Which Fabrics Make the Most Effective COVID-19 Face Covering

COVID HACKS
Healthy Actions • Community Knowledge • Science

Measure How Much Air Flows Through Different Fabrics

FOR GRADES
3–5 6–8

OVERVIEW

Not all fabrics make equally protective face coverings or masks. The selection of material should not be left to chance. In this activity, students construct a mask tester to evaluate the filtering effectiveness of different fabrics.

LEARNING OBJECTIVE

Students will test and evaluate the permeability of different fabrics; and then reach conclusions about the suitability of different fabrics for use in face masks to protect against the spread of viruses and other microbes.

SCIENCE, HEALTH AND MATH SKILLS

- Comparing and contrasting
- Measuring
- Interpreting

NGSS SCIENCE AND ENGINEERING PRACTICES

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

TIME

- Set Up: 30 minutes
- Activity: Two 60-minute classes

MATERIALS FOR SCIENCE INVESTIGATION

The teacher will use a set of materials such as those listed below to create a demonstration anemometer. The teacher also will need a handheld fan, hairdryer set at the lowest speed or sheet of cardboard for the demonstration.

- Anemometer Assembly Instructions (www.bioedonline.org)
- Printed copies of the paper patterns and instructions for making the tester: Parts 1 and 2 (www.bioedonline.org)
- Sheet of cardboard, such from as a pizza or cereal box (approximately 8 x 10 inches)
- Glue, such as white school glue or a glue stick
- Tape, such as masking tape, painter's tape or clear plastic tape
- Nail or pointed punch
- Scissors

- A variety of test fabrics, such as a tee shirt, pillowcase, handkerchief, kitchen towel, bandana, washcloth, etc. It is not necessary to cut the fabric.
- Handheld hairdryer (optional). If students will be testing their anemometers in the classroom or with other people, they will need to use a hairdryer set to "cool" and the lowest speed to test the various fabrics.

SET UP AND TEACHING TIPS

Build an anemometer following the assembly instructions, so that you can demonstrate its use to students. You'll need a small fan or sheet of cardboard to create a breeze for the demonstration. To avoid having students breathing through various fabrics in the classroom, consider having students construct their anemometers at school, but conduct the fabric tests as an assignment at home. Or, have students use a handheld hairdryer to test the fabrics in the classroom.

PROCEDURE

ENGAGE

1. Begin the lesson by asking, *Why is it important to wear face coverings during the COVID-19 pandemic?* Accept all responses and discuss.

Explain that the masks we wear during this pandemic and other disease outbreaks have two main functions. They protect the wearer from breathing in virus-laden moisture droplets, and they protect others from droplets breathed out by the wearer that may contain virus particles. COVID-19 is caused by a coronavirus called SARS-CoV-2. Unfortunately, symptoms of COVID-19 may not appear for 2 to 14 days, so a person may not know he or she has the virus. During that time, a person infected with the virus who does not wear a mask or take other precautions (such as careful hand washing or physical distancing) can unknowingly pass the infection to family, friends and strangers.

The virus particles are extremely small—far too tiny to be seen through the most powerful optical microscopes. Only advanced electron microscopes can image virus particles. Ask, *If virus particles are so small, how can protective masks stop them?* Accept responses and discuss.

Explain that some virus particles "hitch a ride" on the tiny droplets of moisture expelled when an infected person talks, yells, sings, sneezes or coughs. Except for very coarsely woven fabrics, the porosity (open spaces between threads) of many fabrics is large enough to allow air to pass through, but small enough to trap virus-laden moisture particles. *But how do we know which fabrics are best for making masks?*

EXPLORE

2. Tell students they will investigate the effectiveness of different fabrics for protective masks by using a "mask tester" they will construct.

Show students your pre-assembled "mask tester." Explain that this is an anemometer, a device used for measuring air movement. Anemometers are most commonly used to measure outdoor wind speed, but they also are used to measure air flow in air conditioning, gauge wind conditions for sports, check ventilation in mines, and other uses.

Anemometers take many forms, including cups spinning around an axle, propeller blades, and electronic sensors. The anemometer used in this activity is one of the simplest forms.

Use a handheld fan or hair dryer (or wave a small sheet of cardboard) with the anemometer to demonstrate how the needle moves on a pivot and swings upward when air flows by.

Read the Anemometer Instructions page with students, and review the paper patterns to ensure students understand what to do. Using your model, point out how you (the teacher) assembled yours. Also demonstrate how to position the anemometer on a door.

