Lead Poisoning Prevention

A Text for Grades 9-12

Prepared by the California Tableware Education and Enforcement Program

Lead Poisoning Prevention

Introduction

Lead, a relatively soft, heavy bluish-grey metal, is one of the elements, appearing as number 82 on the periodic table. Lead has been mined in more than 45 countries and on every continent except Antarctica. When ingested or absorbed into the body in significant amounts, lead can be damaging in a number of ways.

Lead was used to make pipes in ancient Rome when underground plumbing was first developed. The Romans also used lead for wine storage containers and for drinking goblets. Some scientists now say evidence suggests that many of the ancient Romans were suffering from lead poisoning , and that this perhaps may have contributed to the decline of the Roman Empire.

In the Twentieth Century lead has been widely used for many purposes, including the following:

- In gasoline as an antiknock additive.
- In paint as an ingredient for gloss and hardness.
- In pipes and plumbing fixtures.
- In glazes on ceramic dishes–lead added for shine and durability.

The Hazards of Lead

Even though lead occurs naturally in the environment, it serves no useful purpose in the human body, and when lead does get into the body it can cause lead poisoning.

The body first stores ingested lead in place of iron, in the blood cells. After a period of time, lead is deposited as a substitute for calcium in the bones and in developing brain tissue. In children, lead in developing brain tissue can lead to impaired brain functioning and development, including lower IQ levels and slower reflexes.

Mild lead poisoning symptoms include

28 Ni 58.71 Nickel	29 Cu 63.54 Copper	30 Zn 65.37 Zinc	31 Ga 69.72 Gallium	32 Ge 72.59 Gemanium	33 As 74.922 Arsenic	34 Se 78.96 selenium	35 Br 79.909 Bromine	36 Kr 83.80 Krypton
46 Pd 106.4 Palladium	47 Ag 107.870 Silver	48 Cd 112.40 Cadmium	49 In 114,82 Indium	50 Sn 118.69 Tin	51 Sb 121.75 antimony	52 Te 127.60 Tellurium	53 I 126.904 Iodine	54 Xe 131.30 Xenon
78 Pt 195.09 Platinum	79 Au 197.967 Gold	80 Hg 200.59 Mercury	81 Tl 204.37 Thallium	82 Pb	83 Bi 208.980 Bismuth	84 Po 210 Polonium	85 At 210 Astatine	86 Rn 222 Radon
96 Cm 247 Curium	97 Bk 247 Berkelium	98 Cf 251 Californium	99 Es 254 Einsteinium	100	101 Md	102 Nb 254 Nobelium	103 Lw 257 Lawrencium	

Lead/Pb

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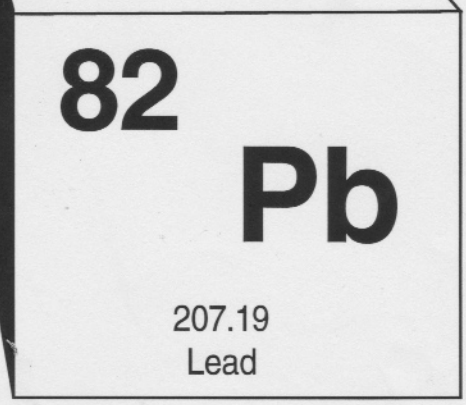


learning and developmental deficits in children, and high blood pressure and reproductive problems in adults. The symptoms of acute lead poisoning include high blood pressure, muscle weakness, seizures, fatigue and kidney and brain damage.

When a person is exposed to small amounts of lead over a long period of time , chronic lead poisoning can develop.

Children are especially sensitive to lead. Children with chronic lead poisoning can develop learning disabilities, decreased intelligence levels and behavior problems.

Lead Exposure

Although lead has been removed from use in many materials in recent years, it persists in the environment; past uses of lead have contaminated the soil, water and air in homes and backyards.

People can be exposed to lead by breathing contaminated dust, eating contaminated soil or drinking contaminated water.

Small children are exposed when they eat paint chips from the inside or the outside of the house, or from toys or furniture painted with lead paint. Even paint that isn't peeling can be a problem because the lead is present in dust that slowly forms on the surface of the paint. The hand-to-mouth behavior of young children makes it likely that they will get lead into their mouths when there is lead in their environment.

