Take the Lead — Get the Lead Out

by
Terrill L. Nickerson
Dolores Huertes Preparatory School
Pueblo, Colorado

Bob Roddie
Peterborough Collegiate and Vocational School
Peterborough, Ontario, Canada

CDC's 2007 Science Ambassador Program

This lesson is for a high school environmental science or introductory chemistry class and emphasizes the leaching of inorganic lead [Pb+2] compounds as found in association with historic building sites. Students will collect soil, water, and paint chip samples from their homes and use a qualitative precipitate laboratory to locate geographic lead hot spots, correlated with the historic construction of building episodes in their community. Associated with this lesson will be the construction of a word wall detailing the physiological effects of prolonged exposure to inorganic lead, culminating in a writing assignment outlining a fictional case study of a child afflicted with lead poisoning.

Take the Lead — Get the Lead Out

by
Terrill L. Nickerson
Dolores Huertes Preparatory School
Pueblo, Colorado

Bob Roddie
Peterborough Collegiate and Vocational School
Peterborough, Ontario, Canada

Summary

This lesson is for a high school environmental science class or an introductory chemistry class and emphasizes the leaching of inorganic lead [Pb+2] compounds, as found in association with historic building sites. Students will collect soil, water, and paint chip samples frm their homes and use a qualitative precipitate laboratory to locate geographic lead hot spots,correlated with the historic construction of building episodes in their community. Associated with this lesson will be the construction of a word wall detailing the physiological effects of prolonged exposure to inorganic lead, culminating in a writing assignment outlining a fictional case study of a child afflicted with lead poisoning.

Learning Outcomes

- Students will use lab skills, mapping skills, and research skills to learn about lead in their environments and how exposure affects people.
- Students will collect samples (soil, water, wood) from the field, and complete a qualitative analysis testing for the presence of lead from the areas of collection.
- Students will research and present various physiological effects of prolonged exposure to organic lead.
- Students will analyze presence or absence of lead and their location of collection, then attempt to link demographics and lead exposure (such as age of neighborhood or location near a major roadway).

Materials

1. Photocopies of the Lead Pretest — one per student
2. A large wall map of the community — one per class
3. Map pins — one per student
4. A small piece of masking tape — one per student
5. A fine point permanent marker
6. Plastic, sealable sampling bottles capable of holding at least 10mL for individual water samples — one per student
7. Plastic Ziploc®-style sandwich bags for soil and wood chip samples — two per student
8. Plastic sealable container — one per student (BD Falcon® screw-cap 10mL containers are recommended, but any small plastic sealable container will do)
9. Plastic spoon — one per student
10. Masking tape for labeling samples
11. 12-well microscale reaction plate (a general, all-purpose spot plate for micro-size labs will work)
12. Micropipettes at least 5mL — one per student
13. Acetic acid — 3 drops
14. Nitric acid — 3 drops
15. Sulfuric acid — 5 drops
16. Three pipettes for chemicals
17. Beakers — one per lab table
18. Soil sample — 1 teaspoon
19. Water sample from bathroom tap — 10mL

20. Paint chips from outside window sill — 3 to 5 chips
21. Mortar and pestle
22. Plastic tweezers — one per student
23. Distilled water
24. Goggles — one pair per student
25. Protective lab apron — one per student
26. Disposable gloves — one pair per student
27. Computer with Internet capability — one per three students
28. Computer printer
29. 8 1/2” x 11” printer paper

Total Duration

5 hours

Procedures

Teacher Preparation

The teacher should prepare photocopies of Supplemental Document 1: Lead Pretest; one per student. The teacher should also have a copy of Supplemental Document 2: Lead Pretest Answer Key. Acquire a map of your community and a box of map pins and have masking tape and fine tip marker available.

The teacher should preread the two websites on lead chemistry and become familiar with the chemistry for the laboratory experiment in Step 3. The teacher should also purchase and have ready enough plastic Zip-lock-style sandwich bags so that students can collect home soil and paint chip samples (two sandwich bags per student). The teacher will also need one sealable container that can hold at least 10mL for the home water sample; one per student (BDFalcon® screw cap containers are recommended). Plastic spoons are also needed; one per student.

Teachers should make copies for each student of

- Supplemental Document 3 (Lead Chemistry)
- Supplemental Document 4 (Proper Methods for Taking Water, Soil, and Paint Chips from the Field)
- Supplemental Document 5 (Lead Precipitate Instructions)
- Supplemental Document 6 (Precipitate Lab Data Table)
- Supplemental Document 7 (Precipitate Lab Evaluation
- Supplemental Document 8 (Word Wall Rubrics)
- Supplemental Document 9 (Word Wall Examples)
- Supplemental Document 9 (Word Wall Examples and Worksheet)
- Supplemental Document 10 (Word Wall Answer Key)
- Supplemental Document 11 (Lead Poisoning Case Study)
- Supplemental Document 12 (Case Study Answer Sheet)

Introduction

Step 1 (Duration: 35 minutes)

Before beginning the lesson, the pretest can be used to assess each student's prior knowledge. The Pretest Answer Key contains the answers to the pretest for the teacher's reference.
The teacher should hand out the pretest at the beginning of class. After 15 minutes, the teacher should stop testing and collect the pretests. The teacher then should go over the correct answers using the key. Grade the pretest on the same day that it is given to ascertain the range of knowledge of the subject by the students.

Supplemental Document
Title: Supplemental Document 1 – Lead Pretest
Description: A quick pre-assessment tool for determining students' existing knowledge of lead.

Step 2 (Duration: 45 minutes)

The purpose of this segment is for students to locate their homes on a map so that a geographic data base can be created. This will allow the class to define potential trends in the presence or absence of lead, based upon the results from their precipitate lab. Students will individually take a map pin and tear off a small piece of masking tape (large enough to write a number, yet not too large as to prevent the pin from sticking in the bulletin board). The students will be given a number that they will write on their maps' pin tape with the fine point pen. Students will proceed to the map and place their pins on the map that corresponds to the location of their personal residence.

Once this portion is completed, students will be given their homework assignment for the evening. The homework assignment involves an instruction sheet describing how to properly collect soil, water, and

paint chip samples in the field. The students will be provided with two Zip-lock style plastic bags, a plastic spoon, a sealable 10mL container for sampling water, and a piece of masking tape for labeling their sampling containers. The teacher will go over the sampling instructions, and each student will attach the label on their plastic bags and 10mL container before leaving class for the day.

Web Resource
Title: Google Earth
URL: http://earth.google.com
Description: This popular website has aerial photographs for most regions on the earth. It may require a download to acquire the free version. The free version has limitations regarding the addition of data to the map and printing resolution.

Step 3 (Duration: 2 hours)

The teacher should begin the day by handing out a worksheet that discusses the chemistry of lead. The class and the teachers should go over the worksheet to prepare for the upcoming laboratory experiment. It is advisable not to spend more than 15 minutes on this step to allow enough time for the actual lab.

