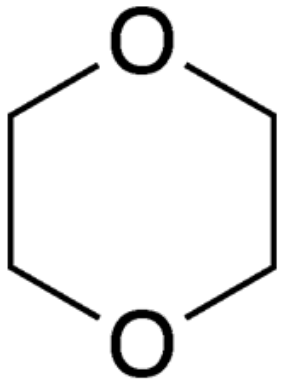
Yale University

Aptamer biosensor for 1,4 Dioxane

Dr. Irvan Luhung

irvan.luhung@yale.edu

PEPH 2024 | Climate Change and Environmental Justice
Feb 20 – 22, 2024



1,4-dioxane

Focus of P42 Research:

P1: Toxicity

P2: Exposure

P3: Detection

P4: Treatment

Exposure to human

https://delltech.com/blog/and https://nyponros.com/en/

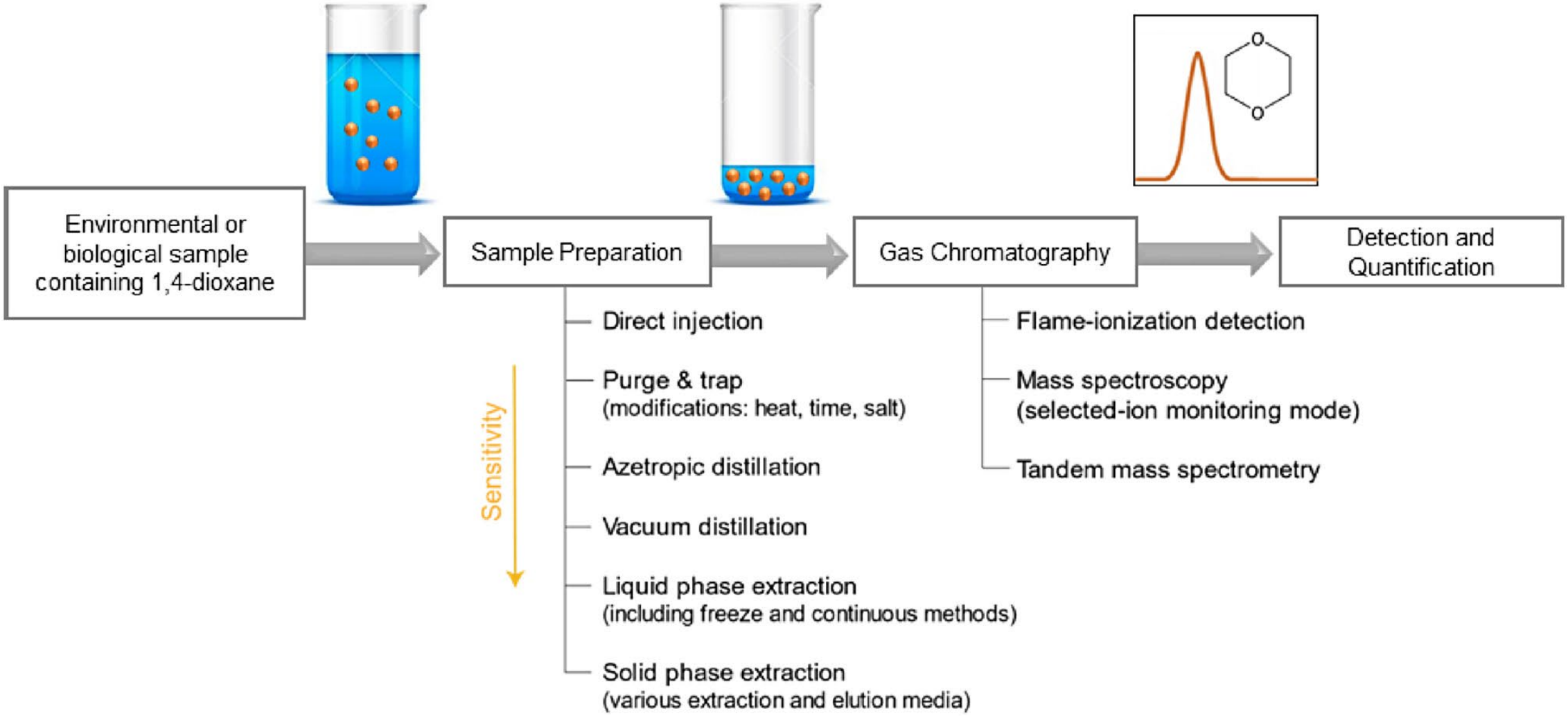
Health impact

- Animal studies
- Liver damage, including cancer
- Potential carcinogenic

Concentration level and standards

- Highly soluble in water: 800 g/L at 25 °C
- Industrial discharge not yet regulated
- EPA (HAL) for drinking water: 0.35 µg/L (ppb)
