

CAUGHT RED-HANDED



When was the last time you washed your hands? Did you use soap? How long did it take you? What have you done since you washed? Have you eaten? Touched your face? Touched someone else?

Goal

To evaluate the effectiveness of different handwashing times, techniques, and materials in reducing the number of microbes.

Activity Time

50 minutes

Time to Get Ready

15 minutes

What You Need

Have the following for each team of 3 or 4:

- 1 apron or smock
- 1 timer
- sink with running water or bucket of water
- 1 opaque shield or blindfold
- 30 mL washable paint or glitter
- paper or fabric towels
- hand cleansing agents
- hot running water (optional)
- 2 cookies (for demonstration)
- old newspaper

Getting Ready

- If a sink is not readily available in the room, fill a bucket of water for each group.
- Obtain 2 cookies and 5 mL of washable paint for pre-lab demonstration.
- Dirty the palm of one hand conspicuously with the washable paint just before the group meets. Glitter may be used in place of paint.

Useful Information

A survey was taken of scientists at an infectious disease meeting. The results were pretty scary. Only 80 percent of these learned women and 60 percent of the men washed their hands after using the restroom. Yet, thorough handwashing is one of the best ways to reduce microbes and prevent infections. The human body naturally carries an abundant supply of microbes. The resident microbes, which are usually harmless, establish a miniature ecosystem with the body to maintain health. But these microbes are very sensitive to certain factors. An upset in their balance can allow them to be replaced by more transient microbes which may be harmful. Handwashing with plain soaps suspends the microbes and allows them to be rinsed off. Antibacterial soaps inhibit the growth of microbes.

Suggestions to Modify the Activity for Those Who Are Exceptional

Specific modifications for this activity are found here. For common considerations when modifying activities for exceptional participants, see page V of the **Introduction**.

Blind or Visually Impaired

- Touch the participant with the "soiled" (painted) hand when introducing the activity and during the demonstration. This will enable the participant to experience what the other participants are experiencing visually. Emphasize the coughing, too!
- Advise participants to provide specific observations. Glitter or glitter mixed with colored paint is an excellent alternative to the colored paint. Glitter provides the participant with the ability to feel how dirty his/her hands are.



- Allow participants to shade in and color cardboard cutouts of hand shapes. The cutouts will provide the participant tactile boundaries when coloring. Have the participant use crayons to make a waxy film. More wax represents more dirt. A hole punch can mark how well each hand is cleaned. For example, use one punched hole to represent one "+."

Deaf or Hard-of-Hearing

- See **the General Modifications** for *Blind or Visually Impaired* listed in the **Introduction**, page V.

Mobility Impaired

- Wrap any exposed pipe underneath the sink area if it is not already protected. Running hot water while washing hands may be a safety concern for a participant in a wheelchair. A participant with paralysis in the lower extremities will not be aware that his/her legs are against the hot pipes.

Physically Impaired

- Offer crayons that are flat on one side and larger in size to allow the participant more control when coloring. The crayons will not roll off the table. If necessary, provide participants with assistance when tracing their hands.

Cognitively Impaired

- See the **General Modifications** for *Cognitively Impaired* listed in the **Introduction**, page V.

For More Information

- Gavzer, B. (October 19, 1997). We can make our food safer. *Parade Magazine*, 4-6.
- MacKinnon, G.R. (1998). Soap and science. *Science and Children*, 35(5), 28-31.
- Raloff, J. (1998). Staging germ warfare in foods. *Science News*, 153(6), 89-90.
- Raloff, J. (1998). Wash-resistant bacteria taint foods. *Science News*, 153(22), 340.

How to Start the Activity

In front of the participants, simulate a cough into your apparently clean hand that has not been "painted." Pick up identical cookies in each hand and hold them out to the participants. As you do, expose both palms to the participants. Ask them which cookie they would like to eat. They ought to reject both choices as unacceptable. A reasonable hypothesis would be that both the apparently clean and obviously dirty hands have unseen microbes on their surfaces. These microbes may or may not be harmful. Confirming both the microbes' presence and type would require growing a culture. (See "Fun with Fomites" activity.)

Let's Make a Hypothesis

Ask the following questions to help guide the participants to hypothesis formation.

- What have you handled since you last washed your hands?
- How long does it take to adequately wash your hands?
- Does it matter whether the water is hot or cold?
- Is one soap as good as another?
- How can you find the answers to these questions?

What the Data Mean

washer	washing time (seconds)			
	0	1	5	20
1.	++++	+++	++	+
2.	++++	+++	+	+
3.	++++	+++	++	+
average	++++	+++	++	+

