

Heavy Metal Toxicity



Defining Water Pollution

- **Water pollution:** degradation of water quality
- Water Quality Depends On:
 1. **Use-** what will the water be used for?
 2. **Difference from norm-** how different is the water now from how it is normally?
 3. **Health/Ecosystem Effects-** what will happen if humans or animals drink/swim/use this water?



Polluted water in India where clean water is a big environmental problem

Water Uses



Agriculture



Industrial Processes



Power Generation



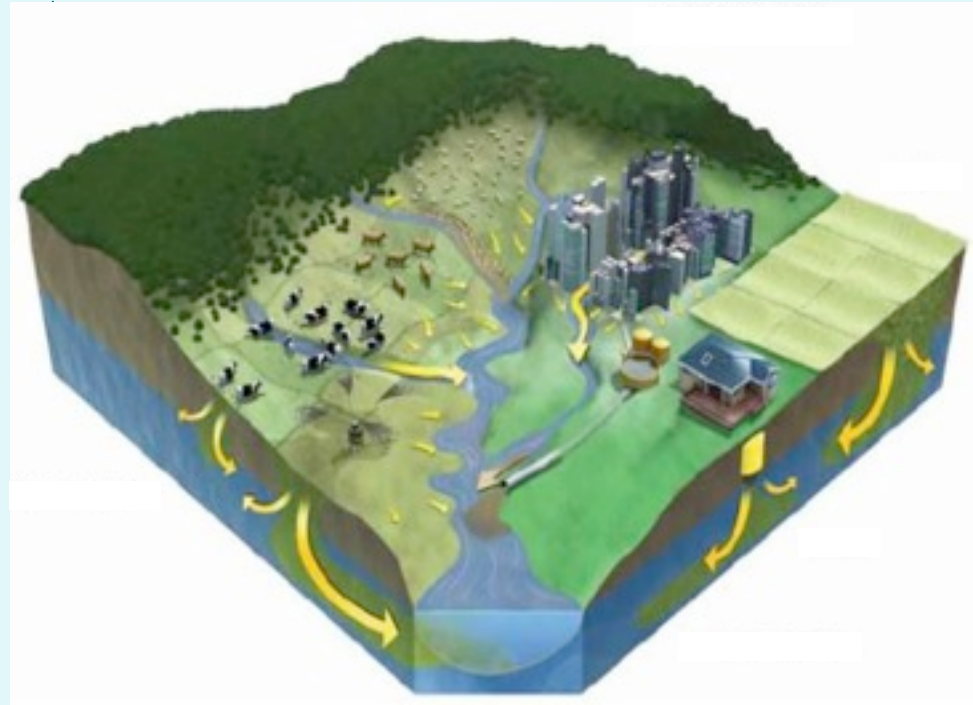
Home Use (Domestic)

Sources of Pollutants to Water



- **Direct Sources**
 - Runoff
 - Leaks
 - Seepage into groundwater
 - Air transport

- **Indirect Sources**
 - Population size- leads to more pollution overall



Categories of Pollutants



Pollutant	Example Sources
Dead organic matter	sewage, agricultural waste
Pathogens	human and animal waste
Drugs	painkillers, etc...
Organic Chemicals	pesticides and herbicides
Nutrients	agricultural use (fertilizers)
Heavy Metals	urban and industrial processes
Acids	sulfuric acid from coal mining
Sediment	construction sites, natural
Heat	power plants
Radioactivity	nuclear power industry



Water Requirements for Home Use



- Water must be free from:
 - Fine sediment
 - Insecticides
 - Pesticides
 - Pathogens
 - Heavy metals
- Should also taste good, be odorless, not damage plumbing



Heavy Metals in the Environment



- “Heavy” metals: high atomic weight
- Examples: Mercury, lead, copper, arsenic, cadmium, gold
 - Can pollute both water and soil
 - Both naturally occurring and human released
- Sources
 - Human Released: Industrial sources (mining), runoff
 - Naturally Occurring: rocks and minerals

