



## CHAPTER 2

### HEALTH EFFECTS: HOW LEAD AFFECTS THE BODY

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## Learning objectives

In this chapter you will learn

- how lead enters and affects the body
- why lead is especially dangerous to children
- how lead levels in the body are measured
- how lead poisoning can be prevented



### **Skit: Lunchtime on the job site**

Tanja, Al, Joe, and Walt are eating lunch on the back porch of a home they are renovating. They live in the community where the home is located. They have been renovating the houses in this community for nearly a month. Let's listen to them while they eat lunch:

**Al:** This porch is feeling like home. We've worked on these houses for a month now. We'll be done by next week.

**Tanja:** It'd feel more like home if we had a table and a few chairs to sit on. I'll be glad when this job is over. I'm tired. My body aches from all this work.

**Joe:** Women weren't made to work construction—that's why your body aches. I don't want a table or chairs. I want a clean bathroom and some cold water to drink. This porch is dirty. Maybe we could get some of that poly plastic and lay it on the porch . . . man, I'm dizzy.

**Al:** Tanja, I've seen you do twice as much work as Joe in a day. Are you sick?

**Walt:** Hey, Joe, too much partying last night? We've worked on these houses for almost a month. I won't miss this porch at all. I used to get real hungry by lunch time. I was eating two or three sandwiches. I'm working just as hard now, but I don't even want to finish one sandwich anymore.

**Al:** Walt, you usually eat like a horse. Ask your wife to fix your lunches again.

**Walt:** My wife made my favorite pot roast last night. I couldn't eat it. It tasted so good, but I wasn't hungry. My stomach hurt. All I wanted to do was go to sleep.

**Joe:** I wish I could get some sleep. The past week I got these headaches and people just bothered me. You know, people are getting on my nerves. The doctor says it's because I'm constipated.

**Al:** You all sound like you got the flu or some kind of bug. Stay away from me. I'm feeling just fine and I want to stay that way.

**Discussion questions**

1. What is going on in this conversation?  
Circle them in the script. Is everyone feeling sick?
2. What were the workers' complaints?  
Circle them in the script. Is everyone feeling sick?
3. Do any of the workers share the same problems?
4. List some things that could be causing these complaints.
5. What suggestions were made to fix the problems?  
What would you suggest?





### Lead poisoning affects you

Lead is poisoning many children and adults around the country. As a lead abatement worker, you can also be poisoned by lead. It can make you very sick and can even kill you. At low levels of exposure, you can feel fine, but lead is still harming you. When you work with lead, you must work carefully. Lead poisoning can be prevented by working with lead-based paint safely. You are in this class to learn how to protect yourself, others, and the environment from lead.

As a construction worker—especially if you do remodeling, demolition, or lead-based paint abatement work—you may be exposed to lead. Without proper protection, **you can get sick from lead in the workplace.** You should wear a respirator and protective clothing when you work with lead. Clean up, shower, and put on clean street clothes before going home. If you forget to shower before leaving the job site or you wear dirty work clothes home, you could expose your family to lead.



## How much lead is dangerous?

Even a small amount of lead can make you sick. Lead can remain in the body for a long time. It stays in the blood for several months and can be stored in the bones for 30 years or more.

The more lead you are exposed to, the more likely you are to get lead poisoned. Many small doses of lead over a long time can cause lead poisoning. One large dose of lead in less than a day can also make you lead poisoned. A low dose of lead can make you feel tired and irritable. A high dose of lead can cause permanent damage to your brain, nervous system, and kidneys. A very high dose of lead can cause death.

**Even a small amount of lead can harm you.**



## How does lead get into your body?

Lead can get into our bodies in two ways: breathing (or inhalation) and eating (or ingestion).

### **Breathing lead**

When lead is in the air, you can breathe tiny lead particles into your lungs. Once in your lungs, lead is absorbed into your blood stream.



### **Eating lead**

You can swallow lead particles by eating, drinking, smoking, or chewing your fingernails without washing your hands after working with lead. If you swallow lead particles, the lead eventually goes through your digestive system and then slowly gets into your blood.

Up to 50 percent of the lead that children and pregnant women ingest is absorbed into their bodies. About 10 to 15 percent of the lead that nonpregnant adults ingest is absorbed into their bodies. People who do not get enough calcium or iron in their diets will absorb more lead into their bodies.



