Key

Gas Pressure and Matter

Name: Mrs. Renn Date: 1/13/20 Period: 6

LT: I can review properties of matter and relate the movement of molecules in gases to pressure.

Directions: Read the passages below and then answer the questions.

Passage 1: Review of Matter

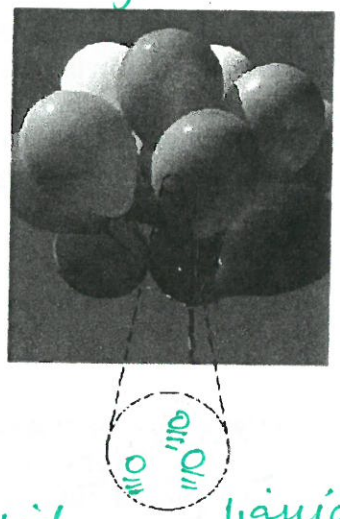
"Chapter 1: Solids, Liquids and Gases." *Middle School Chemistry*, American Chemical Society, 2011, www.middleschoolchemistry.com/lessonplans/chapter1#teaching_resources.

Matter is made of atoms and molecules

We have already used the term *atom* and *molecule* a couple of times. You will learn a lot more about atoms and molecules in later chapters. For now, let's say that atoms and molecules are the extremely tiny particles that make up all the matter on Earth. An atom is the basic building block of all matter. A molecule is made of two or more atoms connected or bonded together.

Even though atoms and molecules are not the same, the model we are using in Chapter 1 shows both atoms and molecules as little circles or spheres. This model makes it easier to show some of the basic characteristics of the different states of matter on Earth.

gas

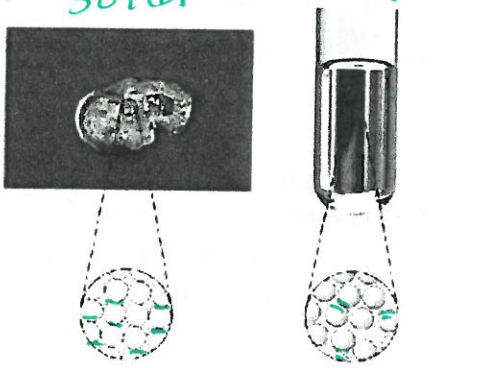


Matter—Solid, Liquid, Gas

On Earth, matter is either found as a solid, liquid, or gas. A particular solid, liquid, or gas might be made up of individual atoms or molecules.

Here is a simplified model of three different substances. One is a solid, another is a liquid and the other is a gas

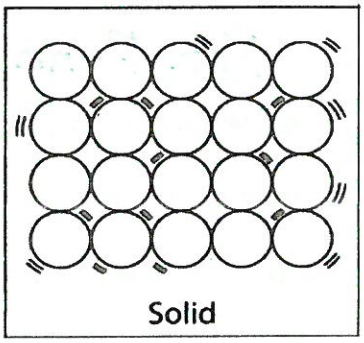
solid liquid



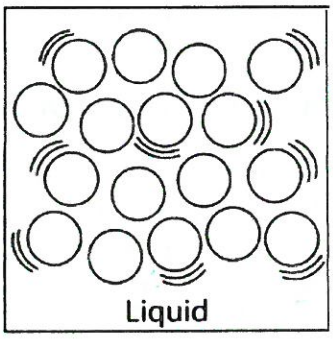
As you look at these pictures, think about these two big ideas which are always true when talking about matter:

- 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.
- These first two ideas make up a very important theory called the Kinetic-molecular theory of matter.

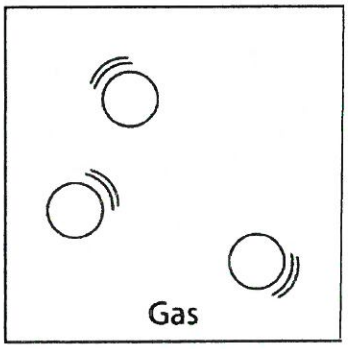
Another big idea is that:
The **atoms** or molecules that make up a solid, liquid or gas are attracted to one another.


Solid

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


Liquid

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.


