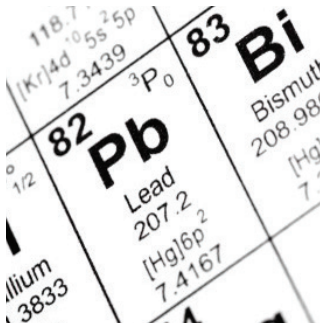


Get the Lead Out

The old expression “Get the lead out” is short for “Get the lead out of your pants,” or, in other words, “Hurry up!”

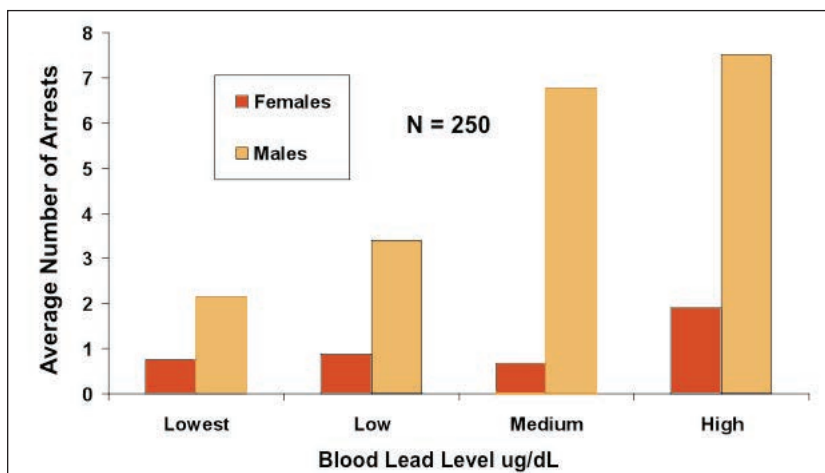
Lead, a dense metal, would certainly slow you down if it filled your pockets. People have used lead throughout history because it is fairly easy to find in the form of ore (lead-containing minerals), the metal easily melts for casting into useful shapes, and the chemical compounds of lead have useful properties.



As useful as lead is, scientists have learned that lead compounds are highly toxic. Research shows that lead exposure in early childhood damages the brain. Mary from Baltimore, Maryland, has claimed to see the effects of lead poisoning in her son, Evan. In 2004, Evan was convicted of first-degree murder and sentenced to life in prison. Mary believes that lead poisoning played a role in his crime, saying, “He never had any problems until he was poisoned [as a child].”

Mary’s observations are supported by the results of a project called the Cincinnati Lead Study. This study has followed a group of Cincinnati residents from birth until today — a span of 33 years — and still continues. The study shows a clear relationship between blood lead levels in childhood and adult criminal behavior.

Criminal Arrests Among Cincinnati Lead Study Participants



Wright, Dietrich, Ris et al. 2008

These days, “get the lead out” might describe the outlawing of lead compounds used in paint and gasoline in the 1970s. Unfortunately, lead remains in the environment, largely because of these two products. Lead from gasoline exhaust has accumulated in soil, and lead-based paint remains in many homes built before the ‘70s.



This coloring book from the 1920s showed members of the “lead family” (other products containing lead) joining Dutch Boy for a party.

Even as knowledge about the dangers of lead paint grew in the 1920s and ‘30s, the National Lead Company, makers of Dutch Boy Paint, actively advertised to children.



This old pump has a sign showing that the fuel it dispensed contained lead.

Although the use of lead in paint and gasoline for cars has been outlawed, lead metal or lead compounds are still used in aviation fuel, batteries, bullets, fishing sinkers, crystal, ceramic glazes, X-ray machines, and nuclear reactors.

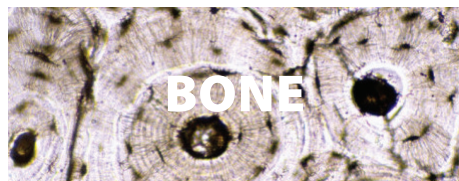
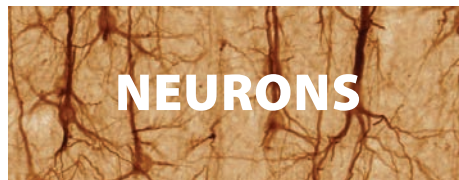
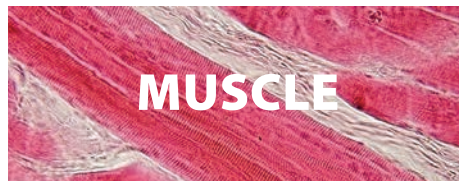
Why is lead so harmful?

Lead is toxic because it is very similar to another metal —calcium— that is essential for many important cell functions. You may have been told to drink or eat calcium-rich foods for strong bones and teeth, which is certainly important, but calcium does much, much more.

