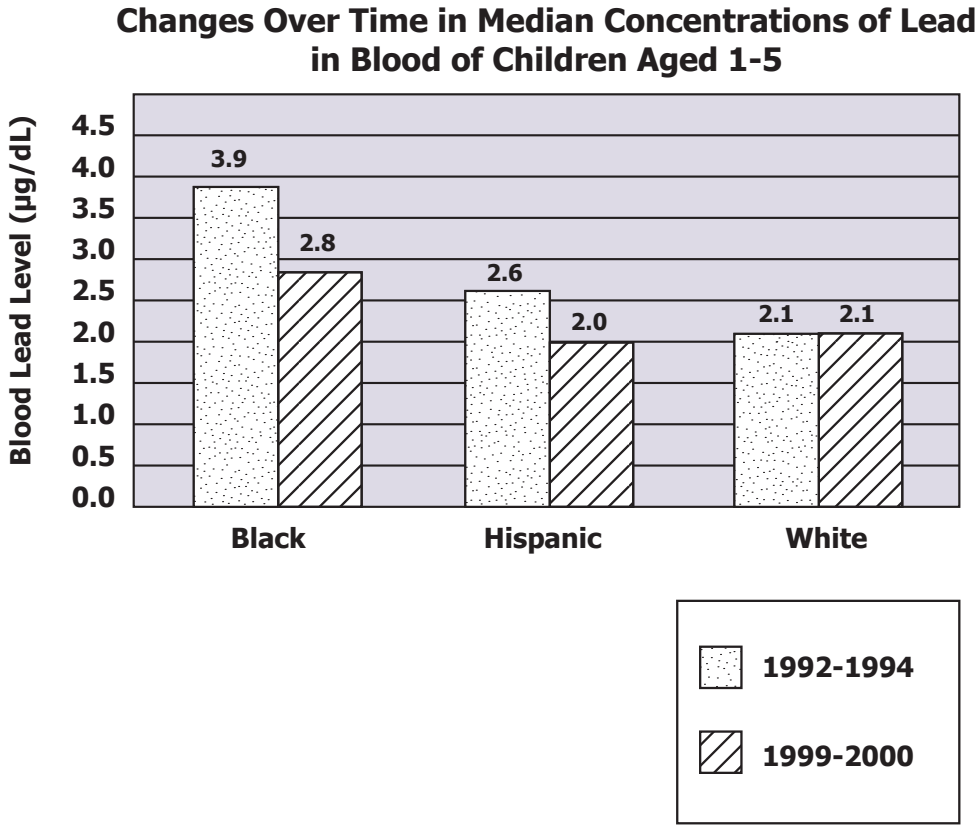


GRAPH #3: Create a bar graph that shows **how median blood lead levels have changed over time for different racial groups**. To do this, first complete the data table below based on the statistics from "America's Children and the Environment" that Celia included in her report. This table will make it easier for you to create the final graph that Celia needs.

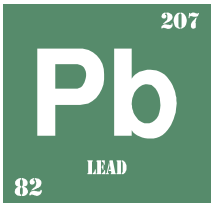
RACE	1992-1994 Median BLLs	1999-2000 Median BLLs
Black	3.9	2.8
Hispanic	2.6	2.0
White	2.1	2.1

Now, create a bar graph with median blood lead levels on the y-axis and race on the x-axis. For each of the three races you should have two bars, one for each period of time. Make sure to title your graph, label the axes, use color and include a key.

Student Assessment:
Did students correctly complete the table, draw their graph, label the axes, and include a title and a key?



Lead in your Health & Fitness Curriculum



Why is lead 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.

As one of the most common childhood environmental health problems in the U.S., lead poisoning is a relevant topic for the Health & Fitness curriculum. People can be exposed to lead through a variety of environmental pathways, including drinking water, soil, air, paint and sometimes even in food. With an understanding of the environmental pathways and the main routes of exposure, students can learn how to protect themselves and their family members from this health hazard.

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

The *Environmental Health Fact File: LEAD* provides lesson plans, activities and resources to introduce the concept of lead poisoning to your students. By using these resources, lead can be taught in the context of:

- Diseases and disorders
- Growth and development
- Environmental health
- Air, water and soil pollution
- Nutrition
- Community health
- Consumer and personal health products
- 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 lead is naturally occurring, people come in contact with lead from a variety of human-made sources.

What is lead?

Lead is a naturally occurring dull-grey metal that is found within the earth's crust. Lead is resistant to corrosion, has a low melting point and is easy to shape. These natural properties have made lead a popular resource for thousands of years. Today, lead can be found in drinking water, soil, air, paint and sometimes even in food.

There is no safe level of lead in the human body. Lead poisoning can harm practically every system in the body, especially the kidneys, blood cells, heart, reproductive

Materials developed by the Integrated Environmental Health Middle School Project (NIEHS Grant #ES10738 and #ES07033).

organs and the central nervous system. Lead poisoning affects about 310,000 children aged one to six years old in the U.S. (Centers for Disease Control and Prevention, May 2005). Fortunately, after years of education and prevention programs, rates of childhood lead poisoning are declining in the U.S.

What are the sources of lead in our everyday environment?

An awareness of the sources of lead can help lessen lead exposure in children and adults. Lead can be found in many places in our everyday environments—in some paints, drinking water, dust, soil, air and food. However, many of our problems with lead come from products that are now banned in the U.S. These banned products include leaded automobile gasoline, residential lead paint and a particular type of insecticide (chemicals used to kill insect pests). Even though these products are now banned, lead continues to pollute air, soil, water and food.

Today, lead is used in many industrial, consumer and hobby products. The list below includes some items that contain lead:

- Automobile batteries
- Night vision equipment
- Some types of exterior paint
- Some types of ammunition (bullets and shotgun pellets)
- Old plumbing
- Computer monitors
- Some brands of Mexican candies
- Some types of pottery glaze
- Mexican remedies (azarcon, greta)
- Some brands of hair-dye
- Fishing weights
- Some types of vinyl miniblinds.
- High definition televisions (HDTVs)
- Stained glass windows

Lead 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 lead" has natural connections to the Health & Fitness curriculum. Many of the lesson plans in this *Environmental Health Fact File*, 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

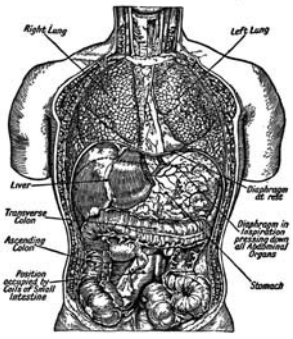
What is Environmental Health and Lead?

Environmental Health Fact File: LEAD

This reading provides students with the background knowledge they need about environmental health and lead poisoning before proceeding with other activities or lessons. (EH Fact File: LEAD Student Introduction).

Suggested Grade Levels: 6-8
Topics: Lead, environmental health
Subject Links: Health, science, reading, writing

Lead in the Body



Environmental Health Fact File: LEAD

Challenge students to create posters or 3-D models that display lead's effects on human body systems (nervous, circulatory and digestive). Students can work individually or in teams. If working in teams, each group can choose a different body system. The students' posters and models should include information on symptoms, physiology, long-term effects, and information on prevention. (EH Fact File: LEAD Science Lesson Two extension activity).

Suggested Grade Levels: 6-8
Topics: Lead poisoning, human biology, body systems
Subject Links: Health, science, biology

Lead Card Games

Rutgers University

Create a deck of cards with “true or false” questions related to lead poisoning. Use the cards to play a simulated version of Hollywood Squares or Jeopardy. A Lead Rummy card game is also available from Rutgers University. This deck of cards has “true or false” questions related to lead poisoning effects, actions, and dangers. Use the cards to quiz students, or play a round of gin rummy. Available from The Resource Center of the Environmental and Occupational Health Sciences Institute. Contact rc@eohsi.rutgers.edu or http://www.eohsi.rutgers.edu/rc.

Suggested Grade Levels: 6-8
Topics: Lead poisoning, human biology, body systems
Subject Links: Health, science, biology

Lead and Environmental Health

Four Lead Awareness Activities

Environmental Health Fact File: LEAD

This lesson focuses on the dangers of lead in household paint, dust, soil and drinking water. Students work in small groups to investigate four different ways that people commonly come in contact with lead in their homes. Each activity includes background reading, data collection and observation. Each group makes a presentation to the rest of the class about their investigation. (EH Fact File: LEAD Science Lesson Two).

- **Activity #1 Lead Dust Cleanup:** This activity compares the effectiveness and safety of cleaning up lead-contaminated dust from a household surface using three different methods.
- **Activity #2 Lead Underfoot:** This activity investigates how much soil can be tracked into a home and involves using a lead swab kit to test for the presence of lead.
- **Activity #3 Effective Handwashing:** This activity challenges students to design an experiment to determine the best hand washing method to protect their family members from ingesting lead-contaminated dust.
- **Activity #4 Pollution Dilution Investigation:** This activity engages students in modeling the measurements of parts per million and parts per billion, both which are used for monitoring and regulating lead in drinking water.

Suggested Grade Levels: 7-8
Topics: Lead, investigations, making predictions and observations, collecting data
Subject Links: Health, science, environmental science, communication

A Time Travel Vacation to the Roman Empire

Environmental Health Fact File: LEAD

Ancient Romans came in contact with lead from a variety of environmental exposures. In this lesson, students learn about the many ways that ancient Romans came in contact with lead. Then, students create a travel guide for a time travel vacation to the Roman Empire. The guide includes a health advisory to educate travelers about the health risks of lead poisoning. (EH Fact File: LEAD Science Lesson One).

Suggested Grade Levels: 6-7
Topics: Lead, Ancient Roman culture, geography
Subject Links: Health, history, geography, social study skills, reading, writing

Community Health and Lead Poisoning

The Geography of Childhood Lead Exposure

Environmental Health Fact File: LEAD

This lesson investigates the geography of childhood lead exposure in Washington State. Students first read about lead poisoning as an environmental justice issue. Then, students use information from a data table to create a Washington State map that plots instances of childhood lead poisoning by county. The lesson can be extended to include discussions about environmental justice, risk factors, and how community health programs can monitor, educate, prevent and treat childhood diseases and disorders such as lead poisoning. (EH Fact File: LEAD Social Studies Lesson Two).

Suggested Grade Levels: 7-8
Topics: Lead, Washington State contemporary issues, Washington State geography, mapping
Subject Links: Health, geography, Washington State history

County Investigation

Environmental Health Fact File: LEAD

Students choose one of the Washington counties that have a higher rate of childhood lead poisoning and use a variety of resources to research reasons why that county may have higher rates than the rest of the state. Students try to identify potential risk factors for lead poisoning in that county, including geography, industry, poverty, and ethnicity. Students can report their findings in a variety of formats, including:

- A written presentation to the county's council members
- An op-ed article for the county's local newspaper
- An oral presentation to the class
- A web page to inform residents of the county about the risks of lead exposure
- A video-taped news segment

(EH Fact File: LEAD Social Studies Lesson Two extension activity).

Suggested Grade Levels: 7-8
Topics: Lead, Washington State contemporary issues, health communication
Subject Links: Health, Washington State history, writing, communication

Childhood Blood Lead Levels

Environmental Health Fact File: LEAD

This lesson uses data from a U.S. Environmental Protection Agency report on the links between childhood lead poisoning, race, and income level. Students play the role of interns at the EPA who must create a series of graphs for an important presentation. The students take information from complicated graphs and a data table, and present the information in several different formats. To extend the activity, you can hold a mock press conference in the classroom. Using presentation software such as Microsoft PowerPoint, students can incorporate their graphs into a complete presentation. Some students can play the role of presenters, others as reporters. Allow time for the reporters to ask questions. Then, challenge student groups to work together to write a brief newspaper article that reports on the findings of the EPA report. (EH Fact File: LEAD Math Lesson Two).

Suggested Grade Levels: 7-8
Topics: Lead, making predictions, graphing, interpreting statistics, making presentations
Subject Links: Health, math, writing, communication

Environmental Justice Speaker

Environmental Health Fact File: LEAD

Invite a speaker to come to your class to discuss the environmental justice movement and links to your own community. The Northwest Environmental and Economic Justice Alliance (http://www.ccej.org) and the Community Coalition for Environmental Justice (http://www.nejanw.org/) both have speakers bureau programs. (EH Fact File: LEAD Social Studies Lesson Two extension activity).

Suggested Grade Levels: 7-8
Topics: Environmental justice
Subject Links: Health, social studies

Lead Poisoning Awareness

Environmental Health Fact File: LEAD

Students are challenged to prepare a lead poisoning awareness campaign for use in Washington. Each student should identify who their audience is (adults, parents, young children, schools, etc.) and design their materials accordingly. Some possible ideas include: posters, news articles, bumper stickers, web pages, ads, or radio segments. The materials should include a description of what lead poisoning is, identify risk factors, describe how it is treated and how it can be prevented. The campaign should be visually appealing and make people want to learn more. (EH Fact File: LEAD Science Lesson Two extension activity).

Suggested Grade Levels: 6-8
Topics: Lead poisoning, media studies
Subject Links: Health, writing, media studies

Leaded Gasoline Around the World

Environmental Health Fact File: LEAD

The phase-out of leaded gasoline in the U.S. began in the 1970s, at a time when 88.2% of children age 1-5 had elevated blood lead levels. The phase-out of leaded gasoline is often called one of the most successful public health campaigns in the U.S. However, leaded gasoline is still used in most countries around the world. Most African countries, in particular, use gasoline that has the highest concentration of lead in the world. Ask students to investigate both the success story of the U.S. and the challenges and health effects faced by countries that still use leaded gasoline. Check out the Global Lead Network, available at:
http://www.globalleadnet.org/
Also, Princeton Environmental Institute's website, Leaded Gasoline Phase-Out, is a good starting place, available at: http://www.princeton.edu/~vmthomas/pbgas.html (EH Fact File: LEAD Social Studies Lesson Two extension activity).

Suggested Grade Levels: 7-8
Topics: Geography, leaded gasoline, policy
Subject Links: Health, social studies

Lead in Consumer and Personal Health Products

Toxic Candies and Dangerous Cures

Environmental Health Fact File: LEAD

In this lesson, students read a short passage about folk remedies and candies from around the world that commonly contain high levels of lead. Students interview four adults to learn about different folk remedies and their origins. Students then work in groups to read case studies about Hispanic children who were exposed to lead

from Mexican folk remedies and imported candies. They then complete case history reports for each child, including recommended treatment options. (EH Fact File: LEAD Science Lesson One).

Suggested Grade Levels: 6-8
Topics: Lead, body systems, interviewing, interpreting case studies, consumer products
Subject Links: Health, science, social studies skills, reading

Health Warning

Environmental Health Fact File: LEAD

As a follow-up activity to the **Toxic Candies and Dangerous Cures** lesson, students are challenged to create a media campaign designed to educate Hispanic populations about the dangers of the Mexican folk remedies *greta* and *azarcon*, and certain imported Mexican candies. The students should consider: targeted audience; language and cultural barriers; where to reach the intended audience; media formats. For an example of a Washington State Department of Health news release, see the bulletin entitled "State Department Warns About Dangers of Mexican Folk Remedies" at: http://www.doh.wa.gov/Publicat/2000_News/00-59.html
(EH Fact File: LEAD Science Lesson One extension activity).

Suggested Grade Levels: 6-8
Topics: Lead, consumer products, health communication, media studies
Subject Links: Health, writing, reading

Medicine Bags

AEL Rural and Urban Images Project

As a follow-up to the **Toxic Candies and Dangerous Cures** lesson, students can explore medicine bags from different cultures and time periods. A medicine bag reflects the culture, climate, biology and medical knowledge of a particular place and time. Students consider what ingredients would be included in a medicine bag from a variety of cultures. For a complete lesson plan for "The Chemistry of Folk Remedies," go to the AEL Rural and Urban Images Project's website: http://www.ael.org/nsf/voices/curric/folk.htm

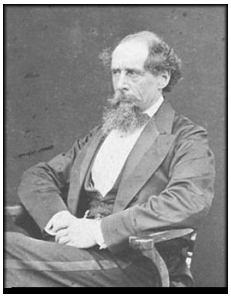
Suggested Grade Levels: 6-8
Topics: Lead, folk remedies, research
Subject Links: Health, social studies, science

Occupational Exposure to Lead

Eighteen Pence a Day

Environmental Health Fact File: LEAD

This lesson examines the working conditions in London's white lead mills in the mid-1800s. Students first read biographical sketches of Charles Dickens and Jack London. Next, they read excerpts from Dickens' *The Uncommercial Traveller*. Finally, each student chooses one young factory worker, described by Jack London in *The People of the Abyss*, and writes a journal entry from her point of view. (EH Fact File: LEAD Language Arts Lesson Two).



Charles Dickens

Suggested Grade Levels: 7-8
Topics: Lead, occupational exposure, writing about literature, point of view, reading history, journal writing
Subject Links: Health, reading, writing

Lead Resources for Health & Fitness Teachers

Lead Statistics and Facts

- Lead poisoning affects about 310,000 children age one to six years old in the U.S. (Centers for Disease Control and Prevention, May 2005. Available at http://www.cdc.gov/lead/).
- In the 1970s, 88.2% of U.S. children age 1-5 had elevated blood lead levels. By 1995, the levels had dropped to 4.4%, due largely to the phase-out of leaded gasoline. The phase-out of leaded gasoline is considered by some to be one of the most successful public health campaigns in the U.S. (Environmental Defense Fund. Data compiled from CDC/National Health and Nutrition Examination Surveys I and II).
- Approximately 24 million housing units in the U.S. contain deteriorated lead paint and lead-contaminated dust, even though the sale of residential lead paint was banned in 1978. More than 4 million of these homes are home to one or more young children.
  (Centers for Disease Control and Prevention, May 2005).
- Lead poisoning disproportionately affects U.S. children from low-income homes and households of color. African-American children are four times more likely to have elevated blood levels than white children, and low-income children are four times more likely to have elevated blood levels than children from wealthier families.
  (Mares, R. Enforcement of the Massachusetts Lead Law and Its Effect on Rental Prices and Abandonment. *Journal of Affordable Housing*. Spring 2003; Vol 12: No 3).

General Lead Resources

Washington State Department of Health Fact Sheet on Lead Poisoning
http://www.doh.wa.gov/topics/lead.htm

National Center for Environmental Health Lead Fact Sheet
Includes a kid's page with a lead crossword puzzle and word search.
http://www.cdc.gov/nceh/lead/about/about.htm

Environmental Protection Agency Lead Website
Includes "Lead in the News" section, fact sheets and more.
http://www.epa.gov/lead/

EPA's Fact Sheet on Lead
http://www.epa.gov/safewater/contaminants/dw_contamfs/lead.html

EPA's Lead in Paint, Dust and Soil Website
http://www.epa.gov/opptintr/lead/index.html

The National Lead Information Center
http://www.epa.gov/lead/nlic.htm

Materials developed by the Integrated Environmental Health Middle School Project (NIEHS Grant #ES10738 and #ES07033).

U.S. Consumer Products Safety Commission
Includes information on products with lead content.
http://www.cpsc.gov/

U.S. Department of Housing and Urban Development
Office of Healthy Homes and Lead Hazard Control
http://www.hud.gov/offi ces/lead/index.cfm

U.S. HUD's Community Outreach and Education Materials
http://www.hud.gov/offi ces/lead/outreach/communityoutreach.cfm

Environmental Health Watch
Includes many resources on lead, including a Lead/Asthma Project that shows the links between these two environmental health topics.
http://www.ehw.org/

Lead Poisoning Prevention Curriculum Project
The Kansas Department of Health and Environment offers lead poisoning curriculum (Preschool - 8th grade) resources on their website.
http://www.unleadedks.com/lead_curriculum.html

Seattle & King County Public Health Department Lead Information
http://www.metrokc.gov/health/tsp/arseniclead.htm

Dangers of Lead Still Linger
FDA Consumer article
http://www.cfsan.fda.gov/~dms/fdalead.html

A Small Dose of Toxicology—Lead Information
http://www.asmalldoseof.org/news/lead_schools.php

Living on Earth Radio Show: The Silent Epidemic
http://www.loe.org/series/lead.htm

Living on Earth Radio Show: The Secret Life of Lead
http://www.loe.org/series/lead2003/

Childhood Lead Poisoning Resources

The Alliance to End Childhood Lead Poisoning
Includes posters, brochures and fact sheets, as well as a community tool kit.
http://www.aeclp.org/

Coalition to End Childhood Lead Poisoning
Includes a lead history timeline and other interesting resources.
http://www.leadsafe.org/index.htm

Washington State Childhood Blood Lead Screening Recommendations
Washington State Department of Health report, November 2000
http://fi nd-it.wa.gov/default.htm

Washington State DOH's Childhood Lead Poisoning Prevention Program
http://www.doh.wa.gov/EHSPHL/Epidemiology/NICE/Lead/default.htm

America's Children and the Environment, 2003
Published by EPA. Consult the "Body Burdens" section for information on blood levels in children.
http://www.epa.gov/environhealth/children/

National Safety Council's Lead Poisoning and Nutrition Information
http://www.nsc.org/issues/lead/leadnutrition.htm

EPA Lead Educational Materials
http://www.epa.gov/lead/leadpbed.htm

Resources for Students

Lead Poisoning Prevention CD-ROM
An interactive CD-Rom for middle school students available for free from the University of Michigan School of Public Health. To order, call 1-800-292-1606 or email rbayer@umich.edu.

National Institute of Environmental Health Sciences (NIEHS) Kid's Pages
A whole section on lead, with many website links and activities.
http://www.niehs.nih.gov/kids/lead.htm

LEAD RESOURCES FOR THE LIBRARIAN

The following resources are intended to provide additional information and in-depth research opportunities for teachers and students studying environmental health and lead.

General Background Resources on Lead

Internet Resources

Integrated Environmental Health Middle School Project Website
http://depts.washington.edu/iehmsp/
Materials and resources for teachers, students and the community.

