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

How Do Heavy Metals Enter the Environment?

- Industrial Effluence
  - https://www.youtube.com/watch?v=I4y_MlX3oXM
- Mining Runoff
- Nonpoint Source Pollution
- Agriculture
- Bioaccumulation

[Link to article for Heavy Metal Reduction: http://www.phadjustment.com/TArticles/Heavy_Metal_Reduction.html]

[Link to article on causes and effects of industrial pollution: http://www.conserve-energy-future.com/causes-effects-of-industrial-pollution.php]
Most Prominent Heavy Metals that Kill Frog Tadpoles

<table>
<thead>
<tr>
<th>Metal</th>
<th>Symptoms</th>
</tr>
</thead>
<tbody>
<tr>
<td>Silver</td>
<td>Vomiting, Low blood pressure, Yellow pigmentation of skin, Gastrointestinal distress, Mortality</td>
</tr>
<tr>
<td>Cadmium</td>
<td>Vomiting, Low blood pressure, Yellow pigmentation of skin, Gastrointestinal distress, Mortality</td>
</tr>
<tr>
<td>Copper</td>
<td>Vomiting, Low blood pressure, Yellow pigmentation of skin, Gastrointestinal distress, Mortality</td>
</tr>
<tr>
<td>Zinc</td>
<td>Vomiting, Low blood pressure, Yellow pigmentation of skin, Gastrointestinal distress, Mortality</td>
</tr>
<tr>
<td>Mercury</td>
<td>Vomiting, Low blood pressure, Yellow pigmentation of skin, Gastrointestinal distress, Mortality</td>
</tr>
</tbody>
</table>

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)

[Image: Figure 21--Sources and Sinks of Heavy Metals]


[Links: http://www.herpsoftexas.org/content/southern-leopard-frog http://keywordsuggest.org/gallery/723691.html]
Lead Poisoning

- Where does it come from?
  - Lead Bullets
  - Fishing Sinks
  - Mine Wastes
  - Paint Chips

- Symptoms
  - Lethargy
  - Lack of appetite
  - Hearing/sight loss
  - Reproductive tract
  - Affects the kidneys, liver, bloodstream, and even body tissue
  - Mortality

Aluminum Toxicity

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

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

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 (e.g., H. chrysoscelis) by inhibiting growth of Bd
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.

Why is Heavy Metal Pollution Important?

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

Wetland Food Chain

→ affects all wildlife when contaminated
References:


References Continued


Image References

http://www.phadjustment.com/TArticles/Heavy_Metal_Reduction.html


http://www.herpsoftexas.org/content/southern-leopard-frog