

# Using phages to treat antibiotic-resistant infections

Jessica Sacher and Jan Zheng



**Phage** Directory

# *How we started the talk (we didn't actually show this slide to class)*

- Asked kids these questions:
  - How many have heard of antibiotic resistance (almost none)
  - How many of you have taken antibiotics? (lots)
  - How many have heard of someone having an infection that antibiotics didn't work on? (some)
  - How many know someone with cancer? (LOTS)
  - Why is that? (Because it's a common disease)
- Then told them:
  - Antibiotic resistance is becoming more common
  - By the time you're in your mid 40s, more people will be dying of antibiotic resistant infections than cancer
  - Most of you will probably know someone who has this happen to them

# *Then: (we didn't show this slide either)*

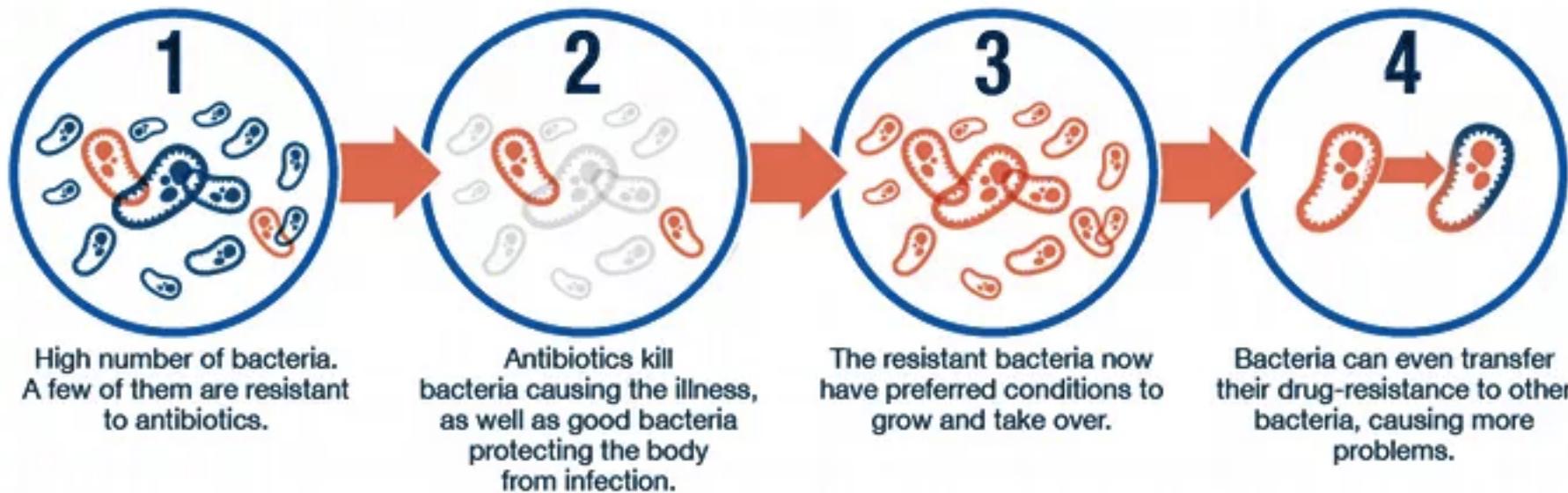
- Went through slides about resistance, phages, phage therapy (see next few slides)
- Stopped to focused on explaining phage infection with props:
  - showing phage binding to cell, explaining that phages burst out of bacteria and go on to infect more... (they were very engaged with this part)
- Showed Phage Kurzgesagt video
- Went through slides about our project, Phage Directory
- A nice long question and answer period!!
- Total time: 1h15 min for first class, 40 min for second (used all the time we were given)

