

# The Water Molecule

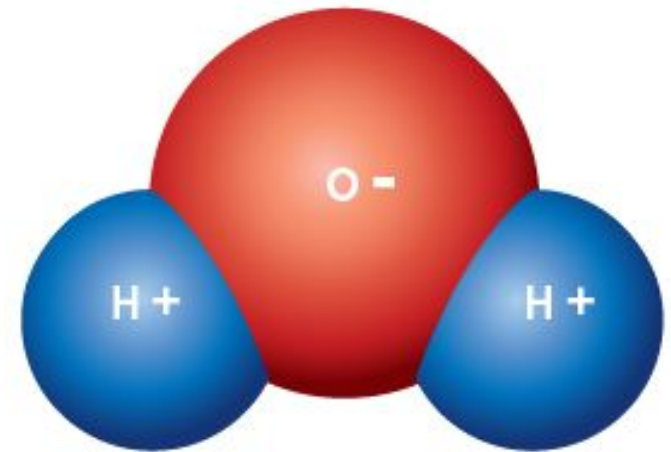
- Water is one of the few compounds found in a **liquid state** over most of Earth's surface.
- Like other molecules, water ( $\text{H}_2\text{O}$ ) is neutral. The positive charges on its 10 protons balance out the negative charges on its 10 electrons.

# The Water Molecule

- How does the **structure of water** contribute to its unique properties?
- Because water is a **polar molecule**, it is able to form multiple **hydrogen bonds**, which account for many of water's special properties.

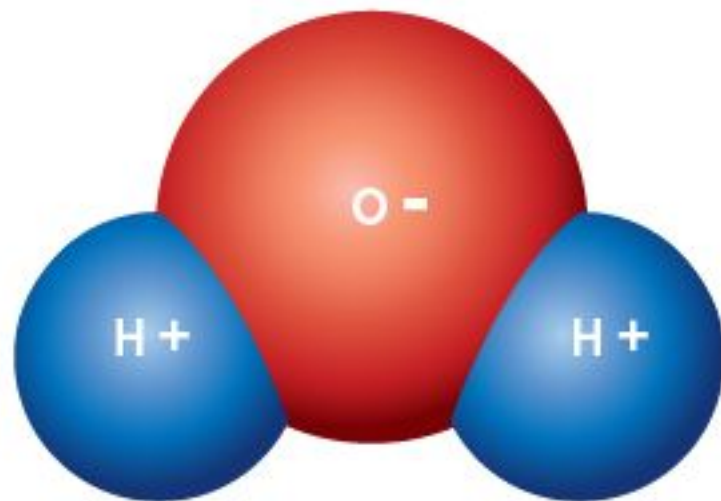
# Polarity

- Because of the angles of its chemical bonds, the oxygen atom is **on one end of the molecule** and the hydrogen atoms are **on the other**.
- As a result, the **oxygen** end of the molecule has a **slight negative charge** and the **hydrogen** end of the molecule has a **slight positive charge**.



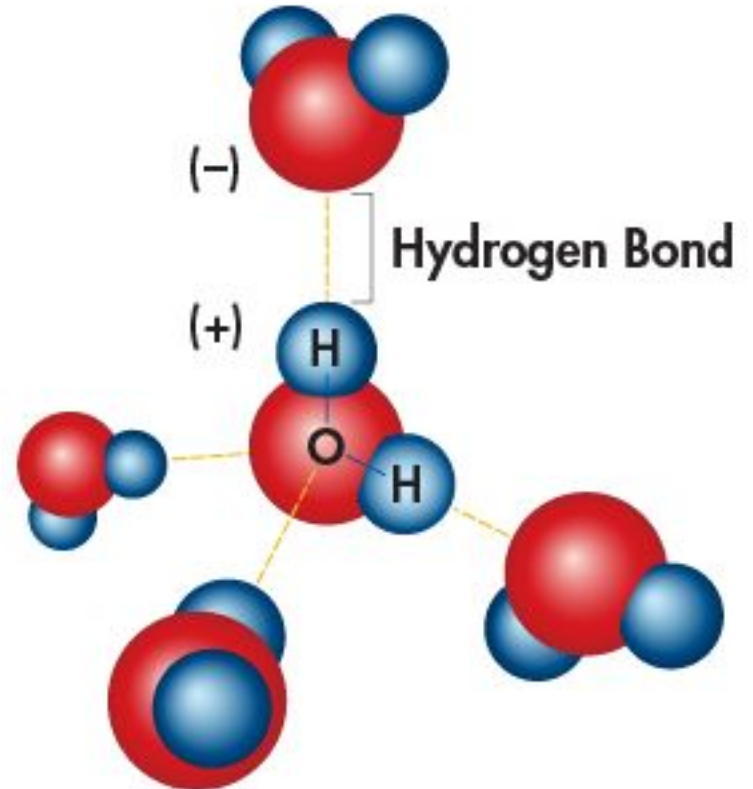
# Polarity

- A molecule in which the charges are **unevenly distributed** is said to be “**polar,**” because the molecule is a bit like a magnet with two poles.
  - The charges on a polar molecule are written in parentheses, (–) or (+), to show that they are weaker than the charges on ions such as  $\text{Na}^+$  and  $\text{Cl}^-$ .



