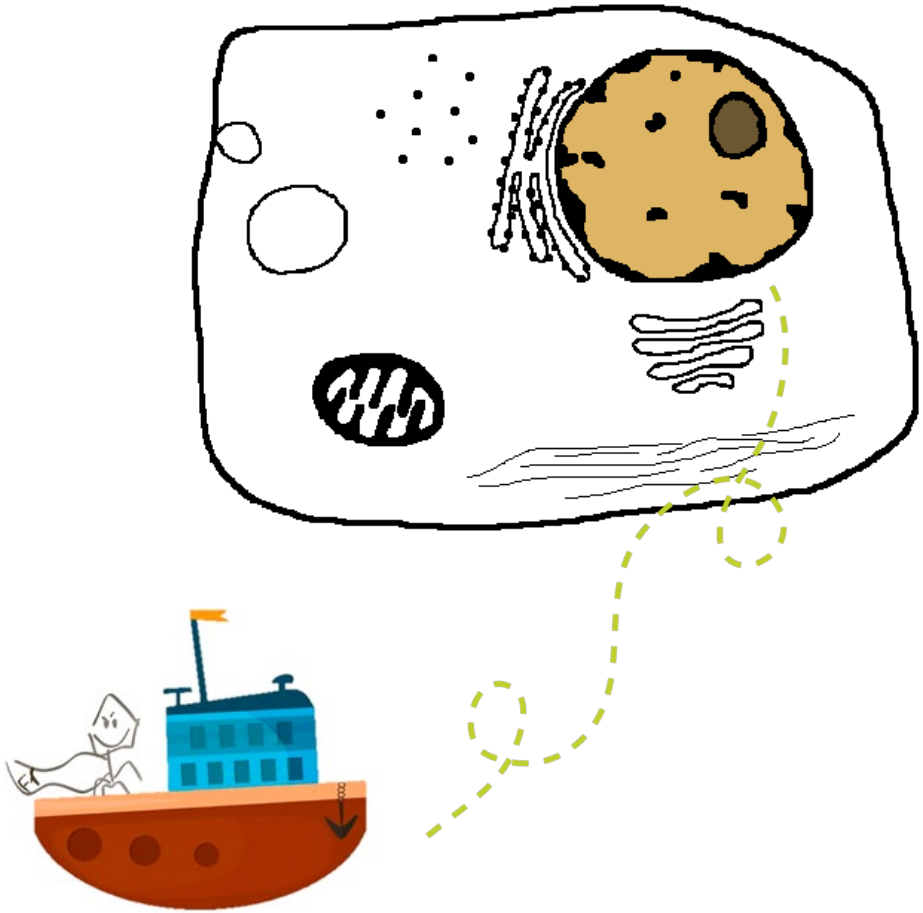
TeachEngineering

STEM Curriculum for K-12

BACTERIOPHAGE BUILDER CHALLENGE



Bacteriophage Builder

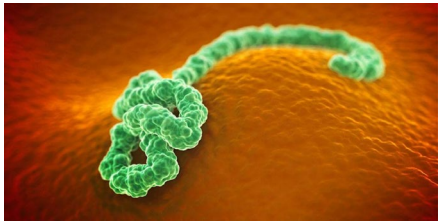
Do First:
Think of a time when you were sick...

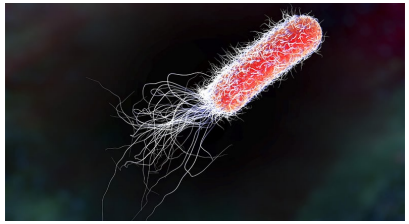
- 1. Sit in groups of 3-4 people
- 2. Grab a worksheet and pen/pencil
- 3. On the paper:
    - Describe a time when you were sick. How did you feel?
    - What do you think caused you to feel sick?
    - Draw on the paper what you think the cause of your sickness looked like.

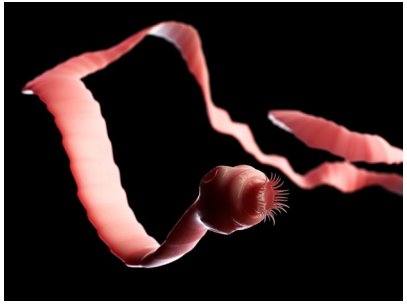
What causes sickness?

