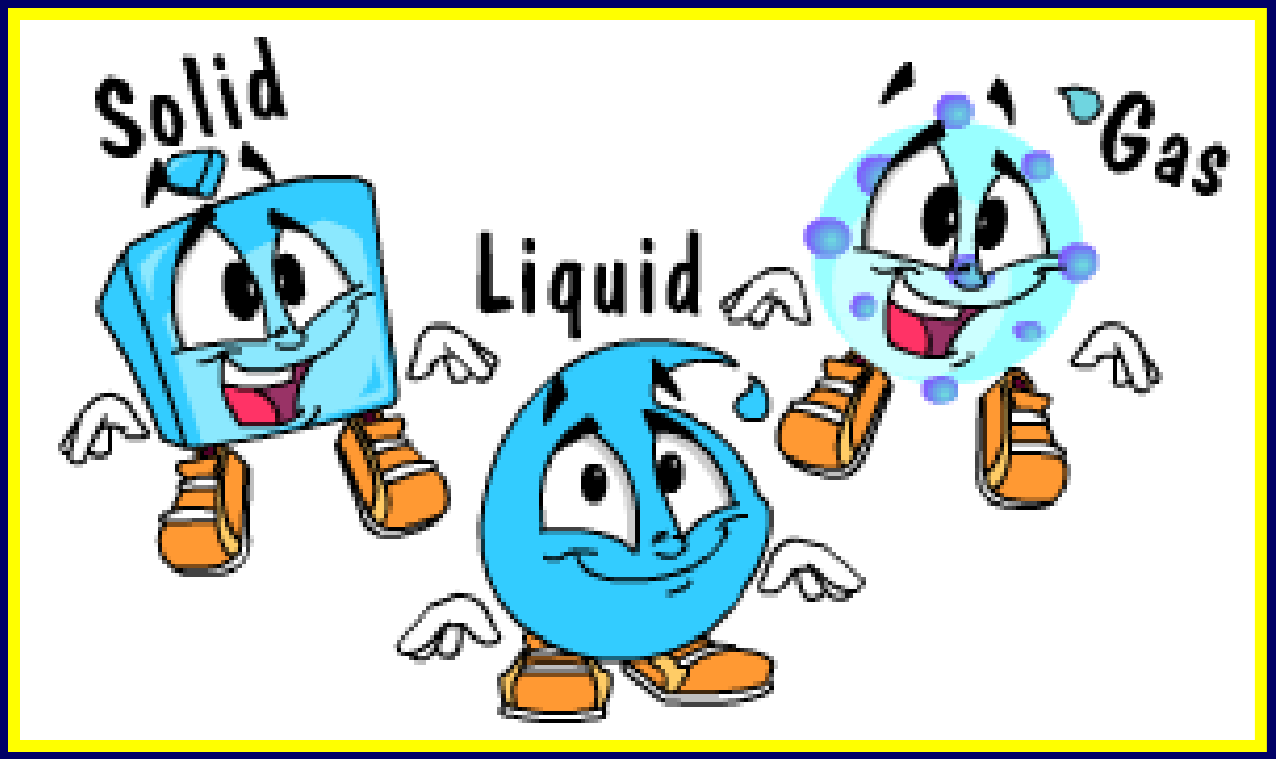
Solids, Liquids, and Gases



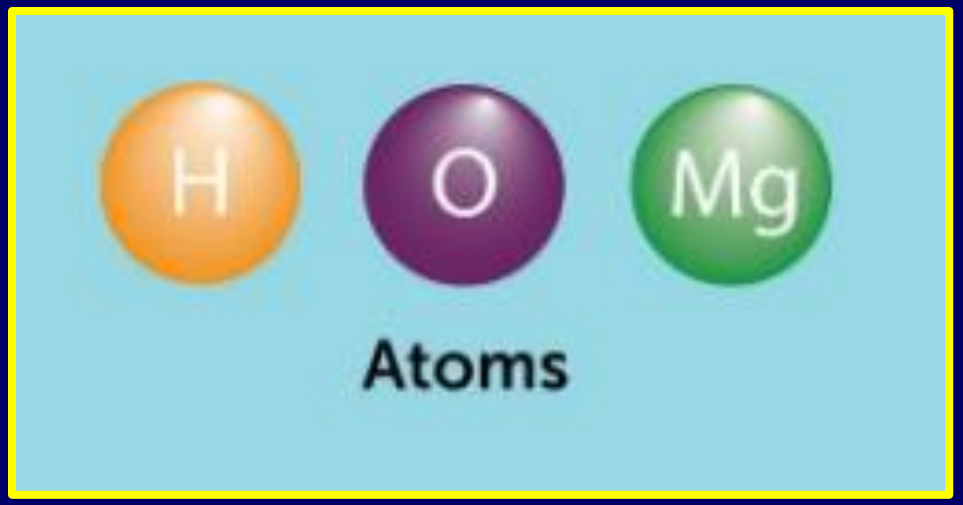
I Can Statements

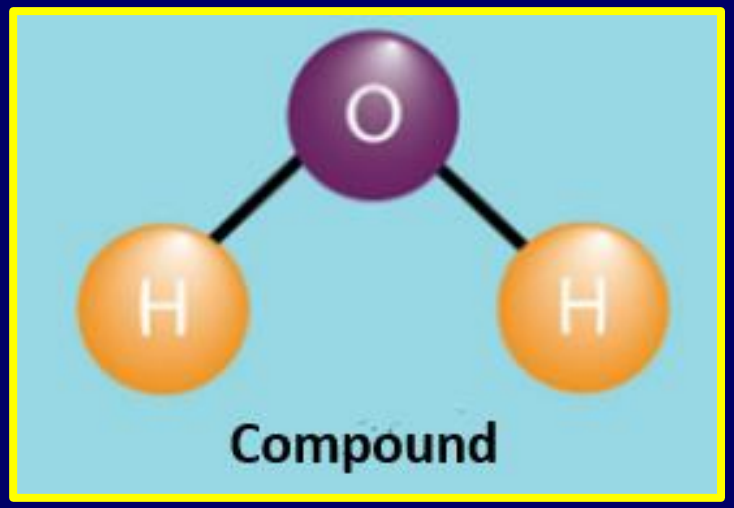
At the end of this lesson, you should be able to say, with confidence:

- I can explain the effect heat has on the motion of atoms.
- I can distinguish between solids, liquids, and gases based on particle motion.