Washington State Department of Health Fact Sheet on Lead Poisoning
http://www.doh.wa.gov/topics/lead.htm

U.S. CDC Childhood Lead Poisoning Prevention Program
http://www.cdc.gov/nceh/lead/lead.htm

The Alliance to End Childhood Lead Poisoning
http://www.aeclp.org/
Includes posters, brochures and fact sheets, as well as a community tool kit.

Environmental Protection Agency Lead Website
http://www.epa.gov/lead/index.html
Includes “Lead in the News” section, fact sheets and more.

The National Lead Information Center
http://www.epa.gov/lead/nlic.htm

U.S. Consumer Products Safety Commission
http://www.cpsc.gov/
Includes information on products with lead content.

U.S. Department of Housing and Urban Development Office of Healthy Homes and Lead Hazard Control
http://www.hud.gov/offices/lead/index.cfm

U.S. HUD’s Community Outreach and Education Materials
http://www.hud.gov/offices/lead/outreach/communityoutreach.cfm

Coalition to End Childhood Lead Poisoning
http://www.leadsafe.org/index.htm
Includes a lead history timeline and other interesting resources.

The Secret Life of Lead
http://www.loe.org/series/lead2003/
An hour long audio feature about the lifelong impacts of lead poisoning on children.

Benjamin Franklin Letter on Lead Poisoning
http://www.leadsafe.org/international_issues/franklins_letter.html
A letter written by Ben Franklin that shows his understanding of the sources and effects of lead poisoning.

Environmental Health Watch
http://www.ehw.org/
Includes many resources on lead, including a Lead/Asthma Project that shows the links between these two environmental health topics.

National Institute of Environmental Health Sciences (NIEHS) Kid's Pages
http://www.niehs.nih.gov/kids/lead.htm
A whole section on lead, with many website links and activities.

Lead Poisoning Prevention Curriculum Project
http://www.unleadedks.com/lead_curriculum.html
The Kansas Department of Health and Environment offers lead poisoning curriculum (Preschool - 8th grade) resources on their website.

Other Resources

Lead Rummy Card Deck
This fun card deck can be used as a quick way to quiz students or can be played as traditional gin rummy. It is described as a childhood lead poisoning prevention education tool for parents and caregivers of young children. Available from The Resource Center of the Environmental and Occupational Health Sciences Institute. Contact rc@eohsi.rutgers.edu, or http://www.eohsi.rutgers.edu/rc.

Jimmy's Getting Better
A powerful theatrical performance designed to give dramatic emphasis to the problem of childhood lead poisoning. Performed by Seattle youth ages 8-18, the 40 minute play is designed to be presented to middle and high school audiences with a follow-up curriculum in the classroom.
http://www.clearcorps.org/theater/

Lead Poisoning Prevention CD-ROM
An interactive CD-ROM for middle school students available for free. Available from the University of Michigan School of Public Health. To order, call 1-800-292-1606 or email rbayer@umich.edu

Mystery Illness Strikes the Sanchez Household
A simulated health hazard investigation that guides students to the discovery of lead-based paint dust and its effects on a family. Order the ToxRap™ curriculum at:
http://www.eohsi.rutgers.edu/rc/toxrap/

Resources for Social Studies Lessons

The following resources are intended to provide additional information specific to the two **SOCIAL STUDIES** lessons on lead and environmental health.

1 LESSON 1: A Time Travel Vacation to the Roman Empire

Time Traveler's Guide to the Roman Empire
http://www.channel4.com/history/microsites/H/history/guide03/index.html
Excellent resource with information on culture, health, politics and more. The "Sex" section is not appropriate for students.

Journey Back in Time to the Ancient Romans
http://oncampus.richmond.edu/academics/as/education/projects/webquests/rome/
This web-based lesson plan asks students to create travel logs about ancient Rome.

The Roman Empire in the First Century
http://www.pbs.org/empires/romans/empire/index.html
PBS Website that accompanies a film. Check out the Classroom Resources section for great lesson plans and the Life in Roman Times section. Includes an online game testing your decision making power when ruling the Empire. The 240-minute film is available from PBS.

BBC – The Romans Website
http://www.bbc.co.uk/schools/romans/
Great research site for kids introducing them to life in the Roman Empire. Check out the Activities section and Lesson Plans section.

Roman Ball Games
http://www.personal.psu.edu/users/w/x/wxk116/romeball.html

Roman Board Games
http://www.personal.psu.edu/users/w/x/wxk116/roma/rbgames.html

The Roman Empire Children's Section
http://www.roman-empire.net/children/index.html
Check out the virtual Roman tour, interactive timeline maps, and so much more.

Ancient Roman Recipes
http://www.mit.edu:8001/people/wchuang/cooking/recipes/Roman/Ancient_Roman.html

Ancient Roman Cuisine
http://www.realm-of-shade.com/sweetlady/cuisine/

Lead Poisoning: A Historical Perspective
http://www.epa.gov/history/topics/perspect/lead.htm

National Center for Infectious Disease Traveler's Health
http://www.cdc.gov/travel/
See sample travel health advisories to help students with their projects.

World Health Organization International Travel and Health
http://www.who.int/ith/preface.html
Information on world travel, including vaccine requirements, world disease maps, and environmental health risks.

U.S. Department of State Travel Warning Information Sheets
http://travel.state.gov
Travel warnings including security, safety, crime and health.

2 LESSON 2: The Geography of Childhood Lead Exposure

Washington State Childhood Blood Lead Screening Recommendations
http://www.doh.wa.gov/Topics/WALeadScreenRecommend.doc
Washington State Department of Health report, November 2000

Washington State DOH's Childhood Lead Poisoning Prevention Program
http://www.doh.wa.gov/EHSPHL/Epidemiology/NICE/Lead/default.htm

Environmental Protection Agency Environmental Justice Homepage
http://www.epa.gov/compliance/environmentaljustice/
Try their Environmental Justice EnviroMapper.

Community Coalition for Environmental Justice (CCEJ)
http://www.ccej.org/

Northwest Environmental and Economic Justice Alliance
http://www.nejanw.org/

Resources for Science Lessons

The following resources are intended to provide additional information specific to the two **SCIENCE** lessons on lead and environmental health.

1 LESSON 1: Toxic Candies and Dangerous Cures

Childhood Lead Poisoning Associated with Tamarind Candy and Folk Remedies, California 1999-2000
http://www.cdc.gov/mmwr/preview/mmwrhtml/mm5131a3.htm
An article published on the Centers for Disease Control and Prevention website.

State Department Warns About Dangers of Mexican Folk Remedies
http://www.doh.wa.gov/Publicat/2000_News/00-59.html
A news release from the Washington State Department of Health.

Lead in Home Remedies Poster
http://www.doh.wa.gov/Topics/HomeRemedies.pdf
From the Washington State Department of Health.

Chemistry of Folk Remedies Website
http://ael.org/nsf/voices/curric/folk.htm
Creative lesson plans about folk remedies from the AEL Rural and Urban Images Project's website.

Special Investigation: Toxic Treats
http://www.ocregister.com/investigations/2004/lead/index.shtml
This six-part *Orange County Register* investigation follows the dangers of lead in candy imported from Mexico. Includes poster, slide show and government documents (Spanish and English).

2 LESSON 2: Four Lead Awareness Activities

Seattle & King County Public Health Department Lead Information
http://www.metrokc.gov/health/tsp/arseniclead.htm

EPA's Fact Sheet on Lead
http://www.epa.gov/safewater/contaminants/dw_contamfs/lead.html

EPA's Lead in Paint, Dust and Soil Website
http://www.epa.gov/opptintr/lead/index.html

Tacoma Pierce County Health Department Hand Washing Website
http://www.gotsoap.net
Lesson plans, kid's activities and more related to proper hand washing.

Resources for Language Arts Lessons

The following resources are intended to provide additional information specific to the two **LANGUAGE ARTS** lessons on lead and environmental health.

1 LESSON 1: Beethoven's Hair

Interactive Map of the Journey of Beethoven's Hair
http://www.randomhouse.com/features/beethovenshair/mapflash.html
Use this fantastic map to track the travels of Beethoven's hair through history and geography. This website features Russell Martin's book, *Beethoven's Hair* and includes an excerpt from the book.

Say Yes Quickly Website featuring Beethoven's Hair
http://www.sayyesquickly.net/syq-bhair.html
Includes a fascinating Public Radio International interview with Russell Martin, author of *Beethoven's Hair* and a timeline of the hair's journey through time.

The Beethoven Reference Site
http://www.kingsbarn.freeserve.co.uk/index.html
Great source of information including a timeline, an extensive picture gallery, and audio files to download.

Beethoven's Hair
A book by Russell Martin. Broadway Books, New York: 2000.
This historical narrative unravels the story of how a lock of Beethoven's hair traveled through time to solve the mystery of Beethoven's illnesses.

Lead Poisoning and Beethoven
http://www.sjsu.edu/depts/beethoven/hair/hairtestpc.html
Text from Press Conference held by William J. Walsh, October 17, 2000 in Naperville, Illinoise, announcing the results of forensics testing on a lock of Beethoven's hair.

The Ira F. Brilliant Center for Beethoven Studies
http://www.sjsu.edu/depts/beethoven/index.html
Includes a guide for an exhibit on Beethoven's hair, including a photograph of the locket.

Ludwig van Beethoven Site
http://www.lvbeethoven.com/index_En.html
A comprehensive resource full of colorful portraits, audio files, and other resources.

2 LESSON 2: Eighteen Pence a Day

Charles Dickens Page Website
http://www.fidnet.com/~dap1955/dickens/index.html
A plethora of resources, including an online glossary of terms used in Dickens' books.

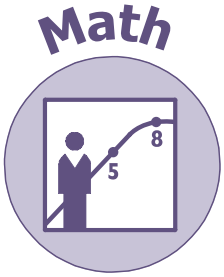
Charles Dickens' Map of London
http://www.fidnet.com/~dap1955/dickens/dickens_london_map.html#top
An 1859 map of London with specific information about places mentioned in Dickens' books.

Some Views on Dirt and Drudgery Website
http://www.st-and.ac.uk/~jfec/ge/drudgery.html
You can access excerpts of *The Uncommercial Traveller* from this website.

A.P. European History Web Links
http://www.historyteacher.net/APEuroCourse/APEuro_Main_Weblinks_Page.htm
The "Industrial Revolution" page includes many links to primary source documents.

Jack London Collection
http://sunsite.berkeley.edu/London/
A comprehensive collection of resources related to Jack London, including a timeline, biography, audio clips, documents and images.

Resources for Math Lessons



The following resources are intended to provide additional information specific to the two **MATH** lessons on lead and environmental health.

1 LESSON 1: Trumpeter Swan Math

The Washington Swan Working Group Website
http://www.swansociety.org/washington.htm

The Trumpeter Swan Society Website
http://www.trumpeterswansociety.org

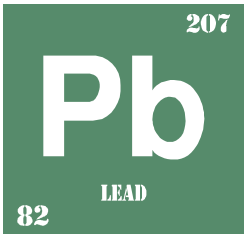
Shadow a Swan Project Website
http://www.uen.org/swan/
Provides opportunities for students to track swans wearing radio-transmitting collars.

The Defenders of Wildlife Website
http://www.defenders.org/trmpth01.html
Provides a Trumpeter Swan Reintroduction Slideshow.

2 LESSON 2: Childhood Blood Lead Levels

America's Children and the Environment, 2003
http://www.epa.gov/environhealth/children/
Published by EPA. Consult the "Body Burdens" section for information on blood levels in children.

Master Copies of Student Handouts



Student Introduction: ENVIRONMENTAL HEALTH & LEAD

Student Handout

Name _____

Date _____

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.

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.

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.

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

Toxicity: A measure of how dangerous a chemical is.

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**.

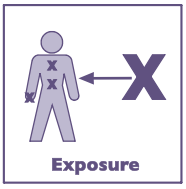
Toxicity

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.

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	

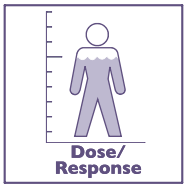
A bottle of bleach, for example, will have the word DANGER on the label, because it is highly toxic if ingested (toxicity rating = 1). Borax powdered cleaner, however, is rated as slightly toxic (toxicity rating = 3) and will have the word CAUTION on the label. This is just one example of a system used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

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.

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.

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).

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**.

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.

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.

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.

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).

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

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

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.

What is Lead Poisoning?

Lead is a naturally occurring dull-grey metal that is found within the earth's crust. Lead is resistant to corrosion, has a low melting point and is easy to shape. These natural properties have made lead a popular resource for thousands of years. Today, lead can be found in drinking water, soil, air, paint and sometimes even in food. Lead is known on the periodic table of the elements as "Pb." The Latin word for lead is *plumbum.* Even today, **lead poisoning** is also known as plumbism and household plumbing in old homes is sometimes made up of lead pipes and solder.

There is no safe level of lead in the human body. Lead poisoning can occur when lead is ingested, inhaled or absorbed into the body. Lead poisoning can affect intelligence, behavior and development. Lead poisoning affects about one million children younger than six years old in the U.S. Fortunately, after years of education and prevention programs, rates of childhood lead poisoning are declining in the U.S.

How do people become lead poisoned? Lead can be found in many places in our everyday environments – in some paints, drinking water, dust, soil, air and food. However, many of our problems with lead come from products that are now banned in the U.S. These banned products include leaded automobile gasoline, residential lead paint and a particular type of insecticide (chemicals used to kill insect pests). Even though these products are now banned, lead continues to pollute air, soil, and water.

Today, lead is used in many industrial and hobby products. The list below includes some items that contain lead products:

- automobile batteries
- some brands of hair-dye
- night vision equipment
- fishing weights
- some types of exterior paint
- some types of shotgun pellets
- some types of folk remedies
- some types of vinyl miniblinds.
- high definition televisions (HDTVs)
- old plumbing
- computer monitors
- stained glass windows
- some types of pottery glaze
- some brands of Mexican candy

What can people do to avoid lead poisoning? Children who live in homes built before 1978 have a potential risk for lead poisoning. If you live in an older home, here are a few easy things you can do to protect yourself and your family:

- Always wash your hands before eating. Frequently wash children's toys, including pacifiers (helps to keep lead dust from being ingested).
- Eat nutritious low-fat meals that are high in calcium and iron to protect yourself from absorbing lead into your body (calcium and iron can decrease how much lead your body absorbs).
- Flush water from your tap for 15-30 seconds, or until it runs cold, for drinking and cooking purposes (standing water can have more lead in it from lead pipes or solder).
- Only use cold water for drinking, cooking and mixing infant formula (hot water can have higher levels of lead than cold water).
- Frequently wipe dust from counters, tables, floors and windowsills with a wet cloth or mop (helps keep lead dust from being ingested and inhaled).
- Use a doormat to wipe your feet, or remove shoes before entering your house (helps keep you from tracking lead-contaminated soil into the house).

What are the effects of lead poisoning? Once lead enters the body, it first becomes concentrated in the blood and soft tissues, then much of it is excreted in the urine. Of the lead that stays in the body, 95% of it will become concentrated in the body's leg bones

and teeth, since lead acts just like calcium within the body. The lead that is stored in the bones can slowly move back into the blood stream during times of body stress, such as a broken bone, pregnancy or old age. Lead poisoning can harm practically every system in the body, especially the kidneys, blood cells, heart, reproductive organs and the central nervous system.

Lead poisoning is most harmful to children under six years old and unborn babies. While an adult will absorb 10% of the lead that he or she ingests, a child will absorb 50% of the lead into his or her body. Young children absorb more lead into their growing bodies, excrete less lead from their bodies, and suffer from greater impacts to their organs. When a growing child ingests lead, the lead acts just like calcium. Growing bodies need a lot of calcium, so young children absorb more lead than adults. Lead poisoning impacts young children by interfering with brain development, impacting the nervous system, causing hearing and vision problems, and damaging the kidneys. Lead poisoning can also decrease IQ and cause behavior problems, hyperactivity and learning disabilities. At high levels, lead poisoning can cause seizures, comas and even death.

The symptoms of lead poisoning include loss of appetite, tiredness, stomachaches and crankiness. Parents and doctors often do not suspect that a child is suffering from lead poisoning because their symptoms may point toward some other illness, such as the flu.

Adults who suffer from lead poisoning may have increased blood pressure, fertility problems, digestive problems, nerve disorders, and memory and concentration problems.

Blood Lead Level (BLL):
A measurement of the amount of lead in a person's blood. BLL shows the individual's exposure to lead over the past 2-3 weeks. After that time, lead is concentrated in the long bones. A BLL test provides a snapshot view of the individual's lead exposure. A BLL of over 10 µg/dL is considered elevated. "Micrograms per deciliter" (or µg/dL) is a measurement of the amount of lead in a person's blood. The Greek symbol µ is pronounced "mew".

Lead poisoning is usually detected using a blood test. The test gives the doctor the patient's **blood lead level (BLL)**, or the amount of lead in the patient's bloodstream. A blood lead level test only tells the doctor about the patient's recent exposure to lead. When a person stops being exposed to lead, their blood lead level will slowly decline. A blood lead level of over 10 micrograms per deciliter (µg/dL) causes concern, although some scientists believe that even this small level is too much for a young child. A doctor can determine a person's past exposure to lead, also called their body burden, by using a special x-ray to analyze lead levels in bone. Since lead stays in bone for many years after exposure to lead, a bone test can tell a doctor more about the person's history of lead poisoning. Similarly, some scientists also look at a child's baby teeth to test lead levels. Hair analysis can also be used to show very recent exposure to lead.

A child who is diagnosed with lead poisoning may require a special kind of medicine called chelation therapy. This medicine chemically binds to the lead in the child's body and helps the child to get rid of the lead through urination. This medicine can help lower the amount of lead in the child's body, but there is no way to completely remove all of the lead. The most important thing is to find the source of lead and get rid of it to protect the child from further exposure.

Some important facts about lead poisoning:

- About one in twenty-two children in the U.S. have elevated levels of lead in their blood.
- 52% of U.S. homes still contain lead paint, even though the sale of residential lead paint was banned in 1977.
- Children from lower income families are eight times more likely to be poisoned than those from higher income families.
- African-American children are more than five times more likely to have potentially harmful levels of lead in their bodies than Caucasian children. Nationwide, about 22% of African American children living in older housing have elevated lead levels.
- In 1979, cars released 94.6 million kilograms (kg) of lead into the air in the United States. In contrast, after leaded gasoline was banned, in 1989 cars released only 2.2 million kg into the air.

Check Your Understanding

1. Your four-year old cousin was just diagnosed with mild lead poisoning. What body systems and organs may be affected?

2. List five possible ways that a young child may come in contact with lead.

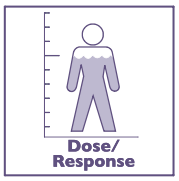
Acute Lead Poisoning: When a person comes in contact with a large amount of lead in a short period of time and absorbs enough to become ill.

Chronic Lead Poisoning: When a person repeatedly comes in contact with a small amount of lead over a long period of time.

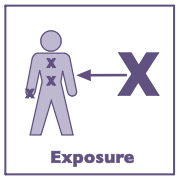
Secondary Lead Poisoning: When an animal becomes lead poisoned from eating another lead poisoned animal.

What Does Lead Have to Do with Environmental Health?

- **What does DOSE have to do with lead poisoning?** People can suffer from acute or chronic lead poisoning. **Acute lead poisoning** occurs when a person comes in contact with a large amount of lead in a short period of time, such as ingesting a folk remedy that has a high lead content. **Chronic lead poisoning** occurs when a person repeatedly comes in contact with a small amount of lead over a long period of time, such as drinking water that has a low level of lead that comes from lead plumbing. Sometimes, animals such as eagles or coyotes suffer from **secondary lead poisoning** when they feed on the body of an animal that has died from lead poisoning.



- **What is the main ROUTE OF EXPOSURE for most cases of lead poisoning?** The most common way that children come in contact with lead is through ingesting house dust containing particles of lead from old lead paint. Occasionally, a child might eat chips of lead-based paint because it tastes sweet. Young children frequently put their fingers or toys in their mouths. If their fingers or toys touched any dust or soil that was contaminated with lead, then the child will swallow some lead. This means that the main route of exposure for lead poisoning is ingestion. Lead can also be inhaled or, during pregnancy, absorbed by the developing baby from its mother's exposure to lead.



- **What does INDIVIDUAL SUSCEPTIBILITY have to do with lead?** How old you are and how big you are has a lot to do with how susceptible you are to lead poisoning. A young child is more susceptible than an adult for several reasons. First, a young child is so small that a small exposure to lead represents a big dose. Second, the child absorbs more lead into their body because it acts just like calcium. Third, young children are more likely to swallow dust from lead paint because they frequently put their toys and fingers in their mouths and spend a lot of time crawling on the floor, where dust settles. Since children's brains and other organs are still growing and developing, they will suffer more from the impacts of lead poisoning than full-grown adults. Pregnant women are also susceptible to lead poisoning because their bodies absorb more lead, since it acts like the calcium that their bodies need. Also, developing babies can absorb lead through the placenta, which can result in brain damage, low birth weight and even miscarriage.

Risk Factor:
Something that increases and individual's chance of becoming ill, hurt, or killed.

- **What environments put people at RISK of getting lead poisoning?** Lead poisoning is often linked with poverty, although it affects people of all ethnicities and income levels. Children who live in homes built before 1978 are more likely to come in contact with lead paint. Adults who are exposed to lead at work (such as at an automobile battery factory) are more likely to suffer from lead poisoning. Also, children whose parents work with lead are more likely to suffer from lead poisoning, since their parents might bring home lead particles on their clothing, shoes or hair. Children who live in mining communities are at a higher risk. Children whose diet is low in calcium and iron and high in fat will absorb more lead into their bodies than children who eat a well-balanced diet. People who use lead-containing folk remedies are at a higher risk for lead poisoning. All of these things are called lead poisoning **risk factors**.