- PATHOGENS!
  - Viruses
  - Bacteria
  - Parasites

- Today we will be focusing on **viruses** and **bacteria**







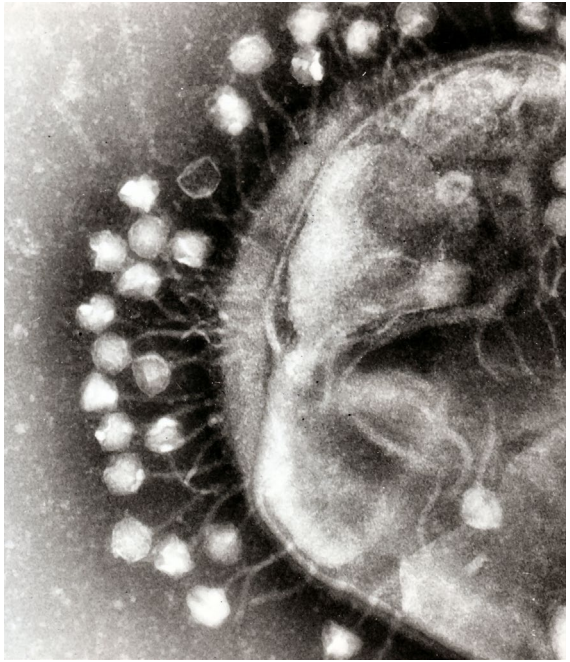
Not all Viruses are bad!

- **Bacteriophages** are viruses that infect **harmful bacteria**
- Phages can be used to disrupt or kill **biofilms** made by bacteria

Define the Problem

- On your paper, define the problem in your own words based on what you saw in the video
  "___ need a way to ___ in order to ___."

- **Problem:** we need a way to engineer viruses to infect as many bacteria as possible in order to eliminate harmful biofilms from water filters



Building Materials

- You will have access to these materials to build your virus in only 15 min
  - foam cubes
  - Styrofoam balls
  - soft Velcro
  - spiky Velcro
  - toothpicks
  - double-sided tape
  - fuzzy pom-poms
  - paper

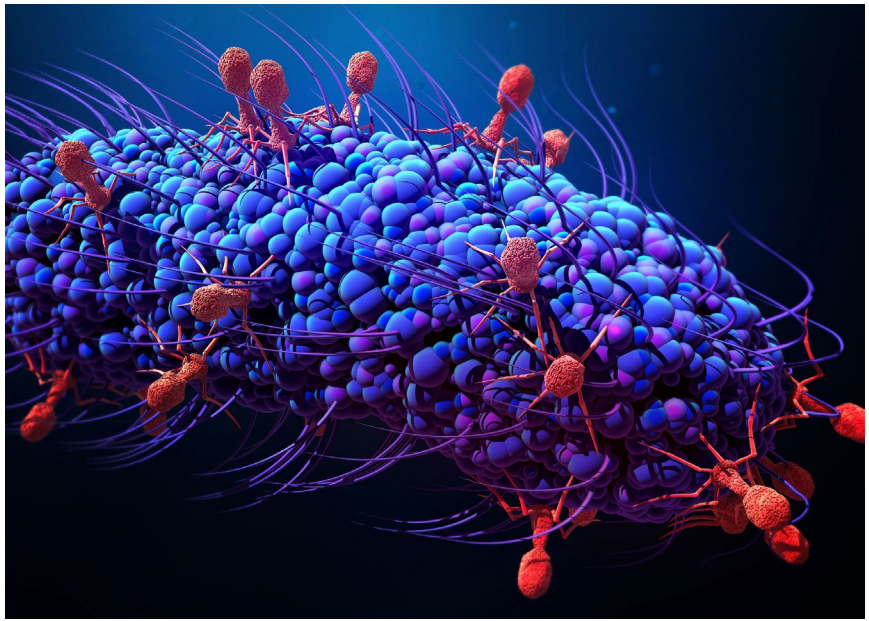
Identify Criteria & Constraints

- **On your paper, identify at least TWO <u>criteria</u>**
  "Our design must be able to ___."
  - Think: how will you know your design is *successful?*
    ex. When building a ladder, one criteria is that it reaches at least 10 feet high.

