

## 2<sup>nd</sup> Grade - Lesson 5.1

### Changes Caused by Heating and Cooling

#### Teacher Background

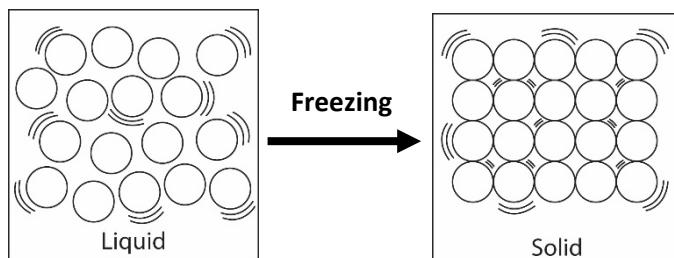
Lesson 5.1 introduces the concept that cooling and heating cause changes in matter and that freezing and melting are reversible processes.

#### The attraction of molecules in solid, liquid, and gas

On the molecular level, solids, liquids, and gases are made from molecules that are attracted to one another and in constant motion. Molecules are most attracted in solids, somewhat less attracted in liquids, and very much less attracted in gases. A combination of the attractions between molecules and their motion determines whether a substance is a solid, liquid, or gas at a given temperature.

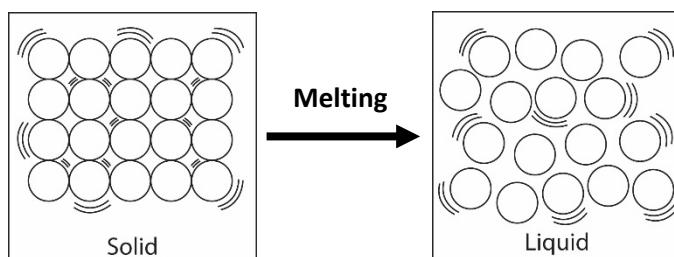
#### From liquid to solid

When a liquid is cooled, the motion of the molecules slows down. The attraction of the molecules competes with this slower motion and brings the molecules closer together. If the molecules are cooled to a sufficiently low temperature, they can slow down enough that their attractions keep them in fixed positions. This is the change from a liquid to a solid and is the process of freezing.



#### From solid to liquid

When a solid is heated, the motion of the molecules increases. Their increased motion competes with their attraction for one another and they move further apart. If the molecules are heated to a sufficiently high temperature, they can speed up enough that their attractions can't keep them in fixed positions any longer and they begin to move past one another. This is the change from a solid to a liquid and is the process of melting.



## Water is special

Water has some unique characteristics when it comes to freezing and melting. As water is cooled, the molecules slow down and get closer together. But at a certain temperature (4 °C), they move further apart as they begin to create the crystal structure of ice. The water molecules in ice are actually further apart than the water molecules in liquid water.

This is different from nearly every other substance, since the molecules of a substance in the solid state are almost always closer together than the same molecules in the liquid state.

Since ice takes up more space than the same amount of liquid water, ice is less dense than water. This is why ice floats in water.

