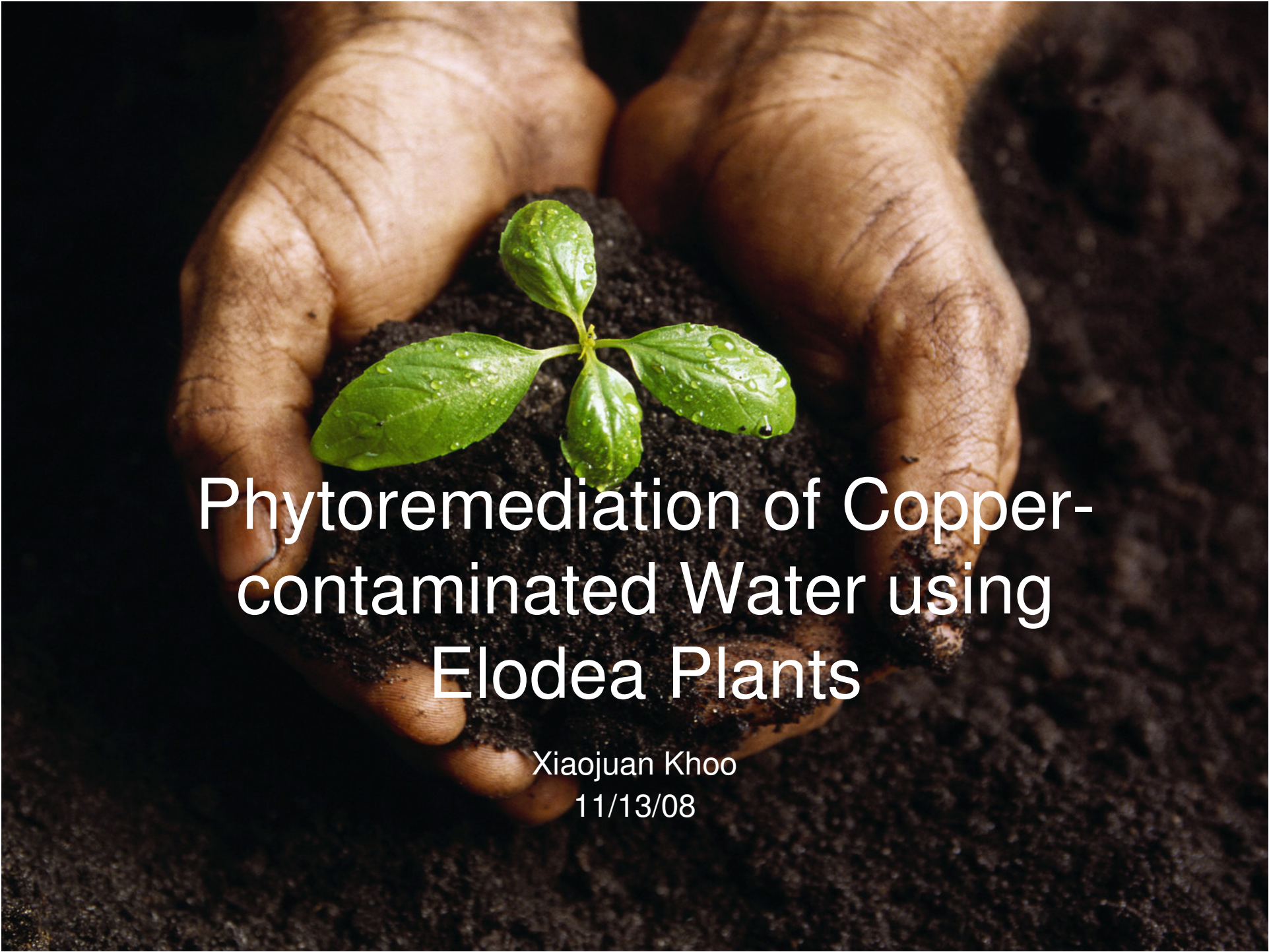




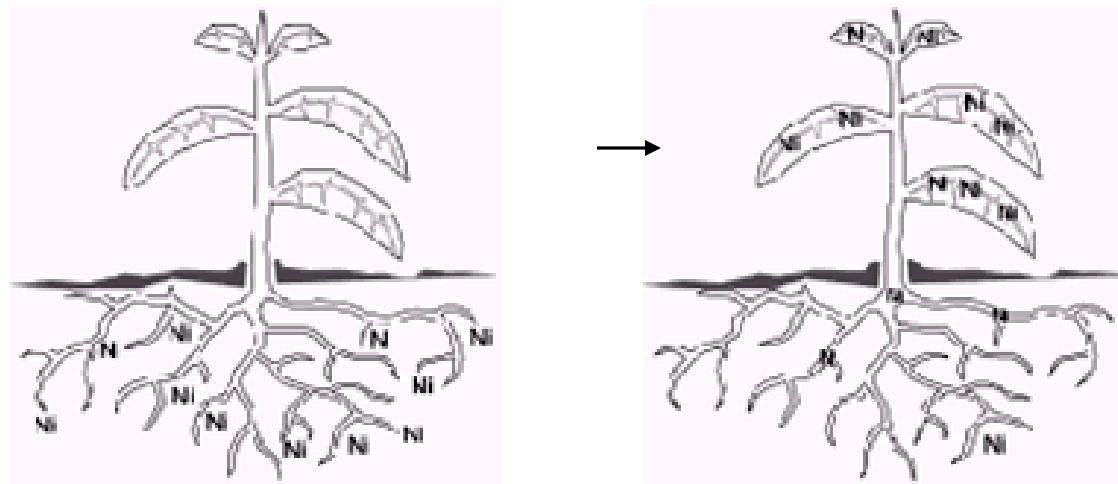
Phytoremediation of Copper-contaminated Water using Elodea Plants

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Background

