Texas Cooperative EXTENSION
The Texas A&M University System

SCS-2005-12
Water and Me Series

What is Water?

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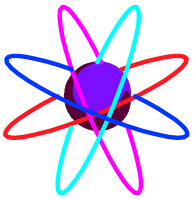
Water is found everywhere — in the air, on and under the ground, in living things, in the soil and even combined with different minerals in rocks. Covering nearly three-fourths of the earth's surface, water supports all life on earth. It has caused the rise and fall of great civilizations and has been a major force shaping the face of the earth. Water determines the climate, assists in the formation of soil, generates hydroelectric power and serves as a major conveyance system of goods and services throughout the world. Water is an indispensable part of nearly all manufacturing and chemical processes.

Water is used everyday for drinking, cooking, washing and recreation. Have you ever stopped to think about water and what makes it such a unique substance?

Although many substances may look like water, nothing else on earth has properties like those of water. Some of the properties include:

- Strong attraction between water particles
- Almost universal dissolving ability
- Large heat-holding capacity
- Great expansion when frozen

Some terms and definitions that you need to be familiar with before starting the activities below include:



Element	matter composed of one atom type
Molecule	smallest physical unit of an element or compound
Compound	molecule with two or more elements
Surface Tension	surface film on water
Universal Solvent	water, dissolves many substances
Hydrogen Bond	bonding force that holds water molecules together
Atom	smallest particle of an element having the chemical properties of that element

Activity

Fill a glass or cup with water and take a close look at it.

Describe the smell _____

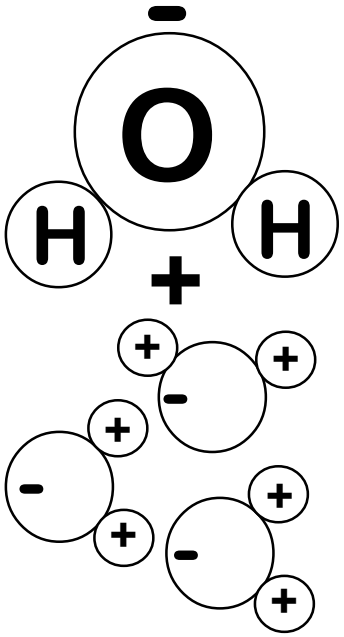
Describe the taste _____

Describe the color _____

You have probably noticed that water has no odor, taste and color (unless something has been added to it). Most other liquids have a

distinct odor, taste and color. Liquids such as alcohol, white vinegar, gasoline and kerosene may look like water, but they have very different properties.

Dip your finger into the water and notice that a drop of water clings to your finger. This single drop contains millions of water particles called **Molecules**.



Water is composed of one atom of the element **Oxygen** and two atoms of the element **Hydrogen**.

Water is a simple compound, but because of the molecule structure, it has many unique properties.

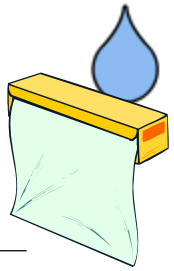
The oxygen end of the molecule has a negative (-) charge, while the hydrogen end has a positive (+) charge. This produces a very strong attraction between water molecules. They act like small magnets. The positive end of a water molecule is attracted to the negative end of another water molecule. The bond that holds them together is called the **Hydrogen** bond.

Water vapor is water in its gaseous form. When heated, water molecules begin to separate and do not bond to each other because of the heat energy that surrounds the molecules.

Water in its liquid form has many hydrogen bonds that bind the molecules in the liquid state. This explains why water is a fluid, or able to flow. Water being siphoned out of a glass is an example of this property.

In the crystalline state, water loses greater energy, and the bonds cluster tightly together in a lattice type of arrangement. When the temperature of water reaches 39 degrees Fahrenheit (F), it is at its greatest density. As the temperature falls below freezing (32 degrees Fahrenheit), the water begins to expand.

The strong attraction between water molecules, caused by hydrogen bonding, produces what scientists call **Surface Tension Film**. Water molecules form a layer or film on the water's surface. This film creates a boundary between air and water.



Activity

1. Place a drop of water on wax paper and push the drop around with a toothpick. Describe the action.

   _____

   _____

2. Pull the toothpick through the water drop. Describe the action.

   _____

   _____

   _____

   _____

Does the water drop appear to stretch? Why or why not?

3. Dip the toothpick into liquid detergent and touch it to the drop. Describe the reaction.

What does the detergent do to the surface tension film?

Activity

1. Place a sewing needle on a small piece of tissue paper. Fill a shallow tray or bowl with water. Place the tissue and needle on the water's surface. With a pencil, carefully push the tissue under the water, being sure not to touch the needle. Describe the results.

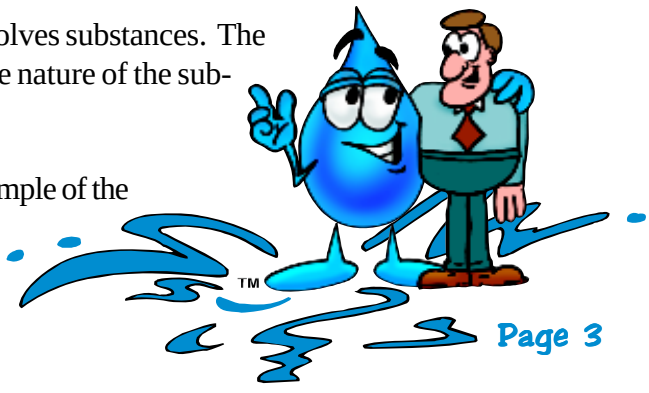
The needle does not float but actually lies on top of the water. What causes this?