Household water pipes can contain lead or be soldered with lead. This lead can leak into the water that is used for drinking or cooking.

Lead can also be found in ceramic dishes. Dishes and glasses can contain lead-based glazes or paints that can leach into the food that is put into them.

In construction and in industry, many people work with lead on a daily basis. Lead dirt and dust from work can be carried on work clothes and shoes and can contaminate a home.

Lead cannot be seen or smelled. The only way to determine if lead is present is to test for it. Water, soil, dust, dishes and paint chips can all be analyzed for lead. If lead is present, the amount and location of the contamination will determine the steps to take to avoid being exposed.

Lead, though pervasive in our environment, is nonetheless avoidable with care and attention. Lead poisoning is a highly preventable disease.

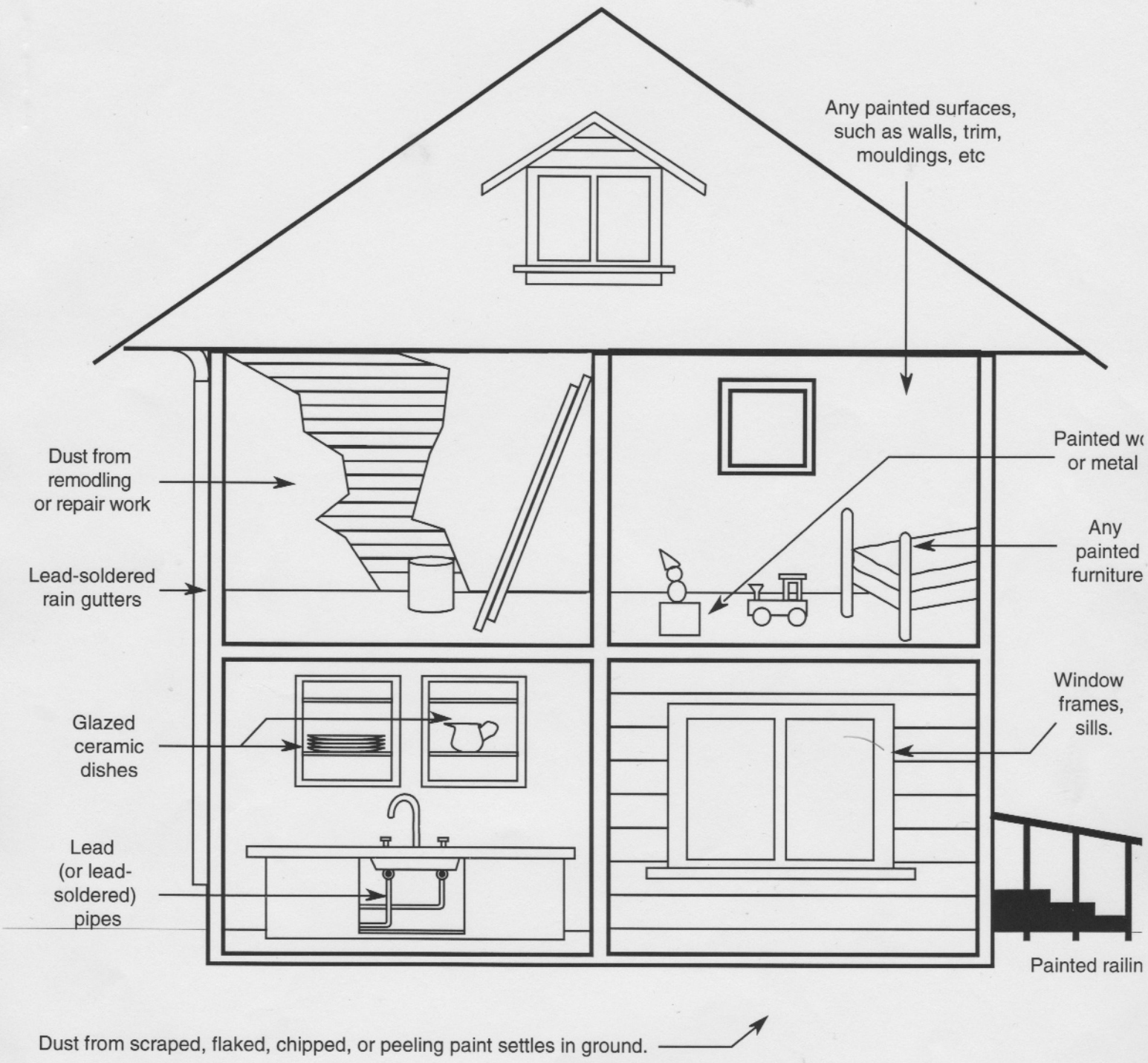
While children in inner-city neighborhoods are indeed five or six times more likely than others to suffer lead poisoning, no family is immune to exposure. One of every six children may have toxic levels of lead in their bodies, and millions more are at risk.