Check Your Understanding

1. Michael is a forty-five year old school librarian who likes to play soccer and golf. Miyoko is a twenty-nine year old woman who is pregnant with her first child. She sells handmade ceramic bowls. Jasper is a two-year old boy whose family lives in an older home that was just remodeled. Which two people do you think are more susceptible to lead poisoning? Why?

2. Name one thing you can do to decrease your risk of lead poisoning.

A TIME TRAVEL VACATION TO THE ROMAN EMPIRE
Student Handout #1

Student Handout

Name _____

Date _____

Welcome!

Welcome to the Roman Empire in the year 85 A.D. You've come a long way during your travels here to the great Roman Empire, the strongest and most glorious empire in the world. During your stay, you are sure to enjoy yourself, for the Romans truly know how to have a good time. We have festivals and celebrations for almost every day of the year, and all of them include great feasts overflowing with food and wine. In fact, you are probably thirsty from all of your traveling. Here, I've laid out a goblet of wine for you and some preserved fruits. Feast, and when you have rested, we will begin our tour — I have some wonderful sites for us to visit over the next few days — a gladiator tournament at the great Colosseum, a visit to the public bathhouse, a tour of our largest lead mine, and so much more.

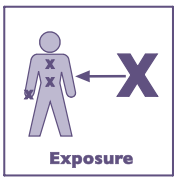
Those Drunken Romans

If there is one thing we Romans enjoy, it is a party. It seems like there is always some reason to celebrate and, at least for the **aristocrats**, the food is abundant and the wine is always flowing. We value our Emperor's ability to throw lavish parties — and you should see how much he eats and drinks all day long. The average Roman ingests about 1-5 liters of wine per day.

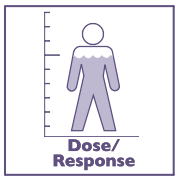
In order to keep up with our demand for wine, there are winemakers all over the Empire. We have one problem with our wine, though. We haven't figured out how to stop the fermentation process, so often our wine becomes quite sour. We do know how to compensate for the sourness, however. We add a sweet syrup made from grapes called **sapa**. We follow a special recipe for creating sapa. The grapes are simmered slowly in a lead pot or lead-lined copper kettle until they turn into a thick syrup. The use of the leaden kettle results in "sugared lead," or lead acetate, which seems to sweeten the wine and helps to preserve it. It's not all that surprising that wine consumption counts for 50-60% of the daily lead intake by the aristocrats.

While the aristocrats enjoy our most superior kinds of wine, the lower classes – **plebians** and **slaves** – drink an inferior kind of wine that isn't usually sweetened with sapa. The difference between lead intake by the aristocrats and the lower classes is significant. An average aristocrat probably consumes about 250 µg of lead each day, while the average plebian absorbs about 36 µg and a slave 15 µg per day.

Aristocrats:
The upper class in ancient Rome, made up of the senators and the equestrians.



Sapa:
A grape syrup used to sweeten and preserve sour wine. It was made by boiling grapes in a lead kettle. Scientists believe that one teaspoon of the syrup would have been more than enough to cause lead poisoning. Sapa was also used to preserve fruit.



Plebians:
The urban poor of ancient Rome.

Slaves:
The lowest class in ancient Rome. Slaves often worked in the lead mines and had short, hard lives.

Check Your Understanding

1. Describe the three social classes mentioned: aristocrats, plebians and slaves.

2. What was sapa and how was it made?

Gouty Aristocrats

Gout:
A painful condition where the joints become swollen. Gout often affects the foot, leaving the patient unable to walk. It is often a symptom of lead poisoning.

Some of our physicians have noticed some common health problems among the aristocrats. Strangely, these health problems don't seem to be affecting the lower classes. Many of our aristocrats are plagued by **gout** and **colic**.

Colic:
An extremely painful stomachache, often caused by chronic lead poisoning.

We've noticed that married aristocrats are having a hard time having children and that many women are having miscarriages. There used to be a law that prohibited women from drinking wine, but now it is legally acceptable. These reproductive troubles are becoming a major problem because the aristocrats need to have heirs to inherit their property and fortunes, as well as to keep their blood lines going. This has been a particular problem among the **senators**, who need an heir to inherit their position in the government.

Senator:
The highest class in ancient Rome. Senators held government positions and were either appointed by the emperor or inherited their position.

A Roman Wine Jug

Dropsies:
A condition caused by lead poisoning that makes the hands hang useless from the wrists.

In some ways, it seems our emperors might suffer the worst. While many of our leaders through history have been known for their gluttony, many have also suffered from health problems such as gout, colic and **dropsies**. For example, one of our former emperors, Claudius, who reigned from 41-54 A.D. had all sorts of health problems. Some poets and actors of the time liked to mimic his disturbed speech, weak limbs, tremors and the strange way he walked. They also poked fun at Claudius' quick fits of temper and his often inappropriate fits of laughter. Claudius was known for being a bit absent-minded and dim-witted. He often complained of **dry gripe**, a terrible kind of stomachache. He even sometimes slobbered – in public! Our current emperor, Domitian, also enjoys wine in excess. I have heard rumors that he drinks from fountains that flow with wine.

Dry Gripe:
A particularly painful stomachache that feels like the bowels are being pinched. It is often a symptom of lead poisoning.

A few people seem to think that the wine has something to do with these strange health problems. I don't know for sure. Domitian certainly drinks excessive amounts of wine, and so did Claudius. Even if the lead is causing these problems, there is no way the aristocrats will give up their wine.

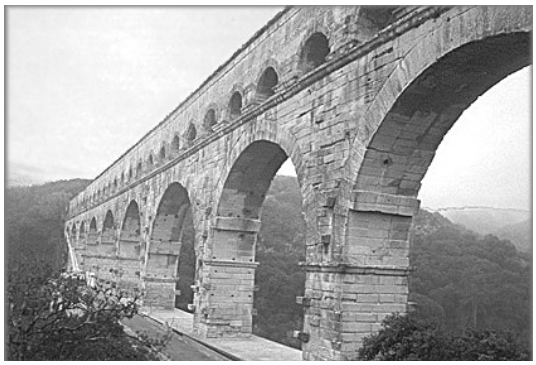
Some Lead with your Water?

Aqueduct:
A structure for carrying a large amount of water over long distances. The water pipes in aqueducts were either lead or earthenware. Lead pipes were more popular in the city while earthenware was more common in rural areas.

We Romans are known throughout the world for our innovations in science and technology. See, look over there against the horizon. That stone structure stretching as far as you can see is part of our **aqueduct** system. The aqueducts bring fresh water from its source to the city of Rome and neighboring towns. Our water is fresh, sweet and clean. Some aristocrats even have indoor plumbing, but most people fill their water pitchers at the fountain in the town square. The public bathhouses are also filled with water from the aqueducts.

The aqueducts are tall structures with lead-lined pipes that carry the water. Some

aqueducts in rural areas have earthenware pipes; these are less expensive and easier to repair, but our engineers still prefer lead pipes. In fact, the word plumbing comes from the Latin word for lead, plumbum.



A Roman Aqueduct

The architect and writer Vitruvius, who lived from 70-25 B.C., was critical of using lead pipes. He thought that earthenware pipes produce more "wholesome" water while water from lead pipes is "harmful to the human body." He seemed to think that lead pipes were a health risk. He might have been right, but at least in the city of Rome, lead is still the choice for water pipes.

Risks & Benefits

Check Your Understanding

1. What were some of Claudius' symptoms that might be attributed to lead poisoning?

2. The word *plumbism* means lead poisoning. How is this word linked to the aqueducts in ancient Rome?

The Father of Metals

You seemed to really enjoy the preserved fruits I gave you! One of our favorite snacks is preserved fruits like grapes, apples, figs, plums, pears and cherries. We preserve the fruit by using sapa as a preservative.

I'm glad that you noticed the tableware. Not only are they handmade by artisans, but the artwork is very important to us. The designs and borders on our plates, goblets, vases and other tableware depict scenes of everyday life in the Empire. Earthenware plates and goblets are painted with a lead-based glaze and then fired. Most of our cookware is made from lead. It is such a soft, malleable metal that we find so many different uses for it. Some cook pots are made from copper or bronze, but most people prefer lead or lead-lined copper pots.

Lead really is our most useful metal. We consider lead to be the father of all metals and associate it with the god Saturn. We use lead as an ingredient in some medicines, to make our metal coins, and for roofing, coffins, even writing tablets and toys. Our favorite paint color is a deep red called Pompeian red which is made with **minium**, a lead salt.

Minium:
A lead salt, often used as a pigment to create red paint.

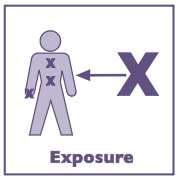
Women use many lead-containing products. It is a main ingredient in many cosmetics, including face powders and hair dyes.

Vase painting of a Roman woman looking in a mirror

The Great Roman Mines

I thought you might enjoy a tour of one of our largest lead mines. When the Romans first began using lead, it was a by-product of silver production. Now we've found so many uses for lead, that we mine specifically for it. Lead has such a low melting point that it is easy to **smelt**. The lead mines are worked by slaves. It is hard work in the lead mines, and there are many dangers associated with it. Oftentimes, the slaves don't live long.

Smelt:
To melt an ore in order to separate a particular metal. In ancient Rome, the ore galena was smelted to produce lead and silver.



A long time ago, the scientist and writer Pliny the Elder explained how white lead (used as a pigment) was created. "For medicinal purposes lead is melted in earthen vessels, a layer of finely powdered sulphur being put underneath it; on this thin plates are laid and covered with sulphur and stirred with an iron rod. Whilst it is being melted, the breathing passages should be protected...otherwise the noxious and deadly vapour of the lead furnace is inhaled."

We used to have lead smelting forges in every part of the city. The noxious fumes that come from the lead smelting forges are overwhelming, so now most forges seem to be located farther out from the cities in smaller towns.

Check Your Understanding

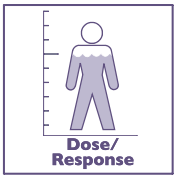
1. Name five ancient Roman household items that contained lead.

2. Why did Pliny the Elder believe that the lead mines and smelters were dangerous?

Pliny's Thoughts on Lead Poisoning

Pliny the Elder, who lived from 23-79 A.D., sometimes wrote about the impacts of lead on people's health. I thought you might enjoy talking with his nephew, Pliny the Younger, who has studied many of his uncle's manuscripts. Since you seem so interested in how we use lead here in the Empire, I asked him to describe his uncle's opinions on the dangers of consuming lead. Here's what Pliny the Younger has to say:

Greetings, Time Traveler! My uncle noticed that colic from lead poisoning was a new disease that became widespread during his own days. He thought that it was interesting that while the wealthy suffer from many common health problems, the lower classes seem to almost completely avoid these troubles. While it is true that the slaves that work in the lead mines and forges often become sick or even die from the noxious fumes, most of the poor people do not seem to be as affected as the wealthy.



For one reason, the lower classes eat a simple diet, mostly a grain-based porridge. They cannot afford delicacies like preserved fruit or expensive wine. My uncle once wrote that the practice of adding lead in one form or another to wine is so prevalent that 'genuine, unadulterated wine is not to be had now, not even by the nobility.' He noticed a connection between consumption of leaden wine and health issues, writing that 'from the excessive use of such wines arises dangling...paralytic hands.' Large doses of lead from food and wine seem to make people sick!

The poor have cookware and tableware made from earthenware instead of expensive lead kettles and pots. Also, the poor do not have luxuries like lead-containing cosmetics or paints. Finally, many of the lower classes live farther out from the cities, where the aqueducts have earthenware instead of lead pipes. Ironically, this makes the poor less at risk of getting sick from lead exposure.

Well, Pliny the Younger certainly had a lot to say about the possible dangers of lead. Between you and me, I think there is probably some truth to these ideas. However, lead is such a popular metal, and the aristocrats so love their wine, I cannot imagine that there will be any changes in the way we use lead, at least not anytime soon.

We have certainly seen a lot today. You look a little tired. Let me take you to one of Rome's grandest bathhouses, The Baths of Caracalla, so that you can have a massage and take a dip in the pools there. Tomorrow, we'll see a gladiator tournament at the Colesseum – you'll want to be well rested for that event!

Check Your Understanding

1. How did the diet of the lower classes differ from that of the aristocrats?

2. Why did Pliny the Elder believe that the lower classes suffered less from lead poisoning than the aristocrats?

Travel Guide Activity

Now that you have had a guided tour of the Roman Empire, it's time to create a travel guide that includes some general information about the Roman Empire as well as what you have learned about the dangers of lead poisoning. You should include a health advisory on lead poisoning that warns travelers about the many ways that they might come in contact with lead during their vacation to the Empire. Your health advisory should include the following sections:

- Sources of Lead (provide at least four).
- To Avoid Getting Sick (provide at least four).
- What You Need to Bring With You (provide at least one).
- After You Return Home (provide at least one).

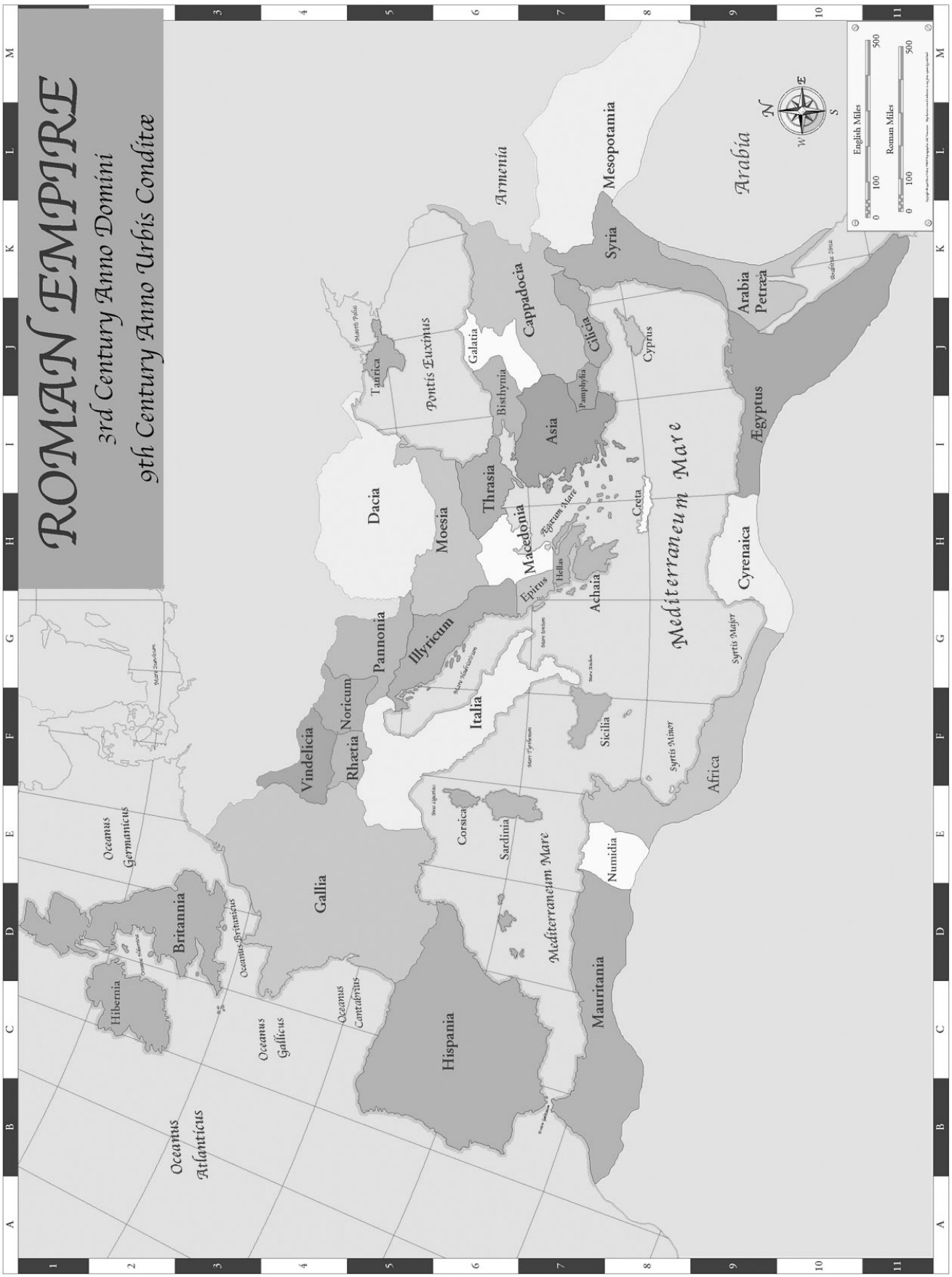
It's a good idea to use real government travel and health warnings as examples when working on this project. Examples can be found at:

- **National Center for Infectious Disease Traveler's Health Pages**
  http://www.cdc.gov/travel/
- **World Health Organization International Travel and Health Pages**
  http://www.who.int/ith/preface.html
- **U.S. Department of State Travel Warning Information Sheets**
  http://travel.state.gov/travel_warnings.html#f

In addition to a health advisory on lead poisoning, your travel guide should include a map of the Roman Empire with major landmarks or travel destinations marked (such as major cities and must-see tourist spots). The map of the Roman Empire included in this lesson can be used as a starting point for your travel guide.

Your travel guide should also include information about at least five of the following aspects of Roman culture:

- Must-see tourist spots
- Money
- Hygiene and Health
- Religion
- Politics
- Social Class System
- Technology
- Entertainment
- Art and Music
- Celebrations
- Fashion
- Weather and Climate
- Important Latin Words to Know



THE GEOGRAPHY OF CHILDHOOD LEAD EXPOSURE Student Handout #1

Student Handout

Name _____

Date _____

Background

Childhood lead poisoning is an important environmental health problem that affects children across America. The Centers for Disease Control estimate that about 434,000 American children, ages 1-5, each year suffer from lead poisoning. That means about 2.2 percent of all children ages 1-5 are affected by lead poisoning. Ever since leaded gasoline and lead-based paint were banned over twenty years ago, rates of childhood lead poisoning have been declining across the country.

Blood Lead Level (BLL): A measurement of the amount of lead in a person's blood. A BLL of over 10 µg/dL is considered dangerous.

Compared to the United States as a whole, Washington State has low levels of childhood lead poisoning. The Washington State Department of Health keeps records of all children who have been tested for lead poisoning. Since the levels of lead poisoning across the State are quite low, most children are never even tested for lead poisoning. In fact, only about 3 percent of children ages 1-5 ever have a blood test for lead. Of the 3 percent of children who are tested, only about 4 percent of them have an elevated **blood lead level** (higher than 10 **ug/dL**). Compare this to 28 percent of children in Philadelphia!

µg/dL: Micrograms per deciliter. A measurement of the amount of lead in a person's blood. The Greek symbol "µ" is pronounced "mew.".

Childhood lead poisoning is considered to be an **environmental justice** issue. Environmental justice is a social and political movement that believes that all people – regardless of race, country of origin, income level or education – have a right to a clean environment, including clean air, water, and soil. Childhood lead poisoning is an environmental justice issue because certain groups of children are more likely to suffer from lead poisoning than the rest of the population. If we look at the United States as a whole, a child's risk of lead poisoning increases if he or she:

Environmental Justice: The belief that all people — regardless of race, country of origin, income level, or education — have a right to clean air, water, and soil.

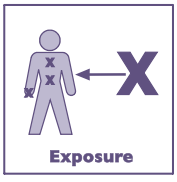
- Lives in a high risk community (geography)
- Comes from a low-income family (poverty)
- Is Black or Hispanic (ethnicity)

Other types of environmental justice issues include air pollution, water pollution, solid waste disposal, transportation, industry, human health and disease. "Environmental classism" refers to the fact that low-income people often live in less healthy environments than middle and high income people. "Environmental racism" refers to the fact that people of color are also more likely to live in neighborhoods where environmental health hazards are located, such as factories and hazardous waste sites.

In Washington State, public health officials have examined many statistics to learn about the **risk factors** for childhood lead poisoning that are specific to this region. The more the health department understands about lead poisoning risk factors, the better they can educate families of young children. The risk factors that increase a child's risk of having elevated blood lead levels include age of housing, poverty, geography, Hispanic ethnicity and parents' occupation.

Risk Factor: Something that increases an individual's chance of becoming ill, getting hurt, or being killed.

Age of Housing: Lead-based interior house paint was banned in 1977, but many old homes still have paint that contains lead. In Washington, there are 1.5 million homes that were built before 1978 and 80% of them probably still have some lead-based paint. Young children may ingest paint dust that gets on their hands, food or toys. Also, old homes may have lead plumbing, which can contaminate drinking water with lead.

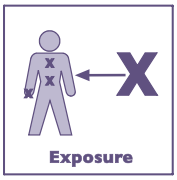


Poverty: Children who come from low-income families are more likely to live in older homes, which may have lead-based paint. Also, low-income children may not receive a proper, well-balanced diet. Children whose diets are high-fat and low in calcium are more susceptible to lead poisoning. In a child's body, lead acts just like calcium. A child with a poor diet will absorb more lead than a child with a well-balanced diet.

Geography: There is a higher rate of childhood lead poisoning in Central Washington than the rest of the state. There are several possible reasons for this risk factor. First of all, some counties in these regions might have industries that use lead products, such as a factory that releases lead-rich ash from its smokestacks. Even if the factory is now shut down, the soil downwind of the factory's location may still have high levels of lead.

Central Washington is known for its agriculture. Between 1905 and 1947, many Washington fruit orchards used a pesticide that contained lead arsenate, a combination of lead and arsenic. Most orchard soils still have elevated levels of lead and arsenic today. Some communities have built developments on land that used to be orchards. A sub-division, school or playground may now be located on soil that still contains lead and arsenic. People come in contact with the contaminated soil by tracking soil into their homes on their shoes, playing in the dirt, or eating vegetables grown in the contaminated soil.

