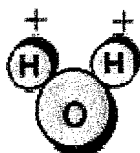


Water Properties

What are the physical and chemical properties of water that make it so unique and necessary for living things? When you look at water, taste and smell it—well, what could be more boring? Pure water is virtually colorless and has no taste or smell. But the hidden qualities of water make it a most interesting subject.

Water's Chemical Properties

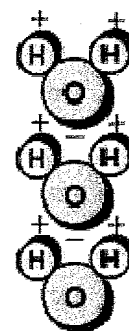
You probably know water's chemical description is H_2O . As the diagram to the left



shows, that is one atom of oxygen bound to two atoms of hydrogen. (If the water molecule here looks familiar, remember that everyone's favorite mouse is mostly water, too). The hydrogen atoms are "attached" to one side of the oxygen atom, resulting in a water

molecule having a positive charge on the side where the hydrogen atoms are and a negative charge on the other side, where the oxygen atom is. A compound with one negatively charged side and one positively charged side is called a **polar molecule**.

Since opposite electrical charges attract, water molecules tend to attract each other, making water kind of "sticky." As the right-side diagram shows, the side with the hydrogen atoms (positive charge) attracts the oxygen side (negative charge) of a different water molecule.



All these water molecules attracting each other mean they tend to clump together. This is why water drops are, in fact, drops! If it weren't for some of Earth's forces, such as gravity, a drop of water would be ball shaped -a perfect sphere. Even if it doesn't form a perfect sphere on Earth, we should be happy water is sticky (aka-polarity).

Water is called the "**universal solvent**" because it dissolves more substances than any other liquid. This means that wherever water goes, either through the ground or through our bodies, it takes along valuable chemicals, minerals, and nutrients.

Pure water has a **neutral pH of 7**, which is neither acidic nor basic.

Water's Physical Properties

Water is unique in that it is the only natural substance that is **found in all three states** -- liquid, solid (ice), and gas (steam) -- **at the temperatures normally found on Earth**. Earth's water is constantly interacting, changing, and in movement.

Water **freezes at 0° Celsius (C) and boils at 100° C at sea level**. In fact, water's freezing and boiling points are the baseline with which temperature is measured: 0° on the Celsius scale is water's freezing point, and 100° is water's boiling point. Water is unusual in that the solid form, ice, is less dense than the liquid form, which is why ice floats.

Water has a high **specific heat index**. This means that water can absorb a lot of heat before it begins to get hot. This is why water is valuable to industries and in your car's radiator as a coolant. The high specific heat index of water also helps regulate the rate at which air changes temperature, which is why the temperature change between seasons is gradual rather than sudden, especially near the oceans.

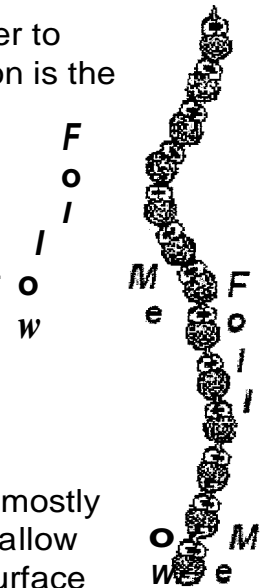
Water has a very high **surface tension**. In other words, water has a thin "skin" on its surface due to the water molecules sticking together. Because of this surface tension, water tends to clump together in drops rather than spread out in a thin film. Surface tension also allows light objects to float on the surface of water.

The stickiness of water is responsible for two other important properties: adhesion and cohesion. **Cohesion** means that water molecules stick to each other. **Adhesion** means that water molecules stick to other materials.

The properties of polarity, cohesion, and adhesion all work together to create **capillary action**, also known as **capillarity**. Capillary action is the ability of water to move upward, against gravity, through small openings. As water molecule #1 starts climbing, it pulls along water molecule #2, which, of course, is dragging water molecule #3, and so on. For example, water can move upward through soil or porous rocks. (Porous objects have many small holes in them). Capillary action is extremely important for living organisms. It is what allows water (and any substances dissolved in it) to move through the roots of plants and through the tiny blood vessels in our bodies.

So, the next time you spill your glass of soda (which is, of course, mostly water) on the kitchen table, think of the properties of water, which allow you to wipe it up before your parents see it. First, you can thank surface tension, which keeps the liquid in a nice puddle on the table, instead of a thin film of sugary goo that spreads out onto the floor. When you put the paper towel onto your mess the liquid attaches itself to the paper fibers because of adhesion. The liquid is then absorbed into the small holes in the paper towel and can move throughout the towel due to capillary action.

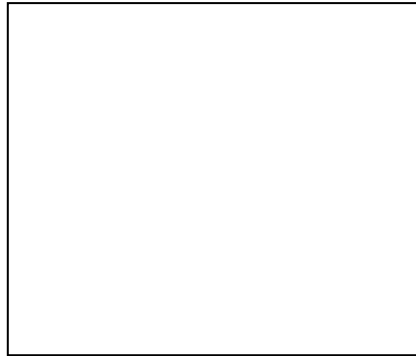
o



Properties of Water Notes

Directions: Read the **Water Properties** handout. As you read, complete the following guided reading notes.

1. Draw a water molecule in the box below. Label each of the atoms and show the charges.


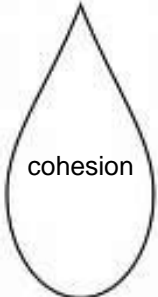
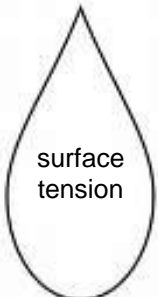



2. Water is “sticky” because...
3. Why is water called the **universal solvent**?
4. Water is the only natural substance found in all 3 states 1) _____, 2) _____, and 3) _____ at the temperatures normally found on Earth.
5. Complete the following chart:

Water Property	°F	°C
Freezing Point		
Boiling Point		

6. Why does ice float on liquid water?
7. Why is water said to have a high **specific heat index**?

8. Complete the following chart:

Property	Definition	Example
 <p>adhesion</p>		
 <p>cohesion</p>		
 <p>surface tension</p>		
 <p>capillary action</p>		

9. What characteristic of water causes it to display **all** of the properties described above?