# Antibiotics

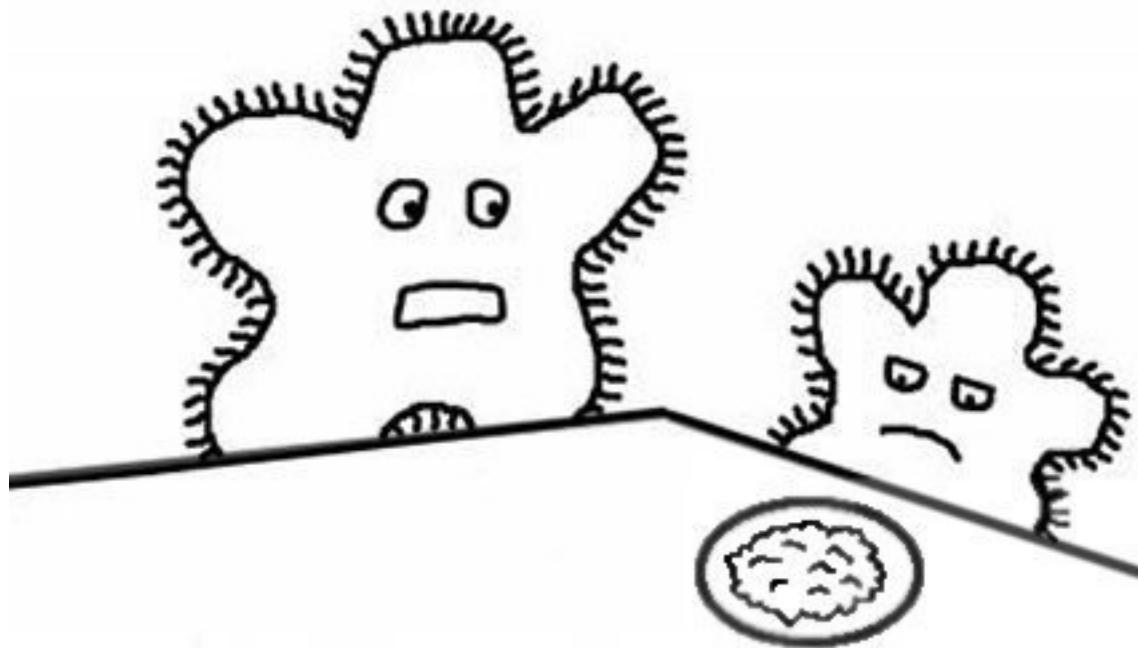
- The “miracle drug” against bacterial pathogens (bacteria that cause disease)
  - Pneumonia
  - Sepsis
  - Wound infections
  - Ear infections
  - Etc.
- The problem: antibiotics have stopped working, and people are dying of infections that used to be curable

# Antibiotic Resistant Infections

## How does antibiotic resistance occur?



# Antibiotic Resistance



**“But Timmy, you have to eat your antibiotics or you’ll never become a big strong bacteria.”**

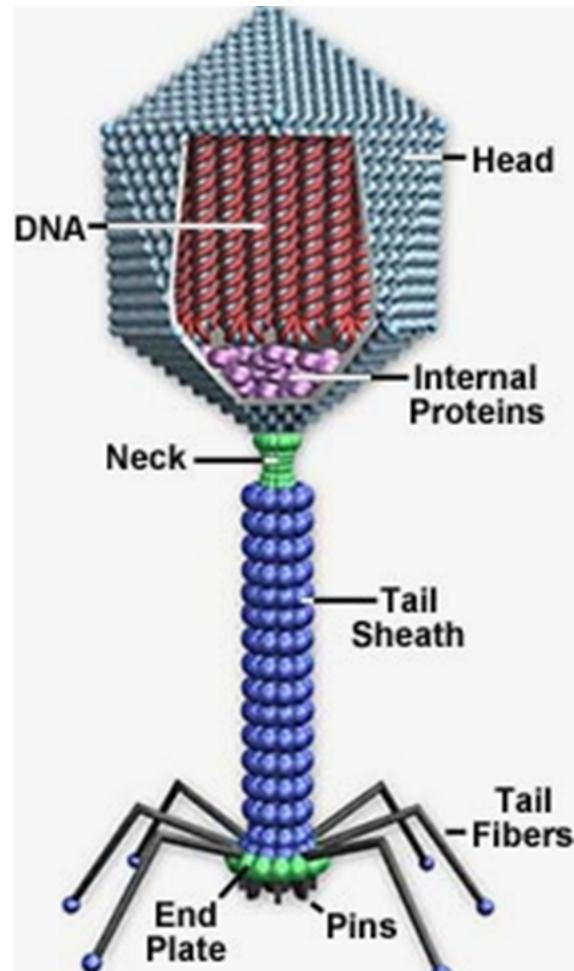
sott.net

# A growing problem

- Antibiotic resistance will cause more deaths than cancer by 2050 (when you're in your mid-forties)
- It's already killing about 700,000 people each year
- What can be done?
  - Use the natural, “living” predators of bacteria against them: Phage Therapy