- I can explain how temperature affects the density of liquids and gases.

Atoms in Motion

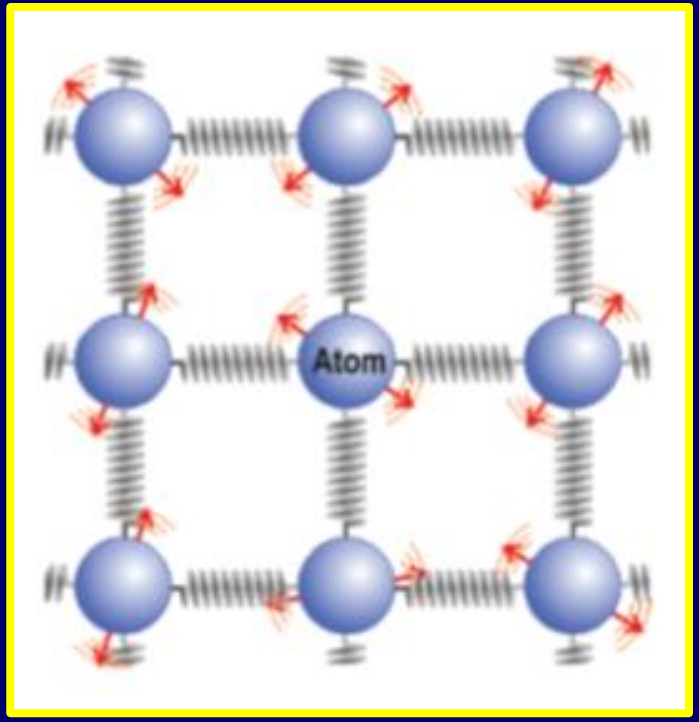
All matter is made up of atoms, compounds, or a mixture of atoms and compounds.





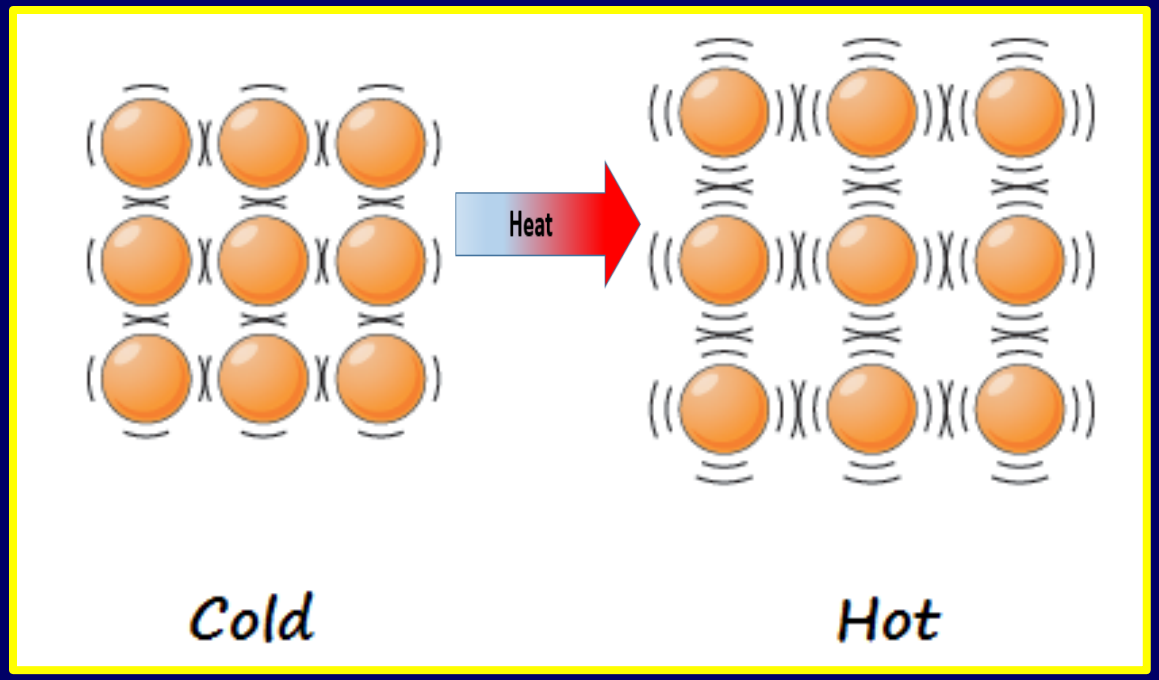
Atoms in Motion

Even though atoms in compounds are chemically bonded, the atoms are always in constant motion.



