Changing States of Matter

By Cindy Grigg

[1] On Earth, almost all matter exists in just three states. Matter is usually a solid, a liquid, or a gas. Plasma, the fourth state of matter, is rare on Earth. It sometimes can be found as lightning. Stars, including our sun, are made of matter in the plasma state. In fact, most matter in the universe exists in the plasma state! States of matter can also be called phases of matter. What causes a solid to be a solid? What causes liquids to be liquid or gases to be gaseous?

[2] All matter is made up of tiny particles called atoms and molecules. These particles attract each other, just like opposite poles of magnets attract each other. The greater the attraction between atoms and molecules, the closer together they get. Atoms and molecules are in constant motion. The temperature of a substance is related to the speed of the particles' motion.

[3] The state of matter of a substance depends on how fast its particles move and how strong the attraction is between its atoms and molecules.

[4] Solids keep their shape and volume. The particles of the substance vibrate in place. The vibration isn't strong enough to overcome the attraction of the particles and cause them to separate. As a result, the forces between the particles cause them to lock together.

[5] Liquids don't have a shape of their own. They take on the shape of the container they are in. Liquids do have a definite volume, though. If you have six ounces of milk, it is still six ounces whether it has been poured into a glass or spilled on the floor. The particles of a liquid move faster than particles of a solid. As a result, the particles in a liquid can overcome some of the attraction between them. Unlike the particles in a solid, which are locked together, the particles in a liquid can flow around and over each other. If you spill a glass of water, the water molecules stick together enough to make a puddle, but not enough to keep the shape the water had in the glass.

[6] Gases don't have a definite shape or volume. Gases can flow throughout a room. Particles in a gas move so fast they are able to overcome the attraction between them. The particles of a gas will drift apart and will spread out in all directions. They do this whether they are filling up a balloon, a room, or all the Earth's atmosphere.

[7] Changing the state of matter of a substance is a physical change. It is usually caused by changing the temperature or surrounding pressure of a substance. Remember that we said that the temperature of a substance is related to the speed of the particles' motion. The speed of the particles determines the state of matter of the substance.

[8] **Melting** is the change from a solid state to a liquid state. The temperature at which a solid melts is called its melting point. Different substances have different melting points. The melting point of ice is 0 ° Celsius or 32 ° Fahrenheit. If you heat a solid, the particles in that solid will begin to move faster. If you keep heating the solid, the particles will vibrate faster and faster. Eventually, with enough heat, the motion of the particles will become great enough to overcome the attraction that locks the particles together. When that happens, the solid becomes a liquid. Energy is required to change a solid to a liquid.

[9] The reverse of this process is called freezing. **Freezing** is the change from a liquid to a solid state. Because freezing is the reverse of melting, a substance will freeze at the same temperature at which it melts. Water freezes at 0 ° Celsius or 32 ° Fahrenheit. For water, we can call 0 ° Celsius or 32 ° Fahrenheit the melting point or the freezing point of water.

[10] When a substance changes from a liquid to a gas, we say that it vaporizes. **Vaporization** is the change from a liquid state to a gaseous state. As a substance is heated, its particles begin to move faster and faster. The fastest particles are able to overcome the attraction of the particles around them. They break free completely and become a gas. Think about a pan of boiling water on the stove. As the water heats, steam rises over the pan. The steam is water vapor, a gas. If you continue to let the water boil, eventually all of its particles will escape. The pan will boil dry. Water boils at 100 ° Celsius or 212 ° Fahrenheit. This is called the boiling point.

[11] What happens to puddles on the street after it rains? The water in puddles evaporates. **Evaporation** is vaporization that occurs at the surface of a liquid. Evaporation can take place at temperatures below the liquid's boiling point.

[12] **Condensation** is the change from a gaseous state to a liquid state. As a gas cools, its particles begin to slow down. Condensation takes place when the particles slow down so much that they cannot overcome the attraction of the particles around them. They clump together and form a liquid. You can easily observe condensation with a cold drink on a warm day. The beads of water that form on the outside of the glass came from the air surrounding the glass. When the air touched the icy glass, the air's particles of water vapor slowed down and clumped together in drops. The temperature at which a gas condenses is called its condensation point. At sea level, the condensation point of water vapor is 100 ° Celsius or 212 ° Fahrenheit - the same as the boiling point of water. Condensation is the reverse of vaporization.

[13] Sometimes a substance will pass directly from a solid state to a gaseous state without going through the middle state or phase. Ice and snow on Earth's surface will sometimes do this when the temperature is below the freezing point. This process of passing directly from a solid to a gas is called **sublimation**. Frozen carbon dioxide (a solid) is commonly called dry ice. It sublimates, or changes from a solid to a gas, at a temperature of -109 ° Fahrenheit or -78 ° Celsius. This can be handy when you need to keep something cold, but you don't want a mess left when it warms up. Dry ice can be used to package foods for mailing. Since frozen carbon dioxide gas goes directly from a solid to a gas, there's no watery mess as it changes states.

[14] The reverse of this process is when a gas goes directly to the solid state. This is called **deposition**. When carbon dioxide gas has been frozen and becomes a solid, it has gone through deposition.

Name _____ Science Pd _____

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1. How many states of matter are often found on Earth?
   - (A) Two
   - (B) One
   - (C) Three
   - (D) Four

2. Most matter in the universe exists in the:
   - (A) Liquid state
   - (B) Solid state
   - (C) Gaseous state
   - (D) Plasma state

3. All matter is made up of particles called:
   - (A) Electrics, protectics, and neutrectics
   - (B) Atoms and molecules
   - (C) Electromagnetic particles
   - (D) Solids, liquids, and gases

4. The temperature of an object is related to the:
   - (A) Number of atoms and molecules it has
   - (B) Type of matter it is
   - (C) The speed of the particles' motion
   - (D) Temperature of the atmosphere

5. Solids have:
   - (A) A definite shape and a definite volume
   - (B) A definite shape but not a definite volume
   - (C) A definite volume, but no definite shape
   - (D) No definite shape; no definite volume

6. Liquids have:
   - (A) No definite shape; no definite volume
   - (B) A definite volume, but no definite shape
   - (C) A definite shape but not a definite volume
   - (D) A definite shape and a definite volume

7. Gases have:
   - (A) A definite shape but not a definite volume
   - (B) A definite volume, but no definite shape
   - (C) A definite shape and a definite volume
   - (D) No definite shape; no definite volume

8. Changing the state of matter is usually a result of:
   - (A) You can't change states of matter.
   - (B) Mixing two different states of matter together
   - (C) Changing the temperature or surrounding pressure of a substance
   - (D) Changing the atoms of the matter

9. Changing matter from a solid to a liquid is called:
   - (A) Evaporation
   - (B) Melting
   - (C) Freezing
   - (D) Condensation

10. What is required to change a solid to a liquid?
    - (A) Freezing
    - (B) Energy
    - (C) Condensation
    - (D) Nothing

11. Which two temperatures are the same?
    - (A) The freezing point and the melting point
    - (B) The condensation point and the melting point
    - (C) The evaporation point and the sublimation point
    - (D) None of the above

12. What is sublimation?
    - (A) When a substance freezes
    - (B) When a substance evaporates
    - (C) When a substance changes directly from a gas to a solid
    - (D) When a substance changes directly from a solid to a gas