

## Properties of Water

Water is a unique compound that is made up of molecules. Each **water molecule** consists of two atoms of the element hydrogen joined to one atom of the element oxygen. An interesting property of water is the ability of its molecules to “stick together.” This occurs because one side of each water molecule is slightly negative and the other side is slightly positive. The positive portion of a water molecule is attracted to the negative portion of an adjacent water molecule. As a result, water molecules are called **polar molecules**. They attract other water molecules like little magnets.

The “sticky” property of water is called **cohesion**. The cohesion between water molecules is so strong that when they come in contact with another substance, such as air, the water molecules at the surface create a “sticky skin.” This is known as **surface tension**. Water has a high surface tension. These bonds are so strong that they can support the weight of insects such as water striders. Striders can move across the surface of water without sinking.

Water molecules also have **adhesive** properties. This means that they are attracted to other substances that have **polar molecules**. Some common household items that water is attracted to are glass, plastic, soap, bleach, table salt, and sugar. You can witness the adhesive property of water when you observe the curved surface of water in a graduated cylinder. The upward curving edge of the *meniscus* is caused by an attraction between the water molecules and the polar molecules of the glass or plastic cylinder. As the water molecules are pulled up the sides of the cylinder, other water molecules follow. This adhesive nature of water also occurs in plants. Water molecules are initially pulled into a plants roots and stems by the polar attraction of molecules. Other substances, such as wax paper, do *not* have polar molecules. You have probably noticed that when water is placed on wax paper, it will bead up in an attempt to pull away from the wax surface. Oil is another non-polar substance. Water is not attracted to oil.

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A large number of substances that are attracted to water will mix or “dissolve” in water. For this reason, water is often called the **universal solvent**. Water is able to dissolve many substances because of its polar molecules. The positive and negative ends of a water molecule attract the molecules of other polar substances. This attracting or pulling force causes other polar substances to pull apart into individual, or separate, molecules. An example of this occurs when you place sugar in a glass of water. The water molecules will surround the sugar molecules and cause them to break apart from other sugar molecules. Before too long, the entire glass of water is sweetened.

The **ability of substances to dissolve in water** is important to some of the life processes of living organisms. For example, many gases like oxygen and carbon dioxide will dissolve in water. This means that organisms living underwater, like fish and aquatic plants, can get the oxygen and carbon dioxide they need to survive. This property of water also allows nutrients to be dissolved and carried throughout the bodies of living organisms as well as deep into the soil and groundwater of the Earth’s crust.

Another property of water allows it to absorb thermal (heat) energy without showing large changes in temperature. This property is called **specific heat**. Because of its high specific heat, large bodies of water moderate, or control, the climate of surrounding areas by absorbing heat in the summer and slowly releasing that heat in the winter. Therefore, the climate near large bodies of water is slightly milder than areas without large bodies of water. This property of water also helps living organisms regulate their body temperature more effectively.

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Another interesting property of water is when it is in a **liquid state**, it has a large range of temperatures. This range stretches from 0 to 100° Celsius and allows water to remain as a liquid in most places on Earth. More than 70% of the Earth's surface is covered by water. Most of this water can be found in its liquid state filling our oceans, lakes, rivers, and streams.

Some of the water on Earth is locked into ice caps and glaciers. This water is in its **solid state**. Unlike other substances, water expands when it freezes and is less dense than its liquid form. This unique property of water occurs because as water freezes, its molecules arrange themselves into a highly organized, geometric pattern similar to a hexagon. The larger oxygen atoms are located at each corner of the hexagon. This rigid pattern spaces the molecules farther apart with large open spaces. These large open spaces cause water to expand when it freezes.

This wide spacing of molecules also causes solid water, or **ice**, to be less dense than liquid water. Because of this property, ice floats in water. If ice were more dense than liquid water, it would sink and ponds and other smaller bodies of water would freeze from the bottom up. This would make it very difficult for fish and other aquatic organisms to obtain food and oxygen during the winter months.