

Heavy Metal Detectors

Gaston Day School

2012 iGEM Team

Lead

- Lead Pipes
- Ammunition & Fishing Equipment
- Industrial Sector
- Paint (Lead-Based)
- Maximum (Allowable) Contaminant Level
 - 0.015 mg/L
- In adults, High Lead Levels → High Blood Pressure
- In children, lead can affect development
 - Inhibits brain development
 - Symptoms: Migraines, shortened of attention span, etc.

Arsenic

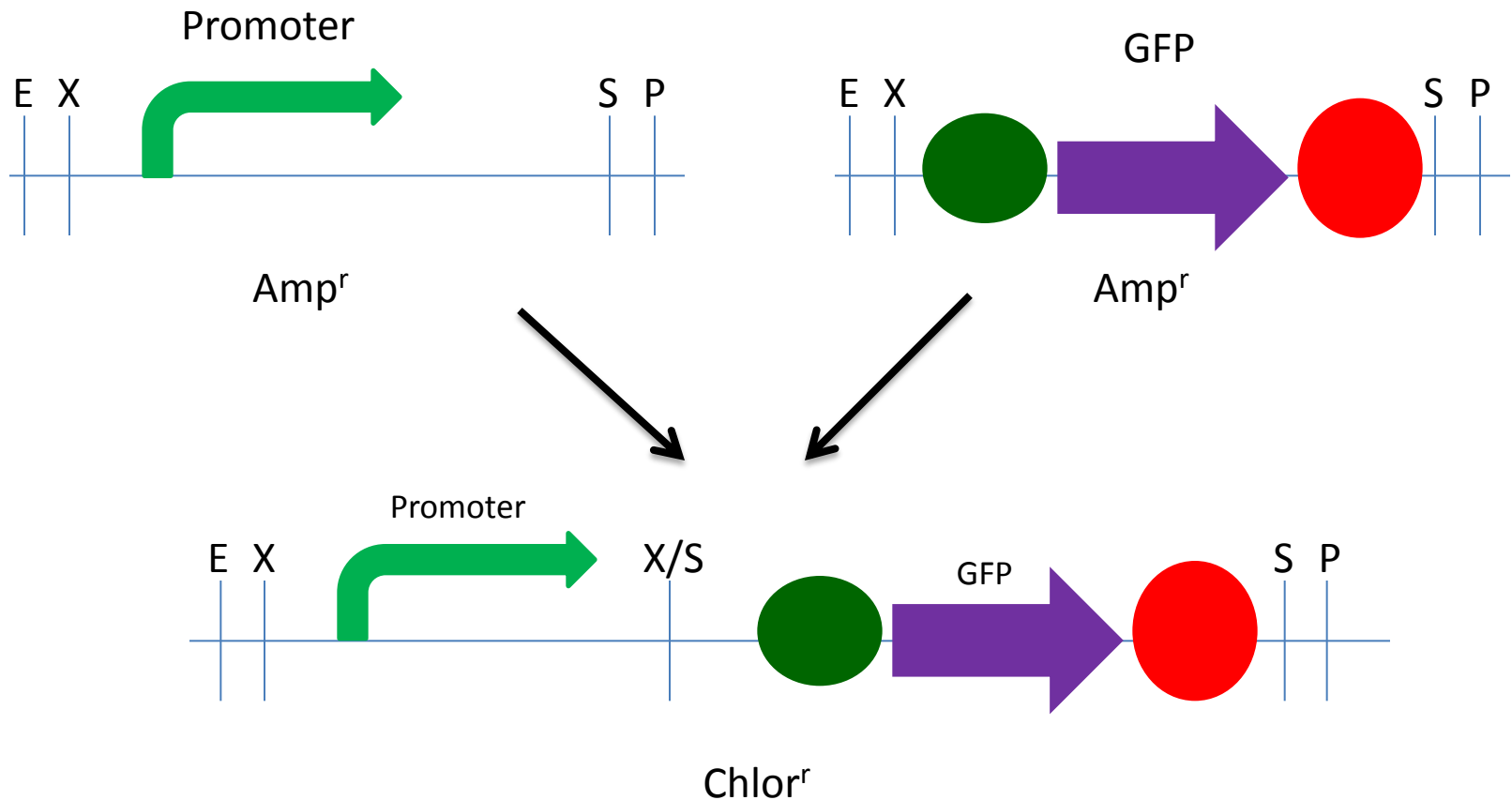
- Ground water
- Smelting and Construction Industries
- Paint pigments
- Wood Preservatives
- Maximum (Allowable) Contaminant Level
 - 0.010 mg / L
- Linked to Cancer of Urinary, Respiratory, and Dermal Systems
- Other effects: skin discoloration, stomach problems, paralysis, and loss of sight
- Prolonged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