Even when the effects of lead poisoning are subtle, they can last a lifetime. Children process lead differently from adults, absorbing up to 50 percent of the lead they ingest, as compared to 10 percent in adults. Those under age 7 are at greatest risk because their still-developing brains and nervous systems are sensitive to small amounts of lead. Infants under age 1 may be most vulnerable of all.

Despite these guidelines, fewer than 10 percent of children have been tested for lead poisoning. To identify lower levels of lead exposure, blood must be analyzed in a laboratory. Researchers are currently working to develop a simpler way to test for low-

level lead exposure

Other sources of lead include folk medicines, cosmetics, ammunition, fishing weights, and toy soldiers. People can be exposed to lead at home by making stained glass, making pottery, refinishing furniture and burning lead-painted wood.

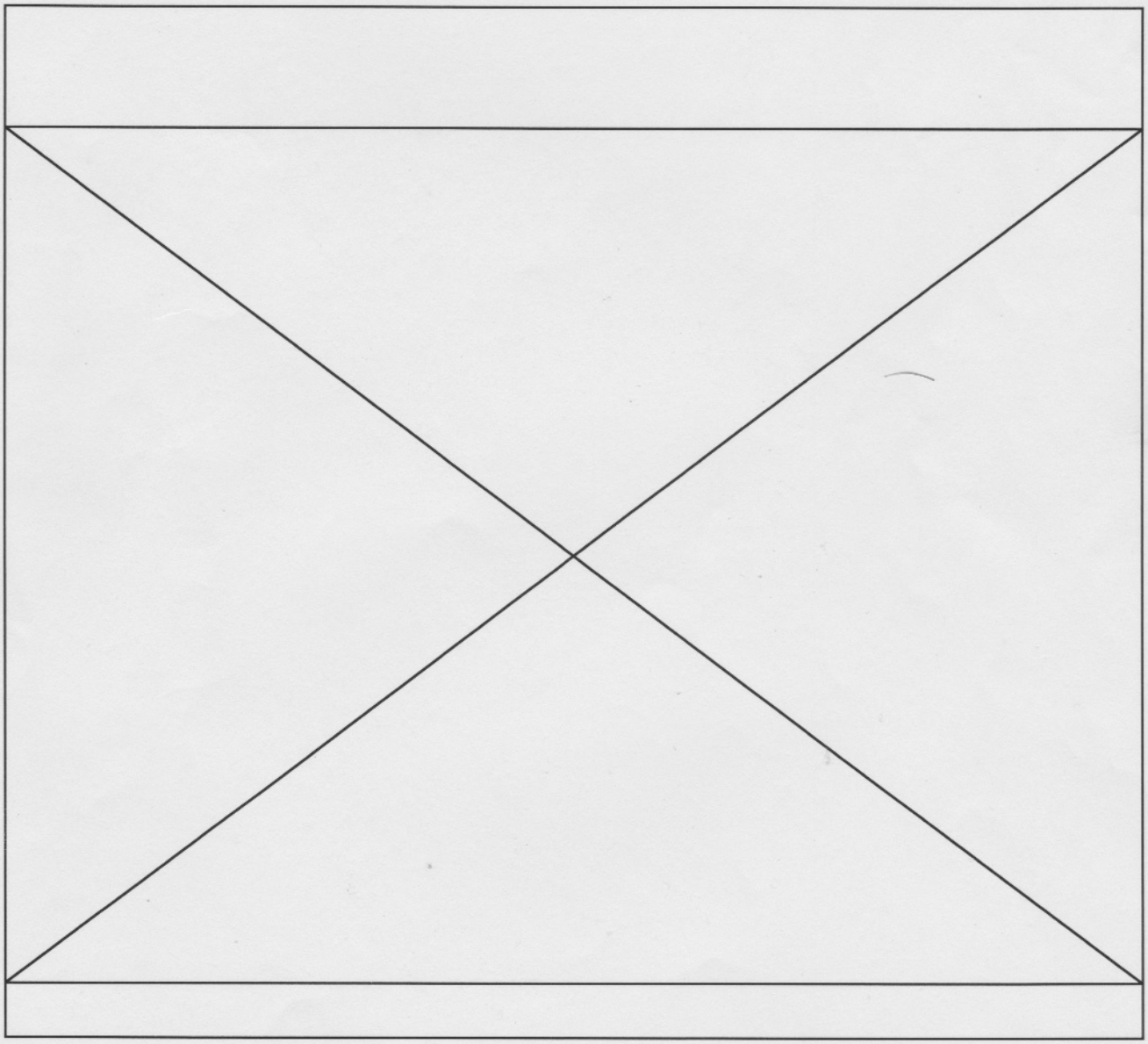

Any painted surfaces, such as walls, trim, mouldings, etc
Dust from remodling or repair work
Lead-soldered rain gutters
Painted w or metal
Any painted furniture
Glazed ceramic dishes
Window frames, sills.
Lead (or lead-soldered) pipes
Painted railin
Dust from scraped, flaked, chipped, or peeling paint settles in ground.

Lead Poisoning In Human Beings

Lead is a poison that affects virtually every system in the body. It is particularly harmful to the developing brain and nervous system.

The risks of lead exposure are not theoretical The risks are well-known and are based on carefully designed scientific studies that have been conducted on children who have been poisoned.

The Federal Center for Disease Control and Prevention (CDC) in Atlanta has set a standard for determining if a child is suffering from lead poisoning. If the child has more than 10 micrograms (written as **10µg**) of lead in every deciliter of blood, the child is considered to lead–poisoned. Before 1970, the standard was 70 micrograms per deciliter. As we have learned more about the subtle effects of chronic, low-dose exposure to lead, the standard has been dropping. Today's 10µg per deciliter may go even



lower.

What are the effects of lead poisoning?

Figure 2 shows the possible symptoms of lead poisoning at various levels of exposure.

Children who are exposed to very high levels of lead can suffer convulsions, coma or even death.