Once the introduction is completed, the teacher should hand out the Lead Precipitate Lab Instructions handout, the Precipitate Lab Data Sheet handout, and the Precipitate Lab Evaluation sheet. Have students work in pairs to begin preparing and testing their samples according to the instruction sheet and recording their data on the accompanying data sheet. Note: Because students are using dilute acids, they all need to wear safety goggles and be aware of proper acid handling procedures.

The data collection portion of the lab should be completed in one class period (approximately 50 minutes). All materials and surfaces must be properly cleaned and equipment should be properly stored. The second day is reserved for tabulation of the class data into one data set, the identification of any trends in lead occurrences, and conclusions.

Web Resources
Title: Lenntech – Lead PB
URL: http://www.lenntech.com/Periodic-chart-elements/Pb-en.htm
Description: Website includes a short description of the properties of the element lead with common uses, environmental occurrences, health hazards, and basic chemistry

Title: Oxidation State Trends in Group 4
URL: http://www.chemguide.co.uk/inorganic/group4/oxstates.html
Description: Website provides a short overview of the typical reactions of period four elements, including lead

Supplemental Documents
Title: Supplemental Document 3: Lead Chemistry
Description: A summary of the properties of lead and a brief description of its reactive properties

Title: Supplemental Document 5: Lead Precipitate Instructions
Description: A laboratory format outlining instructions for forming the hypothesis and performing the actual precipitate experiment

Title: Supplemental Document 6: Precipitate Lab Data Table
Description: Two data tables, one for individual data results and a second for tabulation of the class results

Title: Supplemental Document 7: Precipitate Lab Evaluation
Description: A set of questions addressing the hypothesis, data, and conclusions regarding visible trends in the geographic occurrences of lead

Step 4 (Duration: 50 minutes)

Divide the class into 8 groups (made of 3–4 students, depending on size of class). Prepare one copy of each of the word wall blocks (Supplemental Document 9) for each group. Every group should receive a different word wall block. Prepare one copy of the marking rubric for each group for assessment purposes. Please note that computer access is necessary for completion of this activity; a minimum of one computer with Internet access for each group to complete the research aspect of the task. Tape, tacks and staples, or other means to put blocks up on existing wall of classroom is required. Crayons, pencils, and pens are necessary to complete the word wall for students. Students can use creativity in constructing the work wall blocks.

A word wall is a series of blocks generated by students placed together on a wall to create a large quilt of information — the word wall. The information contained in the word wall are used by students to complete other tasks in the course. By asking groups of students to complete different parts of the whole wall, each student does not have to do extensive research, but in the end, can obtain necessary diverse research to complete more complicated tasks without using excess class time.

Web Resources

Title: Demonstration of the Physiological Effects on the Body
URL: http://www.atsdr.cdc.gov/HEC/CSEM/lead/physiologic_effects.html
Description: This site outlines the specifics of what happens to the body when it is exposed to lead. It explains in very clear terms what happens and how the body is affected by the lead.

Title: ToxGuide for Lead
URL: http://www.atsdr.cdc.gov/toxguides/toxguide-13.pdf
Description: This document explains the methods of exposure for lead contamination, the effects on the body, and environmental levels and how to test for lead.

Title: Lead Intake
URL: http://www.atsdr.cdc.gov/cabs/lead/#route
Description: This website explains how lead enters the body and where in the environment contamination occurs.

Title: Lead Exposure
URL: http://www.atsdr.cdc.gov/cabs/lead/#effect
Description: This website provides precise lead toxic levels for various physiological effects.

Title: What does lead do to your health?
URL: http://www.environment.nsw.gov.au/leadsafe/leadinf2.htm
Description: This is an Australian publication that looks at the effects of lead physiology.

Title: How Does Lead Effect the Nervous System?
URL: http://serendip.brynmawr.edu/bb/neuro/neuro00/web2/Patel.html
Description: This site looks at the specific effects that lead has on the human nervous system.

Title: Lead Toxicity: Its Effects on Fetal and Infant Development
URL: http://www.indstate.edu/thcme/anderson/MJS.html
Description: As the name implies, this website is useful for research when looking at the effects lead has on small children and during human development.

Supplemental Documents

Title: Supplemental Document 8: Word Wall Rubrics
Description: This outlines the rubric to assess the students' work on the word wall and how effective each student's content is.

Title: Supplemental Document 9: Word Wall Examples and Student Worksheet

Description: These are templates for use when constructing word wall blocks. Students can choose to use the template, or design their own, ensuring proper content is contained within the block.

Title: Supplemental Document 10: Word Wall Answer Sheet
Description: This document provides sample answers with references for teachers to check for completion and correctness when assessing the student word walls.

Conclusion (Duration: 50 minutes)

In this task, students will be presented with a case study, and imagine themselves as doctors. They are to answer the questions on the second page of the case study. Prepare copies of case study for each student (Supplemental Document 11: Lead Poisoning Case Study). Ensure the word wall is complete and posted for students to use for this task. Students should complete the task in class and can continue at home if necessary. Students will read the case study and answer the accompanying case study questions.

Assessment

At the end of Step 1, the students will have completed a pretest, helping the teacher gauge the students' understanding of lead chemistry and physiology. The teacher will have a basic understanding of what the students already know about lead chemistry and physiology.

At the end of Step 2, every student should have located their homes on the base map. Thus, if any presence and absence trends occur as a result of the data collected from the precipitate lab, they can be identified and discussed.

At the end of Step 3, each student will have participated in a chemistry lab, collected data on their samples, analyzed their data, and written a formal lab write-up (including a hypothesis, individual and class data sets, evaluations, and conclusions). When students have completed the tests on their individual soil, water, and paint chip samples — and recorded their results —they will be asked collectively to share their data with the class.

At the end of the Step 4, each student will research and illustrate their knowledge of some aspects of the physiological affects of prolonged lead exposure on the human body. The class will construct a wall from the individual student pieces to form a thematic wall outlining the physiology of lead exposure. The word wall blocks will be marked according to the attached rubric. Content, as well as written assignments, will be assessed on a 5-point scale. See attached rubric for details. Students will be assessed by the thoroughness and accuracy by which they answer the questions that go along with the case study.

At the end of the conclusion, students will demonstrate their knowledge of lead chemistry and physiology by acting as a physician and diagnosing a case study about an example of lead poisoning.

Modifications

Extension

Students may choose to map their data on an aerial photograph of their community using Google Earth, and shade the areas of concentrations using various colors, patterns, or symbols.

Web Resource
Title: Google Earth
URL: http://earth.google.com
Description: This popular website has aerial photographs for most regions on the earth. It may require a download to acquire the free version. The free version has limitations regarding the addition of data onto the map, and resolution in printing maps can vary.