- Florida: groundwater (3.2 µg/L), surface water (120 µg/L)
- New York: Personal care product (1 mg/L), cleaning product (10 mg/L)

P3: Current detection approach for 1,4-dioxane

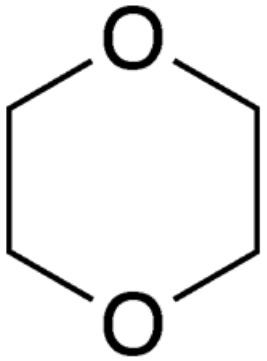


Detection limit: 10 µg/L to 0.15 µg/L to **0.05 µg/L**

Reminder: HAL = 0.35 µg/L

Godri Pollitt, et al. *STOTEN* (2019)

P3 Goal : 1,4 DX Sensor



1,4-dioxane

Sensor development challenges:

- Simple structure
- Low molecular weight
- Neutral charge
- High Polarity
- Low reactivity

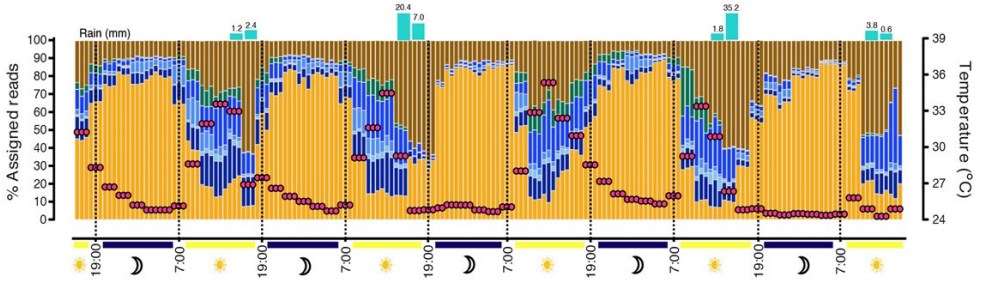
Sensitivity

- Detection limit target: 0.35 µg/L

Specificity

- Specific relative to co-contaminants

Turn-around time (Time resolution)