Before students begin construction, discuss their ideas for fabrics to test with the anemometer. Discuss possible options, such as tee shirt (cotton knit fabric), old pillowcase, cloth handkerchief, kitchen towel, bandana, washcloth, etc. Students should ask permission before using any fabrics they find at home. It is not necessary to cut fabrics for testing.

Instruct students to follow the Procedure described on the Anemometer Instructions page.

SAFETY NOTE: If students are conducting this activity in the classroom, have them use a hairdryer to test the fabrics. Otherwise, have them build the anemometer in class and test it at home with various fabrics.

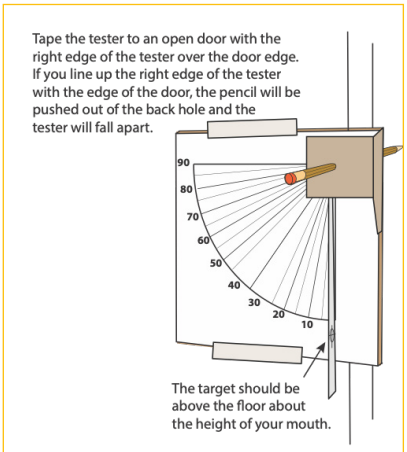
Remind them to record their results, including the material used and the anemometer measurements.

In addition, have students devise a qualitative plan to evaluate and report (1) how well they were able to breathe through the fabric, and (2) how comfortable the fabrics felt on their faces.

EXPLAIN

3. Upon completing the investigation, students will share and explain their results.

DIAGRAM



Is it good or bad when the anemometer needle swings to the top of the protractor scale during a test?
(Bad. The anemometer detects air movement, so the less the needle swings, the more effective the fabric is as a filtering barrier.)

Were any fabrics good at blocking outgoing breath but difficult to breathe through?

Which fabrics were most comfortable? Were they among the most effective?

(People may not want to wear a mask made from a fabric that is scratchy or causes skin irritation.)

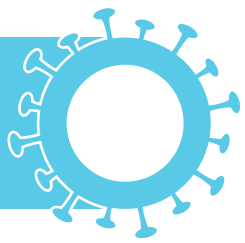
4. Conclude with a class discussion based on the question, *Combining everything you've learned in your investigation, which kinds of fabrics are best for making protective cloth face masks?*

EXTEND

5. Review the Centers for Disease Control and Prevention (CDC) information regarding masks with students (www.cdc.gov).

6. What comes next? Have students make their own masks from the selected material. See CDC instructions for making masks (www.cdc.gov).

Some virus particles "hitch a ride" on the tiny droplets of moisture expelled when an infected person talks, yells, sings, sneezes or coughs. Except for very coarsely woven fabrics, the porosity (open spaces between threads) of many fabrics is large enough to allow air to pass through, but small enough to trap virus-laden moisture particles.



THE SCIENCE

The COVID-19 pandemic already has killed more than 1 million people around the world and caused illness in more than 35 million. At the beginning of the pandemic, scientists did not have enough evidence about whether masks would be effective against SARS-CoC-2, the virus that causes COVID-19. Now, growing evidence shows that wearing face coverings prevents spread of the virus.

N95 masks, which are used in medical settings, block about 90% of aerosols down to a size of 0.3 µm. Most fabric masks can block more than 80% of aerosols of 4–5 µm (2020. Face Masks: What the Data Say. Nature News Feature).

RESOURCES

- Centers for Disease Control and Prevention (CDC). How to Select, Wear and Clear Your Mask. https://www.cdc.gov/coronavirus/2019-ncov/prevent-getting-sick/about-face-coverings.html.
- Centers for Disease Control and Prevention (CDC). How to Make Masks. https://www.cdc.gov/coronavirus/2019-ncov/prevent-getting-sick/how-to-make-cloth-face-covering.html.

COVID HACKS
Healthy Actions • Community Knowledge • Science

COVID HEALTHY ACTIONS, COMMUNITY KNOWLEDGE AND SCIENCE

A SCIENCE-BASED CURRICULUM FOR THE COVID-19 PANDEMIC

We are grateful to Laura and John Arnold and other community donors for their generous support, which enabled development of the COVID HACKS curriculum materials. We also thank the many scientists, educators and physicians from Baylor College of Medicine (BCM) who provided content, feedback and technical reviews.

