
# How Do Liquids Behave?

Activity from My World: Water *Teacher's Guide*

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*My World is a series of multidisciplinary science teaching materials for elementary students.*

BioEd℠

Teacher Resources from the
Center for Educational Outreach at
Baylor College of Medicine

# Properties of Water

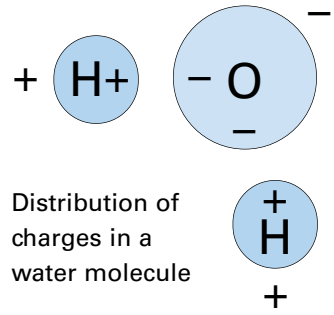
Physical Science Basics

More than 70% of the Earth's surface is covered by water. This amazing substance is essential for all life on our planet and helps maintain Earth's climate. Water has several unique properties that distinguish it from most other substances.

- **Water has both a high boiling point (100°C; 212°F) and a low freezing point (0°C; 32°F).** Consequently, it can be found naturally as a solid (ice or snow), a liquid (liquid water) and a gas (steam or water vapor), at any given time on our planet.
- **Liquid water changes temperature very slowly.** This helps animals maintain the temperatures of their bodies. It also keeps large areas of water from warming or cooling rapidly and, consequently, helps regulate Earth's climate.
- **Liquid water is an excellent solvent.** This makes water particularly valuable to living organisms. All of the thousands of chemical processes inside cells take place in water. Water also is used to carry dissolved nutrients throughout the bodies of living organisms and to transport wastes. Unfortunately, the same characteristics make liquid water easy to pollute, because so many different chemicals can be dissolved in it.
- **Molecules in liquid water are attracted to one another** and, as a result, "stick" very closely together. This accounts for water's ability to form rounded droplets and to rise within a thin, hollow tube. This characteristic is important for plants which conduct water and nutrients through very narrow tubes that reach from the roots to the branches and leaves.
- **Liquid water expands when it becomes a solid (ice).** Most substances take up less space when they are transformed from a liquid to a solid. Water, on the other hand, actually takes up more space as a solid because the molecules in ice crystals are farther apart than those in liquid water. Because it is less dense, ice floats on top of liquid water.
- **Water is colorless and allows light to shine through it.** Plants can grow underwater because water is transparent to the wavelengths of light needed for photosynthesis.

Most of these properties are related to the structure of the water molecule. Each water molecule consists of two hydrogen atoms and one oxygen atom. As with all molecules of this type, the oxygen atom and the hydrogen atoms share electrons. However, the electrons are not shared equally—they are pulled toward the oxygen side of the molecule, which ends up with a slight negative charge. Correspondingly, the hydrogen side of the molecule ends up with a slight positive charge. This separation of positive and negative charges (polarity) makes each water molecule act like a tiny magnet—capable of clinging to other water molecules and to any other particle or surface that is electrically charged.

Earth sometimes is called the blue planet because of the way it appears from outer space. All of the water on the Earth's surface makes it look blue.




Distribution of charges in a water molecule

Science background from My World: Water *Teacher's Guide.*

# How Do Liquids Behave?

Physical Science Basics

## CONCEPTS
- Water is a unique liquid.
- Many of water's unique properties are caused by its polarity.

## OVERVIEW
Students will explore and compare some of the physical properties of water and oil.

## SCIENCE, HEALTH & MATH SKILLS
- Predicting
- Making and recording observations
- Drawing conclusions

## TIME
**Preparation:** 10 minutes
**Class:** One or two 30-minute sessions

## MATERIALS
**Each team of two students will need:**
- 4 colored toothpicks (see SETUP)
- 2 crayolas, pencils or markers (one color per group, to match food coloring)
- 2 pipets or droppers
- Bottle of food coloring (one color per group)
- Cup containing a small amount of water (see SETUP)
- Cup containing a small amount of clear oil (baby, cooking, or mineral)
- Paper towels

**Each student will need:**
- Hand lens (or magnifier)
- Sheet of cm graph paper (8-1/2 x 5-1/2)
- Sheet of wax paper to cover graph paper
- Copy of student sheet

Water molecules are attracted to each other because, in many ways, they act like tiny magnets. Each molecule in liquid water has a positive end and a negative end. The forces of attraction between the opposite charges hold the molecules together very tightly. Attraction among molecules of the same kind is called cohesion.