Other Modifications
Students could create their own template for the actual blocks and create collages to illustrate their key points and information.

Education Standards

National Science Education Standards

PHYSICAL SCIENCE, CONTENT STANDARD B
As a result of activities in grades 9–12, all students should develop an understanding of
Structure of atoms
Structure and properties of matter
Chemical reactions

SCIENCE IN PERSONAL AND SOCIAL PERSPECTIVES, CONTENT STANDARD F
As a result of activities in grades 9–12, all students should develop understanding of
Personal and community health
Environmental Quality
Natural and human induced hazards
Science and technology in local, national, and global challenges

Supplemental Document 1: Lead Pretest

Take the Lead — Get the Lead Out
Terrill L. Nickerson and Bob Roddie, CDC's 2007 Science Ambassador Program

1. Which answer below is the correct chemical symbol for lead?

   a) Ag b) Au c) Pb d) Sn

2. The atomic number for lead is 82, this number refers to

   a) The number of protons in the nucleus
   b) The number of neutrons in the nucleus
   c) The number of protons and neutrons in the nucleus
   d) The number of electrons in the nucleus

3. Lead, when found in nature is shiny, conducts heat and electricity, is highly reactive, and easily shaped. Given these physical properties, what class of element is lead considered?

   a) Alkaline earth metal
   b) Metal
   c) Metalloid
   d) Non-metal

4. Inorganic lead has a valence of +2. This means

   a) The atom of lead has gained two extra electrons
   b) The atom of lead has lost two electrons
   c) The atom of lead has lost two neutrons
   d) The atom of lead has gained two protons

5. Inorganic lead is easily dissociated in acid. This means

   a) It tends to form colloidal forms when exposed to acids
   b) It tends to evaporate when exposed to acid
   c) It tends to aggregate when exposed to acid
   d) It tends to detach itself from its original compound and dissolve when exposed to acid

6. A precipitate happens when

   a) A compound detaches itself from one compound in solution and forms a solid by attaching itself to another compound or element
   b) A compound reacts quickly when exposed to a solution
   c) A compound dissolves when exposed to a solution
   d) A compound does not react when exposed to a solution

7. Where is one source of lead contamination in humans?

   a) New water pipes in homes
   b) New latex paint
   c) Older buildings, soil, and yards
   d) Fiberglass insulation

Supplemental Document 2: Lead Pretest Answer Key

Take the Lead – Get the Lead Out
Terrill L. Nickerson and Bob Roddie, CDC's 2007 Science Ambassador Program

1. Which answer below is the correct chemical symbol for lead?

   ANSWER:
   c) Pb. The chemical symbol for lead is an abbreviation of the name used by the ancient Greeks, Plumbum, due to its soft, gray properties (2).

2. The atomic number for Lead is 82, this number refers to

   ANSWER:
   a) The number of protons in the nucleus. The atomic number is the number of protons found in the nucleus in electrically neutral atom and is designated by the capital letter, Z (3).

3. Lead, when found in nature is shiny, conducts heat and electricity, is highly reactive, and easily shaped. Given these physical properties, what class of element is lead considered?

   ANSWER:
   b) Metal. Lead is part of a large group of elements found in the center of the periodic table called metals. Lead is a bluish-white lustrous metal. It is very soft, highly malleable, ductile, and a relatively poor conductor of electricity. It is very resistant to corrosion but tarnishes upon exposure to air.

4. Inorganic lead has a valence of +2. This means

   ANSWER:
   b) The atom of lead has lost two electrons. Lead atoms tend to lose electrons to form positive ions (1).

5. Inorganic lead is easily dissociated in acid. This means

   ANSWER:
   d) It tends to detach itself from its original compound and dissolves when exposed to acid. Lead often occurs in a +4 valence state, but easily oxidizes, releasing a gas (often O2 or Cl2), reducing to a +2 valence state (1).

6. A precipitate happens when

   ANSWER:
   a) Precipitation occurs when a solid is formed in a solution as a result of a chemical reaction (5).

7. Where is one source of lead contamination in humans?

   ANSWER:
   c) Older buildings, soil, and yards (6).

References

1. Webelements [online]. [2007]. [cited 2007 December 5]. Available from URL: http://webelements.com/webelements/elements/text/Pb/vrad.html

2. Los Alamos National Laboratories Chemistry Division [online]. [2003] [cited 2007 December 5]. Available from URL: http://periodic.lanl.gov/elements/82.html

3. University of Illinois Urbana Champaign, Inorganic Chemistry Lectures [online]. [2007]. [cited 2007 December5]. Available at URL: http://butane.chem.uiuc.edu/pshapley/312/Lectures/L1/index.html

4. Webelements [online]. [2007]. [cited 2007 December 5]. Available from URL: http://www.webelements.com/webelements/elements/text/Pb/key.html

5. Lawrence Berkeley National Laboratory [online]. [March 2000]. [cited 2007 December 5]. Available from URL: http://www.lbl.gov/NABIRarchive/fieldresearch/frc/ea/ea_12_0.html

6. Massachusetts Department of Environmental Protection [online]. [cited 2007 December 5]. Available from URL: http://www.mass.gov/dep/toxics/leadcon1.htm

Supplemental Document 3: Lead Chemistry

Take the Lead — Get the Lead Out
Terrill L. Nickerson and Bob Roddie, CDC's 2007 Science Ambassador Program

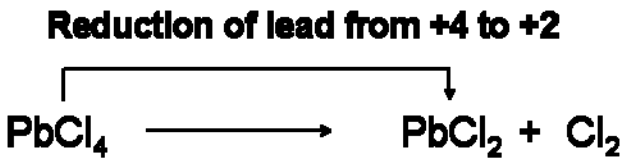
Lead occurs naturally in the environment. However, most lead concentrations found in the environment are a result of human activities. Due to the application of lead in gasoline, an unnatural lead cycle exists (1).

Lead is a soft metal that has known many applications over the years. It has been used widely since 5000 BC for application in metal products, cables and pipelines, but also in paints and pesticides. Lead is one out of four metals that have the most damaging effects on human health. It can enter the human body through uptake of food, water, and air (1).

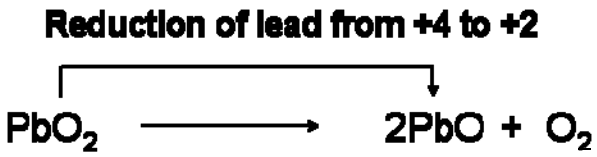
Lead can enter drinking water through corrosion of pipes. This is more likely to happen when the water is slightly acidic (1). That is why public water treatment systems are required to carry out pH-adjustments in water that will serve drinking purposes (1).

