

The Lead Placemat: Understanding Lead Exposure

by

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Middle school students will design and construct a two-sided placemat looking at both the physical and chemical properties of lead and the adverse effects of lead on humans. The completed laminated placemat will provide information and an opportunity to incorporate interactive activities.

Disclaimer: The findings and conclusions in this report are those of the authors and do not necessarily represent the views of the Centers for Disease Control and Prevention.

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Summary

Middle school students will design and construct a two-sided placemat looking at both the physical and chemical properties of lead and the adverse effects of lead on humans. The completed laminated placemat will provide information and an opportunity to incorporate interactive activities.

Learning Outcomes

- Students will describe the historical background and discovery of lead.
- Students will identify the chemical and physical properties of lead.
- Students will gain knowledge about some of the uses of lead in society and industry.
- Students will display possible adverse effects of lead on public health.

Materials

1. Standard sheet of construction paper — one per student
2. Internet access for each pair of students or as teacher sees fit for research
3. Glue — 1 per student
4. Scissors — 1 per student
5. Metric ruler — 1 per student
6. Access to pictures in magazines, newspaper, online, etc. Some appropriate magazines include *Scientific American*, *Popular Science*, or *Science News*. Pictures from these magazines can be used on the placemat, where fitting.
7. Lead Pretest — one per student.
8. Lead Placemat Instruction Sheet — for each student
9. Lead Worksheet — for each student
10. Lead Scoring Rubric — for each student

Total Duration

1 hour, 40 minutes

Procedures

Teacher Preparation

The teacher should obtain one sheet of colored construction paper per student. Copies of the following should be made for each student:

- Lead Pretest
- Lead Placemat Instruction Sheet
- Lead Worksheet
- Lead Scoring Rubric

Students should have access to art supplies as well as Internet access. If students have no Internet access, the teacher could print off pages from the following Web sources for students to obtain information about lead:

Web Resources

Title: Department of Health and Human Services: Agency for Toxic Substances and Disease Registry, Chemical Agent Briefing Sheets: Lead

URL: <http://www.atsdr.cdc.gov/cabs/lead/>

Description: This website will provide students with specific properties of lead, common uses of lead, routes of exposure to lead, toxic effects of lead, and ways to prevent lead exposure.

Title: U.S. Environmental Protection Agency: Lead in Paint, Dust, and Soil—Basic Facts

URL: <http://www.epa.gov/lead/pubs/leadinfo.htm#facts>

Description: This website will provide basic facts about properties of lead, sources of lead exposure, and preventions to lead exposure. It also contains several links to additional resources for researching lead.

Title: U.S. Department of Labor: Occupational Safety and Health Administration, Lead Exposure in Construction (#1 of 6) — Worker Protection Programs

URL: http://www.osha.gov/pls/oshaweb/owadisp.show_document?p_table=FACT_SHEETS&p_id=161

Description: This website provides sources of lead exposure and preventative measures for construction workers.

Title: History of the Origin of the Chemical Elements and Their Discoverers

URL: <http://www.nndc.bnl.gov/content/elements.html>

Description: This website provides basic facts about the discoveries of each element on the periodic table, including lead.

Introduction

Step 1

Duration: 30 minutes

The teacher could introduce the activity by announcing the following to the class:

The local restaurant has asked for your help to create placemats, which will entertain customers while they wait for their food order. Because of your knowledge of chemistry, your artistic abilities, and your creativity, we would like you to create a placemat examining lead. When you were younger and you went to your favorite local restaurant, when you walked in, you might have been presented with a small collection of crayons and a placemat to color while you were seated. Now that you are older, we want to expand on this activity and provide an opportunity to educate your local community about this important element.

The teacher should administer the Lead Pretest to the class to assess prior knowledge. The teacher will then discuss the answers to the pretest with the class, using the Lead Pretest Answer Key.

Supplemental Documents

Title: Lead Pretest

Description: This document is the pretest that can be used to assess students' prior knowledge of the chemical, the physical properties of lead, and the adverse effects of lead exposure.

Title: Lead Pretest Answer Key

Description: This document is the pretest answer key that can be used to discuss the students' answers to the pretest.

