



What Dissolves in Water?

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

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

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

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The activities described in this book are intended for school-age children under direct supervision of adults. The authors, Baylor College of Medicine and the publisher cannot be responsible for any accidents or injuries that may result from conduct of the activities, from not specifically following directions, or from ignoring cautions contained in the text.

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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.

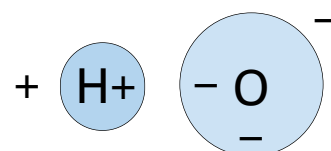
- **Water has both a high boiling point (100°C; 212°F) and a low freezing point (0°C; 32°F).** Consequently, it can be found naturally as a solid (ice or snow), a liquid (liquid water) and a gas (steam or water vapor), at any given time on our planet.
- **Liquid water changes temperature very slowly.** 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

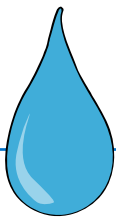


the way it appears from outer space. All of the water on the Earth's surface makes it look blue.



Distribution of charges in a water molecule





What Dissolves in Water?

Physical Science

CONCEPTS

- Some liquids and solids will dissolve in water.
- Substances dissolved in water sometimes are invisible.

OVERVIEW

Students will investigate whether several common substances are soluble in water.

SCIENCE, HEALTH & MATH SKILLS

- Predicting
- Making and recording observations
- Measuring
- Drawing conclusions

TIME

Preparation: 10 minutes

Class: One or two 30-minute sessions

MATERIALS

Each group will need:

- 6 cups, 9-oz clear plastic
- 6 cups, 2-oz plastic, or bottle caps
- 6 spoons or coffee stirrers
- Beaker, 100–250 mL
- Tsp each of clear oil, diluted food coloring, flour, ground coffee (not instant), salt and sugar
- Water
- Copy of Disappearing Act—My Observations student sheets

One of the most important properties of liquid water is its ability to dissolve many different substances. The same forces of attraction among molecules that account for the “stickiness” of water also act as tiny magnets that pull certain types of molecules (such as table salt) apart or allow some substances (alcohol, for example) to mix uniformly with water. In general, molecules that have a positive end and a negative end, or that can separate into components that have positive and negative charges, will dissolve in water. Molecules without these characteristics, such as oils, will not dissolve in water.

The uniform mixture that results when one substance (such as table salt) is dissolved completely in another (such as water) is called a solution. Many common items are solutions. Household vinegar, for example, is a solution of acetic acid in water.

The reactions that take place inside living cells depend on the presence of water. Likewise, organisms require water outside of cells to carry nutrients and other substances from place to place, and to take waste products away. In our daily lives, we take advantage of water’s abilities to dissolve and remove unwanted substances by using it for cleaning and rinsing.

SETUP

Before beginning, prepare a dilute solution of food coloring. Use this for one of the substances to be tested. Place a small amount of each test substance in a separate 2-oz. plastic cup (see Activity sheet).

This activity should be conducted with the students working in groups of 4. Set all the materials in a central area for the Materials Managers.

PROCEDURE

1. Each group of students should have a copy of the Disappearing Act—My Observations sheet and a set of all of the materials listed.
2. Show the students a clear glass of water. Ask, *Have you ever mixed or stirred something into a glass of water? What happened? Do you think that everything can mix with water?* Tell students that they will observe what happens when they mix different things with water.
3. Before student groups begin, have them predict what will happen when they mix each of the substances with water. You



Unit Links

Mystery of the Muddled Marsh

Story, pp. 4–9

Explorations

The Great Dissolver, p. 4





may want to allow time for groups to discuss criteria for deciding if something has “dissolved.” For example, a substance could be considered dissolved if the water is transparent, not cloudy, after the mixture has been stirred.

- To begin, have students measure approximately 100 mL of water into each of the six 9-oz. cups. Next, guide the groups as they conduct their tests, one substance at a time in separate cups. Have students observe the substance. Ask, *Is it a liquid or a solid?* Next, have students measure about one teaspoon of the substance into one of the cups of water and stir for several seconds. Finally, have students note what happened and record their observations.
- When students have completed their investigations, discuss their observations. Project a transparent copy of the “My Observations” sheet or draw a similar table on the board, and call on each group to provide its observations for one of the substances. Expect the following results.
 - Salt.** Will dissolve (disappear), leaving a clear solution.
 - Sugar.** Will dissolve (disappear), leaving a clear solution.
 - Flour.** Will not dissolve; the mixture will be cloudy, because the large flour particles will stay suspended in the water (example of a colloid).
 - Oil.** Will not dissolve; the oil will float on top of the water because the oil is less dense.
 - Food Coloring.** Will dissolve; the resulting transparent liquid will be colored.
 - Coffee.** Part of the coffee will dissolve in the water, coloring it brown; the remainder of the coffee (woody parts of the coffee bean) will not dissolve or disperse through the liquid and will float.
- Conclude with a discussion of the observations. Ask, *Which things disappeared into the water when you stirred? Do you think that they (salt or sugar) are still there? How could you figure this out?* Ask about the other substances.
- Extend the discussion to include students’ ideas about how the role of water as a “dissolver” is useful in daily life. Have students think about what happens to the things that remain in water after it is used for cleaning, rinsing, etc. Ask for suggestions about how this might contribute to water pollution. Also ask, *How many substances did you dissolve in (or add to) water today?*

VARIATIONS

- Create filtering cups by punching holes in the bottoms of disposable cups. Line the cups with coffee filters or paper towels and have the groups pour the contents of each of the cups used for the activity through the filtering cups and report on the results.

When one substance becomes dissolved in another, the atoms or molecules of each substance are mixed evenly together.

COLLOIDS

When fine particles are dispersed throughout another substance, the mixture is called a colloid. The particles in a colloid usually are greater in size than those in a solution. The easiest way to tell a colloid from a true solution is to shine a light through the mixture. The beam of light will pass through a solution (such as salt mixed in water) without any visible effect. However, when light is shone through a colloid (such as a mixture of flour and water), the beam’s path will be illuminated clearly. There are different kinds of colloids. A sol is a solid dispersed in a liquid. An aerosol is a solid or liquid in a gas (fog is an aerosol). An emulsion is small globules of one liquid in a second liquid, and a foam is gas bubbles in a liquid or a solid.

Substances like alcohol that dissolve easily in water are called hydrophilic, from the Greek words *hydro-* (water) and *-philos* (loving).



Disappearing Act — My Observations

Substance

What do you think will happen?

Describe what happened.

Salt



Sugar



Flour



Oil



Food Coloring



Coffee



Acto de Desaparición—Mis Observaciones



Sustancia	¿Qué piensas que va a pasar?	Escribe lo que pasó.
Sal	<hr/> <hr/> <hr/>	<hr/> <hr/> <hr/>
Azucar	<hr/> <hr/> <hr/>	<hr/> <hr/> <hr/>
Harina	<hr/> <hr/> <hr/>	<hr/> <hr/> <hr/>
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