Examples from Lead Chemistry

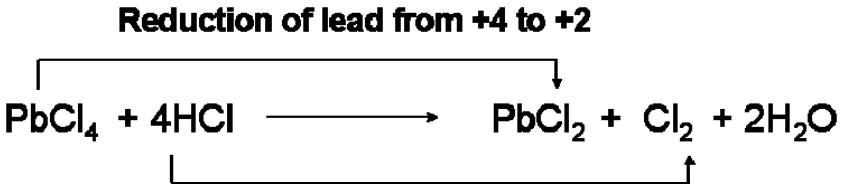
Lead (II) oxidation state is the more stable, and there is a strong tendency for lead (IV) compounds to react to give lead (II) compounds. Lead (IV) chloride, for example, decomposes at room temperature to give lead (II) chloride and chlorine gas (2)



Lead (IV) oxide decomposes on heating to give lead (II) oxide and oxygen (2).



Lead (IV) oxide also reacts with concentrated hydrochloric acid, oxidizing some of the chloride ions in the acid to chlorine gas. Once again, the lead is reduced from the +4 to the more stable +2 state (2).



For images of stepwise reactions of lead and lead precipitates, visit http://www.public.asu.edu/~jpbirk/qual/qualanal/lead.html (3).

References

1. Lenntech, Periodic Table: Lead. [online]. [cited 2007 September 28]. Available from URL: http://www.lenntech.com/Periodic-chart-elements/pb-en.htm

2. Chemistry Guide [online]. [2004]. [cited 2007 September 28]. Available from URL: http://www.chemguide.co.uk/inorganic/group4/oxstates.html

3. Arizona State University, General Chemistry Course Materials. [online] [cited 2007 December 5]. Available from URL: http://www.public.asu.edu/~jpbirk/qual/qualanal/lead.html

Supplemental Document 4: Proper Methods for Taking Soil, Water, and Paint Chip Samples from the Field

Take the Lead — Get the Lead Out
Terrill L. Nickerson and Bob Roddie, CDC's 2007 Science Ambassador Program

Introduction

For this experiment, you will be expected to collect three types of samples from areas around your home. In each instance, you will be expected to use good scientific field sampling techniques. Sample collection methods are explained below.

Materials

2 plastic Zip-lock-type sandwich bags per student
1 plastic spoon per student
1 sealable container (BD Falcon screw-cap 10mL containers recommended) per student
3 pieces of masking tape per student

Procedures

Step 1: Water sampling

- Have the student place a small piece of masking tape on the outside of the 10mL container to use as a label for recording necessary information (on that piece of tape, the student will write his/her name, the date, the number on the map pin, and the water source used for the sample)
- Once home, select a water source (outside water taps are recommended, as in older dwellings they are least likely to have been replaced and therefore, the most likely source where lead plumbing or lead solder might still exist)
- Turn on the tap so that a small trickle is flowing. Do not place the container on the ground, as lead in the soil may contaminate the sampling container
- Carefully unscrew the sealed cap of the 10mL container
- Slide the open container under the running stream of water and fill the container
- Pull the container out of the water stream and carefully screw the cap on tightly
- Wipe the excess water off the outside of the container

Step 2: Soil Sample

- Have the student place a small piece of masking tape on the outside of one Zip-lock type sandwich bag to use as a label for recording necessary information (on that piece of tape the student will write his/her name, the date, the number on the map pin, and the soil source used for the sample)
- Find a place on the ground next to the foundation of the student's home (below a window). Record the room where the window is located on the piece of masking tape
- Unzip the plastic bag and open it (as wide as possible)
- Collect three teaspoons of soil from the location chosen (using the plastic spoon)
- Re-zip the sandwich bag and carefully set it aside. Caution: do not set the bag or the plastic spoon on the bare ground at any time in order to avoid contamination.

Step 3: Paint Chip Sample

- Have the student place a small piece of masking tape on the outside of one Zip-lock type bag to use as a label for recording necessary information (on that piece of tape, write the student will write his/her name, the date, the number on the map pin, and the window sill source where the sample came from)

- Find the oldest window at the house (if all the windows are the same age, select the window receiving the greatest amount of sun) and record the room where the window sill is located on the piece of masking tape
- Unzip the plastic bag and open it as wide as possible
- Using the butt of the plastic spoon (or another sharp object), carefully pry up 3 to 5 pieces of paint from the selected window trough and without using your hands, nudge the paint chips into the plastic bag (make sure to get all layers of paint)
- Re-zip the sandwich bag and carefully set aside. **Caution: Do not set the bag or the plastic spoon on the bare ground at any time in order to avoid contamination.**

Place all samples in a safe location and bring the samples to the following class session.

Supplemental Document 5: Lead Precipitate Instructions

Take the Lead — Get the Lead Out
Terrill L. Nickerson and Bob Roddie, CDC's 2007 Science Ambassador Program

Purpose

During the nineteenth and early portion of the twentieth centuries, many houses and buildings used lead pipes or lead solder in the plumbing. Also during this time, window trim and building exteriors were painted with lead-based paint. Over time, it was realized that many medical maladies were associated with the presence of these lead related products. Eventually, around the middle of the twentieth century, legislation was passed outlawing the use of lead-based products. Because lead is a very reactive metal, it is easily decomposed, where it ends up in the soil of housing water sources.

Materials

1. Plastic, sealable sampling bottles capable of holding at least 10mL (one per student)
2. Plastic Zip-lock type sandwich bags (two per student) for soil and wood chip samples
3. Plastic sealable container (one per student) or BD Falcon screw-capped 10mL container
4. Plastic spoon (one per student)
5. Masking tape for labeling samples
6. 12-well microscale reaction plate
7. Micropipettes at least 5mL (one per student)
8. Acetic acid (3 drops)
9. Nitric acid (3 drops)
10. Sulfuric acid (5 drops)
11. Three pipettes for chemicals
12. Soil sample (1 teaspoon)
13. Water sample from bathroom tap (10mL)
14. Paint chips from outside window sill (3–5 chips)
15. Mortar and pestle
16. Distilled water
17. Goggles (one pair per student)
18. Protective lab apron (one per student)
19. Disposable gloves (one pair per student)
20. Plastic tweezers (one per student)

Procedures

Pre-Lab Precautions

Be sure to put on eye protection, lab apron, and gloves before beginning. Because students are using dilute acids, they all need to wear safety equipment and be reminded of the proper procedure for working with acids and water.

Step 1: Water sampling

1. Pair up with one other student to share reaction plates.
2. Place the 12-well microscale reaction plate on the table in between partners. One student will use three of the pores on one side of the reaction plate, and the other student will use three on the opposite end of the reaction plate.
3. Have the Individual Data Sheet nearby, ready to record the experimental data.
4. Place the sample of water on the table, and while holding the bottle with one hand, unscrew the cap and place the cap to the side.

