

A Small Dose of Lead

An Introduction To The Health Effects of Lead Department of Labor and Industries Lead Stakeholder Meeting October 25, 2016

Pb

Lead

Atomic Number: 82
Atomic Mass: 207.20

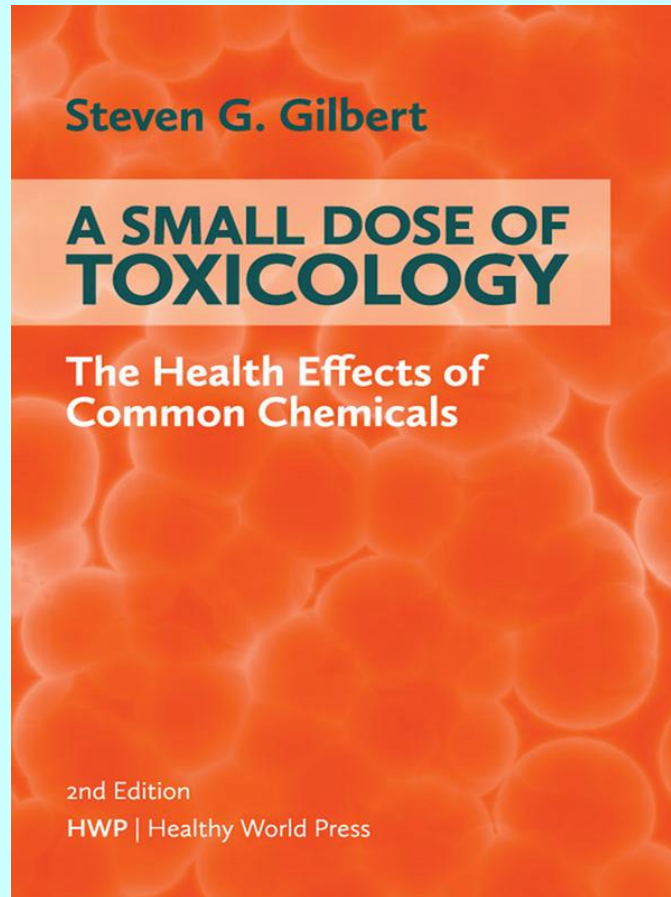
Steven G. Gilbert, PhD, DABT [https://
www.asmalldoseoftoxicology.org/
toxipedia/](https://www.asmalldoseoftoxicology.org/toxipedia/)

Lead Poisoning Prevention Week

October 23 – 29, 2016



A Small Dose of Toxicology 2nd Edition



**Free e-book
Healthy World
Press**

**PowerPoint slides
for each chapter
Translated into
German, Arabic, &
Chinese**

See: <https://www.asmalldoseoftoxicology.org/toxipedia/>

Protecting future generations



My grandchildren



Contact information: Steven G. Gilbert at sgilbert@innd.org – more information at www.asmalldoseof.org – © 2005 Steven G. Gilbert

A Small Dose of Lead

A free toxicology encyclopedia and resource center that anyone can edit.

Toxipedia provides comprehensive, accurate, and scientifically based information on the hazards and risks of chemical and physical agents, with the goal of advancing human and environmental health. [Toxipedia](#)



Washington State Constitution

ARTICLE II SECTION 35 PROTECTION OF EMPLOYEES.

The legislature shall pass necessary laws for the protection of persons working in mines, factories and other employments dangerous to life or deleterious to health; and fix pains and penalties for the enforcement of the same.



Current CDC/NIOSH Standards

Healthy People 2020, to reduce the rate of adults (age 16 or older) who have blood lead levels (BLL) equal or greater $\geq 10 \mu\text{g/dL}$

In 2015, NIOSH designated $5 \mu\text{g/dL}$ (five micrograms per deciliter) of whole blood, in a venous blood sample, as the reference blood lead level for adults. An elevated BLL is defined as a BLL $\geq 5 \mu\text{g/dL}$.



Current Standards

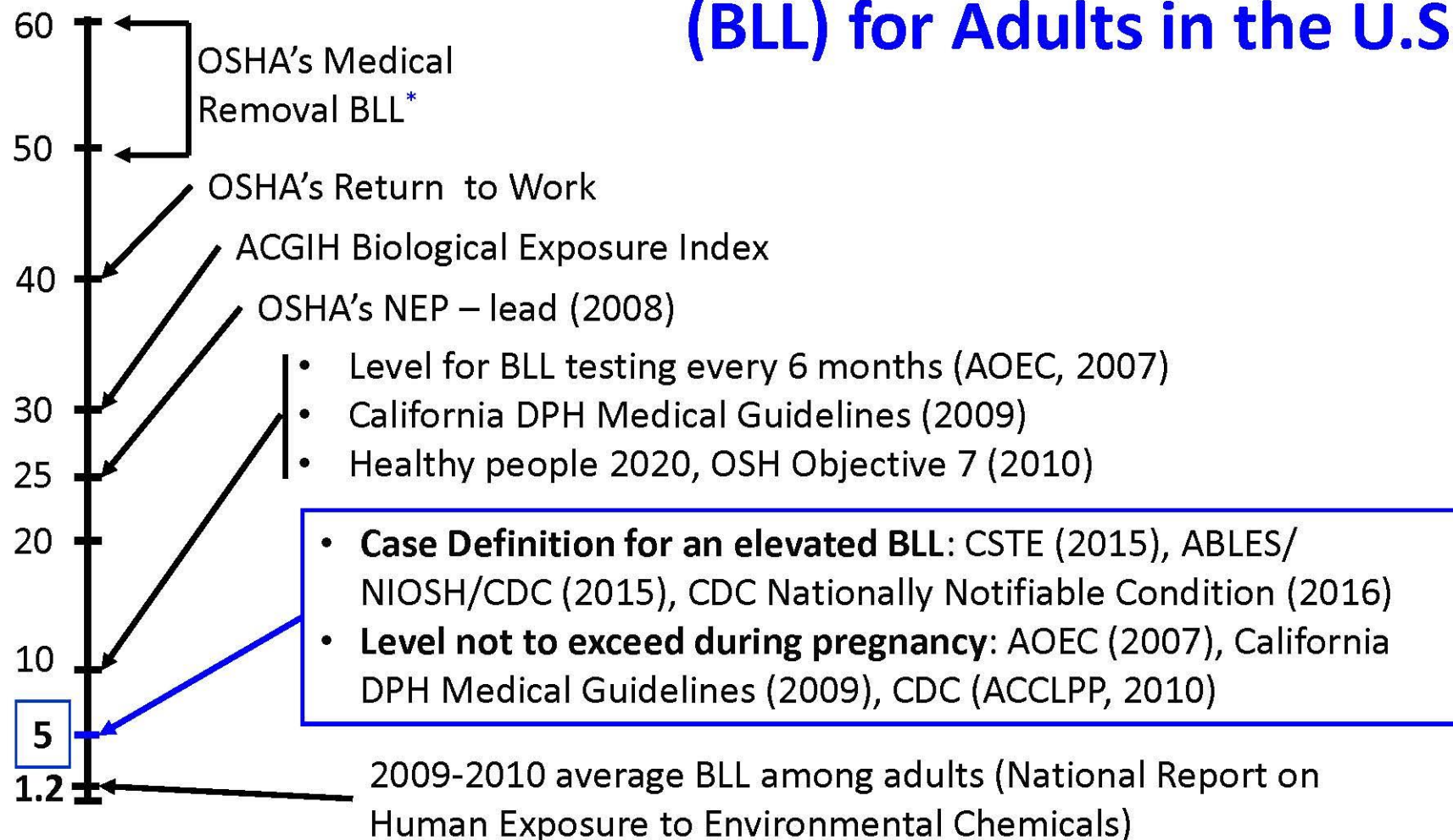
The U.S. Department of Health and Human Services recommends that BLLs among all adults be reduced to $<10 \mu\text{g/dL}$.

