Maker Closure: Packet

SCHOLAR NAME: _____

DATE:_____

CLASS:_____

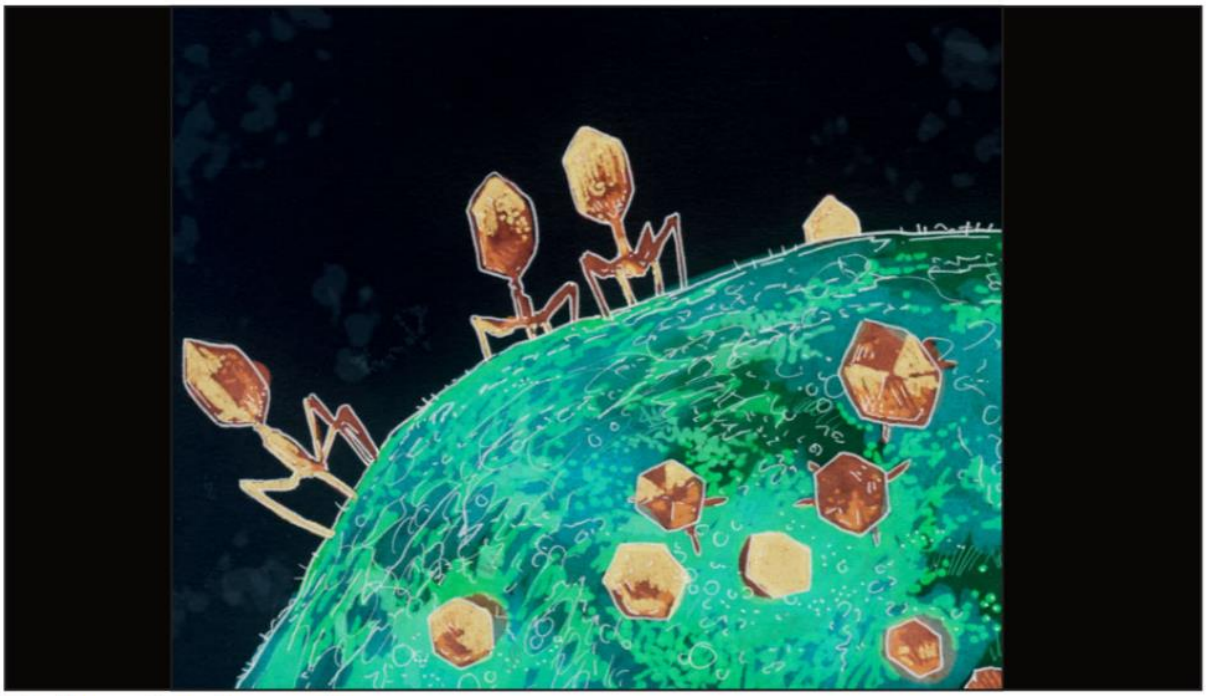
TEACHER:_____

Take Home Engineering Notebook:
Outbreak Alert! Engineering a Pandemic Response

Your task is to use the engineering design process to develop a pandemic response strategy. You will explore, analyze and question the current coronavirus pandemic response to design a strategy for future pandemics.

Part 1 Understand the coronavirus pandemic problem - Gather details:
Driving Question: How do viruses spread through a population?

- Students are provided with the simple definition of a virus: A virus is a biological agent that reproduces inside the cells of living hosts. When infected by a virus, a host cell is forced to produce thousands of identical copies of the original virus at an extraordinary rate.



T2 viruses invading a cell

- Students answer (and share in the google classroom post):
    - Write a paragraph (at least 25 words) discussing what you know right now about the coronavirus,
    - Write a paragraph (at least 25 words): What your feelings about the coronavirus and the response to it,
    - Write down three questions you have about the coronavirus. These questions should be based in inquiry, meaning that they should lead you to a better understanding of how viruses spread and how they are contained.
- In another comment, compliment one other student's post. Be specific about what you liked about their posts
- In another comment, identify the three most important questions asked by your peers.