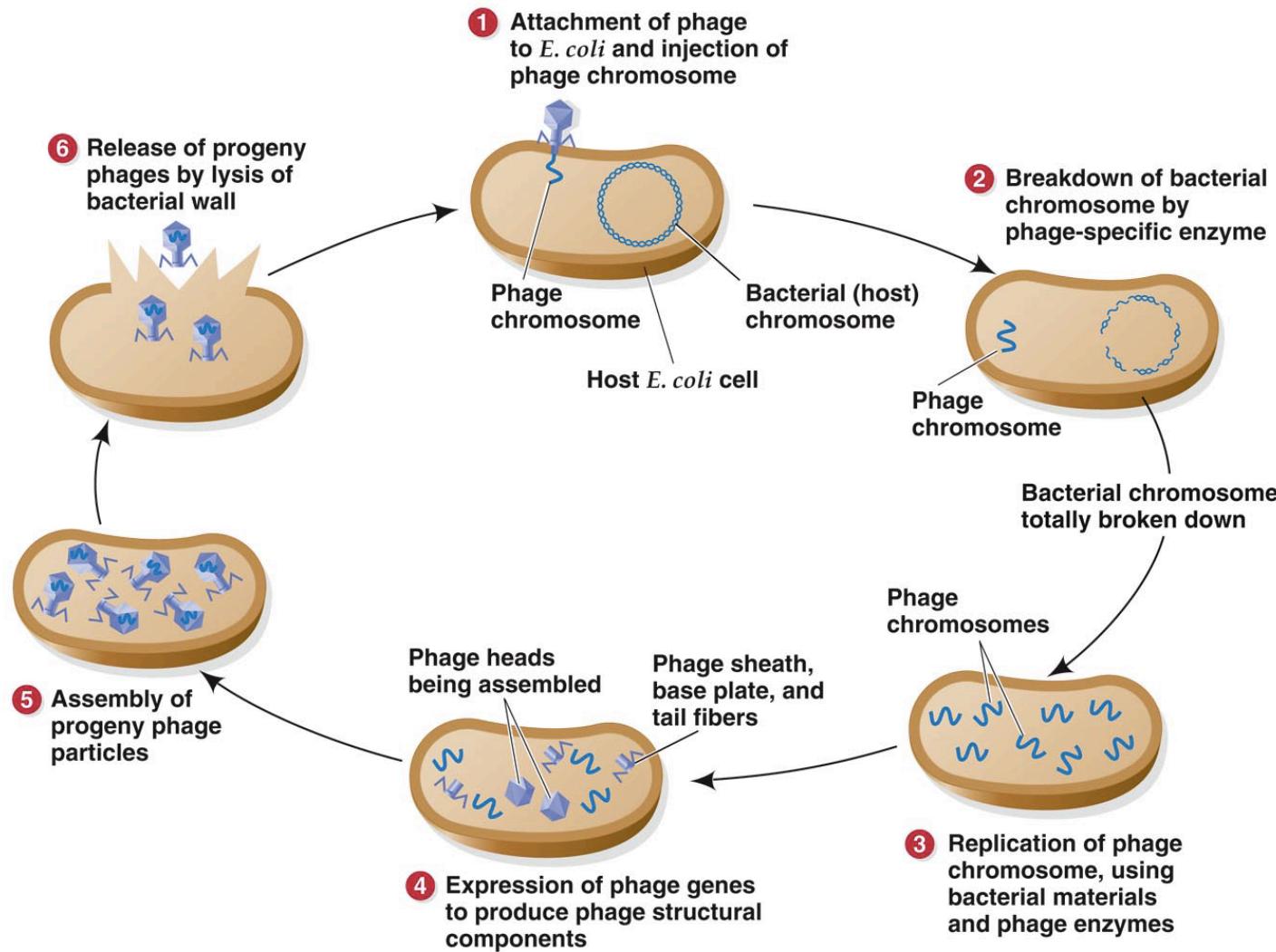
# What are phages?

