COVID-19 Sparks Community Action

hhmi | BioInteractive

Scientists at Work
Educator Materials

OVERVIEW

This activity accompanies the Scientists at Work video *COVID-19 Sparks Community Action*, which shows how a group of students, scientists, and volunteers came together to make hand sanitizer and masks for their community during the COVID-19 pandemic. In this activity, students connect information on viral structure and modes of transmission to public health recommendations. The activity also highlights the collaborative nature of science and its ability to address societal needs.
Additional information related to pedagogy and implementation can be found on this resource's webpage, including suggested audience, estimated time, and curriculum connections.

KEY CONCEPTS

- Knowledge of a virus's structure and mode of transmission can inform public health recommendations that reduce the virus's spread.
- Collaborative scientific and community efforts can address the needs of society at large.

STUDENT LEARNING TARGETS

- Explain how hand sanitizer destroys viruses like SARS-CoV-2.
- Explain how wearing masks reduces the spread of viruses like SARS-CoV-2.
- Identify ways in which scientists and science practices can address the needs of society at large.
- Express the importance of collaboration among scientists and other community members in solving scientific and societal problems.

PRIOR KNOWLEDGE

Students should have a basic understanding of:

- viruses as a type of pathogen that can cause disease in an organism
- viral transmission (that viruses can spread from one organism to another within a population)

TEACHING TIPS

Running the Activity

- Give students time to review the "Student Worksheet" before they watch the video.
  - In particular, prompt students to pay attention to the individuals and groups involved in the collaborative work described in the video. They will need that information to answer Question 6 in the worksheet.
- To increase accessibility, turn on closed captioning while playing the video. It may also be helpful to provide a copy of the video's transcript, which can be downloaded from this resource's webpage.
  - Captions are available in English, Spanish, and Auto-translate on YouTube.
  - An audio descriptive version of the video is also available.
- Consider using the following pause points for the video:
  - At 1:59, pause to allow students to fill out the "nonessential facilities" row of the table in Question 2.
  - At 2:50, pause to allow students to fill out Question 1. They can also fill out the "soap/hand sanitizer" row of the table in Question 2.
  - At 6:17, pause to allow students to fill out Question 3. They can also fill out the "masks" rows of the table in Question 2.

- Consider having students share out or discuss in small groups their answers to Question 9.

Clarifications and Caveats

- Make sure students are aware that making hand sanitizer at home is *not* recommended. To be safe and effective, hand sanitizer must be made under sterile conditions following specific standards and practices (CDC 2020). For example, Yvonne and Abrar made hand sanitizer in a lab using a protocol developed by the World Health Organization that was approved by their university.
- Students may have heard that handwashing with soap is recommended over hand sanitizer. You may need to clarify that making and distributing hand sanitizer is still important, since not everyone has consistent access to water for handwashing. If water is available, soap is recommended because it is more effective at cleaning hands that are dirty or greasy (CDC 2020).
- The scientists in the video hold a variety of positions: Abrar is a PhD student, Yvonne was a research assistant (and has since become a medical student), Chris is a postdoctoral researcher (someone who has earned a PhD and is continuing to conduct research in the lab), and Robert Tjian is a professor and a head of Abrar and Yvonne's lab (sometimes referred to as a principal investigator). If students are unfamiliar with the structure of a research lab, you may want to discuss what these different positions are and the roles they may play in a lab.

Supplements and Extensions

- For more information on the SARS-CoV-2 virus, explore BioInteractive's *Biology of SARS-CoV-2* animation series, which also has accompanying worksheets.
- The video mentions that both soap and hand sanitizer disrupt the virus's envelope. You may want students to explore their mechanisms in more depth.
    - Soap molecules have one part that is hydrophilic (attracted to water) and another part that is hydrophobic (repelled by water). When soap molecules encounter SARS-CoV-2, their hydrophobic parts insert into the virus's envelope and ultimately pull the virus apart. This 3D animation from the Protein Data Bank provides a narrated depiction of this process.
    - Hand sanitizers typically destroy the virus using alcohol, such as ethanol or isopropanol. Like soap molecules, alcohol molecules have both hydrophilic and hydrophobic parts, and they interact with the lipids and proteins in the virus's envelope. These interactions denature proteins and destabilize the envelope, causing the virus to fall apart (Singh et al. 2020).
- The video and worksheet discuss respiratory particles that inadvertently spread the SARS-CoV-2 virus. You may want to discuss the different types of particles, aerosols and droplets, in more depth. See the review paper Jayaweera et al. (2020) for additional information.
- The animation of mask fibers is based on images taken with a scanning electron micrograph (SEM) microscope. You may wish to show your students the original images. This interactive animation by *The New York Times* can also be used to explore the structure and science of masks in more depth.
- Students may want to know more about how the masks in the film were tested. Chris worked with the International Society for Aerosols in Medicine to test prototypes for the masks.
    - To test a mask's efficiency, a person wears a mask fitted with tubes connected to a machine that counts respiratory particles. The mask wearer is put through several tests to simulate everyday activities (e.g., talking, looking around, bending over). The machine calculates the percentage of particles that were trapped by the mask in each test. Chris's masks trapped an average of 85% of particles over all the tests.

ANSWER KEY

1. The SARS-CoV-2 virus is made up of three main types of molecules. One of these molecules (not shown in the video) is RNA, the virus's genetic material.

a. List the **two** other types of molecules that make up the virus.
lipids and proteins

b. Which part of the virus do soap and hand sanitizer disrupt?
the envelope

c. How does this disruption affect the virus's ability to cause an infection and spread to other people?
This disruption makes the virus's envelope fall apart. The virus becomes inactive, so it is unable to cause an infection or spread to other people.

