

Lesson 2.5

Solid, Liquid, Gas, and Plasma

vaporize: to change from a solid or liquid into a gas

neutral: having no electrical charge

Although the atoms drifting through space and filling the areas between galaxies and stars are extremely spread out, they are also ionized, which means they are plasmas.

Plasma screen TVs contain hundreds of thousands of tiny, individual cells. Each one contains a mixture of neon and xenon gases. The cells are connected to electrodes that excite the gases and change them into light-emitting plasmas.

A fifth state of matter, called the *Bose-Einstein condensate*, occurs when matter loses enough heat energy to begin approaching absolute zero. On Earth, these temperatures are found only in laboratory experiments. At such low temperatures, the individual atoms move so slowly that they begin clumping together into single particles.

Does a plasma TV really contain plasma?

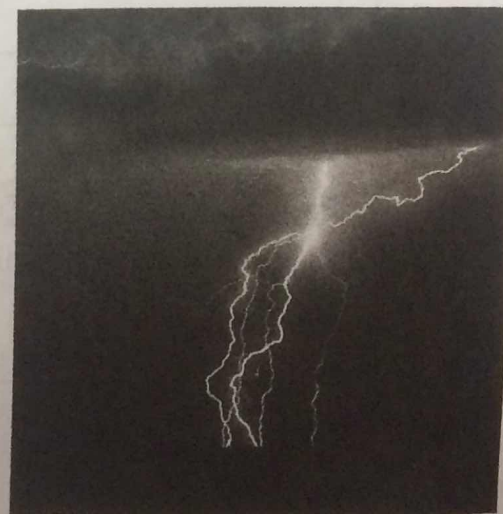
One of the first things you learn when studying chemistry is that substances can undergo physical changes in state. They can be solids, liquids, or gases, depending on how energized the atoms and molecules have become. Although these changes occur at different temperatures depending on the substance, when enough heat is present—or absent—each substance will solidify, liquefy, or **vaporize**. These are the three best-known states because they're the ones we observe most often here on Earth. However, there's actually a fourth state that's much more common—plasma. In fact, some scientists estimate that nearly 99 percent of all matter in the universe exists as plasma.

Plasma is similar in structure to gas, but the atoms and molecules in plasma have reached such high levels of excitement that they begin to lose electrons. Gases contain **neutral** atoms, whereas some or all of the atoms in plasmas have become ionized. The positive ions and free electrons moving about in plasmas make them excellent conductors.

As the energy level in a gas increases, and it begins changing to the plasma state, every atom and molecule doesn't become ionized at once. Cooler plasmas may contain only an extremely small percentage of ions in relation to the number of atoms that are still whole. The hottest plasmas, though, have become completely ionized.

The ionized atoms in a plasma emit visible light waves. Unlike most solids, though, plasmas don't need to have reached high temperatures in order to emit light. Probably the most familiar plasma that people see every day is the one glowing inside a fluorescent light bulb. An electrical current is applied to a mixture of mercury and argon gas enclosed inside the bulb. The electricity excites the atoms and creates a plasma state that emits light. A fluorescent lamp creates light at a much cooler temperature than an incandescent light bulb, which burns brightly when a solid, metal wire has become hot enough to glow.

The aurora borealis and lightning are both examples of plasma occurring naturally in Earth's atmosphere. However, the most important plasma in the solar system is the giant, scorching ball of light and heat known as the sun. Deep in the sun's core, hydrogen atoms fuse together to form helium atoms. This creates a tremendous amount of energy that changes gases inside the sun into plasmas. In fact, all stars are plasmas energized by nuclear fusion.



Circle the letter of the best answer to each question below.

- Plasma is
 - an ionized gas.
 - a glowing liquid.
 - a solid that has become so energized it doesn't melt, but simply vaporizes.
 - All of the above
- The energy in a lightning bolt changes _____ into plasr
 - moisture in the air
 - gases in the atmosphere
 - dust particles
 - electricity
- Which of the following is an example of vaporization?
 - gas changing into a plasma
 - ice melting and then refreezing
 - a puddle of spilled gasoline evaporating into the air
 - water droplets condensing onto a window

Write your answers on the lines below.

- Name the four most common states of matter, from least energized to most energized.

- Explain how the substance inside a fluorescent tube changes when an electrical charge is added to it.

Unifying Concepts and Processes

Do you think a neon light is more similar to an incandescent light or a fluorescent light? Explain how you know.