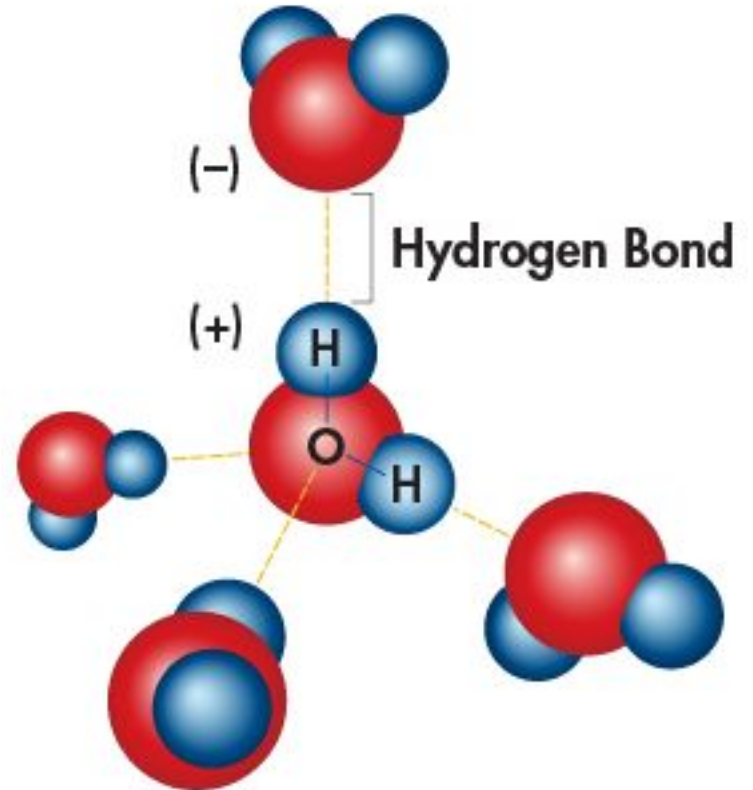
# Hydrogen Bonding

- Because of their **partial positive and negative charges**, polar molecules such as water can **attract each other**.
- The attraction between a hydrogen atom on one water molecule and the oxygen atom on another is known as a **hydrogen bond**.



# Hydrogen Bonding

- Water is able to form **multiple hydrogen bonds**, which account for many of its special properties.
  - Hydrogen bonds are **not as strong** as covalent or ionic bonds



# Cohesion

- Cohesion is an attraction **between molecules of the same substance.**
  - Cohesion causes water molecules to be drawn together, which is why drops of water form beads on a smooth surface.



# High Surface Tension

- Cohesion also produces **surface tension**, the elastic-like force existing on the surface of water.
  - This explains why some insects and spiders can walk on a pond's surface.





# Adhesion

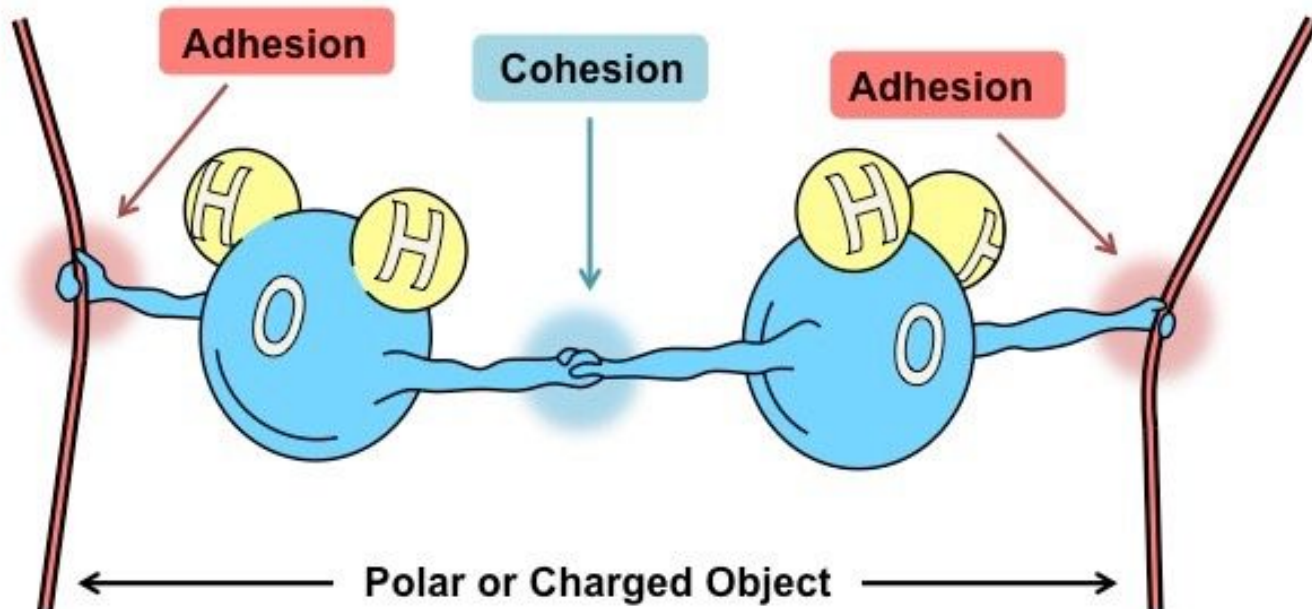
- Adhesion is an attraction **between molecules of different substances.**
  - Water molecules can stick to each other or to the sides of a glass tube
  - Adhesion also helps plants transport water from roots to their leaves





