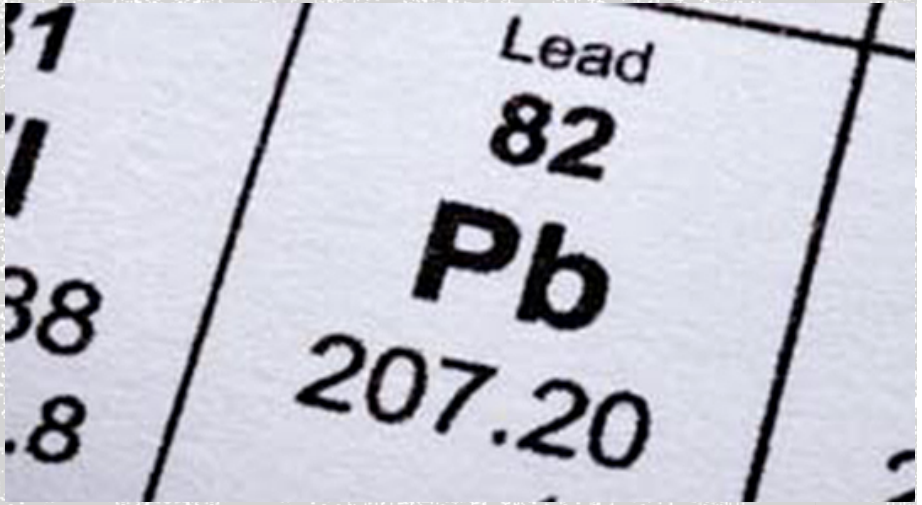
GOT LEAD?



By the WPI 2017 iGEM Team
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OBJECTIVES

By the end of this case study, you should be able to:

- Understand the principles of synthetic biology
- Describe the application of synthetic biology to decontaminating lead from water
- List lead testing laboratory and home testing techniques
- Understand the mechanism through which drinking water becomes contaminated with lead

PART I : IGEM

"How are we ever going to come up with an idea to enter into this year's iGEM competition?" Mike asked, as the team of six biology and biotechnology students gathered together in a small conference room outside of the laboratory. "What is iGEM anyway?"

"iGEM stands for **I**nternational **G**enetically **E**ngineered **M**achine," answered Haylea. "The competition involves solving a problem through the use of synthetic biology."

"Oh, oh, I know! What about lead pollution in our drinking water? One of the students from our DNA extraction program mentioned they can't drink their water at school because of lead!" said Cat eagerly.

"Okay, but how can we solve such a huge problem just by using biology?" asked Locke.

"Don't some organisms that are already being used as probiotics have lead binding capabilities? I think I just read a paper about that for one of my classes," Edith replied.

"What if we modify one of those probiotics to bind even more lead," Aylin added, "to protect the people that have no choice but to drink the contaminated water from lead poisoning."

And just like that the WPI iGEM team was a contender for the competition.

QUESTIONS FOR DISCUSSION (DQS)

- What is synthetic biology? (Use your resources! Phone, tablet, computer, etc.)
- How could lead contaminated water be solved through the use of synthetic biology?