Therefore, the most current guidelines for management of lead-exposed adults should be implemented by the medical community at the current CDC/NIOSH reference BLL of $5 \mu\text{g/dL}$.



**Blood lead concentration
($\mu\text{g}/\text{dL}$)**

Reference Blood Lead Levels (BLL) for Adults in the U.S.



*The OSHA Lead Standards state that the examining physician has broad flexibility to tailor protections to the worker's needs.

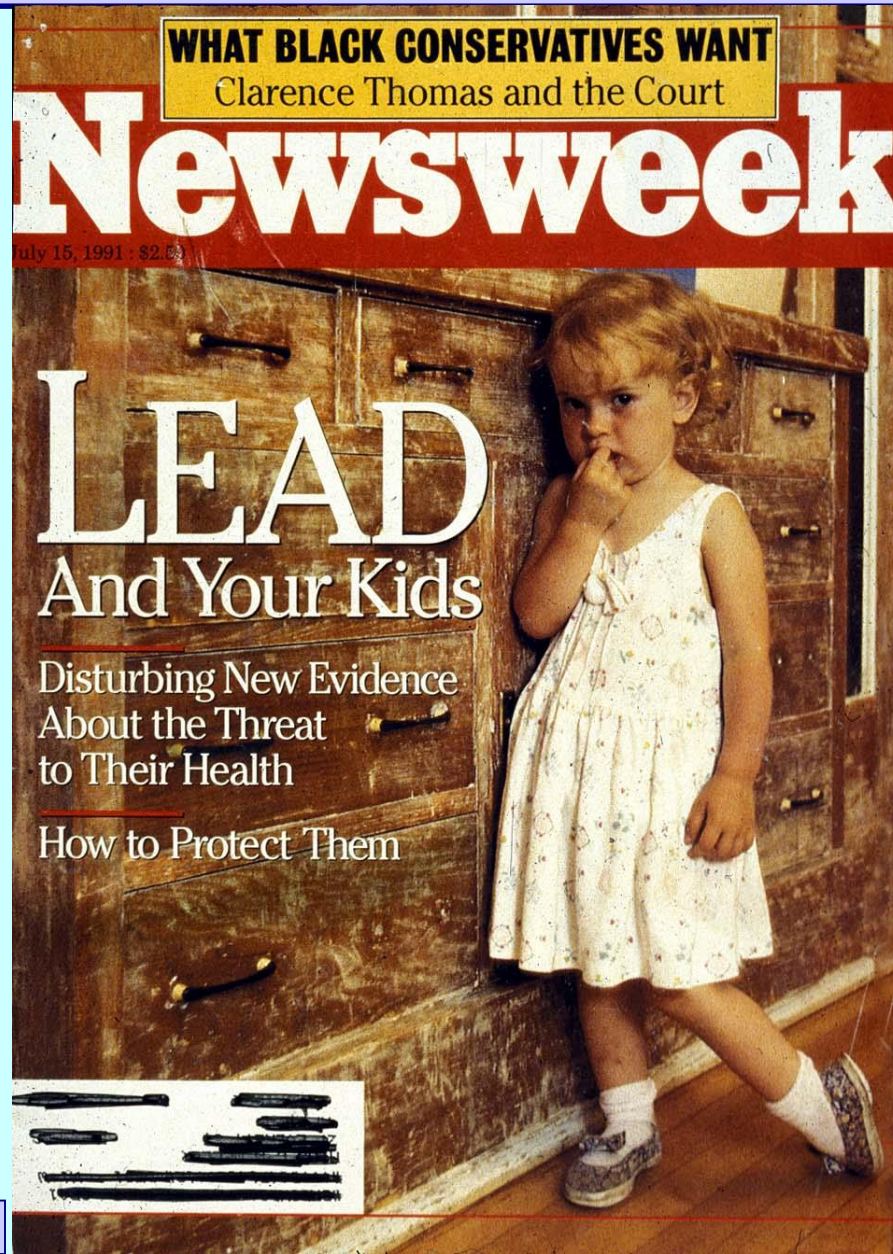
Key Words of Toxicology

Dose / Response

Hazard + Exposure = Risk

Individual Susceptibility

Lead In Homes



Ancient Awareness

- **6500 BC. - Lead discovered in Turkey, first mine.**
- **500 BC-300 AD.- Roman lead smelting produces dangerous emissions.**
- **100 BC. - Greek physicians give clinical description of lead poisoning**
- **First recorded occupational disease (lead colic in a 4th century BC metal worker).**



Ancient Awareness

**"Lead makes the
mind give way."**

Greek

Dioscorides - 2nd BC

Lead Based Paint Products



Lead Based Paint

- 1887 - US medical authorities diagnose childhood lead poisoning**
- 1904 - Child lead poisoning linked to lead-based paints**
- 1909 - France, Belgium and Austria ban white-lead interior paint**
- 1914 - Pediatric lead-paint poisoning death from eating crib paint is described**
- 1921 - National Lead Company admits lead is a poison**
- 1922 - League of Nations bans white-lead interior paint; US declines to adopt**
- 1943 - Report concludes eating lead paint chips causes physical and neurological disorders, behavior, learning and intelligence problems in children**
- 1971 - Lead-Based Paint Poisoning Prevention Act passed**
- 1978 - Lead-Based Paint mostly Banned**