Step 2

Duration: 90 minutes

Distribute the Lead Placemat Instruction sheet to each student. After discussing the content of the instruction sheet, each student will be given an opportunity to begin their research and outline for themselves *how* they plan to organize the information that is going to be found on their placemat.

Pictures from magazines and newspapers need to be neatly cut out. All pictures and diagrams need to be neatly and clearly labeled. Large amounts of written information needs to be summarized and kept to a minimum. The placemat needs to be attractive, colorful, easy to follow, and informative. The interactive activities, such as crossword puzzles, word searches, mazes, etc. need to be challenging, while allowing another person to find success. All answers or keys need to be included somewhere on the placemat.

The teacher should also distribute the Lead Placemat Worksheet to each student. This worksheet should be completed and turned in along with each student's placemat. The worksheet will allow students to explain and elaborate on pictures and short descriptions they have placed onto their placemats. In addition, the teacher should distribute a Lead Placemat Scoring Rubric to each student. This rubric will inform students how their placemat will be assessed.

Web Resources

Title: Department of Health and Human Services: Agency for Toxic Substances and Disease Registry, Chemical Agent Briefing Sheets: Lead

URL: <http://www.atsdr.cdc.gov/cabs/lead/>

Description: This website will provide students with specific properties of lead, common uses of lead, routes of exposure to lead, toxic effects of lead, and ways to prevent lead exposure.

Title: U.S. Environmental Protection Agency: Lead in Paint, Dust, and Soil — Basic Facts

URL: <http://www.epa.gov/lead/pubs/leadinfo.htm#facts>

Description: This website will provide basic facts about properties of lead, sources of lead exposure, and preventions to lead exposure. It also contains several links to additional resources for researching lead.

Title: U.S. Department of Labor: Occupational Safety and Health Administration, Lead Exposure in Construction (#1 of 6) — Worker Protection Programs

URL: http://www.osha.gov/pls/oshaweb/owadisp.show_document?p_table=FACT_SHEETS&p_id=161

Description: This website provides sources of lead exposure and measures to prevent exposure for construction workers.

Title: History of the Origin of the Chemical Elements and Their Discoverers

URL: <http://www.nndc.bnl.gov/content/elements.html>

Description: This website provides basic facts about the discoveries of each element on the periodic table, including lead.

Supplemental Documents

Title: Lead Placemat Instruction Sheet

Description: This document provides instructions informing students as to what is expected on their completed placemats.

Title: Lead Placemat Worksheet

Description: This document will enable students to explain and elaborate on pictures and information on their placemats.

Title: Lead Placemat Scoring Rubric

Description: This document will show students exactly how their placemats will be assessed. It will also serve as a grading tool for teachers to score each student's placemat project.

Step 3

Duration: 30 minutes

When placemats are completed, students should make an oral presentation to the class. They can use their placemats as a prop, but should not read the information word-for-word. During oral presentations, questions and discussion between students can take place.

Placemats do not need to be laminated for students to make presentations. If the placemat is going to be used or saved, lamination will make them very durable.

Conclusion

Duration: 15 minutes

The teacher should take the completed placemat and assess it according to the Lead Placemat Scoring Rubric provided in **Step 2**. Students should revisit the Lead Pretest provided in the introductions — and now be able to discuss their new knowledge.

Assessment

The Lead Placemat Scoring Rubric provided in **Step 2** should be used to assess the oral presentation, as well as the actual placemat.

Modifications

Extension 1

This activity could easily be modified to include any element. With over 100 elements, each student can be given the chance to choose their own element. The teacher could substitute other elements anytime lead is presented in this lesson. Students can also orally present their different element placemats to the class, so many elements could be covered at one time.

Extension 2

If the placemats are actually going to be used, the teacher should laminate students' completed placemats, making them more durable. Within the community, the teacher could contact local restaurants, daycare facilities, or near by elementary school classes to get permission to bring in the completed placemats for use in such settings.

Extension 3

Students could be given the opportunity to put the information on their placemats in their own native language. It could be entirely in that language or that language matched with English.

Other Modifications

This activity could be done as a cooperative learning group. This would allow students to complete the project more quickly. It could also be divided, assigning one student to the front and the other to the back.