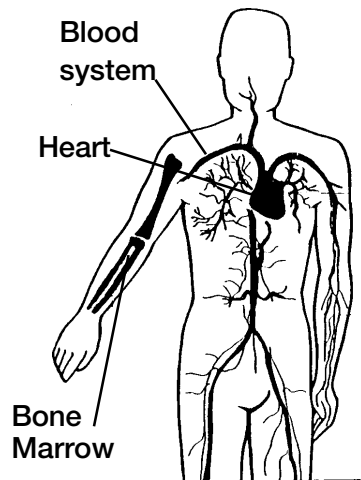
**You can breathe or swallow lead.**

**You may swallow lead if you don't wash before you eat or smoke.**





## How can lead harm your body?



### Heart and blood system

When lead reaches your blood, it attaches to red blood cells in the area where iron and oxygen are. If your body does not get enough iron, lead will attach to the red blood cells more quickly. Then, the red blood cells cannot carry oxygen, and you cannot get oxygen to the rest of your body. Without enough iron or red blood cells in the blood, a condition called **anemia** can develop. Anemia can make you very tired.

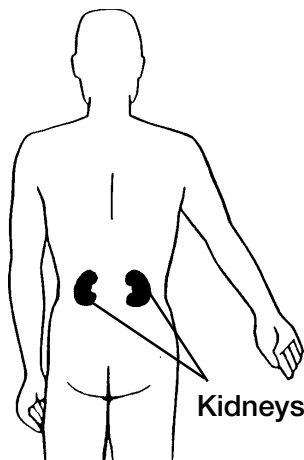
Lead can damage red blood cells by shortening the life of the cells. Lead also reduces your body's ability to make more red blood cells in the bone marrow.

Lead poisoning may cause high blood pressure.

When you have high blood pressure your heart muscles cannot relax. This increases your risk of heart attack and stroke.

Lead attaches to your red blood cells.

Lead can cause high blood pressure.



### Kidneys

Your blood is cleaned and filtered in your kidneys. Most (65 percent) of the lead that is in the blood gets filtered in the kidneys, where it can cause damage. Kidney damage can be very serious. Often this damage cannot be detected until much of the kidneys' function is lost. This damage requires serious medical treatment to prevent the kidneys from failing. Kidney failure can cause death.

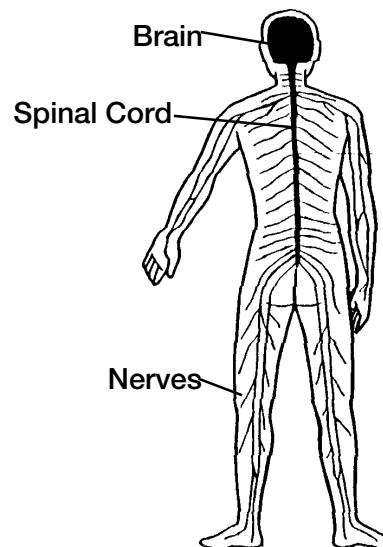
### Nervous system

The nervous system is the system in your body most affected by lead. The nervous system includes your

rain, spinal cord, and nerves. The damage lead causes to the nervous system can be permanent.

Lead damages the brain and can even kill brain cells. Lead damage to your brain can make you depressed, irritable, forgetful, clumsy, and affect your ability to learn. At very high doses, lead poisoning can cause hallucinations, swelling of the brain, coma, and even death.

Lead damages the ability of your nerves to give and receive messages. Lead can damage the nerves that go to your hands and feet. This nerve damage can cause your hands to shake; and in severe cases, it can cause your hand or foot to become weak and drop. If wrist drop or foot drop develops, you may never have full use of your hand or foot again.

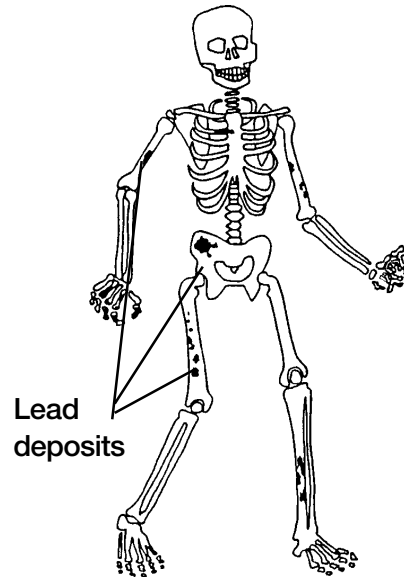


Lead can damage your kidneys.

