

ScienceNews

EDUCATOR GUIDE



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Why Bat Viruses Are So Dangerous



SOCIETY FOR SCIENCE & THE PUBLIC

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About this Guide

This Guide, based on the *Science News* article "[Why bat viruses are so dangerous](#)," will help students understand how viruses in other animals can infect people, sometimes leading to epidemics or pandemics. In a group activity, students will imagine they are health officials developing action plans to prevent or stop an epidemic.

This Guide includes:

Article-based Comprehension Q&A — Students will answer questions about the *Science News* article "[Why bat viruses are so dangerous](#)" (Readability: 11.8), which explores how the animals' immune defenses might lead to killer human pathogens. Related standards include NGSS-DCI: HS-LS1; HS-LS4; HS-ETS1.

Student Comprehension Worksheet — These questions are formatted so it's easy to print them out as a worksheet.

Cross-curricular Discussion Q&A — Students will explore the definitions of outbreak, epidemic and pandemic and research how an outbreak becomes an epidemic or pandemic. Related standards include NGSS-DCI: HS-LS2; HS-LS3; HS-ETS1.

Student Discussion Worksheet — These questions are formatted so it's easy to print them out as a worksheet.

Activity: Collaborating to Stop an Epidemic

Summary: Students will imagine that they are officers at the World Health Organization and will work in groups to develop action plans to prevent the spread of a new virus, such as coronavirus.

Approximate class time: 1 to 2 class periods.

Why Bat Viruses Are So Dangerous

Article-based Comprehension, Q&A

Directions: After your students read "[Why bat viruses are so dangerous](#)," ask them to answer the following questions.

1. The article mentions three well-known human viruses that bats also carry. What are they?

Bats can carry Ebola virus, Marburg virus and coronaviruses.

2. How do the viruses affect bats and humans differently?

Though the viruses can cause deadly infections in people, bats seem unaffected by the viruses.

3. Why do bats and humans respond differently, according to recent evidence?

Past research has shown that bats' immune systems tolerate viruses in part because they can limit inflammation. A new study suggests that, in response to bats' immune defenses, viruses seem to ramp up their ability to quickly spread between cells. When a virus jumps from a bat to a person, whose immune system may not have batlike defenses, the virus could cause serious infection.

4. How did ecologist Cara Brook test for viruses' effects on bats and monkeys in the lab? What was the result of her experiment?

Cara Brook and her colleagues infected monkey cells and bat cells in lab dishes with viruses engineered to look like Ebola and Marburg — two viruses commonly found in bats. In the experiment, bat cells survived better than monkey cells.

5. How did monkey and bat cells fare in a mathematical simulation of the experiment? How did the mathematical simulation complement the lab work?

The viruses spread more quickly in bat cells than in monkey cells. However, monkey cells were killed more quickly than bat cells. The mathematical simulation allowed researchers to explore how fast the viruses spread from cell to cell and whether antiviral defenses played a role in how fast the viruses spread.

6. Why does the author refer to the relationship between immune systems and viruses as "a sort of arms race"? What type of literary device is this, and why do you think the author uses it?

The term "arms race" typically refers to a competition for superiority between various parties in developing and acquiring weapons. The relationship between immune systems and viruses is like an

arms race because the two are constantly trying to conquer each other. This is an example of a metaphor and the author probably uses it to help the reader understand the relationship between viruses and the immune system.

7. How many bat species are there in the world, according to disease ecologist Kevin Olival? How does this figure relate to Brook's study?

Olival says there are more than 1,400 bat species in the world. He notes that Brook's study focused on only two species — other bat species might have different responses to viruses.

8. According to Olival, or based on your own thoughts, what are some areas for further research?

In addition to researching other bat species, Olival thinks research on other types of nonhuman animals that carry and cope with deadly viruses would be beneficial.

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Student Comprehension Worksheet

Directions: After reading "[Why bat viruses are so dangerous](#)," answer the following questions.

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2. How do the viruses affect bats and humans differently?
3. Why do bats and humans respond differently, according to recent evidence?
4. How did ecologist Cara Brook test for viruses' effects on bats and monkeys in the lab? What was the result of her experiment?
5. How did monkey and bat cells fare in a mathematical simulation of the experiment? How did the mathematical simulation complement the lab work?
6. Why does the author refer to the relationship between immune systems and viruses as "a sort of arms race"? What type of literary device is this, and why do you think the author uses it?
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8. According to Olival, or based on your own thoughts, what are some areas for further research?

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Cross-curricular Discussion, Q&A

Directions for teachers:

After reading "[We may be on the brink of a coronavirus pandemic. Here's what that means](#)," originally published on the *Science News* website in late February, ask your students to answer the individual questions below.

With a partner, students will then choose a disease outbreak and do an archive search on the [Science News website](#) to construct a timeline of reporting on the outbreak and ultimately determine if and when the outbreak became an epidemic or a pandemic. Once students have constructed their timelines, bring students together to share and discuss their findings.