5. Pick up the extra pipette, squeeze the air out of the pipette, immerse the end of the pipette just under the surface of the water line, release the pipette bulb, and draw a 1mL–3mL sample of water.
6. Move the pipette over one of the wells of the reaction plate nearest them and slowly squeeze the bulb, emptying the water sample from the pipette.
7. Rinse out the pipette with distilled water.

Step 2: Soil Sample

1. Place the soil sample on the desk near the reaction plate.
2. Unzip the locked bag, opening the bag as wide as possible. Then using the plastic spoon, take out about ¼ teaspoon of soil from the bag, and carefully transfer the soil to a second well of the nearest reaction plate.
3. Take up the pipette and return to the source of distilled water, squeeze the pipette bulb and draw in a full pipette sample of the distilled water.
4. Return to the soil sample in the reaction well. Slowly and carefully empty the distilled water sample into the soil sample cell. Be careful not to splash water into any neighboring cells to avoid contamination.
5. Let the soil sample sit and soak up the water as each student progresses to the paint chip procedure.
6. Zip up the bag with the soil sample and set it aside.

Step 3: Paint Chip Sample

1. Have the student place their paint chip samples on the desk near the reaction plate.
2. Students will take turns with the mortar and pestle, being sure to rinse the mortar and pestle thoroughly with distilled water after each student is done using it (to prevent contaminating the next person's sample).
3. Open the locked bag containing paint chips.
4. Use tweezers to remove several paint chips from the bag and place them in the mortar.
5. Using the pestle, grind the paint chips to a fine powder.
6. Lay the pestle aside, return to the distilled water source, fill the pipette with distilled water, and return to the reaction plate.
7. Hold the pipette (tip up) with one hand, and with the opposite hand pick up the mortar and hold it over a third well of the reaction plate. Point the pipette toward the paint powder and rinse the paint out of the bottom of the mortar into the open reaction well. *Be careful not to splash water into any neighboring cells to avoid contamination.*
8. Zip up the sandwich bag of paint chip samples and set it aside.

Step 4: Control sample

1. Fill the pipette with distilled water and empty in into a fourth empty reaction well.

Step 5: Acetic acid Wash

2. Apply this process to all four of the wells containing samples.
3. Carefully bring the bottle of acetic acid to the work station. Transfer some acetic acid from the bottle into a beaker.
4. Reinsert the pipette into the acid beaker and draw out about 3mL of acid into the pipette.
5. Place the pipette over the first reaction well with the home water sample, and carefully squeeze the contents into the sample. Be careful not to splash water into any neighboring cells to avoid contamination and injury.
6. Return the pipette to the acetic acid container and repeat Step 4 for each of the other three samples (soil, paint chips, and control).
7. Return the acid pipette back into the acetic acid container and carefully return the acetic acid container to the teacher's station for the next student to use.

Step 6: Nitric acid Wash

1. Apply this process to all four of the wells with the samples.
2. Carefully bring the bottle of nitric acid to the work station. Remove the pipette from within the nitric acid bottle, and while holding the pipette over the acid container, carefully squeeze the pipette bulb, emptying the contents of the pipette back into the acid bottle.
3. Reinsert the pipette into the acid container and draw out about 3mL of nitric acid into the pipette.
4. Place the pipette over the first reaction well with the home water sample and carefully squeeze the contents into the sample. Be careful not to splash water into any neighboring cells to avoid contamination and injury.
5. Return the pipette to the nitric acid container and repeat Step 4 for each of the other three samples (soil, paint chips, and control).
6. Return the acid pipette back into the nitric acid container and carefully return the acetic acid container to the teacher's station for the next student to use.

Step 7: Sulfuric acid Wash

1. Apply this process to all four of the wells with the samples.
2. Carefully bring the bottle of sulfuric acid and while holding the pipette over the acid container, carefully squeeze the pipette bulb, emptying the contents of the pipette back into the acid bottle.
3. Reinsert the pipette into the acid container and draw out about 3mL of sulfuric acid into the pipette.
4. Place the pipette over the first reaction well with the home water sample and carefully squeeze the contents into the sample. Be careful not to splash water into any neighboring cells to avoid contamination and injury.
5. Return the pipette to the sulfuric acid container and repeat Step 4 for each of the other three samples (soil, paint chips, and control).
6. Return the acid pipette back into the sulfuric acid container and carefully return the sulfuric acid container to the teacher's station for the next student to use.

Step 8: Observation and Data Collection

1. Return to the reaction plate of samples.
2. At this point, observe each sample cell and record the presence or absence of any precipitate. The data will be qualitative and descriptive. Use one of the following descriptions.
   - Strong reaction — obvious and visible white solid precipitate is formed – heavy lead presence
   - Moderate reaction — liquid converted to solid and some solid particles are visible – moderate lead presence
   - Weak reaction — liquid is milky and some strings or small particles are visible – weak lead presence
   - Slight reaction — liquid is mostly clear with some light discoloration or small particle floating in the liquid – very little lead presence
   - No reaction — no visible change in the liquid – no lead presence
3. Record the reaction in each well on the Individual Data Sheet using one of the five descriptors above as applicable.
4. Take the reaction plate to the sink and rinse the reactions wells free of all samples into the chemical collection bottle. Be careful not to splash water to avoid contamination and injury.
5. Wipe the reaction plate with paper towels and return to the teacher's work station.
6. Return to work stations and clean wash any equipment and return to its proper place; wipe off the work station surface and dry with paper towels.

Step 9: Class Data Tabulation

1. Bring the data to the front board and record it for each of the four samples on the Class Data Table next to the number representing the map pin number.

2. Return to the work stations and continue to record the remainder of the class data as it is entered on the board on the Class Data Sheet.

Hypothesis

Given what each person knows about the chemistry of lead and the purpose of this experiment, formulate a hypothesis predicting which part of town would be the most likely location for lead to occur in the greatest quantities. Write the hypothesis as a prediction statement. Complete the hypothesis on the Lab Data form.

Supplemental Document 6: Precipitate Lab Data Tables

Take the Lead – Get the Lead Out
Terrill L. Nickerson and Bob Roddie, CDC's 2007 Science Ambassador Program

Name _____ Period _____ Date _____

Hypothesis —

Individual Data Table

Student Map Pin Number	Reaction Well #1: Water Sample	Reaction Well #2: Soil Sample	Reaction Well #3: Paint Sample	Reaction Well #4: Control Sample

Class Data Table

Student Map Pin Number	Reaction Well #1: Water Sample	Reaction Well #2: Soil Sample	Reaction Well #3: Paint Sample	Reaction Well #4: Control Sample

Supplemental Document 7: Precipitate Lab Evaluation

Take the Lead — Get the Lead Out
Terrill L. Nickerson and Bob Roddie, CDC's 2007 Science Ambassador Program

Name _____ Period _____ Date _____

Conclusions

1. Re-state your hypothesis. This step is to help remind you what the question or prediction is that you are attempting to prove.