- “*Phyto*” = Plant, “*Remediation*” = restore balance
- The use of certain plants to remove toxins from the environment. (e.g., metals in soil – Cu, Pb, Zn)



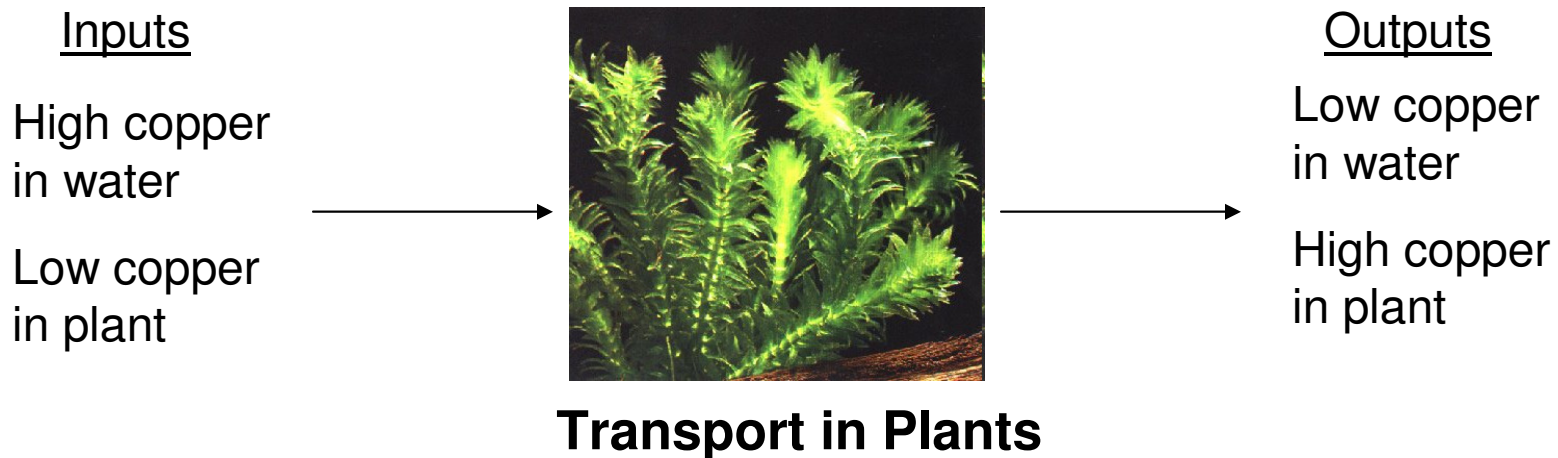
These plants work like a vacuum cleaner!