Directions for students:

After reading "[We may be on the brink of a coronavirus pandemic. Here's what that means](#)," originally published on the *Science News* website in late February, answer the questions below.

Individual questions

1. Define the following terms using your own words:

Outbreak
Epidemic
Pandemic

2. What are some characteristics of a disease that could make it likely to cause an outbreak?

3. When is an outbreak considered an epidemic? Are the two words interchangeable? Explain.

4. Can you think of an example of an epidemic that was not caused by a disease? If so, what was the epidemic and what caused it? If not, brainstorm conditions other than disease that could cause an epidemic.

5. What makes an epidemic become a pandemic? What factors might contribute to an epidemic becoming a pandemic? Can you think of an example of a pandemic that has occurred in your lifetime?

Partner work

Working with a partner, choose a disease from the following list: Ebola, H7N9 bird flu, Zika virus, coronavirus (SARS-CoV-2)

1. Do research to answer the following questions:

What causes the disease?

What are its symptoms?

How is the disease typically treated in humans?

2. Search for news articles on the [Science News website](#) about a time when your disease caused an outbreak. Find at least three articles about a single outbreak and construct a timeline that tracks the progression of the outbreak. Be sure to consider an appropriate scope of time. Include in your timeline the dates the articles were published and the most important findings they report. Try to answer as many of the following questions as possible within your timeline.

Where did the outbreak originate?

Where and how did it spread?

What was the approximate rate of spread?

How many people were infected?

What measures were put in place to try to prevent the spread of the disease?

How many people died from the outbreak?

What was the approximate death rate?

Did the outbreak affect certain groups of people more than others?

3. Using evidence from your timeline, did your outbreak become an epidemic? A pandemic? If so, when did it progress from one stage to another? If not, what prevented it from progressing?

Class discussion

After sharing key points about your research with your classmates, discuss the questions that follow.

1. According to [an article](#) by researchers at the University College London and London School of Hygiene and Tropical Medicine, the frequency of reported infectious disease outbreaks has increased in the past three decades and is predicted to continue increasing in the future. What factors might be contributing to the increase in the number of outbreaks reported? Does an increase in the number of reported outbreaks necessarily mean that there are more outbreaks? Explain.

2. Based on your class's research about infectious diseases, what factors may contribute to an outbreak reaching epidemic or pandemic status? For the outbreaks the class chose, was it always clear when an outbreak became an epidemic or pandemic? What factors could affect how and when the status of an outbreak is elevated? Who makes the decision about an outbreak's status and what are the potential implications?

Student Discussion Worksheet

Directions:

After reading "[We may be on the brink of a coronavirus pandemic. Here's what that means](#)," originally published on the *Science News* website in late February, answer the questions below.

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2. What are some characteristics of a disease that could make it likely to cause an outbreak?

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Activity Guide for Teachers: Collaborating to Stop an Epidemic

Purpose: Students will work in groups to develop action plans with the goal of preventing the spread of a new virus, such as coronavirus.

Procedural overview: After reading the *Science News* article "[Why bat viruses are so dangerous](#)," students will receive a briefing on a new outbreak of a zoonotic disease. Imagining they are officers at the World Health Organization, students will identify and establish committees that will develop action plans to prevent the spread of the virus. Students will need to make changes to their action plans as new information becomes available and will need to incorporate feedback from other committees.

Approximate class time: 1 to 2 class periods

Supplies:

Paper

Pencils

Collaborating to Stop an Epidemic student worksheet

A projector (optional)

Copies of a hypothetical briefing (optional)

Directions for teachers:

The setup

After students read the *Science News* article "[Why bat viruses are so dangerous](#)," introduce them to the idea of a zoonotic disease, one that can be transferred to humans from other animals. Though it doesn't happen often, zoonotic viruses have caused outbreaks that spread globally.

Tell students that they will be acting as officers of the World Health Organization who have just been notified of a new outbreak of a zoonotic disease. It will be up to the class to develop committees and action plans to prevent the spread of the disease. Students will present those action plans to you, the teacher, who will be playing the role of the head of the WHO.

Provide the briefing below and go over it together as a class. You can adapt the details and the amount of information to match the needs of your classroom. You may want to connect the activity to a recent outbreak of a zoonotic disease, such as the novel coronavirus that spread from Wuhan, China, beginning in December 2019.

WHO Briefing

Situation: A novel coronavirus is sickening people in China.

Known facts:

-The virus was not previously known before the start of the outbreak in Wuhan, China, in December 2019.

- The disease affects the upper respiratory tract and causes flu-like symptoms.
- People with immune system illnesses, breathing issues (asthma) and the elderly are more likely to suffer severe symptoms.
- Source of the virus is currently unknown.
- The virus can be transmitted between people through respiratory droplets (coughing, sneezing).
- Disinfectant cleaners (bleach, Lysol) are able to kill the virus.
- It is unknown how long the virus can live on surfaces.
- Lab tests are currently required to confirm the virus and rule out another virus like the flu or a cold.

Source: www.who.int/news-room/q-a-detail/q-a-coronaviruses

If you want additional resources for the discussion or to provide resource for student groups, check out the links below.