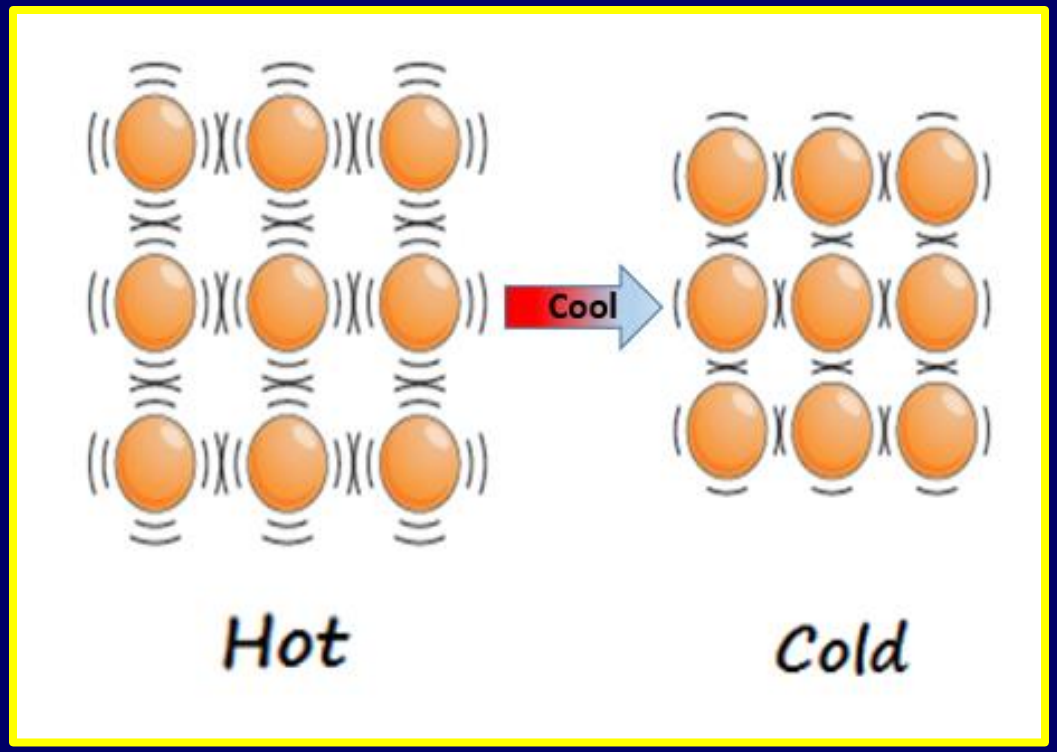
Effect of Heat

Adding heat to a substance increases the amount of motion of the atoms, causing the atoms to spread out.



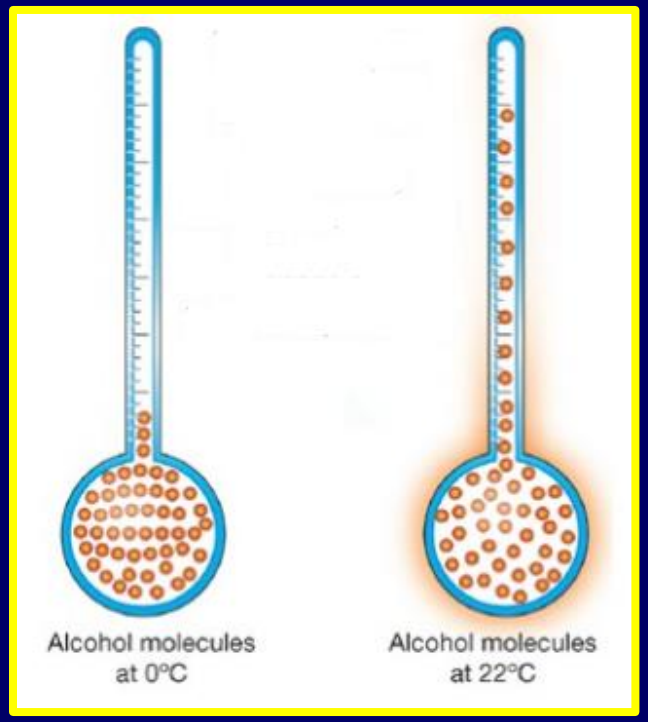
Loss of Heat

When a substance cools down, the motion of the atoms decreases and the atoms contract.



Measuring Temperature

Thermometers measure the expansion or contraction of the alcohol in the thermometer.

