

Preventing Outbreaks with Herd Immunity

Name: _____

Date: _____

Student worksheet—*Answer key*

Part 1: What is community immunity and who does it help?

- First watch this video: [How does herd immunity work?](https://youtu.be/8BUCi5Tuzms) (<https://youtu.be/8BUCi5Tuzms>)
 - Next, navigate to the [Preventing Outbreaks with Herd Immunity Notebook](https://sbgo.org/herd-immunity) (<https://sbgo.org/herd-immunity>) at SimPandemic. SimPandemic is an online simulator that lets you explore how various factors change a pandemic's evolution. Read through scenarios 1-2 and study the accompanying graphs.
 - Use the information in the video and the SimPandemic Notebook to answer questions 1-5.
1. In your own words, explain what community immunity (also called "herd immunity" or "herd protection" in the video) is.

Community immunity is the concept that the more people in a community who are immune to a communicable disease, the more protected the community is from an outbreak. Even people who are not immune to the disease are less likely to catch it because those who are immune cannot pass along the disease and thus block the transmission pathway of the disease.

2. Which of these groups of people increase community immunity? Mark all that apply.
- ☒ People who are immune to a disease because they have been vaccinated.
 - ☐ People who were vaccinated but did not mount an immune response.
 - ☒ People who have been sick and recovered from the disease.

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3. Fill out *Table 1: Outcomes for Scenarios 1-2* based on the graphs and tables in scenarios 1-2 in the SimPandemic Notebook. You will use this information to support your claims in other questions. (Note: SimPandemic reports economic outcomes of the pandemic, too. While this feature is not used in this lesson, you might find it interesting to take a look at.)

Outcomes	Scenarios	
	1. COVID-19 Outbreak with No Interventions	2. COVID-19 with 30% Community Immunity
Epidemic Size (Total Infections per 100,000)	95,523	60,080
Hospitalized (% of capacity)	150-200%	100-150%
Total Deaths Caused by Pandemic per 100,000	263	154
Total Number Immune per 100,000 on Day 1	0	30,000
Total Number Immune per 100,000 on Day 365	95,260	89,926

Table 1: Outcomes for Scenarios 1-2

4. Does having 30% of the community already immune to COVID-19 protect the population from a new COVID-19 outbreak? Support your claim(s) using evidence from Table 1.

Students should note that 30% community immunity does not prevent an outbreak from occurring, but it does lessen the severity of the outbreak as the epidemic size (total number of people infected) and total deaths caused by the pandemic were both lower in scenario 2 compared to scenario 1.

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5. Name at least three groups of people who community immunity might help protect:

- *Infants*
- *Elderly*
- *People who are immunocompromised (weakened or non-existent immune system) and cannot be vaccinated (e.g., cancer patients undergoing chemotherapy)*
- *People who are vaccinated but fail to mount an immune response*
- *People who do not get vaccinated, regardless of their reason*

Part 2: What does it mean to reach the herd immunity threshold?

- In this part, you will use the Sandbox to run your own simulations with settings you put in. If you have questions about how to use the Sandbox, read the [FAQ](https://www.sciencebuddies.org/simpandemic/faq) (<https://www.sciencebuddies.org/simpandemic/faq>).
- Make sure to save your work as you go (see FAQ).
- When you have completed all your simulations, paste (or write) the URL for them here for your teacher to see:

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- Use what you learn from your own simulations to answer questions 6-9.

6. Follow the instructions in the Sandbox to run a simulation of COVID-19 transmission in a community where 50% of the population is immune. Does an outbreak still occur? If so, is the outbreak better or worse than in scenario 2 when there was 30% community immunity? Give evidence to support your claim.

Students should see that while an outbreak still occurs, it is a significantly smaller outbreak compared to when 30% of the community was immune. Numbers will vary, but students should cite a drop in both epidemic size (total number of infected individuals) and death at 50% immunity compared to 30% immunity.

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7. In your own words, what is the herd immunity threshold of a disease?

The herd immunity threshold is the minimum percentage of a population that needs to be immune to a communicable disease in order to prevent the disease from spreading in the population and causing an outbreak.

8. Follow the instructions in the Sandbox to find the herd immunity threshold for COVID-19. Based on your simulations, what is the herd immunity threshold for COVID-19?

Students' answers will vary depending on what numbers they tried in their simulations and how much refining they did, but the number should be around 66%. Anywhere between 60% and 70% is a reasonable answer.

9. Based on the simulations you ran and what you know about the COVID-19 pandemic, do you think it is a good idea to achieve COVID-19 herd immunity naturally by letting people get infected and passing it along, unchecked, to others? Why or why not? Explain your reasoning using data and facts.

Answers should be firmly grounded in data. Possible data points include:

- The herd immunity threshold is approximately 66%.*
- When left unchecked in scenario 1, the COVID-19 outbreak overwhelmed the hospital.*
- Even in countries where mortality has been high for COVID-19, herd immunity threshold has not been met (outside fact, requires student research).*