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Anemometer Assembly Instructions

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OVERVIEW

- Read the instructions before you begin
- Gather the tools you will need for assembly
- If you cannot print out the patterns, trace them careful

MATERIALS

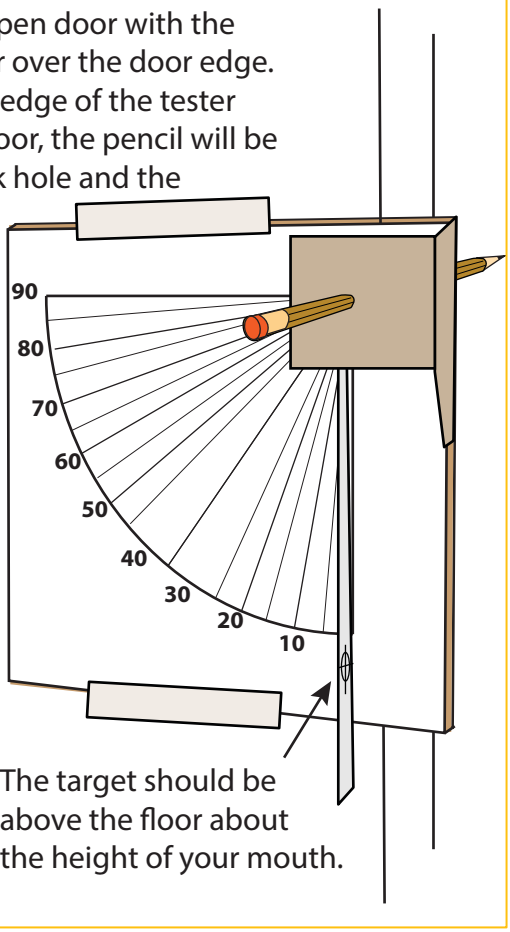
- Printed copies of Parts 1 and 2 of the paper patterns and instructions to make the tester
- Sheet of cardboard, such from as a pizza or cereal box (approximately 8 x 10 inches)
- Glue, such as white school glue or a glue stick
- Sharpened pencil
- Tape, such as masking tape, painter's tape or clear plastic tape
- Nail or pointed punch
- Scissors
- A variety of test fabrics, such as a tee shirt, pillowcase, handkerchief, kitchen towel, bandana, washcloth, etc. It is not necessary to cut the fabric.

