H2whOa Teacher Guide

OBJECTIVE

- Students will explore how water can turn from a solid to a liquid to a gas and how the properties of water make it a unique substance.

CONCEPTS COVERED

- States of matter and how water cycles through those states.
- Properties of water, including cohesion, capillary action, surface tension, and basic chromatography.

SCIENCE PRACTICES

- Making hypotheses, making observations and noting changes over time, testing and experimentation.

STANDARDS ADDRESSED

- P-PS1-1. Ask questions and use observations to test the claim that different kinds of matter exist as either solid or liquid.
- 2-PS1-1. Plan and conduct an investigation to describe and classify different kinds of materials by their observable properties.
- 2-PS1-4. Construct an argument with evidence that some changes caused by heating or cooling can be reversed and some cannot.

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How to Use This Guide

This video is an introduction to properties of water; defining concepts like surface tension and cohesion. Your students will watch the *H2whOa* video and will have access to the Student Guide that accompanies the video. The Student Guide includes a materials list and a procedure list to help them to recreate the experiment and to follow along with the experiment. The materials are all simple items they can find in their homes. If your students are not able to gather the materials to follow along with the experiment, they can observe the instructor conducting the experiment and its results. They will still be able to answer the reflection questions which are located at the end of the Student Guide. We have included those questions in the Teacher Guide with the answers. There are vocabulary words in the Student Guide which students can refer to when any new concepts have been introduced. At the end of the Teacher Guide, there are some links to other related NYSCI resources to extend the learning. We hope this video and guide can add some enrichment to your water exploration.

Video Synopsis

In this video, students will explore the properties of water that make it unique. The three experiments allow students to observe the water cycle, explore surface tension of water, and note how water moves through a medium to separate inks (chromatography).

Activity 1 demonstrates how water can be in solid, liquid, or gas form, and allows students to track the changes that occur as the water moves through these states.

Activity 2 enables students to experiment with surface tension and cohesion, as well as play with how soap disrupts cohesion.

Activity 3 is an art project that uses capillary action and chromatography to create a unique colorful design.

To get the most out of any science activity, students should be encouraged to follow their inquiries, further investigate, and create their own experiments. They can try the activities with different materials or different methodology and compare results, as well as use this video as a launching point to create their own water experiments based on the additional questions that arise for them.

Background information

Activity 1: Water Cycle Baggie The sun heats up the ice cube and melts it into a liquid. After a while evaporation occurs and that liquid will turn into water vapor. It rises to the top of the bag where condensation occurs, where that water vapor turns back into water droplets which, when enough collect in a "cloud," they get too big to stay up and come down, which is called precipitation. Precipitation can be rain, snow, sleet, hail — anything that comes down from the sky. From there the water cycle starts all over again.

TROUBLESHOOTING TIPS

Activity 1: Water Cycle Baggie

- Leave the Ziploc bag for a few days. It will take some time for the condensation to form in the bag.
- The temperature and humidity will affect how the environment in the Ziploc bag responds.
- The ideal location for the water cycle baggie would be a window that gets a lot of sunlight.

Activity 2: Surface Tension Experiments

- When doing the activity, be sure to use a big bowl.
- When placing the paperclip on the paper towel, gently place the paper towel in the water.
- Use the pencil to gently poke the paper towel on the sides to make it sink away from the paper clip.

Activity 3: Chromatography Experiment

- Make sure the ink line does not directly touch the water, and place only the tip of the coffee filter in the water.
- Depending on the type of marker, the ink may take more time to separate the colors.

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Activity 2: Surface Tension The place where the liquid water meets the air is called a surface. The surface of the water has some really special properties. The water molecules at the surface are attracted to each other and are sticking together to form that surface, this is called cohesion. If you drop the paperclip in the bowl narrow end first, it will slice through the surface barrier and sink to the bottom. However, if you set it down gently so that you're distributing the weight of the paperclip evenly over the surface, the water molecules, due to their attraction to each other and the paperclip, will stick together and hold the paperclip up. Water actually has the highest surface tension of any liquid besides mercury!

While some soaps have antibacterial or other kinds of disinfecting properties, the way most soaps work is by disrupting the surface tension of the water. Water won't mix with grease or oil, so it can't rinse away grime easily by itself. Part of the soap is attracted to grease and dirt sticks to the gross stuff, and another part of the soap is attracted to the water. The soap particles, mixed now with the grime and dirt, break up the water and then all of it — the soap, grime and water — get washed away down your drain. So you see, soap doesn't exactly clean things, it just makes it possible for the water to wash grime away.

The pepper is floating on top of the water because of surface tension. When the soap touches the water, it breaks up that surface tension. The soap breaks up water cohesion which causes the water molecules on the surface to break apart from one another taking the pepper with them as they move away and new water molecules come up from underneath to replace the surface area.

Activity 3: Chromatography Experiment This happens through capillary action, which is when water can flow through a narrow space, a solid material with small holes, or a hollow tube. This is because of cohesion! The water molecules are sticking together, and when they interact with another object or surface, they also stick to that object. The force of cohesion allows the water to flow up or through the object. An example of this is when you leave a straw in a cup of water. (Show this with a clear straw in a cup of water). What you might notice is that the water is traveling up the straw. This is capillary action.

Capillary action is important in our everyday life. It helps move fluids throughout our body, it helps water travel through plants, and it even affects weathering in rocks. Actually, capillary action is part of why New York City tap water tastes so good. The water comes from the Catskill Mountains which are low in limestone, meaning the water doesn't pick up much calcium (which is bitter tasting) as it passes through the rock. Some people say that's why New York has the best bagels and pizza! And it's all thanks to capillary action.

Chromatography in Greek means color writing (from the Greek words *chroma* and *graphe*). Chromatography is the separation of a chemical mixture into different parts by using a liquid or a gas. The water is traveling through the coffee filter, separating the inks in the marker and carrying the ink dyes.

Questions and Answers

Look at your student's charts, and encourage them to make connections to the water cycle and how we use water in our everyday lives. Student's observations for the chromatography activity may vary based on the type of marker used and the patterns made.

- Describe/draw ways that you use water every day? Don't forget about water in solid and gas form too!
- What do you think would happen if we didn't have water?
- Draw a picture of what your coffee filter looked like below:
- What color(s) marker did you use on your dry coffee filter?
- What color(s) did you see on your coffee filter at the end of the experiment?

Try These Next

Check out more activities at www.nysci.org.

Explainer TV Video: Have your students watch this video of the soap and milk experiment and compare the result to our water and pepper experiment: https://www.youtube.com/watch?v=mXSOOTvgeos&t=4s

If your students enjoyed the chromatography activity, here is another version that uses Skittles:

1. Materials: Skittles, a coffee filter, straw, shallow dish or bowl, and water.
2. Place the coffee filter in the bowl, and lay out the Skittles in a circle on the coffee filter.
3. Take a straw, and place it in water. Then place your finger on top of the straw to make a homemade water dropper. Place a few drops of water on top of the skittles and watch what happens.
4. What is happening? The water travels through the coffee filter and carries the color dye from the skittles throughout the coffee filter.

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