

Getting the Lead Out

Chemist Hilary Godwin:

Investigating the Chemistry of Lead Poisoning

Hilary Godwin Is an Atomic Sleuth

Chemist Godwin investigates how lead disrupts protein function.



Lead

- Changes a protein's shape
- Interferes with gene function
- Displaces calcium and zinc inside proteins

Question:

How is lead toxic to kids?

Answer: Lead can damage the brain and nervous system

High levels of lead in routine blood tests: often the first symptom of lead poisoning in children

Lead poisoning is linked to

- Developmental delays
- Learning disabilities
- Behavior problems

2.2 percent of American children age 1-5 years have blood levels of lead measuring at least 10 micrograms per deciliter.

—Centers for Disease Control and Prevention

Where Do We Find Lead?



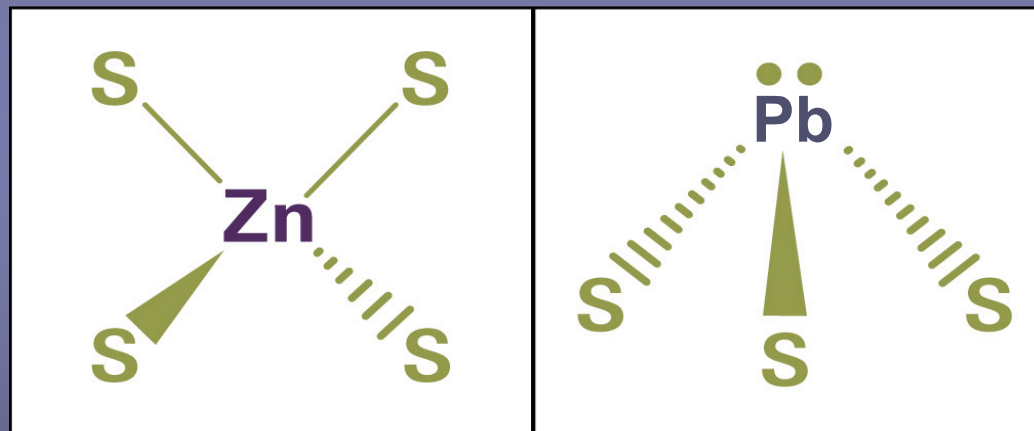
Lead contaminants can be found in

- Older homes containing lead paint
- Old pipes and pipe sealants
- Lead dust residues in soil from gasoline formulated with lead up until the mid-1980s

Lead Is a Metal Thief

Lead (Pb) can attach tightly to proteins, knocking out key metals such as zinc (Zn) or calcium (Ca), which are needed for good health.

Zinc (Zn)
forms 4
chemical
bonds
with
proteins



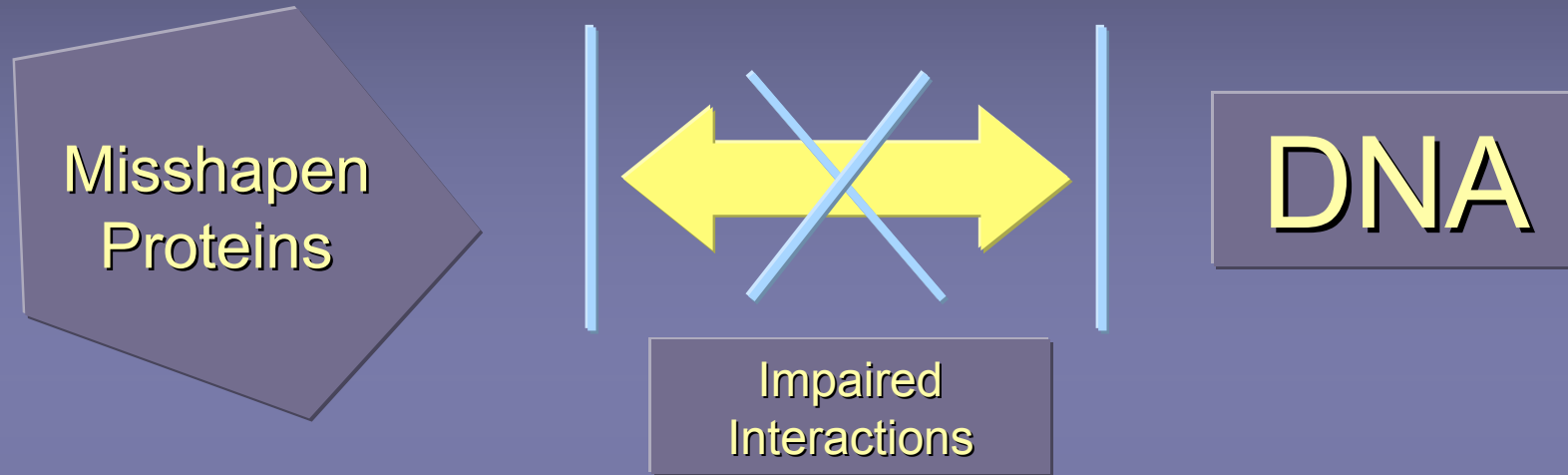
Lead (Pb)
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Misshapen
Proteins