Lead can damage your brain and nerves.



The nervous system of a fetus, infant, or child is affected by even small amounts of lead. Lead poisoning can decrease the intelligence of children. Lead can cause behavior problems in children. Some studies have linked learning disabilities, such as attention deficit disorder (ADD), and delinquent behavior to childhood lead poisoning.



### Bone tissue

As blood travels through the bones, lead from the blood is deposited into the bone tissue. Lead blocks your body's natural process of making new blood cells.

Lead also competes with calcium in the bone. Calcium is released from bone tissue as our bodies need it. If lead is there instead of calcium, then lead is released into the blood.

The bones and teeth store 95 percent of the lead in the body. **Lead can be stored in bone tissue for more than 30 years.** Lead can be cycled from bone to blood to body organs. When the body is under stress, lead is released from the bone tissue into the blood. A body is under stress during illness, overactivity,

pregnancy, or during times of anxiety. **If the lead goes from the bone back into the blood, then other body systems are exposed, and problems can begin all over again.**

Lead that stays in your body is called a “**body burden.**” The more lead you are exposed to, the higher your lead body burden is. The lead body burden is not easy to measure because it is mostly found in your bone tissue. Samples of bone tissue are difficult to get. A child's tooth can be tested for lead when it falls out. The tested tooth can tell you how much lead is in the child's bones—that is, the child's lead body burden. A special X-ray machine can measure shin bone lead to tell us body burden, but these machines are used for research only.

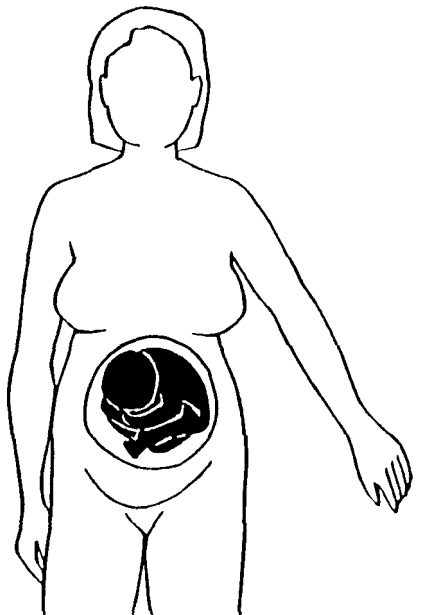


## Health Effects: How Lead Affects the Body

### Female reproductive health and Pregnancy

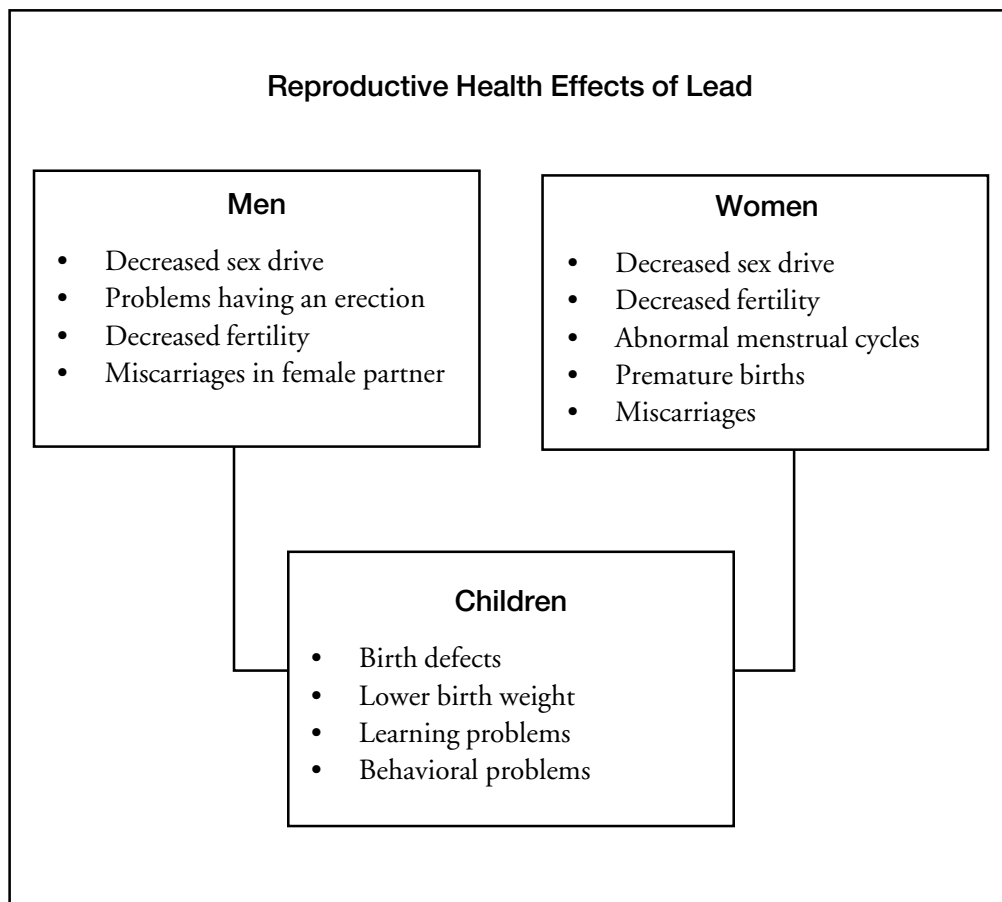
Lead poisoning is very dangerous to the female reproductive system. It can make women less fertile and can cause abnormal menstrual cycles and affect menopause.