- Students read why the Coronavirus is being labeled as a pandemic: Link to article

Part 2: Gather Data to build a model of the corona virus.
Comparing our model to the reality of where we are now with the coronavirus outbreak in NYC

The Key Takeaways:

- On January 21st, 2020, the first coronavirus case in the USA was confirmed in Washington state.
- On March 1st, 2020, the first coronavirus case was confirmed in New York.
- On March 11, 2020, the World Health Organization labels the coronavirus a pandemic.
- When a new virus emerges, such as the coronavirus, it is imperative that governments respond quickly to contain the virus. The CDC

What to do: You will develop a model that can predict the spread of the coronavirus in New York City in cases without protective measures and with protective measures using the concept of exponential growth and logarithms.

Act 1: Spreading the Virus:

1. Go to the following website: https://www.mathalicious.com/lessons/pandemic/teach (if you can't access the site, then just use the formula for each week mentioned in bullet 5 below.
2. Assume that you are in an isolated community of 200 people. Imagine one person is infected with a contagious virus, and that anyone who's infected spreads the virus to one new person each week.
3. Using the table below and the site, track how the infected and healthy populations change during the first ten weeks of the outbreak.

X	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O
O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O
O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O
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O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O

4. Complete the table below to document the infection rate over ten weeks.

Week	0	1	2	3	4	5	6	7	8	9	10
X -Infected	1	2									
O - Healthy	199	198									

5. Now let's turn this into a function where we can predict the number of infected people at any given week. Follow the instruction below.
   - Use this formula: N(w) = $(N + r)^{w}$
     - Let N = infected people,
     - w = weeks if each person infects one person per week,
     - r (growth rate of infection) = *1*
     - Infected population in week 1 = 2

     Example 1: How many people are infected at week 5 if each person infections one more person
     FORMULA: 32 = 1^{5} ANSWER : 32 Infected People

     Example 1: How many people are infected at week 6 if each person infections one more person
     FORMULA: 32 = 2^{1x6} ANSWER : 64 Infected People

   Calculate the number of infected people at week 7
   Calculated the number of infected people at week 8
6. Use the same formula to predict the infection rate up to the current week of infection in the USA. However, let's use the real numbers. So far, we don't know what the growth rate is of the coronavirus, so use the same growth rate above.

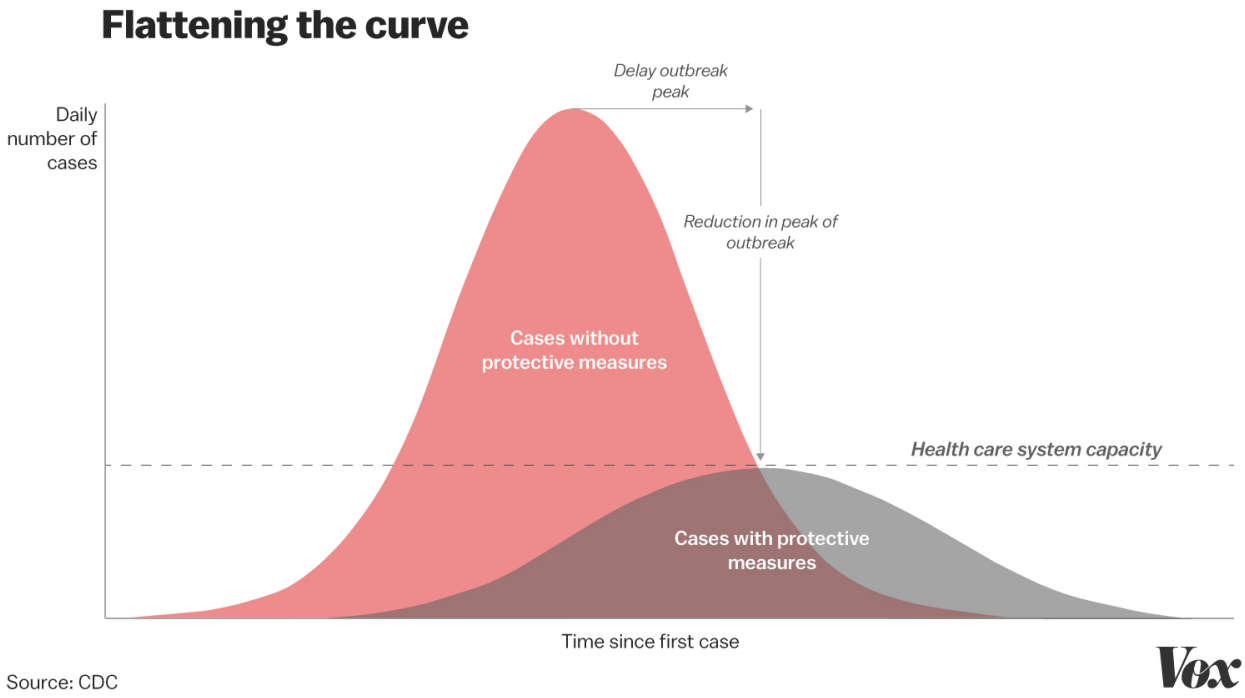
Week	Infected = (N+1) ^{w}
0	1
1	2
2	4
3	8
4	16
5	32