2. Evaluate the quality of your own personal data and the class data as a whole. Are there any weaknesses in the experiment, or any mistakes that might have compromised the accuracy and quality of the data?

3. Summarize the class data. Don't offer opinions or discuss aspects of the data, just report it.
   a) How many of the water samples showed a strong presence of lead? _____
   b) How many of the water samples showed a moderate presence of lead? _____
   c) How many of the water samples showed a weak presence of lead? _____
   d) How many of the water samples showed a slight presence of lead? _____
   e) How many of the water samples showed no presence of lead? _____

   f) How many of the soil samples showed a strong presence of lead? _____
   g) How many of the soil samples showed a moderate presence of lead? _____
   h) How many of the soil samples showed a weak presence of lead? _____
   i) How many of the soil samples showed a slight presence of lead? _____
   j) How many of the soil samples showed no presence of lead? _____

   k) How many of the paint samples showed a strong presence of lead? _____
   l) How many of the paint samples showed a moderate presence of lead? _____
   m) How many of the paint samples showed a weak presence of lead? _____
   n) How many of the paint samples showed a slight presence of lead? _____
   o) How many of the paint samples showed no presence of lead? _____

   p) How many of the control samples showed a strong presence of lead? _____
   q) How many of the control samples showed a moderate presence of lead? _____
   r) How many of the control samples showed a weak presence of lead? _____
   s) How many of the control samples showed a slight presence of lead? _____
   t) How many of the control samples showed no presence of lead? _____

4. Which locations in the community contained the greatest presence of lead?

5. Did you prove your hypothesis? Include a clear statement as to why you think that you did or why did not prove your hypothesis. Refer to the data in #3 for evidence.

6. How does the individual data from your home compare with your hypothesis?

7. How does your data compare with the rest of the class data?

8. What does the data suggest about the ages of buildings in your community? Which parts of the community were built first and which parts were built at a later time?

9. Is this consistent with what you personally know about the history of your community? Why or why not?

10. Are there any other observations or trends that were observable that were not covered above? Explain.

Supplemental Document 8: Word Wall Rubrics

Take the Lead – Get the Lead Out
Terrill L. Nickerson and Bob Roddie, CDC's 2007 Science Ambassador Program

Assessment Criteria	Level 0	Level 1	Level 2	Level 3	Level 4	Level 5
Content Ability to accurately explain how lead enters the body	No attempt to complete. Content, not present	Far Below Expectations. Content demonstrates little or no understanding	Substandard. .Some content is correct, missing key points	Satisfactory level. Most material is present and correct, some minor content errors	Good level of understanding demonstrated. Content is correct, and all content is present.	Outstanding. Demonstrates profound understanding of the content.
Content Ability to accurately explain signs and symptoms of lead exposure to specific part of the body	No attempt to complete. Content, not present.	Far Below Expectations. Content demonstrates little or no understanding.	Substandard. Some content is correct; missing key points.	Satisfactory. Most material is present and correct; some minor content errors.	Good level of understanding demonstrated. Content is correct, and all content is present.	Outstanding. Demonstrates profound understanding and depth in the content.
Communication Effective use of scientific terminology and ability to convey understanding of these terms	No attempt to use any scientific terminology present.	Some scientific terminology is used, but not explained.	Scientific terminology is used for the most part, and some explanation used to define terms.	Wall contains all necessary scientific terminology; might not have some explanation of new terms.	Wall contains all pertinent scientific terminology, with explanation explained for most new terms.	Writing with sound use of scientific terminology evident and completely explained.
Communication Word Wall Block looks professional, and contains appropriate spelling and diction.	Word Wall not completed.	Many errors with spelling and word usage, but has attempted to demonstrate understanding	Some errors in spelling and usage, but able to understand meaning. Errors present.	Few errors in spelling and or usage. Reading the material is easy, not compromised by errors.	Easy to read. Usage and spelling are not problems. Language is appropriate for age group.	Totally clear. No errors evident and high level of language use evident.
Level Attained:						

Supplemental Document 9: Word Wall Examples and Student Worksheet

Take the Lead – Get the Lead Out
Terrill L. Nickerson and Bob Roddie, CDC's 2007 Science Ambassador Program

Word Wall Block

Student Names: _____

Region of the body: Reproductive System
How does lead reach this part of the body? Please list resources below.
What effects does lead have on this part of the body? Please include exposure levels. Please list resources below.

Word Wall Block

Student Names: _____

Region of the body: Embryonic Development
How does lead reach this part of the body? Please list resources below.
What effects does lead have on this part of the body? Please include exposure levels. Please list resources below.

Word Wall Block

Student Names: _____

Region of the body: **Blood Pressure**
How does lead reach this part of the body? Please list resources below.
What effects does lead have on this part of the body? Please include exposure levels. Please list resources below.

Word Wall Block

Student Names: _____

Region of the body: **Endocrine System**
How does lead reach this part of the body? Please list resources below.
What effects does lead have on this part of the body? Please include exposure levels. Please list resources below.

Word Wall Block

Student Names: _____

Region of the body: **Blood Composition**
How does lead reach this part of the body? Please list resources below.
What effects does lead have on this part of the body? Note exposure levels when discussing here. Please list resources below.

Word Wall Block

Student Names: _____

Region of the body: **Kidney and Excretion (Renal Effects)**
How does lead reach this part of the body? Please list resources below.
What effects does lead have on this part of the body? Please include exposure levels. Please list resources below.

Word Wall Block

Student Names: _____

Region of the body: Neurological/Brain — Child
How does lead reach this part of the body? Please list resources below.
What effects does lead have on this part of the body? Please include exposure levels. Please list resources below.

Word Wall Block

Student Names: _____

Region of the body: Neurological/Brain — Adult
How does lead reach this part of the body? Please list resources below.
What effects does lead have on this part of the body? Please include exposure levels. Please list resources below.

