

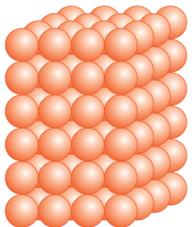
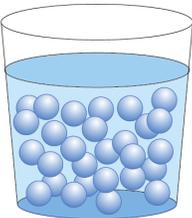
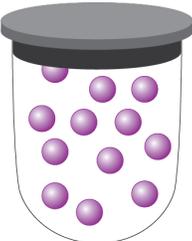
How Matter Changes Phase



Most of us have experienced ice cream melting or water droplets appearing on the outside of a cup. Both of these scenarios are examples of everyday phase changes.

States of Matter

Most matter on Earth is either a solid, liquid, or gas. Solids, liquids, and gases are three different **states of matter**. States of matter are the different forms in which matter can be found. The differences between solid, liquids, and gases occur at the molecular level.

State of Matter	Molecular Level	Motion and spacing Between Particles	Attraction Between Particles	Shape and Volume
Solid		Vibrate close together but do not move past each other	Very attracted to each other	Definite shape Definite volume
Liquid		Vibrate close together but can slide over each other	Attracted to each other	Takes shape of container Definite volume
Gas		Vibrate but not close together and can freely move around	Barely attracted to each other	Takes shape of container Takes volume of container

Temperature and Thermal Energy

The state of matter of a pure substance is determined by the temperature of the pure substance. Temperature is affected by the average kinetic energy (movement) of the atoms and molecules in a substance. The faster the atoms or molecules are moving, the hotter the temperature. Regardless if matter is solid, liquid, or gas, atoms and molecules in a substance are in constant motion.

To increase the temperature of a pure substance, energy must be added into the system. This can occur by transferring the thermal energy of one system to another.

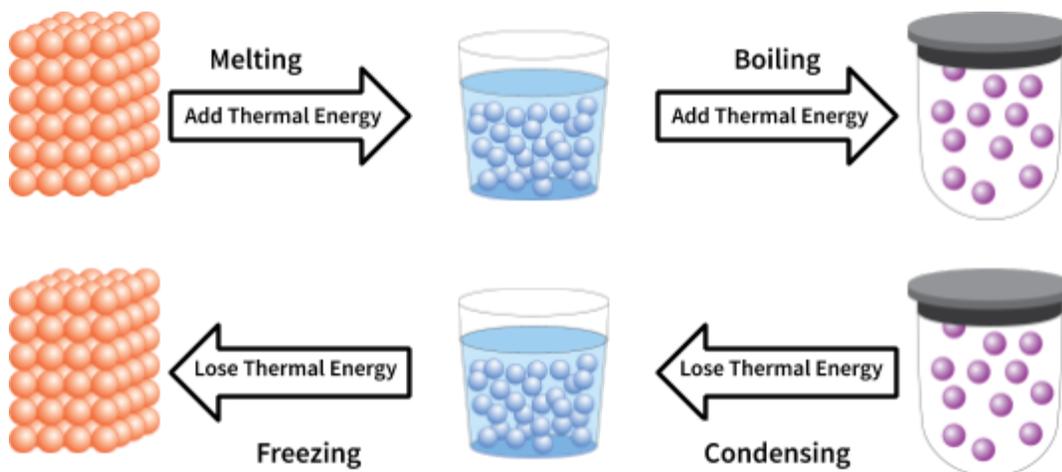
Thermal energy is the total kinetic energy of moving particles in matter. The system with a higher temperature will transfer thermal energy to the system with a lower temperature (energy is transferred from hot to cold). When thermal energy is transferred into a system, the atoms and molecules move faster, increasing the temperature and the average kinetic energy of the system. Atoms and molecule transfer kinetic energy (motion) to one another through molecular collisions.



In the image to the left, thermal energy from the stove top is transferring to the pot of water. This is because the stove top is hotter than the pot of water. As it transfers thermal energy, the temperature of the water is increasing. As the temperature of water increases, so does the kinetic energy (movement) of the water molecules.

Phase Changes

When the atoms and molecules move faster, the attraction between them weakens. For example, water molecules in ice have a strong attraction toward each other. As the temperature of ice increases, the increase in motion weakens the attraction between water molecules. This is how solids become liquids. As substances changes from a solid to a liquid it is called **melting**. The molecules are still very close together, but do not hold on as tightly to each other. As water is heated on a stove, the attraction between water molecules breaks. The water molecules move far enough apart until they are not attracted to each other, becoming gaseous. When a substance transforms from a liquid to a gas, the substance is **boiling**.



When gases lose energy, they slow down, allowing for the atoms or molecules to attract to each other again. When this happens, the gas becomes a liquid. This process is called **condensing**. As liquids lose energy, the attraction between atoms or molecules becomes even stronger, turning it into a solid. When a liquid becomes a solid, the substance is **freezing**. When a substance changes its state of matter, this is a **phase change**. While kinetic energy of atoms and molecules increase with the addition of thermal energy, they stop speeding up during phase change. The energy instead goes into separating the atoms and molecules. This is why the temperature stays consistent during the phase change.