

# PS02A Water and Solutions

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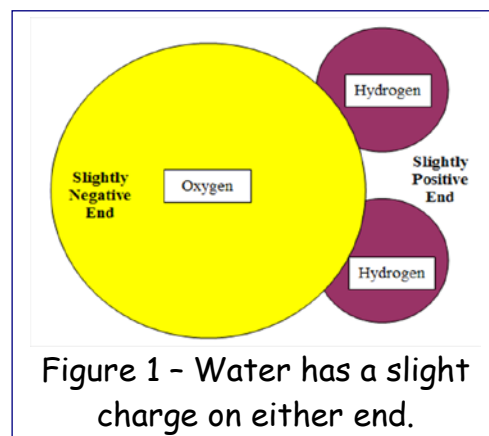


## Did you know?

- 1 The arrangement of the molecules in a liquid structure accounts for most of the physical properties of liquids.
- 2 Liquids maintain their own volume but take the shape of their container.
- 3 Liquids have much less space between molecules and stronger attractive forces than gases. In the liquid state, attractive forces between molecules are a major factor in the behavior of the liquids.

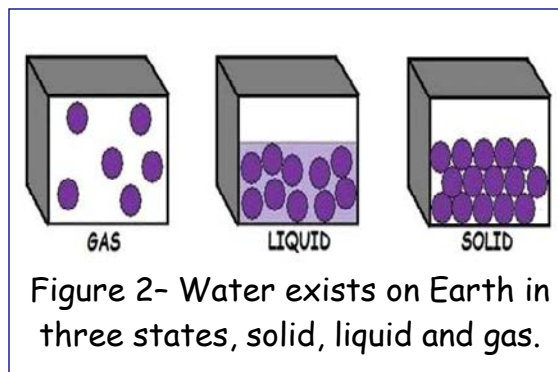
## So, why is it important to me?

- 4 The way water molecules arrange themselves, because of the slight charge, makes it a very special molecule that is unlike others (see Figure 1).
- 5 At the surface of a body of water, the atoms pack together and form a "skin" that is strong enough to float a paper clip!
- 6 Water expands when it freezes. It is most dense at 4 degrees centigrade, but at a lower temperature, it expands as it freezes. This is why ice, made from water, floats!



## What are the big ideas I need to know?

- 7 Because water has a slight charge it is said to be polar. Like the poles of a bar magnet, opposite ends are attracted to each other. These forces combine to form bonds that hold molecules together.
- 8 Water is a simple chemical compound. Each molecule of water contains two hydrogen atoms ( $H_2$ ) and one oxygen atom (O). You drink liquid water and use it to shower. You breathe gaseous water vapor in the air. You may slip on icy, solid water in the winter (see Figure 2).



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9 Water is one of the few substances that exist on Earth in all three states of matter. This is unique among other planets in our solar system (see Figure 3).

10 Evaporation is the process by which liquid water changes to water vapor. This happens at 100 degrees centigrade. When we take heat away from water vapor, it changes from a gas to a liquid in a process we call condensation. This also happens at 100 degrees centigrade.

11 When we take even more heat from liquid water, it freezes and changes into a solid. This happens at zero degrees centigrade. If we then add energy and heat the ice, it melts into liquid water. This also happens at zero degrees centigrade.

12 If we put something into the water like salt, it lowers the melting temperature and raises the boiling temperature of water. This is a solution - one thing dissolved into another (see Figure 4). Salt is placed on a frozen street in the winter and melts the ice - the freezing point is lowered. We put salt into a pot of pasta to cook it at a higher temperature, taking less time.



Figure 3 - Frozen water, ice, is water.

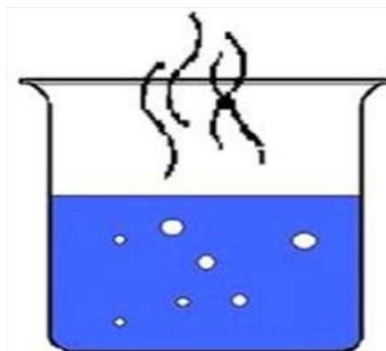


Figure 4 - A solution of salt and water.

13 Water is known as the universal solvent because so many things can be dissolved in it. As a polar molecule having a slight charge at each end, it can pull apart other molecules and recombine with them in a new way.

## What about?

14 The surface of water forms a "skin" because of the attraction of water molecules to each other. This is known as surface tension - it makes the surface tight like a drum. Insects and paper clips can rest on this surface without sinking. To break the effect - just add a small amount of soap to the water.