- Bacteriophages (phages for short) are the natural predators of bacteria
- There are LOTS of them in every environment on earth!  
(10,000,000,000,000,000,000,000,000)  
000)
- They don't kill or bother human cells



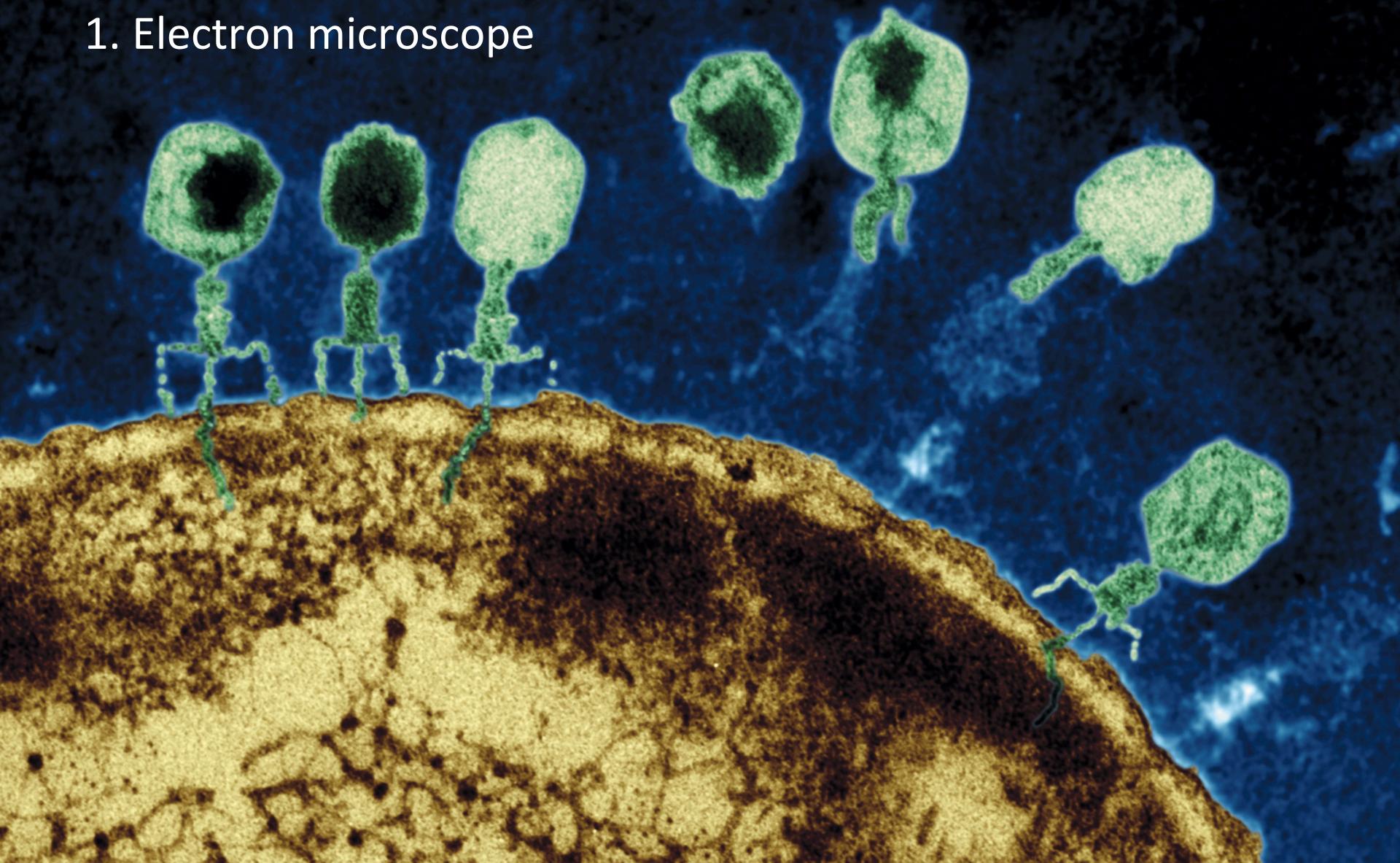
Hatful and Hendrix (2011)