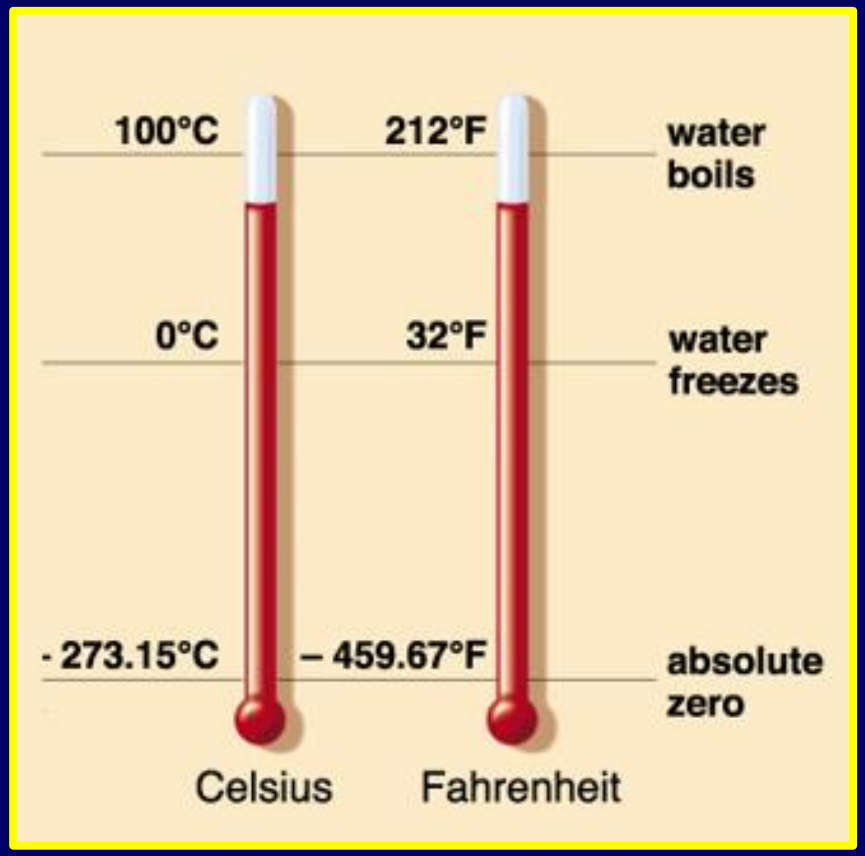


Temperature increases, alcohol expands.

Temperature decreases, alcohol contracts.

Temperature Scale

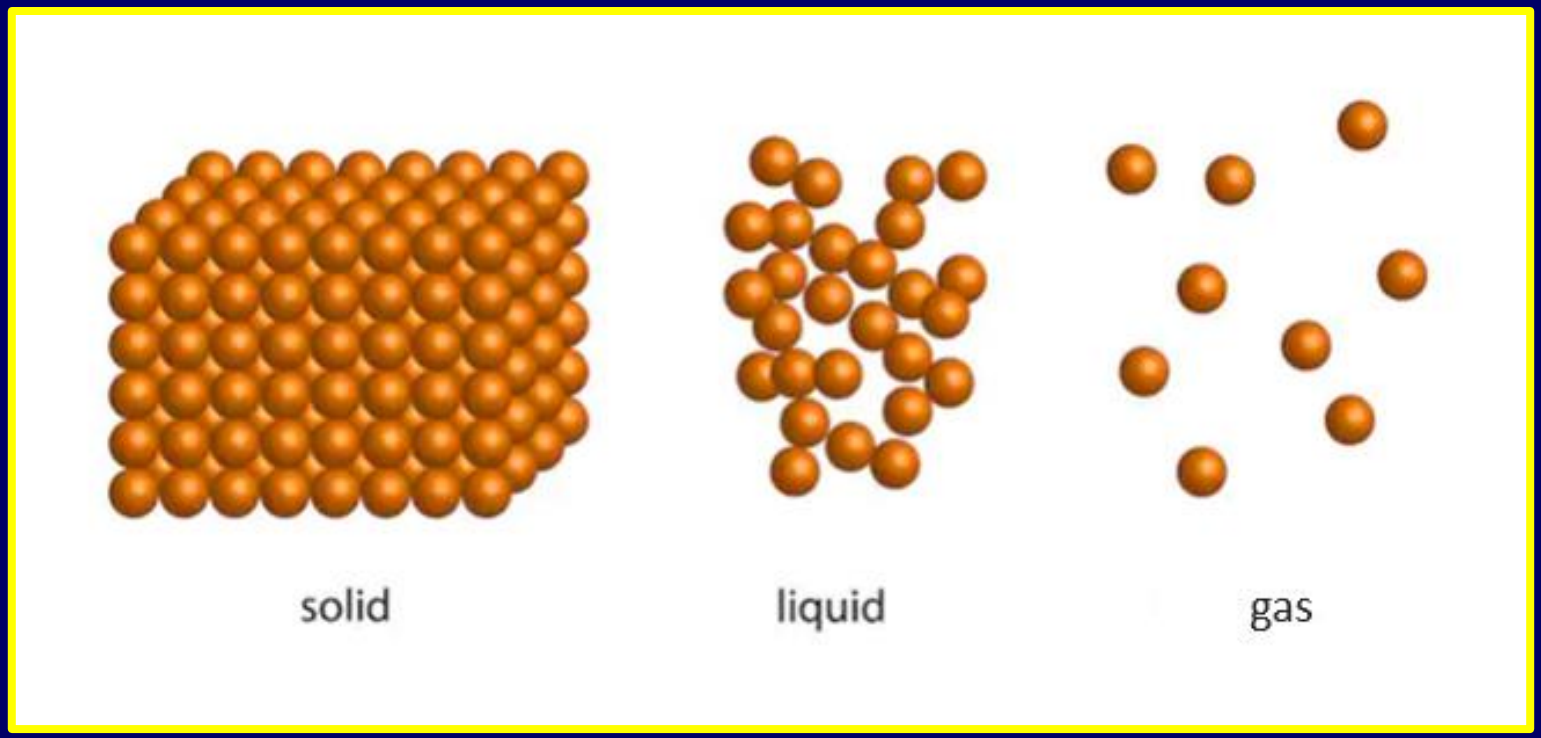
The metric unit for temperature is Celsius, ^{o}C.