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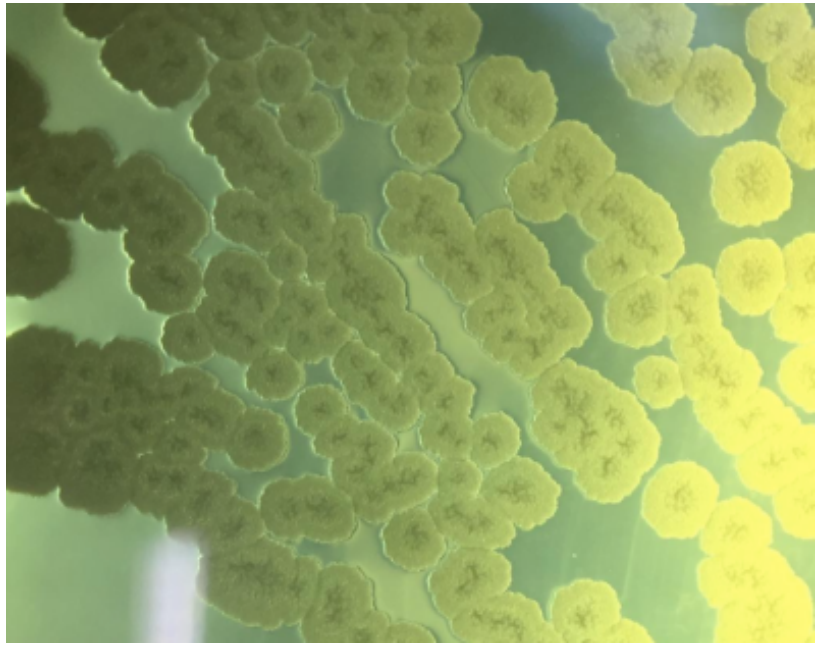
DQ1: WHAT IS SYNTHETIC BIOLOGY?

D2: HOW COULD LEAD CONTAMINATED WATER BE SOLVED THROUGH THE USE OF SYNTHETIC BIOLOGY?

BACTERIAL LEAD BINDING CAPABILITIES: BACILLUS SUBTILIS



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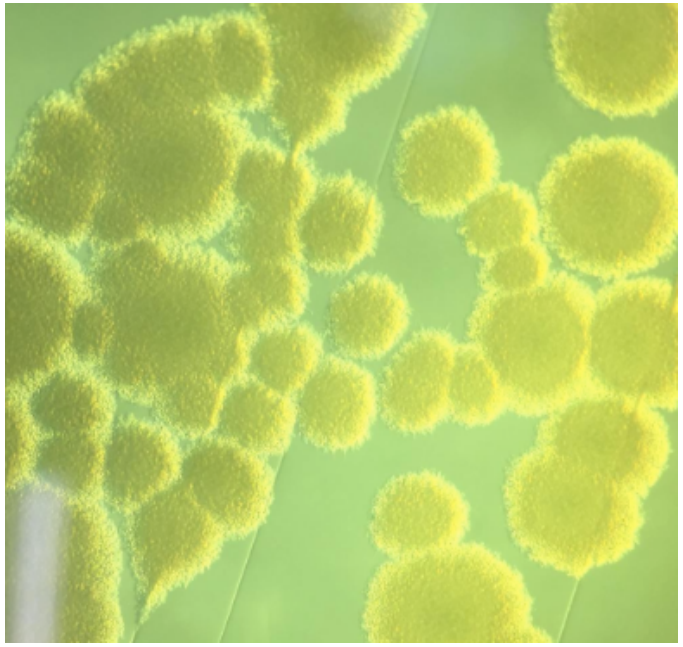

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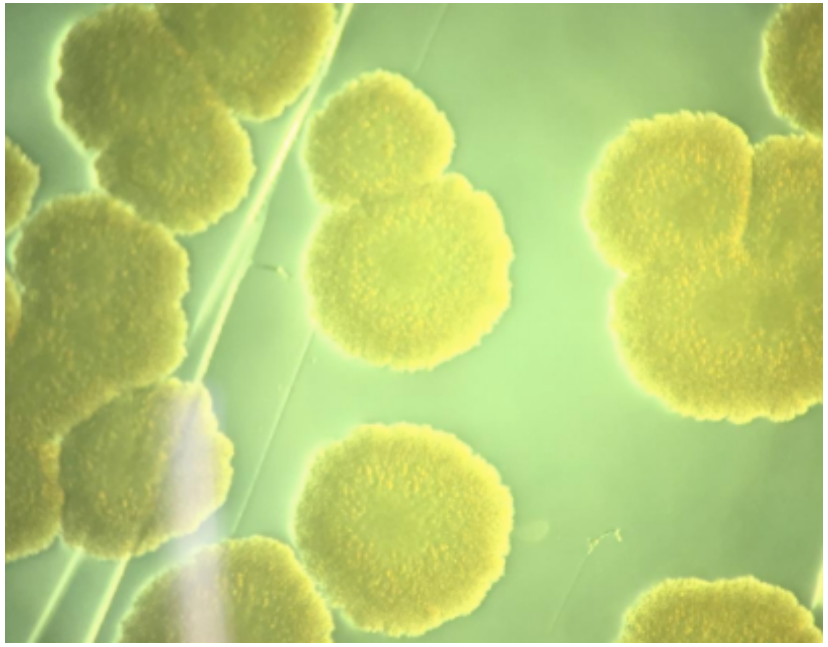