# Phage infectious lifecycle



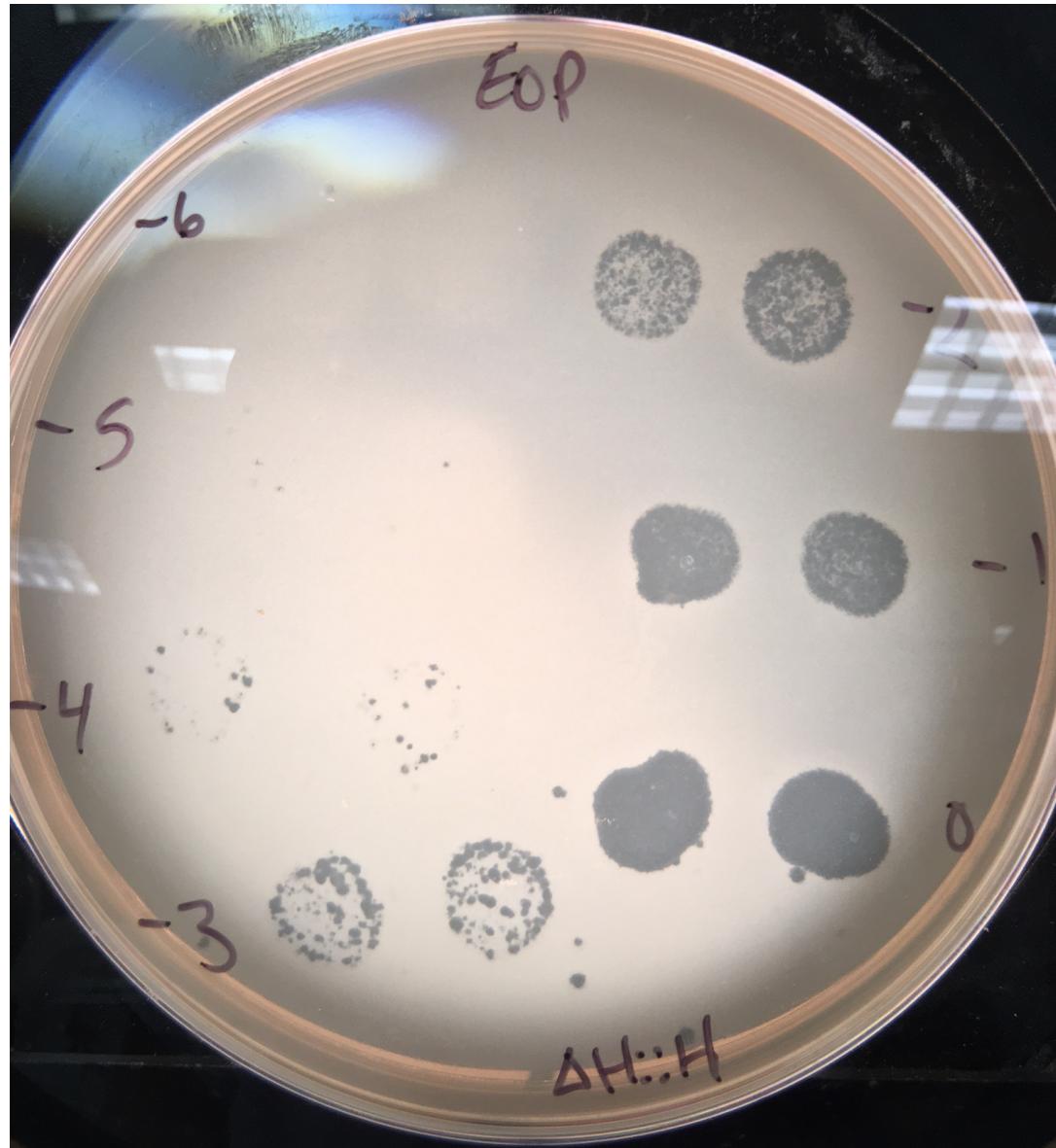
# How do you “see” a phage?