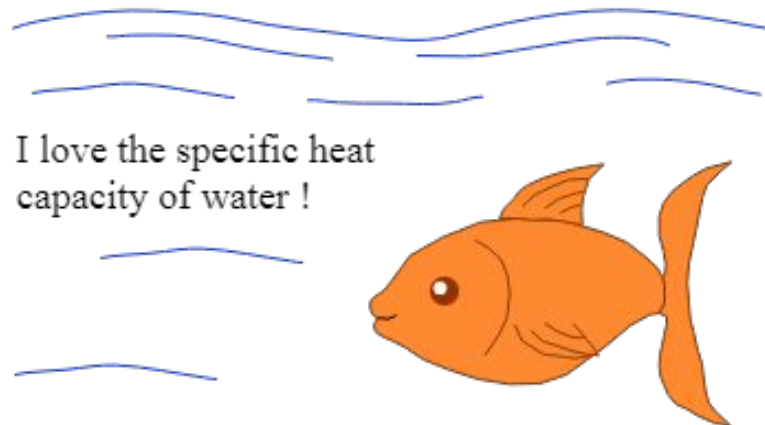
**Cohesion**  
causes the  
formation of  
water drops  
when it rains.

**Adhesion**  
causes the drops to  
cling to other surfaces.



# High Specific Heat

- Because of the multiple hydrogen bonds between water molecules, it takes a **large amount of heat energy to raise the temperature of the water.**
- This means that **water has a high specific heat** and resists change in temperature
  - Large bodies of water, such as oceans and lakes, can absorb large amounts of heat with only small changes in temperature, protecting the organisms that live in it.

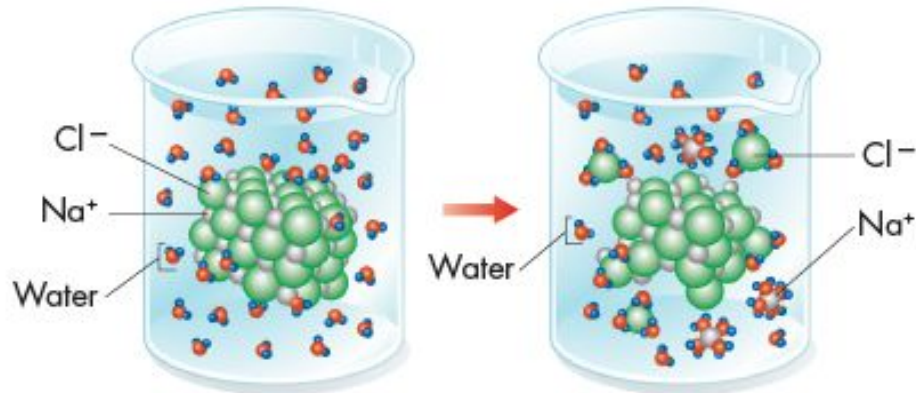


# Water as a Solvent

- Water is not always pure; it is often found as part of a mixture.
- A mixture is a material composed of **two or more elements or compounds that are physically mixed together but not chemically combined.**
  - Living things are in part composed of mixtures involving water.