Hispanic Ethnicity: In Washington State, Hispanic children have a higher rate of lead poisoning than do non-Hispanic children. About 0.9% of all children between the ages of one and two in Washington have elevated blood levels. If you look at Hispanic children between the ages of one and two, however, about 3.8% have elevated blood levels.



Many farm workers in Central Washington are Hispanic. Farm workers that work in areas with contaminated orchard soil may bring home lead particles on their clothing, shoes and hair. Many farm workers and their families live near agriculture fields and orchards. Their children may ingest the lead dust when it gets on their hands, toys or food. In addition, several Mexican folk remedies and some types of Mexican candy sometimes contain lead. Two common folk remedies given to children to treat stomachaches, *greta* and *azarcon*, can contain up to 97% lead.

Rates of childhood lead poisoning continue to drop over time as people become more aware of the risks of lead poisoning. As a whole, lead poisoning rates have dropped considerably since household lead-based paint and leaded gasoline were banned. Hopefully in the future lead poisoning will rarely affect children.

Check Your Understanding

1. How do rates of childhood lead poisoning in Washington State compare to those across the rest of the United States?

2. The banning of what two products had a tremendous impact on lowering rates of childhood lead poisoning across the United States?

3. Why is lead poisoning an environmental justice issue?

THE GEOGRAPHY OF CHILDHOOD LEAD EXPOSURE
Student Handout #2

Student Handout

Name _____

Date _____

Data Mapping Activity

Examine the data chart below. This chart shows the percentage of children in various counties of Washington State who have elevated levels of lead in their bodies.

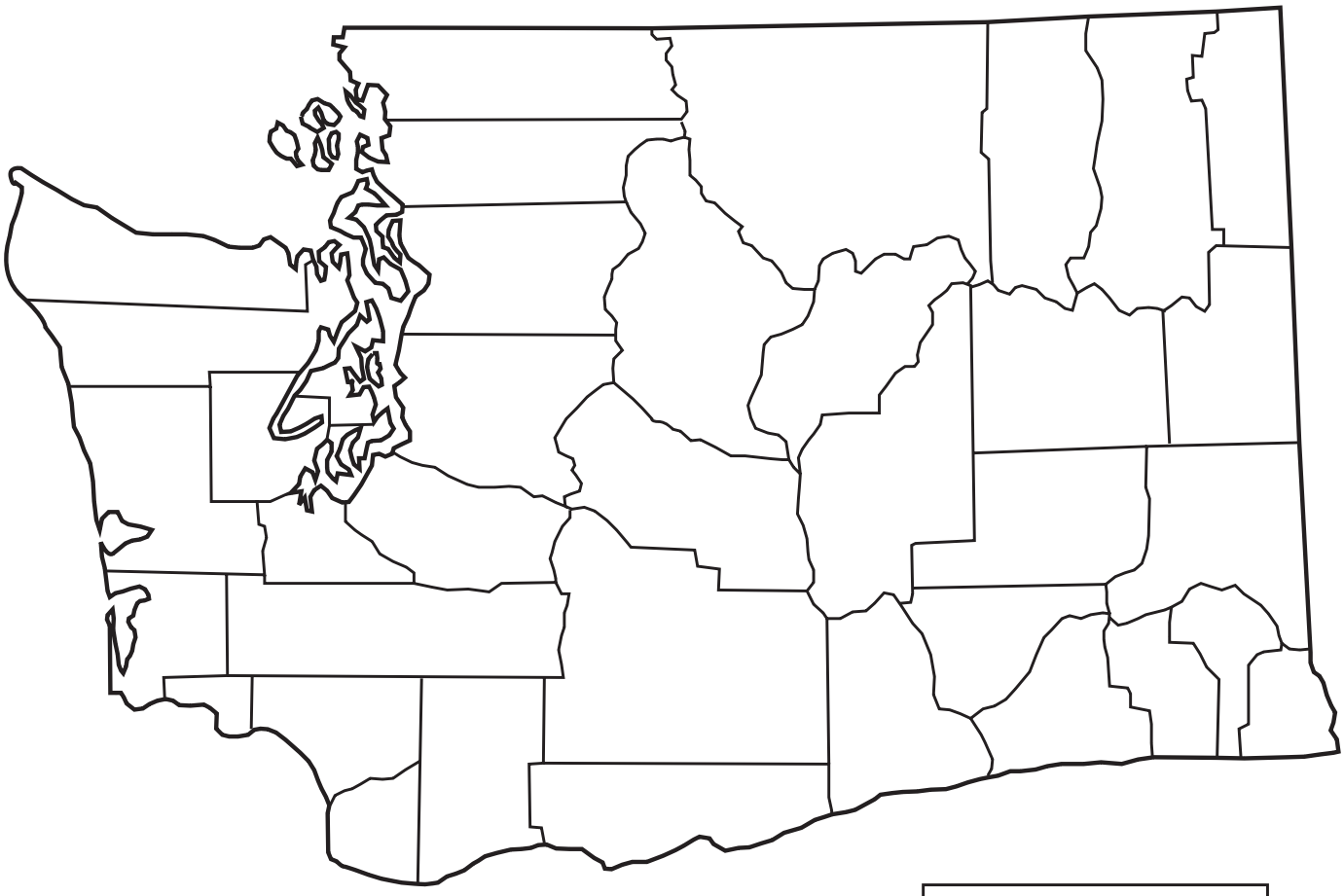
Elevated Blood Lead Levels in Children in Washington State, 1993-1998*

County	% of Children with BLLs above 10 µg/dL	Symbol or Color
Adams	4.2	
Benton	1.0	
Chelan	9.1	
Clark	1.7	
Cowlitz	1.9	
Franklin	0.8	
Grant	1.6	
Island	1.7	
King	4.0	
Kitsap	5.0	
Lewis	3.8	
Okanogan	3.7	
Pierce	4.7	
Skagit	2.1	
Snohomish	2.8	
Spokane	3.4	
Stevens	0.0	
Thurston	2.6	
Walla Walla	10.8	
Whatcom	2.8	
Whitman	1.6	
Yakima	5.3	

* From: Washington State Department of Health, Office of Epidemiology, 2000.

Now, it's time to put the data set on a map to make it easier to visualize what is happening. Do the following:

- Fill in the name of each county on the Washington state map below.
- Using colored pencils or pens, decide on a combination of symbols or colors to represent the range of data shown in the data key on the map below. For example, you might use green for counties where 0-1.9% of children have BLLs above 10 µg/dL, and blue for counties where 2.0-3.9% of children have BLLs above 10 µg/dL. Fill in the key below to show what colors or symbols you have chosen.
- On the data chart, complete the last column by indicating what symbol or color applies to that county.
- Locate the counties included in the data chart and color code each one based on the colors you have assigned on your data chart.



% of Children above 10µg/dL BLL
= 0-1.9%
= 2.0-3.9%
= 4.0-5.9%
= 6.0-10.9%

TOXIC CANDIES AND DANGEROUS CURES
Student Handout #1

Student Handout

Toxic Candies

Mexican candies—sweet and spicy lollipops, powders, jellies, wafers, rolls, suckers and chewing gum—are imported into the United States and sold in supermarkets, candy stores and on ice cream trucks. Many of these brightly wrapped sweets are actually toxic treats. Children in Washington, Oregon and California have suffered from lead poisoning traced to eating certain types of imported Mexican candy.

Risks & Benefits

Candies that are manufactured in Mexico often do not meet the same food safety laws that candies manufactured in the United States must meet. When Mexican candies are imported into the United States, they are rarely inspected by regulators or tested by health officials. Candies are often brought over the border in suitcases and car trunks, to be shared with family members. This makes the challenge of regulating the flow of Mexican candies into the U.S. even more difficult.

The California Department of Health Services has conducted over 1,500 tests on Mexican candy since 1993, finding that one out of four candies tested high for lead. In the past decade, over 112 brands of imported candy—mostly from Mexico—have been found to contain dangerous levels of lead. Some candies contain enough lead that a child could exceed the daily allowable lead limit by eating just one piece of candy.

These candies can become contaminated with lead from several different sources. Some candy wrappers and lollipop sticks are printed with ink that contains lead. The ink on the wrapper can be transferred onto the sticky candy. Children also ingest lead when they lick and chew the wrappers and sticks.

Many popular Mexican candies contain spicy chili powder or sticky **tamarind** pulp. When chili peppers are processed, they are harvested from the field, dried and ground up into powder. Usually, the peppers are not cleaned before drying, so soil, fertilizers and pesticides (all of which may contain lead) that are stuck to the peppers get ground up into the chili powder. Likewise, these contaminants also stick to tamarind pods and are not removed during processing.

Tamarind candy from Mexico can contain high levels of lead

Tamarind:
A bean-like fruit from the tamarind tree, often made into candies in Mexico.

Some Mexican candies are packaged in tiny handmade clay pots. In order to make the pots shiny, a pottery glaze is applied to them. Many of these pots are made with a traditional glaze called *greta* that contains lead. The lead in the glaze can then get into the sticky candy jelly. The candy is made from a spicy-sweet mixture of tamarind pulp and chili powder. Mexican candy in handmade pots has three possible sources of lead contamination: the glaze on the pot, the tamarind pulp, and the chili powder.

Exposure

The Mexican government, while aware of the problem with the contaminated candies, has been unsuccessful in stopping the manufacture and export of these toxic treats.

Materials developed by the Integrated Environmental Health Middle School Project (NIEHS Grant #ES10738 and #ES07033).

While some health officials have worked toward regulating candy makers, their resources are limited. Many candy manufacturers say that they do not believe that there is a problem with their candy. However, some candy manufactures have made changes to their manufacturing and packing processes in an effort to reduce lead contamination.

Health advisories have been issued by health departments in Washington, Oregon and California warning about lead in imported candies. So far, the federal government has not taken serious action toward Mexican candy manufacturers or strengthened import regulations. The U.S. Food and Drug Administration regulates the importation of candies while the Consumer Product Safety Commission regulates the candy wrappers.

Dangerous Cures

Folk remedies, also known as home remedies, are used to help treat a sickness or injury. You probably know of many folk remedies that your own family uses. For example, have you ever eaten chicken soup for a cold, gargled with salt water for a sore throat, or drank ginger ale or mint tea for a stomach ache? Folk remedies tend to be passed down through generations and many have their origins in other cultures.

Folk Remedy:
Any method of treating injury or illness that is passed down through tradition and is related to a specific region or culture.

Some folk remedies have been proven to work, while others are ineffective. Some folk remedies can even be harmful since they include dangerous ingredients, like lead. Some ancient folk remedies seem silly nowadays, such as treatments used by the Ancient Romans for lead poisoning. Ancient Roman physicians had some strange prescriptions for the stomach aches and cramps that went along with lead poisoning. For example, they might have the patient get a puppy to lie across his or her stomach. The thinking was that because dogs are such empathetic creatures, they would take the patient's pain onto themselves. Another remedy involved placing buttered toast onto a sore stomach.

Student Assessment:
Did the students complete the reading?

In the Pacific Northwest, Hispanic families are at a higher risk for becoming lead poisoned from folk remedies. Two particularly dangerous folk remedies are Mexican stomach ache treatments traditionally given to Hispanic children. These powdered medicines, known as *greta* and *azarcon,* are mixed with water and then swallowed (ingested). Both remedies can contain up to 99% lead. Oftentimes, Hispanic families will bring these Mexican remedies with them to the U.S.

Other Sources of Lead

Other common sources of lead poisoning include paint, miniblinds and pottery. Older homes built before 1978 may contain lead-based paint. Children are at risk from ingesting paint chips or inhaling paint dust, especially during renovations when paint is scraped or sanded. Some brands of imported vinyl miniblinds contain lead. The vinyl breaks down in sunlight, releasing lead-contaminated dust, which can be ingested or inhaled. Some types of glazes used on pottery and ceramics contain lead. When food and beverages are stored in or served on pottery or ceramic dishes treated with lead-based glazes, the lead can get into the food or beverage and be ingested.

Source: McKim, J., Sharon, K., and Heisel, W. Hidden Threat, *Orange County Register*. April 25, 2004. Available at http://www.ocregister.com/investigations/2004/lead/index.shtml.

Check Your Understanding

1. Name two sources of lead contamination found in some types of Mexican candies.

2. How could the manufacturing process be changed to reduce how much lead gets into some types of Mexican candies?

3. Name one folk remedy that you or your family has used to treat an illness or injury.

4. Through what route of exposure are children exposed to the Mexican folk remedies *greta* and *azarcon*?

Interview Activity

Folk Remedy:
Any method of treating injury or illness that is passed down through tradition and is related to a specific region or culture.

Folk Remedy Interview Sheet

Select four adults to interview for this activity. You should interview at least one family member, but seek out adults of different generations and different ethnic or cultural backgrounds. Use this page to take notes during the interview (one sheet per person interviewed).

Your Name: **Date:**

Name of Person Being Interviewed (Subject):

Subject's Age:

Subject's Ethnicity/Cultural Background:

Ask the interview subject what **folk remedies** he or she has used to treat the following conditions:

CONDITION	FOLK REMEDY
Acne	
Allergies	
Asthma	
Bites & Stings	
Bleeding	
Burns	
Colds	
Dandruff	
Earache	
Headache	
Heartburn	
Hiccups	
Nosebleed	
Snoring	
Sore Throat	
Sprains	
Stomach Ache	
Sunburn	
Teething & Toothache	
Other	

TOXIC CANDIES AND DANGEROUS CURES
Student Handout #2

Student Handout

Name _____

Date _____

Chart of Lead Levels in Folk Remedies from Around the World*

Name of product	Region of origin	Typical Lead level	Medicinal use	Route of Exposure
Albayalde or **Albayaidle**	Mexico and Central America	93%	*Empacho* (vomiting, colic, fatigue)	Ingestion
Alarcon, Azarcon, Coral, Luiga, or **Maria Luisa**	Mexico	95%	*Empacho* (see above)	Ingestion
Alkohl	Middle East	85%	Topical medical preparation; applied to umbilical stump	Absorption
Ba Bow Sen	China	Up to 100%	Hyperactivity and nightmares in children	Ingestion
Bint al dahab, Bint or **Bent dahab**	Oman, Saudi Arabia, India	98%	Diarrhea, colic, constipation	Ingestion
Cebagin	Middle East	51%	Teething powder	Ingestion, absorption
Cordyceps	China	2%	Hypertension, diabetes, bleeding	Ingestion
Deshi Dewa	Asia, India	12%	Fertility pill	Ingestion
Ghasard	India	2%	Daily tonic	Ingestion
Greta	Mexico	97%	*Empacho*	Ingestion
Kohl, Surma, Saoott	Africa, Asia, India, Pakistan, Middle East	Up to 86%	Cosmetic, astringent for eye injuries and umbilical stump, teething powder	Absorption, Ingestion
Kushta	India, Pakistan	73%	Diseases of the heart, brain, liver, and stomach	Ingestion
Pay-loo-ah	Laos (Hmong)	90%	High fever, rash	Ingestion

*Adapted from New South Wales EPA, "Traditional Remedies Reported to Contain Lead" http://www.epa.nsw.gov.au/leadsafe/remedies.htm

Case Study Activity

Blood Lead Level (BLL):
A measurement of the amount of lead in a person's blood. A BLL of over 10 µg/dL is considered dangerous.

µg/dL:
Micrograms per deciliter. A measurement of the amount of lead in a person's blood. The Greek symbol "µ" is pronounced "mew".

Blood Lead Level Chart*

BLOOD LEAD LEVELS (BLL)	SEVERITY AND RECOMMENDED TREATMENT
LEVEL 1 Low Zone < 10 µg/dL	**Indicates a low blood lead level.** Inform parents of potential lead hazards in child's environment. **Retest child at physician's discretion or as parental concerns arise.**
LEVEL 2 Border Zone 10 – 19 µg/dL	**These children are in a border zone.** Adverse health effects will be subtle and children probably will not show symptoms. In order to identify and control the specific source of lead exposure, parents should be provided with family lead education. Conduct a home interview and environmental investigation in conjunction with local health department. **Continue retesting at 2-3 month intervals until the child's BLL has dropped below 10 µg/dL.**
LEVEL 3 Danger Zone 20 – 44 µg/dL	**While symptoms still may not be apparent, the potential for adverse health effects is greatly increased.** The source of lead in the child's environment must be indentified and controlled. A home interview and environmental investigation should be carried out in conjunction with the local health department. Other family members may also need to be tested. **Continue retesting at regular intervals (weekly or monthly) until the child's BLL drops below 10 µg/dL.**
LEVEL 4 Emergency Zone 45 µg/dL or higher	**Hospitalize the child and begin medical treatment immediately.** Serious mental or nervous system damage can result. Provide family lead education. Conduct home interview and environmental investigation in conjunction with local health department. All members of the household need to be tested. **Retest within 48 hours.**

*Adapted from Washington State Department of Health, "Medical Management of Children with Elevated Blood Lead Levels."
http://www.doh.wa.gov/Topics/MEDmgmt.doc

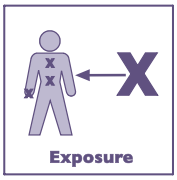
Patient Case History Sheet
Case Study

Date:

Patient Name: **Sex:** **Age:**

BLL Lab Results:

Diagnosis and Severity:



Possible ROUTES OF EXPOSURE:

- **Inhalation:**

- **Ingestion:**

- **Absorption through Skin:**

Recommended Treatment:

Recommended Follow-up with Family:

Case Study Cards

Lead Poisoning Case Study #1

In March 1999, two Hispanic children residing in the Central Valley of California were identified during routine lead poisoning screening.

José, a four year-old boy, had a blood lead level of 88.0 µg/dL. His six year-old sister, Carmen had a blood lead level of 69.0 µg/dL. Neither the children nor their parents had recently traveled outside of the United States.

Folk Remedies: The children had been given *greta,* a Mexican folk remedy used to treat stomachaches. *Greta* powder collected from the family's home had a lead level of 770,000 ppm (or 77%).

Pottery: No pottery in the home tested positive for lead.

Home Environment: Tests on paint and dust from their home did not indicate high lead levels. Miniblinds on the windows of the home tested positive for lead.

Mexican Candies: Imported candies, including Dulmex-brand Bolirindo lollipops, were found in the home. Tests on imported candies collected from the home revealed a candy wrapper with a lead level of 16,000 ppm (or 1.6%).

Lead Poisoning Case Study #2

In May 2000, a four year-old Hispanic boy named Carlos was identified during routine lead screening. Carlos had a blood lead level of 26 µg/dL. His family had recently moved to Fresno County, California from Oaxaca, Mexico.

Folk Remedies: It is not known if Carlos received any folk remedies while in Mexico or the U.S.

Pottery: In Mexico, the family had used a ceramic bean pot and water jug regularly.

Home Environment: An environmental investigation did not reveal high lead levels in dust, paint, or soil.

Mexican Candies: Tests on imported candies collected from the home revealed a candy wrapper with a lead level of 16,000 ppm (or 1.6%).

Lead Poisoning Case Study #3

In June 2000, a Hispanic boy named Luis, aged 2 years, was identified through routine screening. Luis had a blood lead level of 26 µg/dL. He resides in Orange County, California.

Folk Remedies: Luis had been given *greta* and *azarcon* to treat a stomachache, Mexican folk remedies that usually contains substantial amounts of lead.

Pottery: It is not known if the family uses any imported pottery at home for cooking, serving or storing food.

Home Environment: The family's house was built in 1963 and had been renovated during early 2000. Tests on soil, paint, and dust in and around the child's home did not reveal high lead levels.

Mexican Candies: Luis had eaten various imported tamarind fruit candies purchased routinely by his family in Mexico. High lead levels were found in one of the three brands of imported candies the child had eaten. A Dulmex-brand Bolirindo lollipop had levels of 404 ppm (.04%) in the stick and 21,000 ppm (2.1%) of lead in the wrapper.

Lead Poisoning Case Study #4

In August 2000, a four year-old Hispanic boy named Daniel was identified through routine screening. Daniel, a resident of Los Angeles County, California had a blood lead level of 22 µg/dL. When the child was tested at age 1, he had an acceptable BLL of 5 µg/dL. Daniel was born in the United States and had not traveled to Mexico.

Folk Remedies: Daniel's family reported that they do not use folk remedies.

Pottery: Daniel's family said that they do not use imported pottery.

Home Environment: An environmental investigation of their apartment, which was built in 1986, did not reveal high lead levels.

Mexican Candies: Family members reported that Daniel had been eating Mexican candies regularly for 3 years. A Dulmex-brand Bolirindo lollipop found in the home had levels of 404 ppm (.04%) in the stick and 21,000 ppm (2.1%) of lead in the wrapper.

Case Study Cards

Lead Poisoning Case Study #5

In June 2000, a two year-old Hispanic girl named Marie was brought to see a doctor. The physician recognized the symptoms of lead poisoning and tested her blood lead level. Marie, a resident of Walla Walla, Washington, had a blood lead level of 124 µg/dL. This was the highest blood lead level seen in the State in seven years. Marie's family had recently moved to Washington from Mexico.

Folk Remedies: Marie's family told her physician that they had given her *greta,* a traditional Mexican folk remedy as a treatment for stomachaches. The state public health laboratory tested a sample of the remedy and found that it contained nearly 80% lead. The family had purchased the medicine in Mexico and brought it with them to Washington State.

Pottery: It is not known if Marie's family used imported pottery.

Home Environment: An environmental investigation of their apartment did not reveal high lead levels.

Mexican Candies: It is not known if Marie ate imported candies.

Case studies adapted from: "Childhood Lead Poisoning Associated with Tamarind Candy and Folk Remedies: California, 1999-2000" and Washington State Department of Health News Release, "State Department of Health Warns About Dangerous Mexican Folk Remedies," (June 15, 2000).