The Celsius scale in based on the freezing and boiling point of water.

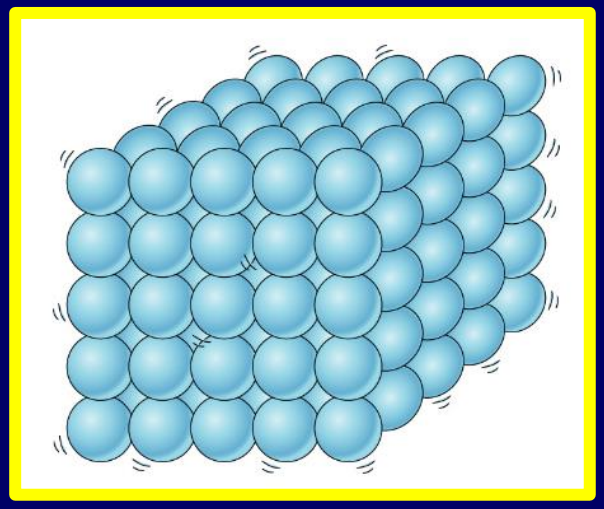
Three States of Matter

Most matter on Earth usually exists in three different states: solid, liquid, and gas.



Solids

In solids, the atoms are packed closely together, remain in one place, and vibrate just a little bit.



Solids have a definite shape and volume.

Expanding Solids

On warm days, railroad tracks expand.

If there is no room for them to expand and they will begin to buckle.

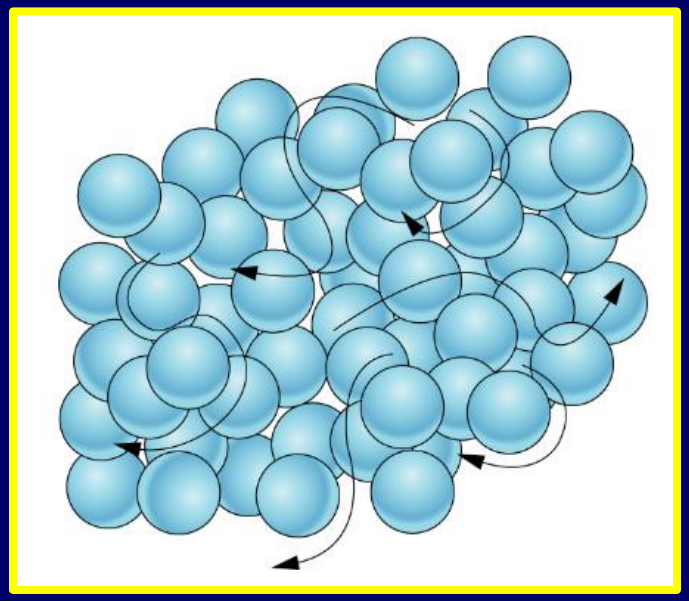
Expanding Solids

To prevent buckling, tracks are put down with gaps between them, called expansion joints.

When trains go over these expansion joints, the train makes a “clickety-clack” sound.

Liquids

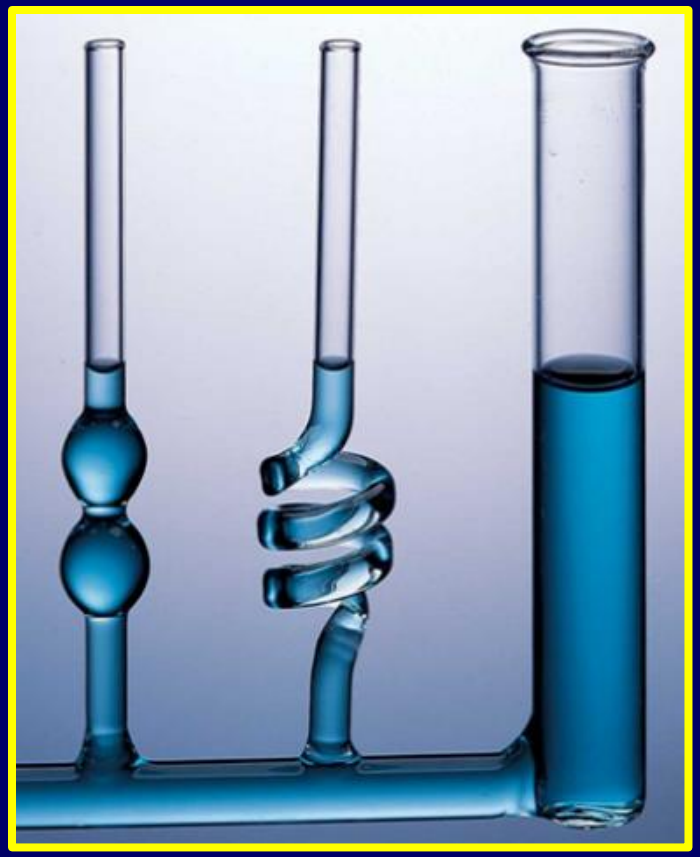
In liquids, the atoms vibrate faster but still remain attached to each other.