Once lead enters your body through ingestion (eating) or inhalation (breathing), cells absorb lead in the same way that they absorb calcium. Once in cells, lead interferes with normal cell functions that depend on calcium.

The many jobs of calcium

- Calcium is involved in the process of blood coagulation.
- Calcium is an essential part of muscle contraction.
- Calcium helps maintain normal blood pressure.
- Calcium ions are part of an information pathway that tells cells about chemicals in their environment.
- The flow of calcium ions between neurons (nerve cells) is essential for brain development and function.
- Calcium is the main component of bones and teeth.



ULABS



A worker in Kenya sorts through used lead acid batteries. Photo by Blacksmith Institute.

Recycled lead is valuable, and many developing countries have entered the business of buying used lead acid batteries (ULABs) in order to remove and sell lead.

ULABs are often shipped over long distances from the industrialized countries that produce and use the batteries.

ULAB lead removal businesses are often located in countries with few (if any) pollution controls. These businesses often release large amounts of lead contaminated waste into the local environment.

The Blacksmith Institute estimates that over 12 million people are affected by lead contamination from processing of ULABs throughout the developing world.

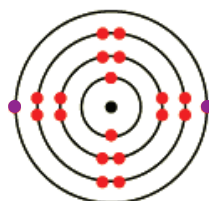
Why can lead mimic calcium?

Lead can mimic calcium in cells because lead and calcium are both metals that readily form an ion with a charge of 2+.

A 2+ charge means that the calcium ion is missing two of the electrons found in the calcium atom. The charge of an ion is an important factor in its interactions with other ions and compounds.

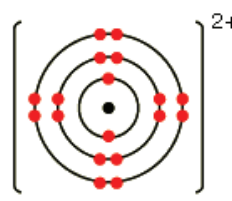
calcium atom

symbol: Ca
electron
configuration:
2,8,8,2



calcium ion

symbol: Ca²⁺
electron
configuration:
[2,8,8]²⁺



How does lead enter the body?

Lead can enter your body through your mouth (ingestion) or lungs (inhalation).

If a home or school has lead paint, lead-containing dust forms where painted surfaces rub together. The soil in the yard or playground can also be contaminated with lead from peeling paint or particles from gasoline exhaust.

A common route of lead ingestion is touching lead dust from paint or contaminated soil followed by putting fingers in your mouth or on your food.

Less common sources of lead ingestion are chewing on lead-containing substances (such as paint chips or toys) or eating food grown in lead-contaminated soil.

Lead also enters the body through inhaling lead dust or air contaminated with lead fumes, such as near industrial sources.



Urban gardening and backyard chickens are becoming popular, especially with people who want to avoid pesticides or antibiotics often used in large-scale farming. Unfortunately, vegetables or chickens raised in urban areas with lead contamination can become sources of ingested lead.



Wildlife is also harmed by lead. Birds and fish may eat lead shot or lead fishing sinkers, mistaking them for pebbles.

Bone—An accidental lead bank

Because of its ability to mimic calcium, some of the lead that enters the body ends up being stored in the bones along with calcium. One of the functions of bone is to provide a storehouse of calcium ions. The hardness of bone might lead you to think it never changes. But bone actually breaks down and rebuilds throughout life in a process called remodeling.

During remodeling, calcium ions are constantly leaving dying bone cells, circulating in the blood, and then becoming part of new bone cells. If bones also contain lead, the lead ions can leave the bones and circulate just like calcium.

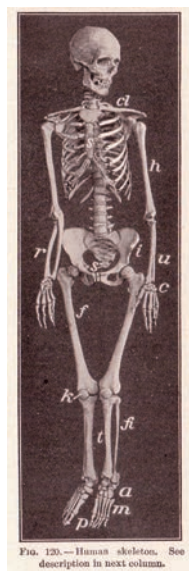
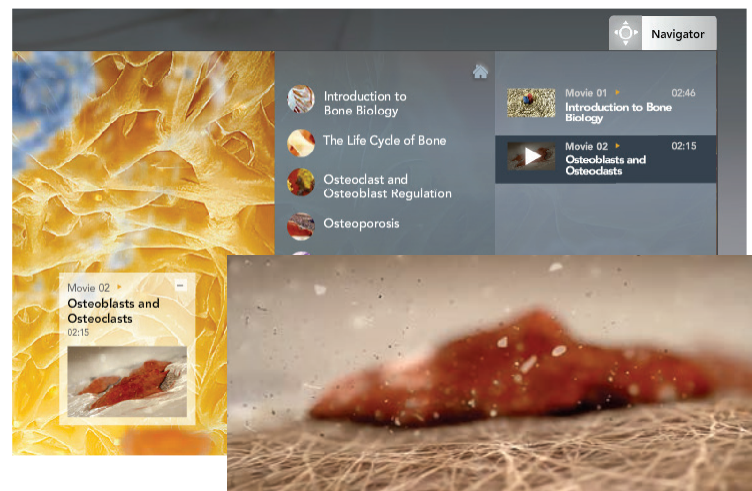


FIG. 120.—Human skeleton. See description in next column.