During pregnancy, current or past exposure to lead by the mother could present a risk to the fetus. When a woman is pregnant, the fetus gets blood from the mother. If the mother has been exposed to lead, the lead absorbed by her body could be released and passed on to the fetus through the blood. This lead could cause brain damage and even death to the fetus. It could also cause miscarriages and premature (early) births.



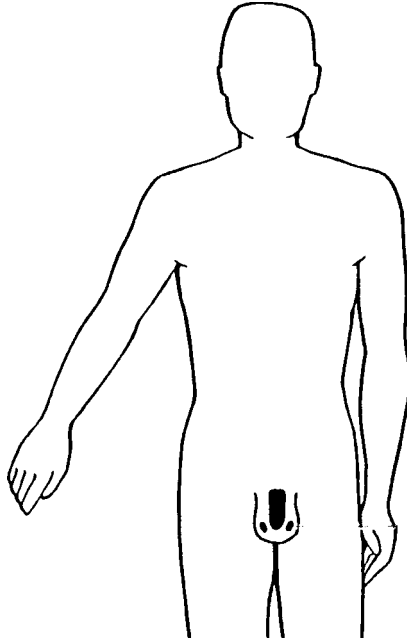
Even a small amount of lead can make a pregnant woman sick.

Lead can cause miscarriages and birth defects.





Lead can cause men to have difficulty having an erection.



### Male reproductive system

Lead is very dangerous to the male reproductive system. Lead can make men lose interest in sex, and it can cause men to have problems having an erection. Lead can cause infertility. It damages sperm. Lead causes the sperm to have an odd shape. It makes sperm move slowly. Wives of leadpoisoned workers have more miscarriages and premature births, and their children have more birth defects.

### Fetal protection policies

In the past, many companies developed policies with the stated purpose of protecting the fetus. They were called **fetal protection policies**. Fetal protection policies may really have been developed to protect the companies against lawsuits.

To keep their jobs, women were forced to prove they could not have children. Women who wanted to have children in their lifetime were fired or given lower paying jobs. In some cases, women had to be sterilized to keep their jobs.

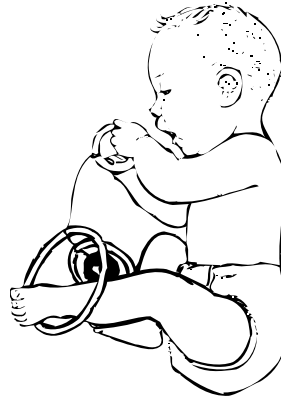
In 1991, the Supreme Court decided that fetal protection policies discriminated against women. Fetal protection policies are now illegal.

Lead affects both male and female reproductive systems. Both men and women need to be protected from harmful levels of lead to have healthy babies. The employer must provide a safe workplace for both male and female workers.



## Children are at high risk

Children can get lead poisoned very quickly. Even a small dose of lead can poison a young child. A child's rapidly developing brain, central nervous system, and entire body are affected by lead. Toddlers (age one to three) are at a very high risk of lead poisoning, because they typically crawl on floors and put things in their mouths and therefore can swallow a lot of lead dust. Children absorb up to 50 percent of the lead that they take in.