However, because of the faster vibrations, the bonds holding the atoms together weakens, allowing the atoms to slide past each.

Liquids

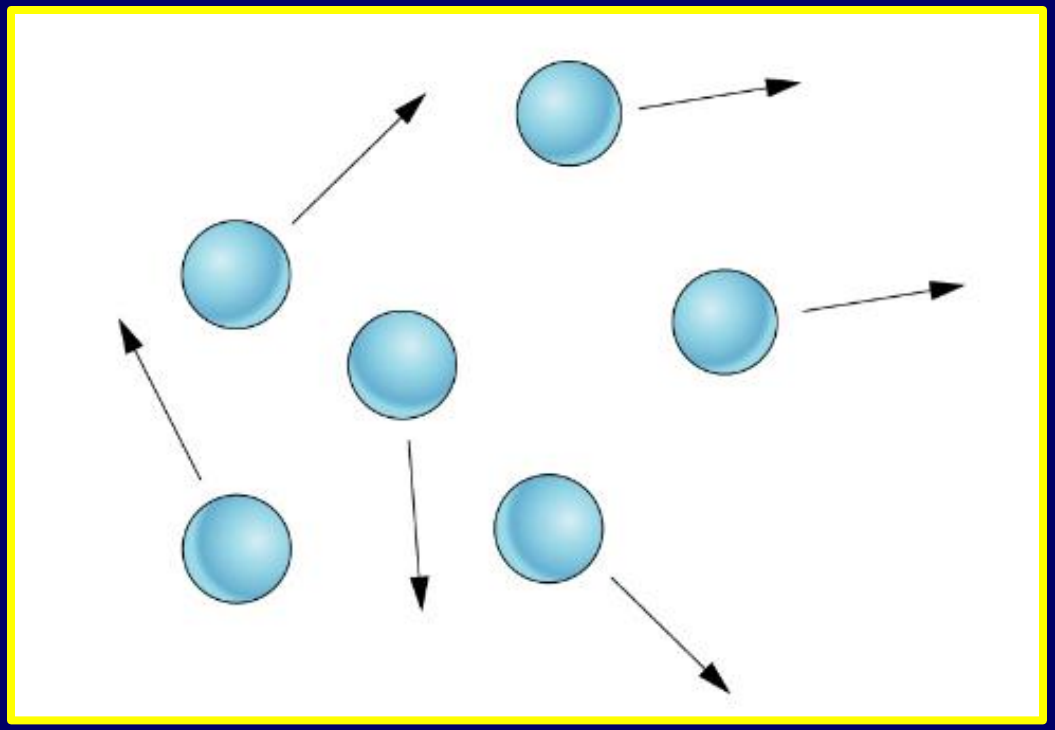
The ability of the atoms to slide past each other enable liquids to flow.



Liquids maintain the same volume but will take the shape of whatever container they are poured into.

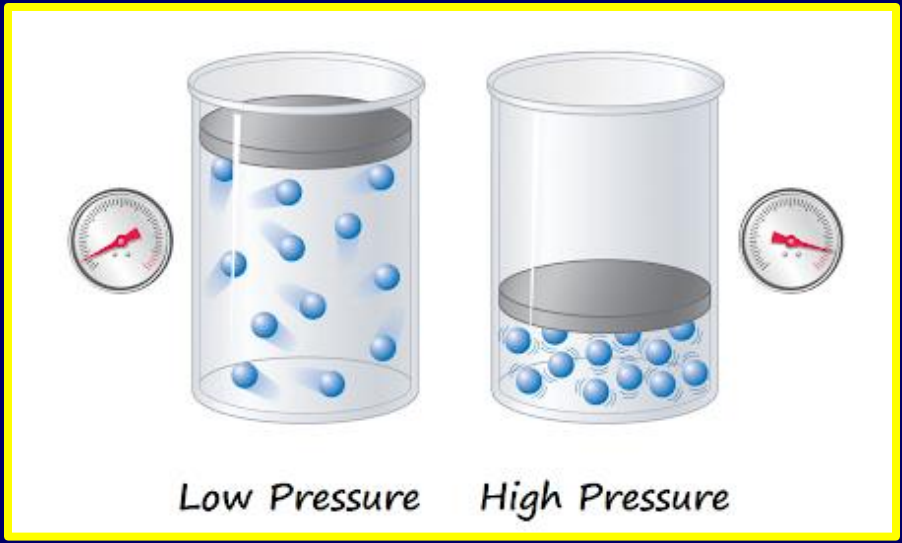
Gases

The atoms in gases vibrate so fast that they completely break free and spread far apart from each other.



Gases

Since there is so much space between that atoms, gases can be squeezed or compressed into smaller volumes.



Gases take both the volume and the shape of their container.