H																	He	
Li	Be											B	C	N	O	F	Ne	
Na	Mg											Al	Si	P	S	Cl	Ar	
K	Ca	Sc	Ti	V	Cr	Mn	Fe	Co	Ni	Cu	Zn	Ga	Ge	As	Se	Br	Kr	
Rb	Sr	Y	Zr	Nb	Mo	Tc	Ru	Rh	Pd	Ag	Cd	In	Sn	Sb	Te	I	Xe	
Cs	Ba			Hf	Ta	W	Re	Os	Ir	Pt	Au	Hg	Tl	Pb	Bi	Po	At	Rn
Fr	Ra																	
La Ce Pr Nd Pm Sm Eu Gd Tb Dy Ho Er Tm Yb Lu																		
Ac Th Pa U Np Pu Am Cm Bk Cf Es Fm Md No Lr																		

Effects Of Metals on Health



- **Direct Effects**
 - Physiological- metals can inhibit basic body functions
- **Indirect Effects**
 - stored in tissues over time- initial dose might be ok, but can accumulate over time (bioaccumulation)
- **Example: Mercury**
 - “mad hatter”- mercury used in hat making

Health Effects from Toxic Metals: Minamata, Japan

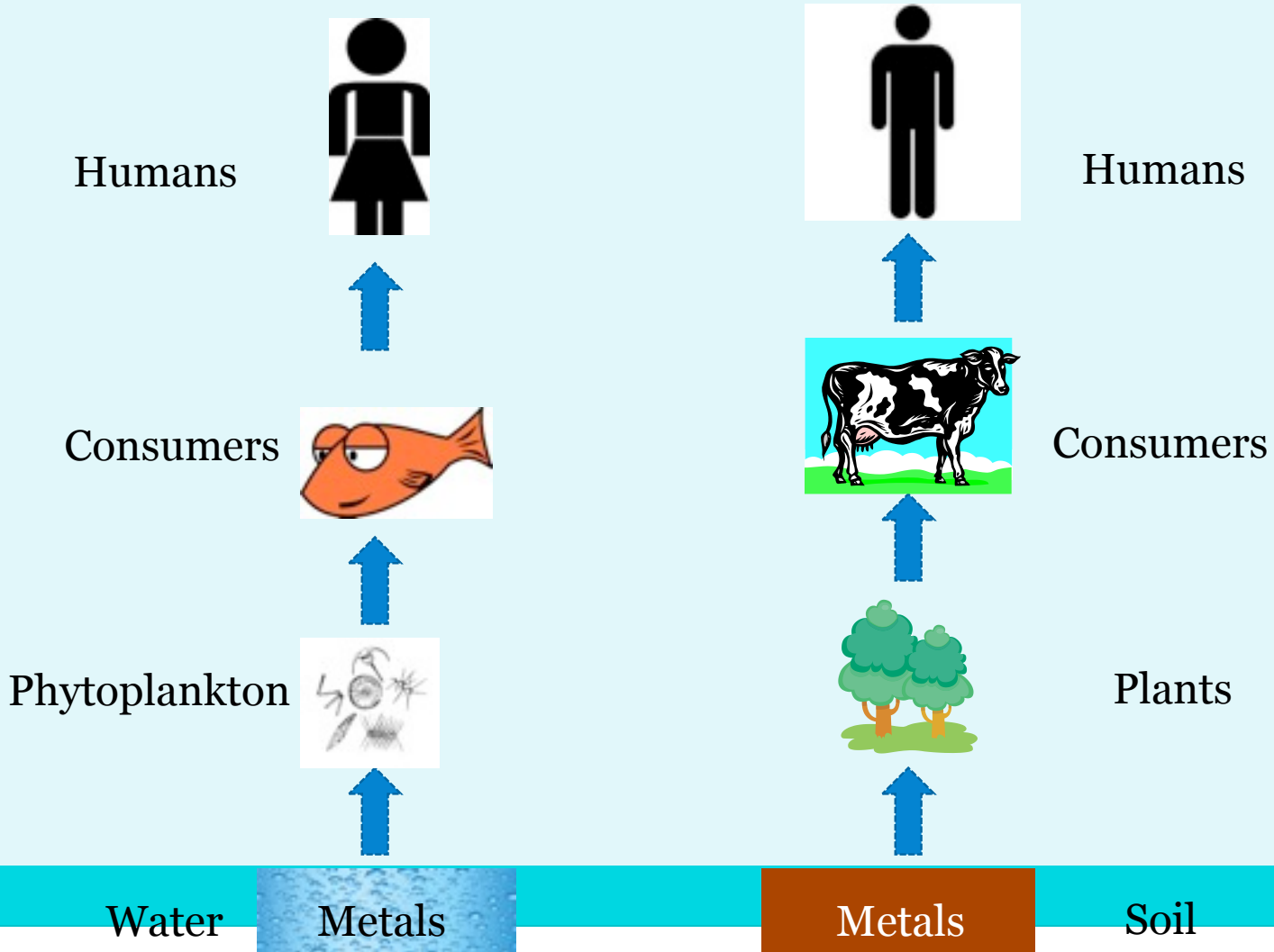
- Chisso Corporation released methyl mercury into Minamata Bay from 1932-1968.
- Methyl mercury *bioaccumulated* in shellfish and fish which were eaten by the residents
- 2,265 victims were reported and 1,784 of them had died
 - Mercury poisoning: muscle weakness, damage to hearing/speech, coma, death