Lower levels can cause problems in the central nervous system, the kidneys, the reproductive system and the blood system. Low-dose lead exposure over a long period of time can cause decreased intelligence, reduced stature and growth, reduced fertility, decreased hearing ability, and a decreased ability to maintain a steady posture.

Unborn babies who are exposed to lead from their mothers may be born prematurely, and have low birth weight.

What are sources of lead exposure in children?

A child's environment is full of lead. Children are exposed from different sources such as paint, ceramic dishes and solder, and through different pathways such as air, food, dust, water, and soil.

Soil and dust act as pathways to children for lead deposited from paint, gasoline and industry.

The largest source of lead in the environment today is lead-based paint on old houses and other buildings. There are about 42 million houses in the United States that have been painted with lead-based paint. Before 1940, what we knew as paint was simply white lead oxide mixed with linseed oil and pigments. Houses painted before that time were literally painted with lead. Lead in paint for residential use was banned in 1978.

Contamination of drinking water with lead usually occurs in the municipal distribution system or through lead solder in household pipes. Lead in water is absorbed more completely than lead in food.

Municipal solid waste incinerators put more than 44,000 tons of lead into the air each year in the United States. This lead is then deposited on the soil around the incinerators.

Other sources of lead include folk medicines, cosmetics, ammunition, fishing weights, and toy soldiers. People can also be exposed to lead through making stained glass or pottery, refinishing furniture or burning lead-painted wood.

How lead enters and affects the body.

Lead has been used for industrial purposes in two different forms: organic lead and inorganic lead. Inorganic lead, such as that found in solder, paint, ceramics, plumbing, and crystal enters the body through eating or breathing. Organic lead, such as the tetraethyl lead that was used as an antiknock ingredient in gasoline can also enter the body through skin absorption. Lead can be inhaled when lead dust, mist or fumes are present in the air. Lead can be ingested when particles of lead from paint, soil, water or food are eaten or put into the mouth. For small children, ingestion is the main route of exposure.

