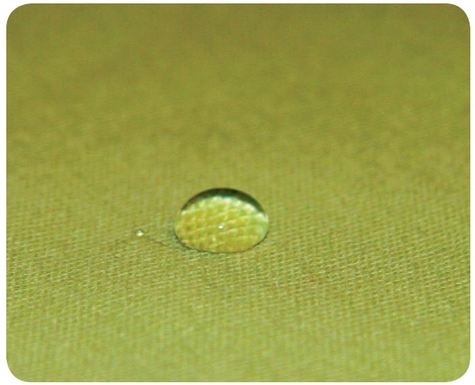
WRAP-UP

To wrap-up the investigation, bring your students together for a group discussion to help them understand why and how they achieved their results. It is important to share results so that everyone has a clear picture of what happened. To help you facilitate the discussion, review the explanation in "The Why and The How" using the Group Discussion questions as a guide.

Group Discussion
Explain to students that scientists learn from each other through discussion, and they build upon the work of others to make new discoveries. Just as scientists come to conclusions based on the findings of their experiments, they will now come together as a group to share their results and make conclusions about the investigations they've conducted. Have students record their final results and the explanation in their journals.

- What did you learn about water in comparison to other liquids?
- What were your results from the fabric activity?
- Which fabric did the water adhere to most? The least?
- How did this compare with your prediction?
- Which liquids behaved similarly/differently?
- What surprised you?
- What other liquids would you like to test?
- What new questions do you have?



meniscus on a flat surface

The "Why" and The "How"
The bonding or adhesive forces vary between water and different fabrics. Water does not have a strong attraction to nylon, which is why it is often used to make outerwear to protect people from the rain. However, water is strongly attracted to cotton, which is why it is used in items like mops. Materials such as cotton become wet when water bonds or adheres to the surface and spreads through the fibers of the fabric. A material such as nylon has much stronger bonds between its molecules, making it difficult for water to penetrate. Instead, water will form droplets that bead or fall off when it is unable to soak through a material.

Curriculum Match-Up

- Repeat the investigation and find the ratio of the weight of the fabric to the amount of water the fabric absorbed.
- If you dropped a cup of water on the floor in your kitchen and wanted to clean it up fast, which fabric would you use?
- Watermelon is a fruit that is made up of 85% water. Using the following words, can you explain how water can stay inside of the skin of a watermelon?
  - Attraction
  - Molecules
  - Adhesion
- Imagine that it is raining outside and you need to get from your home to the car without getting wet? What materials would you use to keep dry? How will this object keep you from getting wet?

References:
www.uark.edu/~k12info/teacher/workshops/AIMS-lessons/Water_Olympics.pdf
www.bpa.gov/Corporate/KR/ed/sold/water/k1/drip_drop.pdf

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Stuck on You: Adhesion I

Learning Objectives

Students will:

1. Learn that water molecules can also stick to molecules found in other materials, a property known as adhesion.
2. Measure and record how water adheres, or sticks, to different fabrics.
3. Explore how the adhesive forces of water vary for different materials.

Vocabulary Ventures

molecule
atom
teddy bear molecule
attraction
cohesion
adhesion

Have you ever wondered how water sticks to a window pane when it rains? What keeps the water in a watermelon? Why does water roll off a duck's back? It has to do with a property of water known as adhesion.

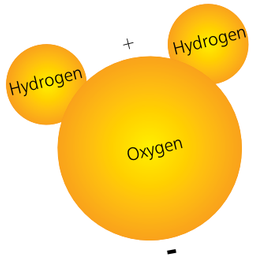
Everything on the planet is made of something smaller. The smallest unit of water that can exist by itself and still have the same chemical features or properties is called a **molecule**. A molecule is made up of several small particles called **atoms** that are joined by a chemical **attraction**. In a water molecule, two hydrogen atoms with a positive charge are attached to an oxygen atom with a negative charge. When these atoms attach to each other, they form a shape that looks like the head of a teddy bear. The water molecule is known as the **"teddy bear molecule".**

Water molecules are polarized, behaving much like a magnet, with a positive end and a negative end. The oxygen atom in one molecule of water is attracted to the hydrogen atom in another water molecule.

adhesion of water to leaf

This attractive force causes water molecules to stick together, a property known as **cohesion**. Cohesion helps little drops of water form into a larger pool of water.