Lead Industry Advertisements



History of Lead Industry Advertisements ([LINK](http://www.cincinnatichildrens.org/research/project/enviro/hazard/lead/lead-advertising/default.htm))

<http://www.cincinnatichildrens.org/research/project/enviro/hazard/lead/lead-advertising/default.htm>



Lead In Gasoline

- 1854 - Tetraethyl lead discovered by German chemist**
- 1921 - Midgley discovers that tetraethyl lead curbs engine knock**
- 1922 - Public Health Service warns of dangers of lead production, leaded fuel**
- 1923 - Leaded gasoline goes on sale in selected markets**
- 1936 - 90 percent of gasoline sold in US contains Ethyl**
- 1972 - EPA gives notice of proposed phase out of lead in gasoline.**
- 1986 - Primary phase out of leaded gas in US completed**
- 1994 - Study shows that US blood-lead levels declined by 78 percent from 1978 to 1991**
- 2000 - European Union bans leaded gasoline**

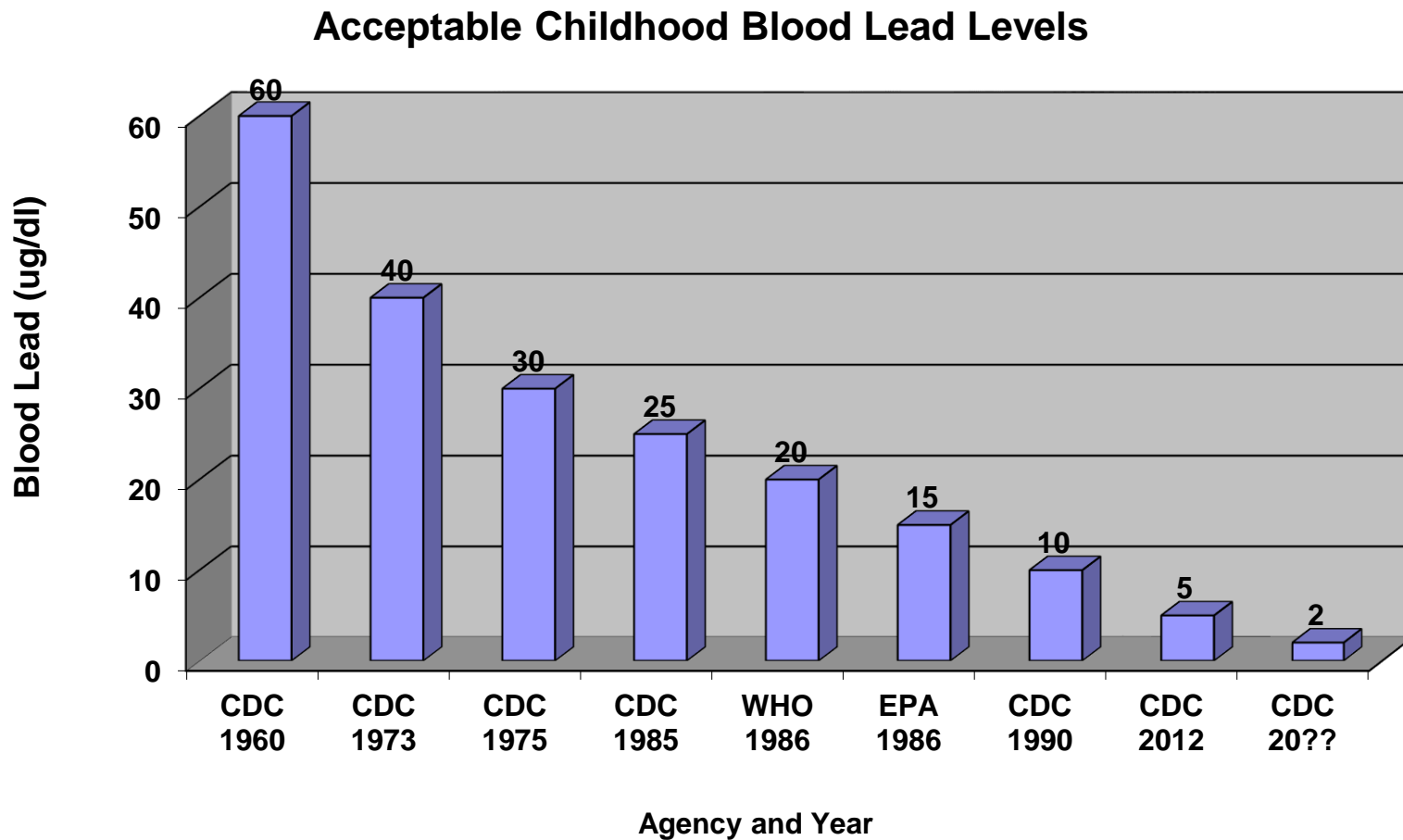


History Of Lead Toxicology

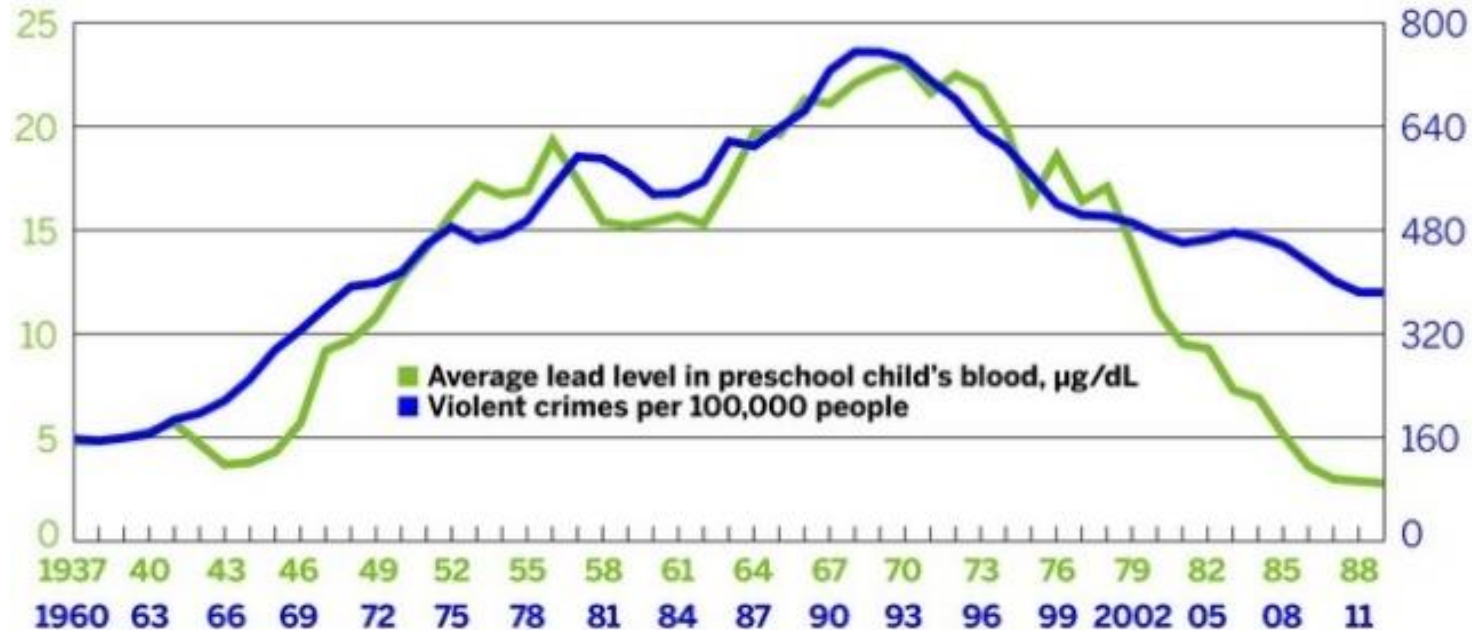
| Investigator | Date | Blood | Findings |
|---------------|--------|-------|---------------------------------|
| Dioscerides | 2nd BC | 100 | "Lead makes the mind give way." |
| B. Franklin | 1763 | 100 | "Dry gripes" |
| A.J. Tuner | 1894 | 80 | Childhood plumbism |
| R. Byers | 1943 | 80 | Long-term sequelae |
| CDC | 1973 | 40 | Undue lead exposure |
| CDC | 1975 | 30 | Undue lead exposure |
| CDC | 1985 | 25 | Undue lead exposure |
