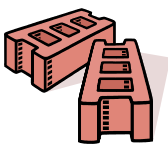
# Chapter 3

States of Matter



## Matter and NRG

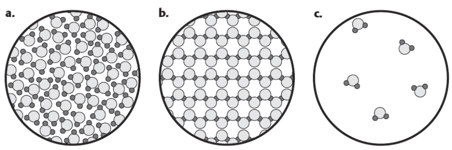
Section 3.1

## Key Ideas

- What makes up matter?
- What is the difference between a solid, a liquid, and a gas?
- What kind of NRG do all particles of matter have?

## Question…

Examine the drawings shown below
How do you think the atoms and molecules are arranged in the different states of matter?




- *What makes up matter?*

- According to the kinetic theory of matter, matter is made _______________. These atoms and molecules act like tiny particles that are always in _____________.

## Kinetic Theory

- The three main points of the kinetic theory are as follows:

1. _____________________________________
2. _____________________________________
3. _____________________________________

- The Kinetic theory helps explain the differences between the three common states of matter: __________________________.

## States of Matter

- *What is the difference between a solid, a liquid, and a gas?*
- You can classify matter as a solid, a liquid, or a gas by determining whether the shape and volume are definite or non definite.

## States of Matter

| | Solid | Liquid | Gas |
|---|---|---|---|
| **Shape** | | | |
| **Volume** | | | |

Video

## States of Matter

- **Fluid**: a ________________ state of matter where particles can move past each other
  - Gases and liquids are fluids
- **Plasma**: a state of matter that is made of free moving ____________________(like a gas)
  - This is the most abundant state of matter in the ____________!

## Examples

- Solids
  - Ex.
- Liquid
  - Ex.
- Gas
  - Ex.
- Plasma
  - Ex.

## Question

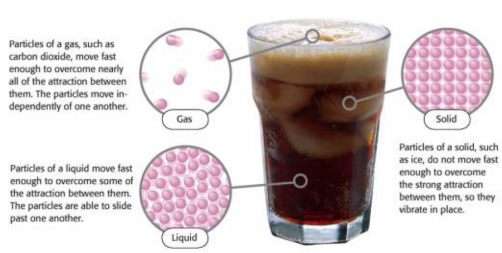
- Compare AND contrast plasma and gas.

**Compare**:

**Contrast**:

## States of Matter

- Compare the space between the particles in this diagram. What do you notice?



## NRG's Role

- *What kind of NRG do all particles of matter have?*
- All particles have kinetic NRG because they are moving
  - Kinetic NRG is the NRG of _____________
- **Energy**: ______________________

## NRG's Role

- What is temperature?
- **Temperature** is the measure of ___________________________________
  - Some of the particles are moving faster and some slower (AVERAGE)
- The more kinetic NRG the particles have, the ___________________________
- Demo: cup and marbles

## NRG's Role

- Temperature is also the measure of how "hot" or "cold" something is
- But… be careful when using these terms
- Are the following HOT or COLD
  - 55 degrees C
  - My Room
- Explain you answer

## NRG's Role

- The temperature of an object is NOT determined by how much of it you have
  - Gallon of milk and cup of milk
- Thermal NRG however, does depend on the amount of a substance
- **Thermal NRG** is the ____________________

## NRG's Role

- So, back to the gallon and cup of milk…
  - Which has a higher temperature?
  - Which has a higher thermal NRG?
  - Are these trick questions…..

## In the kinetic theory, we assume that particles are constantly moving.

1. True
2. False

What happens when the temperature of the particles increases?

1. Nothing
2. Slow Down
3. Speed Up
4. Not enough info

When the temperature goes down, the average kinetic NRG goes up.

1. True
2. False

Solids have a …

1. Definite shape, non definite volume
2. Non definite shape, definite volume
3. Definite shape and volume
4. Non definite shape and volume

## Assignment

- EOSQ pg 81 (1-6)
- CR

## Changes of State

Section 3.2

## Key Ideas

- What happens when a substance changes from 1 state of matter to another?
- What happens to mass and NRG during a physical and chemical change?

## NRG and Changes of State

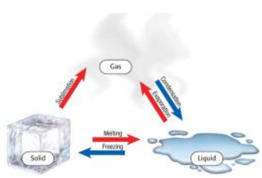
- *What happens when a substance changes from 1 state of matter to another?*
- The identity of a substance does <u>not</u> change during a change of state, but the energy of a substance does change.
- What does this mean?

## NRG and Changes of State

- When NRG is added, the particle start to move _______________ and vice versa
- The NRG added is usually ___________, which will change the ___________of the substance
  - Faster particles = _____________ in temp
- If enough NRG (heat) is added, the_____________
  - Ex.