Heavy Metal Uptake Pathways

WATER

LAND



Example: Lead (Pb) Contamination



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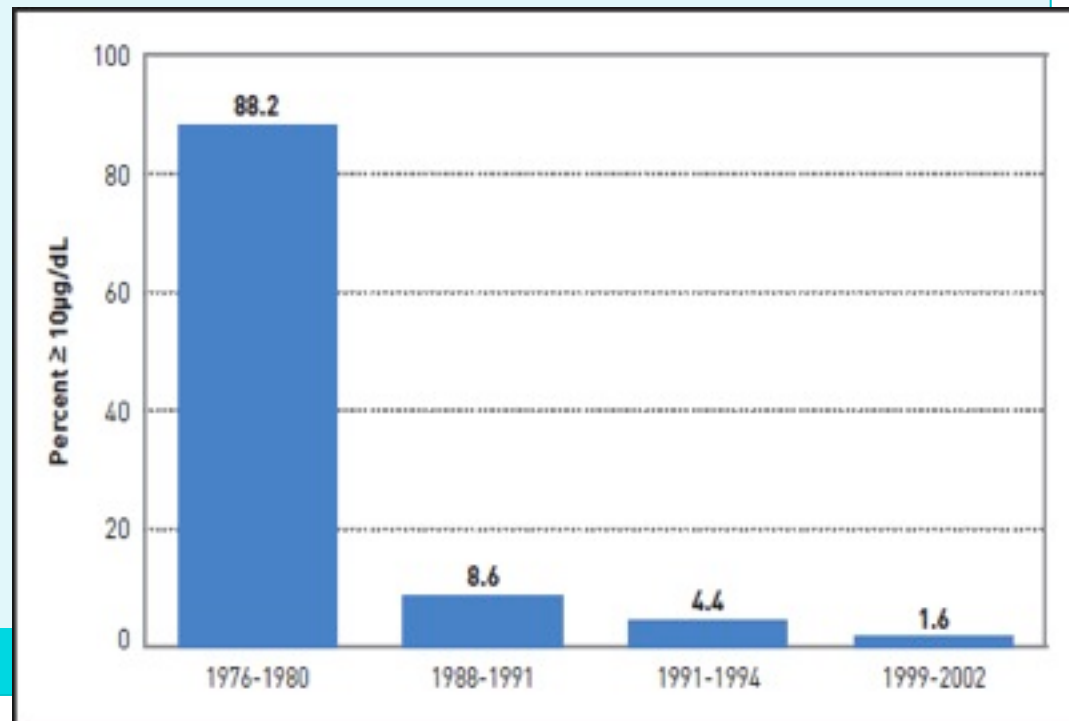


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- Leaded paint and gasoline- used heavily in the past
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Example: Copper in San Diego Bay



- Copper levels in San Diego bay are much higher than in neighboring Mission Bay. Why?