WHO resources:

[Video on the recent coronavirus outbreak](#)

[Q&A on the same outbreak](#)

Additional *Science News* articles:

[MERS virus hits South Korea](#)

[Record Ebola epidemic strikes](#)

[Explainer: Animals' role in human disease](#)

[As the coronavirus outbreak evolves, we answer some key questions](#)

To help students get started, answer the following questions (1–3) as a class.

1. What information do you already know about this disease and what other information do you want to find out?
2. Who would be affected by the global outbreak of this disease? (Encourage students to consider not only individuals who get sick, but also professions, industries and other government and international bodies. Consider the immediate health consequences as well as social, cultural, economic and financial consequences of a disease outbreak.)
3. How do various people, countries and international organizations work together to ensure world health?

Explain that in order to build the action plan, students will need to form various committees that specialize in different aspects of preventing the spread of a virus (such as scientific research, health care response, quarantine and/or border control, international collaboration, emergency funding, public communication, etc.). Lead students in brainstorming and determining the committees they will form.

Once students have identified and agreed on committees, have them divide themselves into groups (one per committee) or assign them to groups.

Action plans

Students will now work in small groups to develop their action plans. To support collaboration, consider having students use a white board, a Google doc or some other platform that will allow members of each group to work on aspects of the plan simultaneously and to give one another immediate feedback.

Encourage students to identify knowledge gaps as they work and incorporate the steps required to fill those gaps into their action plans. Once or twice as students work, you can provide the committees with “Breaking Updates.” These updates will give students some new information about the virus that will have to be incorporated into their action plans.

Example “Breaking Updates” include:

- We now know that the disease can be spread before symptoms are shown.
- Outbreaks have now been reported on additional continents.
- It was discovered that antiviral medications can be beneficial within the first 72 hours of symptoms appearing.
- The virus is not only affecting the elderly more seriously but also spreading more rapidly in this population.

Students should answer the following questions (4–12) in their groups:

4. What committees has your class identified?
5. What committee are you on?
6. What are some general responsibilities of your committee?
7. What are some concerns that this committee will need to think about?
8. What questions does the committee need to answer?
9. What goals does the committee need to achieve?
10. How do the committee goals help serve the general purpose of preventing further spread of the disease?
11. What are five immediate steps that need to be taken to answer the questions and meet the goals?
12. What two steps would need to be taken in the future (within the next five years)?

Presentations and revisions

Allow each committee time to present its action plan to you and the other committees to receive feedback. As students present, they should keep in mind that each committee is looking at the problem from a different viewpoint and can help improve the plans by bringing up issues the original groups might not have considered.

Give students time to answer the following questions (13–16) and revise their plans according to the feedback. To encourage further collaboration, have students send representatives to other committees to discuss any changes to their action plans.

13. How could you incorporate feedback from different committees into your portion of the action plan? Provide examples from at least two different committees.

14. What do you think is the most crucial part of your action plan to help prevent the spread of the disease? Be sure to support your claim with a well-reasoned and detailed response.

15. Why is it important to collaborate and seek feedback from other committees working toward the same overall goal?

16. How can your committee combine resources and expertise with other committees to most effectively reach the overall goal?

While students are working in their groups to answer these final questions, walk around and help facilitate the conversations. Use this time to formatively assess group progress. You should hear students discussing their action plan and how it aligns with the overall goal of preventing the spread of the disease.

Some questions to ask students to check for understanding include: “How does your plan fit in with the other committees’ plans?” “Are you considering the information through more than one viewpoint?” and “How can you improve goal X to make it more clear and effective?”

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Activity Guide for Students: Collaborating to Stop an Epidemic

Directions:

In this activity, you will be acting as officers of the World Health Organization who have just been notified of a new outbreak of a zoonotic disease. It will be up to you to develop committees and action plans to prevent the spread of the disease. After presenting your action plan to your teacher, the head of WHO, and the other committees, you will revise your plan.

The setup

Answer the following questions as a class:

1. What information do you already know about this disease and what other information do you want to find out?
2. Who would be affected by the global outbreak of this disease?
3. How do various people, countries and international organizations work together to ensure world health?

Action plans

After your class has brainstormed and identified committees, answer the following question in your group:

4. What committees has your class identified?
5. What committee are you on?
6. What are some general responsibilities of your committee?
7. What are some concerns that this committee will need to think about?

8. What questions does the committee need to answer?

9. What goals does the committee need to achieve?

10. How do the committee goals help serve the general purpose of preventing further spread of the disease?

11. What are five immediate steps that need to be taken to answer the questions and meet the goals?

12. What two steps would need to be taken in the future (within the next five years)?

Presentations and revisions

After presenting your action plan and receiving feedback, revise your plans and answer the following questions:

13. How could you incorporate feedback from different committees into your portion of the action plan? Provide examples from at least two different committees.

14. What do you think is the most crucial part of your action plan to help prevent the spread of the disease? Be sure to support your claim with a well-reasoned and detailed response.

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