900 ppb

PART II : LEAD POLLUTION IN DRINKING WATER

"Before we jump right into the biology, I think we should do a little bit of research about what lead pollution entails," Locke said.

"Look at this data I found!" beamed Cat.

EPA Description	Cause for Concern	Action Level	Hazardous Waste
Reference Level	5 ppb	15 ppb	5,000 ppb

"I wonder how much lead is in my tap water," Mike pondered, so after work he headed home to take a sample of his tap water, then to the nearest laboratory to get his water tested for lead. A week later, Mike got his results back. There was 17 ppb of lead in his water.

QUESTIONS: What are potential ways in which the amount of lead in water could be quantified? Could Mike have tested his water at home? How do you think Mike's water became contaminated?

DQ4: WHAT ARE POTENTIAL WAYS IN WHICH THE AMOUNT OF LEAD IN WATER COULD BE QUANTIFIED? COULD MIKE HAVE TESTED HIS WATER AT HOME?

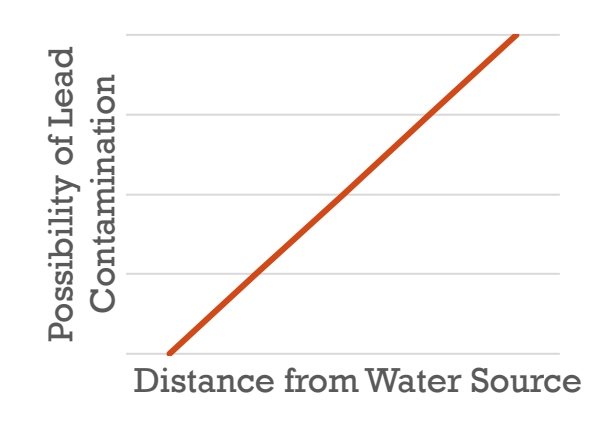
DQ5: HOW DO YOU THINK MIKE'S WATER BECAME CONTAMINATED?

PART III : THE SOURCE OF CONTAMINATION

"Bad news guys… there's lead in my water!" Mike exclaimed the following morning as the team conversed about the day's proceedings. "So I did some research on lead contamination and found this pamphlet:"

Lead Contamination: Protect Yourself!

Are you aware of possible lead contamination in your drinking water? Protect yourself by:



- Flushing your water for at least 30 seconds prior drinking
- Using cold water as opposed to hot water
- Checking in regularly with your physician

"It's very interesting how the possibility of lead contamination in drinking water increases as you move away from the source," Edith said. "I wonder why that is…"