The digestive systems of adults will absorb about 10 to 15% of any ingested lead. Small children and pregnant women will absorb

Chemistry/Lead in Ceramic Dishes

The physical and chemical properties of lead have contributed to its use as a component of ceramic dishes since the beginning of civilization. Most ceramicware sold in the United States today is coated with glazes that contain lead. A glaze is a thin, glassy coating that is applied and fused onto a shaped body of clay. After fusing by firing in a kiln, the dish has a shiny, smooth look. Cadmium is sometimes added to the glaze to enhance the vividness of the colors.

A ceramic glaze that contains lead must be fired at a very high temperature for a sufficient length of time to be sure that it is safe. The temperature and time vary, depending on the glaze formulation used, the size of the dish and other factors. If the glaze is properly formulated, applied and fired, the lead in the glaze will not leach out into the food that is put in the dish.

Most glazed dishes manufactured before very recently contain lead in the glaze. Practically everyone uses ceramic dishes, so this is one of the largest sources of lead contamination. It is a combination of the lead content of dishes and the way in which dishes are used that determines the risks of being affected by lead in glazes.

In 1989, California voters approved the Safe Drinking Water and Toxic Enforcement Act, known as proposition 65. Under this law, warnings must be put on dishes by their manufacturers if there is an potential for lead exposure from the dishes. The warnings are accompanied by a yellow triangle that is easy to spot, warning the consumer of the possible hazard. Dishes that don't contain lead hazards are not required to have this warning. Most dishes, are, in fact, lead-safe.

How does lead in dishes get into food ?

Lead in dishes can be either in the glaze on the dish, in the color for the decoration underneath or in a decoration on top of the glaze.

When acidic foods are put into a dish with a lead glaze that has not been fired at a high enough temperature, the acid in the food will eat away at the glaze, causing some of the lead to leach into the food.

Over time, even a properly fired glaze may disintegrate, exposing the lead in the pigments underneath the glaze.

Heat, such as that from cooking in a stove or microwave will increase the lead-leaching process.

Any ceramic pot used to cook for a long time, such as a pot used for cooking beans, can leach more lead into food because of the length of time the food is in contact with the glaze. The combination of cooking and storing food with high acidity in a ceramic pot can greatly multiply the amount of lead released into food

.

What kinds of dishes are the riskiest to use?

- Old, antique china or heirloom dishes that have been handed down from one generation to the next.

- Homemade or hand crafted china, either

made in the United States or abroad.

- Glazed terra cotta dishes made in the United States or abroad.

- Dishes with highly decorated multicolored inside surfaces.

- Dishes with decorations on top of the glaze instead of beneath it.

- Dishes that have a corroded glaze or a chalky or dusty residue on the surface. These dishes should never be used.

What kinds of dishes are usually safe to use?

- Clear glass dishes. Cut glass is often safe, but lead crystal can leach lead. Glass dishes have no glaze on them. Clear glass plates, cups, mugs and other dishes without painted or decal decorations on their surface are reliably lead-free.

- Stoneware dishes that don't have painted or decal-type decorations on the top. Stoneware is fairly heavy and often has a low shine instead of a bright, full gloss like glazed china. These dishes are usually coated with a material that contains no lead. Unless they have painted or decal type decorations on the top, stoneware dishes are almost as lead-free as glass.

- Lead-free china. This china looks just like other china but is made with a lead-free glaze. A number of large ceramicware manufacturers use all lead-free glazes.

Chapter V

Lead in the Environment

After a great pain, a formal feeling comes -
The nerves sit ceremonious, like Tombs -
The stiff heart questions was it He, that bore,
And Yesterday, or Centuries before?

The Feet, mechanical, go round -
Of Ground, or Air, or Ought -
A Wooden way
Regardless grown,
A quartz contentment, like a stone-

This is the Hour of Lead -
Remembered, if outlived,
As Freezing persons, recollect the snow -
First - chill - then stupor - then the letting go -

From *The Hour of Lead* by Emily Dikinson

Since lead is so pervasive in our environment, the hazards of lead poisoning are all around us.

Let's take a typical house, in a typical neighborhood. It looks innocent enough. But what are the chances that lead is lurking, and where? First, let's look at the yard.

