Teachers' Notes for "Get the Lead Out!" Game

This game is intended as a review, after students have learned about the environmental sources of lead, the effects of lead on health and behavior, and effective ways to prevent lead exposure.

To prepare the game, print a copy of the instructions, game board, and the pages for the chance cards and the question and answer cards. To prepare the chance cards, photocopy back-to-back the page of rectangles with the word CHANCE and the page beginning with "You clean your house and ..."; then cut out the rectangles. To prepare the question and answer cards, photocopy back-to-back the page of questions and the page of answers, which begins with "From old lead water pipes..."; then cut out the rectangles. For each player's marker, we use small post-it strips; one advantage is that they stay in place, even when the game board is jiggled.

Background Information on Lead

1. What are the biological effects of lead?

The most significant effects of lead on the body are on the brain and nervous system. The effects of lead exposure in children include:

- learning disabilities, lower IQ
- behavior problems, including inability to inhibit inappropriate behavior
- distractibility, difficulty following directions, impulsiveness
- sleep disturbances
- poor coordination.

A lead atom can form an ion with two positive charges. These lead ions interfere with the functions in the body of other ions with two positive charges, especially calcium and iron. For example, lead interferes with calcium's role in the neurons in the brain. Lead also interferes with the incorporation of iron into hemoglobin, which carries oxygen in the blood. Therefore, elevated blood lead can result in anemia (too little hemoglobin in the blood).

Lead can also damage kidneys, impair growth, interfere with hormones, and contribute to infertility.

High blood lead levels can have extremely harmful health effects, even resulting in death. Lower blood lead levels have less harmful health effects, but do harm the brain.

The current US government upper limit for blood lead levels in children is 10 micrograms per dl. However, harmful effects on intelligence occur even at this level. For example, recent studies have found that the average IQ is 7 points lower for children who have average blood levels of 10 micrograms/dl from infancy through kindergarten age than for children who average 1 microgram/dl (controlling for mother's IQ, quality of home environment, etc.).

Exposure to lead in infancy or early childhood, while the brain is growing and developing rapidly, is especially harmful, and can have long-term effects. For example, higher blood lead levels in the first few years after birth are correlated with lower IQ at ages 4-6. Long-term follow-up studies have shown that people who were exposed to lead as young children (even at relatively low levels) are more likely to be involved in crime as teenagers and young adults. Some of the damage to the brain is irreversible, so prevention is crucial. However, some of the damage is reversible if blood levels are lowered by reducing exposure to sources of lead contamination and treating with
chelation therapy (which binds to lead and removes it in the urine). This may improve IQ and behavioral problems, if done before age 4.

2. **What are the major sources of lead and how does lead enter the body?**

The most significant sources of lead exposure vary by age.

For a developing **fetus**, lead can come from the mother, if the mother is currently exposed to lead or if she has lead stored in her bones. The body stores lead in place of calcium in bones and teeth. When a woman is pregnant, calcium can be mobilized from her bones (especially if her calcium intake is low), and lead can also move from the bones into the blood. The lead in the woman's blood can cross the placenta and damage the developing fetal brain.

For **infants**, a major source of lead can be formula prepared with water from lead pipes, pipes soldered with lead, or brass or bronze fixtures (which may contain lead). The amount of lead in water is higher for hot water (which dissolves more lead) and for the first water drawn from the tap in the morning (which has absorbed more lead while in the pipes overnight).

For **toddlers** and **young children**, major sources of lead include:
- Old paint (in houses built before 1978), which may chip or form lead-containing dust (e.g. when small particles of paint wear off as windows are opened and closed)
- Soil contaminated with lead from old paint or from leaded gasoline (which was widely used in earlier decades).

Children may ingest lead dust from dirty hands or toys which they put in their mouth or inhale dust which contains lead.

Babies and young children are especially vulnerable to lead poisoning because:
- They are more likely to put things in their mouth.
- Their nervous systems are developing rapidly.
- Since their bodies are growing rapidly, they consume more food and water per body weight.

Other sources of lead exposure are described in the section below entitled "Other Ways to Reduce Lead Exposure".