- 

Cost

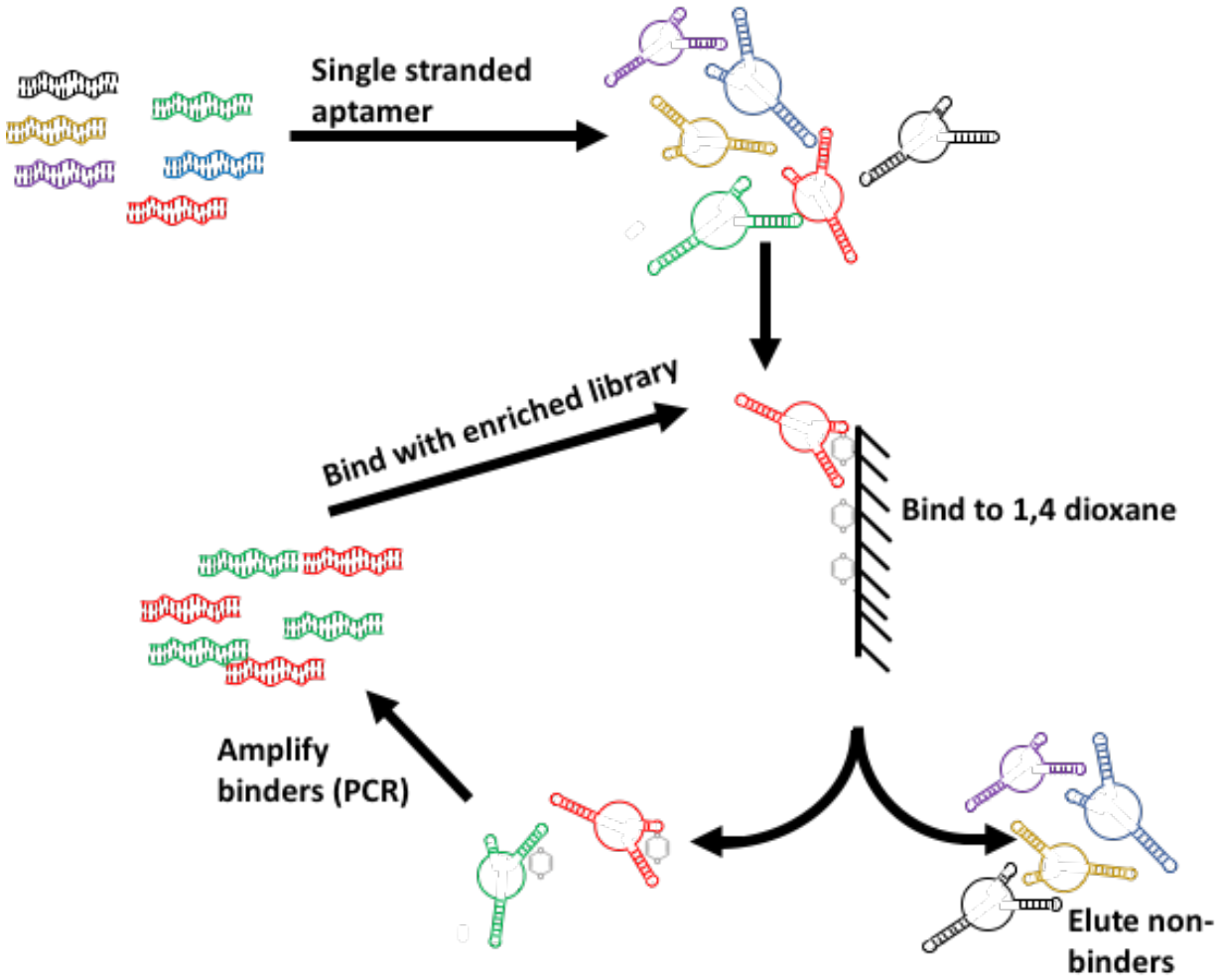
- Development and production cost

Automation and Networking

- Fast decision making

Aptamers biosensors – SELEX process

Systematic Evolution of Ligands by Exponential Enrichment (SELEX)

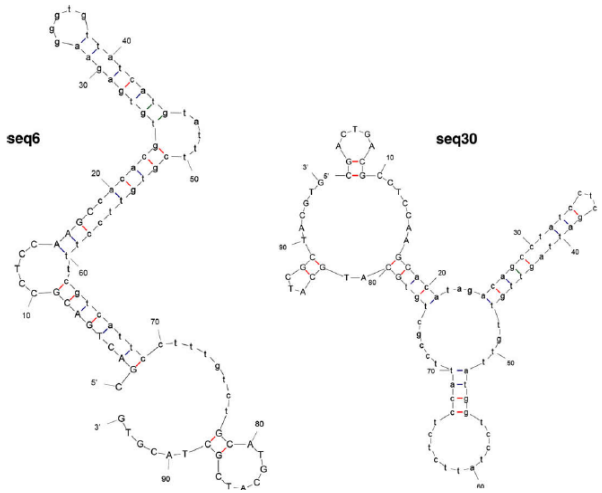


Low, et al. *Biochem. and Biophy. Rec. Comm.* (2008)

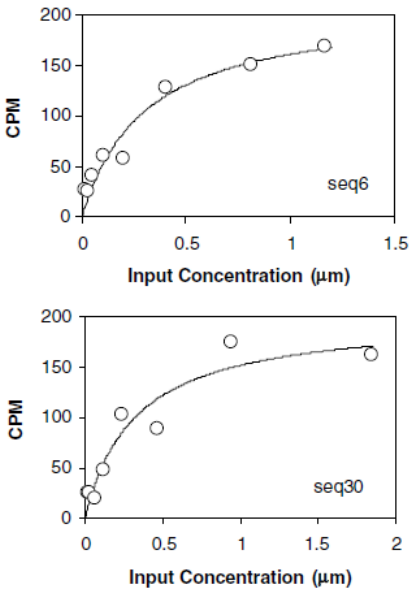
Random Oligos for Aptamer development:

GGAGGCTCTCGGGACGAC- **NNN…(N30)…NNN** -GTCGTCCCGACTCTATGATGACTGT

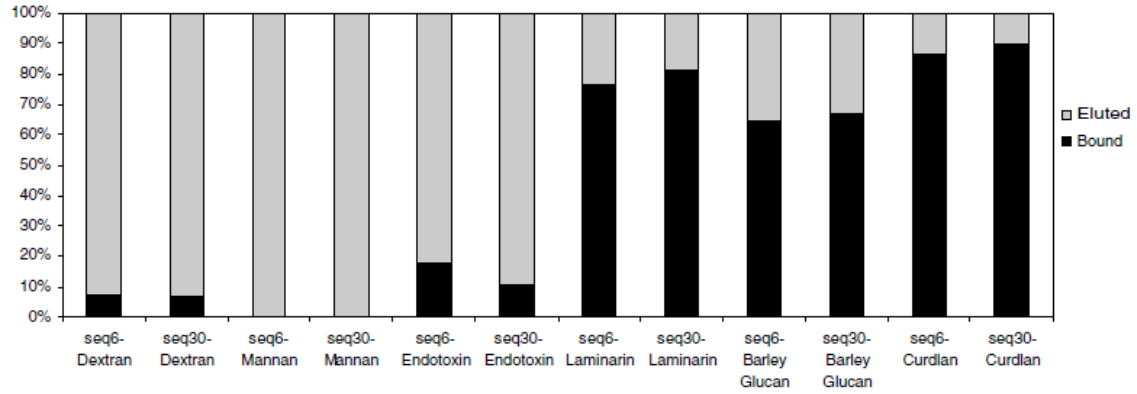
Folding prediction:



Measuring Kd:



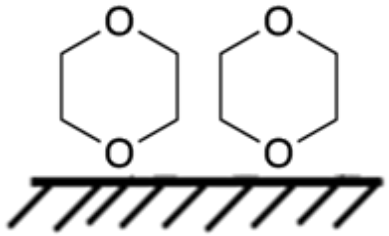
Testing on other compounds



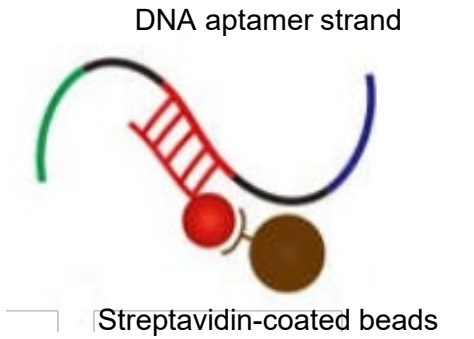
SELEX approach: Capture SELEX

Challenges:

1. Fixing our target on agarose or special beads



Fixing our target to a fixed medium



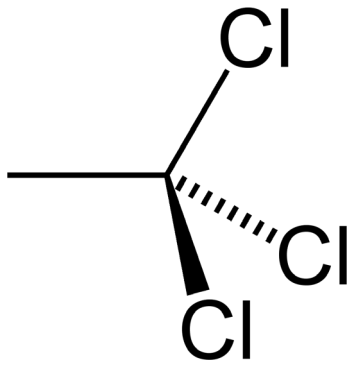
Fix the aptamer instead

UNIVERSITY OF WATERLOO

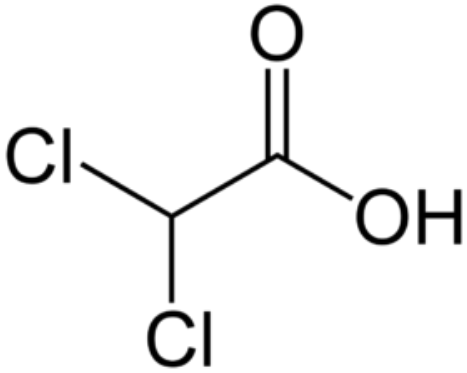
Capture-SELEX

2. Counter-SELEX for Specificity

Co-occurring contaminants



TCE



DCA

Thank you