1. Electron microscope



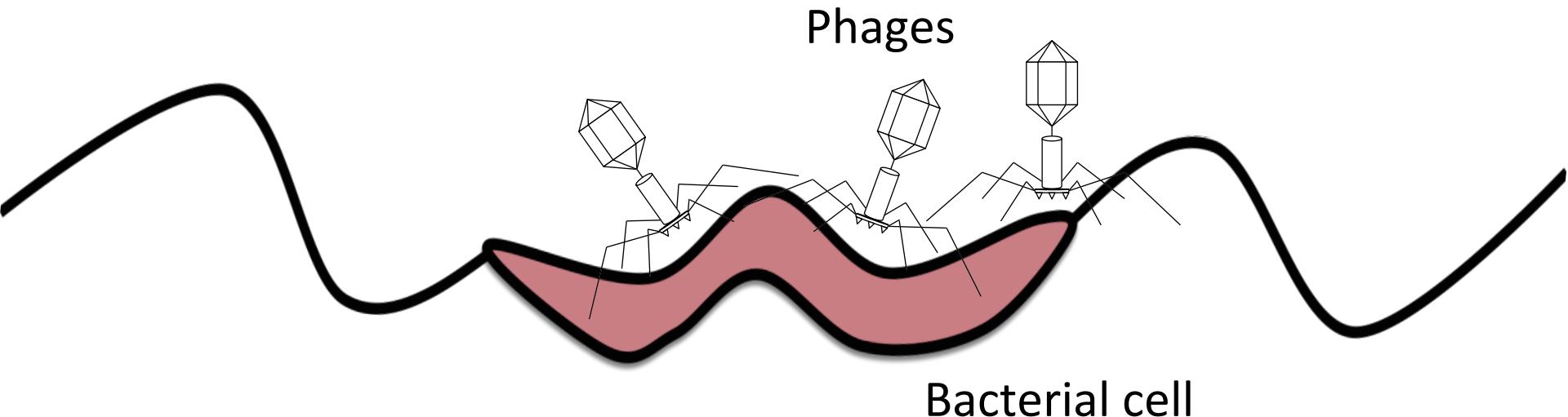
# How do you “see” a phage?

## 2. Plaque assay



# Phage Therapy

- Using phages as medicine to treat antibiotic-resistant infections



# Videos!

Phage therapy / Kurzgesagt

Antibiotic apocalypse / Kurzgesagt

Superbug snipers / Netflix

*The next slides are Phage Directory specific... We told the kids how we got started, what we're building... (replace these slides with your research/whatever you like!)*

# Why we decided to start a company

- 1 microbiologist / phage biologist
- 1 product designer / computer programmer
- 2 tweets
- 1 idea



**Phage** Directory

# The first tweet... a girl needs phages



Dr Steffanie Strathdee, ✒ Superb...

@chngin\_the\_wrld

Following

#Phage researchers! I am working with a team to get Burkholderia cepacia phages to treat a 25 y old woman with CF whose infection has failed all #antibiotics. We need lytic non-lysogenic phage URGENTLY to find suitable phage matches. Email sstrathdee@ucsd.edu if you can help!

4:15 PM - 7 Nov 2017

392 Retweets 169 Likes



19

392

169



# The second tweet... people are actually sending phages!!



Dr Steffanie Strathdee, ✨ Superb...  
@chngin\_the\_wrld

Following



#Phage phans - Mallory is getting her first dose of #phagetherapy tonight and her life hangs in the balance as we wait for news. Many thanks to @JonDennis8 who sent phage from Alberta to her rescue....the phage hunt continues for more of nature's ninjas! #CysticFibrosis #AMR