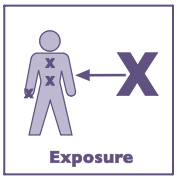
FOUR LEAD AWARENESS ACTIVITIES
Student Handout #1

Student Handout

Name _____

Date _____

Activity #1 – Lead Dust Cleanup



Older homes and apartments that were built before 1978 may have lead-based paint in them. As this paint ages, it may chip or flake. Also, the paint might be rubbed off as dust in areas where the surface rubs against another surface, such as a door jam or a window track. This lead-contaminated dust can collect on countertops, along windowsills, in carpets and on floors. Families with young children need to be especially careful to regularly clean their homes to make sure that children do not ingest dust that gets on their toys or their hands. However, common cleaning techniques, like sweeping with a broom or dusting with a feather duster, can actually make the problem worse by scattering the dust into the air where it can be inhaled. The United States Environmental Protection Agency recommends a three-bucket cleaning method for cleaning areas with lead contaminated dust.

You can use an all-purpose cleaner for cleaning up lead dust, or there are special detergents with high phosphate contents designed specifically for cleaning up lead dust.

In this activity, you will compare the effectiveness and safety of cleaning up lead contaminated dust from a household surface using three different methods. For safety purposes, you will be using either flour, cornstarch or baby powder to represent dust that is contaminated with lead. **Make sure to wear rubber gloves during your investigation in order to demonstrate proper safety techniques.**

Investigation Procedure

Do the Following:

1. First, sprinkle a fine layer of “dust” on a horizontal surface, such as a lab table or desk top.

2. You will be using three different cleaning techniques and comparing them on levels of effectiveness and safety. Make a prediction about the effectiveness and safety of each cleaning method on your data chart.

3. One person in your group should clean up the dust using a hand whisk broom or duster. Observe how well the dust is cleaned up and how much dust is scattered into the air and onto other surfaces. Write your observation on your data chart. If needed, scatter more dust for the next investigation.

4. Now, one person in your group should use the spray bottle to mist water over the dust. Then, try sweeping the dust. Write your observations on your data chart. If needed, scatter more dust for the next investigation.

5. This time, you will use a three-bucket cleaning technique. Fill one bucket with water and a small squirt of dish soap. Fill the second bucket with plain water. Leave the third bucket empty so that you can squeeze dirty water from a rag or sponge into it. Clean up the dust using the following procedure:

Materials developed by the Integrated Environmental Health Middle School Project (NIEHS Grant #ES10738 and #ES07033).

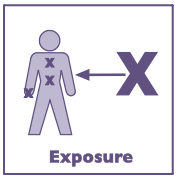
- Wet a clean rag or sponge with the cleaning mixture in Bucket 1.
- Wipe the dusty surface with the damp rag or sponge.
- Rinse the rag or sponge in the plain water in Bucket 2.
- Squeeze extra water out of the rag or sponge into the empty Bucket 3.
- Continue this process until the entire surface is clean.

Data Chart

	Dry Sweeping or Dusting	Wet Sweeping or Dusting	Three-Bucket System
Prediction: Effectiveness			
Prediction: Safety			
Observation: Effectiveness			
Observation: Safety			

1. Which cleaning method seemed to be the **most effective** at cleaning the dust?

2. Which cleaning method seemed to be the **safest** when cleaning up lead contaminated dust?



3. What are the possible **routes of exposure** that lead can get into the body when someone is cleaning up an area with lead contaminated dust?

4. What should be done with cleaning rags or sponges after they have been used to clean up lead contaminated dust?

FOUR LEAD AWARENESS ACTIVITIES
Student Handout #2

Name _____

Date _____

Student Handout

Activity #2 – Lead Underfoot

Lead can occur naturally in soil. The Washington State Department of Ecology and the United States Geological Survey have determined that the natural level of lead in soil around the Puget Sound area is 24 ppm (**parts per million).** The Washington State average is 17 ppm. One of the reasons for the elevated lead levels in Puget Sound area soil is thought to be related to an old **smelter** that used to be located near Tacoma. The smelter emitted both lead and **arsenic** in the area. Depending on the direction of the wind, these heavy metals settled in soil around much of the Puget Sound area. Other parts of the state may have elevated lead levels in soil because of industry, like smelters, or in agricultural areas where pesticides containing lead and arsenic were once applied. Also, lead levels can be elevated in the soil around buildings that have lead based paint on their exterior. When the paint ages, it flakes off into the surrounding soil. When paint is sanded or scraped off during renovations, paint dust can fall into the surrounding soil.

First, read the handout entitled **Soil Safety Guidelines to Reduce Your Risk from Contaminated Soil.** Then, conduct the following investigation to learn about how much soil can be tracked into a home. You will also use a simple lead swab test kit to learn how to test for the presence of lead. It is important to note that the lead swab test kit only tells you whether or not lead is present in the soil. It does not provide any information about the amount of lead in the soil. Remember that lead can occur naturally in soil.

Parts per Million (ppm): A measurement of the amount of a substance within a solution. Represents a dilution of 1/1,000,000.

Smelter: An industrial process of using high temperatures to melt (or "smelt") a metal from an ore. Smelting processes often release hazardous substances into the air.

Arsenic: A naturally occurring chemical element that is toxic to human health. At one time, it was used as in ingredient in lead arsenate pesticides applied to orchards. Arsenic can be emitted as a by-product of copper smelting. Its chemical symbol is "Ar".

Investigation Procedure

Do the following:

1. First, weigh the clean fabric mat to determine its weight. Record this information on your data chart.

2. With your teacher's permission, one person from your group should go outside and walk around in areas where the soil is exposed. Before this person comes back inside the building, have them carefully wipe their feet on the fabric mat until their shoes are relatively clean.

3. Record some observations about the condition of the soil outside and about how you collected the soil. Some observations you might want to include: How wet was the soil? Has it rained recently? How long and how far did the person walk while collecting soil on their shoes? What kind of tread was on their shoes? Also make some observations about the soil collected on the fabric mat.

4. Then, re-weigh the mat and calculate the weight of the soil that has been collected on it.

5. Use the lead swab test kit to test a small sample of soil taken from the fabric mat. Carefully follow the directions that came with the test kit for testing soil samples. Record your findings on the data chart.

Materials developed by the Integrated Environmental Health Middle School Project (NIEHS Grant #ES10738 and #ES07033).

Data Chart

Weight of Clean Mat:

Weight of Mat with Soil:

Total Weight of Collected Soil:

Observations of Outside Soil Conditions and How Soil was Collected	
Observations of Soil Collected on Mat	
Results of Lead Swab Test	

1. How would your results differ if the outside soil had been muddier or drier?

2. Do you think that you would get different results if you tried shoes with different kinds of treads on the soles? How would the results differ?

3. List three things that people can do to protect themselves from lead contaminated soil.

FOUR LEAD AWARENESS ACTIVITIES
Student Handout #3

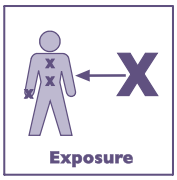
Student Handout

Name _____

Date _____

Activity #3 – Effective Handwashing

One common way that young children become exposed to lead is by getting dust from lead paint on their hands or toys. Young children naturally put their hands and toys in their mouths, which causes them to ingest the lead dust. Also, children might come in contact with lead contaminated soil when playing outside. It is important for children to learn to properly wash their hands before eating or drinking and after playing outside.



You are challenged to design an experiment to determine the best hand washing method. You will use a product called Glo Germ Gel to represent lead dust. This product glows when held underneath a UV light. This product only represents lead dust; it does not contain any lead. In real life, you cannot see or smell lead in dust.

Investigation Procedure

Do the following:

1. First, decide on four different hand washing methods. The methods may use soap or no soap, cold water or warm water, and differing amounts of time spent washing. You can also use antibacterial hand gel. Describe each of your four hand washing methods on the data sheet.

2. Then, come up with a hypothesis for how well each method will work. Record what percentage of the hands you think will still remain dirty after using each method.

3. Next, have one person in your group place a quarter-sized amount of Glo Germ Gel™ in their hand and rub it all around. Now, proceed to try out your first hand washing method. One person should keep track of the amount of time spent on hand washing on the data sheet.

4. When you have finished washing, hold your hands under the UV light. If there is any lead dust still remaining on your hands, it will glow brightly. Record on your data sheet an estimate of the percentage of your hands that are still dirty. You might also want to trace your hand print on another piece of paper and draw where there was lead remaining. Also record any observations.

5. When you are finished, make sure to wash your hands well until no lead dust remains (check with UV light) and dry them before starting your next trial.

6. Repeat this process for each trial, beginning with clean hands and using the same amount of gel each time.

Data Chart

Trial	Hand Washing Method	Time (seconds)	Prediction: % of Hand Still Dirty	Actual Result: % of Hand Still Dirty	Observations
#1					
#2					
#3					
#4					

1. Which hand washing method was the most effective? What percentage of the hands were still dirty after using this method?

2. Explain how you would teach a young child to wash their hands using this method.

FOUR LEAD AWARENESS ACTIVITIES
Student Handout #4

Student Handout

Name _____

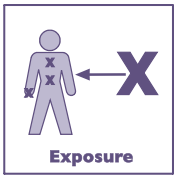
Date _____

Activity #4 – Pollution Dilution Investigation

The **U.S. Environmental Protection Agency** (EPA) sets the action level for lead in drinking water using the measurement **parts per billion (ppb)**. What exactly is parts per billion? In the following activity, you will use food coloring to represent a small amount of lead in a drinking water supply.

U.S. Environmental Protection Agency: Established in 1970, this government agency protects human health by safeguarding the air, water and land upon which life depends.

In the world of water quality testing, a pollutant is measured in **parts per million (ppm)** or **parts per billion (ppb) –** but what do these measurements really mean? In this activity, you will use food coloring to represent **lead in drinking water**, which in real life cannot be seen. At what point does the color disappear? Does this mean the pollutant is gone? Is any level of lead acceptable in your drinking water?



Before conducting the dilution activity, read the **EPA Consumer Fact Sheet on Lead** given to you by your teacher. Answer the following questions about the reading:

Parts per Million (ppm): A measurement of the amount of a substance within a solution. Represents a dilution of 1/1,000,000.

1. What is the Maximum Contaminant Level Goal (MCLG) for lead in drinking water and how is this level set?

2. What is the Action Level for lead in drinking water? How are public water supplies monitored for lead?

Parts per Billion (ppb): Represents a dilution of 1/1,000,000,000.

3. What are two ways that lead might get in drinking water?

Investigation Procedure

Now you are ready to begin your investigation activity. The dilution of the lead (represented by food coloring) is shown on the data chart, assuming that the food coloring begins with a dilution of dye-to-water of 1/10. Do the following:

1. Line up 8 plastic spoons in a row and fill the plastic cup with water. Using an eyedropper, place 9 drops of water into each of the spoons.

2. Add one drop of food coloring (dark colors work best) to the spoon on the far left (spoon #1).

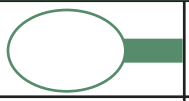
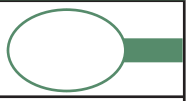
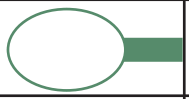
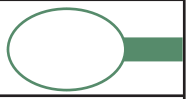
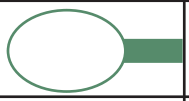
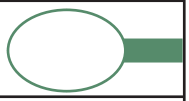
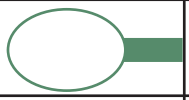
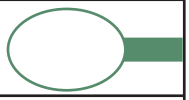
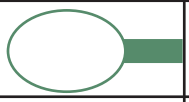
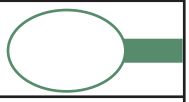
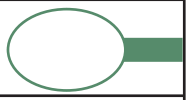
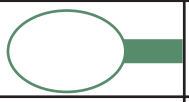
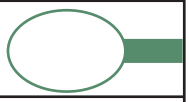
3. On the data chart, in the column labelled “prediction,” record your prediction of how much lead will be in each spoon at the different concentrations. To do this, use a colored pencil to carefully shade the ovals representing each spoon. Do you think that the lead will disappear at some point? If so, by which spoon will it seem to disappear?

Materials developed by the Integrated Environmental Health Middle School Project (NIEHS Grant #ES10738 and #ES07033).

4. Then, use the eyedropper to pick up some water from spoon #1. Carefully add ONE drop to spoon #2. Then, empty the remaining water in the eyedropper back into spoon #1. Rinse out the eyedropper in the cup of water. Next, take one drop from Spoon #2 and add it to Spoon #3, and so on down the line of spoons, following the same procedure: pick up, one drop, empty, rinse.

5. Record on your data sheet the amount of lead in each spoon using a colored pencil to carefully shade the oval representing each spoon.

Data Chart

Spoon	Dilution	Prediction of Appearance	Actual Appearance
#1	1/100		
#2	1/1,000		
#3	1/10,000		
#4	1/100,000		
#5	1/1,000,000 **(1 ppm)**		
#6	1/10,000,000		
#7	1/100,000,000		
#8	1/1,000,000,000 **(1 ppb)**		

1. At what point did the food coloring seem to disappear?

2. Even if you cannot see the food coloring in some of the spoons, does this mean that there is no longer any “lead” in the water? Explain your answer.

Corrode:
To weaken or destroy, usually slowly, as the result of a chemical reaction.

3. Lead often gets into drinking water when the water sits in lead pipes overnight. If the water is acidic, the lead in the pipes might **corrode** into the water. One way you can protect yourself from lead in drinking water is to flush your water before using it for drinking or cooking, especially if the water has been sitting in the pipes for six or more hours. All you have to do is flush the water until it runs cold, approximately 15-30 seconds. What is one way that you can teach your family how to flush their drinking water?

BEETHOVEN'S HAIR
Student Handout #1

Name _____

Date _____

Student Handout

A Biography of Beethoven

Ludwig van Beethoven was a famous classical music **composer** who was considered a child genius. Born in 1770 in Bonn, Germany, he began performing publicly at the age of six and left school when he was thirteen to begin touring full-time. He went on to compose many famous works that are still widely performed today, including his Symphony No. 9, Fur Elise and Moonlight Sonata. Beethoven's compositions were passionate, dramatic and full of emotion. While his music has withstood time, he wasn't always accepted by his peers.

Composer:
A person who writes music.

While Beethoven's beautiful music seems to rise above the drudgery of daily life, he suffered greatly from physical illness and depression. Though only a teenager at the time, he took on the guardianship of his two younger brothers due to his father's alcoholism. Beethoven traveled to Vienna to study with Hayden and Bach, two other well known classical musicians. While in Vienna, Beethoven took on a paid position as a court musician to support his family back home in Bonn.

Unlucky in Love

Beethoven never married, but was often falling in and out of love. While he often fell deeply in love, the women rarely felt the same way, causing him much pain. His famous *Moonlight Sonata* is said to have been written as he sat at his piano one evening, bathed in moonlight, after his marriage proposal to Countess Giulietta had been turned down. Beethoven was a frail, sickly man, and not particularly handsome. His moodiness and violent temper often frightened away the women he loved.

Although single, Beethoven did assume the guardianship of his nine-year-old nephew, Karl, when his brother Casper Carl died. Although the boy's mother was still alive, Beethoven thought her to be unfit, and underwent a costly legal battle for custody of his nephew. Unfortunately, Beethoven did not make the best parent, and the two frequently fought. When Karl attempted suicide in 1826, Beethoven was greatly saddened to discover that his volatile relationship with Karl contributed to Karl's unhappiness.

A Lifetime of Illness

It was well known by Beethoven's friends that as time wore on, his anti-social behavior and depression deepened. Beethoven began noticing trouble with his hearing and by 1818 he was virtually deaf at age forty-eight. However, he tried to keep his hearing loss a secret at first. In an unsent letter written to his brothers in 1802, considered to be a confession of his secret deafness, Beethoven explained his self-imposed seclusion,

> "From childhood on, my heart and soul were full of the tender feeling of goodwill, and I was always inclined to accomplish great deeds. But just think, for six years now I have had an incurable condition...Though born with a fiery, lively temperament, susceptible to the diversions of society, I soon had to withdraw myself, to spend my life alone. And yet if I wished at times to ignore all this, oh how harshly was I pushed back by the doubly sad experience of my bad hearing..."

Beethoven made his last public performance in 1814, although he continued to compose right up until his death. As Beethoven's hearing worsened, he relied on "conversation notebooks," within which his guests wrote down their questions or thoughts for the deaf composer.

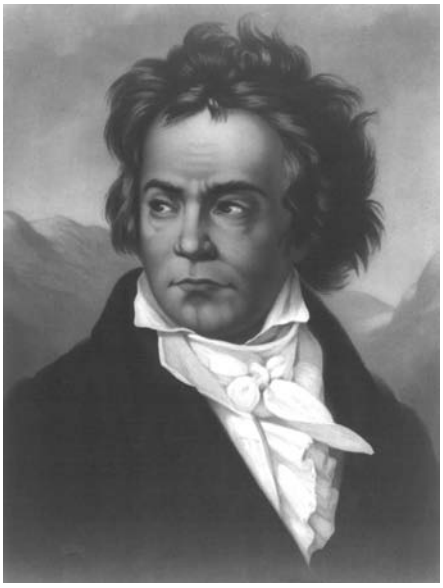
Beethoven suffered greatly from a number of physical ailments, which grew worse up until his painful death in 1827 at age fifty-six. It seemed that just when he recovered from one illness, another more painful sickness took over. Beginning in his early twenties, Beethoven was plagued with severe abdominal pain, gastrointestinal distress, persistent headaches, infections, pneumonia, bronchitis, **jaundice** and depression. He saw over thirty doctors in hope of finding relief from his constant illness. In a letter written to his brothers Carl and Johann in 1802, yet never mailed, Beethoven pleaded, "...as soon as I am dead, if Dr. Schmidt is still alive, ask him in my name to describe my disease, and attach this written document to his account of my illness, so that at least as much as possible the world may be reconciled to me after my death..."

Jaundice:
A condition in which there is yellowing of the whites of the eyes, skin, and mucous membranes, caused by bile pigments in the blood. It is a symptom of liver disease or of a blocked bile duct.

Beethoven received over 75 different medications during the months leading up to his death, however it is important to note that he refused morphine, a common pain killer at the time. Although he was in great pain from his illness, it appears that Beethoven preferred to keep his mind clear and unclouded by mind-altering drugs so that he could continue composing rather than numb his pain and be without an outlet for his creativity.

Heavy Metal Musician

Beethoven died after spending more than four painful months bedridden by a variety of illnesses. His actual death was caused by failure of his liver. Upon his death, many friends, and even some strangers, cut locks of Beethoven's hair to keep as mementos of the great composer. This was fashionable at the time, since photographs, which help people remember their loved ones, had not yet been invented. So many people took locks of hair that by the time Beethoven was buried, his head was almost completely bald. Tens of thousands of people witnessed Beethoven's funeral procession in 1827.

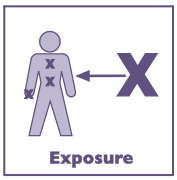

Ludwig van Beethoven, 1770–1827

In 1994, a lock of Beethoven's hair — cut from his head the day after his death by a fifteen-year-old musician — was offered for sale by Sotheby's auction house and purchased by a small group of Beethoven enthusiasts from America for $7,300. A portion of the hair underwent intense scientific experiments revealing a startling finding. Beethoven's hair showed extremely high levels of the heavy metal lead, finally offering a possible explanation for some of his chronic illnesses and strange behavioral traits. Many of Beethoven's complaints are consistent with chronic **plumbism**. Common symptoms of plumbism include severe gastrointestinal distress, jaundice, gout, headaches, irritability and erratic behavior. It is even remotely possible that Beethoven's deafness was also

Plumbism:
Lead poisoning.

caused by lead poisoning, but it is thought his deafness may have been caused by another disease, or from the frequent thrashings his father gave him as a child, which included boxing his ears.

While we will never know for sure how Beethoven came in contact with lead, it is possible that he was exposed by eating food that was prepared in lead cooking pots and served on earthenware plates with leaden glazes. He might also have been exposed to lead by drinking ever increasing amounts of wine, which at that time was often “plumbed,” or treated with lead to sweeten bitter or sour flavors.



BEETHOVEN'S HAIR
Student Handout #2

Name _____

Date _____

Student Handout

Beethoven's Hair: A Historical Narrative

(Inspired by the book *Beethoven's Hair* by Russell Martin)

A Rare Encounter

The story of Beethoven's hair begins in the spring of 1827. Johann Hummel, a well-known German musician, heard that his esteemed friend, Ludwig van Beethoven was dying. Hummel and his wife, along with a fifteen-year-old musician named Ferdinand Hiller, traveled to Vienna, Austria to see Beethoven. Ferdinand was a young musician whose talent had received much attention. As was common in that time, Hiller was living with Hummel and his wife in order to receive instruction in piano and composition.

When they arrived in Vienna, Beethoven had already been bedridden for four miserable months by a variety of illnesses. His doctors tried every treatment they knew, including prescribing over 75 different medications, but Beethoven only grew weaker. Beethoven was also completely deaf and relied on "conversation notebooks," in which his guests wrote down their side of the conversation for the deaf composer.

Over the next two weeks, Hummel and Hiller visited Beethoven four times. Hiller later wrote this description of their first encounter,

> "Through a spacious anteroom in which high cabinets were piled with thick, tied-up parcels of music, we reached — how my heart beat! — Beethoven's living room, and were not a little astonished to find the master sitting in apparent comfort at the window. He wore a long, gray sleeping-robe and high boots reaching his knees. Emaciated by long and severe illness, he seemed to me, when he arose, of tall stature; he was unshaven, his thick, half-gray hair fell in disorder over his temples."

When Hummel and Hiller heard that Beethoven had died, they hurried back to his home. Now, Beethoven lay in a coffin with a white crown of roses on his head. At the time, it was common for people to cut a lock of hair from a deceased person to remember them by. Young Hiller asked permission from his tutor to cut a lock of Beethoven's hair. By the time Beethoven was buried, so many people had cut locks from his head, that he was almost completely bald. Shortly afterwards, Hiller had a locket made for the hair. The wooden locket held the precious lock of hair between two plates of glass.