Paint

Lead paint was commonplace until the 1978, when all lead was removed from all paint by law. Any house with paint still on it from before that time will probably contain lead.

In addition to this, paint that has been chipped, scraped, or simply flaked or fallen off of the surface of the house may have gotten in to the dirt in the yard. There often exists what is termed a *lead ring* around the house, meaning the area that is contaminated with lead dust. In the yard, painted swing-sets, bars, and other structures used by children may have peeling flaking paint that may contain lead.

As we approach he house, we see the painted walls themselves, along with windowsills, doors, and any other surface that may contain lead paint. Children touch these surfaces on a regular basis, and again small amounts of lead can build up on their hands, and get into their mouths.

As we step inside, we see the painted walls of the inside of the house, which ay contain lead. As we enter the kitchen, we see cupboards full of dishes, all of which have the potential for containing lead in the glazes. In the cupboard, are cans which may contain lead-soldered seams.

We approach the sink, where the faucets are attached to a plumbing system that may contain lead, either in the pipes themselves or in the soldered seams. The water also may contain lead from environmental pollution of the water supply itself.

We leave the kitchen, and enter a child's bedroom. Here, there are painted wooden toys, some of which may contain lead paint. These are often chewed by children. Any painted surface--cribs, playpens, bureaus, have the potential for lead contamination.

In the bathroom, old tubs, showers, sinks or other surfaces may have peeling paint, and all may have lead content.

A Widespread Problem

This well-kept house is fairly typical, with only a chance that there is serious lead contamination existing. In some areas, however, lead is so prevalent in deteriorating housing that overwhelming numbers of

children have been poisoned by it. Lead in paint dust is the leading cause of lead-poisoning in children. Lead dust is created by sanding, scraping paint off walls, or even just opening and closing painted windows.

Sources of Contamination

In addition to lead paint in housing, there are a number of other environmental sources of lead poisoning.

Food

Fresh fruit and vegetables may carry lead residues from soil or air tainted by pesticides or pollution. Lead from inks used on bread wrappers can leach into food if the bags are turned inside out and reused.

Water

In many old homes, plumbing installed before the 1930s consisted of lead pipes. More recent plumbing pipes generally consist of copper, galvanized iron, steel, or plastic. However, the solder traditionally used in the joints contained lead. In general, when the solder is new, the most lead is leached.

High levels can remain for as long as five years, but the highest levels from solder occur within the first two years. Over time, mineral deposits from the water passing through the pipes will coat the interior. This accretion reduces the lead level leached into the water.

More recently manufactured solder may be lead-free. In some areas, building codes now mandate use of lead-free solder.
The water in as many as 20 percent of American homes may have elevated lead levels. Lead can leach into tap water from lead pipes, connectors or service lines and from bronze or brass faucets, which contain lead. Even copper pipes can have lead solder. Random EPA audits at day-care centers and schools have found high lead levels in some drinking fountains with lead cooling chambers. Only half of the nation's schools have had
their water tested.

What else can be done to minimize lead in water? If lead is present in pipes, the water that is stored overnight will leach some lead. Therefore, it is a good practice to run the faucet for two to five minutes every morning to flush out water standing overnight in the pipes. Follow this procedure before drawing water for drinking or cooking purposes. The flushed water need not be wasted. It can be caught in containers and used to scrub floors or for other non-drinking purposes. Water drawn for drinking and cooking can be held in containers, and refrigerated for use throughout the day. Upon returning home after any long absence, flush the water pipes longer than the daily routine.

Lead dissolves more quickly in hot water than in cold water. Therefore use only the cold water faucet to draw water for drinking and cooking. This is especially important in preparing infant feeding formulas. Recent studies show that 24% of infants suffering from lead poisoning were made ill from the tapwater used to prepare their formulas. Most of them had been given formulas prepared with extensively boiled water, and inadvertent use of lead-based kettles for boiling.

By the mid-1980s, public drinking fountains were examined as lead sources. The U.S. Public Health Service reported that "virtually all electric drinking fountains in schools appear to have sizable elevations of lead in their water." The problem was widespread, since most electric water coolers contain lead plumbing. A federal au-

dit in 1989 showed that similar water quality problems existed for airlines, trains, and buses, but were not being rectified.

