Lead

- Lead Pipes
- Ammunition & Fishing Equipment
- Industrial Sector
- Paint (Lead-Based)
- Maximum (Allowable) Contaminant Level
  - 0.015 mg/L

- In adults, High Lead Levels $\rightarrow$ High Blood Pressure
- In children, lead can affect development
  - Inhibits brain development
  - Symptoms: Migraines, shortened of attention span, etc.
Arsenic

- Ground water
- Smelting and Construction Industries
- Paint pigments
- Wood Preservatives
- Maximum (Allowable) Contaminant Level
  - 0.010 mg / L
- Linked to Cancer of Urinary, Respiratory, and Dermal Systems
- Other effects: skin discoloration, stomach problems, paralysis, and loss of sight
- Prolonged exposure may cause death
Cadmium

- Industrial Workplaces
- Nickel-Cadmium Batteries
- Metal-Coating
- Maximum (Allowable) Contaminant Level
  - $0.005 \text{ mg} / \text{ L}$
- Affects the Cardiovascular, Respiratory and Gastrointestinal systems
- Known Carcinogen
Our BioBricks

• 3 Parts
  – Cadmium, Arsenic, and Lead detectors
Initial Testing Protocol

• 4 mL LB cultures with varying concentrations of Cadmium Nitrate or Lead Acetate
  – Cadmium and Arsenic Promoters
    • 0 – 100 mM Cadmium Nitrate
  – Lead Promoter
    • 0 – 20 mM Lead Acetate
Problems

- Control (left) & 50 mM Cadmium Nitrate (right)

- LB Fluoresces Naturally!
Problems & Solutions

• M9 Salts – Bacteria did not grow

• Grow in LB
  – Spin Cells
  – Resuspend in PBS

• PBS
  – Phosphate Buffered Saline
    • Inexpensive

• Fluorescence / OD
Working Constructs
Results: Lead Detector

- Inconsistent
- Increase at 0.05 mM
- Sharp increase for low concentrations
Results: Arsenic Detector

- Tested using Cadmium Nitrate
- Minimum Detectable level is below 1 mM
Results: Cadmium Detector

- Detection Level is between 1 & 5 mM
## Sensitivity?

<table>
<thead>
<tr>
<th>Contaminant</th>
<th>Federal Limit (mg/L)</th>
<th>Federal Limit (ppm)</th>
<th>Our Detectable Level (ppm)</th>
</tr>
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<tbody>
<tr>
<td>Lead</td>
<td>0.015</td>
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<td>10</td>
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<tr>
<td>Arsenic</td>
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<tr>
<td>Cadmium</td>
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<td>0.005</td>
<td>1182</td>
</tr>
</tbody>
</table>
Future Plans

• Increase Sensitivity
  – Mutagenic PCR
    • 2011 UC Davis iGEM Team
  – Sensitivity Tuners
    • 2007 Cambridge iGEM Team

• Fluorescent Proteins
  – Which is the most sensitive?

• Duplex
  – Multiple promoters & reporters
  – Identify mixing of colors

• “Cell Suicide Gene”
  – 2010 University of Hong Kong 2012 iGEM Team

• Research lead promoter
Sponsors

Sandra & Bill Hall
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