Gas

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.

attractions vs motion

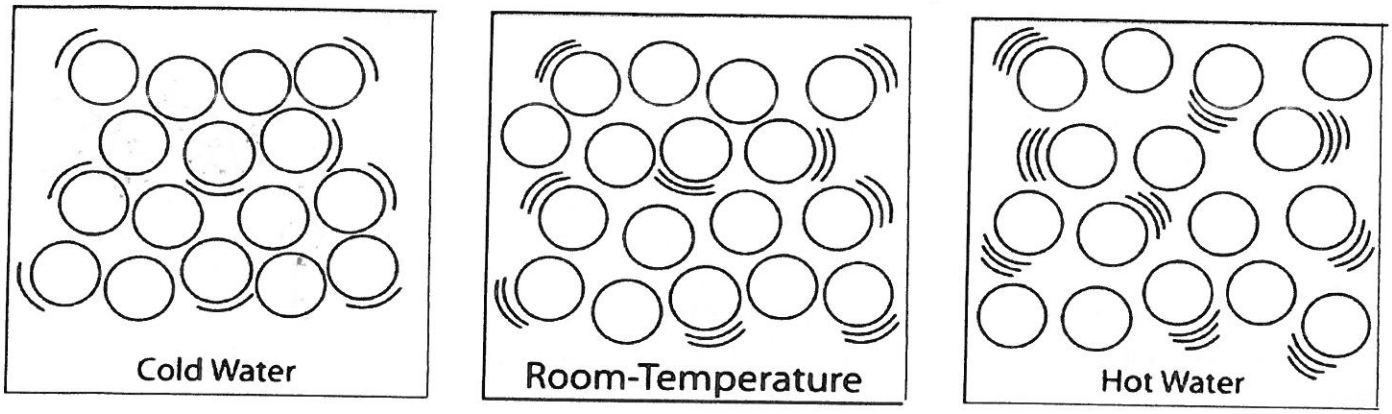
When looking at the different states of matter, it's kind of like a competition between the attractions the molecules have for each other compared to the motion of their molecules. The attractions tend to keep the atoms or molecules together while the motion tends to make the atoms or molecules come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

Comparing Matter

	Solids	Liquids	Gases
Attractions	Atoms or molecules are very attracted to one another.	Atoms or molecules are attracted to one another.	Atoms or molecules are barely attracted to one another.
Movement	Vibrate but do not move past one another.	Vibrate but are able to move past one another.	Vibrate and move freely past each other.
Volume and Shape	Have a definite volume and a definite shape.	Have a definite volume, but does not have a definite shape.	Does not have a definite volume or a definite shape.

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.

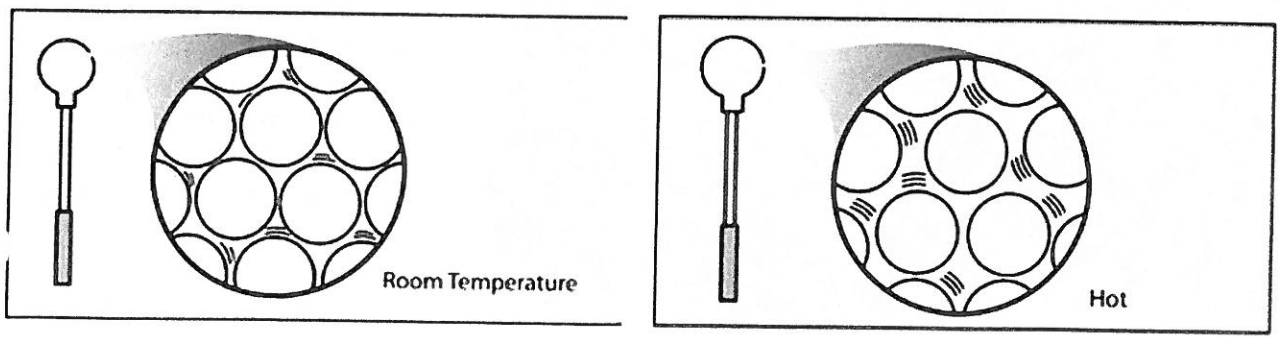
Heating and cooling solids

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.