PROCEDURE

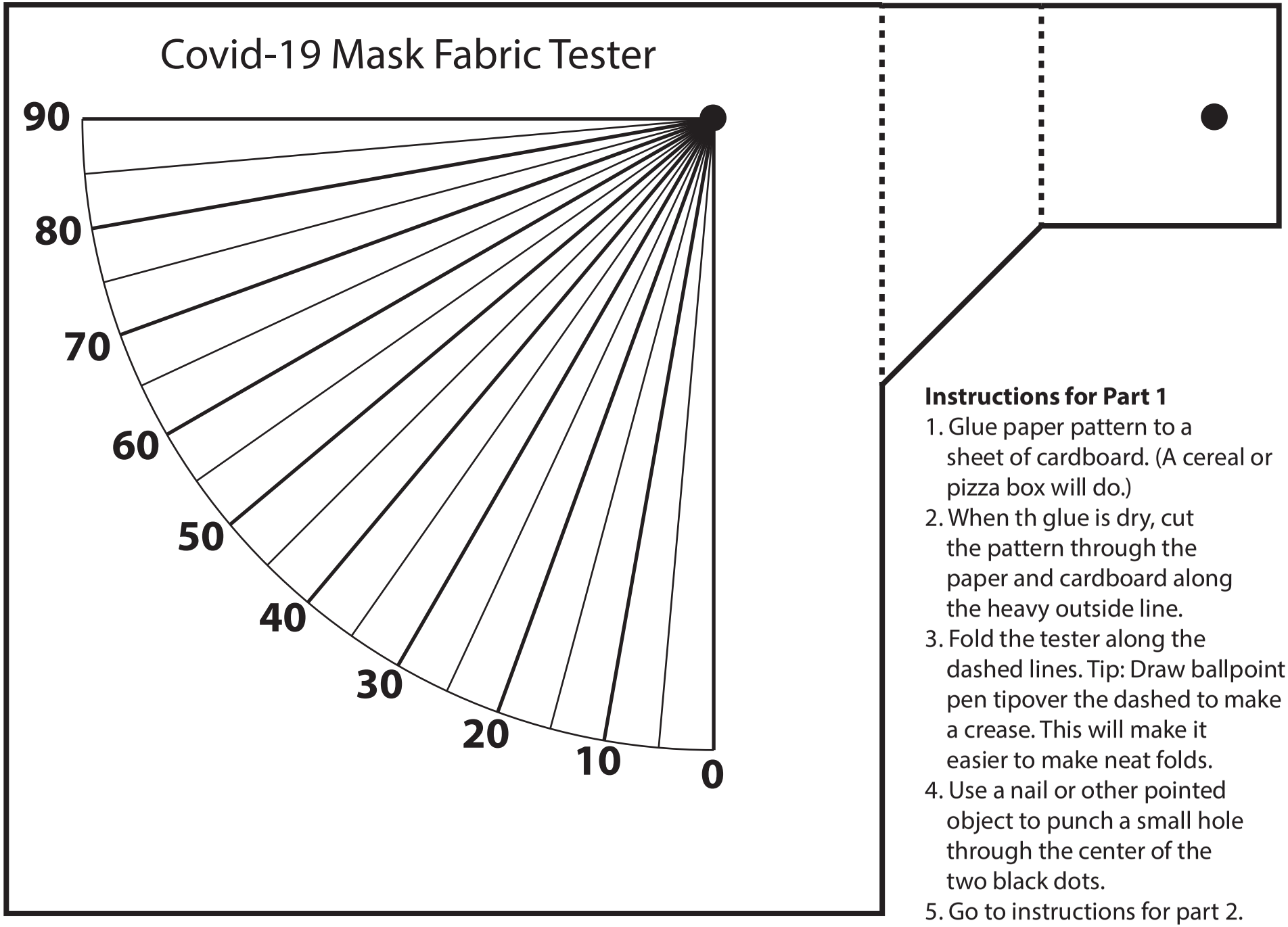
1. The construction steps are printed on the anemometer paper patterns (Part 1 and Part 2).
2. Without cutting it out, glue the Part 1 pattern onto the cardboard. After it dries, cut it out along the thick outside lines. Then, use a ballpoint pen to score the dashed lines and fold along the dashed lines.
3. Do not glue the Part 2 pattern to cardboard. Cut out the long rectangle. Fold the top portion over to create a loop and tape it as shown on the diagram. This forms the "needle" of the meter that will swing on the pencil.
4. Use a nail, paper punch or pointed end of the scissors to punch small holes carefully through the black dots on the anemometer.
5. Push the pointed end of the pencil through the hole in the folded-over piece of the pattern, through the paper needle loop, and then through the back hole. The paper needle should swing freely.
6. When the anemometer is completed, tape it to an open door. It should extend over the door edge at head height. When the anemometer is properly positioned, the pencil point will line up alongside the door edge (see diagram on next page).
7. Before beginning the investigation, create a chart or log to record your results. Include the type of fabric used and the three resulting anemometer measurements for each fabric. Also, include a section on which to record ratings for (1) how well you were able to breathe through the fabric, and (2) how comfortable the fabrics felt on your face.
8. When ready, stand next to their anemometer and hold a test fabric tightly over your mouth Blow hard through the fabric at the target and observe how high the needle swings. Repeat three times to get an average reading. Or, if you are in the classroom or with other people, use a hairdryer set to "cool" and the lowest speed to test the various fabrics.
9. Test as many different fabrics as you can find. Save your results for sharing.

DIAGRAM

Tape the tester to an open door with the right edge of the tester over the door edge. If you line up the right edge of the tester with the edge of the door, the pencil will be pushed out of the back hole and the tester will fall apart.



The target should be above the floor about the height of your mouth.



Instructions for Part 1

1. Glue paper pattern to a sheet of cardboard. (A cereal or pizza box will do.)
2. When th glue is dry, cut the pattern through the paper and cardboard along the heavy outside line.
3. Fold the tester along the dashed lines. Tip: Draw ballpoint pen tipover the dashed to make a crease. This will make it easier to make neat folds.
4. Use a nail or other pointed object to punch a small hole through the center of the two black dots.
5. Go to instructions for part 2.

Covid-19 Mask Fabric Tester Indicator

Instructions for Part 2

1. Cut out paper pattern on the thick outside line.
2. Curl over the end to make a loop. place the upper edge along the thin dashed line.
3. Use tape to hold it in place.
4. Go to assembly instructions.