2. The video shows several methods used to reduce the spread of SARS-CoV-2 among people, such as shutting down labs and other nonessential facilities, cleaning hands regularly with soap or hand sanitizer, and wearing masks. Fill in the table below to indicate whether each method would be effective or not effective at keeping the virus from spreading via droplets, aerosols, and touching. Briefly describe your reasoning for each choice.
Example answers are shown below. Note some parts may be open to alternative interpretations and explanations; be open to a range of reasonable responses.

	Droplets	**Aerosols**	**Touching**
Shutting down nonessential facilities	***Effective. If people aren't going to as many places, they're less likely to be exposed to (or expose others to) droplets with the virus.***	***Effective. If people aren't going to as many places, they're less likely to be exposed to (or expose others to) aerosols with the virus.***	***Effective. If people aren't going to as many places, they're less likely to be exposed to (or expose others to) liquid particles with the virus that can get on hands.***
Cleaning hands with soap or hand sanitizer	***Not effective. A person can still breathe in (or produce) droplets with the virus even if their hands are clean.***	***Not effective. A person can still breathe in (or produce) aerosols with the virus even if their hands are clean.***	***Effective. If a person gets the virus on their hands, soap and hand sanitizer can destroy the virus before it gets into their body.***
Wearing a mask with a *loose* weave	***Effective. Droplets are large enough for most masks to trap.***	***Not/less effective. Aerosols may be too small for masks with loose weaves to trap.***	***Not/less effective. A mask-wearing person could still touch their eyes, nose, or mouth with contaminated hands. (Alternatively, students may say masks are effective because they keep people from touching their nose and mouth.)***
Wearing a mask with a *tight* weave	***Effective. Droplets are large enough for most masks to trap.***	***Effective. Masks with tight weaves can trap aerosols.***	***Same as above.***

3. Some public health officials have suggested wearing masks with multiple layers or layering multiple masks on top of each other. How might these practices help reduce the spread of SARS-CoV-2?
Multiple layers provide more fibers that can trap liquid particles. This reduces the spread of SARS-CoV-2 by making it less likely for particles containing the virus to get in/out.

4. Another method to reduce the spread of SARS-CoV-2 is **social distancing**, the practice of staying at least 6 feet away from other people in public places. Based on what you've learned about how the virus spreads, why do you think social distancing was set specifically at 6 feet?

One of the ways that SARS-CoV-2 spreads is through droplets, which usually carry the virus less than 6 feet. So, staying 6 feet apart from other people can reduce the risk of spreading the virus through droplets.

5. Public health officials have recommended using all the methods described above — for example, washing hands/using hand sanitizer *and* wearing masks *and* social distancing. Why might combining these methods, rather than just picking one, better reduce the spread of SARS-CoV-2?
Different methods are effective against different ways of spreading the virus. For example, washing hands/using hand sanitizer helps reduce spread through touching, whereas wearing masks helps reduce spread through droplets and aerosols. Even if multiple methods are effective against the same thing (for example, both masks and social distancing help reduce spread through droplets), using the methods together provides extra protection.

6. In the video, making and distributing hand sanitizer and masks required collaboration among many groups. Describe **three** of the groups involved in this collaboration and their contributions to the project.
The example answer below includes more detail than would be provided by most students. It is meant to give additional information that you may want to discuss with students. Students could also describe broader groups (such as students, scientists, community members, volunteers, organizations, etc.) rather than specific individuals.
    - ***Abrar Abidi and Yvonne Hao from the University of California, Berkeley, recognized the need for hand sanitizer in their community. They came up with a plan to make hand sanitizer and distribute it.***
    - ***Professor Robert Tjian supported Yvonne and Abrar's project and helped them get approval from their university.***
    - ***People at the university volunteered to help with the project. The university also contributed extra research labs to expand the project.***
    - ***Community organizations (including shelters, fire departments, hospitals, and more) helped distribute the hand sanitizer.***
    - ***Christopher Gee developed a method to produce masks that were inexpensive, effective, and easy to make. He worked with Yvonne and Abrar to integrate masks into the project.***
    - ***Elaine Qian organized over 200 volunteers, who prepared, made, and distributed masks. A variety of people volunteered, including high school students.***

7. As of April 2021, this collaborative project has distributed 45,000 masks and 6,400 gallons of hand sanitizer. If the project hadn't happened, how might that have impacted this community?
Answers will vary, but students should make the connection that if fewer masks and less hand sanitizer had been available in the community, then the spread of the virus likely would have increased. This, in turn, likely would have increased the number of hospitalizations and deaths related to COVID-19.

8. In one or two sentences, explain how the scientists in the video adapted to respond to a societal need.
Answers will vary, but students will likely discuss how the scientists collaborated and found creative ways to make and distribute hand sanitizer and masks to those who needed them during the pandemic. Students may also say that many other scientists redirected their research to studying different aspects of the SARS-CoV-2 virus, which is briefly mentioned in the video.

9. Consider the needs of your community. Describe one way in which your community could be improved (in terms of health, safety, etc.). How could your community's members, including scientists, collaborate to fulfill this need?
Answers will vary but should address both parts of the question: how students' communities could be

improved and how scientists and other community members might be involved in this improvement. Consider having students share their answers in small groups or as a class.

REFERENCES

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CREDITS

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