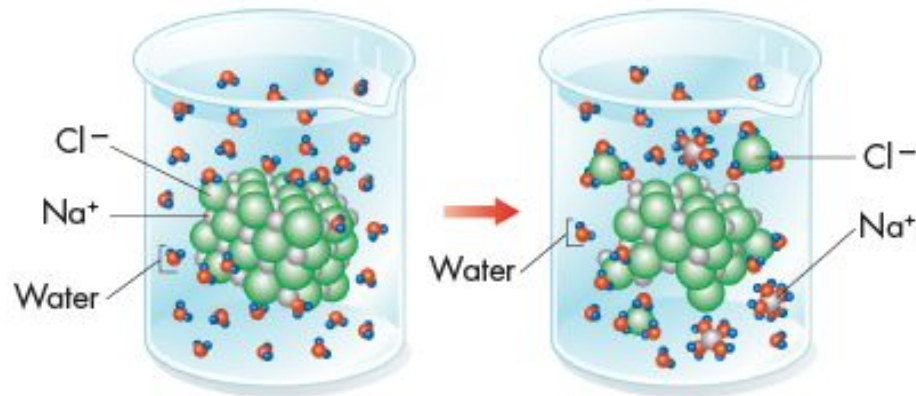
# Water as a Solvent

- If a crystal of table salt is placed in water, sodium and chloride ions on the surface of the crystal are attracted to the polar water molecules.
- Ions break away from the crystal and are surrounded by water molecules.
- The ions gradually become dispersed in the water, forming a type of mixture called a **solution**.



# Water as a Solvent

- All the components of a solution are evenly distributed throughout the solution.
- In a saltwater solution, table salt is the solute—**the substance that is dissolved.**
- Water is the solvent—**the substance in which the solute dissolves.**

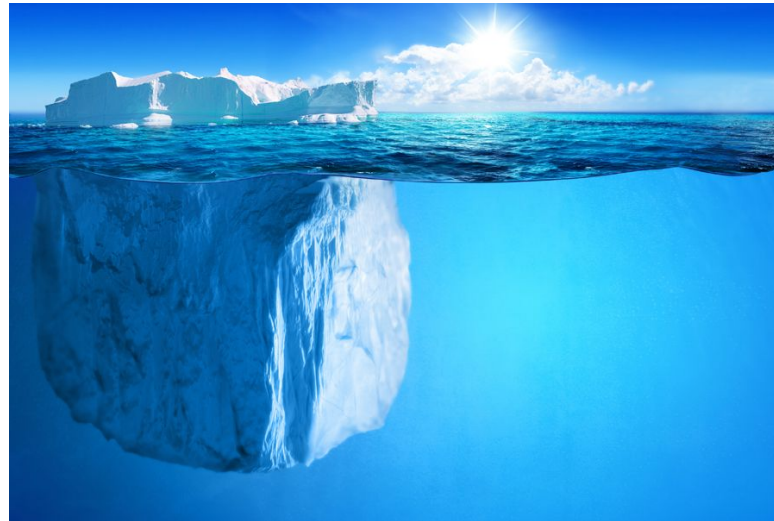


# Water as a Solvent

- Water's polarity gives it the ability to dissolve both ionic compounds and other polar molecules.
  - Substances that dissolve in water are said to be **hydrophilic**.
  - Substances that do not dissolve in water are said to be **hydrophobic**.
- Water is often called **the universal solvent**.

# Density of Water

- Water is the only substance on Earth that exists in **all three physical states of matter**: solid, liquid and gas.
- Water is the only substance where **the maximum density does not occur in it's solid state**
  - As ice is lighter than water, it floats.





# Let's review... Try to answer without looking at your notes!

The charges on a water molecule are unequal.

The oxygen end of the molecule has a slight negative charge and the hydrogen end of the molecule has a slight positive charge.

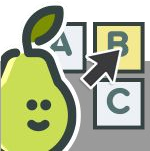
This is called:



Students, write your response!

**Let's review... Try to answer without looking at your notes!**

Which property of water causes water molecules to stick to **another surface?**



**Let's review... Try to answer without looking at your notes!**

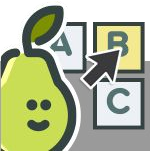
Which property of water allows insects to walk on the surface of a pond?



Students, write your response!

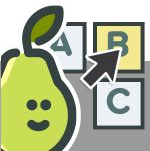
**Let's review... Try to answer without looking at your notes!**

Which property of water causes water molecules to stick to **one another?** (forming drops)



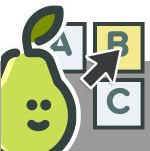
**Let's review... Try to answer without looking at your notes!**

Substances that do NOT dissolve in water are:



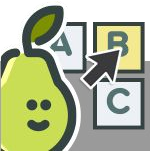
**Let's review... Try to answer without looking at your notes!**

Hydrogen bonds are:



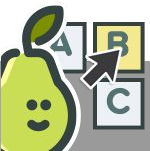
**Let's review... Try to answer without looking at your notes!**

Substances that dissolve in water are:



**Let's review... Try to answer without looking at your notes!**

Which state of water has the highest density?



Students choose an option



**Let's review... Try to answer without looking at your notes!**

Water has a high specific heat. This means that water:

