Chapter 1 – Student Reading

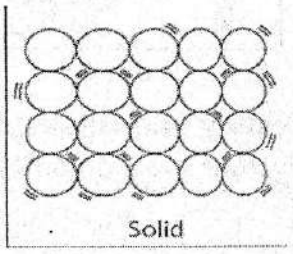
Chemistry is the study of matter

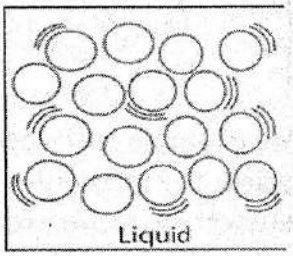
Adapted from Middle School Chemistry Unit – American Chemical Society

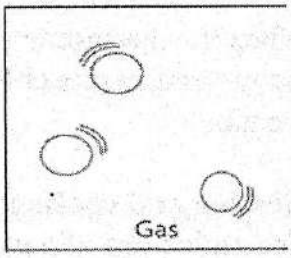
As you look at these pictures, think about these two big ideas which are always true when talking about matter:

- Matter (solid, liquid, and gas) is made up of tiny particles called atoms and molecules.
- The atoms or molecules that make up matter are always in motion.
- C. These first two ideas make up a very important theory called the Kinetic-molecular theory of matter.

Another big idea is that: The **atoms** or molecules that make up a solid, liquid or gas are attracted to one another.







In a **solid,** the atoms are very attracted to one another. Because of this strong attraction, the atoms are held tightly together. The attractions are strong enough that the atoms can only vibrate where they are. They cannot move past one another. This is why a solid keeps its shape.

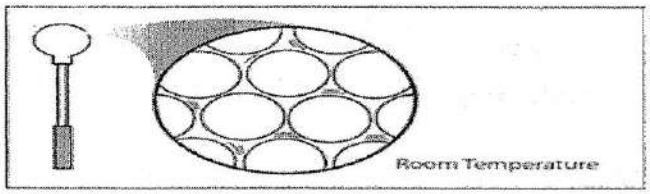
In a **liquid,** the molecules are also in motion. The attractions between the molecules in liquids are strong enough to keep the molecules close to each other but not in fixed positions. Although the molecules stay very near one another, the attractions allow the molecules of a liquid to move past one another. This is why a liquid can easily change its shape.

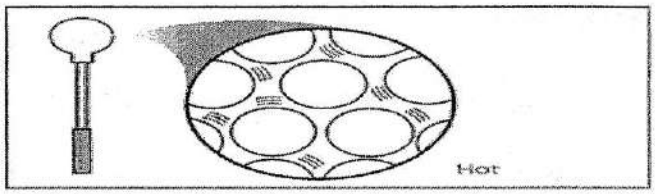
In a **gas**, the molecules are also moving. The attractions between the molecules of a gas are too weak to bring the molecules together. This is why gas molecules barely interact with one another and are very far apart compared to the molecules of liquids and solids. A gas will spread out evenly to fill any container.

When looking at the different states of matter, it's kind of like a competition between the attractions the molecules have for each other compared to the motion of their molecules. The attractions tend to keep the atoms or molecules together while the motion tends to make the atoms or molecules come apart.

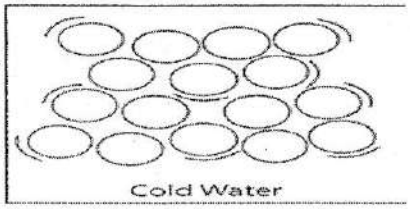
Heating and cooling solids

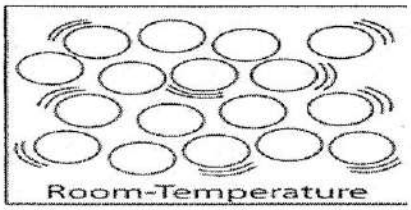
There is a device made out of a metal ball and ring that lets you see the effect of heating and cooling a solid. At room temperature, the ball just barely fits through the ring. When the ball is heated sufficiently, it will not fit through the ring. This is because heating the metal ball increases the motion of its atoms. This motion competes with the attractions between the atoms and makes the atoms move slightly further apart. The slightly larger ball no longer fits through the ring. When the metal ball is cooled, the atoms slow down and their attractions bring the atoms closer together. This allows the metal ball to fit through the ring again.

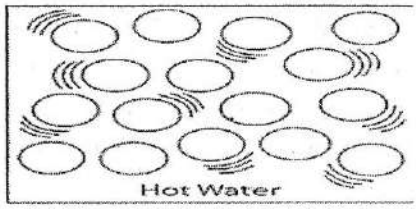




Heating and cooling liquids Heating and cooling a liquid can affect how far apart or close together the molecules are.



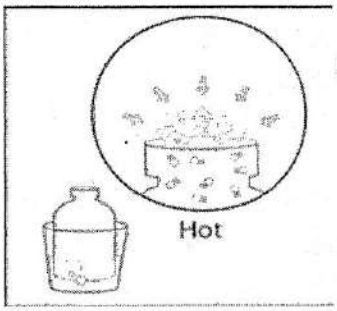


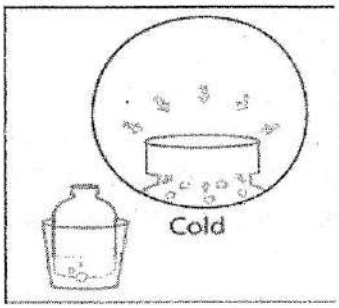


One example is the red alcohol inside the thin tube of a thermometer. When the thermometer is heated, the molecules of alcohol move faster. This faster motion competes with the attraction between the molecules which causes them to spread out a little. They have no where else to go so they move up the tube.

When the thermometer is cooled, the molecules of alcohol slow down and the attractions bring the molecules closer together. This attraction between the molecules brings the alcohol down in the tube.

Heating and cooling gases
The molecules of a gas are not very attracted to each other and are much further apart than in liquids and solids. This is why heating a gas easily increases the
motion of the gas.





For example, if you dip the opening of a bottle in a detergent solution and then heat the bottle, a bubble will form on the bottle. This happens because heating the bottle increases the motion of the gas molecules inside the bottle. Since molecules of the gas are not very attracted to each other, they spread out quickly and easily. The molecules hit the inside of the bottle and the bubble film harder and more often. The molecules push against the inside of the film harder than the surrounding air pushes from the outside. This pushes the bubble film out and forms a bubble.

If you cool the bottle while the bubble is still on top, the bubble will shrink and may go inside the bottle. This happens because cooling the gas causes its molecules to slow down. These slower-moving molecules hit the inside of the bubble film less often and with less force. The molecules in the outside air are moving faster and push against the bubble from the outside. Since the outside molecules are pushing harder, the bubble gets pushed down and in and gets smaller.

Summary Questions:

1. What two ideas make up the kinetic theory of matter?
   a. _____
   b. _____

2. The atoms or molecules that make up a solid, liquid and gas are _____ to one another.

3. Why doesn't the metal ball fit through the ring after it is heated?

4. Heating and cooling a liquid can affect how far _____ or close together the molecules are.

5. Explain how a thermometer is an example of heating and cooling a liquid.

6. Molecules in a gas are not very _____ to each other and are much further apart than in liquids or solids. This is why heating a gas easily increases the motion of the gas.

7. Why does the bubble get pushed in when the bottle is cooled down?

8. Complete the chart below using your notes

	Solid	Liquid	Gas
Attraction			
Movement			
Volume and Shape			

Science 8
Unit: Phases of Matter

Name_____
Period_____

Chapter 1, Lesson 4□Moving Molecules in a Solid
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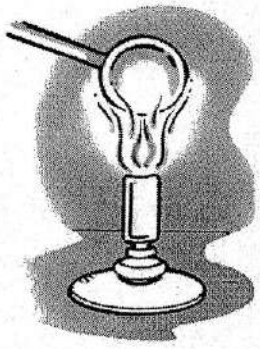
At room-temperature the metal ball fit through the ring.
QUESTION: 1. What happened when your teacher tried to push the heated ball through the ring?

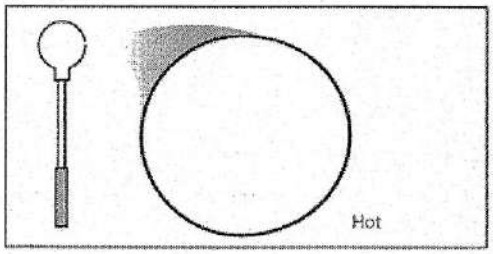


2. What happened to the atoms in the heated metal ball so that it didn't fit through the ring?

3. After the ball was cooled by putting it in the water, why do you think it fit through the ring again?

EXPLAIN IT WITH ATOMS & MOLECULES

You saw in the animation that atoms in a solid move faster and get slightly further apart when heated. You also saw that they slow down and get slightly closer together when cooled.



4. Draw a model of the atoms in the metal ball at room-temperature and after it has been heated. Use circles and motion lines to show the speed and spacing of the atoms in the room-temperature ball. Include captions like "**atoms faster and further apart" or "atoms slower and closer together"** to describe your drawings