| WHO | 1986 | 20 | Undue lead exposure |
| EPA | 1986 | 15 | Undue lead exposure |
| Fulton et al. | 1987 | 15 | IQ Deficits |
| Hansen et al. | 1987 | 15 | IQ Deficits |
| CDC | 1990 | 10 | Undue lead exposure |
| CDC | 2012 | 5 | Finally |



Agency Blood Lead Levels



BLL & Violent Crimes



A timeline of lead reduction

1970

CDC sets acceptable blood-lead level of **40 $\mu\text{g}/\text{dL}$**

1973

EPA mandates a phaseout of leaded gasoline

1978

CPSC bans residential lead paint

1991

CDC sets acceptable blood-lead level of **10 $\mu\text{g}/\text{dL}$**

1996

EPA eliminates lead from all U.S. motor fuel

2012

CDC describes blood-lead level of **>5 $\mu\text{g}/\text{dL}$** as elevated



Health Effects

- **Encephalopathy**
- **Colic**
- **Frank Anemia**
- **Hemoglobin Synthesis**
- **Peripheral Neuropathies**
- **Infertility (MEN)**
- **Systolic Blood Pressure (MEN)**
- **Nerve Conduction Velocity**
- **Erythrocyte Protoporphyrin**
- **DEVELOPMENTAL TOXICITY**
- **IQ, Memory, Learning**
- **Growth**



Sources Of Lead

- **Lead Paint**
- **Dust, Soil**
- **Water**
- **Industry**
- **Hobbies**
- **Traditional Ethnic Remedies**



Lead Contaminated Town

Herculaneum, Missouri

Doe Run – Lead smelter

160,000 tons of lead per year

One of the largest lead smelters in US

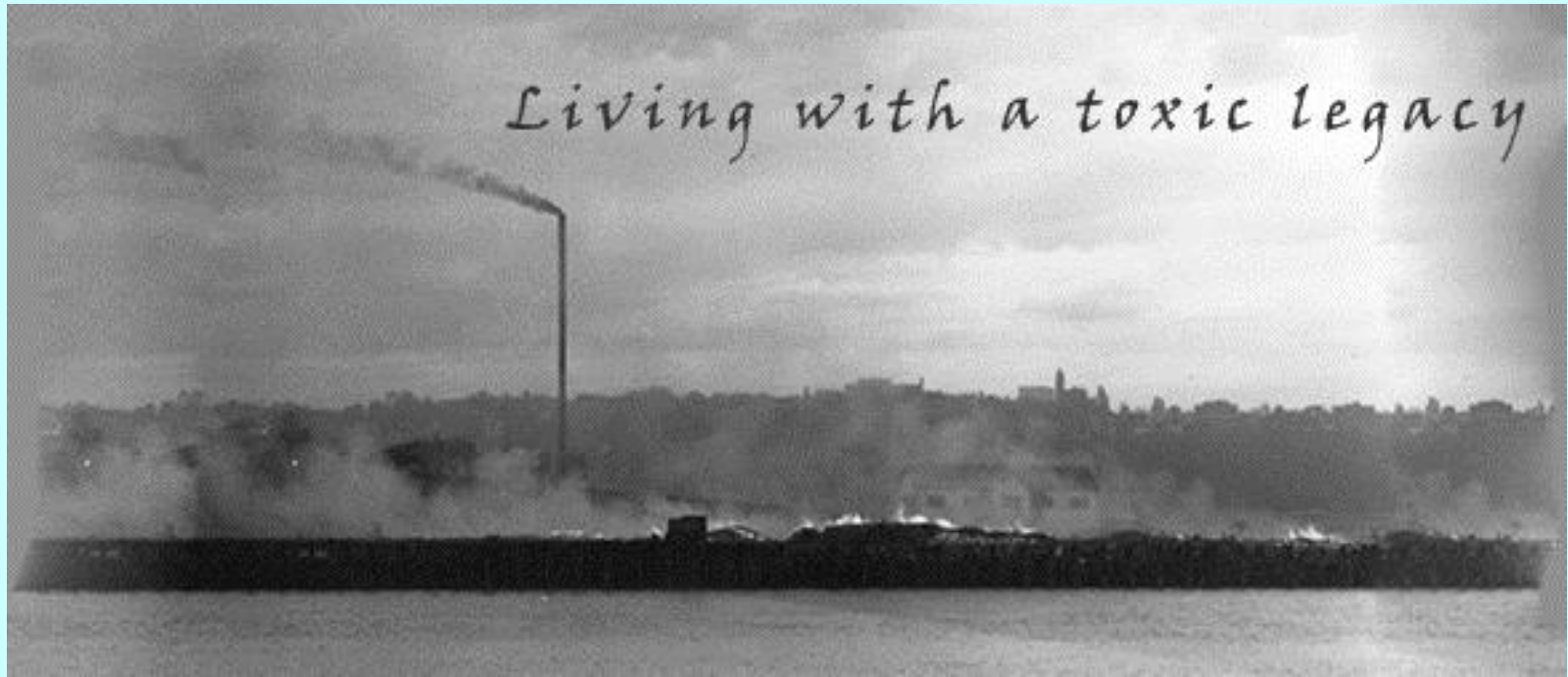
Past over 800 tons of lead released into the environment as part of the smelting process.

