Nanotechnology & Society: Activity 2

Nanosilver

Sock It to Me!

We're Sarah and Mande and we have a story to tell about a special metal that can kill bacteria: silver. Silver has been used throughout history from Egyptians to American settlers to prevent bacteria in food and wounds. The next stop in our silver story was at the **Sciencenter** in Ithaca, New York, where we learned that nanosized silver is being used today to do the job. Nanosilver is just silver broken down into pieces that are even smaller than bacteria. We learned that there are some socks with nanosilver in them to keep them odor-free, but some people are worried that when you wash them, the nanosilver could leak out and potentially harm beneficial bacteria in the environment. We bought a regular pair of socks and two different brands of nanosocks to test.

Our question:

Does any nanosilver leak out of socks when they are washed?

After our own "smell test" we washed the socks. Then we took everything to a lab at **Cornell University** to test how well the socks and the wash water killed bacteria.

Nano Matters

Nanosilver has become one of the most commonly used nanomaterials in consumer products, ranging from socks to food containers and from bandages to toothpaste. Concern has grown in recent years that nanosilver could potentially leak out of the products and enter the environment. This leakage could be detrimental to beneficial microorganisms used to clean up waste in water treatment plants and to bacteria in soil and streams. The EPA classifies products that kill or repel bacteria as pesticides, which require a certain level of testing prior to entering the market. As a result, some companies that make nanosilver products changed their labels to avoid government interference. Scientists are looking into the risks of these and other nanotechnologies and are finding ways to permanently bind the nanosilver so it cannot leach out. Nanotechnology has the potential to improve lives of people around the globe, but we must understand how to use the technology as safely as possible.

Icebreaker
Moving molecules!

30 minutes

DragonflyTV Skill: Predicting

Guide your kids as they

1) Place approximately 1 tablespoon of cornstarch in the plastic sandwich bag. Fill the bag about half full with water. Mix the two and make a knot to tie the bag shut.
2) Rinse off the bag to make sure there is no cornstarch on the outside of it.
3) Mix about 15 drops of iodine with 1 cup of water in a small bowl.
4) Place the sandwich bag in the bowl, making sure the knot sits outside of the liquid.
5) Wait at least 15 minutes and predicted what might happen. Take out the bag and observe.
6) Drop a bit of the iodine solution on a pile of cornstarch. What happens? How can you relate this reaction to your bag experiment?

You'll need:

- iodine (from drugstore)
- cheap plastic sandwich bag
- cornstarch
- water
- small bowl

Are you a nano-bit curious?

The yellow-brown color of iodine changes to purple when it touches starches, like cornstarch. Although a sandwich bag may seem solid, it actually has many tiny holes. Iodine is a smaller molecule than starch. The iodine can fit through the holes and get into the bag, but the starch cannot get out. Nanoscientists know that small molecules can easily maneuver in and out of objects, often without a visual indicator as you saw in this activity. That is why extensive research is being conducted to determine whether or not the nanoparticles in products stay where they belong or migrate into the environment.

nano

View the "Hey, Wait a Nanosecond!" feature from show 703: Small is Different to hear kids' thoughts on the safety of nanotechnology. Use this video as a jumping off point for your own group discussion.

Investigation

Create a model of how nanoparticles travel.

1 hour plus observations over a period of up to 36 hours

You'll need:

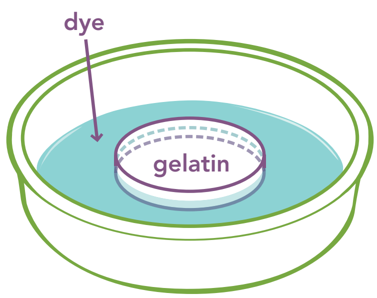
- unflavored gelatin
- brownie pan
- circular cookie cutter
- petroleum jelly or cooking oil
- blue food coloring
- blue RIT dye
- methylene blue (from a fish or pet store)
- 3 aluminum pie pans or equivalent

Preparation:

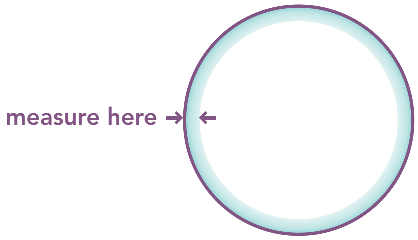
Grease the brownie pan with petroleum jelly or cooking oil. Prepare the gelatin according to the package, but reduce the amount of water by half. Pour the warm gelatin into the prepared pan. The gelatin needs to be at least 1 cm thick. Allow it to cool.