San Diego Bay



Mission Bay



Sources of Copper to San Diego Bay



- Anti-fouling paint on boat hulls



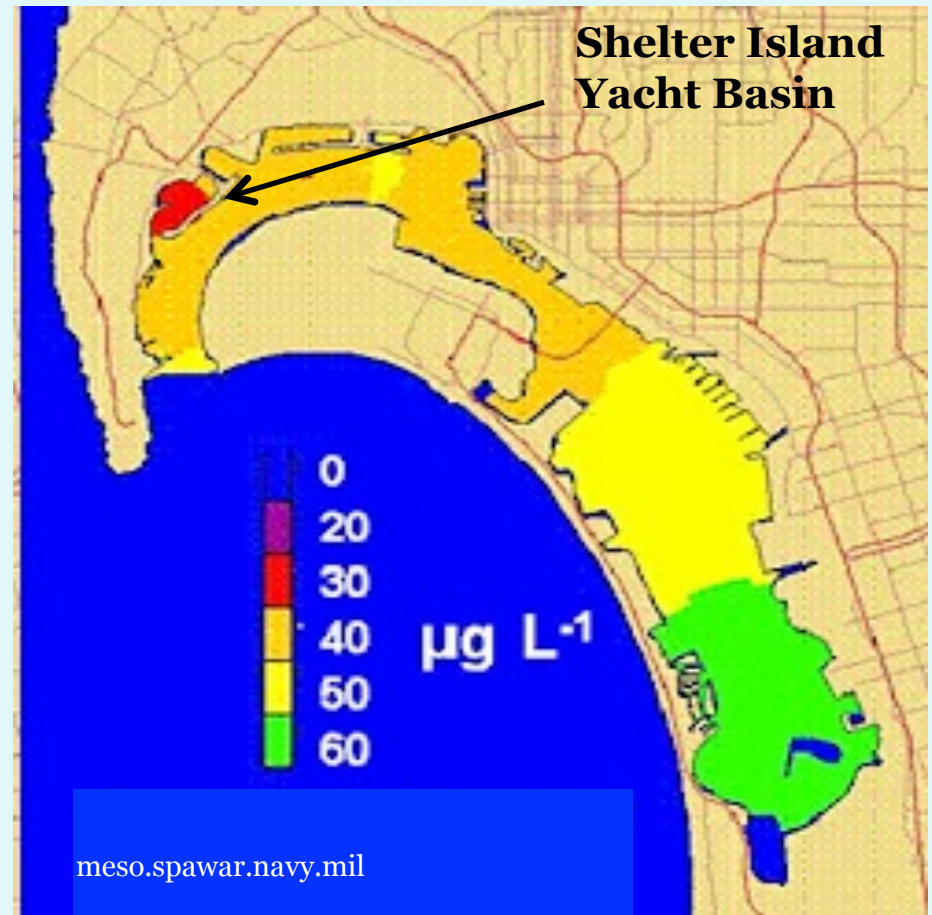
- Run-off- brake pads, storm water



The Effects of Copper in San Diego Bay



- Damaging to plant and fish life
 - Fish, mussels, kelp
- Ultimately un-healthy for humans
 - Lots of recreational activities in the bay- such as fishing