Water can also be attracted to molecules found in other materials such as glass, plants or soil. This property of water is known as **adhesion**.



the "teddy bear" molecule

The forces of adhesion between water and other materials can vary. Water may be strongly attracted to some materials and not attracted to others. For example, water is not very strongly attracted to the oils found on duck feathers. This is why water does not stick to duck feathers and instead rolls off in droplets. Stronger adhesive forces also keep water inside the tissues of the human body and in fruits and vegetables.

Time Needed to Conduct Investigation
This investigation has two parts.
Organize and set up materials: 10 minutes
Introduce the lesson: 10 minutes
Conduct the investigation: 25 – 30 minutes
Student journaling/group reflection: 10 – 15 minutes
Total estimated time: 55 – 65 minutes

Investigation: Fabric Frenzy

Materials

For groups of 3 or 4
Student journals and writing tools

Part 1

Note: fabric samples / swatches should all be the same size *(suggestion: 4 x 4 in. square):*

- Cotton fabric
- Nylon fabric
- Polyester fabric
- Linen fabric
- Twill fabric
- Wool fabric
- Magnifying lenses

Part 2

- ½ liter bottle with tap water
- Tongs
- 1000 mL (1 liter) jar
- Balance
- Sponges for clean-up

fabric under magnifying lens

Part 1
Exploring Fabrics

GET READY!

Brainstorm

Explain to students that they will conduct activities to understand why water stays on a window pane after it rains and why watermelons are so juicy. Ask students to brainstorm what kinds of things they might use to clean up a water spill:

1. Why are these materials so good at soaking up water?
2. Where do you think the water goes?
3. Why wouldn't you use a material like plastic wrap to clean up a spill?
4. Invite student volunteers to try out the various materials to clean up a spill, and discuss their findings.

OBSERVE

Invite students to examine each of the fabrics by looking at them with the magnifying lenses and by touching them with their fingers. Students should record their observations in the chart in Part 2 of their student journals.

Ask students:

- Which fabric would make the best raincoat? Why?
- Which fabric would make the best mop? Why?

Part 2
Testing the Fabrics

pan balance

TIP

Review proper use of a pan balance. Remind students that the balance needs to be balanced (needle in center) prior to the investigation and at the start of each fabric test.

GET READY!

1. Students should weigh each dry piece of fabric on the balance and record the weights in their journals.
2. They should then pour 200 mL of water into the beaker.

PREDICT

Ask students to predict how water will affect the weight of the fabric. Why have they made this prediction? Students should write their predictions in their journals.

PROCEDURE

1. Have students pour 200 mL (7 oz or 14 Tbsp) of water into the jar.
2. Using the tongs, students should place one of the fabrics into the water until it becomes completely wet.
3. Once it is wet, students should lift the fabric out of the jar with the tongs, holding it over the jar until it no longer drips.
4. Next, students should place the wet fabric on the balance and weigh it again.
5. Calculate how much water each piece of fabric absorbed by subtracting the dry fabric weight from the wet fabric weight.

TIP

Students should be sure to dry the balance before testing a new fabric as any extra water in the pan will influence their results.

Remind students to record these observations in the charts in their student journals. The groups should repeat this process with the remaining fabrics and record their observations and results.

Testing Fabrics

	Cotton	*Nylon*	*Polyester*	*Linen*	*Twill*	*Wool*
Look						
Feel (touch/texture)						
Dry Weight						
Wet Weight						
Amount absorbed *(wet weight-dry weight)*						