The forces of attraction among the molecules in most liquids are not as strong as the ones that occur among water molecules. This "stickiness" of water accounts for much of its behavior, including the formation of rounded droplets and its ability to creep upwards inside a narrow tube (capillary action).

This activity lets students discover some of the unique qualities of water and compare and contrast them with another liquid (mineral or salad oil) that behaves differently.

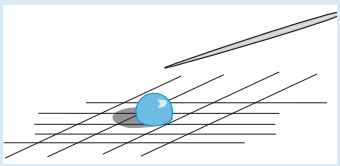
## SETUP
This activity can be done in one or two class periods. Students should work in teams of two in order to share materials. Colored wooden toothpicks work best for this activity. If you prefer to use plain, wooden toothpicks, soak them in a glass of water for an hour or so before using them. (Dry, unvarnished toothpicks will absorb the water droplets.) Do not substitute plastic wrap for wax paper in this activity. (Static charge on the sheets of plastic wrap may affect behavior of the drops of water.) Resealable plastic bags may be substituted for the wax paper.

Cut the cm graph paper sheets in half. Pour a small amount of water (Liquid 1) in 12 cups. Pour a small amount of clear oil (baby, cooking or mineral) in 12 cups (Liquid 2).

Each team will use one color of food coloring. Each team will need a crayon, colored pencil or colored marker to match the food coloring used.

## PROCEDURE
**Session 1: Examining Liquid 1**

1. Demonstrate the use of a pipet (or dropper) by placing several drops of Liquid 1 (water) on the overhead.
2. Ask students to describe the drops that are projected. Explain that they will be examining drops of two different liquids at their own working areas.
3. Have the Materials Manager for each team collect the supplies from a central location. Each student should prepare a working surface by placing the wax paper over the graph paper.
4. Have the students practice making equal-size drops of Liquid 1, sharing the dropper and using the graph paper as an approximate guide to size. Students should examine the drops with their hand lenses.



Students will observe and compare the characteristics of drops of water and oil.

5. Ask the students to draw one of the drops from the side and top views on their Do Your Liquids Behave? student sheets and describe the drop using at least three descriptive words.
6. Next, ask the students to try to split one drop into smaller drops using a toothpick. They should draw the results on their sheets.
7. Now, have the students try to move two drops together and discover what happens. Have them draw the new drop that is formed when the two smaller drops come in contact.
8. After forming the new larger drop, students should dip their toothpicks into a drop of food coloring and mix it into the new drop. Have them draw the drop again and color it appropriately.

**Session 2: Examining Liquid 2**

1. Have students repeat the preceding exploration using Liquid 2 (oil) and record their results in the second column on their sheet.
2. Afterwards, have the students think about and answer the comparison questions at the bottom of the student page. Discuss the observations with the class. Ask, *Did the two liquids behave in the same way?* OR ask, *Which one made round drops? How were the drops alike? How were the drops different?*

## VARIATIONS

- Challenge students to use their toothpicks to push water drops (size of their choice) as quickly as possible from the top of the wax paper to the bottom. Ask, *What size drop moves faster? Is there anything else that affects how fast a drop can be pushed?*
- Encourage students to consider other variables, such as: *What happens when they mix Liquid 1 and Liquid 2 together? What happens if food coloring is added to the mixture?*
- Have students add a drop of liquid soap or detergent to a drop of water and observe what happens. (The soap decreases the attraction among water molecules, and thus makes the drop spread out.)

Activity from My World: Water *Teacher's Guide.*

# Do Your Liquids Behave?

| | Liquid 1 | Liquid 2 |
|---|---|---|
| Draw a drop from the top. | | |
| Draw a drop from the side. | | |
| Write three words that describe the drop. | _____<br>_____<br>_____ | _____<br>_____<br>_____ |
| Draw a split drop. | | |
| Draw the joined drops. | | |
| Draw the colored drops. | | |

In what ways were the drops the same? _____

_____

In what ways were the drops different? _____

_____

# ¿Como Se Comportan Los Líquidos?

| | Líquido 1 | Líquido 2 |
|---|---|---|
| Dibuja una gota vista desde arriba. | | |
| Dibuja una gota vista desde un lado. | | |
| Escribe tres palabras que describan una gota. | _____<br>_____<br>_____ | _____<br>_____<br>_____ |
| Dibuja la gota partida. | | |
| Dibuja las gotas unidas. | | |
| Dibuja las gotas con colores. | | |

¿En que se parecen las gotas? _____

_____

¿En que se diferencian las gotas? _____

_____

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