Recent medical research indicates that lead may affect a child's intelligence even at blood lead levels below 10 micrograms per deciliter ( $\mu\text{g}/\text{dL}$ ). Lead-poisoned children have a higher high school dropout rate than non-lead-poisoned children. Lead poisoning can reduce a child's ability to learn. It can also cause

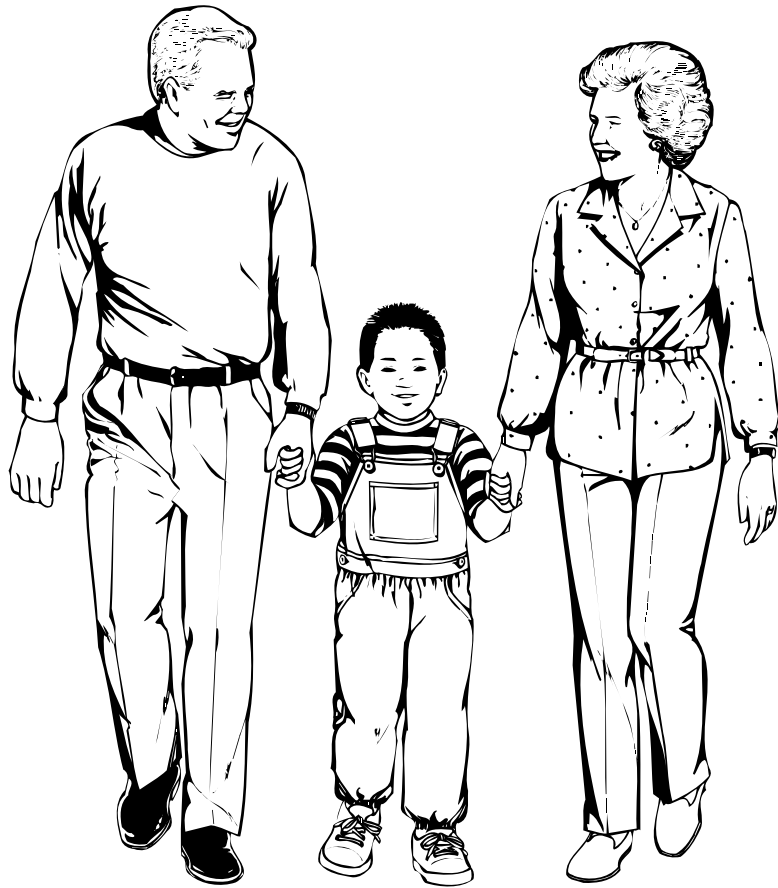
- poor muscle and bone growth
- poor hearing
- speech and language problems
- coordination problems

Lead is the most significant environmental health hazard for children in the United States. Some research has suggested that children exposed to lead may be hyperactive. Other studies have found evidence that lead can make a child react very slowly. Still other research studies indicate that lead can make it hard for a child to pay attention (Attention Deficit Disorder). Lead can make a child very clumsy. Lead kills brain cells and disrupts nerve signals. The effects of childhood lead poisoning can last a lifetime.

**Even low levels of lead can cause permanent damage to a child.**

**Children's developing bodies and brains are easily damaged by lead.**

**Lead is the most significant environmental health hazard for children in the U.S.**



### **Protect yourself and your family from lead poisoning!**

Julia's husband Mike is an auto mechanic and machinist. He is exposed to lead on the job. Julia was exposed to lead on the job for three months while she worked in a shipyard as a burner. Two years later, Julia became pregnant with their son. The parents' lead exposure may have affected their son's health.

"As my son grew up," says Julia, "he developed learning disabilities. He had a lot of trouble paying attention and following directions. He has really poor organization skills. We had to send him to a special education program for several years. My son is 14 years old now. He's doing better, but he still needs help organizing. He still needs special care."

From interview with a worker. (The names have been changed.)



### Health effects of lead poisoning

Lead poisoning can affect you in many different ways. A large amount of lead can make you sick right away. A small amount of lead day after day can make you sick over a long period of time.

The health effects of lead poisoning are often difficult to recognize. There are many different signs and symptoms of lead poisoning that can also be caused by a number of other things, like the flu or a cold. Because the symptoms are so similar, lead poisoning can easily be mistaken for a cold or the flu.

Sometimes the signs of lead poisoning come and go. You have them one day and then they disappear. Then the signs come back again. This can happen for several months.