Reduced to 81 tons in 2001

Target is 34 tons in 2002.

NY Times, Jan 19, 2002

Tacoma Smelter



Air pollution from the smelter settled on the surface soil over more than 1,000 square miles of the Puget Sound basin.

Take Home Lead Exposure

California, 1998

**Lead poisoning in furniture workers
and their families**

Father 46 $\mu\text{g}/\text{dL}$

18-month-old child BLL 26 $\mu\text{g}/\text{dL}$

4-month-old daughter BLL 24 $\mu\text{g}/\text{dL}$

**two refinishers BLLs of 29 and 54 $\mu\text{g}/\text{dL}$,
the four carpenters BLLs of 46, 46, 47, and 56 $\mu\text{g}/\text{dL}$.**

MMWR - April 06, 2001 / 50(13);246-8



Lead - Absorption

**Orally Consumed Lead Absorbed
In Place of Calcium**

CHILDREN – 30-50% OF LEAD

ADULTS – 5-10% OF LEAD

Increased During Pregnancy



Lead - Nutrition

**NUTRITIONAL DEFICIENCIES INCREASE
ABSORPTION**

(high fat diets, iron, calcium)

VITAMIN D (from sun) INCREASES

Half-life Of Lead

- **25 DAYS -- BLOOD**
- **40 DAYS -- SOFT TISSUE**
- **20 YEARS -- BONE**



Children Vulnerability

**CHILDREN are more vulnerable
exposure than ADULTS**

Size

Consume More Food

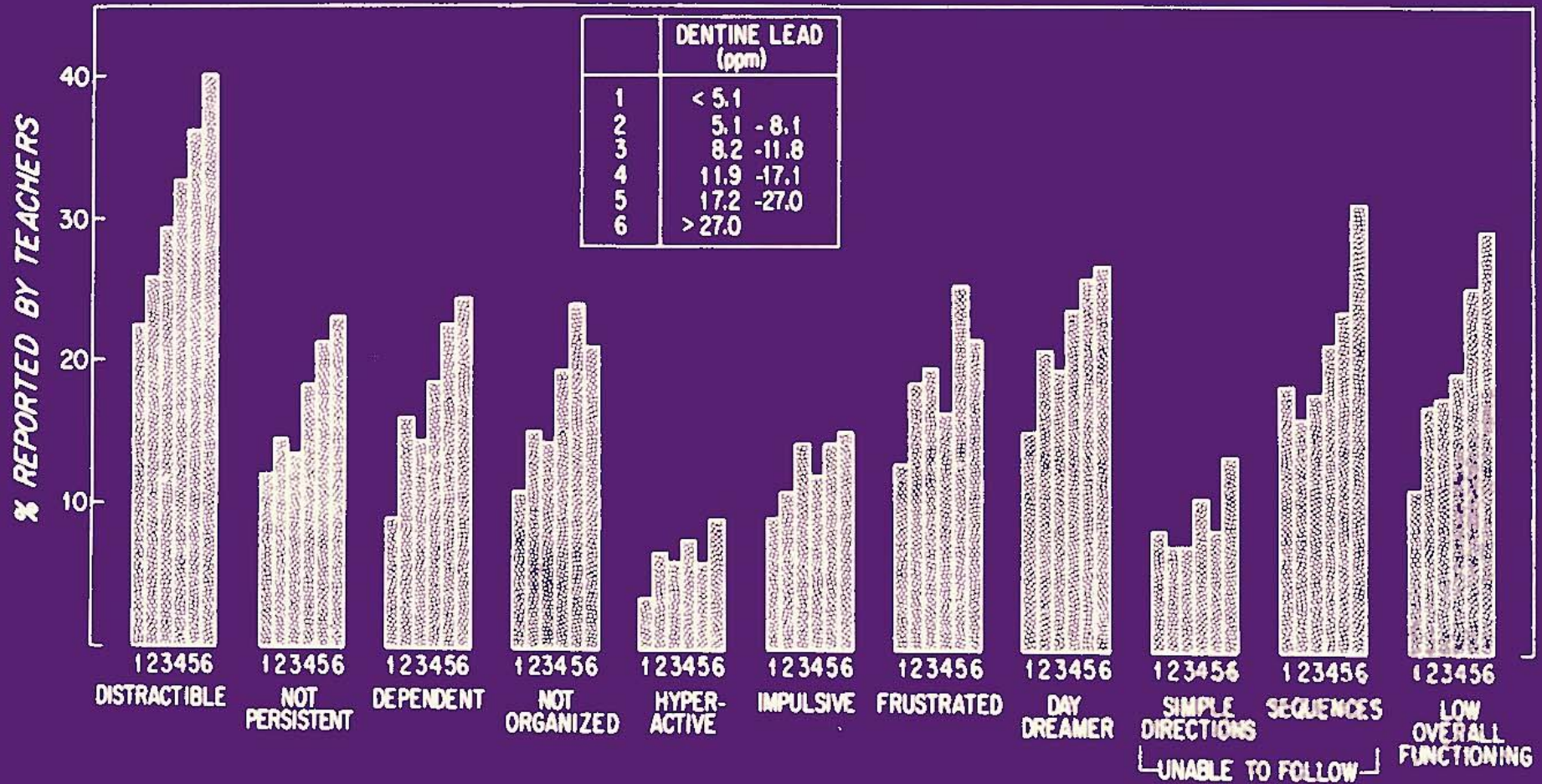
Inhale More Air

Developing Nervous System

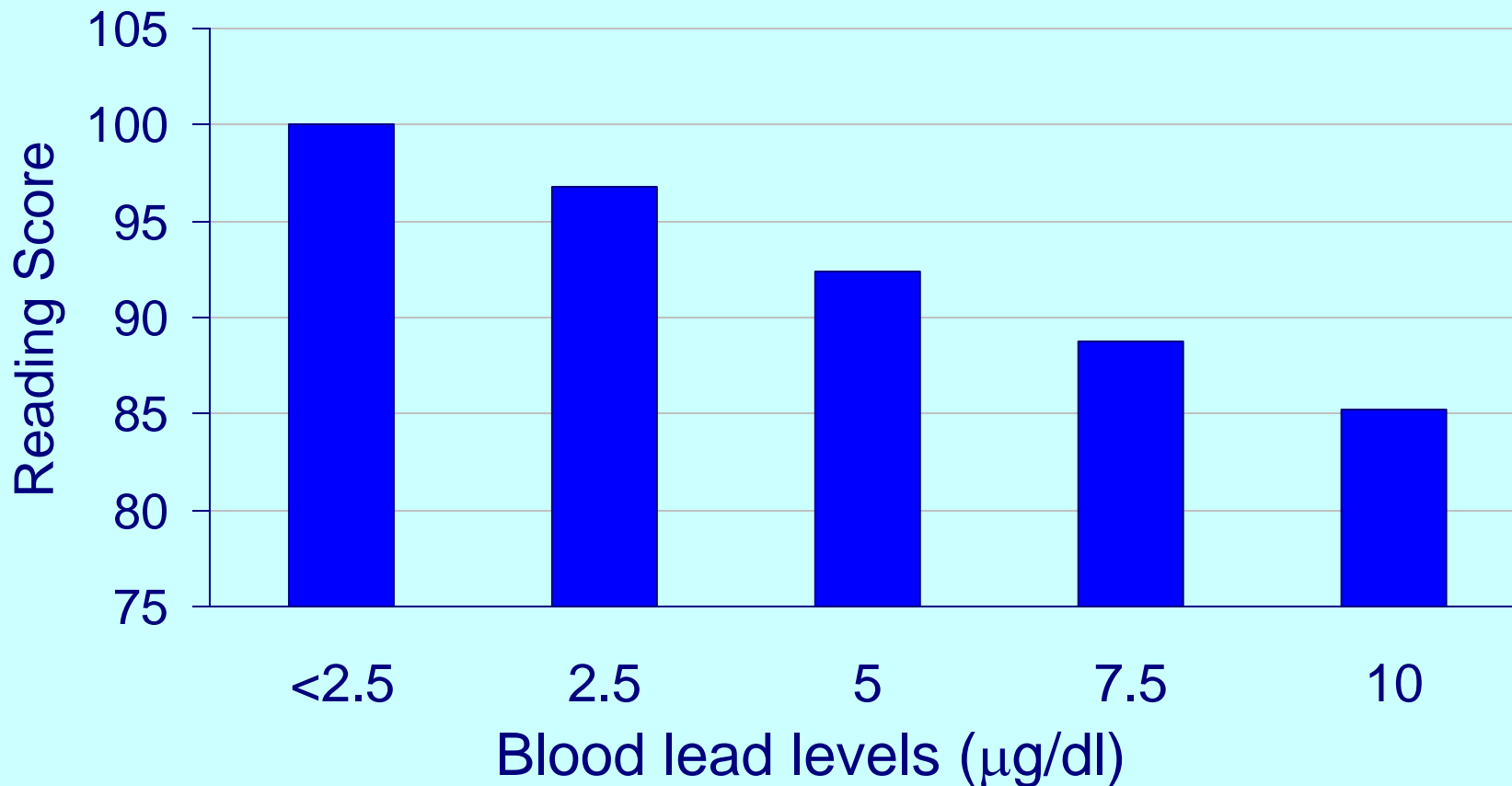
Increased need for Calcium



Needleman, NEJM, 1979



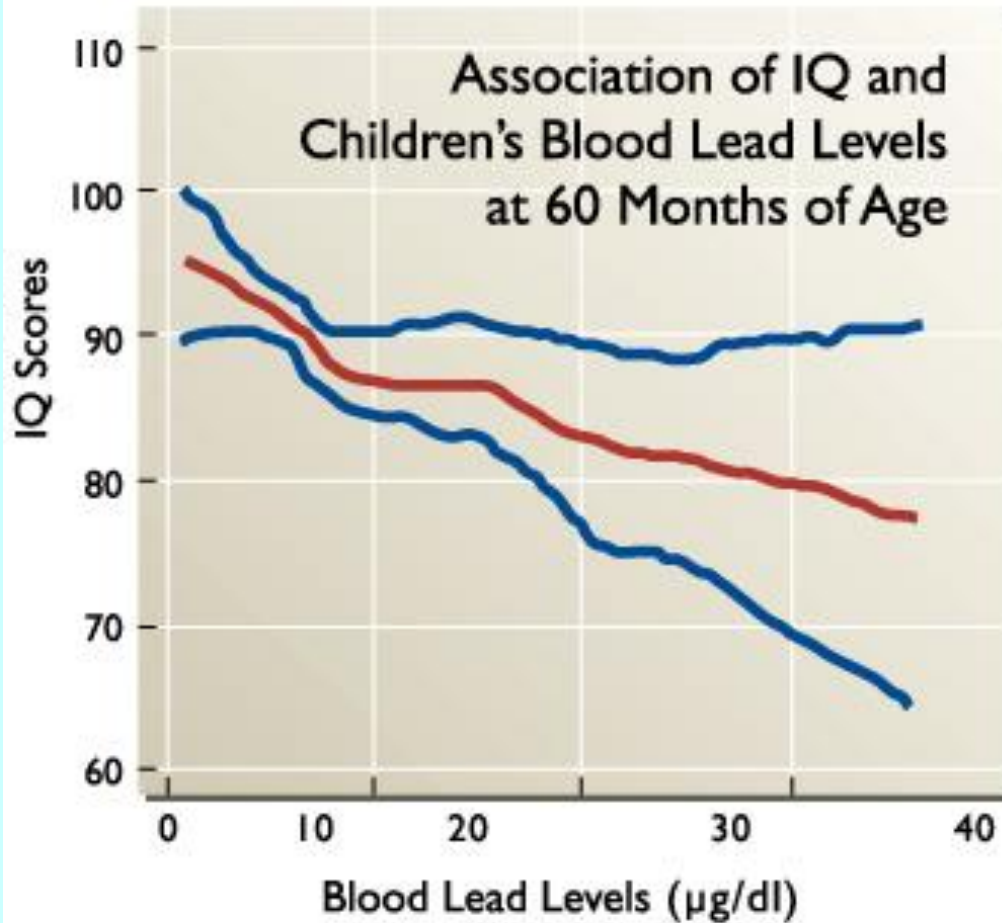
Lead-associated Reading Deficits in U.S. Children



Lanphear BP, et al. Public Health Reports 2000;115:521-529. (BL's slide)