For the pieces of gelatin to be more representative of cells, place some cupcake sprinkles, small candies or jellybeans on the gelatin before it cools. These can represent various organelles (or specialized parts) inside the cell.

1) Cut circular shapes out of the gelatin using cookie cutters and remove each shape. (The greased pan should allow the pieces to remove easily.)
2) Place one gelatin circle (model cell) in each pie pan, making sure the pan is flat and the gelatin securely and fully touches the bottom of the pan.
3) Mix approximately 1–2 cups of water (depending on the size of your pan) with each dye: blue food coloring, blue RIT fabric dye and methylene blue. Try to maintain approximately the same saturation of color for all three. Note: RIT dye and methylene blue will stain!
4) Place a label next to each pan before carefully pouring in the dye. The dye should only surround the gelatin, not cover the top or leak underneath.
5) Predict what will happen over time. Is the gelatin impermeable? Will some dyes diffuse faster than others?
6) Monitor the gelatin over a 24–36 hour period. Note: you may need to add more water to each pan so it does not dry out. You can carefully cover the pans with a lid or plastic wrap to slow evaporation.
7) Measure how far the color has migrated into the gelatin with a ruler and graph your results. Do the dyes diffuse at different rates? Why?



Top view of gelatin



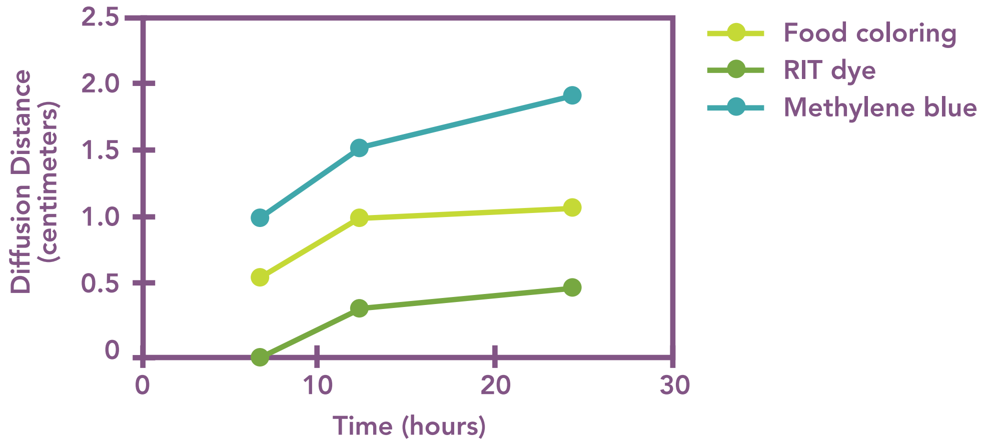
Adapted from an activity developed by Dr. Neil Forbes in the Department of Chemical Engineering at the University of Massachusetts Amherst for the Nanotechnology Summer Institute funded by the National Science Foundation and presented by the University's STEM Education Institute and Center for Hierarchical Manufacturing.

Are you a nano-bit curious?

In this activity, you used gelatin to represent a cell. The molecules present in each dye are nanosized and diffused across the cell membrane to get inside. This activity models how small molecules that we cannot see can penetrate living environments. Since the dyes are chemically different, they have varying diffusion rates. In actuality, most molecules are shuttled or carried across the outer membrane of cells rather than passively diffusing through them. However, in humans, larger organizations of cells, in the form of tissues, do allow diffusion of small molecules. This is one reason scientists are extensively studying the effect of nanoparticles on the human body. No clear evidence exists to date to cause alarm, but thinking about safety implications is a hot topic in nanotechnology circles.

DFTV Kids Synthesize

Data and Analysis



Keep Exploring!

Try this with other blue liquids like sports drinks, grape juice and Kool-Aid. Read the package labels to see what type of blue dye they contain and compare the rates at which the dyes diffuse.