4:51 PM - 14 Nov 2017

19 Retweets 59 Likes



# But... why were they using Twitter?

- Nothing else existed



# Phage Directory

<http://phage.directory>



Phages    Labs

Alerts    Jobs    Capsid & Tail

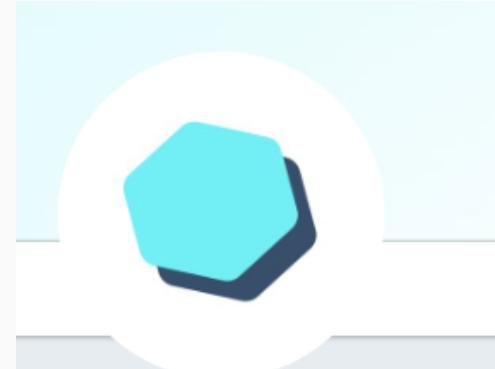
Join

Search

## PHAGE DIRECTORY

A directory of phage experts and phage banks  
to support the safe and effective use of phages  
in medicine and industry around the world.

**Read about our mission.**



**Phage Directory**  
@phagedirectory

We are a directory of information  
on phage research, phage therapy  
and other phage applications. We  
can help you find phages!

## Fast forward 1 year...

Phage Directory has:

- 1,260 Twitter followers
- 104 subscribers to Phage Alerts
- 170 subscribers to Capsid & Tail



**Phage** Directory

# This month: Phage hunt!

Currently ongoing...

Almost 200 phages tested

At least 8 active phages  
found

## Phage Therapy Crowdsourcing

Updates on our latest phage alert

On Nov. 9, 2018, we received an email from Dr. Mikael Skurnik (University of Helsinki) about a patient hospitalized with severe, antibiotic resistant *Klebsiella pneumoniae*. The patient's doctor was already on board, and Dr. Skurnik was already looking for phages that might work for therapy. Twenty-seven phages had already been tested for their ability to infect and kill the patient's strain, and one match had been found, but more were (and still are) needed.

Later that day, we sent a message to our subscribers on **Phage Alert**, our service for crowdsourcing phage therapy. Several labs agreed to test their phages by sending them to Dr. Skurnik's lab or by receiving the patient's strain.

Each lab is indicated on the map. The timeline shows the date each lab's phages were tested, and how many phages they provided for testing.



### Crowdsourcing in progress

Crowdsourcing phages for therapy is still a very new concept for many labs, and as such, it takes time. In many cases, Material Transfer Agreements need to be drafted and signed before phages or strains can be sent.

As more experience is gained from each effort, more processes and agreements are put into place to speed up future crowdsourcing efforts.

The effort is still developing. Follow our twitter updates [@phagedirectory](#) or through our online periodical, Capsid & Tail: <https://phage.directory/capsid>

### Timeline

	Oct. 24, 2018	1 phage tested	1 Match
	Oct. 26, 2018	20 phages tested	
	Nov. 1, 2018	3 phages tested	
	Nov. 1, 2018	3 phages tested	
	Nov. 9, 2018	Phage Alert sent to 89 subscribers	
	+6 Days Nov. 15, 2018	8 phages tested	
	+9 Days Nov. 18, 2018	18 phages tested	
	+10 Days Nov. 19, 2018	49 phages tested	
	+13 Days Nov. 22, 2018	4 phages tested	
	+14 Days Nov. 23, 2018	50 phages tested	1 Match
	+21 Days Nov. 30, 2018	20 phages tested	3 Matches

### Still In Progress

- Strain sent to lab, phage testing in progress
- Phages in preparation
- Coordination in progress
- Coordination in progress

**Phage Testing Hub**  
Dr. Mikael Skurnik's lab.  
Main phage testing and receiving center.

Labs that contributed phage samples to the hub for testing.

Labs that received the patient strain for testing against their phage library.

At least one phage from this lab was found to be a match.



As of Nov. 30, 2018, the hunt for *Klebsiella pneumoniae* phages is still going on.

If you have *K. pneumoniae* phages and think you could help, please email [staff@phage.directory](mailto:staff@phage.directory)

To join Phage Alerts, please visit <https://phage.directory/alerts>

**Phage Directory**

Thanks for  
listening and  
participating!!