Parts of the plant can be removed and the toxins carefully destroyed.

- “Green” technology
 - Less environmental impact than excavation
- Cost-effective

Question

- How is the final copper concentration in Elodea affected by the starting copper concentration of the water that it grows in?
- How does the copper concentration in Elodea plants change over time?



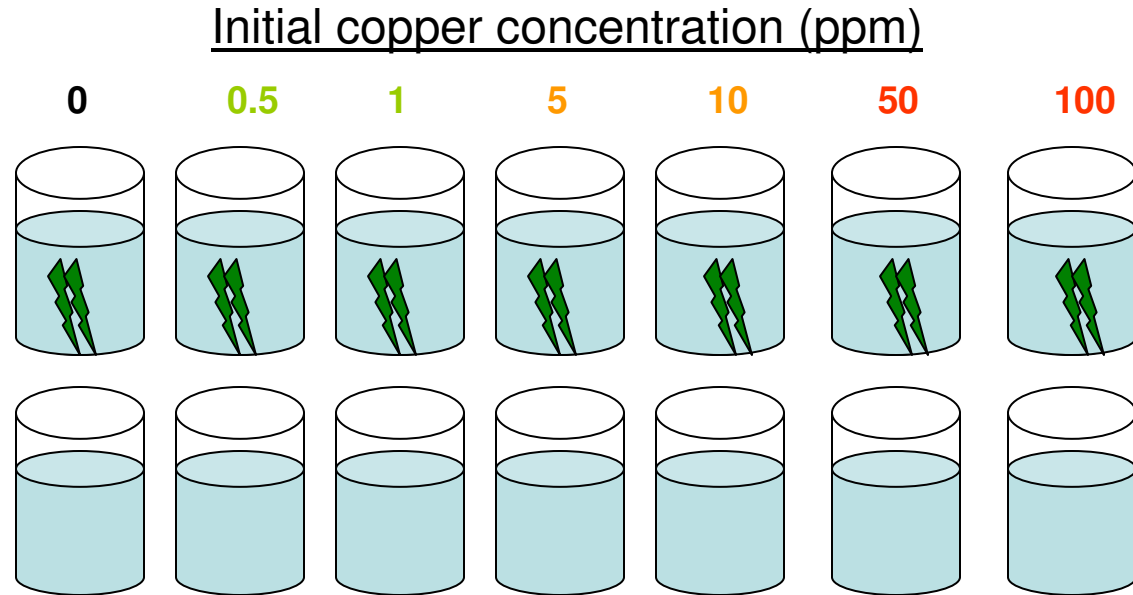
Hypothesis

- Elodea will remove increasing amounts of copper from the polluted water over 5 days.
- Elodea will be most effective at low and moderate concentrations. High copper concentration will result in plant death.
- *Independent* variable: **Time** (days)
- *Dependent* variable: **Copper conc. in Elodea** (ppm)

Experimental Setup

- Materials:

- Elodea plant
- Copper sulfate
- Beakers
- Aluminum foil
- Water with nutrients
- Pipet
- Copper test kit



- Measure copper levels by taking a sample of water at one day intervals for 5 days.
- Use a copper test kit to measure copper levels.
 - Mix water with reagent and look at color change
 - Compare color change to a standard chart
- Calculate and graph the change in copper concentration over 5 days for each beaker.
- Record the appearance of each plant to determine health of the plant over 5 days



Now I have answers...

