From: Aylin Padir <alpadir@wpi.edu>
Subject: Lead Pollution in Drinking Water
Date: June 5, 2017 at 2:54:38 PM EDT
To: Terry.Howard@state.ma.us

Hi Dr. Howard,

My name is Aylin Padir. I am a rising junior studying biochemistry, biology, and global public health at Worcester Polytechnic Institute (WPI), and I am also a member of the school's 2017 iGEM team. The iGEM (International Genetically Engineered Machine) foundation is a non-profit organization that fosters innovation through competition. The iGEM jamboree is an international competition in which students from universities across the globe compete for the best innovative use of synthetic biology that strives to solve a real world problem. We hope to tackle the problem of lead pollution in drinking water.

Ideally, synthetic biology is based on performing biology using engineering principles. The "design-build-test" model is how products and engineering solutions are created, and rarely does the first prototype get deployed to market. But most iGEM teams only work on their research over the span of one summer, so most can only do a single design-build-test cycle before their project is over, students graduate, and the team moves on to other projects the following year. Our goal is to collect information on all heavy metal sensing circuits created to date, and to use the information provided by previous teams to design a "generation 2.0" of heavy metal biosensors. Some issues that have been reported include sensitivity of the sensors to low levels of heavy metals, and creating an output from the sensor that is both reliably quantitative and also interpretable to consumers without the use of laboratory equipment. We will use synthetic biology design principles to optimize the lead-responsive promoters, and through the use of chromoproteins, we ultimately hope to design a plasmid that allows the biosensor to express color dependent on the amount of lead present in the water being tested.

We also must consider biosafety when designing our biosensor. While E. coli is most often used in the lab for these experiments, it may not be the ideal organism to release into the hands of consumers. We plan to experiment with commercially available probiotic bacterial strains, including some strains that are found in food products such as lactobacillus, bifidobacterium, and streptococcus species, to see if any of these would be an ideal organism for our heavy metal biosensor, and could possibly allay any concerns about the biosafety of the organism.

Something interesting to point out is that recent research suggests that some gut bacterial strains are very good at naturally binding to heavy metals. These bacteria can absorb the heavy metal in the digestive tract before it is absorbed by the body, and are passed out of the body with the fecal waste. We plan to test bacterial strains to measure their endogenous lead binding properties, and then

use a selection approach to evolve probiotic strains with higher metal binding capacity. These strains would be selected through evolution and would not have directly manipulated genomes, meaning that they could reasonably be used as probiotics for people in areas where water supplies cannot efficiently be filtered or purified.

That all being said, I am reaching out to you, given that you are listed as the program contact for the Massachusetts Childhood Lead Poisoning Prevention Program by the CDC, to see whether you have any ideas or concerns that we should consider as we begin to plan out our project. Additionally, if you have anyone in mind that you think may be able to help us in the planning and execution of our biosensor or probiotic, I'd greatly appreciate it if you could direct me to them. Please feel free to reach out to me via email or phone if you have any questions or would like more information. Thank you so much for your time and I look forward to hearing from you!

Sincerely,
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