Gases

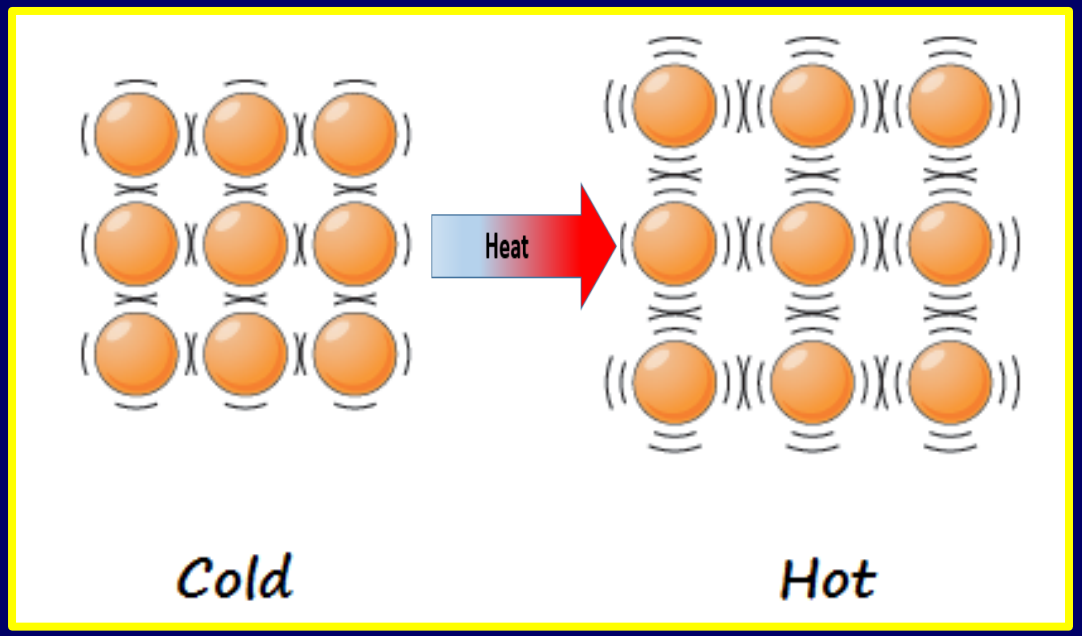
When cars and bicycles were first invented, they had solid tires made out of iron or wood.

This early bicycle was built with wooden wheels inside of iron tires. The ride was very uncomfortable as there was nothing to absorb the impact when hitting bumps in the road .

When air filled tires hit a bump, the air is compressed which reduces the impact of the bump on the rider.

Heat and Density

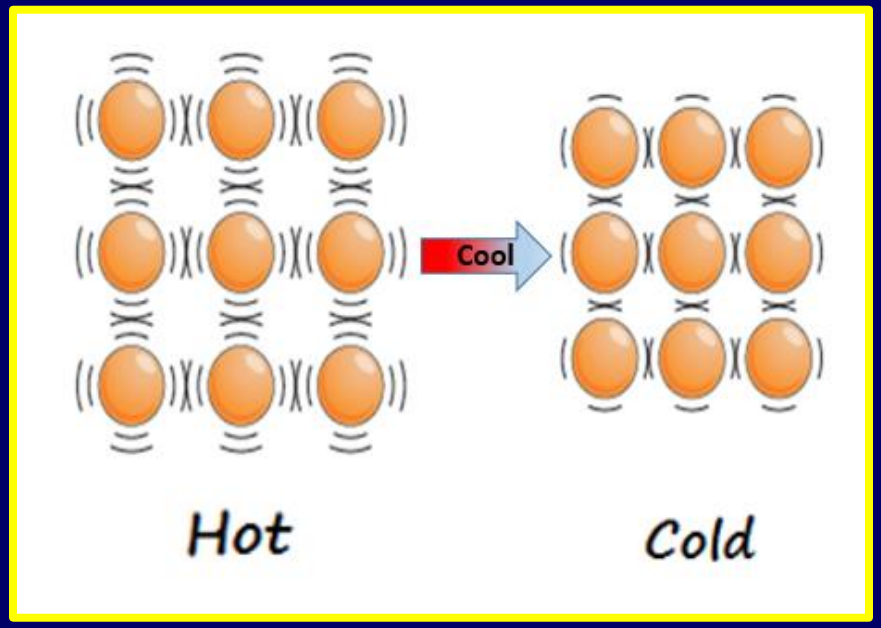
When heat is added, atoms spread out, increasing the volume of the substance and thereby decreasing the density of the substance.



$$\downarrow D = \frac{M}{V \uparrow}$$

Heat and Density

When substances cool down, the atoms move closer together, decreasing the volume and thereby increasing the density of the substance.



$$D = \frac{M}{V}$$

Heat and Density

When liquids or gases are heated, the density of the fluid is decreased and the hot fluids rise.

This is how hot air balloons work.