Lead can cause damage without symptoms. Lead poisoning often goes unnoticed, and you may not know you have lead poisoning. Children with lead poisoning may seem healthy while damage is being done to their bodies. Signs and symptoms of the damage usually do not develop until the condition is serious.

#### Signs and symptoms of lead poisoning

- Tiredness (fatigue)
- Sleep problems
- Dizziness
- Irritability
- Nervousness
- Headaches
- Difficulty concentrating
- Depression
- Forgetfulness
- Hyperactivity (children)
- Numbness
- Wrist or foot drop
- Weakness
- Clumsiness
- Joint and muscle pain
- Vomiting
- Loss of appetite
- Stomach aches
- Constipation
- Metal taste in the mouth
- Problems having healthy children

#### Some health effects of lead poisoning

- Anemia
- High blood pressure
- Damage to blood cell formation
- Kidney disease
- Brain damage
- Nerve damage
- Decreased fertility
- Premature births
- Miscarriages

You may not know that you have lead poisoning.

Lead can cause damage without signs or symptoms.

Lead poisoning is sometimes mistaken for the flu.

The health effects of lead poisoning are often difficult to recognize.



Lead can cause permanent damage.

### Short-term or long-term effects

Sometimes the effects of lead poisoning are **short term**. This means they do not last a long time—maybe a few weeks or months. Sometimes the symptoms of lead poisoning are **long term**. This means the symptoms stay with you a long time—sometimes for years or even permanently. Long-term effects can be caused by repeated small doses of lead or by a very high dose at one time.

### Reversible or permanent damage

Some effects of lead poisoning can be **reversed**. This means the effects may go away. High blood pressure is an effect of lead poisoning that is reversible. High blood pressure can return to normal when the lead in your body decreases.

Lead poisoning can cause **permanent damage**. This means that the damage is always there. An example of permanent damage caused by lead is wrist drop. Wrist drop is when your wrist hangs limp at the end of your arm. You may never be able to use that hand again. Wrist drop is caused when lead damages your nervous system. When lead damages the development of the electrical connections in a child's brain, the effect is permanent.

#### Lead can cause permanent damage to your

- brain
- learning ability
- coordination
- hearing
- nerves
- digestive system
- heart
- blood cell formation
- kidneys
- reproductive system





### Testing for lead in your body

The only way to determine the amount of lead in your body is to get a blood test. When lead enters your body, it gets into your blood. The amount of lead in your blood is called your **blood lead level**.

There are two kinds of tests to monitor blood lead levels—the blood lead level test and the ZPP test (zinc protoporphyrin). Both tests can be done from blood taken from either your arm or your finger. Both can be done from the same sample of blood.

#### Blood lead level test

This test measures the amount of lead in your blood. Blood lead levels are only a snapshot of lead exposure. The test shows how much lead you have been exposed to in the **last 6 to 8 weeks**. The blood lead test is the more accurate test. Your blood lead level is measured in **micrograms** of lead per **deciliter** of blood ( $\mu\text{g}/\text{dL}$ ).

#### ZPP test (Zinc Protoporphyrin)

ZPP is produced when lead stops one of the body's building blocks from making blood. Your ZPP level becomes abnormal when a lot of lead has entered your body over the last **few months**. It tells how much lead your body has absorbed by looking at some of your body's building blocks. It does not measure the amount of lead in your blood. Results are measured in **micrograms per deciliter** ( $\mu\text{g}/\text{dL}$ ). Normal results for the ZPP test are 35-50  $\mu\text{g}/\text{dl}$ . The ZPP test is not as accurate as the blood lead level test for early or low-level lead exposures. ZPP results can vary because of diet, anemia, and other factors.

**Blood tests find out how much lead is in your blood.**

#### Understanding Units

A **microgram** is a measure of weight. There are 1 million micrograms in a gram. The abbreviation for microgram is  $\mu\text{g}$ .



A penny weighs about two grams. Imagine cutting a penny into 2 million pieces. A microgram would weigh the same as **one** of those 2 million pieces.

A **deciliter** is a measure of volume. It is equal to a little less than half a cup. A person weighing 165 pounds has about 60 deciliters of blood. The abbreviation for deciliter is **dL**.





**You may not know that lead is harming you.**

**People have different reactions to the same blood lead level.**

### Blood lead levels

Recent studies claim that lead can be harmful at blood levels below 10 µg/dL. Imagine that penny broken up into 2 million pieces again. Now picture 10 of those pieces dissolved in a half cup of liquid. That tiny amount of lead in your blood can cause health problems!