Education Standards

National Science Education Standards CONTENT STANDARD B

As a result of their activities in grades 5-8, all students should develop an understanding of

- **Properties and changes of properties in matter**
- **Motions and forces**
- **Transfer of energy**

CONTENT STANDARD F

As a result of activities in grades 5-8, all students should develop understanding of

- **Personal health**
- **Populations, resources, and environments**
- **Natural hazards**
- **Risks and benefits**
- **Science and technology in society**

Lead Pretest

The Lead Placemat: Understanding Lead Exposure
Erica Derryberry and Kevin Keehn, CDC's 2007 Science Ambassador Program

- 1. Describe at least three properties of lead. Examples are color, texture, relative weight, cost, and hardness.**
- 2. Lead is classified as a nonmetal, metal, or metalloid? Choose one.**
- 3. Name at least one known use of lead, either historically or in today's world.**
- 4. Name at least one adverse effect of lead exposure.**
- 5. What is the chemical symbol for lead?**

Lead Placemat Pretest Answer Key

The Lead Placemat: Understanding Lead Exposure
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1. Describe at least three properties of lead. Examples: color, texture, relative weight, cost, hardness, etc.

Answers will vary, but may include the following: Lead is bluish-gray in color. It is soft (malleable and ductile) and heavier than most metals. It has no odor. Lead is relatively inexpensive and easily obtained. (1)

2. Lead is classified as a nonmetal, metal, or metalloid? Choose one.

Lead is a metal. It is both ductile and malleable. (1)

3. Name at least one known use of lead, historically or today.

Answers will vary, but may include the following: storage batteries, fishing equipment, lead based solder (electronics, formally used in tin cans), lead shot and ammunition, plumbing, stained-glass making, and x-ray shielding. It was formally used as a gasoline additive and in some paints. (1)

4. Name one adverse effect of lead exposure.

Answers will vary, but may include the following: Some common adverse effects of lead exposure are negative effects on the development of the nervous system, the hematological and cardiovascular systems, and soft tissues (liver, kidneys, lungs, and brain). (1)

5. What is the chemical symbol for lead?

The chemical symbol for lead is Pb, from the Latin name *Plumbum*. (2)

References

1. Department of Health and Human Services: Agency for Toxic Substances and Disease Registry, Chemical Agent Briefing Sheets: Lead
<http://www.atsdr.cdc.gov/cabs/lead/>
2. Los Alamos National Laboratories. Periodic Table of the Elements, Lead.
<http://periodic.lanl.gov/elements/82.html>

Lead Placemat Instructions

The Lead Placemat: Understanding Lead Exposure
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Your task is to develop a creative, informational, and interactive placemat (much like the ones found at local restaurants) about the element lead. Each side of the placemat will serve a different function. Side #1 will display the properties, history, and uses of lead. Side #2 will display the adverse side effects of lead, behaviors that put people at risk for getting lead into their bodies, and preventions to keep lead out of the human body.

In addition, you will create a total of four interactive activities to make your placemat both educational and fun. These interactive activities might include crossword puzzles, word search, mazes, fill-in-the-blanks, etc. Pictures for this project may be drawn, obtained from the Internet, cut out of magazines or newspapers, or photocopied from other sources. Have fun and be creative.

Websites providing information about lead are as follows:

Department of Health and Human Services: Agency for Toxic Substances and Disease Registry, Chemical Agent Briefing Sheets: Lead
<http://www.atsdr.cdc.gov/cabs/lead/>

U.S. Environmental Protection Agency: Lead in Paint, Dust, and Soil — Basic Facts
<http://www.epa.gov/lead/pubs/leadinfo.htm#facts>

U.S. Department of Labor: Occupational Safety and Health Administration, Lead Exposure in Construction (#1 of 6) — Worker Protection Programs
http://www.osha.gov/pls/oshaweb/owadisp.show_document?p_table=FACT_SHEETS&p_id=161

History of the Origin of the Chemical Elements and Their Discoverers
<http://www.nndc.bnl.gov/content/elements.html>

Below is a list of what must be included on each side of your placemat.