Heat and Density

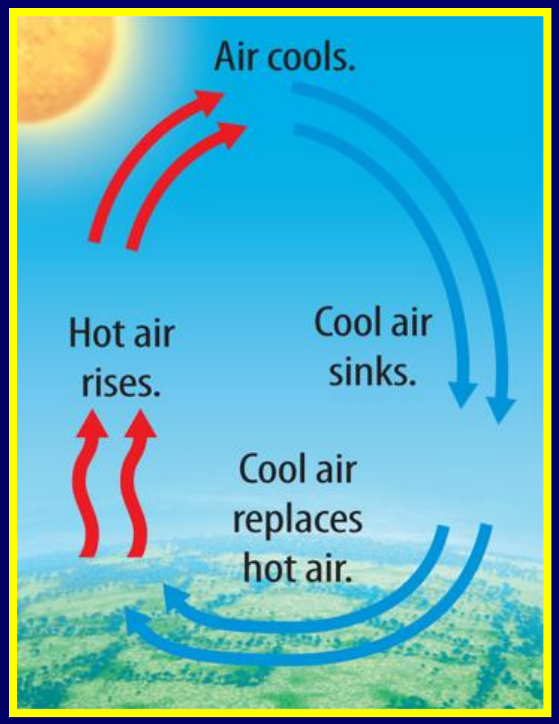
At the top of a hot air balloon is a vent called the parachute valve.

When the parachute valve is opened, the hot air escapes and is replaced by cooler air.

The density of the cooler air is greater, so the hot air balloon begins to descend.

Convection Currents

In the atmosphere, the rising of less dense, hot air and the sinking of more dense, cool air creates convection currents.



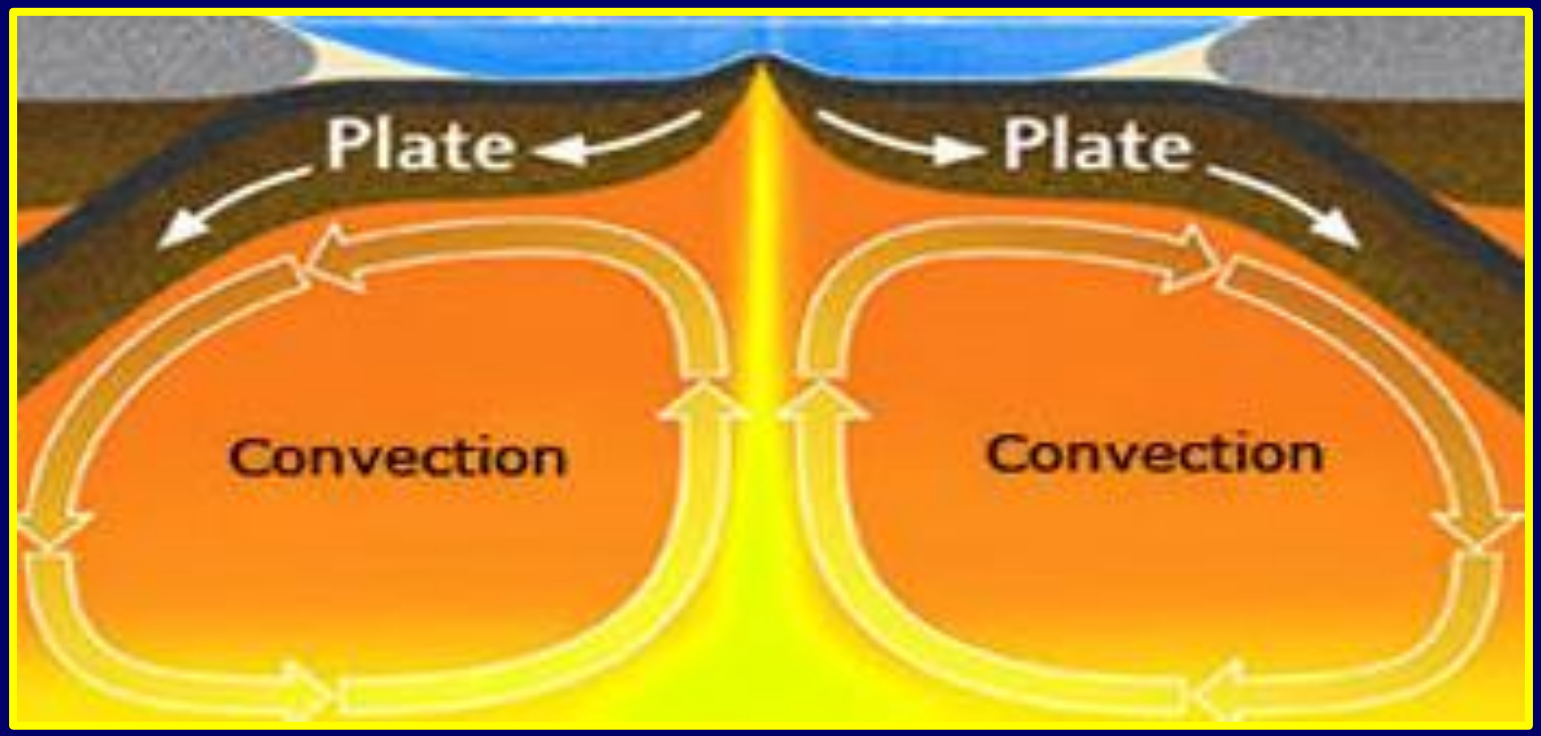
Convection currents in the atmosphere, are responsible for a lot of our weather.

Convection Currents

Convection currents are also responsible for sea breezes as hot air, over land, rises and cool air, over the sea, flows in to replace it.

Convection Currents

Convection currents are the driving force behind the plate tectonics.



Deep Ocean Currents

Temperature and density also play a role in deep ocean currents.

When the ocean water freezes into ice near the poles, the salt is left behind in the cold water.

With the water already being cold, the extra salt makes the water extremely dense, causing it to sink the bottom of the ocean.

The End