

Lesson 6: Herd Immunity – Have You “Herd”? Modeling Influenza’s Spread

OBJECTIVES

1. Students will learn how mathematical models are used to determine disease spread and intervention effectiveness.
2. Students will learn the effects of physical (e.g., social distancing or nonpharmaceutical interventions) and medical (e.g., vaccines) countermeasures for disease outbreak scenarios.
3. Students will be able to identify public health countermeasures that restrict the spread of a disease outbreak.
4. Students will be able to explain the importance of vaccinations and the monitoring cases of infectious diseases.

PREPARATION

1. **Note that this lesson will take 75 minutes to complete.**
2. **Email** link to have youth watch TEDEd **Videos** before the meeting:
[How does your immune system work?](#)
 - a. <https://www.youtube.com/watch?v=PSR-JfaAYkW4>
 - b. Familiarize yourself with these two **web-sites**:
 - c. CA COVID-19 Cases Dashboard: https://public.tableau.com/app/profile/ca.open.data/viz/COVID-19CasesDashboardv2_0/CaseStatistics
 - d. Pandemics Explained: Unlocking evidence for better decision making (from Harvard Global Health Institute) <https://globalepidemics.org/>
3. Review L6 Immunity Slide Deck and have available to **screen share**
4. Review and have available the **website**: [ILI Activity Map](#) and be ready to **“Play”** the map for the Year 2019-20.

INSTRUCTIONS

1. **Welcome everyone back and check in with the youth. (3 minutes) Slide 1**
2. **Review the group agreements if necessary (2 minutes)**
 - a. You can either **screen share** and show the image you took from last week, or you can create a new image using a **Google or Powerpoint slide**, and display it as your **background image**.
3. **Team Builder: Would You Rather... (10 min) Slides 2 through 11**
 - a. Use the L6 Immunity **Slide Deck** slides 3-11 to play “Would you Rather”.
 - b. Present each slide and force the youth to select which one they would rather do. Have them **use the reaction options to respond**.
4. **Activity - Modeling Influenza’s Spread (30 min) Slides 12-19**
 - a. Use the L6 Immunity Slide Deck slides 12-19.
 - b. Go over the Urban Scenario as a large group.
 - i. Ask youth to share if they’ve experienced a nasopharynx swab.

Modeling Influenza’s Spread

Urban Scenario

The site of the flu outbreak is San Francisco, an **urban area with a dense population**.

During a 24-hour period, nasopharynx swab samples were taken from hospitalized patients with respiratory infections. To determine if the patients were positive for influenza, the nasopharynx swab test was done.

Lab Results

	Patient 1	Patient 2	Patient 3	Patient 4	Patient 5
Test Results (Positive or Negative) / Diagnosis (Influenza, Not Influenza)					

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- ii. Review the data on slide 15 with participants.
- iii. Using **slide 16**, review questions with the youth
 - “On the basis of your data, should you report influenza to the state public health laboratory and CDC?”
 - “The nasopharynx swab is a quick way to check for influenza. On average it has a false-negative rate of 30%–50% (people who have influenza receive a negative result by mistake). Explain one way a false--negative test result might occur?”




Modeling Influenza's Spread

Urban Scenario

When more than one influenza case (+) occurs in a 24-hour period (above baseline), information is sent to state public health labs and CDC for additional testing and research.

1. On the basis of your data, should you report influenza to the state public health laboratory and CDC?
2. The nasopharynx swab is a quick way to check for influenza. On average it has a false-negative rate of 30%–50% (people who have influenza receive a negative result). Explain one way a false–negative test result might occur?



- iv. Using **slide 17**, review R_0 (R naught)- talk about each of the 3 components of R_0 and what communities could do to reduce R_0 :
- number of contacts in 1-day
 - number of days a person stays infectious
 - likelihood of transmission for each contact

Modeling Influenza's Spread


Urban Scenario

To determine the ability of a virus to spread a model is used to calculate the reproduction number:

$$R_0 = (k) \times (d) \times (p) \quad R_0 > 1 \text{ can lead to an epidemic}$$

Avg # People a Sick Person will Infect =

(# contacts in 1-day) x (# days a person stays infectious) x (likelihood of transmission for each contact)



- v. Using **slide 18**, demonstrate how to calculate R_0 and ask youth to complete the mathematical computation to determine R_0 .

Modeling Influenza's Spread

To determine the ability of a virus to spread a model is used to calculate the reproduction number:


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Avg # People a Sick Person will Infect =

(# contacts in 1-day) x (# days a person stays infectious) x (likelihood of transmission for each contact)

Urban Scenario

$$R_0 = (16) \times (7) \times (0.02)$$

$$R_0 =$$



- vi. Using **slide 19**, review **herd immunity threshold** (I_c) - have youth calculate I_c using the R_0 calculation from slide 18.