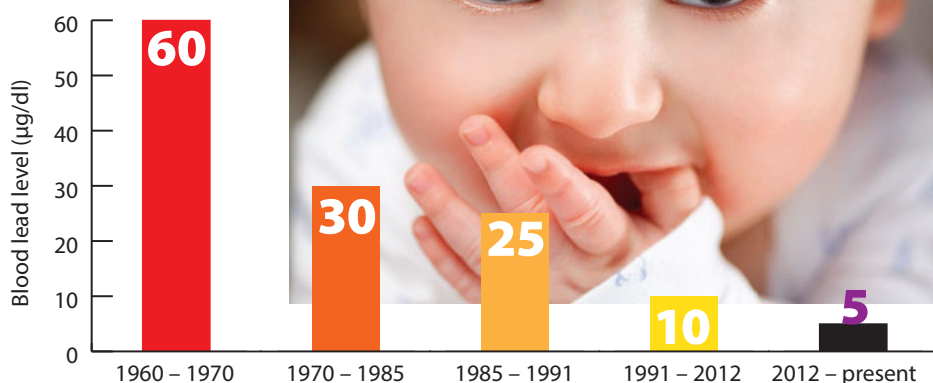


The amazing animation in [Movie 02 Osteoblasts and Osteoclasts](#) shows bone tissue being formed by cells called osteoblasts. Osteoblasts deposit collagen and also release calcium, magnesium, and phosphate ions—and, if present, lead ions. These ions combine within the collagen to form a crystalline mineral called hydroxyapatite that makes up bone.

How much lead is harmful?

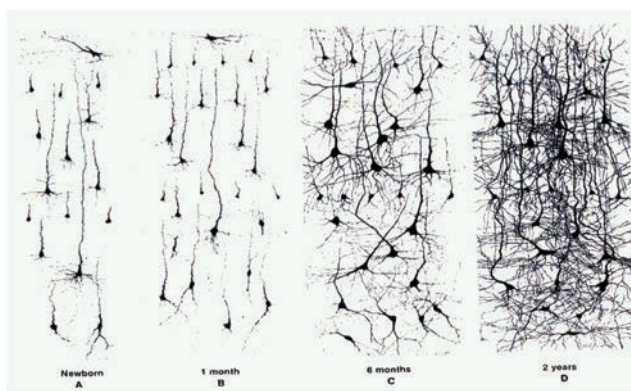
As scientists have learned more about the effects of lead on the developing brains of children, ideas about how much lead is harmful have changed.

Scientists now know that even at very low levels, lead exposure in early development shrinks key areas of the brain and leads to problems with learning and behavior. The effects of childhood lead exposure on the brain appear to be permanent.



Blood lead levels considered harmful to children

In May 2012, the U.S. Centers for Disease Control and Prevention (CDC) announced that 5 micrograms per deciliter (µg/dL) is now the level of lead at which notification of parents and follow-up actions, including eliminating sources of lead in the child's environment, are recommended. This new level is half the previous level of 10 µg/dL. The graph above shows how the level of lead considered harmful to children has changed since 1960.



The role of food in fighting lead

Eating and drinking calcium-rich foods and beverages helps fight the effects of lead exposure in two ways:

1. Before something we ingest gets into our bloodstream and cells, it must be absorbed by the digestive system.

Scientific research shows that increased dietary intake of calcium decreases the absorption of lead by the digestive system. So, even if you are exposed to lead and possibly ingesting it, getting enough calcium means less lead may be absorbed and more lead may be eliminated.



2. When the body needs more calcium, an increase in bone remodeling releases more calcium into the blood. If the bones contain lead, more lead is released at the same time. Getting enough calcium in the diet reduces the amount of calcium your body needs to get from bones. If less bone remodeling is needed to provide calcium, less lead is released.

Getting enough calcium from food is especially critical during pregnancy. Women without enough calcium intake during the second half of pregnancy are more likely to have elevated blood lead levels from previous low-level lead exposures. Lead in the blood of a pregnant woman is transported across the placenta, resulting in lead exposure to the developing fetal nervous system.

This picture shows the development of neural connections in the human brain from birth to two years. Exposure to lead interferes with this neural development.