Side #1

- Picture of lead in its natural state
- Pictures displaying uses of lead (a minimum of four different uses)
- Atomic model drawing of lead, showing the correct number of protons, neutrons, and electrons in the correct energy levels
- A brief description of the discovery of lead
- A minimum of two interactive activities

Side #2

- Pictures displaying a minimum of four different at-risk behaviors for lead entering the body
- Descriptions of at least two adverse side effects of lead poisoning
- A minimum of two pictures of different preventions people can take to keep lead out of their bodies
- A minimum of two interactive activities
- The student's name should appear neatly in the lower right hand corner

Note: You will be expected to list all sources for pictures, descriptions, and any other information found on your placemat.

Lead Placemat Worksheet

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Directions: Fill in the answers to this worksheet and turn the sheet in with your placemat project.

Side #1

1. State how your pictures show uses of lead.
 - a.
 - b.
 - c.
 - d.
2. What did your research tell you about the discovery of lead?
3. Provide answers to the interactive activities on the back of this paper.

Side #2

4. Describe the four at-risk behaviors your pictures show.
 - a.
 - b.
 - c.
 - d.
11. Describe how the preventive behaviors on your pictures help to keep people from getting lead into their bodies.
 - a.
 - b.
6. Provide answers to the interactive activities on the back of this paper.

List all sources used to help develop both sides of the placemat (including sources for pictures and any other information used).

Lead Placemat Scoring Rubric

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 Total Points Possible: 44 points

Student Name: _____

| | 4 | 3 | 2 | 1 |
|-------------------------------------|---|---|---|---|
| Picture of Lead | The picture of lead is clear and accurate. | The picture of lead is unclear, but it is accurate. | The picture of lead is clear, but it is inaccurate. | The picture of lead is unclear and inaccurate OR the picture of lead is missing. |
| Uses of Lead | The placemat shows at least four clear pictures of accurate uses of lead. | The placemat shows 3 clear pictures of accurate uses of lead. | The placemat shows 1–2 clear pictures and accurate uses of lead. | The placemat shows 0 clear pictures and accurate uses of lead. |
| Chemical Properties | The placemat shows an atomic model of lead, accurately showing the correct number of protons, neutrons, and electrons in their proper shells. | The placemat shows an atomic model of lead with one of the following being inaccurate: number of protons, neutrons, or electrons in their proper shells. | The placemat shows an atomic model of lead with two of the following being inaccurate: number of protons, neutrons, or electrons in their proper shells. | The placemat shows an atomic model of lead with all of the following being inaccurate: number of protons, neutrons, or electrons in their proper shells OR the atomic model is missing. |
| Discovery of Lead | The description of the discovery of lead is entirely accurate. | The description of the discovery of lead is somewhat inaccurate. | The description of the discovery of lead is mostly inaccurate. | The description of the discovery of lead is completely inaccurate. |
| Interactive Activities- -Side #1 | The 2 interactive activities on Side #1 are present, accurate, and answers for both are provided. | The 2 interactive activities on Side #1 are present and accurate, but answers are not provided, OR they are present and inaccurate, and answers are provided. | The 2 interactive activities on Side #1 are present and inaccurate, and answers are not provided, OR only one interactive activity is present on Side #1. | There are no interactive activities on Side #1. |

