SPRAY WHAT?
Investigating the Impact of Wearing a Mask

Jennifer Richards, Ph.D., Curriculum Specialists, Tennessee 4-H Youth Development

Real. Life. Solutions.”
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Skill Level
Beginner (4th and 5th grade) and Intermediate (6th and 7th grade)

Learner Outcomes
The learner will be able to:
- Write a hypothesis
- Collect, analyze and draw conclusions from the data

Educational Standard(s) Supported
4.ETS2.1; 5.ETS1.2; 6.ETS1.2; 7.ETS2.1

Success Indicator
Learners will be successful if they:
- Conduct a scientific experiment designed to simulate the effectiveness of wearing a mask in reducing the spread of germs from a sneeze

Time Needed
Approximately 50 minutes

Materials List
pH sensitive paper (two sheets per group)
Small spray bottle containing water and baking soda solution* (one bottle per group)
Disposable masks (three per group)
Student Data Collection handout (one per student)
Masking or scotch tape (one roll per group)
Ruler (one per group)
One bandana and two hair ties (per student)
*Before the lesson, dissolve 1 teaspoon of baking soda into approximately 4 ounces of tap water in each spray bottle.

Introduction to Content
The CDC recommends wearing a facemask to help prevent the spread of COVID-19. In this lesson, investigate how a mask affects the distribution of water droplets while simulating a sneeze.

Introduction to Methodology
Students will work in small groups to conduct a simple scientific experiment. They will construct a hypothesis, set up the experiment, collect and analyze data to draw a conclusion regarding the impact of wearing a mask when sneezing.

*Accommodations for socially distancing groups are included on page 4.

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Prepared using research based practices in youth development and experiential learning.
Terms and Concepts Introduction


People with COVID-19 have reported a wide range of symptoms – from mild symptoms to severe illness. Symptoms may appear 2-14 days after exposure to the virus. If you have fever, cough or other symptoms, you might have COVID-19.

Setting the Stage and Opening Questions

Pose the following questions to students to generate discussion:

- What do you know about COVID-19?
- What are some ways that you can keep yourself and others safe from COVID-19?

Allow students to share their knowledge and experiences. Students can do this in pairs or as a whole group. The goal of this discussion is to connect the topic of today’s lesson to what students have heard about wearing a mask.

Show students the following video about how and why to wear a mask.

https://www.youtube.com/watch?v=kjyq1vs4URg

After the video, tell students: “Today you are going to work with a small group to conduct an experiment to see how much masks can reduce the spread of germs. To do this, we are going to simulate sneezes with spray bottles.”

Experience

1. Organize students into small groups of 2-4. Provide each group with two sheets of pH sensitive paper, a spray bottle containing at least 4 ounces of a baking soda and water solution, a pair of scissors, three disposable masks and one copy of the student handout for each student.
2. Ask students to cut each piece of pH sensitive paper into four equal quarters.
3. Share the objective of the experiment with students “To measure the impact of a mask on the distribution of water droplets” and encourage students to generate a hypothesis. Students should write both the objective and hypothesis on their data collection handout.
4. Share the procedure with students:
   - Tape one square of pH sensitive paper to the wall.
   - Measure 6 inches away from the wall.
   - One group member should hold a disposable mask just in front of the spray nozzle while one member holds the spray bottle.
   - Squeeze the spray bottle to simulate a sneeze.
   - Remove the paper from the wall and classify the spray pattern on the paper as small, medium or large.
5. Students should repeat these procedures with the mask at 12 inches and 24 inches from the wall. Make sure students use a new mask for each trial.
6. Students should then repeat these procedures without a mask at 6 inches, 12 inches and 24 inches from the wall. Make sure students use a new mask for each trial.
7. Have students use the density guide images on their lab sheet to classify the results of each trial as low, medium or high. Remind them to record their results on the results chart.
**Share**

After each group completes all six trials (three distances with a mask, three distances without a mask), direct them to work as a group to complete the analysis and conclusions sections of their data collection handout.

Encourage each group to share their overall results and conclusions with the class. If there are variations in the results, lead a discussion exploring why different groups might wind up with different results.

**Process**

Lead a discussion exploring why different groups might wind up with different results. Things to consider:

- Are there variables that were not controlled in the experiment?
- To what extent did groups make errors in measuring differences?
- How confident is each group in their results, analysis and conclusion?