Modeling Influenza's Spread

For a community to be protected from an epidemic or pandemic, a specific percentage of the community must be immune to the virus; this is called the **herd immunity threshold** (I_c).


For example, if the herd immunity threshold is 0.5, that means a total of 50% of the community would need to be vaccinated or develop the immunity to prevent the outbreak from becoming an epidemic or pandemic.

$$I_c = 1 - 1/R_0$$

Urban Scenario

$R_0 =$ _____

$I_c =$ _____ % of the San Francisco would need to be vaccinated

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- vii. Discuss how these mathematical models are used by disease scientists and identify countermeasures that could be used by public health professionals

5. Activity - Investigating your Community's Health Status (15 min) Slides 20-23

- a. Use the L6 Immunity Slide Deck **slides 20-23**.

Investigating your Community's Health Status


- CA COVID-19 Cases Dashboard
https://public.tableau.com/views/COVID-19CasesDashboard_159310204250125210?cases7=embed&showVizHome=no
- Pandemics Explained: Unlocking evidence for better decision making (from Harvard Global Health Institute)
<https://globalepidemics.org/>

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Investigating your Community's Health Status


CA COVID-19 Cases Dashboard
https://public.tableau.com/views/COVID-19CasesDashboard_159310204250125210?cases7=embed&showVizHome=no

- Select your County
 - Look at the Positive Cases Graph
 - What do you notice about the graph? (flat, up, down)
 - Look at the Case Demographics Chart
 - What do you notice about the chart? (similarities, differences)
 - Given what you've learned, what might help explain the similarities and differences?
 - How do these maps compare with the CDC 2019-20 Influenza Season?
 - What would you do in your county if you were the Public Health Officer?

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Investigating your Community's Health Status

- Pandemics Explained: Unlocking evidence for better decision making (from Harvard Global Health Institute)
<https://globalepidemics.org/>
- Click on the US Map and Select CA
 - Find your County
 - What color is your County? What does the color mean?
 - Find a County with a color that is different from yours
 - Given what you know today, why do you think there is a difference between the two counties?
 - What would you do in your county if you were the Public Health Officer?

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- b. Demonstrate the activity to the whole group.
c. Show CA COVID-19 Cases Dashboard (**slide 21**).

https://public.tableau.com/app/profile/ca.open.data/viz/COVID-19CasesDashboardv2_0/CaseStatistics

- i. Select your County
 - Look at the Positive Cases Graph
 - What do you notice about the graph? (flat, up, down)
 - ii. Look at the Case Demographics Chart
 - What do you notice about the chart? (similarities, differences)
 - iii. Given what you've learned, what might help explain the similarities and differences?
 - iv. What would you do in your county if you were the Public Health Officer?
- d. Divide the group into smaller teams and place youth in break out Zoom Rooms (with one adult per break out room if possible).



- e. Have them answer the questions above for another county.
- f. **Copy and paste** the questions into **chat** for them to see.
- g. (If time allows) Pandemics Explained: Unlocking evidence for better decision making (**slide 22**) from Harvard Global Health Institute <https://globalepidemics.org/>
 - i. **Click** on the US Map and select your state.
 - ii. Find your county.
 - iii. What color is your county? What does the color mean?
 - iv. Find a county with a color that is different from yours.
 - v. Given what you know today, why do you think there is a difference between the two counties?
 - vi. What would you do in your county if you were the Public Health Officer?
- h. Report Back (**slide 23**).
 - i. Have all youth **return to main Zoom room**. Have youth report back from their breakout rooms:
 - i. Please share on your exploration of the US, state, and your home County maps and trends.
 - ii. Please share your thinking on wearing the hat as your county's Public Health Officer.

6. Preparation for next lesson (5 min) Slide 24

- Introduce the Look Around, What do you see? worksheet
<https://ucanr.edu/sites/DiseaseDetectives/files/329187.pdf>

Introduce the PSA activity to plant the seed for creativity. If time allows: <https://www.youtube.com/watch?v=XjfCeY4D2QI>

- **Additional resources**

Video on herd immunity, and why masks must still be worn even after getting vaccinated.

<https://www.usatoday.com/videos/news/justthefacts/2020/09/11/covid-19-how-herd-immunity-works-why-you-still-need-wear-mask/3471374001/>

Credit: These materials were adapted from the CDC Science Ambassador Workshop 2014 [Lesson Plan: Have You “Herd”? Modeling Influenza’s Spread](#) <https://www.cdc.gov/careerpaths/scienceambassador/documents/hs-have-you-herd-modeling-influenza-2014.pdf>