Source: Martin, R. (2000). *Beethoven's Hair*. Broadway Books, NY.

Check Your Understanding

1. Why did Ferdinand Hiller go to visit Beethoven?

2. How did Beethoven, who was completely deaf, communicate with his visitors?

A Well Traveled Lock

While Beethoven had not traveled much in his lifetime, Hiller enjoyed constantly changing his surroundings as a young adult. In Hiller's possession, the lock of Beethoven's hair traveled extensively through Europe, including Germany, France, and Italy.

In May of 1883, Ferdinand Hiller began preparing for his own death. He chose to pass the lock of hair onto his son, Paul Hiller, as a 30th birthday present. Ferdinand had safeguarded the locket for 56 years and now left it in the hands of his son.

In 1911, when Paul Hiller was 58 years old, he asked an art dealer in Cologne, Germany to refurbish the locket that had held Beethoven's hair for the last 84 years. Paul wrote an inscription on a piece of paper and pasted it onto the back of the locket. The inscription read, "This hair was cut off of Beethoven's corpse by my father, Dr. Ferdinand v. Hiller on the day after Ludwig van Beethoven's death, that is on 27 March 1827, and was given to me as a birthday present in Cologne on May 1, 1883."

The locket containing Beethoven's hair (Reproduced with permission of the Ira F. Brilliant Center for Beethoven Studies, San Jose State University)

Paul Hiller died at age 81 in 1934, survived by his wife Sophie and three sons. For the next nine years, there remains no historical account of the lock of Beethoven's hair. Some people believe that Hiller may have donated the locket to a local museum, while others suspect that he may have given it to one of his sons. The most mysterious part of the story is where and when Beethoven's hair next appears in history.

Check Your Understanding

1. How did the lock of hair come into Paul Hiller's possession?

2. What happened to Beethoven's hair after Paul Hiller died?

Midnight in a Dark Church Loft

Nazis: During WWII, Germany was under the control of Adolph Hitler and his Nazi party. The Nazis took control of many neighboring countries before being defeated by Allied forces (including the United States).

During World War II, the German **Nazis**, under Adolf Hitler's command, swept across Europe, invading neighboring countries and engaging in battles with Allied troops. Jewish citizens were forced to flee their homes to seek refuge in sympathetic nations. Many of those who couldn't flee were captured by the Gestapo, the Nazi's secret police troops, and sent to **concentration camps**. In Germany and Austria, many Jews flee to

Denmark in hopes of escaping the terror of the Nazis.

In April 1940, Denmark falls under the control of Germany. Many Jews attempt to flee to Sweden in hopes of escaping the concentration camps. And so our story takes us to Gilleleje, a small fishing port in Denmark, in the chilly month of October 1943.

Concentration Camps: Camps in Europe where people, mostly of Jewish ancestry, were sent during WWII under the orders of Adolph Hitler. Many of those sent to concentration camps were tortured and killed.

Word was leaked that the Gestapo were about to descend on Denmark, so Danish citizens across the country mobilized to protect their Jewish neighbors. Hospitals sent out their ambulances to pick up Jews with no place to hide, registering them as patients with changed last names to conceal their identities. Trains and buses were packed with Jews traveling throughout the night to small port towns, where fishing boats would transport them to the safety of Sweden.

On October 6, 1943, hundreds of Jews arrived by train in the small town of Gilleleje. The townspeople agreed it was their duty to help these troubled **refugees**, and hide them in their homes, attics, and the town church. The townspeople crafted a plan, convincing the captain of a large fishing vessel to allow passage for several hundred Jews across the channel to Sweden. However, while the ship was being boarded, a mass panic was caused when someone mistakenly heard a shout, “the Gestapo are here!” The ship set sail with only a handful of Jews onboard, leaving many refugees stranded on the shore. The townspeople hid the Jews in the loft of the church that night, planning to make another attempt the next day. And it is here, in the frigid, pitch-black church that the locket of Beethoven’s hair mysteriously reappears.

Refugee: A person who flees to a foreign country to avoid persecution or danger.

Shortly before midnight, the town’s physician, Dr. Kay Fremming, was called to the church to attend to an ill refugee. Later, he said that he had been given something special as a gift that night. Unfortunately, at midnight, the Gestapo descended on the church, arresting 120 Jews. Ultimately, most of them were sent to a concentration camp called Theresienstadt in Czechoslovakia. Due to unrelenting pressure from the Danish government, most of the Danish Jews were not transferred to the Nazi death camps, and were later released. Upon returning home, they were welcomed by their Danish neighbors, who had tended their homes and gardens in their absence.

Check Your Understanding

1. Why did Jewish refugees suddenly arrive in Gilleleje in 1943?

2. How did Danish Jews fare in the concentration camps, compared to other Jews? Why?

Into the Hands of an Orphan

Sometime during that chaotic night, a stranger gave Dr. Fremming the locket of hair, perhaps as repayment for helping the Jewish refugees. But no one knows how the locket made its way to the small fishing village. Some believe that Paul Hiller had donated the locket to a museum, but that it was later stolen out of fear that it would come under control of the Nazis. Perhaps, in the fear of the night spent in the church loft, someone chose to leave it with a sympathetic doctor, hoping it would be safeguarded.

After WWII ended, a group of thirty French war orphans arrived in Denmark for adoption. A six-year-old girl named Michèle de Rybel arrived in Gilleleje and was adopted by a county administrator and his wife. Michèle felt that her adoptive parents were cruel, so one day, she planted herself on the front steps of Dr. Kay and Marta Fremming's house and asked them if she could be their daughter. Surprisingly, the childless couple agreed.

Dr. Kay Fremming died in 1969 at age 64. Upon his death, Marta showed Michèle the precious locket of Beethoven's hair, which Kay had kept secretly stashed in his desk drawer. Marta later gave the locket to Michèle in the late 1970s. Michèle was very attached to the locket, a reminder of her adoptive father.

In 1994, Michèle and her son Thomas were having some financial troubles and considered selling the locket. They inquired with Sotheby's, one of the largest auction houses in the world and decided to put it up for sale in December.

Check Your Understanding

1. Who gave Dr. Fremming the locket? Why?

2. How did Michèle come to be adopted by Kay and Marta Fremming?

3. What did Michèle and her son decide to do with the locket? Would you have made the same decision? Explain.

Two Americans and a Forensics Discovery

When Beethoven enthusiast Ira Brilliant spotted the listing in the Sotheby catalog in 1994, he could barely believe it. Brilliant collected first edition Beethoven compositions and other relics, but the wooden locket caught his attention. He called his friend and fellow Beethoven enthusiast Dr. Alfredo "Che" Guevera, and together with a small group of investors, they pooled together enough money to buy the hair. The locket sold for $7,300, and soon it arrived in a package mailed to Brilliant's home.

Brilliant and Guevera decide to open the locket and submit a sample of hair for scientific testing, with hopes of gaining some insight into Beethoven's life and his countless illnesses. On December 12, 1995, the locket was opened by Dr. Guevera in front of an anxious crowd at the University of Arizona Medical Center. As the surgeon used a scalpel to break the seal between the glass plates, he remarked, "Wow, could you hear that? I heard a rush of air like a vacuum when I started to separate the glass." For the first time in at least eight decades, the lock of Beethoven's hair was exposed. Among the lock of brown and gray hairs, there were 582 total hair strands. The hair was divided, with most of it being returned to the locket and given to the Ira F. Brilliant Center for Beethoven Studies at San Jose State University. The remaining hair was given to Guevera, who curled it into a petri dish and locked it in his office safe, happy to go about his daily work knowing a piece of his mentor, Beethoven, remained so close.

In May 1996, Guevera sent 20 hairs from his bundle to Los Angeles for drug analysis and then off to Illinois for further scientific analysis. After several years of careful testing by some of the world's top hair analysts and **forensic** chemists, an exciting discovery was announced in the year 2000. Beethoven's hair showed elevated levels of lead. His hair had forty-times the lead average that was contained in control hairs that were tested (hair samples taken from living people). Another separate test showed lead levels that were 100 times the lead levels found in control hairs!

Forensic:
A type of scientific analysis used to examine evidence, often from a deceased person, to solve a crime or a mystery.

Lead acts like calcium in the body and is stored in bones. Special x-rays of bones can help determine how much lead a person was exposed to during their lifetime.

Hair analysis only provides information on recent exposure to lead. The hair samples from Beethoven help tell the story of the last few months of his life. The results from the hair analysis suggest that Beethoven was suffering from lead poisoning at the time of his death. But what does this tell us about the illnesses that plagued Beethoven for most of his adult life? Unfortunately, it doesn't tell us anything for certain. The scientists who did the hair analysis suggested that since Beethoven was sick for so much of his life, it is possible that lead poisoning was the cause of his various illnesses. They believe that his illnesses were similar to the common symptoms of lead poisoning, such as severe stomachaches, jaundice, gout, headaches, irritability and moodiness.

Hair analysis only tells us for sure about Beethoven's exposure to lead during the months leading up to his death. The only way to determine Beethoven's exposure to lead over his lifetime would be to test a sample of his bone for the presence of lead. Since lead acts like calcium, the body stores lead in bones. A special x-ray of a piece of bone could determine the amount of lead that was stored in Beethoven's body over his lifetime. Fortunately, one of the scientists working on this project has announced plans to study some skull fragments that were stored after Beethoven's body was exhumed in the mid-1800s. This would give us more information about long-term lead exposure and the effects it might have had on Beethoven's health.

Over 170 years after Beethoven's death, his illness remains a mystery. Although some people believe that Beethoven's lengthy illness was due to lead poisoning, we do not know for sure. Perhaps future testing of Beethoven relics will solve this historical, scientific mystery once and for all!

Check Your Understanding

1. What scientific discovery was made about Beethoven by testing his hair?

2. What test is needed to determine Beethoven's exposure to lead over his lifetime?

Timeline Activity

The story of Beethoven's hair is an exciting scientific mystery that covers over 170 years of history. In this activity, you will create a timeline that plots important dates and events from the story. Use colored pencils or pens to create a colorful and informative timeline that plots the events in chronological order. Be sure to include the date and location for each event. Your timeline should begin with the year Beethoven died and end with the year that the forensic test results were announced. Include the following events in your timeline (they are not listed in chronological order):

- The locket is opened and the hairs are counted
- A Jewish refugee gives the locket to Dr. Fremming in a church loft
- Ferdinand Hiller cuts a lock of Beethoven's hair after his death
- Paul Hiller has the locket refurbished and adds an inscription
- Scientists announce results of forensic tests on the hair
- After Paul Hiller dies, there is no record of the locket for 9 years
- Ferdinand Hiller gives the locket to his son, Paul, as a birthday gift
- Ira Billiant, Dr. Guevara, and a group of investors buy the locket

Creative Writing Activity

Now that you have read about Beethoven's hair, it's time to try your hand at some creative writing. Writers of historical fiction combine historical facts (people, places, events) with fictional, or made-up, elements. In this activity, you will choose a time period mentioned in the narrative of Beethoven's hair and create a short historical fiction story.

Choose a distinct time period described in the narrative above. For the period you have chosen, write a creative story set at that moment in history. You can write from the point of view of a real character mentioned in the narrative (Beethhoven, Ferdinand Hiller, Michèle de Rybel, etc.), or a character from your imagination. It doesn't have to be a person. The story could be told through the eyes of a bird perched in the rafters of the church of Gilleleje. Your story should include at least one reference to Beethoven's lock of hair. To make your story more believable, you should conduct some research on the art, music, and culture of the time period you have chosen and incorporate that research into your writing.

EIGHTEEN PENCE A DAY
Student Handout #1

Name _____

Date _____

Student Handout

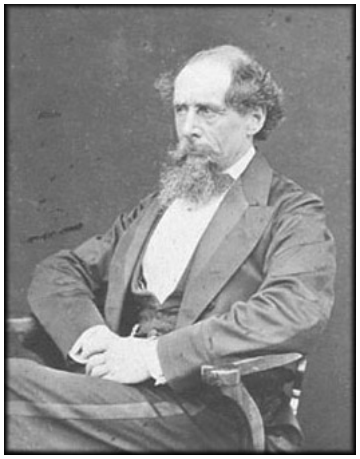
Biographical Sketches of Charles Dickens and Jack London

The Life of Charles Dickens

Charles John Huffham Dickens was born on February 7, 1812 in England. In 1814, his family moved to London and later to Chatham, England.

At age 12, he was sent to work at Warren's Blacking Factory, a shoe dye warehouse, when his father was imprisoned for debt. This was one of the worst times in Dickens' life, and he rarely spoke of it. However, his experiences in the factory influenced his later writings about working class Londoners. Dickens briefly returned to school for three years, but at age 15 was forced to work to help support the family. He worked as a clerk for a law office and then became a court reporter.

In 1833, Dickens began contributing essays and short stories to magazines and quickly acquired a large following. Dickens had a busy writing career, including publishing well known works such as: *A Christmas Carol* (1843), *David Copperfield* (1850), *Hard Times* (1854), *A Tale of Two Cities* (1859) and *Great Expectations* (1861).



Charles Dickens, 1812-1870

In 1836, Dickens married Catherine Hogarth. The couple had ten children over the next 16 years. While they were happy in the early years of their marriage, Catherine quickly became overwhelmed with the pressures of being the wife of a famous writer and the responsibility of caring for ten young children. Charles also became discontent in the marriage. Catherine and Charles were legally separated in 1858.

In 1865, Dickens survived a frightening train accident on a return trip from Paris. The train jumped a 42 foot long gap in the tracks over a bridge. All but one first-class coach, the one carrying Dickens, fell into the ravine below. As the train was being evacuated, Dickens remembered something he had left behind. He climbed back into the wrecked train to retrieve the manuscript for *Our Mutual Friend*, the novel he was writing at the time.

Through his writings and lectures, Dickens addressed important social issues such as education reform, **public health** improvements, and workers' rights. His book, ***The Uncommercial Traveller***, was a work of journalism based on his experiences traveling through the neighborhoods of East London. In two chapters of the book, he focused on the **white lead** mills in London that employed mostly poor, young women.

Dickens died in 1870 at age 58.

Public Health:
The science of protecting community health by preventing illness, controlling disease, and educating people about how to lead healthier lives.

Uncommercial Traveller:
Dickens uses this nickname for himself. In this book, he observes and reports on the everyday lives of the working class of East London.

White Lead:
A white pigment that contains lead, marketed as a powder or paste and used as an exterior paint.

The Life of Jack London

John Griffith London was born in 1876 in San Francisco, California to an unmarried woman named Flora Wellman who came from a wealthy family. His mother was ill, so London was mostly raised by an ex-slave named Virginia Prentiss. Jack's mother married John London and the family later settled in Oakland, California.

Jack London, 1876-1916

London took on the name "Jack" as a teenager. He worked in a variety of odd jobs as a young man, including pirating oysters, being a member of a "fish patrol" to catch poachers, and sailing on a sealing ship. He even travelled around the country as a hobo.

In 1900, London married Bess Madden. The couple had two daughters. Bess and Jack later divorced, and Jack remarried in 1905.

London was a **prolific** writer, producing over fifty volumes of stories, novels and essays. He considered himself to be a **socialist** and argued in support of **women's suffrage** and **prohibition**. His novel, *The People of the Abyss* (1903), described the underworld of London and was a critique of capitalism and poverty. London traveled extensively, including a winter spent in the Yukon and a trip by small boat to Hawaii.

London's well known books include: T*he Call of the Wild* (1903), *The Sea-Wolf* (1904) and *White Fang* (1906). He was one of the first writers to work with the film industry; many of his novels were made into major motion pictures.

Jack London died in 1916 at age 40 from kidney failure.

Prolific:
Producing an abundance of fruit, work, or results.

Socialist:
Belonging to the socialist party, which believed that the means of producing and distributing goods should be owned collectively or by a centralized government.

Women's Suffrage:
A movement to give women the right to vote. American women were finally granted the right to vote in 1893.

Prohibition:
The period 1920-33, during which alcoholic beverages were illegal in the United States.

Venn Diagram Activity

A Venn diagram is a great way to record information when reading about two subjects that share some similarities. On a separate piece of paper, draw two large circles that slightly overlap. Label one circle "Charles Dickens" and the other one "Jack London." After you have read the two biographical sketches about Dickens and London, record information about the two writers on your Venn diagram. Place information that is unique to only one of the writers in his circle. An example of something that is unique to Dickens might be that he was born in London. Place information that is common to both in the area where the two circles overlap. An example of a commonality between the two writers is that they both had children. Try to find at least four unique things for each writer and four things they have in common.

EIGHTEEN PENCE A DAY
Student Handout #2

Name _____

Date _____

Student Handout

The Literature of the White Lead Mills

Excerpts from *The Uncommercial Traveller,* by Charles Dickens from Chapter 32, "A Small Star in the East"

... It was a dark street with a dead wall on one side. Nearly all the outer doors of the houses stood open. I took the first entry, and knocked at a parlour door. Might I come in? I might, if I plased, sur.

The woman of the room (Irish) had picked up some long strips of wood, about some wharf or barge; and they had just now been thrust into the otherwise empty grate to make two iron pots boil. There was some fish in one, and there were some potatoes in the other. The flare of the burning wood enabled me to see a table, and a broken chair or so, and some old cheap crockery ornaments about the chimney piece. It was not until I had spoken with the woman a few minutes, that I saw a horrible brown heap on the floor in the corner, which, but for previous experience in this dismal wise, I might not have suspected to be "the bed." There was something thrown upon it; and I asked what that was.

"Tis the poor craythur that stays here, sur; and 'tis very bad she is, and 'tis very bad she's been this long time, and 'tis better she'll never be, and 'tis slape she does all day, and 'tis wake she does all night, and 'tis the lead, sur."

"The what?"

"The lead, sur. Sure 'tis the lead-mills, where the women gets took on at eighteen-**pence** a day, sur, when they makes application early enough, and is lucky and wanted; and 'tis lead-pisoned she is, sur, and some of them gets lead-pisoned soon, and some of them gets lead-pisoned later, and some, but not many, niver; and 'tis all according to the **constitooshun**, sur, and **some constitooshuns is strong, and some is weak**, and her constitooshun is lead-pisoned, bad as can be, sur; and her brain is coming out at her ear, and it hurts her dreadful; and that's what it is, and niver no more, and niver no less, sur."

The sick young woman moaning here, the speaker bent over her, took a bandage from her head, and threw open a back door to let in the daylight upon it, from the smallest and most miserable back-yard I ever saw.

"That's what cooms from her, sur, being lead-pisoned; and it cooms from her night and day, the poor, sick craythur; and the pain of it is dreadful; and God he knows that my husband has walked the streets these four days, being a labourer, and is walking them now, and is ready to work, and has no work for him, and no fire and no food but the bit in the pot, and no more than ten **shillings** in a **fortnight** ..."

The woman's married daughter had by this time come down from her room on the floor above, to join in the conversation. She herself had been to the lead-mills very early that morning to be "took on," but had not succeeded. She had four children; and her

White Lead:
A white pigment that contains lead, marketed as a powder or paste and used as an exterior paint.

Uncommercial Traveller:
Dickens uses this nickname for himself. In this book, he observes and reports on the everyday lives of the working class of East London.

Pence:
A coin that was once used in England, equal to one penny.

Constitooshun:
Here, Dickens spells the word "constitution" the way it would sound in the Cockney dialect. Constitution refers to the physical makeup of a person, including his or her overall health and susceptibility to illness.

Shilling:
A coin that was once used in England, equal to twelve pence.

Fortnight:
A period of two weeks.

husband, also a waterside-labourer, and then out seeking work, seemed in no better case as to finding it than her father. She was English, and by nature of a buxom figure and cheerful. Both in her poor dress and in her mother's there was an effort to keep up some appearance of neatness. She knew all about the sufferings of the unfortunate invalid, and all about the lead-poisoning, and how the symptoms came on, and how they grew, – having often seen them. The very smell when you stood inside the door of the works was enough to knock you down, she said: yet she was going back again to get "took on:" What could she do? Better to be **ulcerated** and paralyzed for eighteen-pence a day, while it lasted, than see the children starve.

Ulcerated:
Covered in lesions or sores.

Check Your Understanding

1. What is wrong with the young woman lying in a corner of the room?

2. What are some symptoms of lead poisoning?

3. Why are the women willing to work at the lead mills, even though they know they will become poisoned by the lead?

from Chapter 35, "On an Amateur Beat"

... I found myself near to certain "Lead Mills." Struck by the name, which was fresh in my memory, and finding, on inquiry, that these same lead-mills were identified with those same lead-mills of which I made mention when I first visited ... [the neighbourhood] as Uncommercial Traveller, I resolved to have a look at them.

Received by two very intelligent gentlemen, brothers, and partners with their father in the concern, and who testified every desire to show their works to me freely, I went over the lead-mills. The purport of such works is the conversion of pig-lead into white-lead. This conversion is brought about by the slow and gradual effecting of certain successive chemical changes in the lead itself. The processes are picturesque and interesting,--the most so, being the burying of the lead, at a certain stage of preparation, in pots, each pot containing a certain quantity of acid besides and all the pots being buried in vast numbers, in layers, under **tan**, for some ten weeks.

Tan:
The bark from oak trees which would decompose and heat the pots to about 180 degrees Fahrenheit.

