# Sticky Molecules

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**Skill Level**

4th grade

**Learner Outcomes**

Youth will be able to identify the two atoms present in a water molecule.

Youth will be able to identify one property of water.

**Education Standard(s)**

CCSS.ELA-Literacy.SL.4.1.C

CCSS.ELA-Literacy.SL.4.1.D

GLE 0407.9.1

**Success Indicator**

Observe the properties of water.

**Life Skill(s)**

Communication

**Tags**

STEM, science, chemistry, molecules

**Time Needed**

30 minutes

**Materials** (per student)

Water in small cup, dropper, popsicle sticks, wax paper, large index cards, tape, liquid dish soap

For demonstration: tall clear plastic cup, food coloring

## Background

*Note: Background information is provided here; facilitators do not distribute to the learners. It can be discussed briefly after youth have completed the experience.*

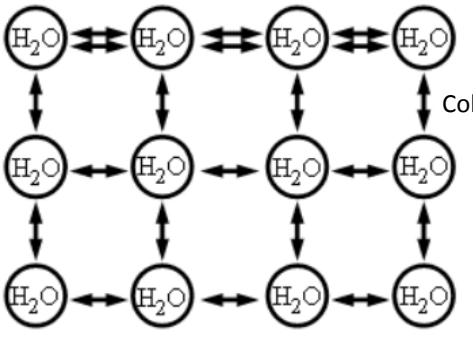
Water is made up of two very tiny *atoms* called *hydrogen* and *oxygen*. When two or more atoms are bonded together, a *molecule* is formed. One water molecule consists of two hydrogen atoms and one oxygen atom. These water molecules are very, very small. For example, each drop of water contains hundreds of thousands of water molecules.

Water molecules tend to stick together due to the structure and charge of the atoms present in the water. Hydrogen atoms are positively charged while oxygen atoms are negatively charged. This means that the hydrogen atoms of one water molecule are attracted to the oxygen atom of another water molecule since opposite charges attract. This attraction between the atoms of neighboring molecules is called *cohesion* and is what keeps water molecules sticking together and is what causes raindrops to form. This attraction is also what causes water to flow in streams and rivers. Water molecules will stick together until an external force breaks them apart.

*Cohesion* also leads to *surface tension* on the water's surface. All water molecules are exerting cohesive forces on all the molecules around them including those on the surface of a body of water. Because there are no water molecules on the top, more force is applied to the molecules on the other sides and creating surface tension on the top. This surface tension leads to a type of 'skin' on the surface of the water that causes it to be tougher to break things through the surface than it is to move the item through the water after the item is submerged. Surface tension is also why you see insects seem to glide across the surface of the water.

Youth will experiment with water molecules to observe the attractive forces and understand how atoms stick together to form molecules.

Surface Tension on Water's Surface




Cohesion Between Water Molecules

Source: USGS

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## Introduction and Opening Questions

*Script: We will be learning today about how water drops stick together instead of just falling apart.*

When it rains, what happens to the water drops? Do water drops spread evenly on the ground or do puddles form? Have you ever spilled water on a flat surface? What happened to the water that you spilled—did it stay close together or did it spread all over the surface? Several you may have attended 4-H camp or other outdoor camps that have swimming pools. Is it sometimes difficult to break through the water's surface? What about a dive where you belly-flop? Why do you think that belly flop hurts so much?

*Water is made up of two very tiny atoms, or particles, called hydrogen and oxygen. When two or more of these atoms are bonded together, a molecule is formed. There are two hydrogens and one oxygen in each water molecule. And water drops have many, many molecules in them because the molecules 'stick' together. In the activity today we are going to study the behavior of these water drops.*

## Experience *(use the Experiential Learning Model and encourage critical thinking and the use of science abilities and skills)*

**Activity:**

1) Give each student a large index card, wax paper, tape, one dropper, and one popsicle stick. Each student will also need water but a cup of water can be shared between two-three students.
2) Cover a large index card with a piece of wax paper so that the wax paper completely covers the card. Tape the wax paper in place.
3) Use the dropper to gently squeeze out a drop of water but try not to let the drop fall completely out of the dropper. See how far you can make the drop hang off the end of the dropper without the drop falling (this shows the attractive forces between water molecules). *Facilitator should demonstrate how to squeeze out one water drop gently without it falling.*
4) Place 4 or 5 drops of water together on a piece of wax paper to make one medium-sized drop.
5) Gently tilt the wax paper in different directions so that the drop moves (students should observe the entire drop moving together without splitting apart). *Facilitator should demonstrate how to gently tilt the paper in different directions.*

