**Plasma Basics**

Plasmas are a lot like [**gases**](http://www.chem4kids.com/files/matter_gas.html), but the atoms are different, because they are made up of free [**electrons**](http://www.chem4kids.com/files/atom_electron.html) and ions of an element such as [**neon**](http://www.chem4kids.com/files/elements/010_speak.html) (Ne). You don't find naturally occurring plasmas too often when you walk around. They aren't things that happen regularly on Earth.   
  
If you have ever heard of the Northern Lights or ball lightning, you might know that those are types of plasmas. It takes a very special environment to keep plasmas going. They are different and unique from the other states of matter. Plasma is different from a gas, because it is made up of groups of **positively and negatively charged particles**. In neon gas, the electrons are all bound to the **nucleus**. In neon plasma, the electrons are free to move around the system.

**Finding a Plasma**

While natural plasmas aren't found around you that often, man-made plasmas are everywhere. Think about **fluorescent** light bulbs. They are not like regular light bulbs. Inside the long tube is a gas. **Electricity** flows through the tube when the light is turned on. The electricity acts as an energy source and charges up the gas. This charging and exciting of the atoms creates glowing plasma inside the bulb. The electricity helps to strip the gas molecules of their electrons.   
  
Another example of plasma is a neon sign. Just like a fluorescent lights, neon signs are glass tubes filled with gas. When the light is turned on, the electricity flows through the tube. The electricity charges the gas and creates plasma inside of the tube. The plasma glows a special color depending on what kind of gas is inside. Inert gases are usually used in signs to create different colors. [**Noble gases**](http://www.chem4kids.com/files/elem_noblegas.html) such as helium (He), Neon (Ne), Argon (Ar), and Xenon (Xe) are all used in signs.   
  
You also see plasma when you look at **stars**. Stars are big balls of gases at really high temperatures. The high temperatures charge up the atoms and create plasma. Stars are a good example of how the temperature of plasmas can be very different. Fluorescent lights are cold compared to really hot stars. However, they are still both forms of plasma, even with the different **physical** characteristics.

**Bose-Einstein Basics**

The Bose-Einstein state of matter was the only one created while your parents were alive. In 1995, two scientists, Cornell and Weiman, finally created the condensate. When you hear the word **condensate**, think about [**condensation**](http://www.chem4kids.com/files/matter_changes.html) and the way gas molecules come together and condense and to a liquid. The molecules get **denser** or packed closer together.   
  
Two other scientists, Satyendra Bose and Albert Einstein, had predicted it in the 1920s, but they didn't have the equipment and facilities to make it happen at that time. Now we do. If plasmas are super hot and super excited atoms, the atoms in a Bose-Einstein condensate (BEC) are total opposites. They are super unexcited and super cold [**atoms**](http://www.chem4kids.com/files/atom_intro.html).

**About Condensation**

Let's explain condensation first. Condensation happens when several [**gas**](http://www.chem4kids.com/files/matter_gas.html) molecules come together and form a [**liquid**](http://www.chem4kids.com/files/matter_liquid.html). It all happens because of a **loss of energy**. Gases are really excited atoms. When they lose energy, they slow down and begin to collect. They can collect into one drop. Water (H2O) vapor in the form of steam condenses on the lid of your pot when you boil water. It cools on the metal and becomes a liquid again. You would then have a condensate.   
  
The BEC happens at super low temperatures. We have talked about temperature scales and **Kelvin**. At zero Kelvin (**absolute zero**) all molecular motion stops. Scientists have figured out a way to get a temperature only a few billionths of a degree above absolute zero. When temperatures get that low, you can create a BEC with a few special elements. Cornell and Weiman did it with rubidium (Rb).

**Let the Clumping Begin**

So, it's cold. A cold ice cube is still a solid. When you get to a temperature near absolute zero, something special happens. Atoms begin to **clump**. The whole process happens at temperatures within a few billionths of a degree, so you won't see this at home. When the temperature becomes that low, the atomic parts can't move at all. They lose almost all of their energy.   
  
Since there is no more energy to transfer (as in solids or liquids), all of the atoms have exactly the same levels, like twins. The result of this clumping is the BEC. The group of rubidium atoms sits in the same place, creating a "**super atom**." There are no longer thousands of separate atoms. They all take on the same qualities and, for our purposes, become one blob.