Cadmium

- Industrial Workplaces
- Nickel-Cadmium Batteries
- Metal-Coating
- Maximum (Allowable) Contaminant Level
 - 0.005 mg / 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

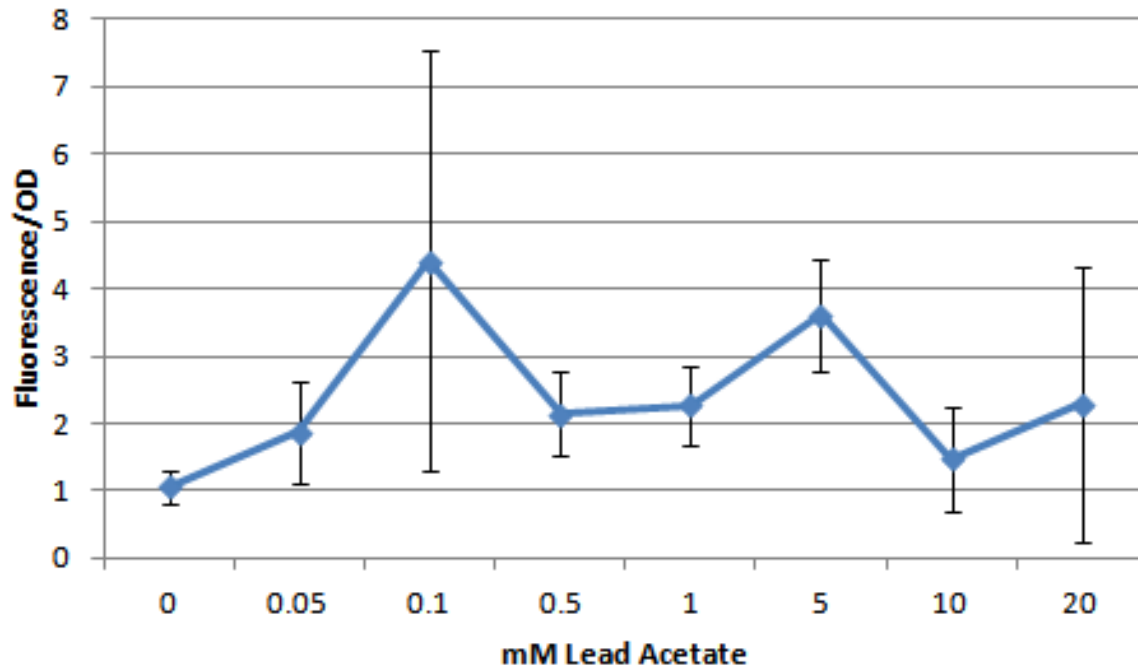
- M9 Salts – Bacteria did not grow
- Grow in LB
 - Spin Cells
 - Resuspend in PBS
- PBS
 - Phosphate Buffered Saline
 - Inexpensive
- Fluorescence / OD