**Experience** *(use the Experiential Learning Model and encourage critical thinking and the use of science abilities and skills)*

**Activity (cont.):**

6) Use a popsicle stick to slowly drag the drop of water around the wax paper a bit. Try using your popsicle stick to separate your drop in two.
7) Use your popsicle stick to move the drops near each other. Then move one drop so that the two drops touch.
8) Have students record their observations in the Student Handout provided at the end.
9) If time allows, have youth drop a small drop of liquid dish soap onto the drop of water and observe what happens.

*Note: Students may not all observe the same thing within the activity.*

**Demonstration (Optional):**

*Once students have had a chance to explore the sticky behavior of water molecules, facilitator should show students that water molecules do not simply stick to each other. Each water molecule is constantly in motion. To show this, facilitator should fill a tall clear plastic cup with water and place the cup on a flat surface in front of the classroom. Ask students to watch closely as one or two drops of food coloring is added to the water. Facilitator should NOT stir the water. Instead, allow the color to slowly mix into the water on its own. The drops of food coloring will slowly move and mix into the water until the entire cup is evenly colored. While waiting for the food coloring to spread, facilitator may briefly explain that the "stickiness" of the molecules is referred to as* ***cohesion*** *of water molecules.*

*Facilitators can also play a video to show the above property of water:*

*https://www.youtube.com/watch?v=FPvcfmiuyIg*

*or to compare the diffusion of warm vs. cold water:*

*https://www.youtube.com/watch?v=xPDYmvIcSzc*

# Talk It Over...

**Share…**

1) What did you study about water (the property) in this activity?
2) Was it easy or difficult to keep water molecules together?
3) (Optional) What happened when you added the liquid dish soap to the drop of water?

**Process…**

1) How did experimenting with water molecules on wax paper help you understand this property?
2) Would water molecules stick to each other if they contained only hydrogen or only oxygen?

**Generalize…**

1) When it rains, does water spread evenly on the ground or do puddles form?
2) When you pour water out of a cup, do the water molecules come apart or do they flow together out of the cup?
3) What is another scenario where you have observed this property of water?

**Apply…**

1) What might the world look like if water did not have cohesive properties?
2) Do you think we would still have oceans and rivers if water molecules were not attracted to each other?

## Term and Concept Discovery

Atom- the smallest particle of a substance with its own unique properties

Molecule- two or more atoms bonded together

Cohesion– the stickiness of water molecules causing them to bond due to negative charge of oxygen and positive charges of hydrogen

Surface Tension– the property of the surface of a liquid that allows it to resist an external force, due to the cohesive nature of its molecules

# Appendix

## Standards:

CCSS.ELA-Literacy.SL.4.1.C—Pose and respond to specific questions to clarify or follow up on information, and make comments that contribute to the discussion and link to the remarks of others.

CCSS.ELA-Literacy.SL.4.1.D—Review the key ideas expressed and explain their own ideas and understanding in light of the discussion

GLE 0407.9.1– Collect data to illustrate that the physical properties of matter can be described with tools that measure weight, mass, length, and volume.

## Resources:

Adapted from: American Chemical Society – “Molecules Matter”

Molecules Matter. (2015). Retrieved from: http://www.middleschoolchemistry.com/lessonplans/chapter1/lesson1

Adhesion and Cohesion of Water. (2014). Retrieved from: https://water.usgs.gov/edu/adhesion.html

Surface Tension and Water. (2014). Retrieved from: http://water.usgs.gov/edu/surface-tension.html

# Sticky Molecules

## Student Handout

NAME _____

1) What happened to the water when you were squeezing it out of the dropper? Did it hold together or break apart?

2) When you were tilting your index card, did the water drop stay together or break apart?

3) When you were trying to split your drop with the popsicle stick, did the drop separate easily?

4) Was it easy or difficult to make the drops come together? Why or why not?