Supplemental Document 10: Word Wall Answer Sheet

Take the Lead – Get the Lead Out!
Terrill L. Nickerson and Bob Roddie, CDC's 2007 Science Ambassador Program

Word Wall Block

Student Names: _____

Region of the body: Reproductive System
How does lead reach this part of the body? Although the blood generally carries only a small fraction of the total lead body burden, it serves as the initial receptacle of absorbed lead and distributes lead throughout the body, making it available to other tissues or for excretion. It is blood plasma, which transfers lead between the blood compartment and the soft and mineralizing tissues, and therefore, may be more biologically significant. In addition, the higher the lead concentration in the blood, the higher the percentage partitioned to plasma. (1) **Please list resources below.** http://www.atsdr.cdc.gov/HEC/CSEM/lead/biologic_fate.html
What effects does lead have on this part of the body? Please include exposure levels. Male: impotence, decreased libido; occupational exposures may decrease sperm count totals and increase abnormal sperm frequencies. Long-term lead exposure (independent of current lead exposure levels) also may diminish sperm concentrations, total sperm counts, and total sperm motility (1) **Please list resources below.** http://www.atsdr.cdc.gov/HEC/CSEM/lead/physiologic_effects.html

Word Wall Block

Student Names: _____

Region of the body: Embryonic Development
How does lead reach this part of the body? Maternal blood lead, from exogenous and endogenous sources, can cross the placenta and put the fetus at risk. Although the blood generally carries only a small fraction of the total lead body burden, it serves as the initial receptacle of absorbed lead and distributes lead throughout the body, making it available to other tissues (or for excretion). It is blood plasma, however, which transfers lead between the blood compartment and the soft and mineralizing tissues, and therefore, may be more biologically significant. In addition, the higher the lead concentration in the blood, the higher the percentage partitioned to plasma. (1) **Please list resources below.**
What effects does lead have on this part of the body? Please include exposure levels. Lead, which readily crosses the placenta, adversely affects fetus viability as well as fetal and early childhood development (1) **Please list resources below.** http://www.atsdr.cdc.gov/HEC/CSEM/lead/physiologic_effects.html

Word Wall Block

Student Names: _____

Region of the body: **Blood Pressure**
How does lead reach this part of the body? Although the blood generally carries only a small fraction of the total lead body burden, it serves as the initial receptacle of absorbed lead and distributes lead throughout the body, making it available to other tissues (or for excretion). It is blood plasma, however, which transfers lead between the blood compartment and the soft and mineralizing tissues and therefore may be more biologically significant. In addition, the higher the lead concentration in the blood, the higher the percentage partitioned to plasma. (1) **Please list resources below.** http://www.atsdr.cdc.gov/HEC/CSEM/lead/physiologic_effects.html
What effects does lead have on this part of the body? Please include exposure levels. **Please list resources below.**

Word Wall Block

Student Names: _____

Region of the body: **Endocrine System**
How does lead reach this part of the body? Although the blood generally carries only a small fraction of the total lead body burden, it serves as the initial receptacle of absorbed lead and distributes lead throughout the body, making it available to other tissues (or for excretion). It is blood plasma, which transfers lead between the blood compartment and the soft and mineralizing tissues, and therefore, may be more biologically significant. In addition, the higher the lead concentration in the blood, the higher the percentage partitioned to plasma. (1) **Please list resources below.** http://www.atsdr.cdc.gov/HEC/CSEM/lead/physiologic_effects.html
What effects does lead have on this part of the body? Please include exposure levels. Lead impedes vitamin D conversion into its hormonal form, 1,25-dihydroxyvitamin D. Diminished 1,25-dihydroxyvitamin D, in turn, may impair cell growth, maturation, and tooth and bone development. Lead appears to have a minimal, if any, effect on thyroid function. Lead exposure could adversely affect the thyroid over time. No effects of lead on thyroid function have been found in children. (1) **Please list resources below.** http://www.atsdr.cdc.gov/HEC/CSEM/lead/physiologic_effects.html

Word Wall Block

Student Names: _____

Region of the body:	**Blood Composition**

How does lead reach this part of the body?
Although the blood generally carries only a small fraction of the total lead body burden, it serves as the initial receptacle of absorbed lead and distributes lead throughout the body, making it available to other tissues (or for excretion). It is blood plasma, which transfers lead between the blood compartment and the soft and mineralizing tissues, and therefore, may be more biologically significant. In addition, the higher the lead concentration in the blood, the higher the percentage partitioned to plasma. (1)

Please list resources below:
http://www.atsdr.cdc.gov/HEC/CSEM/lead/physiologic_effects.html

What effects does lead have on this part of the body? Please include exposure levels.
Lead inhibits the body's ability to make hemoglobin by interfering with several enzymatic steps in the heme pathway. Lead decreases heme biosynthesis by inhibiting δ-aminolevulinic acid dehydratase and ferrochelatase activity. Lead can induce two types of anemia, often accompanied by basophilic stippling of the erythrocytes and hemolytic anemia in high acute lead poisoning. In chronic lead exposure, lead induces anemia by both interfering with heme biosynthesis and by diminishing red blood cell survival. (1)

Please list resources below:
http://www.atsdr.cdc.gov/HEC/CSEM/lead/physiologic_effects.html

Word Wall Block

Student Names: _____

Region of the body:	**Kidney and Excretion (Renal Effects)**

How does lead reach this part of the body?
Although the blood generally carries only a small fraction of the total lead body burden, it serves as the initial receptacle of absorbed lead and distributes lead throughout the body, making it available to other tissues (or for excretion). It is blood plasma, which transfers lead between the blood compartment and the soft and mineralizing tissues, and therefore may be more biologically significant. In addition, the higher the lead concentration in the blood, the higher the percentage partitioned to plasma. (1)

What effects does lead have on this part of the body? Please include exposure levels.
The lowest level at which lead has an adverse effect on kidneys remains unknown.
Many studies show a strong association between lead exposure and renal effects.
Continued or repetitive exposures can cause a toxic stress on the kidneys that, if unrelieved, may develop into chronic and often irreversible lead nephropathy (i.e., interstitial nephritis).
Some renal disease or decrement in renal function may be caused by latent effects of lead exposure that occurred years earlier. Lead exposure is also believed to contribute to the onset of saturnine gout, which may develop as a result of lead-induced hyperuricemia due to decreased renal excretion of uric acid. (1)

Please list resources below:
http://www.atsdr.cdc.gov/HEC/CSEM/lead/physiologic_effects.html

Word Wall Block

Student Names: _____

Region of the body: Neurological/Brain — Child
How does lead reach this part of the body? Travels through the blood, freely in the plasma. Although the blood generally carries only a small fraction of the total lead body burden, it serves as the initial receptacle of absorbed lead and distributes lead throughout the body, making it available to other tissues (or for excretion). It is blood plasma, which transfers lead between the blood compartment and the soft and mineralizing tissues, and therefore, may be more biologically significant. In addition, the higher the lead concentration in the blood, the higher the percentage partitioned to plasma. (1)
What effects does lead have on this part of the body? Please include exposure levels. Acute exposure to very high levels of lead may produce encephalopathy. There is a large body of evidence that associates decrement in intelligence quotient (IQ) performance and other neuropsychologic defects with lead exposure. There is also evidence that the probability of ADHD and hearing impairment in children increases with increasing BLLs. Lead exposure may disrupt balance and impair peripheral nerve function. Lead exposure is linked with lower class standing (classroom performance); greater absenteeism; more reading disabilities; and deficits in vocabulary, fine motor skills, reaction time, and hand-eye coordination, childhood neurologic effects, including possibly ADHD (1) **Please list resources below.** http://www.atsdr.cdc.gov/HEC/CSEM/lead/physiologic_effects.html

