Name: _____ **Date:** _____ **Class Notes**
Chemistry

Energy

Energy is the ability to move or change matter. The different forms of energy include kinetic, potential, thermal, gravitational, sound, elastic and electromagnetic energy. Usually a form of energy can be associated with a related force. For our purposes, we are interested in kinetic and potential energy. **Kinetic energy** is the energy an object has due to its motion. **Potential energy** is stored energy due to an object's position or chemical composition.

"Nothing changes unless something moves." –Albert Einstein

The Phases of Matter

The five phases of matter are distinguished from one another by the differences in physical properties and these differences are due to the **kinetic energy** in the atoms or molecules of the substance. The more kinetic energy contained in a substance the greater the ability of the particles to break loose from each other. Thus, the molecules of a liquid have more kinetic energy than those of a solid.

It is necessary that you know each phase of matter and its physical properties to completely understand the chemical behavior of matter.

- Bose-Einstein Condensate (BEC)
- Solid
- Liquid
- Gas
- Plasma

Bose-Einstein Condensate (BEC)

In the 1920's Satyendra Nath Bose proposed that if a gas became cold enough all the atoms would drop to the lowest energy level creating a new state of matter. But, he was unable to reach temperatures low enough (absolute zero) to prove his hypothesis. So, Bose turned to Einstein for help in order to get his paper published. Einstein agreed with Bose's idea and helped get the paper published. However, it would be 70 years before anyone would prove that the Bose-Einstein Condensate could exist.

Solids

Solids contain a very small amount of kinetic energy. So, the particles in a solid have a strong attraction to each other. Thus, solids have a definite volume and a definite shape. There are two main types of solids: **crystalline** and **amorphous**.

Crystalline solids are solid materials in which the particles are arranged in repeating geometric patterns. The particles of amorphous solids lack any particular order and do not form crystals.

Crystalline	Amorphous

Liquids

Liquids contain a little more kinetic energy than solids so the particles are able to pull away from each other. Thus, liquids can flow and take the shape of the container but still have a fixed volume. Some liquids flow faster than others, this is referred to as viscosity. **Viscosity** is the resistance to flow. The slower something flows the greater the viscosity. Honey is more viscous than oil which is more viscous than water.

Gases

Gases contain a lot of kinetic energy and the particles are in constant, random motion. Thus, gases can flow; take the shape of the container and the volume of the container. Gases are described by the Kinetic-Molecular theory which states the particles of a gas are in constant, random motion; the motion of one particle is unaffected by the motion of others unless particles collide; the collision of a particle with the side of the container creates a "push" called pressure.

Plasma

Plasma was first identified by Sir William Crookes in 1879. Plasma is similar to gas in that it has no definite shape or definite volume. But, plasma is extremely high in energy due to the removing of electrons from atoms to create ions. Examples of plasma are neon lights and stars.

Phase Changes

Ice, water and water vapor are all the same substance; H_2O. The difference between each phase is the amount of kinetic energy present in the water molecules. The water vapor (gas) has more kinetic energy than the water (liquid) and the water has more kinetic energy than the ice (solid). So, the water vapor moves more freely than the water and the water moves more freely than the ice.

Kinetic energy is responsible for the different phases of matter. The more kinetic energy available to a substance the easier the atoms or molecules of that substance can pull free from the forces that hold the particles together. If you want to change ice to water you increase the kinetic energy and melt it. If you want to change water to ice

you decrease the kinetic energy and freeze it. The key to a phase change is the removing or adding of kinetic energy.

Phase Changes	Name	Energy
Solid to Liquid		
Liquid to Solid		
Liquid to Gas		
Liquid to Gas		
Gas to Liquid		
Solid to Gas		
Gas to Solid		

Think About It

- Do you know the phases of matter?
- Do you know the phase changes?
- Can you describe energy?
- Can you recognize the transfer of heat?