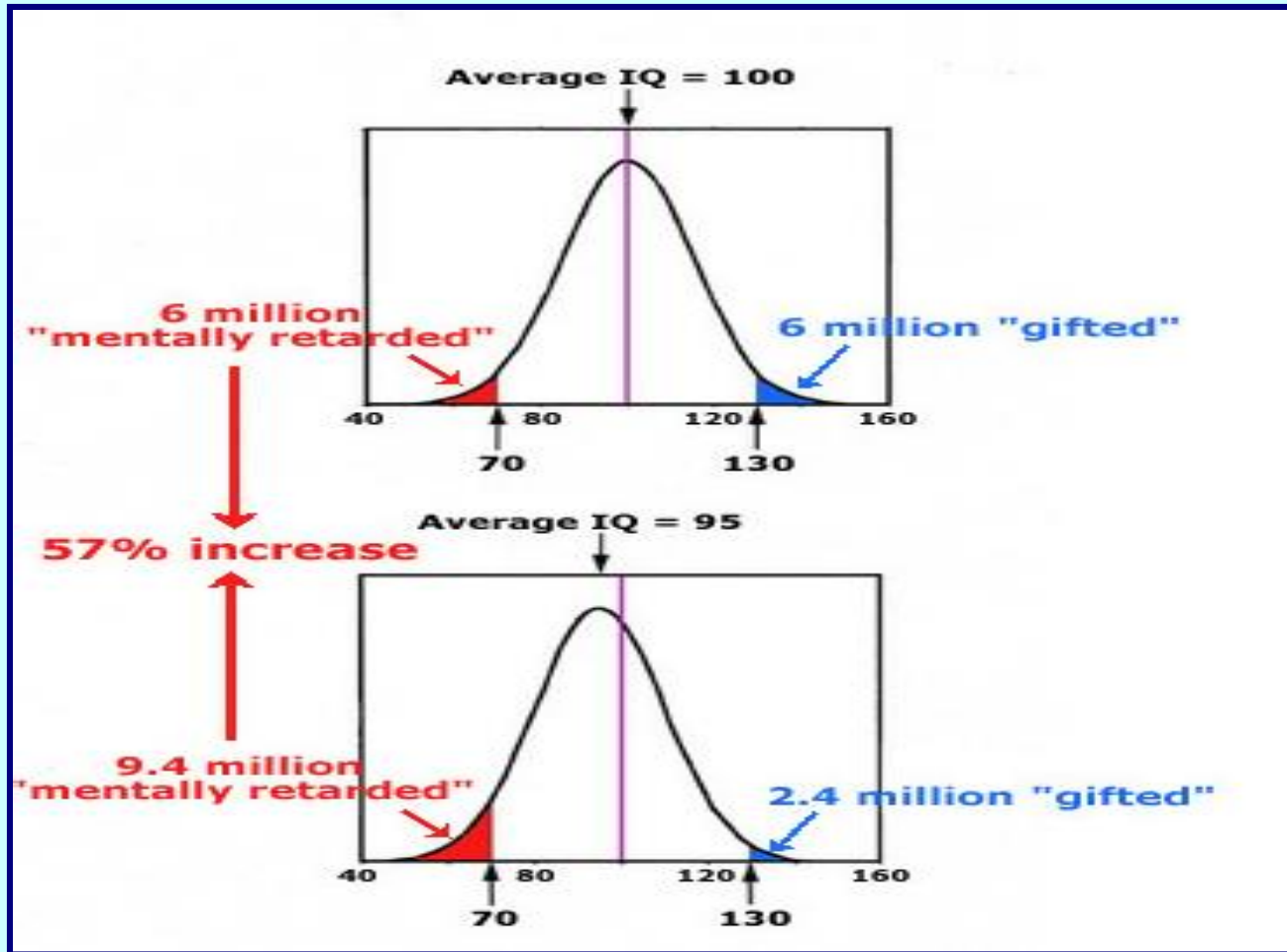
IQ and Blood Lead



Canfield R, et al. NEJM 2003;348:1517-1526. (slide from BL)



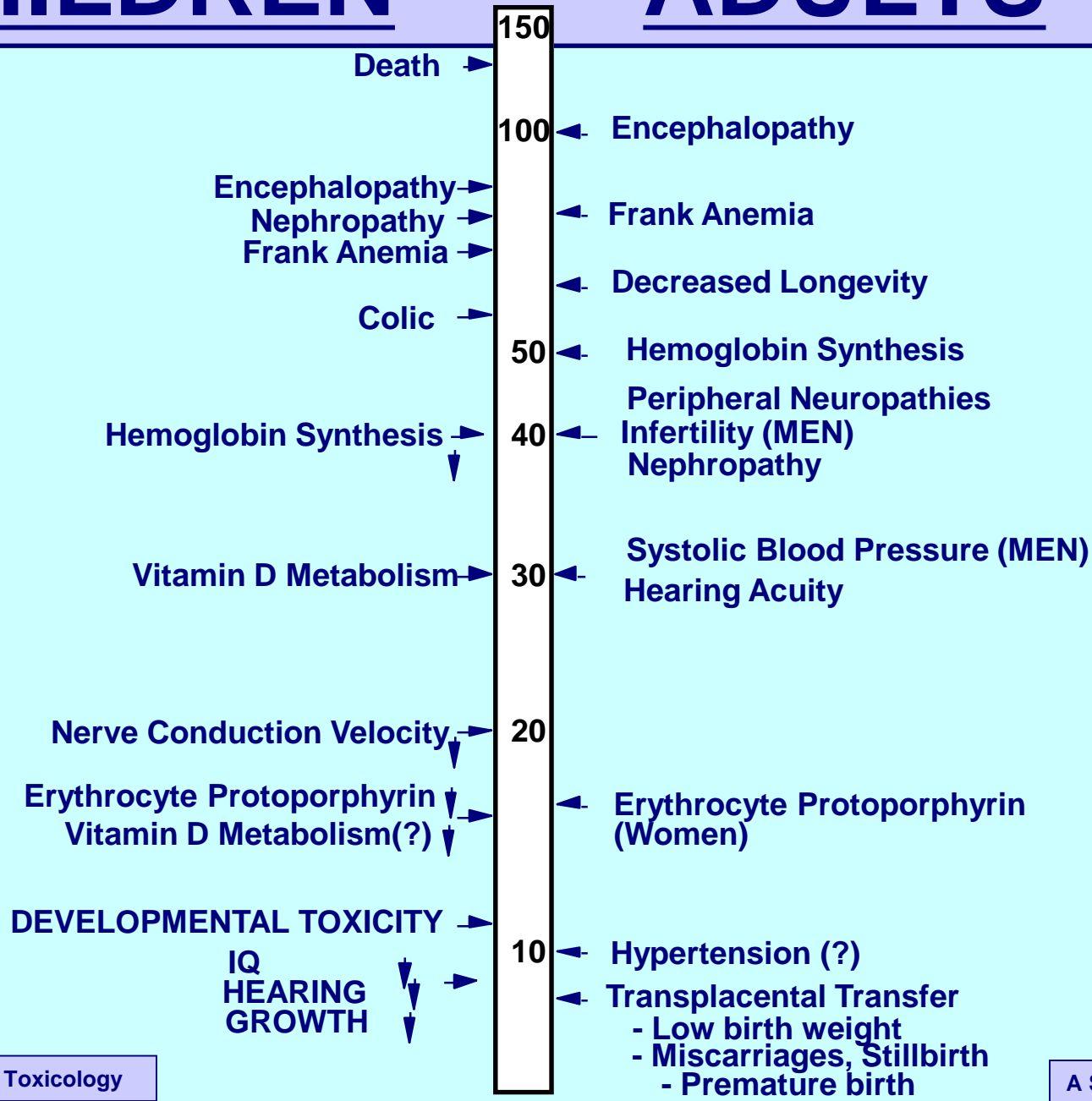
A 5-Point (5%) Shift in IQ Scores in a Population of 100 Million