**Lead is dangerous because it builds up in your body.** It can stay there for years. It is difficult to say exactly what happens to your body with specific lead levels because each person is different. Different people have different reactions to lead in their bodies. You may not know that lead is harming your body. Some people do not even know that they are having problems with lead poisoning when their blood levels are 60 µg/dL. Other people suffer obvious signs of lead poisoning at 30 µg/dL.

#### ADULT REACTIONS TO LEAD

Blood Lead Level	Possible Health Effects
15 µg/dL	Increase in blood pressure; harmful effects on fetus; joint and muscle aches
25 µg/dL	Reproductive problems
40 µg/dL	Kidney damage; damage to blood formation
60 µg/dL	Anemia; nerve damage; constipation; stomach pains; irritability and fatigue; memory and concentration problems; clumsiness; drowsiness and sleep problems
80 µg/dL and above	Blue line on gums; uncontrollable shaking of hands; wrist and foot drop; hallucinations; brain damage; coma; death

**ATSDR 1989; California Health Department 1993**



Every child is also different in his or her reaction to lead. A lead poisoned child may not look or act sick but his or her body is being damaged. Researchers have known for a long time that children are especially sensitive to lead exposures. Scientists have discovered that even very low exposures to lead can cause serious health effects in children.

In 1991, the Centers for Disease Control and Prevention (CDC) lowered the level of concern for children's blood lead levels from 25  $\mu\text{g}/\text{dL}$  to 10  $\mu\text{g}/\text{dL}$ . About 2 percent of all children aged 1 to 5 years (about 400,000 children) are estimated to have blood lead levels at or above 10  $\mu\text{g}/\text{dL}$ . Lead dust from deteriorating lead-based paint is the major source of lead exposure for children.

**The effects of lead can be different for each child.**

CHILD REACTIONS TO LEAD	
Blood Lead Level	Possible Health Effects
10 $\mu\text{g}/\text{dL}$	Slight loss in IQ; hearing and growth problems
20 $\mu\text{g}/\text{dL}$	Moderate loss in IQ; hyperactivity; poor attention span; difficulty learning; language and speech problems; slower reflexes
40 $\mu\text{g}/\text{dL}$	Poor bone and muscle development; clumsiness; lack of coordination; early anemia; fewer red blood cells to carry oxygen and iron; tiredness; drowsiness
50 $\mu\text{g}/\text{dL}$	Stomach aches and cramps; anemia; destruction of red blood cells; brain damage
100 $\mu\text{g}/\text{dL}$ and above	Swelling of the brain; seizures; coma; death

**A child who has lead poisoning may not look or act sick.**



**Lead poisoning can be prevented.**

## **Preventing lead poisoning**

One way of reducing the chance of lead poisoning is to properly abate lead-based paint hazards in homes that are occupied by children. Lead-based paint **abatement** eliminates the lead hazard permanently. Abatement can be expensive and often cannot happen right away. In that case **interim controls** may be used to control the lead hazard. “Interim” means temporary. Interim controls reduce the amount of lead that children are exposed to without permanently removing the source. Depending on the extent of the lead hazard, interim controls may not take the place of abatement. **By doing lead abatement and using interim controls, you are helping prevent lead poisoning.** (Chapter 6 will cover abatement and interim controls.)

## **Making sure that you do not get sick**

When you work with lead, you have a higher risk of getting lead poisoned. As much as possible should be done to reduce that risk. Some things that you can do are

- make sure your employer provides a safe workplace;
- know your rights as a worker;
- wear protective gear;
- use safe work practices;
- make sure you don't create a lead hazard while you work;
- use good personal hygiene;
- do not take lead home on your clothes or in your car;
- get the medical exams that your employer provides;
- inform your employer if you develop any signs of lead poisoning;
- avoid lead-related work if your blood lead level is too high;
- eat a balanced diet.