6	64
7	
8	
9	
10	
….	

Answer: We are currently in week 7 since the first infection case was reported in the USA. As of March 13th, according to this site, the current number of coronavirus cases in the USA is 2,068 coronavirus cases. This is well above our projection. Use the formula above to determine a more accurate projection of the growth rate.

Research:

- Students read the article "How canceled events and self-quarantines save lives, in one chart"
- Explain what this graph means by "flattening the curve":



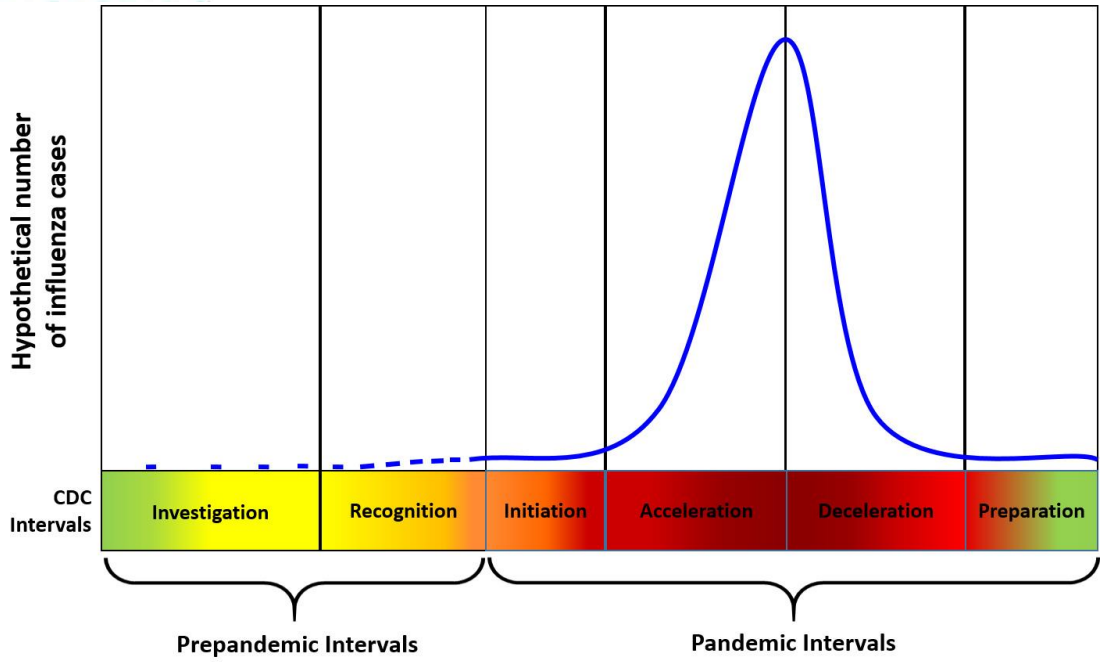
- Students define the problem and what it means to flatten the curve
    - Explain: If coronavirus has such a low mortality rate, do you think the protective measure New York City is currently taking to contain the virus is fair, not enough or too extreme (shutting down events, schools, etc.)? Use evidence from the reading and the model you created above to defend your claim.