CHILDREN

Blood Lead
(ug Pb/dl)

ADULTS



Reproductive Effects Of Lead

WOMEN

- lead crosses the placenta
- low infant birth weight
- retarded mental development
- miscarriages
- premature birth
- stillbirth

MEN

- decreased sex drive
- impotence
- sterility
- altered sperm-birth defects



Why Screen For Lead Exposure

Find the source

Reduce risky behaviors

Education about the hazards

Education about nutrition

Why set an action level of 5 ug/dl ?

1. Protective / precautionary
2. Consistent with Science
3. Consistent with Medicine
4. Consistent with CDC / NIOSH
5. Sends a strong message
6. Protect young workers (16)
7. Protect women
8. Protect the home and family
9. Educational
10. Environmental justice



Recent Commentary

Environmental Health News – 9/12/16

- Commentary: Lead exposure beyond Flint—protecting our nation's workers

Seattle Times Editorial – 7/31/16

Outdated Lead Standards Put Washington State Workers & Families at Risk

By – Rachel Shaffer and Steven Gilbert



Lead 10 to 2

Rationale for Lowering the Blood Lead Action Level From 10 to 2 $\mu\text{g}/\text{dL}$

Steven G. Gilbert and Bernard Weiss

Neurotoxicology Vol 27/5, September 2006, pp 693-701.

<http://dx.doi.org/10.1016/j.neuro.2006.06.008>



Lead - References

EPA – Lead site – the best

<https://www.epa.gov/lead>

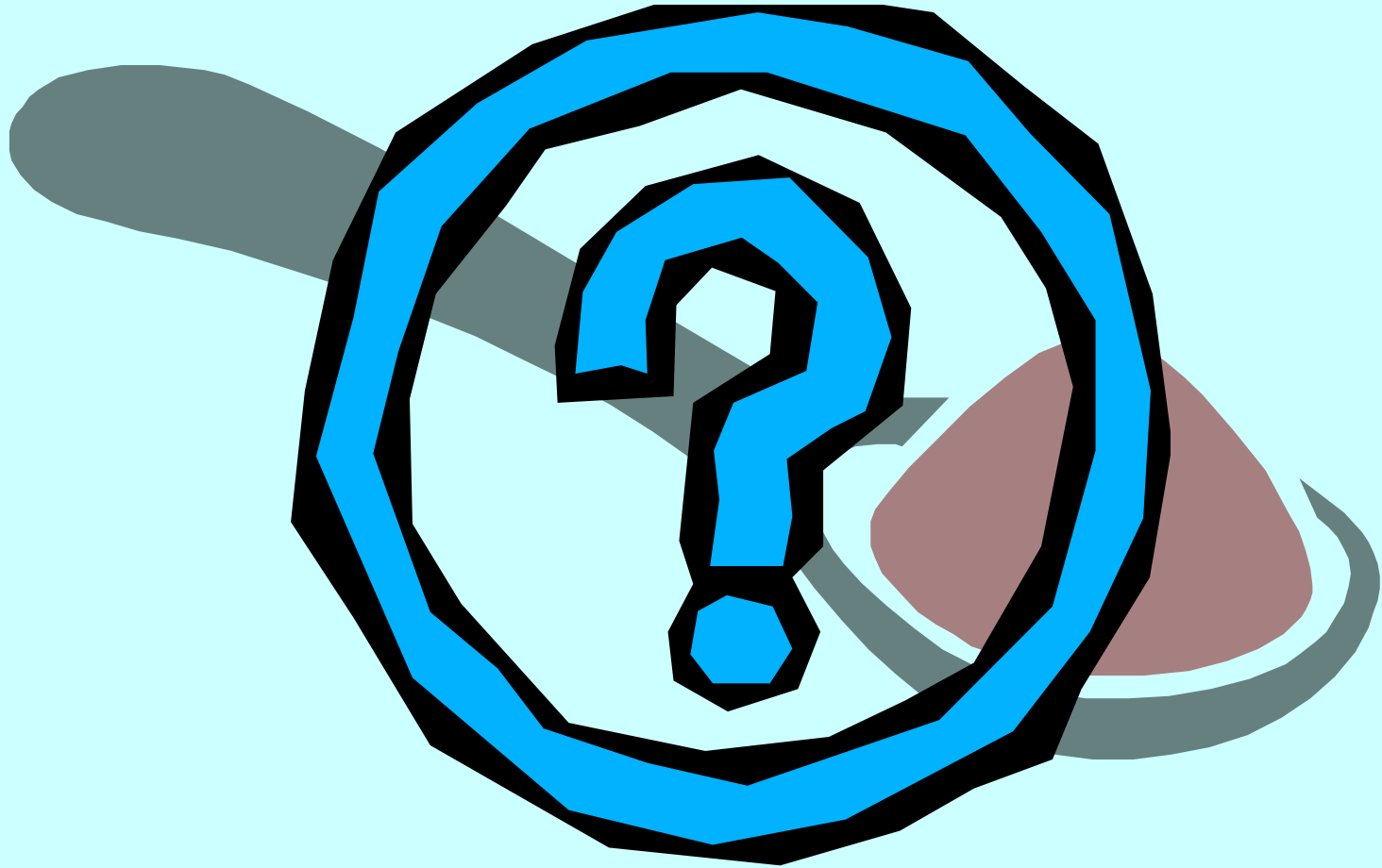
**CDC Childhood Lead Poisoning Prevention
Program <https://www.cdc.gov/nceh/lead/data/blood-lead-reference-value.htm>**

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<https://www.asmaildoseoftoxicology.org/toxipedia/>



A Small Dose of TM Lead



Authorship Information

**This presentation is supplement to
“A Small Dose of Toxicology”**

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