Word Wall Block

Student Names: _____

Region of the body: Neurological/Brain — Adult
How does lead reach this part of the body? Although the blood generally carries only a small fraction of the total lead body burden, it serves as the initial receptacle of absorbed lead and distributes lead throughout the body, making it available to other tissues (or for excretion). It is blood plasma, which transfers lead between the blood compartment and the soft and mineralizing tissues, and therefore, may be more biologically significant. In addition, the higher the lead concentration in the blood, the higher the percentage partitioned to plasma. (1) **Please list resources below:** http://www.atsdr.cdc.gov/HEC/CSEM/lead/physiologic_effects.html
What effects does lead have on this part of the body? Please include exposure levels. Lead encephalopathy may occur at extremely high BLLs. Precursors of encephalopathy, such as dullness, irritability, poor attention span, muscular tremor, loss of memory, and hallucination, may occur at lower BLLs. Effects include the following: malaise, forgetfulness, irritability, lethargy, impaired concentration, depression and mood changes, increased nervousness, headache, fatigue, impotence, decreased libido, dizziness, weakness, and paresthesia, as well as diminished reaction time, a decrease in visual motor performance, hand dexterity, IQ scores, and cognitive performance. There is also some evidence that lead exposure may affect adults' postural balance and peripheral nerve function, slowed nerve conduction and forearm extensor weakness (wrist drop). Late signs of lead intoxication are more classic in workers chronically exposed to high lead levels. (1) **Please list resources below:** http://www.atsdr.cdc.gov/HEC/CSEM/lead/physiologic_effects.html

References:

Centers for Disease Control and Prevention, Agency for Toxic Substances and Disease Registry, Lead Toxicity: What are the Physiologic Effects of Lead Exposure? [online]. [cited 2007 September 28]. Available from URL: http://www.atsdr.cdc.gov/HEC/CSEM/lead/physiologic_effects.html

Supplemental Document 11: Lead Poisoning Case Study

Take the Lead – Get the Lead Out!
Terrill L. Nickerson and Bob Roddie, CDC's 2007 Science Ambassador Program

Name _____ Period _____ Date _____

Case Study

Patient Name: Delerius Plumbomb
Dr. (your name): _____
Age of Patient: 5 years old

Key Symptoms Presented to You

- ☐ Slightly delayed speech abilities
- ☐ Parent has been told by teacher that the child is becoming more and more impulsive in class
- ☐ Blood work demonstrates a slight anemia
- ☐ Was just tested for an IQ test at school, and scored much lower than parents expected
- ☐ Vitamin D deficiency
- ☐ Blood pressure is slightly higher than expected for a person of this age

Previous Diagnosis

- ☐ Possible iron deficiency, low hemoglobin counts
- ☐ Another pediatrician noted a possible Attention Deficit Disorder diagnosis if continues to be impulsive

Other Environmental Notes

- ☐ Patient lives in an older neighborhood with keen, handy parents
- ☐ Parents are currently remodeling their home and are preserving the old banister and crown moldings back to their original wood stain after years of being white
- ☐ Normal diet, without excess salt

Case Study Questions

1. As the doctor, you suspect the possibility of lead poisoning when you look at the symptoms presented. Answer based upon the patient in question. List three of the symptoms above that represent the possibility of lead poisoning.
    a) With each symptom, explain how this symptom could have occurred because of lead poisoning.

    b) This patient complains of being tired most of the time. Why might the person be fatigued? If the patient has lead poisoning, why might he be frequently tired?

    c) The patient has decided to stop drinking milk. Why would restricting milk intake possibly increase the symptoms?

    d) As the doctor, if you had the opportunity to take a look at the bones, knowing the case history and environment, what would you expect to find with regards to bone structure and make up?

2. Understanding lead sources, contamination, and methods of ingestion, answer the following:

a) Based on this case, describe two possible sources of lead contamination for the patient. Explain your answer.

b) Explain how lead could have found its way into this 8 year old patient.

Supplemental Document 12: Case Study Questions Answer Key

Take the Lead – Get the Lead Out!
Terrill L. Nickerson and Bob Roddie, CDC's 2007 Science Ambassador Program

1. As the doctor, you suspect the possibility of lead poisoning when you look at the symptoms presented. Answer based upon the patient in question.

    a) List three of the symptoms above that represent the possibility of lead poisoning. With each symptom, explain how this symptom could have occurred because of lead poisoning.

    Answers will vary, but may include: delayed speech; increased impulsiveness; childhood neurological effects; possibly ADHD; anemia; decreased IQ; vitamin D deficiency; and increased blood pressure. (1)

    b) This patient complains of being tired most of the time. Why might the person be fatigued? According to lead poisoning, why might the person be frequently tired?

    Answers will vary, but may include anemia symptoms (including fatigue, weakness, headache, and dizziness), that are a result of lower than normal levels of red blood cells or hemoglobin, or both (2). Approximately 99% of the lead in blood is associated with red blood cells (3). Lead present in the blood will inhibit hemoglobin production, thus inhibiting blood's ability to carry oxygen providing a reason for anemia diagnosis (1).

    c) The patient has decided to stop drinking milk. Why would restricting milk intake possibly intensify the symptoms?

    Lead tends to accumulate in bone regions undergoing the most active calcification at the time of exposure. Inert lead can leave the bones and reenter the blood and soft-tissue organs. Bone-to-blood lead mobilization is exacerbated by calcium deficiency. This means that if the patient stops drinking milk, this could mean a drop in free calcium in the blood, which also means the normally locked up lead in the bones becomes released as free lead allowing lead poisoning symptoms to intensify. (1)

    d) As the doctor, if you had the opportunity to take a look at the bones, knowing the case history and environment, what would you expect to find with regard to bone structure and make up?

    There should be some lead found in the bones, and growth arrest lines!

2. Understanding Lead sources, contamination, and methods of ingestion, answer the following:

    a) Based on this case, describe two possible sources of lead contamination for this patient. Explain your answer.

    Student answers will vary.

    b) Explain how lead could have found its way into this 8 year old patient.

    Student answers will vary.

References

1. Centers for Disease Control and Prevention, Agency for Toxic Substances and Disease Registry, Lead Toxicity: What are the Physiologic Effects of Lead Exposure? [online]. [cited 2007 September

28]. Available from URL: http://www.atsdr.cdc.gov/HEC/CSEM/lead/physiologic_effects.html

2. Northwestern University, Life Science Glossary [online]. [cited 2007 September 28]. Available from URL: http://www.biochem.northwestern.edu/holmgren/Glossary/Definitions/Def-A/anemia.html

3. Centers for Disease Control and Prevention, Agency for Toxic Substances and Disease Registry, Lead Toxicity: What is the Biologic Fate of Lead? [online]. [cited 2007 September 28]. Available from URL: http://www.atsdr.cdc.gov/csem/lead/pbbiologic_fate2.html