Solve the Problem

- Read the CDC's **Description of the Six Pandemic Intervals - LOVEY can you complete this table for me?**

Interval	Description
1) Investigation of cases of novel influenza A virus infection in humans	When novel influenza A viruses are identified in people, public health actions focus on targeted monitoring and investigation. This can trigger a risk assessment of that virus with the Influenza Risk Assessment Tool (IRAT), which is used to evaluate if the virus has the potential to cause a pandemic.
2) Recognition of increased potential for ongoing transmission of a novel influenza A virus	When increasing numbers of human cases of novel influenza A illness are identified and the virus has the potential to spread from person-to-person, public health actions focus on control of the outbreak, including treatment of sick persons.
3) Initiation of a pandemic wave	A pandemic occurs when people are easily infection with a novel influenza A virus that has the ability to spread in a sustained manner from person-to-person.
4) Acceleration of a pandemic wave	The acceleration (or "speeding up") is the upward epidemiological curve as the new virus infects susceptible people. Public health actions at this time may focus on the use of appropriate non-pharmaceutical interventions in the community (e.g. school and child-care facility closures, social distancing), as well the use of medications (e.g.

	antivirals) and vaccines, if available. These actions combined can reduce the spread of the disease, and prevent illness or death.
5) Deceleration of a pandemic wave	The deceleration (or "slowing down") happens when pandemic influenza cases consistently decrease in the United States. Public health actions include continued vaccination, monitoring of pandemic influenza A virus circulation and illness, and reducing the use of non-pharmaceutical interventions in the community (e.g. school closures).
6) Preparation for future pandemic waves	When pandemic influenza has subsided, public health actions include continued monitoring of pandemic influenza A virus activity and preparing for potential additional waves of infection. It is possible that a 2nd pandemic wave could have higher severity than the initial wave. An influenza pandemic is declared ended when enough data shows that the influenza virus, worldwide, is similar to a seasonal influenza virus in how it spreads and the severity of the illness it can cause.