Hopping up ladders, and across planks, and on elevated perches, until I was uncertain whether to liken myself to a bird or a bricklayer, I became conscious of standing on nothing particular, looking down into one of a series of large **cocklofts**, with the outer day peeping in through the chinks in the tiled roof above. A number of women were ascending to, and descending from, this cockloft, each carrying on the upward journey a pot of prepared lead and acid, for deposition under the smoking tan. When one layer of pots was completely filled, it was carefully covered with planks, and those were carefully covered with tan again, and then another layer of pots was begun above; sufficient means of ventilation being preserved through wooden tubes. Going down into the cockloft then filling, I found the heat of the tan to be surprisingly great, and

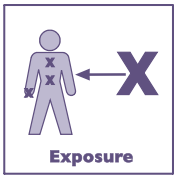
Cocklofts:
A loft or room, just under the roof of a building.

also the odour of the lead and acid to be not absolutely exquisite, though I believe not noxious at that stage. In other cocklofts, where the pots were being **exhumed**, the heat of the steaming tan was much greater, and the smell was penetrating and peculiar. There were cocklofts in all stages; full and empty, half filled and half emptied; strong, active women were clambering about them busily...

Exhume:
To dig up or bring to light. To remove from a grave.

As is the case with most pulps or pigments, so in the instance of this white-lead, processes of stirring, separating, washing, grinding, rolling, and pressing succeed. Some of these are unquestionably **inimical** to health, the danger arising from inhalation of particles of lead, or from contact between the lead and the touch or both. Against these dangers, I found good respirators provided (simply made of flannel and muslin, so as to be inexpensively renewed, and in some instances washed with scented soap), and gauntlet gloves, and loose gowns. Everywhere, there was as much fresh air as windows, well placed and opened, could possibly admit. And it was explained that the precaution of frequently changing the women employed in the worst parts of the work (a precaution originating in their own experience or apprehension of its ill effects) was found salutary. They had a mysterious and singular appearance, with the mouth and nose covered, and the loose gown on...

Inimical:
Hostile or unfriendly, having harmful effects.



At last this vexed white-lead, having been buried and resuscitated, and heated and cooled and stirred, and separated and washed and ground, and rolled and pressed, is subjected to the action of intense fiery heat. A row of women, dressed as above described, stood, let us say, in a large stone bake house, passing on the baking-dishes as they were given out by the cooks, from hand to hand, into the ovens. The oven, or stove, cold as yet, looked as high as an ordinary house, and was full of men and women on temporary foot-holds, briskly passing up and stowing away the dishes. The door of another oven, or stove, about to be cooled and emptied, was opened from above, for the uncommercial **countenance** to peer down into. The uncommercial countenance withdrew itself, with expedition and a sense of suffocation, from the dull-glowing heat and the overpowering smell. On the whole, perhaps the going into these stoves to work, when they are freshly opened, may be the worst part of the occupation.

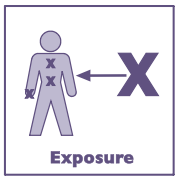
Countenance:
The face or facial features. Here Dickens refers to himself as the "uncommercial countenance".

But I made it out to be **indubitable** that the owners of these lead-mills honestly and **sedulously** try to reduce the dangers of the occupation to the lowest point.

Indubitable:
Too obvious to be doubted, unquestionable.

Sedulously:
Very carefully, painstakingly.

A washing-place is provided for the women (I thought there might have been more towels), and a room in which they hang their clothes, and take their meals, and where they have a good fire-range and fire, and a female attendant to help them, and to watch that they do not neglect the cleansing of their hands before touching their food. An experienced medical attendant is provided for them, and any **premonitory** symptoms of lead-poisoning are carefully treated. Their teapots and such things were set out on tables ready for their afternoon meal, when I saw their room; and it had a homely look. It is found that they bear the work much better than men: some few of them have been at it for years, and the great majority of those I observed were strong and active. On the other hand, it should be remembered that most of them are very **capricious** and irregular in their attendance.



Premonitory:
Warning, foreboding.

Capricious:
Unpredictable, on a whim.

American inventiveness would seem to indicate that before very long white-lead may be made entirely by machinery. The sooner, the better. In the meantime, I parted from my two frank conductors over the mills, by telling them that they had nothing there to be concealed, and nothing to be blamed for. As to the rest, the philosophy of the matter of lead-poisoning and workpeople seems to me to have been pretty fairly summed up by the Irish woman whom I quoted in my former paper: "Some of them gets lead-pisoned soon, and some of them gets lead-pisoned later, and some, but not many, niver; and 'tis all according to the constitooshun, sur; and some constitooshuns is strong and some is weak."

Check Your Understanding

1. What are some of the steps in the process of creating white lead?

2. What are some ways that the workers come in contact with the lead?

3. What are Dickens' thoughts about the safety of the lead mill?

A Description of the Effects of Lead Poisoning. An excerpt from *The People of the Abyss "The Precariousness of Life",* by Jack London

Dissolution:
Termination, extinction, or death.

"... Worst of all is the lead dust in the white lead trades. Here is a description of the typical **dissolution** of a young, healthy, well-developed girl who goes to work in a white lead factory:

Blue Line:
A telltale sign of severe lead poisoning is a blue line along the gums near the teeth.

Here, after a varying degree of exposure, she becomes anemic. It may be that her gums show a very faint **blue line**, or perchance her teeth and gums are perfectly sound, and no blue line is discernible. Coincidentally with the anemia she has been getting thinner, but so gradually as scarcely to impress itself upon her or her friends. Sickness, however, ensues, and headaches, growing in intensity, are developed. These are frequently attended by obscuration of vision or temporary blindness. Such a girl passes into what appears to her friends and medical adviser as ordinary hysteria. This gradually deepens without warning, until she is suddenly seized with a convulsion, beginning in one-half of the face, then involving the arm, next the leg of the same side of the body, until the convulsion, violent and purely epileptic in character, becomes universal. This is attended by loss of consciousness, out of which she passes into a series of convulsions, gradually increasing in severity, in one of which she dies or consciousness, partial or perfect, is regained, either, it may be, for a few minutes, a few hours, or days, during which violent headache is complained of, or she is delirious and excited, as in acute mania, or dull and sullen as in melancholia, and requires to be roused, when she is found wandering, and her speech is somewhat imperfect. Without further warning, save that the pulse, which has become soft, with nearly the normal number of beats, all at once becomes low and hard; she is suddenly seized with another convulsion, in which she dies, or passes into a state of coma from which

she never rallies. In another case the convulsions will gradually subside, the headache disappears and the patient recovers, only to find that she has completely lost her eyesight, a loss that may be temporary or permanent."

Journal Writing Activity

After reading the excerpts from the work of Charles Dickens and Jack London, you should be very familiar with the plight of the young women who worked in the white lead mills of 19th century London. Now do the following:

- Read the short descriptions below of the lives of four real women who worked in the mines.
- Choose ONE young woman and write a journal entry as if you were that character.
- Your entry should include the following information: How much is she paid for a day's work at the lead mill? How is the job affecting her health? Why is she willing to do such terrible work?
- Write the way you imagine the character would speak. Use slang, Cockney dialect, and non-traditional spelling where appropriate, as in the reading.

Charlotte Rafferty, a fine, well-grown young woman with a splendid constitution who had never had a day's illness in her life became a white lead worker. Convulsions seized her at the foot of the ladder in the works. Dr. Oliver examined her, found the blue line along her gums, which shows that the system is under the influence of the lead. He knew that the convulsions would shortly return. They did so, and she died.

Mary Ann Toler a girl of seventeen, who had never had a fit in her life three times became ill and had to leave off work in the factory. Before she was nineteen she showed symptoms of lead poisoning had fits, frothed at the mouth, and died.

Mary A., an unusually vigorous woman, was able to work in the lead factory for twenty years, having colic once only during that time. Her eight children all died in early infancy from convulsions. One morning, whilst brushing her hair, this woman suddenly lost all power in both her wrists.

Eliza H., aged twenty-five, after five months at lead works, was seized with colic. She entered another factory (after being refused by the first one) and worked on uninterruptedly for two years. Then the former symptoms returned, she was seized with convulsions, and died in two days of acute lead poisoning.

— The above descriptions are from Jack London's *The People of the Abyss.*

TRUMPETER SWAN MATH
Student Handout #1

Name _____

Date _____

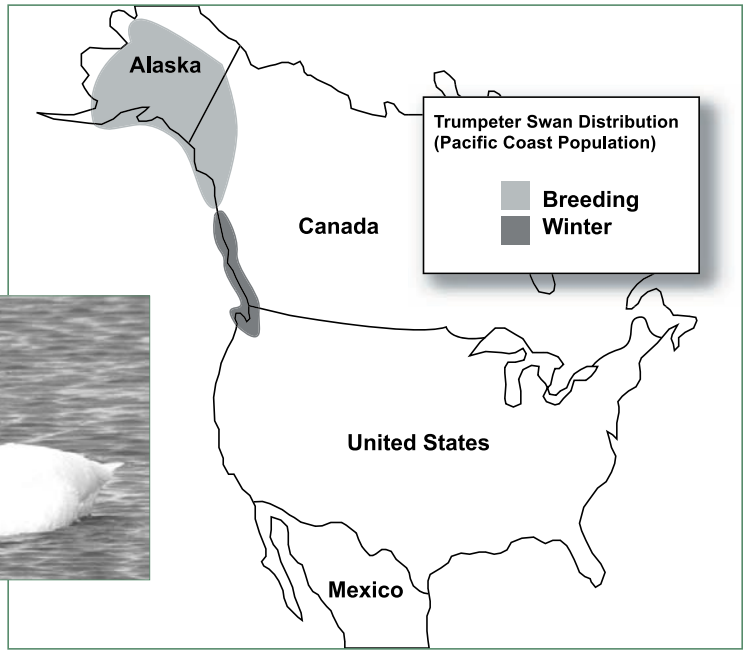
Student Handout

Introduction

In this lesson, you will learn about how **trumpeter swans** are being poisoned by years of accumulated **lead shot** from hunting. First, look at the map below. It shows where the Pacific Coast population of trumpeter swans breeds and spends the winter.

Trumpeter Swan: A large white swan with an eight foot wing span that mates for life and returns to the same nest each year. The Pacific Coast population spends the winter in Northwestern Washington and British Columbia and has mating grounds in Alaska. Trumpeter swans have a loud call that sounds like bugling trumpets.

Lead Shot: Tiny lead pellets used in a shotgun cartridge.



In the following activities, you will read three articles about lead poisoning among trumpeter swans. Each article includes several math problems based on the information contained in the article. You will also work with a data chart to create your own bar graph with information about lead poisoning in waterfowl.

Readings

ARTICLE #1

Decades of old lead shot linked to massive swan die-offs: State biologists seek mystery site feeding decline of trumpeter population

— by M.L. Lyke, from the *Seattle Post-Intelligencer* (1/23/03)

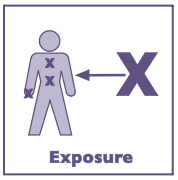
WHATCOM COUNTY – A bitter Fraser Valley wind ruffles the water of the unlikely lake, a rain-filled gravel pit surrounded by skeletal trees and heaps of excavated dirt. The dozen trumpeter swans bobbing on the water's surface add the only touch of beauty to the barren scene.

Community Resources & Action

Roosting Area:
An area in which birds settle down to rest. Oftentimes groups of birds will roost together at night.

The elegant white birds shouldn't be here. This is a night **roosting area**. It's 10 a.m. The birds are supposed to be off feeding. Binoculars reveal more irregularities. Some of the birds' proud long necks hang limp. A few loners straggle off by themselves – a bad sign.

A somber Mike Davison surveys the scene from the shore. The flock at this pit lake near the tiny town of Everson is in trouble. "Ninety percent of these birds are already dead," says Davison, the Washington Department of Fish and Wildlife biologist leading an investigation into the massive die-off of trumpeter swans in Whatcom County.



Last year, 229 of the 2,400 trumpeter swans that wintered in Whatcom County died of lead poisoning, the result of birds ingesting lead pellets from hunters' spent shotgun shells. This year's unseasonably warm, dry winter seems to have delayed migration – a midwinter count on Tuesday showed roughly 827 trumpeter swans in Whatcom. The odd weather may have also delayed mass deaths seen in years prior. As of Tuesday, the department had tagged 75 dead birds.

Davison and other wildlife professionals working on the project suspect the source of the problem may be a deadly "hot spot," a body of water or agricultural field in the county containing very high levels of lead left by bird hunters. "We are pretty well convinced that this site will have a 60-year history of hunting, and this lead will have accumulated year after year after year," says Davison. The lead is likely old shot.

Use of lead shot to hunt waterfowl was outlawed in Washington in 1986, although it still is legal for shooting other game birds. However, hundreds of tons of old lead pellets have settled into lakes, marshes, wetlands, fields and other hunter haunts over the decades. But the toxic lead could also be new shot -- from hunting **scofflaws**. "Just because there's a law, doesn't mean that people are complying with it," says Davison, who has studied swan mortality in the county for 15 years.

Scofflaw:
Someone who regularly breaks the law.

He suspects the lethal site is a field with "sheet water," water that spreads across agricultural lands in wet winters. And he has a hunch crops on the hot spot may have been rotated from swan-friendly food such as corn or potatoes to undesirable strawberries, raspberries or ornamental plants during a seven-year stretch in the '90s when no swan die-offs were recorded.

Like hard-boiled street detectives with a drawerful of clues, Davison is not ruling out any possibilities in the hunt for the Whatcom County's mystery site.

Radio Transmitter Collar:
A collar that scientists attach to an animal to track its movements by satellite.

Last winter, for the first time, the Department of Fish and Wildlife captured 18 trumpeter swans and fitted them with **radio transmitter collars**. This season, crews collared another 23 swans. This has allowed researchers to track flocks, pinpoint their locations and connect the dots on a map, narrowing their focus to a central chunk of the county.

Fortunately for the search, a number of the collared birds have died of lead poisoning. Davison notes the irony. "In our business, when you go to all the expense to capture animals and put radio collars on them, the normal scenario is you want them to live forever. That's how you get information. in this scenario, for us to be successful, these birds that we collar have to die.

The death of a collared bird allows researchers to track all the areas the animal visited. If five or six of them die, investigators can determine whether the birds use particular areas in common. Such clues could break this case.

It's a staggering investigation. The county spreads across 1,356,864 acres. The majestic birds, with 8-foot wingspans, range over a large part of it. "This is a virtual needle in the haystack situation," the biologist says.

Check Your Understanding

1. In 2002, 229 of the 2,400 trumpeter swans that wintered in Whatcom County died of lead poisoning. What percentage of the total population of trumpeter swans wintering in Whatcom County died from lead poisoning in 2002?

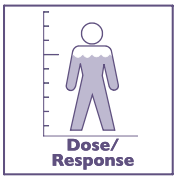
2. Hunters use ammunition called “shells” to hunt waterfowl. Each shell contains a large number of small pellets which, when shot, scatter in a wide pattern to increase the likelihood of hitting a bird. We can assume that one shell has an average of 250 pellets. On average, a hunter shoots 6 shells for each bird that is bagged. This means that up to 732 million pellets may be fired each year to harvest the average of 488,000 upland birds (pheasants, quail, doves, etc.) that are taken annually in Washington state.

   a. On average, how many pellets are shot for each bird that is actually harvested?

   b. How many shotgun shells are shot each year, on average?

Miles Davis:
One of the most famous jazz trumpet players of all time.

Estuary:
An ecosystem where a river meets an ocean so that there is a mix of fresh water and salt water.



Student Assessment:
Did students complete the reading and provide correct answers to the math problems?

Drawn by abundant food

In winter, the Pacific Northwest draws an estimated 80 percent of the country's trumpeter swans, known scientifically as *Cygnus buccinator.* The handsome white birds, which look like long white arrows in flight and bugle a mean **Miles Davis** chorus overhead, mate for life and tend to return to the same nest year after year.

They are drawn here by a mild climate, productive **estuaries** and rivers, and abundant agricultural lands with after-harvest pickings of corn, potatoes and grains. Flocks usually arrive in October and leave by March, heading back to Alaska and points north. The largest concentration is in the Skagit Valley, which last year had about 5,000 birds, and Snohomish County, which had close to 600.

In addition to the die-off in Whatcom County, lead deaths in Skagit and Snohomish are on the rise this year, according to Martha Jordan, a Northwest trumpeter swan expert.

Susan Murphy, with the Pilchuck Wildlife Rehabilitation Center, says some swans have been migrating from Whatcom County to Snohomish and Skagit counties to roost this year. Of the 20 dead birds picked up in Skagit County and the 26 picked up in Snohomish County so far this season, more than 50 percent apparently died of lead poisoning.

Trumpeter swan populations, which have rebounded since the species was hunted nearly to extinction for feathers and skin earlier in the century, are particularly susceptible to lead shot. With their long necks, the swans can easily reach deep into the mud, where they ingest pebbles and grit — and lethal shot pellets — to help them grind and digest their food.

Symptoms can develop as soon as 10 days after they ingest a pellet. One pellet can be a large enough dose to kill a bird. Many of the Whatcom County carcasses have contained hundreds.

Check Your Understanding

1. It is estimated that the total population of trumpeter swans in the U.S. is about 16,000 swans. If the Pacific Northwest draws an estimated 80% of the country's swans, how many swans can be found in this region?

Total number of swans = 16,000
Percentage of swans in Pacific Northwest = 80%
16,000 * .80 = 12,800
<u>Answer</u>: About 12,800 swans can be found in the Pacific Northwest.

Capturing sick swans

At the gravel pit lake, wildlife technician Erin Schneider, running a 14-foot Lund skiff, has already picked up one dead trumpeter by 10 a.m. She has also hauled in a sick juvenile, a listless lump of a bird whose gums have turned from healthy pink a telling ghostly white.

Volunteers at the site on private land -- ironically dubbed Wilder Ponds -- use a large fish net, bent from pulling dying birds from the water, to capture two more sick swans over the course of an hour. The gasping, 20-pound birds don't even struggle as Schneider and volunteer Sean Donalty put them in burlap bags, holding their heads and talking softly to them.

The birds are to be **euthanized**. No one can save them, says Davison. “There is no going back. When we get it, it’s a dead bird.” Taking sick and dying swans out of the environment quickly is critical. Eagles, coyotes and other predators could feast on the poisoned birds and themselves sicken and die.

Euthanized: When a hopelessly sick animal has been put to death in a relatively painless way as an act of mercy.

The euthanization is also an act of mercy. The lead shuts a bird’s system down, making them weak and reluctant to fly. As the poison progresses, the animals lose muscle control and coordination. Blocked organs can swell until the birds aren’t able to process food.

The swans usually die within 17 to 21 days after ingesting a pellet -- although Davison theorizes large quantities of pellets found inside Whatcom County’s swans may shorten that to as little as 10 days. “That’s a relatively short period,” he says, “unless you’re the one dying.”

‘Catastrophic die-off’

The 2002-2003 season marks the fourth consecutive year of swan mortality in Whatcom County. Davison calls the losses, the largest in North America, a “catastrophic die-off.” Last year’s midwinter death toll represented almost 10 percent of the population.

Any additional stress -- a bad hatch year or a year of reproductive failure -- could cause a serious crash in the population over time. “229 out of 2,400 -- that’s way too many birds. You can’t tolerate that level,” says Davison, known as “The Goose God.”

The statistics add urgency to the work at hand -- locating the mysterious hot spot with the toxic lead load. Davison describes the investigation as tangled, labor-intensive and costly. It relies on help from state, federal and Canadian wildlife biologists, members of the Trumpeter Swan Society and Whatcom County’s Audubon Society, the Pilchuck Valley Rehabilitation Clinic and volunteers, including waterfowl hunters.

The project’s $35,000 annual budget comes from state and federal funds. Davison says it’s already running at a slight deficit. And the work has just begun. Once wildlife investigators can narrow their search to four to six acres, intensive sampling will begin. Crews will use clam guns to pull plugs of soil from suspected sites and check these core samples for lead pellets. “One site could require thousands of core samples,” says Davison.

After the “hot spot” is located, costs could escalate dramatically. If the mystery site is a lake or slough, cleanup could involve dredging out the lead. If the site is an agricultural field, with a large amount of standing water, it could involve diking and draining the land, as well as chasing off birds with cannons and electrical alarms. That’s expensive. But so is the alternative. “If we don’t solve this soon, we’ll have to cycle through the money again next year,” says Davison as he checks other swan haunts.

He pulls up at a favorite roosting site, little Wiser Lake, southwest of Lynden. It’s a postcard-perfect suburban scene, with ducks cutting “V’s” on the lake’s silver surface in front of waterfront homes with manicured lawns.

The veteran wildlife biologist quickly spots the white hump hauled out in the lakeside brush. He gets out of the truck and moves in slowly. It raises its long neck in a tired question mark and waddles away. The sickness, says Davison, is just beginning. The bird will be dead by month’s end.

HOW TO HELP

If you find a trumpeter swan in distress in Whatcom County, call the Wildlife Rescue Network toll-free at 877-953-7377. Do not attempt to pick up or rescue the animal on your own.

The Pilchuck Wildlife Rehabilitation Center can be contacted at 360-387-8299.

P-I reporter M.L. Lyke can be reached at 425-252-2215 or m.l.lyke@seattlepi.com

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http://seattlepi.nwsource.com/local/105452_swans23.shtml

ARTICLE #2

Searching For Sources of Lead Poisoning in Swans

— by Doug Williams, from *Fish & Wildlife Magazine*

While it has been banned in the United States for more than a decade, the toxic legacy of lead birdshot continues to take a grim toll on visiting northern trumpeter and tundra swans in Skagit and Whatcom counties. “Research has shown that from the day a swan picks up lead shot, it will take about three weeks for that bird to die,” said Mike Davison, wildlife biologist for the Washington Department of Fish and Wildlife (WDFW), who is spearheading the Department’s efforts to end the poisoning of swans.

The winter of 2001-02 was the deadliest on record, with an estimated 247 swans — 95 percent of them trumpeters — dying from lead poisoning in the two counties and adjacent portions of British Columbia. About 4,000 swans over-winter in Skagit County, with another 1,000 or so in Whatcom County.

Gizzard:
Part of a bird’s digestive system which has strong muscles and a tough lining to grind down food.