| | 4 | 3 | 2 | 1 |
|--|--|---|---|---|
| At-risk Behaviors | The placemat shows at least four pictures of accurate, at-risk behaviors for lead entering the body. | The placemat shows at least three pictures of accurate, at-risk behaviors for lead entering the body. | The placemat shows two pictures of accurate, at-risk behaviors for lead entering the body. | The placemat shows no pictures of accurate, at-risk behaviors for lead entering the body. |
| Adverse Side Effects of Lead Poisoning | The placemat gives a clear description of two accurate, adverse side effects of lead poisoning. | One of the two descriptions is unclear OR inaccurate. | Both of the descriptions are either unclear OR inaccurate, OR there is only one description present. | Both of the descriptions are unclear AND inaccurate, OR both descriptions are absent. |
| Preventions to Keep Lead Out of the Human Body | At least two pictures clearly and accurately display actions to prevent lead poisoning. | Two pictures are present, but one picture is inaccurate. | Both of the pictures are inaccurate preventions, OR there is only one picture present. | There are no pictures displaying preventions. |
| Interactive Activities — Side #2 | The 2 interactive activities on Side #2 are present, accurate, and answers for both are provided. | The 2 interactive activities on Side #2 are present and accurate, but answers are not provided, OR they are present and inaccurate, and answers are provided. | The 2 interactive activities on Side #2 are present and inaccurate, and answers are not provided, OR only one interactive activity is present on Side #1. | There are no interactive activities on Side #2. |
| Oral Presentation | Interesting, well-rehearsed with smooth delivery that holds the audience's attention. | Relatively interesting, rehearsed with a fairly smooth delivery that usually holds audience's attention. | Delivery is not smooth, but able to hold the audience's attention most of the time. | Delivery is not smooth and audience attention is lost. |
| Overall Neatness and Creativity of Project | The poster is exceptionally attractive in terms of design, layout, and neatness. | The poster is attractive in terms of design, layout and neatness. | The poster is acceptably attractive, although it is a bit messy. | The poster is distractingly messy or very poorly designed. It is not attractive. |

Lead Placemat Answer Key

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NOTE: There will be a large amount of variance between the students' placemats, but this answer key will provide some concrete answers that should be included on the mats.

1. **Picture of lead** **some samples are shown at** —
<http://www.webelements.com/webelements/elements/text/Pb/pics.html>
2. **Uses of lead can include (but are not limited to) the following** —
Cosmetics and hair dye, fishing equipment, glazing, lead based paint, lead batteries, solder, lead-shot and ammunition, and shielding for x-ray machines. (1)
3. **Chemical properties of lead** —
Students should show an atomic diagram showing that lead has 82 protons, 125 neutrons, and 82 electrons. A sample of what a student might draw as an atomic structure is shown at
<http://www.webelements.com/webelements/elements/text/Pb/econ.html>
4. **Discovery of lead** —
Answers may vary, but students will find that the details of the exact discovery of lead is not known, as lead has been known since ancient times. (2)
5. **Interactives for Side #1** —
Answers will vary greatly among students. There needs to be any two interactive activities, such as crossword puzzles, word finds, mazes, or fill-in-the-blanks.
6. **At-risk behaviors** —
Pictures could include (but are not limited to) the following: living near hazardous waste sites, lead smelters or refineries, battery recycling or crushing centers, or other industrial lead sources; workers in occupations who have sources of lead exposure, such as plumbers, miners, mechanics, and lead smelter or refinery workers; some folk remedies; radiator repair; smoking cigarettes or breathing second-hand smoke; and ingesting lead-contaminated soil, dust, or paint. (3)
7. **Adverse side effects of lead poisoning** —
Answers could include (but are not limited to) the following: negative effects to the developing nervous system, the hematological and cardiovascular systems, and the kidneys. Lead could potentially affect any system or organ in the human body. (3)
8. **Preventions to keep lead out of the body** —
Pictures could include (but are not limited to) the following: not allowing children to chew on surfaces that may have been painted with lead-based paint; flushing cold water pipes before drinking or cooking with the water; avoiding lead-based paint; hiring a professional to remove lead-based paint; washing hands and faces to remove dust and soil; and regularly cleaning the house of dust and soil. (3)
9. **Interactives for Side #2** —
Answers will vary greatly among students. There must be any two interactive activities included, such as crossword puzzles, word finds, mazes, or fill-in-the-blanks.
10. **Oral Presentation** —
Will vary with each student.
11. **Overall Neatness and Creativity** —
Will vary with each student.

References:

1. Department of Health and Human Services: Agency for Toxic Substances and Disease Registry, Chemical Agent Briefing Sheets: Lead
<http://www.atsdr.cdc.gov/cabs/lead/#use>
2. WebElements Periodic Table: Professional Edition: Lead
<http://www.webelements.com/webelements/elements/text/Pb/hist.html>
3. Department of Health and Human Services: Agency for Toxic Substances and Disease Registry, Chemical Agent Briefing Sheets: Lead
<http://www.atsdr.cdc.gov/cabs/lead/#population>