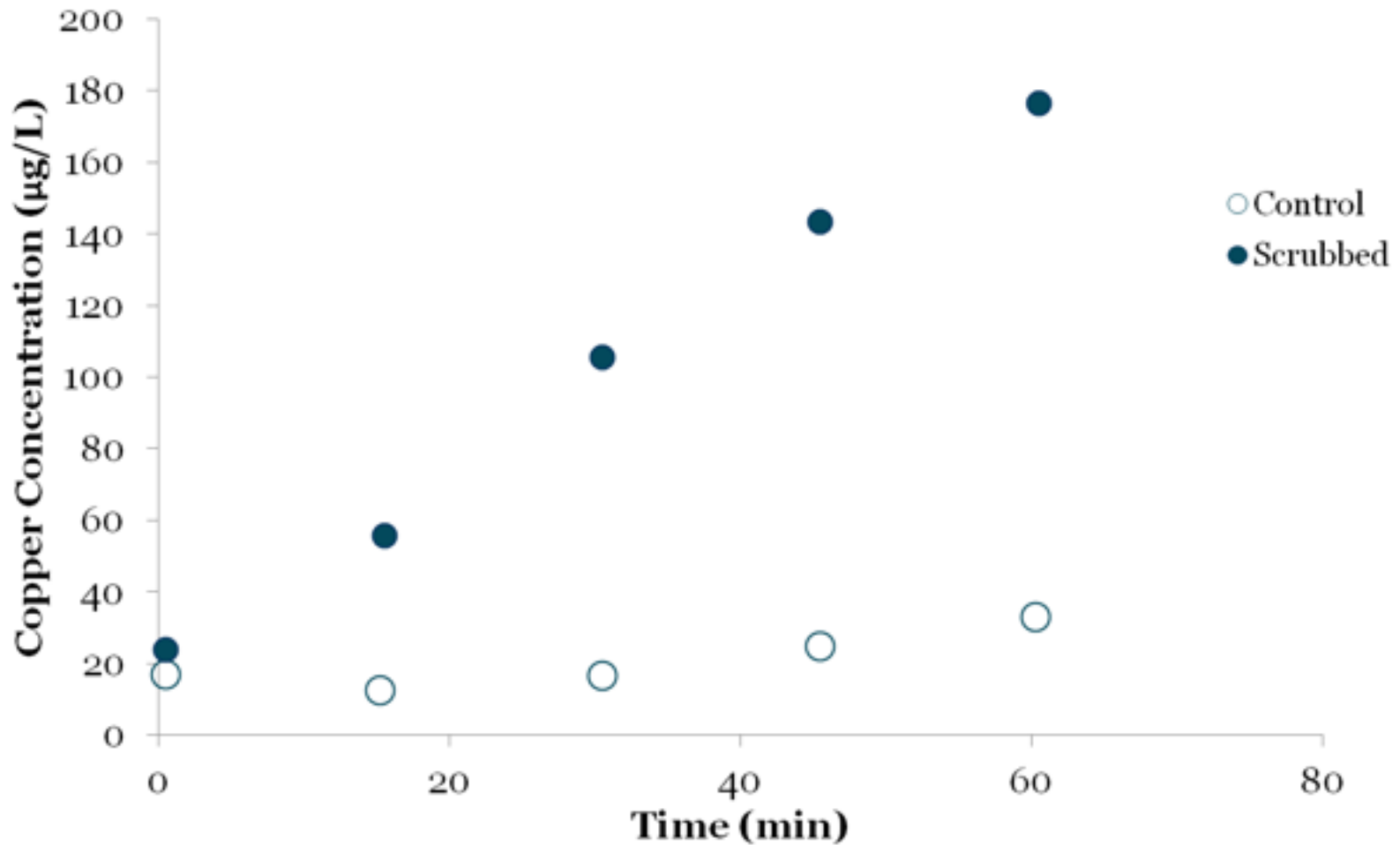


Studying the Effects of Anti-fouling paint on Cu concentrations in San Diego Bay

- Regulations prevent excess copper from being introduced into the bay
 - Including from anti-fouling paint
- Tests are being done to determine why so much copper is entering the bay
 - Type of paint
 - Boat cleaning methods



SPAWAR Results



Conclusions



- Water pollution is any degradation of water quality from it's original state
 - This can vary depending on the intended use of the water- drinking, home, industrial, etc...
- Heavy metals are particularly harmful pollutants to water quality
 - Dangerous to human health
 - Toxic to marine life
- Heavy metal contamination in water has declined recently, but some metals such as copper still remain high