FINDINGS

National Institutes of Health
National Institute of General Medical Sciences

Lead's Molecular Damage



Lead can disrupt gene function:

- Misshapen proteins cannot interact properly with genes (DNA)
- Lead can displace metals in proteins that switch genes on or off

Godwin's Metal Test

Godwin uses analytic chemistry to determine how tightly lead binds with proteins.

1. Mix metals with protein

Mix protein sample with lead

+

second metal to which protein normally binds

2. Test binding

Determine whether lead or the other metal sticks to the protein more tightly

3. Compare results

If lead binds to target protein more tightly than competitor metal, protein is likely vulnerable to lead damage

Nothing Good About Lead

1. Severe lead poisoning can damage the nervous system



Which mineral is displaced when lead levels are very high?

2. Lead toxicity can cause anemia



How does lead impair red blood cells?

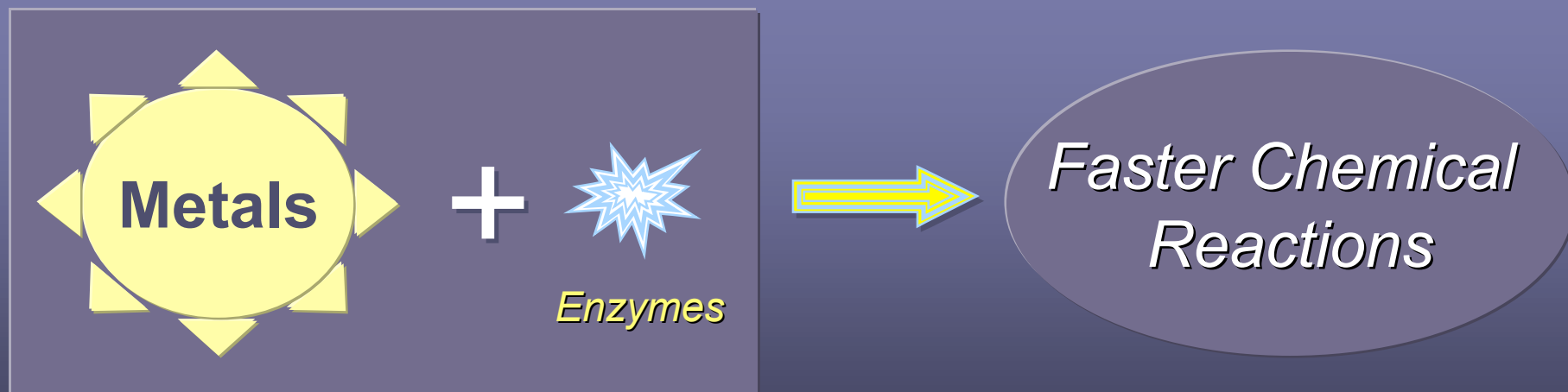
3. Lead poisoning is associated with male infertility



How does lead affect sperm production?

“Good Metals” Help Body Chemistry

- Metals work with the body’s enzymes to speed up healthful chemical reactions
- “Good metals” (e.g., calcium, zinc, cobalt) are important dietary staples



Healthy Metals

Metal	Sources	Promotes
[Ca] Calcium	Dairy, broccoli, figs, sardines	Muscle and nerve signaling, bone growth
[Fe] Iron	Meat, beans, spinach	Red blood cell function
[Cu] Copper	Lobster, crab, beans, nuts	“Mop up” of free radicals
[Mg] Magnesium	Dark green leafy vegetables	Strong bones and teeth, muscle contraction
[Zn] Zinc	Oysters, chick peas, whole grains	Hormone regulation, gene activity
[Co] Cobalt	Leafy green vegetables, meat and dairy products	Red blood cell formation
[Mn] Manganese	Cereals, whole grains	Break down of fats, carbohydrates, proteins

Research Applications

Could other metals be used to displace lead from body molecules?