The birds aren’t being shot. Instead, the long-necked swans are ingesting spent lead shot that has settled onto the bottom of shallow lakes and ponds where the birds feed. The lead shot ends up in the bird’s **gizzard** where the soft metal is ground up and slowly leaches into the swan’s bloodstream.

The Department has teamed with Canadian fish and wildlife biologists, the U.S. Fish and Wildlife Service, the Trumpeter Swan Society, the Bellingham Chapter of the Audubon Society, and the Pilchuck Valley Rehabilitation Clinic to identify the places where swans are ingesting spent lead shot, and finding ways of removing the poisonous material from the environment.

The main thrust of the work has been to collect more data on the birds’ movements. A total of 26 swans — 19 in Whatcom County, plus seven in British Columbia — have been fitted with radio-transmitting collars that allow biologists and volunteers to track the birds’ movements throughout the region, and possibly pinpoint the places where they’re picking up spent shot.

Core Sampling:
A cylindrical tube is inserted into the ground and the contents are examined to see what lies beneath the surface at various depths.

Davison said the 26 collared birds were tracked to 50 different sites. Two of the collared birds died from lead poisoning, and their deaths led the biologists and volunteers to focus in on about 12 specific locations. The team has done preliminary **core sampling** at some of the sites of interest, and early analysis is beginning to reveal lead shot sources, Davison said.

“Based on our early analysis, there appears to be a window of time when the birds are becoming exposed to the lead shot, so we’ll focus our future research on the locations that

the birds are visiting earlier during the time frame that they're in the area," he said. "Our goal for this coming winter is to try to get more collars on birds earlier in the season."

Davison said an intensive sampling effort of suspected lead-poisoning sites is outside WDFW's ability, given current budget and staffing levels. "We're looking to take the lead on all of the research work, while another agency or group could come in and facilitate the more-intensive core sampling effort," he said.

Non-toxic shot requirements were phased in over time, beginning in 1986, and ending in 1991 throughout the United States. Non-toxic shot has been required for all waterfowl hunting in Canada since 1999 but has been required in parts of British Columbia for almost 10 years. Non-toxic shot is also required for public hunting areas that are used for both pheasant and waterfowl hunting, and includes all of the pheasant release sites in northern Puget Sound. Hunters are encouraged to convert to non-toxic shot for all upland bird hunting.

Secondary Lead Poisoning: When a bird of prey or scavenger bird becomes lead poisoned by eating an animal or bird with lead shot embedded in its flesh.

Mortality: A measurement of the number of deaths in a particular time or at a particular place.

Lead-poisoned swans pose a health threat to other wildlife, including bald eagles, which feed on swan carcasses and can get **secondary lead poisoning**. Davison said two dead eagles found this year in the area are being tested for lead poisoning. "Potential secondary **mortalities** point out the importance of collecting sick or dead swans as soon as possible," Davison said. "The value of the rescue and recovery work that our partners do is immense."

Check Your Understanding

1. In 2001-2002, 247 swans died from lead poisoning in Skagit and Whatcom counties and adjacent portions of British Columbia. Ninety-five percent of these were trumpeter swans. About 4,000 swans over-wintered in Skagit county and another 1,000 over-wintered in Whatcom county and adjacent areas in B.C.

   a. What percentage of the total population of swans over-wintering in Skagit County, Whatcom County, and BC died from lead poisoning?

   b. How many trumpeter swans died from lead poisoning in in 2001-2002? Round your answer to a whole number.

2. A total of 26 swans--19 in Whatcom county plus 7 in British Columbia--have been fitted with radio-transmitting collars. The 26 birds were tracked to 50 different sites. Two of the collared birds died from lead poisoning.

   a. What percentage of collared birds survived during the survey?

3. Before lead shot was banned, biologists were able to estimate the amount of lead pellets entering the environment each year. They call this a "distribution rate." In order to come up with this figure, they had to assume that pellets are distributed evenly across all the huntable land in Washington State. This is not true, since some areas (like shooting ranges) have a higher concentration of hunting activity than other areas. However, if we assume that the distribution of pellets on huntable land in Washington is equal, then approximately 21 pellets are distributed per acre per year.

a. How many pellets would be deposited on one acre after 20 years?

b. Lead shot was banned in Washington State in 1986 for waterfowl hunting. Hunters are now required to use non-toxic ammunition instead of lead shot. Calculate how much lead shot would have been deposited on a typical acre of huntable land in Washington state between January 1986 and January 2003 if lead shot had NOT been banned.

ARTICLE #3

Swans Dying of Lead Poisoning in Washington State and British Columbia, Canada

— Washington Swan Working Group and The Trumpeter Swan Society

After six deadly winters, no one yet knows where the swans are getting the lead shot that is killing so many of them. The Trumpeter Swan Society has been working hard to assist Canadian and U.S. wildlife agencies with research to find the source of lead shot, so that it can be cleaned up.

As of late April 2005, the total count of swan deaths since 1999 is around 1,900 swans, with about 97% trumpeter swans and the remaining tundra swans. Most of the birds have been picked up dead or dying on the ponds they use for night roosts on the U.S. side and, to a lesser extent, in Canada. There is no way to estimate the number of additional dead birds that have escaped detection in the wintering grounds or that may have died as they tried to migrate north in the spring.

The die-off has now happened for six years in a row in the same geographical area. During the 2004-2005 winter about 400 dead trumpeter swans were picked up, similar to winter 2003-2004, and considerably more than in previous winters.

You can help! If you choose to hunt, please use non-toxic ammunition. Tell the store why you are buying non-toxic shot and urge them to promote its use. If you allow hunters to use your land, require them to use non-toxic shot only on your property. Voluntarily switching to non-toxic shot is something we all can do—without wasting one more day—to help reduce the needless deaths of swans and other wildlife.

Reprinted with permission from the Trumpeter Swan Society. Available at:
http://www.swansociety.org/washington/lead.htm.

Check Your Understanding

1. Between 1999 and April 2005, around 1,9000 swans have died of lead poisoning. Ninety-seven percent of those were trumpeter swans and the rest were tundra swans. How many of the dead swans were trumpeter swans and how many were tundra swans?

   Solution #1
   Number of swans that died = 1,900
   Percentage that were trumpeter swans = 97%
   1,900 * .97 = 1,843 trumpeter swans
   1,900 – 1,843 = 57 tundra swans
   Answer: 1,843 trumpeter swans and 57 tundra swans

   Solution #2
   Number of swans that died = 1,900
   Percentage that were trumpeter swans = 97%
   1,900 * .97 = 1,843 trumpeter swans
   Percentage that were tundra swans = 3%
   1,900 * .03 = 57
   Answer: 1,843 trumpeter swans and 57 tundra swans

Lead Poisoning in Waterfowl, 1973-1984

Swans are not the only birds being hurt by lead shot. Many different species of **waterfowl** are susceptible to lead poisoning, including trumpeter swans, snow geese, and many species of ducks. The birds accidentally ingest lead shot that is embedded in mud at the bottoms of lakes or ponds. The use of lead shot in hunting waterfowl was banned in the U.S. in 1991. Before the ban, biologists completed an eleven year study of ducks' susceptibility to ingesting lead shot.*

The biologists looked at the four migratory bird **flyways**, existing flight paths used by birds during their migration. During the study, the scientists examined over 95,000 ducks that had been shot by hunters. The scientists dissected the ducks' gizzards to see if they had ingested any lead shot prior to being shot. The data table below shows the results of four species of ducks that were found to have ingested one or more lead pellets.

Directions: Fill in the missing information on the four data tables. The tables have information about the total number of ducks caught in each flyway, and the number of those caught that had ingested lead shot. Use those two numbers to calculate percentages to complete the final column. Round your answers to one decimal place.

Next, use the completed data tables to create a bar graph. Your graph should group information by the four flyways. Place information for the four flyways on the x-axis. Place information on the percentage of ducks with lead shot on the y-axis. Use a different color to represent each species of duck and include a key to the colors that you used. Make sure to label the axes and to title your graph. Once you have completed your graph, answer the **Check Your Understanding** questions.

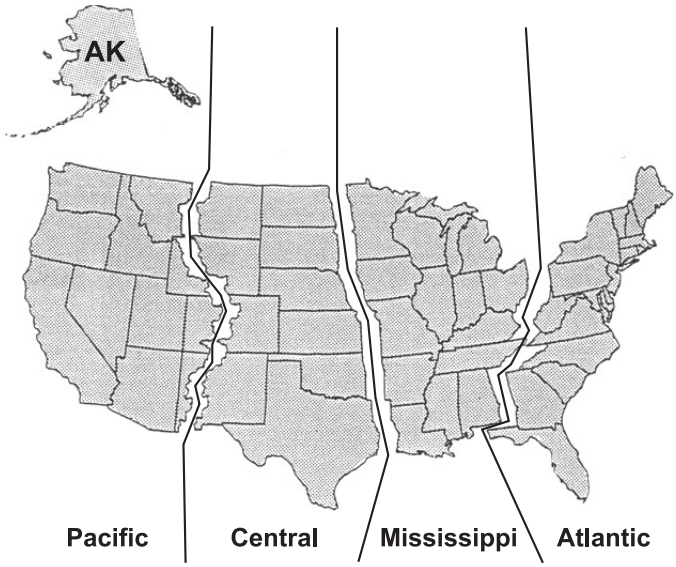
*From "A Review of the Problem of Lead Poisoning in Waterfowl." Northern Prairie Wildlife Research Center.
http://www.npwrc.usgs.gov/resource/othrdata/pbpoison/abstract.htm

Graphing Activity

Waterfowl:
A water bird, especially a swiimming bird.

Flyway:
An established air route that migratory birds follow during their migration.

North American Migratory Bird Flyways



MALLARD	Flyway	Total	# w/shot	% w/shot
	Atlantic	8,602	1,058	12.3%
	Mississippi	45,448	3,681	
	Central	11,092	288	2.6%
	Pacific	16,338	1,585	
	TOTAL	**81,480**	**6,613**	

GADWELL	Flyway	Total	# w/shot	% w/shot
	Atlantic	469	5	
	Mississippi	949	17	1.8%
	Central	998	5	0.5%
	Pacific	1,223	9	
	TOTAL	**3,639**	**36**	

Blue-Winged TEAL	Flyway	Total	# w/shot	% w/shot
	Atlantic	3,084	71	
	Mississippi	3,428	151	4.4%
	Central	528	10	
	Pacific	592	14	2.4%
	TOTAL	**7,632**	**246**	

SHOVELER	Flyway	Total	# w/shot	% w/shot
	Atlantic	831	8	1.0%
	Mississippi	295	5	1.6%
	Central	231	10	
	Pacific	1,302	104	
	TOTAL	**2,659**	**127**	

Draw or attach your bar graph here:

Check Your Understanding

1. Which species of duck seems to be the most susceptible to ingesting lead shot overall?

2. Which species seems to be the least susceptible to ingesting lead shot overall?

3. For each of the four species of ducks, in which flyway are they most likely to ingest shot?

a. Mallard:

b. Gadwall:

c. Blue-winged Teal:

d. Shoveler:

Math

CHILDHOOD BLOOD LEAD LEVELS
Student Handout #1

Student Handout

Name _____

Date _____

Email Sent on: Today, 9:00 AM
From: Celia Summers
Subject: Lead Poisoning Project – URGENT!

Hi. I hope you had a good weekend. I have a new project for you to begin working on right away. I just received a report from our researchers entitled "America's Children and the Environment." One section of the report focuses on childhood lead poisoning. Since I remember you saying that you studied lead poisoning in school, I could really use your help.

I have a big press conference in two days. I will be sharing the information in the report with a group of reporters from across the country. I need to be able to clearly explain to them the relationship between childhood lead poisoning, race and income.

I need you to develop three graphs for me to use during my presentation at the press conference. The graphs should demonstrate:

1. Blood lead levels by income
2. Blood lead levels by race
3. Changes in blood lead levels over time

Make sure that the graphs are clear and easy to read. Please use colors and make sure to put a title on each graph. Also, place "Blood Lead Levels" along the y-axis for each graph.

I left a research file on your desk. You should find all the information that you need for this project in the file.

Thanks!

Celia Summers
U.S. Environmental Protection Agency (EPA)

Blood Lead Level (BLL): A measurement of the amount of lead in a person's blood. A BLL of over 10 µg/dL is considered dangerous.

U.S. Environmental Protection Agency: Established in 1970, this government agency protects human health by safeguarding the air, water and land upon which life depends.

Math

CHILDHOOD BLOOD LEAD LEVELS Student Handout #2

Name _____

Date _____

Student Handout

Background Reading

Research Notes from "America's Children and the Environment"

The United States Environmental Protection Agency (EPA) released a report in 2003 about the health of America's children. The report focused on environmental health issues affecting children, such as asthma, lead poisoning, and childhood cancer.

One important finding in the report is that childhood lead poisoning is on the decline across the country. Scientists believe that the decline can be traced to the banning of lead-based paint in the late 1970s and the banning of leaded gasoline in the early 1980s. For example, the number of U.S. homes with lead-based paint dropped from 64 million in 1990 to 38 million in 2000. Less lead in the environment means fewer instances of childhood lead poisoning.

Hi. Here is some background information for you about lead poisoning and its connections to race and income. These are some research notes that I took while reading through the full report. I plan on using these notes when I write my speech for the press conference.

- Celia

The report attempts to address this question: What are the connections between childhood lead poisoning, poverty and race?

Environmental Justice

First of all, how is poverty measured? Each year, the U.S. Census Bureau 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 level (or low-income). If the family's income is right around the poverty threshold, then they are middle-income. If the family's income is much more than the threshold, then they are high-income.

For example, the poverty threshold for the year 2000 was $17,463 for a family of four (including two adults and two children). So across the country, if a family's income was below $17,463, they were considered to be living below the poverty level. The poverty threshold changes each year to account for inflation. For example, the poverty threshold increased from $17,463 in the year 2000 to $19,157 for 2004.

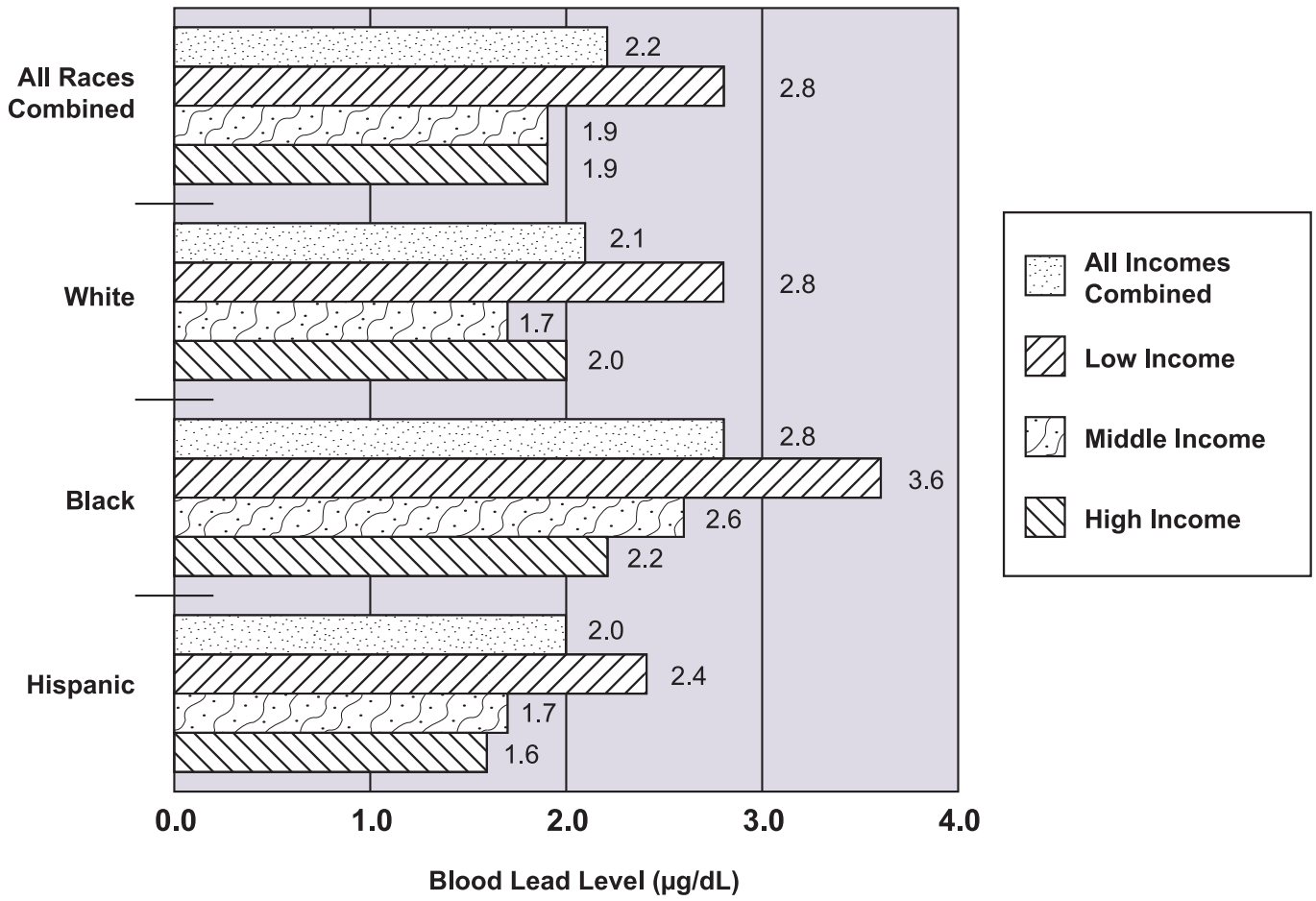
Risks & Benefits

Researchers have discovered that a child's risk for lead poisoning depends on his or her race and family's income level. For instance, a black child living below the poverty level is at a higher risk for lead poisoning than a black child living well above the poverty level. One assumption is that low-income children and children of color more often live in older housing, therefore putting them at higher risk of coming in contact with lead paint or lead in drinking water.

Blood Lead Level (BLL): A measurement of the amount of lead in a person's blood. A BLL of over 10 µg/dL is considered dangerous.

Measuring **blood lead level** by race and family income can help researchers identify populations that might be at greater risk for lead poisoning. This can help focus education, screening and clean-up efforts.

Median Concentrations of Lead in Blood of Children, Ages 1-5, 1999-2000*



*From: "America's Children and the Environment." Environmental Protection Agency, 2003.
http://www.epa.gov/envirohealth/children/ace_2003.pdf

Median:
The middle value in a distribution of numbers.

Here's the bar graph with all the information on it. This comes from the report that I mentioned in the email. You can use this data to create the three graphs that I need for my presentation. This graph is packed with information, but it is too complicated for me to be able to use with the reporters. Your graphs need to present the data in a clearer and simpler format.

– Celia

I took this table directly from the report. This is the data that was used to make the big bar graph with all the information on it. It will help you create the three graphs I need.

- Celia

Median Concentrations of Lead in Blood of Children, Ages 1-5, 1999-2000*

Ethnicity	All Incomes	Low Income	Middle Income	High Income
All Races	2.2	2.8	1.9	1.9
White	2.1	2.8	1.7	2.0
Black	2.8	3.6	2.6	2.2
Hispanic	2.0	2.4	1.7	1.6

Numbers represent blood lead levels measured in µg/dL.

*From: "America's Children and the Environment." Environmental Protection Agency, 2003. http://www.epa.gov/envirohealth/children/ace_2003.pdf

I found these statistics in the report. They provide information on blood lead levels during two different time periods. You will need these statistics to create one of the graphs for my presentation.

- Celia

Statistics from "America's Children and the Environment."

- In 1992-1994, Black children ages 1-5 had a median blood lead level of 3.9 µg/dL and in 1999-2000 they had a median blood lead level of 2.8 µg/dL.
- In 1992-1994, Hispanic children ages 1-5 had a median blood lead level of 2.6 µg/dL and in 1999-2000 they had a median blood lead level of 2.0 µg/dL.
- In 1999-2000, White children ages 1-5 had a median blood lead level of 2.1 µg/dL, unchanged from the level in 1992-1994.

Email Sent on: Today, 12:30 PM
From: Celia Summers
Subject: Lead Poisoning Project - Additional Questions

Hi. I know that you have been working on the lead poisoning presentation all morning. I've been writing my speech for the press conference and I thought of a few questions that I need answered. I'll use your answers as part of my presentation.

Thanks so much for all your help and hard work on this!

Celia Summers
U.S. Environmental Protection Agency (EPA)

Check Your Understanding

1. What three income levels are represented in the graphs?

2. What three races are represented in the graphs?

3. What race is at the highest risk for lead poisoning?

4. What income level is at the highest risk for lead poisoning?

5. Between 1992-1994 and 1999-2000, which race group saw the largest decrease in blood lead levels?

6. What are two possible reasons for this decrease?

Graphing Activity

Now that you have read the background reading and answered some questions, you are ready to create the graphs that Celia needs for her presentation. You can draw the graphs below or attach them as separate pages.

GRAPH #1: Create a bar graph that shows **blood lead levels** by **income level**. Use only the information for "All Races Combined" from the data table. The x-axis should show income levels. The y-axis should show median blood lead levels. Make sure to title your graph, label the axes, and use color.

GRAPH #2: Create a bar graph that shows **blood lead levels** by **race**. Use only the information for "All Incomes Combined" from the data table. The x-axis should show race. The y-axis should show median blood lead levels. Make sure to title your graph, label the axes, and use color.

GRAPH #3: Create a bar graph that shows **how median blood lead levels have changed over time for different racial groups**. To do this, first complete the data table below based on the statistics from "America's Children and the Environment" that Celia included in her report. This table will make it easier for you to create the final graph that Celia needs.

RACE	1992-1994 Median BLLs	1999-2000 Median BLLs
Black		
Hispanic		
White		

Now, create a bar graph with median blood lead levels on the y-axis and race on the x-axis. For each of the three races you should have two bars, one for each period of time. Make sure to title your graph, label the axes, use color and include a key.