    Must be able to attach to at least 10 bacteria cells;
    Must be able to attach to at least 3 types of bacteria; etc.
- **On your paper, identify at least TWO <u>constraints</u>**
  "When building our design, we are limited by __."
  - Think: what *limitations* are there on your design?
    ex. When building a ladder, I'm limited to using only the materials from my garage. We are limited by amount of time (15 min.)
    We are limited by size of the virus

Photo from Wikipedia common

A quick note:
These models are not to scale



- The models you are making do not accurately represent the size difference between bacteria and phages.
- Phages are much smaller than the bacteria they infect
- However, this would make it difficult for you to engineer in this activity, so the size difference is switched.

What is a nanometer?

- Nanometer
- 1 one-billionth of a meter

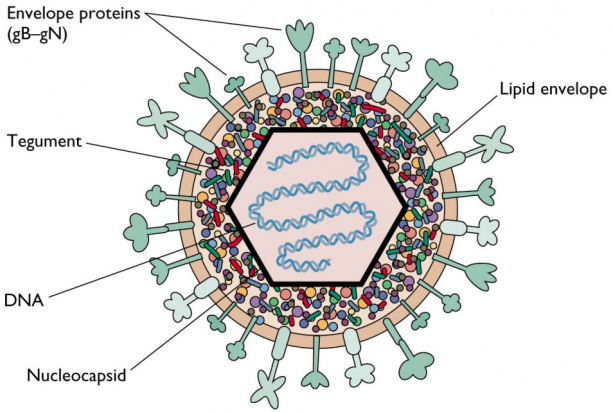
Bacteria: 200-2,000 nm
Viruses: 20-400 nm

Imagine as a Meter

Would be nanometer

Brainstorm Design

- **On your paper, brainstorm a design**
  - Draw a sketch of what it will look like
  - Identify the materials you will use
- **Consider these questions as you are making your design**
  - What do viruses need to be able to do in order to infect the bacteria?
  - What materials do you think will fit/stick together the best?
  - How does the shape impact how it can infect the bacteria?
  - If we are trying to infect lots of harmful bacteria, should the virus have only one type of attachment?



Maker Time!

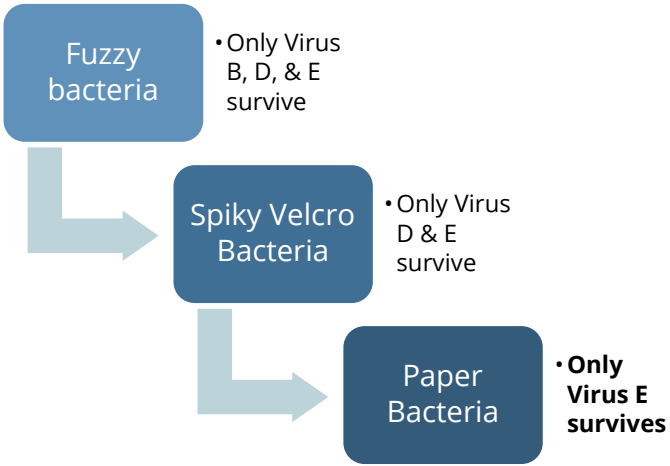
- You have access to these materials to build your virus in **only 15 min**
    - foam cubes
    - Styrofoam balls
    - soft Velcro
    - spiky Velcro
    - toothpicks
    - double-sided tape
    - fuzzy pom poms
    - paper
- When finished with first prototype, bring over your virus to the biofilms for testing! Not perfect? **Make adjustments!**

Communicate Solution

- Okay, engineers, it's time to **communicate your solution! Pick a name for your virus & write it on whiteboard!**
- You will need to present the following items to the group.
    - Brainstorming Process
    - Initial Prototype
    - Iteration (changes to first prototype)
    - Final Design
    - Results from Testing (which biofilms did infect best?)
    - Ideas for the Future

Test your Solution

- In order to isolate the fittest phage to destroy our biofilm, we need to pick the one that can survive & reproduce with multiple different bacterial hosts.
- To find this fantastic phage, we will follow the same procedure that scientists use to pick their phages!



Reflection Questions

- With your groupmates, answer the reflection questions
  - Did your model meet your criteria and constraints? Why/why not?
  - Did you make any changes to your model after testing?
  - In what ways was your design successful? What helped to make it successful?
  - In what ways could your design be improved?