2. Dip a toothpick into liquid detergent and dip it into the water near the needle. Describe and explain the reaction.

The surface tension film is surprisingly strong. Try using different objects (paper clip, sand, metal shavings) to see if the surface film will support them.

Water is called the **Universal Solvent**. A solvent is a liquid that dissolves substances. The dissolving power of water is determined by two basic factors: (1) the nature of the substance being dissolved and (2) the temperature of the water.

The number of different substances dissolved in seawater is a good example of the dissolving power of water. There are approximately seventy elements and thousands of compounds found in seawater.



USING AN ENCYCLOPEDIA OR A BOOK ON OCEANOGRAPHY, MAKE A LIST OF THE 10 MOST ABUNDANT OCEAN ELEMENTS.

_____

_____

_____

_____

_____

LIST REASONS WHY THE DISSOLVING PROPERTY OF WATER IS IMPORTANT TO US.

_____

_____

_____

_____

_____

Activity

Dissolve a teaspoon of each of the following substances in a cup of warm water. Record how each dissolves in the chart below. *(Good = dissolves quickly, Fair = dissolves slowly, Poor = no noticeable dissolving)*

Substance **How It Dissolves (Good, Fair, Poor)**

Sugar _____

Salt _____

Baking Soda _____

Vegetable Oil _____

How does water dissolve something? Water molecules act like cowboys cutting cattle from a herd. They separate and surround the molecules of the substances as they are dissolved.

If the molecules are large and strongly bonded together, as with gelatin, the substance will not dissolve easily. If the molecules are complex, as are oil molecules, water molecules are actually repelled and no dissolving occurs. In fact, if allowed to settle, oil molecules will separate from the water molecules. Which will be on top, the oil or water?

Although water cannot dissolve everything, many substances will dissolve more easily in hot water than in cold water. The process of dissolving requires energy. Hot water has more energy than cold water. Investigate this fact with the following activity:

Activity

Add a level teaspoon of sugar to one cup of hot water . Stir until all of the sugar is dissolved. Continue adding sugar, one teaspoon at a time, until no more dissolves. Record the number of teaspoons of sugar dissolved.

_____

Repeat the activity above but use ice water in place of hot water. Record the number of teaspoons of sugar dissolved.

_____

Describe the difference in the dissolving power between hot and cold water. Why is there a difference?

_____

_____

There is another interesting fact about water that involves heat. Water can store a great deal of heat energy, which means that water has a large **heat capacity**. When water gets hot, heat that is stored is slowly released. As a result, large bodies of water can affect the climate of coastal areas. Winter temperatures along the coast are generally warmer than those farther inland. Try the next activity to find out what affects the cooling rate of water.

Time (minutes)	0	1	2	3	4	5	6	7	8	9	10
Temperature											
Large Container											
Small Container											

How does the amount of water affect the cooling rate?

_____

_____

If water loses enough heat, it will eventually freeze. Water's unique property of expanding when frozen separates it from all other liquids. Other liquids contract when frozen, taking up less space and becoming denser than the liquid state. Ice takes up more space and is less dense than liquid water.

Since it is less dense than liquid water, ice floats. This means that bodies of water freeze from the top down. This is fortunate for the

earth. The layers of ice that form on lakes, rivers and cold oceans act as an insulator, preventing the water below from freezing.

If bodies of water were to freeze from the bottom up, the earth's climate would change drastically. Much of the earth's water would be locked up in ice and much of the earth would become barren wasteland, not to mention the affect this would have on fish and other aquatic organisms.

Activity

Fill a small, disposable plastic or paper container with water (DO NOT USE GLASS). A used pint milk carton is fine. Seal the container and place it in a freezer overnight. Examine it the next day and describe the results.

Explain what happens to the container.

_____

_____

Make a list of the beneficial and damaging effects of ice expansion.

Beneficial	Damaging
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____

There are several other important properties of water:

- Relative high melting and boiling points
- Large amount of energy required to separate atoms of water molecule; however, a small amount of energy recombines them
- Unique ability to climb inside small tubes
- Poor conductor of electricity (pure water)

As you can see, water is a very special substance. Life on earth cannot exist without it and many of the earth's processes depend on it. There are many more interesting facts about water. If you want to learn more about water, visit your local or school library.

Water Facts

Water consists of one atom of _____ and two atoms of _____

Why are water molecules attracted to each other? _____

What is the bond called that holds water molecules together? _____

In which state (liquid, gas, solid) are water molecules closest together? _____

What produces the surface tension film on water? _____

Why is water called the universal solvent? _____

List two factors that affect the dissolving power of water? _____

Texas Water Resources Institute
make every drop count

This publication was funded by the Rio Grande Basin Initiative administered by the Texas Water Resources Institute of Texas Cooperative Extension, with funds provided through a grant from the Cooperative State Research, Education, and Extension Service, U.S. Department of Agriculture, under Agreement No. 2001-45049-01149.

This material adapted from "What is Water," Virginia Cooperative Extension Service, 4-H Marine Project, December 1987.

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