Other sources of exposure include drinking water, contaminated by lead or lead-soldered pipes, and food affected when atmospheric lead drifts on to crops, or when tins of food contain lead solder. The Food and Drug Administration has asked tin manufacturers to phase out lead solder. They are complying, but slowly; in 1989 a consumer group found lead solder in a quarter of the tomato-soup tins it tested.

One old source of lead poisoning has been decisively reduced. The burning of gasoline used to send tons of lead into the air. In 1978 America began switching to unleaded gas. Between 1976 and 1980 the average blood level of adults fell by 5.8 [mug/dl to below 25 ug/dl.

New laws are being designed to reduce lead emissions from other sources. Representative Benjamin Cardin, who hails from Baltimore, unhappy home to a large stock of contaminated housing and children, has introduced a bill that would tax lead heavily, sending the expected $1 billion in annual revenues to cities and states for use in lead-removal. Another bill before Congress would require the disclosure of lead hazards at the time of a house sale or rental.

Lead and Nutrition

The human body, having no use for lead, gets a bit confused when lead is introduced into its system. As described earlier, the body first seems to treat lead as if it were iron, and deposits it in the places iron usually lives, ie: in the blood cells. After a time, the body seems to understand that the lead is not functioning as iron, and so it then guesses that perhaps the lead is calcium, and tries depositing the lead in place of calcium in the bones and brain tissue.

From this it can easily be understood why children who ingest lead will absorb less of it when they have adequate amounts of iron and calcium in their diets. In investigations of children with high lead levels, it has been sometimes found that their siblings, living in the same environment and exposed to the same amounts of lead, nonetheless have much lower levels of lead in their systems. Further investigation sometimes reveals that the child with high lead levels has different dietary habits from his or her brothers and sisters, and this is the only explanation for the higher levels of lead measured in this child's system.

While a diet that is rich in calcium and iron is important for all children, it is especially important that those who are exposed to lead in their environment.

Good sources of calcium:

- Milk and milk products. Nonfat and lowfat milk and buttermilk have just as much calcium as whole milk. (Some very young children who still use a baby bottle may be given almost all of their daily calories in the form of milk. These "milk babies" will receive enough calcium, but because there is no iron in milk they may be suffering from severe iron deficiency anemia.)

- Canned fish like sardines and mackerel that contain bones. Canned tuna is not a good source of calcium.

- Leafy green vegetables like collard and mustard greens, and kale.

- Tofu.

Sources of iron:

- Iron fortified cereals - both hot and cold. (These cereals should be served with an acid-based food such as orange juice or apple juice. The acid helps the body absorb the iron in the cereal.)

- Food cooked in cast-iron cooking pots. (The acid in some foods like spaghetti sauce or salsa will cause some iron from the pot to leach into the food and will make low-iron foods iron-rich. (When cooking nonacid foods like vegetables in a cast iron pot, adding a tablespoon of vinegar will have the same effect.)

Other foods such as red meat, eggs and liver have traditionally been considered to be good sources of iron. Many public health nutritionists are no longer recommending them as sources of iron, however, because they also contain high levels of saturated fat or cholesterol.

Spinach and other greens have also been thought to be good sources of dietary iron. Recent research, however, has shown that although these green vegetables contain iron, the oxalic acid in the plant prevents the body from absorbing the iron. On the other hand, the oxalic acid may also prevent the body from absorbing other heavy metals, like lead, that the plant has taken up in its leaves.

up to 50%.

Lead serves no useful purpose in the body, but because of its chemical similarity to iron and calcium, lead that is taken into the body is treated as if it were one of these substances. Lead will circulate for a short period of time in the blood (as iron does) where it can interfere with the healthy development of red blood cells. After a period of time, usually about a month, the lead will be deposited in place of calcium, into body tissues and organs that require calcium for development. These include the brain and the rest of the nervous system, the kidneys, and bones.

Lead in the soft tissue of the brain and nervous system in place of calcium can cause decreased intelligence, learning disabilities and behavior problems. Because of the inability of nervous tissue that has been damaged to regenerate, the damage that is caused will be permanent.

The total amount of lead that is stored in the body is called the "body burden." Once lead gets into the body, it remains in the system for a long time.