**Review and apply worksheet**

Name: _____

# What's going on here?

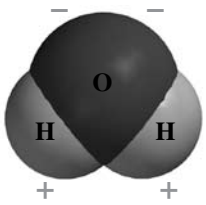
## Water and the process of dissolving

In this investigation, you saw that sugar and color dissolve from an M&M when the M&M is placed in water. Dissolving seems like a pretty simple process, but you can learn a lot if you look at dissolving closely, VERY closely.

The first thing to understand about dissolving is that you have to look at the liquid doing the dissolving (solvent) as well as the substance being dissolved (solute). Dissolving depends on the interaction between the molecules of the solvent and the molecules of the solute. Since dissolving sugar happens way down on the molecular level, you have to know something about the water molecules and the sugar molecules.

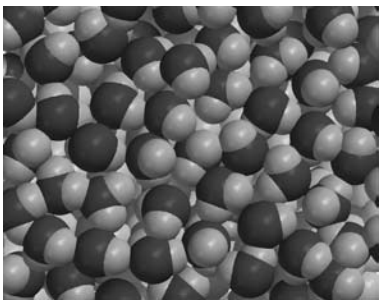
## Water molecules

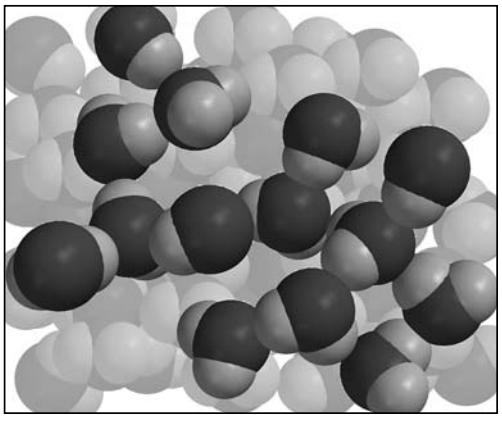
A water molecule is made of two hydrogen atoms bonded to one oxygen atom. All atoms, including hydrogen and oxygen, have one or more protons in the center, or nucleus, of the atom. Atoms also have electrons that move around the nucleus. Protons have a positive electric charge and electrons have a negative electric charge. An atom has the same number of electrons as it has protons. Here is a model of a water molecule. Scientists use models to represent objects or processes that are difficult to actually see. In this model of a water molecule, the space taken up by the dark ball (oxygen) and the lighter balls (hydrogen) represent the area in those atoms where the electrons would be. The nucleus of each atom would be much smaller and in the center of each ball but is not shown in this type of model. Actual water molecules don't really look like these balls stuck together but this is a useful model to help understand more about how water molecules behave.




Because of the characteristics of oxygen and hydrogen and how they are bonded together in the water molecule, there is a slight positive charge near the hydrogen atoms and a slight negative charge near the oxygen atom.

The smaller illustration to the right shows that the molecules in liquid water associate very closely with one another. The larger illustration shows how the water molecules tend to orient themselves according to their opposite charges. Notice how the positive area of one water molecule is attracted to the negative area of another.





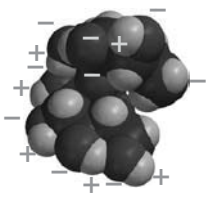
Name: _____

# What's going on here? (*continued*)

But these positive and negative areas on water molecules are also attracted to the positive and negative areas of the molecules of other substances. This is the key to water's great ability to dissolve certain substances, including sugar.

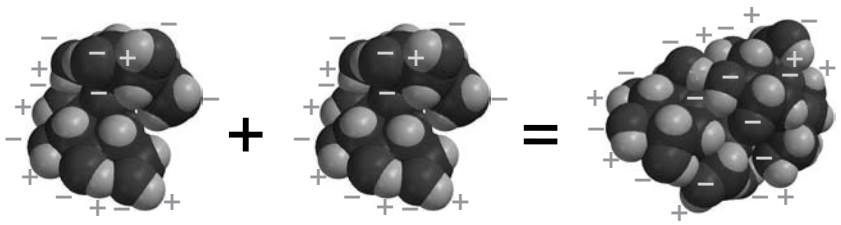
## Sugar

There are many different kinds of sugar. The common sugar that we use in foods and drinks is called sucrose. Sucrose is a pretty big molecule compared to water. Its chemical formula is $C_{12}H_{22}O_{11}$. One reason why water can dissolve sucrose is because it has areas on it that are slightly positive and slightly negative. Look at the illustration of the sucrose molecule. It has many places on it where a hydrogen atom is bonded to an oxygen atom. This is very similar to the oxygen and hydrogen in a water molecule. In the sucrose molecule, the area near the hydrogen is slightly positive and the area near the oxygen is slightly negative.



**Sucrose molecule**

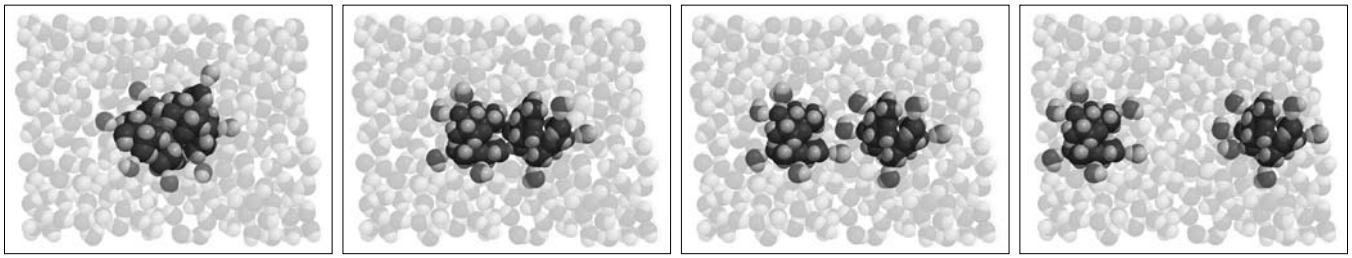
Sucrose molecules are attracted to other sucrose molecules and join together because of the attraction of opposite charges. This is what keeps sucrose molecules together in a piece of sugar.



**Sucrose molecule** + **Sucrose molecule** = **Two sucrose molecules closely associated due to oppositely charged polar areas**

## Why does water dissolve sucrose?

The positive and negative ends of the water molecules attract the negative and positive parts of the sucrose molecule. When the attractions that the water molecules have for the sucrose molecule become stronger than the attractions the sucrose molecule has for the other sucrose molecules that surround it, the sucrose molecule is pulled away and surrounded by water molecules. At that point it is dissolved.



Name: _____

# What's going on here? (*continued*)

1. What atoms is water made of? **Hint**: The chemical formula for water is $H_2O$.

_____

_____

_____

_____

2. Why are water molecules attracted to each other?

_____

_____

_____

_____

3. Why is water able to dissolve sucrose?

_____

_____

_____

_____

## Cool factoid

The drawings and models of water molecules that you see or build are millions of times larger than the actual size of real water molecules. To get an idea of how small they are, consider this: Let's say you had about a tablespoon of water and wanted to count all the water molecules in that amount of water. Assume you were a very fast counter and could count 1 million water molecules every second. Even at your very fast counting speed, it would take you over 190 million centuries to count all the water molecules in that small amount of water. WOW!