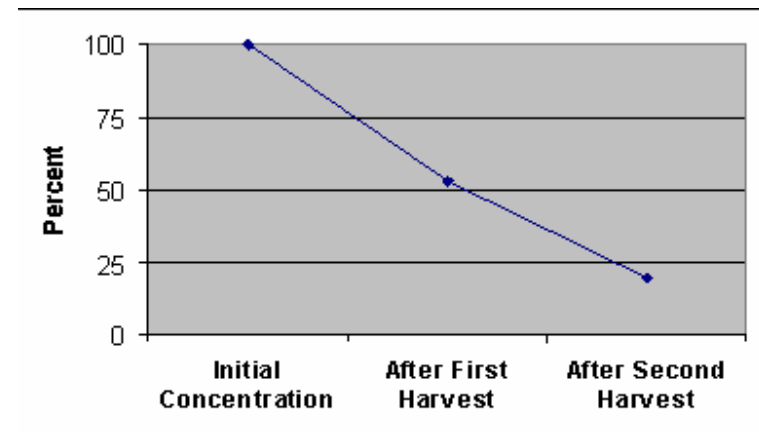
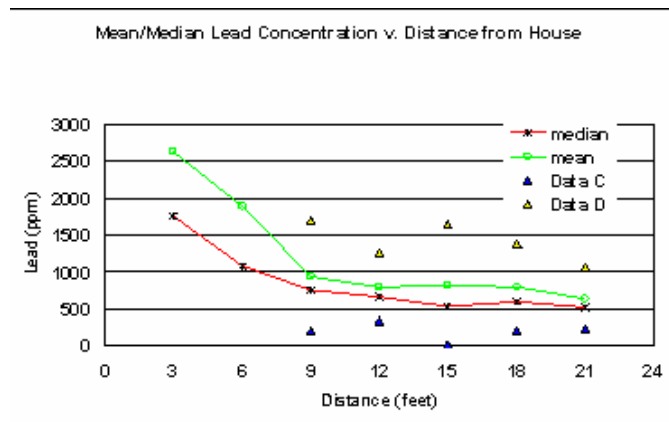
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- How does the copper concentration in Elodea plants change over time?



- How much copper metal can Elodea remove from polluted water over 5 days?
- What is the range for effective phytoremediation?

Global Impact

- Soil and water contaminated with heavy metals and other toxins pose large environmental and human health hazards.
- Phytoremediation can be used to decontaminate large areas without damaging the land.
- **“Phytoremediation of lead in residential soils in Dorchester, MA”**
 - Lead paint was widely used until 1978. Houses were built before 1980.
 - Lead is highly toxic and can cause neurological problems.
 - Federal limit: 400 ppm in children’s play area and 1200 ppm in non-play areas



- Use Indian mustard plant suitable for northeastern soil conditions
 - Can hold 75x more lead than the water it grows in!
 - lead is stored in shoots, so the entire plant does not have to be removed

Questions?

- What type of plants can be used for phytoremediation?
 - “hyperaccumulators”
 - fast growing, deep roots, easy to harvest.
 - Sunflower, duckweed, kale, corn, broccoli etc.
- Do the toxins or metals prevent plant growth?
 - Possibly, so this method may work best when there is moderate contamination.
 - Grow seeds in a nursery and transfer the plants only when they are more mature.
- Can animals be poisoned if they eat these plants?
 - Maybe, but the environmental risk is small compared to the number of human lives that could be protected



Bibliography

- Chaney R.L., Phytoremediation: Using Plants to Clean Up Soils. *USDA Agricultural Research Magazine*, 2006
- ITRC Workgroup, Emerging Technologies for the Remediation of Metals in Soils. *Interstate Technology & Regulatory Council*, 2007
- Kirkwood NG, Here come the Hyperaccumulators!. *Harvard Design Magazine*, 2002
- <http://www.chemetrics.com/> (copper test kit)