**Generalize**

Ask each group to consider their confidence level in their results, analysis and conclusion. Ask them to explain their confidence level.

Remind students that public health recommendations are not made after one single experiment. For an experiment’s results to be trusted, they must include a large sample size, the methods must be valid and repeatable and other researchers must be able to confirm the findings.

**Apply**

Ask students to work within their groups to research the most current CDC recommendations on wearing masks. They should find the following information:

1. When should masks be worn during the current pandemic?
2. What is the proper way to wear a mask?
3. What role do masks play in reducing an individual’s exposure to COVID-19?

Provide each student with a bandana and two rubber bands. Follow the directions on the Tennessee 4-H Face Mask Project: Step-by-step face mask instructions to lead students through making their own facemask.

Ask students to create colorful and visually attractive posters to display the information they have researched. Encourage them to use pictures of themselves wearing their own facemasks on the posters. Display these posters around the school or around your community.
4.ETS2.1: Use appropriate tools and measurements to build a model

5.ETS1.2: Plan and carry out tests on one or more elements of a prototype in which variables are controlled and failure points are considered to identify which elements need to be improved. Apply the results of tests to redesign the prototype.

6.ETS1.2: Design and test different solutions that impact energy transfer.

7.ETS2.1: Examine a problem from the medical field pertaining to biomaterials and design a solution taking into consideration the criteria, constraints, and relevant scientific principles of the problem that may limit possible solutions.

*Accommodations for social distance with group work:

- Arrange students in work teams of three and assign the following roles:
  - Data Recorder: Records the data from all six trials from a location at least six feet away.
  - Manager: Cuts paper into quadrants, hangs paper on the wall, interprets the spray pattern and shares it with the Data Recorder. While the investigator is measuring and spraying, the Manager should move to a location at least six feet away from the paper.
  - Investigator: Manages the spray bottle and masks, is responsible for measuring the distance from the wall and spraying the solution in the spray bottle. The investigator should make sure that they are at least six feet away while the Manager is hanging the paper and interpreting the spray pattern.

- This modification reduces the need for students to be within six feet of one another.

- Also consider moving this activity into an open space (hallway, multi-purpose room, gym, outside) to allow for greater social distancing.

Programs in agriculture and natural resources, 4-H youth development, family and consumer sciences, and resource development. University of Tennessee Institute of Agriculture, U.S. Department of Agriculture and county governments cooperating. UT Extension provides equal opportunities in programs and employment.
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<thead>
<tr>
<th>EXPERIMENT TITLE:</th>
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<tbody>
<tr>
<td>OBJECTIVE:</td>
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<tr>
<td>PROCEDURE:</td>
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### RESULTS:

<table>
<thead>
<tr>
<th>DISTANCE</th>
<th>WITH A MASK</th>
<th>WITHOUT A MASK</th>
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<tbody>
<tr>
<td>6”</td>
<td></td>
<td></td>
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<tr>
<td>12”</td>
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<tr>
<td>24”</td>
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![Graphs showing density levels: Low, Medium, High](image)

### ANALYSIS:

### CONCLUSION:
Make sure your cloth face covering:

- fits snugly but comfortably against the side of the face
- completely covers the nose and mouth
- allows for breathing without restriction

How to Clean:

- **Washing machine:** You can include your face mask with your regular laundry. Use regular laundry detergent and the warmest appropriate water setting for the bandana. Use the highest heat setting and leave in the dryer until completely dry.
- **Washing by hand:** Prepare a bleach solution by mixing 5 tablespoons (1/3rd cup) household bleach per gallon of room temperature water or 4 teaspoons household bleach per quart of room temperature water. Check the label to see if your bleach is intended for disinfection. Some bleach products, such as those designed for safe use on colored clothing, may not be suitable for disinfection. Ensure the bleach product is not past its expiration date. Never mix household bleach with ammonia or any other cleanser. Soak the bandana in the bleach solution for five minutes. Rinse thoroughly with cool or room temperature water. Use the highest heat setting and leave in the dryer until completely dry or lay flat and allow to completely dry. If possible, place the bandana in direct sunlight.

Source: Centers for Disease Control and Prevention, 2020, cdc.gov

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