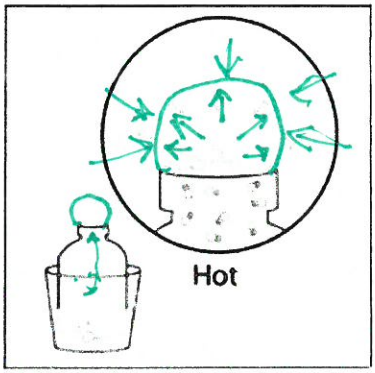
This is because heating the metal ball increases the motion of its atoms. This motion competes with the attractions between the atoms and makes the atoms move slightly further apart. The slightly larger ball no longer fits through the ring.

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.

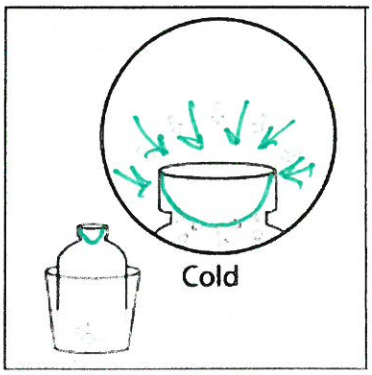


Heating and cooling gases

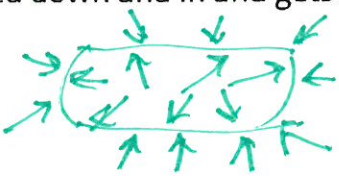
The molecules of a gas are not very attracted to each other and are much further apart than in liquids and solids. This is why heating a gas easily increases the motion of the gas.



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.



Passage 2: Gas Pressure

Ck12 Science. "Gas Pressure." *Ck-12 Science*, 3 July 2019, www.ck12.org/c/chemistry/gas-pressure/lesson/Gas-Pressure-CHEM/.

Many people enjoy riding in hot air balloons. At the beginning of a hot air balloon ride, the balloon is flat because the pressure inside the balloon equals the pressure outside. When the air (gas) inside the balloon his heated, the movement of the air molecules imcreases and the pressure goes up. After a while the balloon is completely expanded the the flight is ready to take off.

Gas Pressure

Pressure is defined as the force per unit area on a surface. This means that the pressure depends both on the mass of the force and the area of the force. We would would use the following equation to define the pressure.

$$\text{Pressure} = \frac{\text{force}}{\text{area}}$$

This means:

When a person stands on the floor, his feet exert pressure on the surface. That pressure is related to both the mass of the person and the surface area of his feet. If the person were holding a heavy object, the pressure would increase because of a greater force. Alternatively, if the person stands on his toes, the pressure also increases because of a decrease in the surface area.

Gas molecules also exert pressure. Earth's atmosphere exerts pressure because gravity acts on the huge number of gas particles contained in the atmosphere, holding it in place. Pressure is also exerted by a small sample of gas, such as that which is contained in a balloon. Gas pressure is the pressure that results from **collisions** of gas particles with an object. Inside the balloon, the gas particles collide with the balloon's inner walls. It is those collisions which keep the balloon inflated. If the gas particles were to suddenly stop moving, the balloon would instantly deflate. **Figure 1.1** is an illustration of gas particles exerting pressure inside a container.

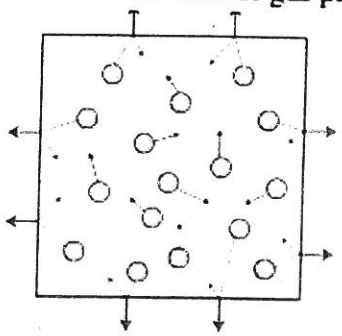


FIGURE 1.1
Collision of gas particles with container wall.

collisions ↑, pressure ↑
temperature ↑, pressure ↑

The pressure inside the hot air balloon is affected by temperature. As the molecules heat up, they move faster and strike the inside wall of the balloon harder. This increased motion of the gas particles increases the force on an area of the balloon, producing a rise in the pressure.

Questions:

1. What causes pressure? Pressure is caused by a force being exerted on an area (surface).
2. What two factors affect how much pressure there is on a surface?
   - force
   - area
3. What would happen to the pressure if the gas molecules suddenly stopped moving? Why?
   If the molecules suddenly stopped, the pressure would decrease because there are less collisions happening.
4. How does temperature affect the pressure? Why? As the temperature increases the pressure increases because there are more collisions
5. Why does the Earth's atmosphere exert pressure? The Earth's atmosphere exerts pressure because gravity pulls (pushes) the molecules down towards the Earth's surface. (i.e. more collisions happen)