3. **How can lead exposure be prevented?**

The good news is that lead exposure can be effectively prevented by public policy and individual action. Campaigns to reduce lead exposure have dramatically reduced blood lead levels in the US. These campaigns have been successful even though lead is indestructible, so it does not break down over time, and even though lead has no special taste or smell, so it is not easily detected.

**Public policy**

Public policies, particularly the drastic reduction of lead in gasoline and paint and lead poisoning prevention programs, have been very effective in reducing lead exposure for children. Children's blood lead levels have been dramatically reduced in recent decades in the US.
Individual Actions

Water

For cooking, making baby formula, or drinking water, use the cold water tap and run it for a few minutes until the water gets as cold as it will get. In addition, you can buy water filters that effectively remove lead from drinking and cooking water. Do not boil water to get rid of lead; lead is indestructible and will not evaporate, so boiling water only increases the lead levels in water.

Cleaning

Clean frequently, using damp or wet rags and mop to avoid spreading lead dust. Don't use these rags or mop for anything else, and don't clean them in the the kitchen sink. Wash toys, stuffed animals, and pacifiers regularly. Clean or remove shoes before entering your home in order to avoid tracking in lead from soil.

Home Renovations

Extreme caution is needed for renovations or paint removal in a home that was built before 1978. See the web sites listed below for advice and, if possible, hire a professional licensed lead abatement contractor and have renovations or paint removal done while your family is not in the home.

If paint is chipping or peeling, you can reduce lead exposure by covering local surfaces with duct tape or contact paper. Covering loose paint and cleaning regularly with a wet mop and damp cloths are often more effective in reducing lead exposure than attempting to remove the lead paint.

Other Ways to Reduce Lead Exposure

In your yard, plant grass or build a sandbox to prevent children from playing in dirt which may be contaminated with lead.

Do not grow food in lead-contaminated soil near older buildings or in urban gardens; have the soil tested for lead. Wash vegetables and fruits thoroughly to remove lead-containing dirt before eating.

Do not store food or beverages in opened imported cans, leaded crystal, or imported pottery with bright glazes which may contain lead.

Avoid lead-containing candies imported from Mexico such as Chaca Chaca and Pelon Pelo Rico.

Do not use home remedies which contain lead, such as Litargirio, Azarcon, Greta, Ghasard, Bala Goli, Kandu, Pay-loo-ah, Kohl or Surma.

If you are exposed to lead on your job, use separate work clothes and shoes while at work and launder work clothes separately. Shower at work before going home.

Avoid lead contamination due to hobbies such as making stained glass windows using lead solder, glazing pottery and ceramics, making lead weights for fishing, reloading and making ammunition, and refinishing furniture.
Cigarette smoke contains lead, so one of the many health benefits of not smoking is reduced lead exposure for yourself and your family.

Testing Blood Lead Levels

All children ages six months through six years should be tested for lead levels every year. A blood test is the only sure-fire way to monitor lead exposure, since lead levels that can damage the brain do not produce specific symptoms. Testing blood lead levels may be especially important for immigrants from Third World countries where lead exposure is more common and blood lead levels are often high.

Nutrition

Increased iron and calcium in the diet can reduce uptake of lead. Food sources for iron include red meat, liver, collard greens, spinach, tofu, baked beans, fortified cereals, and raisins. Food sources for calcium include (low-fat) milk, yogurt, cheese, and cooked greens.

Additional Teaching Suggestions

Useful sources of additional information on the sources and health effects of lead and methods for reducing lead exposure are:

- EPA: <http://www.epa.gov/lead>
- Illinois Department of Public Health: <http://www.idph.state.il.us/>(click on Topics, and find lead)
- Washington State Department of Health: <http://www.doh.wa.gov>(click on Topics, and find lead)
- Coalition to End Childhood Lead Poisoning: <http://www.leadsafe.org/index.htm>

Related useful activities include:

- having students make drawings that show how lead gets from environmental sources to the brain (via the digestive system and circulatory system)
- service learning activities such as educating younger children or families about lead, with classroom presentations or pamphlets

The following useful diagrams are from

- Reducing Lead in Your Home