KEY: Surface Area w/Paint ++++ 100% +++ 75% ++ 50% + 25%

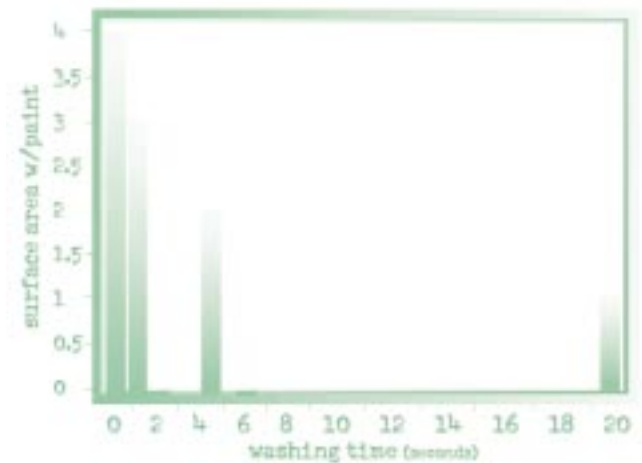
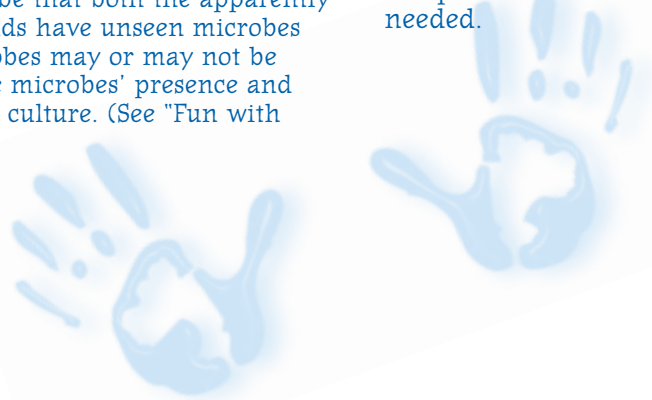


Figure 1. How washing time affects cleaning your hands. Washing longer does appear to be better, but even the longest washing time attempted was not adequate. More washing time or use of a cleanser is needed.



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Questions to Think About

Your dentist has probably told you that an adequate tooth brushing job will take two minutes. The dentist also has given you careful instructions about how to brush. If you follow those instructions every time you brush your teeth, and you brush frequently, you probably have healthy teeth. What do you think the important elements are to washing hands?

Safety Notes

- Food, drinks, and gum are not allowed.
- Use water that is not so hot that it can scald.
- Wear a smock or apron while working with paint.
- Do not touch your face with glitter or paint

What to Do

1. Your group will determine how the length of time spent washing hands affects their cleanliness. You will do this by simulating the removal of microbes from your hands. Instead of using actual microbes, though, you will use either paint or glitter. As a group, devise a scheme for scoring hand cleanliness. Divide a piece of paper into 4 sections. Trace a hand outline in each section of the paper. Then use pencils, crayons, or paint to shade in your idea of a completely dirty, very dirty, dirty, and somewhat dirty hand. Some parts may be darkly shaded, and some parts lightly shaded. Label the completely dirty hand as +++, the very dirty hand as ++, and so on.

2. Cover your work space with old newspapers. Designate 1 member of the group as the hand washer and 1 as the timer. As the washer, put about 5 mL of washable paint in the palm of one hand and spread it, like lotion, as evenly as you can over all the skin of your hands, even the skin next to your fingernails. Without touching anything, allow your hands to dry completely. This will take only a minute or two. If you are using glitter, pour it on a piece of paper and then press your hands into the glitter until they are well covered. Put the paint or glitter away.

3. At the sink, 2 team members hold a shield over the sink so the washer cannot see his/her hands. Have the washer wash for 1 second. After the washing, have the timer blot the washer's hands without letting him/her see them or giving any information about the hands' cleanliness. Using the scoring scheme, record the cleanliness.

4. Have the washer wash for an additional 4 seconds. Have the timer blot the washer's hands and record their cleanliness. Allow the washer to wash for 15 more seconds. Once again, have the timer blot the washer's hands and record their cleanliness.

5. Allow the washer to completely clean his/her hands. Then repeat steps 2 to 4, only this time, permit the washer

to use any available cleaning agent. Change roles and repeat the exercise until you have at least three sets of data. As much as possible, have the same person time the washings and record the cleanliness.

6. Analyze and display the results by creating a graph using the average result at each time interval. In graphing the results, remember to put the element that is changed on the x-, or horizontal, axis. Be certain to leave a space for every number between 0 and the final time, not just one space for each time measured. Put the evaluation of cleanliness on the vertical axis. Can you predict what would happen if you increased the washing time or modified the technique by rubbing more vigorously?

7. What, if any, errors might have been introduced into the experiment? Why was it important to have the same person score all the hands? What infectious diseases might be transmitted by failure to adequately wash your hands? Are your observations likely to change your behavior or impact the health of your family? How?

8. Design a new experiment based on data you gathered or questions you asked during this investigation. What is the question you are investigating? What hypothesis could you propose? What procedures would you use to test this? What variables are important? What is your control? How many trials have you included? What will you measure? How can you show your results in graphs?

What Did You Find Out By Doing the Activity?

Before doing "Caught Red-Handed," did you know:

- why you wash your hands before meals?
- why you use soap when you wash your hands?
- how touching things affects how clean your hands are?
- why the temperature of the water is a factor when washing hands?
- if you could see the microbes that exist on your hands?
- how long you should wash your hands each time?

From this activity, did you discover:

- how hand washing affects microbes?
- how different microbes affect the human body?
- why harmful microbes make you sick when they get into your mouth?
- how antibacterial and plain soaps differ in their effects on microbes?
- how much time is needed for effective handwashing?
- how your handwashing habits may change after doing this activity?
- if the microbes on your hands can have a serious effect on your personal health?