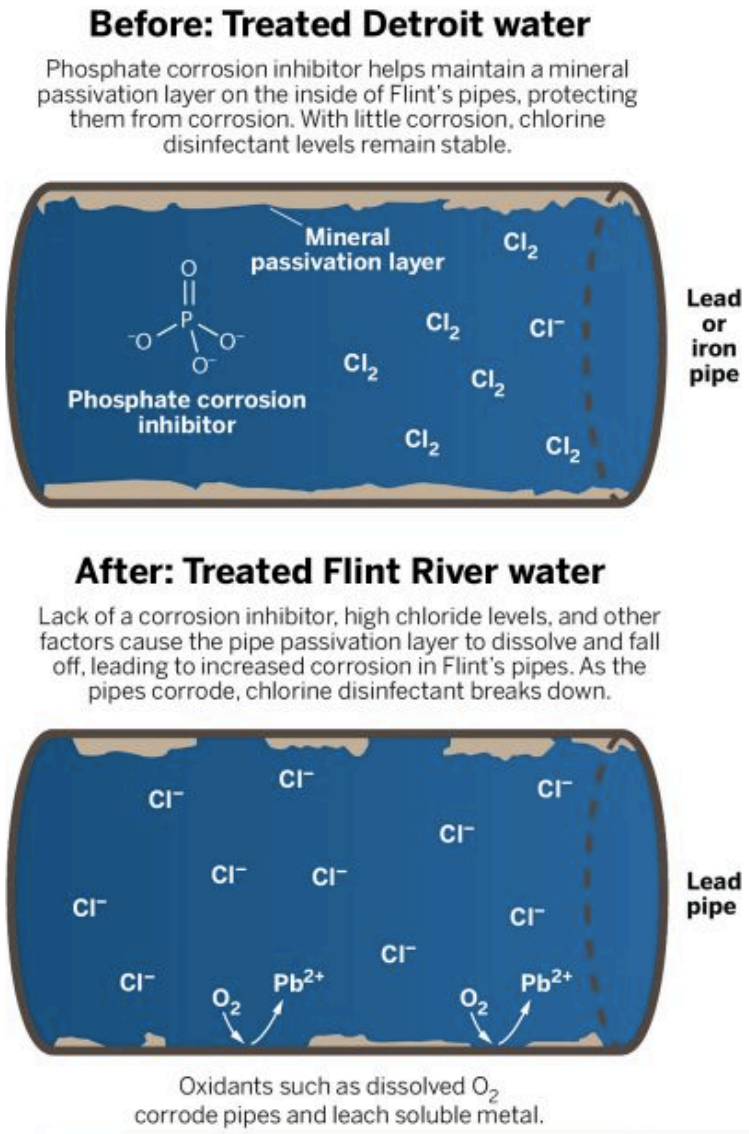
QUESTIONS: Brainstorm possible reasons why lead contamination would increase as the distance from the water source increased.

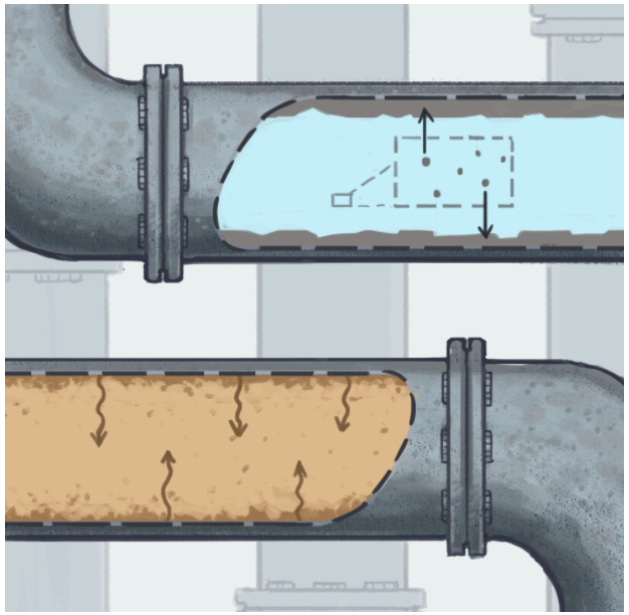
DQ6: BRAINSTORM POSSIBLE REASONS WHY LEAD CONTAMINATION WOULD INCREASE AS THE DISTANCE FROM THE WATER SOURCE INCREASED.

THE SOURCE OF CONTAMINATION DEBUNKED - THE SCIENCE

After a night of research regarding the correlation between the distance away from the water source and the possibility of lead contamination, the group rejoined in their familiar conference room.

"I found a promising explanation!" Haylea exclaimed, eager to share her findings with the group. She turned her computer screen so that it was visible to everyone and displayed the following:





Lead pipes with (top) and without (bottom) corrosion inhibitor.
http://knkx.org/post/how-do-we-get-our-drinking-water-us

https://www.acs.org/content/acs/en/education/resources/highschool/chemmatters/past-issues/2016-2017/december-2016/flint-water-crisis.html