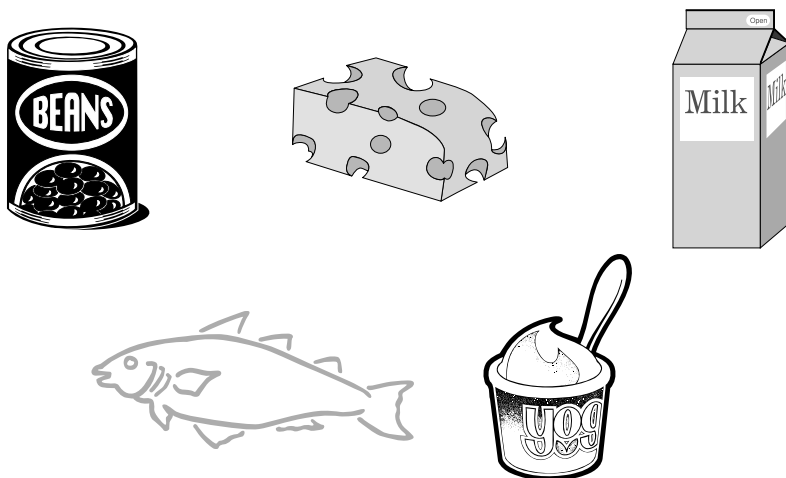
## Health Effects: How Lead Affects the Body

### Good nutrition

Good nutrition is important for anyone exposed to lead. A diet with enough iron and calcium prevents worse lead poisoning. When you eat a diet high in iron and calcium you can reduce lead absorption. People with low amounts of iron and calcium absorb more lead than those with normal amounts of iron and calcium. If you have enough iron and calcium in your body, lead will be absorbed less quickly. Research shows that vitamin C, zinc, and protein—found in a well-balanced diet—appear to decrease lead absorption. Foods with a lot of fat, such as fried foods, appear to increase lead absorption. When choosing dairy products, try to eat low-, non-, or reduced-fat varieties.

**Eat foods high in iron**—cheese, fish, seafood, meat (especially liver), eggs, spinach, beans, raisins, apricots, seeds (pumpkin, squash, sunflower), black walnuts, almonds, barley, wheat germ.

**Eat foods high in calcium**—milk, cheese, ice cream, yogurt, bread, fish, seafood, meat, beans, broccoli, leafy green vegetables (spinach, etc.), cherries, blackberries, raisins, fruit juice (orange, prune, grapefruit, pineapple), peaches, apricots, dates, sunflower seeds, almonds, hazelnuts, pecans.



**Eat a balanced diet with foods high in iron and calcium.**



### Key facts for Chapter 2



**Lead can poison you and make you very sick.**

Even a small amount of lead can make you sick.

Lead is dangerous when you breathe or swallow it.

Lead can cause permanent damage.

Children's developing brains and bodies are easily damaged by lead.

Even low levels of lead can cause permanent damage to a child.

Pregnant women and children are most easily lead poisoned.



**Lead in your body**

Lead can damage your body without your feeling any symptoms.

Lead poisoning can easily be mistaken for the flu.

Lead attaches to your red blood cells and travels through your body.

Lead can be stored in your body for more than 30 years.

**Body burden** is the amount of lead stored in your body.

Lead can be released from your bones and poison you.

Lead can harm many parts of your body—blood cells, heart, kidneys, nervous system, bone tissue, and reproductive organs.

Lead can cause men to have **problems having an erection**.

Lead can cause women to have **stillbirths** or **miscarriages**.



**Blood tests**

Blood tests find out how much lead is in your blood.

The tests used are: blood lead level test and zinc protoporphyrin (ZPP) test. The blood lead level test is the more accurate test.

Blood lead levels are measured in micrograms of lead per deciliter ( $\mu\text{g}/\text{dL}$ ) of blood.

People can have different reactions to the same blood lead level.

Lead poisoning can be prevented.



Your work as a lead abatement worker will prevent future lead poisoning.

**You can protect yourself against lead poisoning.**



- Make sure your employer provides a safe workplace.
- Wash your hands and face carefully when you leave the work area.
- Use safe work practices that you will learn in this class.
- Eat a balanced diet that has enough iron and calcium.



### For more information

These publications have more information on the topics covered in this chapter. Your instructor may have a copy of the publications marked with a star (\*). You can order your own copy by calling 1-800-424-LEAD.

\* CDC, *Preventing Lead Poisoning in Young Children* (October 1991).

\* Environmental Defense Fund, *Legacy of Lead: America's Continuing Epidemic of Childhood Lead Poisoning* (March 1990).

\* EPA, HUD, and CPSC, *Protect Your Family from Lead in Your Home* (June 2003).

Murphy, J. "Fetal Protection v. Women's Jobs: Case Is Before the Supreme Court," *The Nation's Health: Official Newspaper of the American Public Health Association* (November 1990).

National Lead Information Center, "Lead Poisoning and Your Children."