

## Heavy Metals



**Presented By:**  
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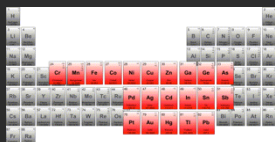
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## What are Heavy Metals?

- Characterized by one of the following:
  - High atomic weight
  - High atomic density
  - Specific atomic number range
- Examples: Cobalt, Copper, Manganese, Zinc, Lead, Iron, Mercury, Cadmium
- Some are necessary for healthy bodily functions, but high amounts can lead to damaging effects
- Prone to accumulation



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## How Do Heavy Metals Enter the Environment?

- Industrial Effluence
  - [https://www.youtube.com/watch?v=X4y\\_MIX3oXM](https://www.youtube.com/watch?v=X4y_MIX3oXM)
- Mining Runoff
- Nonpoint Source Pollution
- Agriculture
- Bioaccumulation



<http://www.conserve-energy-future.com/causes-effects-of-industrial-pollution.php>

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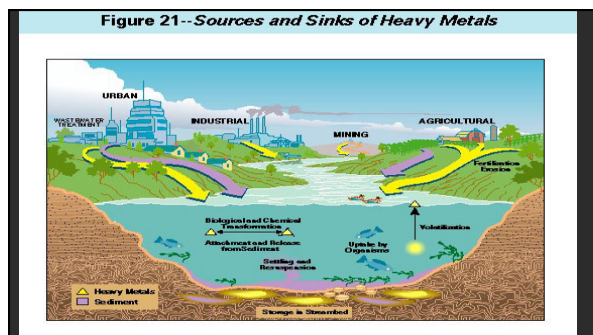
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**Most Prominent Heavy Metals that Kill Frog Tadpoles**

|         |         |
|---------|---------|
| Silver  | Cadmium |
| Copper  | Zinc    |
| Mercury |         |

- Dependant on:
  - Physio-chemical Characteristics
  - Hardness
  - Animal in question
    - Species
    - Developmental Stage

| Metal    | LC50 (95% CI) |              | 95% confidence limits at 100 µM |             | Source reference at 95 °C |
|----------|---------------|--------------|---------------------------------|-------------|---------------------------|
|          | µg/L          | mg/L         | µg/L                            | mg/L        |                           |
| Silver   | 0.027         | 0.027        | 0.026                           | 0.028       | 1201-03                   |
|          | 0.026-0.110   | 0.026-0.080  | 0.026-0.070                     | 0.026-0.080 |                           |
| Mercury  | 2.99          | 0.05         | 0.04                            | 0.04        | 136-7                     |
|          | 1.46-2.50     | 0.71-0.040   | 0.36-0.59                       | ...         | 176-3                     |
| Copper   | 0.04          | 0.04         | 0.04                            | 0.04        | 6-22                      |
|          | 0.03-0.26     | 0.03-0.26    | 0.03-0.26                       | 0.03-0.26   | 2-48                      |
| Zinc     | 40.0          | 40.0         | 37.0                            | 43.0        | 13-36                     |
|          | 18.30-61.70   | 13.60-56.30  | 13.70-27.40                     | 17.60-33.00 | 1-8                       |
| Nickel   | 40.0          | 40.0         | 37.0                            | 43.0        | 13-36                     |
|          | 18.30-61.70   | 13.60-56.30  | 13.70-27.40                     | 17.60-33.00 | 1-8                       |
| Chromium | 76.0          | 76.0         | 74.0                            | 78.0        | 13-36                     |
|          | 36.30-135.60  | 26.10-104.80 | 26.20-52.10                     | 32.40-57.90 | 1-8                       |

95% confidence limits cannot be calculated.

Khanjari, B. S., P. K. Ray. 2007. Sensitivity of frog tadpoles, *Bufo terrestris* (Schneider), to heavy metals. *Bulletin of Environmental Contamination and Toxicology* 33: 522-527.

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**Copper Toxicity (copperiedus)**

Natural & Toxic Copper

- Symptoms-
  - Vomiting
  - Low blood pressure
  - Yellow pigmentation of skin
  - Gastrointestinal distress
  - Growth
  - Effects with offspring and survival rates
  - Mortality
- (Southern Leopard Frog)

<http://www.herculesTexas.org/content/southern-leopard-frog>

<http://newworksproject.org/gallery/723091.html>

<http://srehp.usgs.edu/projects/docs/H021/lancaetal-RanaCooper2012.pdf>

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### Lead Poisoning

- Where does it come from?
  - Lead Bullets
  - Fishing Sinkers
  - Mine Wastes
  - Paint Chips
- Symptoms
  - Lethargic
  - Lack of appetite
  - hearing/sight loss
  - Reproductive tract
  - Affects the kidneys, liver, bloodstream, and even body tissue
  - Mortality

**Lead**

Bluish-white, silvery, or gray metal. Cumulative poison. Repeated low exposures causes: severe neurological effects, blood/kidney damage. Possible cancer hazard. Reproductive damage (sterility, decreased fertility) and developmental damage to fetus.



CAS No. 7439-92-1

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### Aluminum Toxicity

-acidifies amphibian habitat and causes many negative effects to amphibian eggs and larve

Can..

- Decrease hatching success
- Increase egg mortality
- Delay hatching time
- Reduce size of eggs

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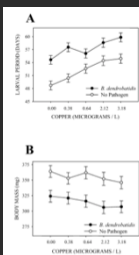
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### Possible Effects with Chytrid (*Batrachochytrium dendrobatidis*)

- associated with amphibian decline worldwide
- Causes changes in the skin affecting water and mineral absorption and oxygen transfer in lungless amphibians.
- Copper presence may decrease the effects of chytrid on some species of larval amphibians (ex. *H. chrysoscelis*) by inhibiting growth of *Bd*



**COPPER AND BUCKLE UP**

**A**

LARVAL ABUNDANCE

0.00 0.10 0.20 0.30 0.40

0.00 0.10 0.20 0.30 0.40

**B**

Bd ABUNDANCE

0.00 0.10 0.20 0.30 0.40

0.00 0.10 0.20 0.30 0.40

**Fig. 1.** (A) Larval growth (length, mass) and (B) Bd abundance in anuran larvae (larvae) for *H. chrysoscelis* were tested in experimental treatments in the presence of copper concentrations in the absence or presence of the chytrid *Batrachochytrium dendrobatidis*. Values reflect the mean abundance of the chytrid per treatment (1, 2, 3, 4) across the 10 replicates per treatment (1, 2, 3, 4).

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### Prevention of Heavy Metal Effects in the Environment

Rate of heavy metals added to the environment exceeds removal by natural processes. Often removed from wetlands through precipitation and absorption through soils and plants)

=accumulation over time

Removal/Prevention?

-Mining→ Dublin, Ireland. Tailings are run through plants that can survive larger metal concentrations before entering wetland areas.



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### Why is Heavy Metal Pollution Important?

- Many Varying Effects
- Environmental Accumulation
- Multiple Sources
  - Industrial Effluence
  - Mining Runoff
- Compounding Effects of Other Stressors
  - Disease (Chytridiomycosis)
  - Pesticides (Herbicides)
- Amphibian Declines
- **Not only does Heavy Metal Pollution affect Amphibians, but it affects all types of wildlife**

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### Wetland Food Chain

→ affects all wildlife when contaminated



Figure 36-4. A wetland food web.  
<http://archives.sundsvobserver.it/2013/01/06/jun03.asp>

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### Image References

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<http://www.conserve-energy-future.com/causes-effects-of-industrial-pollution.php>

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