Working Constructs



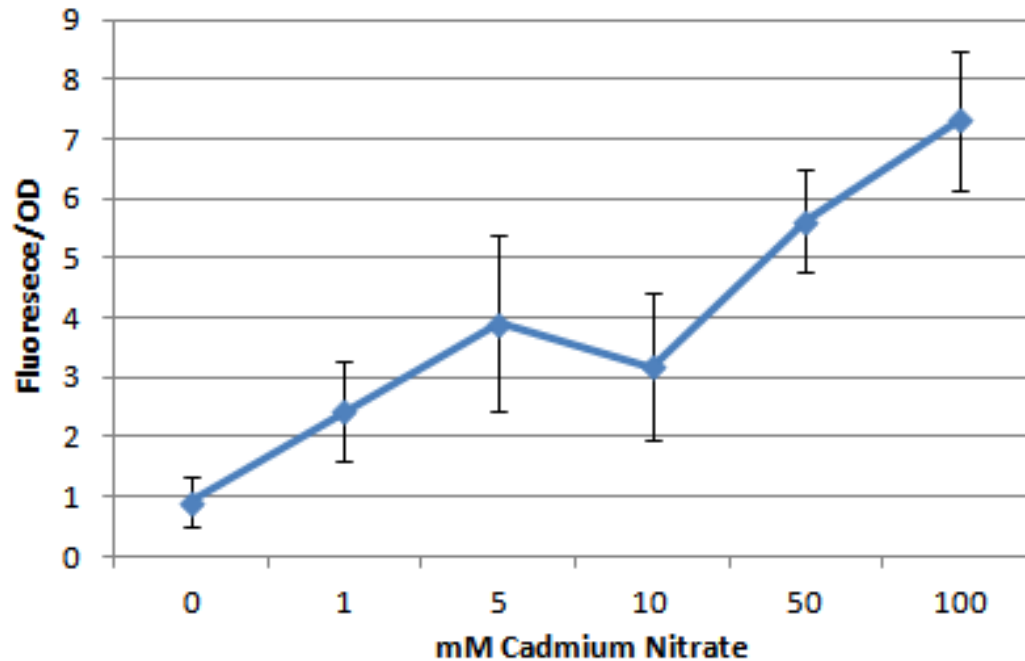
Results: Lead Detector

- Inconsistent
- Increase at .05 mM
- Sharp increase for low concentrations



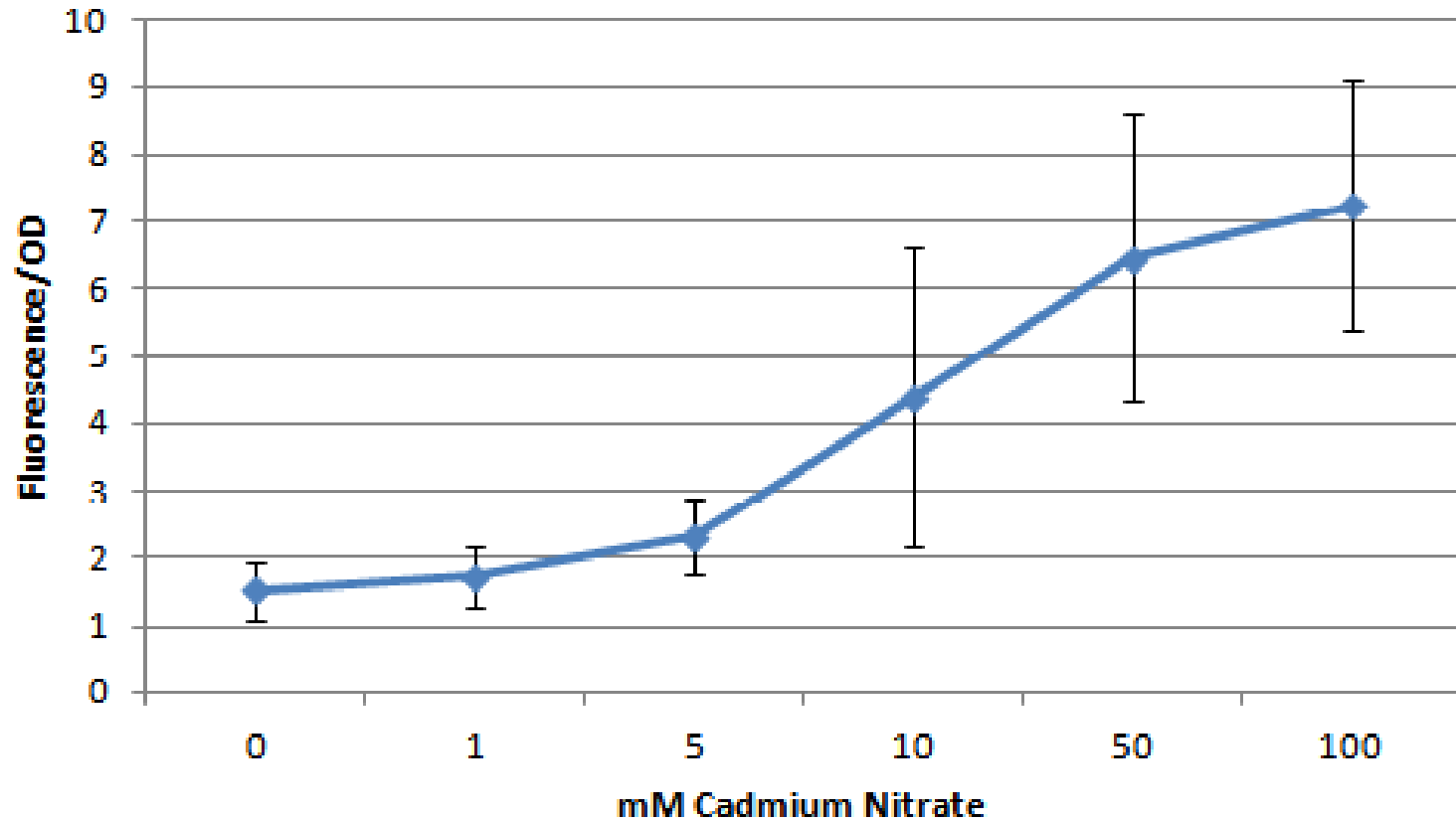
Results: Arsenic Detector

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



Results: Cadmium Detector

- Detection Level is between 1 & 5 mM



Sensitivity?

Contaminant	Federal Limit (mg/L)	Federal Limit (ppm)	Our Detectable Level (ppm)
Lead	0.015 mg/L	0.015	10
Arsenic	0.010 mg/L	0.010	236.4
Cadmium	0.005 mg / L	0.005	1182

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

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