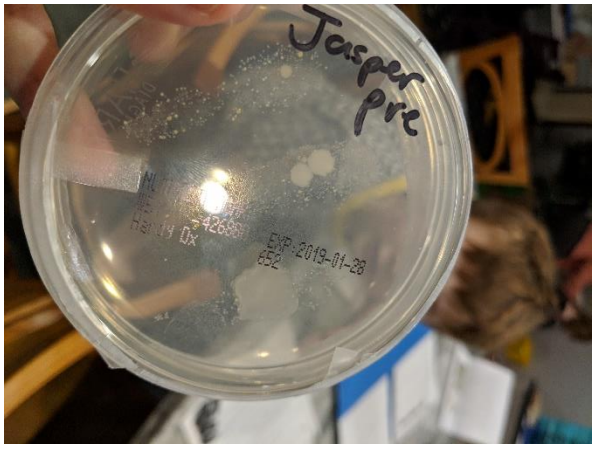
Teaching Your Kids about Hand Hygiene: A Step-by-Step Guide to Experiments You Can Do at Home or at School

By: Westyn Branch-Elliman, MD, MMSc



Please note that some states consider the agar plates to be biohazards so make sure you have a disposal plan before trying them at home.

Option 1: A simple pre/post evaluation of hand hygiene with hand sanitizer.

This experiment is designed to teach children about germs and to show them why hand hygiene is so important. Because we cannot see "germs," the concept can be difficult for children to grasp. This first experiment is designed to actually *show* them (some) germs, and also what happens after you sanitize their hands.

Materials required:

- Agar plates – 2 per child
- Incubater (the folding bread proofer will work)
- Parafilm
- Sharpies
- Hand sanitizer – Cal Stat Plus is my personal favorite, but any alcohol-based hand sanitizer will do (especially these days, when Cal Stat is very hard to come by
- Soap – Your choice!

Prep:

- Label the back of each plate (e.g., the side with the agar in it) with the child's initials, and one with pre and one with post. The labeling up front is very important because it will determine how you interpret the results 2-3 days later!
- Cut the parafilm into pieces that can be used to seal the edge of the plates when you are done with the experiment. Parafilm is only sticky when it is stretched out, and it stretches a lot, so I recommend cutting the parafilm into ~1-inch wide x 3-4-inch long strips for the purposes of the sealing step. You may want to experiment with the parafilm/sealing prior to starting the experiment, because this can be tricky (detailed instructions about how to seal included, below).
- Tell the kids to place the plates with the agar part facing up (e.g., with the labeling facing up).
- Distribute hand sanitizer to the kids (but tell them not to use it until you tell them to).

Before the kids start the experiment:

Ask the kids what they know about hand hygiene. Why do they do it? How does it work? Do they think it is important? Why is it important?

Step 1: Tell the kids you are going to do a science experiment. Ask them what they know about science and how we can use science to answer questions.

Step 2: Ask them to come with an idea about what will happen (also called a "hypothesis"). What do they think the plates with unwashed hands will look like? How do they think this will change after hand hygiene? What do they know about germs?

Step 3: Instruct your students in how to use the hand sanitizer:

A) Take a pump of sanitizer

B) Rub their hands until dry.

C) Remind them that the sanitizer has to dry in order for it to be effective, and they need to keep rubbing until it dries. Also remind them not to throw away any of the sanitizer because they think it is too much! Just keep rubbing until their hands are dry.

Step 4: Unless you have purchased the larger petrie dishes (which tend to be considerably more expensive), instruct the kids to pick up the "pre" plate and to gently press three of their fingers onto the plate (they may need help with this, so as not to push too hard into the agar, and to not rub their fingers all over the plate). I often walk around and help them with this step. It should be more of a full finger "print" than anything else. The agar is soft, so it is important to be gentle, or the plate will be destroyed.

Step 5: Instruct the kids to wash their hands with hand sanitizer and remind them to rub until completely dry. Remind them not to touch anything until after they have performed the second set of fingerprints—otherwise, they will contaminate their hands, and the experiment will not work.

Step 6: Instruct the kids to pick up the "post" plate and to full-finger print the post-hand sanitizer plate with the same fingers they used for the "pre" plate. Remind them to be careful and gentle with this step—if they rub their fingers all around the plate, it may impact the results.

Step 7: Seal both the pre- and post-plates with parafilm. This can be tricky if you have never used parafilm before. First, take off the paper piece. Then, place your thumb or another finger on one edge of the parafilm strip, then stretch out the parafilm and wrap it around the edge of both the top and bottom of the plate, so that both parts of the plate are sealed together. An excellent video demonstration can be found here.

Step 8: Place the agar plates into incubator/proofer and leave them there at ~98.6 degrees for 24-48 hours. I usually check them at the 24-hour mark and see how large the colonies are, and then make a decision about continuing to incubate or taking them out.

Step 9 (2-3 days after the fingerprinting): Return to the classroom and distribute the pre/post plates back to the kids.

Step 10: Ask them what they see. Is there a difference between what they see on the pre hand sanitizer plate, versus the post hand sanitizer plate? Do they think that hand washing worked? How does this make them think about how germs spread?

Option 2: Hypothesis Testing: What Is More Effective? Hand sanitizer or Soap and Water?