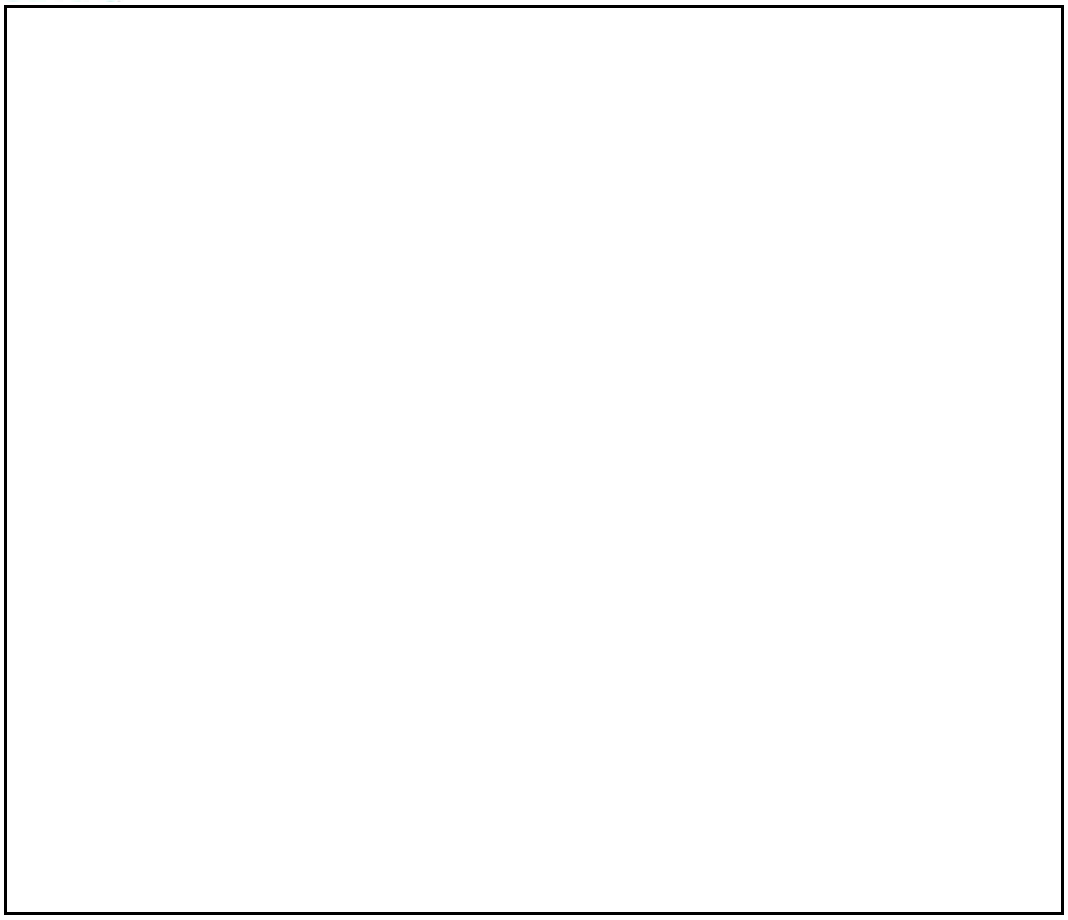


Design the Solution: Given that schools have been shut down, we are currently within the "acceleration of a pandemic wave" interval. A more detailed response to each interval can be found on this link. But let's back track each week to come up with a better containment response. Use your model that you created above to find a way to "flatten the curve".

Interval 1: Investigation

What to do: Public service announcements (PSAs) are video or poster messages that are designed to raise awareness about an important issue. Usually, health PSAs are messages that try to change people's behavior or attitudes so that people can live healthier and safer lives. Look at the examples below for inspiration for your group's PSA. PSAs can be useful tools to combat infections early on in an outbreak. For this activity you must:

1. Design a PSA to meet the following criteria:
    a. Your PSA can be in the form of a 2-3 minute skit/presentation, which could air on TV as a commercial, or a colorful poster, which could be displayed in a public location.
    b. Research PSAs used in other countries, such as this one used in Vietnam.
    c. Describe what information is important to include in a PSA about the coronavirus.
    d. Determine a specific population to target with this PSA.
    e. Determine what spaces are the best to advertise your PSA.
    f. Sketch your PSA below:



Share: Share your solution with others on Google Classroom.

- Compliment the strengths of others solutions in the comment box. Suggest improvements.

Interval 4: Acceleration

What to do: You are currently in the acceleration phase of this pandemic. This level of response is unprecedented in the USA. It's likely that you and/or people that you know are facing many needs at this interval. Try to think of a problem that you think many other people in your community are facing at this interval. Define a problem and propose a solution using the engineering design process.

1. Use the typical problem statement:

_____ (who) needs _____ (what), because _____ (why).

2. Research three existing services, products or technologies that address this need and describe how they meet the need. Describe also what they are lacking.
3. Sketch a solution (product, technology or service) that improves upon these products. Be as creative as you want. Annotate and explain how your sketch addresses the need in your problem statement.