

Transmission by Droplets

Hands-on Exploration of Water Drops from a Spray Bottle



Healthy Actions • Community
Knowledge • Science

FOR GRADES
3-5 6-8

OVERVIEW

Student teams will use water in a spray bottle to observe (1) the importance of physical distancing by at least six feet and (2) why masks are effective in reducing the spread of COVID-19.

LEARNING OBJECTIVES

Students will compare the number of grids on a sheet of paper in which water droplets appear when water is sprayed from (1) three feet away, (2) three feet away with a cloth covering, (3) six feet away, and (4) six feet away with a cloth covering.

SCIENCE, HEALTH AND MATH SKILLS

- Observing
- Comparing
- Measuring
- Interpreting

NGSS SCIENCE AND ENGINEERING PRACTICES

- Asking questions and defining problems
- Developing and using models
- Planning and carrying out investigations
- Using mathematics and computational thinking

TIME

- Set Up: 20 minutes
- Activity: 60 minutes

MATERIALS FOR SCIENCE INVESTIGATION

- Transmission by Droplets Slide Deck (www.bioedonline.org)
- Hand or wall mirror (or use the accompanying slide deck to illustrate water vapor)
- Clean spray bottle (such as an empty window cleaner bottle) filled with plain water
- Four sheets of plain or notebook paper
- Ruler, tape measure or yardstick
- Tape
- Hand or dish towel, or several paper towels
- Area in which to conduct the trials, with a water-resistant vertical surface, such as a plain whiteboard, tile wall, mirror or outside wall
- Science notebook

SET UP AND TEACHING TIPS

This activity can be conducted as a demonstration by you, the teacher, or by each student, either in the classroom or outside at school or home. The activity may be conducted against a tile wall, large mirror or whiteboard or outside on the side of a building.

PROCEDURE

■ ENGAGE

1. Ask students, *Have you seen posters or TV ads that stress the importance of social distancing? What do you think social distancing means?* Give students time to respond. Accept all answers. Mention that “social distancing” also is described as “physical distancing.”
2. Follow by asking, *What about masks? Why are they important?* If students are in school, they probably are wearing masks. Mention the various kinds of masks that individuals might be wearing in school, such as reusable cloth or disposable paper masks. If not brought up by students, mention that masks that use exhalation valves should be avoided. Ask students to think about why these masks might not protect other people.
3. If students do not mention the following points, be sure to include them in the discussion.
 - One way the virus that causes COVID-19 spreads is through droplets in air. If other people breath in (inhale) these droplets, they might become sick.
 - To reduce the spread of COVID-19, it’s important to prevent droplets produced by coughing, talking, singing or sneezing from spraying into the air.
 - It’s possible for a person to be infected with COVID-19 and not feel sick, but still spread the virus to other people.
 - Because masks block some virus-carrying droplets in the air, they also help reduce the risk of the wearer becoming infected with the virus that causes COVID-19.

■ EXPLORE

4. Tell students they will investigate whether social distancing or masks can help to reduce the amounts of droplets sprayed into the air. Use the first two slides in the accompanying slide deck to introduce the activity.
5. First, demonstrate by using a mirror (or have each student use a mirror) and exhale onto the mirror from a distance of a few inches. Omit this step, if it is not possible to conduct the demonstration at a safe distance. Ask, *what do you see on the mirror?* Allow students to answer, before clarifying that the mist on the mirror consists of tiny water droplets. Follow by asking, *Do you think these droplets are present in your breath even when you don’t see them on a mirror?* Help students to understand that breathing, talking, etc. typically release tiny droplets into the air.
6. Tell students they will be investigating ways to protect one another from droplets that we release into the air.
7. Conduct a demonstration, have students conduct the activity outdoors or have each student perform the following trials at home or using a wall in the school building.
 - Before beginning, fold each sheet of paper in half four times, to create a grid with 16 boxes. You will need a fresh sheet for each of the four trials.
 - For each trial, tape a sheet at chest height on a mirror, window or wall that will not be damaged by water. Have a towel ready to dry the wall or other surface after each trial..
 - Fill the spray bottle with water and set it to the mist setting.
 - Use a ruler, yardstick or tape measure to measure distances of 3 feet and 6 feet from the wall or other surface. Mark each distance with a small piece of tape.

- Trial One (three-foot distance).
 - a. Tape a clean grid sheet onto the mirror, window or tile wall, and measure a distance of three feet from the wall.
 - b. Hold the spray bottle at about the same height as the grid and aim at the top of the sheet. Spray firmly one time.
 - c. Count the number of squares on the sheet that have at least one observable wet spot or drop mark.
 - d. Record this number in a science notebook.
- Trial Two (three-foot distance and cloth covering)
 - a. Tape a clean grid sheet onto the mirror, window or tile wall, and measure a distance of three feet from the wall.
 - b. Repeat the same procedure with the spray bottle, but place a cloth covering in front of the spray bottle. Spray firmly one time.
 - c. Count the number of squares on the sheet that have at least one observable wet spot or drop mark.
 - d. Record this number in a science notebook.
- Trial Three (six-foot distance)
 - a. Tape a clean grid sheet onto the mirror, window or tile wall, and measure a distance of six feet from the wall.
 - b. Repeat the test with the spray bottle.
 - c. Count the number of squares on the sheet that have at least one observable wet spot or drop mark.
 - d. Record this number in a science notebook.
- Trial Four (six-foot distance and cloth covering)
 - a. Tape a clean grid sheet onto the mirror, window or tile wall, and measure a distance of six feet from the wall.
 - b. Repeat the same procedure as the previous trial, but place a cloth covering in front of the spray bottle. Spray firmly one time.
 - c. Count the number of squares on the sheet that have at least one observable wet spot or drop mark.
 - d. Record this number in a science notebook.