A more complicated version of this experiment incorporates a comparison of real-world hand sanitizer use versus soap and water use. It incorporates the concept of hypothesis testing and measurement (versus the other experiment which is much more qualitative in nature). The measurement in this experiment is dichotomous, but also paired and a bit more advanced in its scientific design. Results from my son's third grade class can be found here.

Materials required:

- Agar plates – 2 per child
- Incubater (the folding bread proofer will work)
- Parafilm
- Sharpies
- Hand sanitizer – Cal Stat Plus is my personal favorite, but any alcohol-based hand sanitizer will do (especially these days, when Cal Stat is very hard to come by
- Soap – Your choice!

Prep:

- Divide the class into two groups: half who will perform hand hygiene with soap and water and half who will use hand sanitizer.
- Label the back of each plate (e.g., the side with the agar in it) with the child's initials, the arm they are in (S+W or HS) and one with pre and one with post. The labeling up front is *very* important because it will determine how you interpret the results 2-3 days later!
- Cut the parafilm into pieces that can be used to seal the edge of the plates when you are done with the experiment. Parafilm is only sticky when it is stretched out, and it stretches a lot, so I recommend cutting the parafilm into ~1-inch wide x 3-4-inch long strips for the purposes of the sealing step. You may want to experiment with the parafilm/sealing prior to starting the experiment, because this can be tricky (detailed instructions about how to seal included, below).
- Tell the kids to place the plates with the agar part (the side with the labeling) facing up.
- Distribute hand sanitizer to the kids who will be using it (but tell them not to use it until you tell them to), and make sure the other kids have easy access to a sink.

Introduction:

Ask the kids what they know about how germs spread, and why we wash our hands. Ask them if they think hand hygiene works. After discussing their thoughts on hand hygiene for a little bit, ask the kids if they know what an experiment is. Next, ask them if they know what a hypothesis is, and ask them to define it. If they do not know, talk to them about what a hypothesis is and why it is an essential part of the scientific method.

Hypothesis:

After talking a bit about what a hypothesis is, ask the kids to develop one. In this case, I recommend some version of "soap and water is more effective than hand sanitizer for hand hygiene" (you could also propose that sanitizer is more effective, or that they are equally effective—the point is to get them to think about the question they are measuring).

Experimental design:

Explain to the class that we are going to test their hypothesis using an experiment. Ask them if they have any ideas about how we can answer this question. Ultimately, explain to them the overview of the design: half of the class will use soap and water and half will use hand sanitizer. We will then take one "hand print" (actually three fingers, due to the size of the plates) before performing hand hygiene, and one after. We will then look to see if there are more bacterial colonies before or after performing hand hygiene, and then look to see if results are the same in the soap and water and hand sanitizer groups.

Note that this design does NOT include teaching about how to perform the hand hygiene, and thus is designed to present "real-world" results about how effective these two hand hygiene strategies are. Education can certainly be incorporated to look at how well these two options work under ideal settings, but that is a slightly different question (and one that would yield different results!).

Performing the Experiment:

Step 1: Remind the kids which group they are in (soap and water or hand sanitizer).

Step 2: Unless you have purchased the larger petrie dishes (which tend to be considerably more expensive), instruct the kids to pick up the "pre" plate and to gently press three of their fingers onto the plate (they may need help with this, so as not to push too hard into the agar, and to not rub their fingers all over the plate). I often walk around and help them with this step. It should be more of a full finger "print" than anything else. The agar is soft and can easily be damaged—you want to avoid this so they need to be gentle.

Step 3: Instruct the kids to perform the hand hygiene according to the arm they were assigned to, and remind them not to touch anything until after they have inoculated their plate, otherwise, they will re-contaminate their hands, and the experiment will not work!

Step 4: Instruct the kids to pick up the "post" plate and to full fingerprint the post-hand sanitizer plate with the same fingers they used on the pre-plate. Remind them to be careful and gentle with this step—if they rub their fingers all around the plate, it may impact the results.

Step 5: Seal both the pre- and post-plates with parafilm. This can be tricky if you have never used parafilm before. First, take off the paper piece. Then, place your thumb or another finger on one edge of the parafilm strip, then stretch out the parafilm and wrap it around the edge of both the top and bottom of the plate, so that both parts of the plate are sealed together. An excellent video demonstration can be found here.

Step 7: Place the agar plates into incubator/proofer and leave them there at ~98.6 degrees for 24-48 hours. I usually check them at the 24-hour mark and see how large the colonies are, and then make a decision about continuing to incubate or taking them out.

Step 8 (2-3 days after the inoculation step): Return to the classroom and distribute the pre/post plates back to the kids.

Step 9: Lay out the plates and let the kids look at the results of their plates, but also of their friends' plates.

Step 10: Ask them what they see. Tell them to look at the number of different colonies on the plates (the dots) and to assess by eye balling which plate, if either one, has more bacteria on it. Ask each child to categorize their results as "more on pre," or "more on post." Note that they need to look at the *number* of dots, rather than the *size* of the dots—one big dot is still just one bacterial colony!

Step 11: Ask each child to state their measurement and record their result for the class. Divide the findings according to each group, and tally up the count, in a table like this:

Soap and water		Hand sanitizer	
More on pre	More on post	More on pre	More on post

Step 12: Ask the kids what the results of the experiment show. Remind them of their original hypothesis. Did the findings support or refute their hypothesis? If the findings supported the hypothesis, then why do they think that happened? If the findings did not support their hypothesis, then why do they think it didn't? Can they think of more experiments to perform in the future? How would they do things differently next time?

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