■ EXPLAIN

8. With young students, create a class bar graph with sticky notes, showing the number of squares with drops or wet spots in each trial. For older students, compile the class data from each students' results and have students compute the average number of squares for each trial.
9. Discuss the results with students. Ask, *Do you think the drops from the spray bottle were larger or smaller than typical droplets that are released by talking or coughing?* [they likely are larger than droplets typically released by people] *Do you think that your observations still can inform health behaviors?* Yes, because they provide general insights into how water drops might travel in air and how we can protect ourselves.
10. With young students, create a class bar graph with sticky notes, showing the number of squares with drops or wet spots in each trial. For older students, compile the class data from each students' results and have students compute the average number of squares for each trial.

■ EXTEND AND WRAP UP

11. Point out that some people can be infected with COVID-19 and not feel sick. That's why everyone should wear a mask and social distance. Use the accompanying slide deck to summarize the importance of wearing face covering and conclude by showing the video, *Wear a Mask to Protect You and Your Friends* (link also embedded in the slides). (www.youtube.com)

■ EVALUATE

Use students' entries in their science notebook or have them create a table with the results of their investigations. Have each student write three things they learned from the investigation.

THE SCIENCE

Coronavirus (SARS-CoV-2) spreads mainly through person-to-person contact—especially via droplets and fine particles produced when a person coughs, sneezes, sings or talks. These droplets can enter the mouths or noses of other people nearby, and possibly be inhaled into the lungs. The greatest risk of spreading the virus occurs when people are close to one another (within about six feet for fifteen minutes or more).

People infected with the SARS-CoV-2 virus can develop the illness known as COVID-19. The best way to keep from getting sick is to avoid being exposed to the virus. Wear a mask when you are around other people. Masks help to protect you from infection. In case you have the virus but do not have symptoms, a mask also will help prevent you from infecting those nearby. Social (physical) distancing (staying at least six feet away from others) helps people to avoid being exposed to the virus, or from spreading it.

Another option is to choose safe social activities. Use video chat or social media, meet in small groups outdoors while staying at least six feet apart and avoid crowded events and gatherings.

Recent research suggests that masks provide some protection to the wearer, because they allow fewer virus particles to be inhaled.

WORDS TO KNOW

COVID-19 Infectious disease caused by a coronavirus called SARS-CoV-2.

Transmission Passing on an infectious disease through direct or indirect contact.

Mask In a public health context, a “mask” is face covering that covers both the nose and mouth and extends below the chin. Cloth masks should be made of at least two layers of fabric.

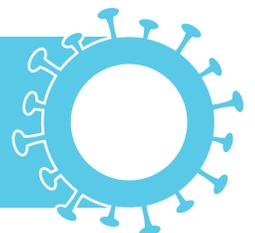
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- Jayaweera, M., Perera, H., Gunawardana, B., Manatunge, J. 2020. Transmission of COVID-19 virus by droplets and aerosols: A critical review on the unresolved dichotomy. *Environmental research*. 109819(188).
- Stadnytskyi, V., Bax, C., Bax, A., Anfinrud, P. 2020. The airborne lifetime of small speech droplets and their potential importance in SARS-CoV-2 transmission. *Proceedings of the National Academy of Sciences*. 117(22):11875-11877.

RESOURCES

- University of California San Francisco, One More Reason to Wear A Mask: You'll Get Less Sick from COVID-19. <https://www.ucsf.edu/news/2020/07/418181/one-more-reason-wear-mask-youll-get-less-sick-covid-19>.
- Wear a Mask to Protect You and Your Friends. <https://www.youtube.com/watch?v=Mn6axdkbGd4>.

The best way to keep from getting sick is to avoid being exposed to the virus. Wear a mask when you are around other people. Masks help to protect you from infection. Social (physical) distancing (staying at least six feet away from others) helps people to avoid being exposed to the virus, or from spreading it.



COVID HEALTHY ACTIONS, COMMUNITY KNOWLEDGE AND SCIENCE

■ A SCIENCE-BASED CURRICULUM FOR THE COVID-19 PANDEMIC

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Investigating Droplets

MATERIALS

- Clean spray bottle (such as from window cleaner) filled with plain water
- 4 sheets of plain or notebook paper
- Tape
- Cloth mask, cloth handkerchief, cloth napkin or other piece of fabric
- Area in which to conduct the trials: a tile wall surface (inside of tub or shower, etc.) or outside against a wall

PROCEDURE

1. You will conduct four trials as part of your investigation. Before beginning, fold each sheet of paper in half four times, to create a grid with 16 boxes (see example below). You will need a fresh sheet for each trial.
2. For each trial, tape a sheet at chest height on the wall. Have a towel ready to dry the wall surface after each trial.
3. Use a ruler, yardstick or tape measure to measure distances of 3 feet and 6 feet from the surface. Mark each distance with a small piece of tape.
4. Set the spray bottle with water to the mist setting.
5. **For each trial**, you will carry out the following steps.
 - Tape a clean grid sheet onto the wall.
 - Stand at the specified distance from the wall (either three or six feet).
 - Hold the spray bottle at about the same height as the grid and aim at the top of the sheet. Spray firmly one time.
 - Count the number of squares on the sheet that have at least one observable wet spot or drop mark.
 - Record this number in a science notebook.

EXAMPLE

EXPLORATION

TABLE

TRIALS	SQUARES
Trial One (three-foot distance)	
Trial Two (three-foot distance, holding a piece of fabric or cloth mask over the spray nozzle)	
Trial Three (six-foot distance)	
Trial Four (four-foot distance, holding a piece of fabric or cloth mask over the spray nozzle)	

EVALUATION

TABLE

INVESTIGATION RESULTS	
One	
Two	
Three	