## NRG and Changes of State

- Go to page 84 and look at Fig 1
- The Blue Arrow mean it is ___________ NRG and Red Arrows mean it is ___________ NRG
- ?



## NRG and Changes of State

- Copy and finish the table (you have 5 minutes)

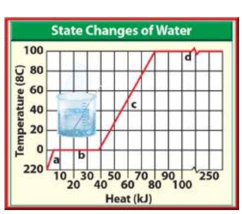
| Name of State of Change | State of matter change | NRG Absorbed or Released |
|---|---|---|
| Freezing | Liquid to a solid | |
| Melting | | |
| Condensation | | |
| Evaporation | | |
| Deposition | | |
| Sublimation | | |

## NRG and Changes of State

- Evaporation vs Boiling
- Boiling occurs __________a liquid at a _____________________depending on the pressure on the surface of the liquid.
  - 100 __________________at STP
- Evaporation is _______________that occurs at the ______________of a liquid and can occur at temperatures _____________
- Glass of water on your nightstand

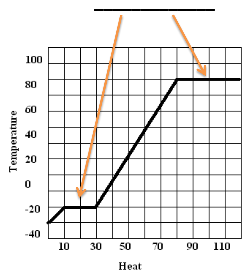
## Heating Curve of a Liquid

- This type of graph is called a ________because it shows the temperature change of water as thermal energy, or heat, is added.
- Notice the two areas on the graph where the temperature does not change.
- At 0°C, ice is ________.



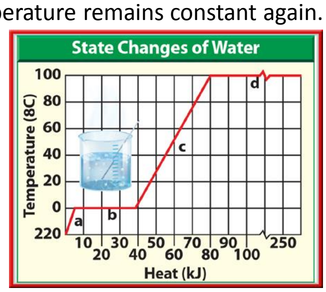
## Heating Curve of a Liquid

- When the line is running ________to the x axis, the substance is ____________________
- Ex.
- The NRG is used to ____________ instead of ____________




## Heating Curve of a Liquid

- At 100°C, water is boiling or vaporizing and the temperature remains constant again.




## In Class Worksheet

- Please get out your "3.2 In class worksheet"
- You and A partner have 8 minutes to finish the wkst…. GO!

Now, lets talk about it

## Conservation of Mass and NRG

- *What happens to mass and NRG during physical and chemical changes?*
- They are both ________________!
- Neither can be ____________________!

## Law of Conservation of Mass

- According to the ___________________ , the mass of all substances that are present before a chemical change equals the mass of all the substances that remain after the change.
- Does burning a log follow the law of conservation of mass?

## Law of Conservation of Mass

- When you burn a log, __________________ ____________________________________.
- If you were to add the mass of the ___________ and the _____________you would get the mass of the __________!

## Law of Conservation of NRG

- The ______________________ states that NRG can change forms but cannot be created or destroyed
- How do you get NRG?

## Assignment

- 3.2 CR
- EOSQ (1,2,3,5)

## Fluids

Section 3.3

## Key Ideas

- How doe fluids exert pressure?
- What force makes a rubber duck float in a bathtub?
- What happens when pressure in a fluid changes?
- What affects the speed of a fluid in motion?

## Pressure

- How doe fluids exert pressure?
- Fluids exert pressure ____________ in all directions
- ______________ is the amount of force exerted per unit area of surface
- For Example: when you fill a tire, the air particle push against each other and the walls of the tire

## Pressure

- Pressure can be calculated by dividing the Force by the Area

$$P = \frac{F}{A}$$

- Area is Length x width

$$A = l * w$$

## Pressure

- The SI unit for pressure is the ___________
- A ___________ = 1 Newton per 1 $m^2$
- So, you have to be in ___________ when completing this math!

## Pressure

- Because pressure is the amount of force divided by area, one Pascal of pressure is the amount of force divided by area, one Pascal of pressure is one Newton per square meter or I $N/m^2$.

**Force must be in N and area MUST be in $m^2$.**

## Squared conversions

- When you convert a squared label ($cm^2$) you need to convert two times
- Convert cm to meters and the convert it again
- 19 $cm^2$ -- > 0.19 m -- > 0.0019 $m^2$

## Practice

- What is the area (in m squared) of a table with a length of 250 cm and a width of 45 cm?
- How much pressure is applied to a 0.5 $m^2$ surface if you apply a 14 N force?
- What is the area of a surface if you apply 50 N of force and a pressure of 75 Pa?

## Buoyant Force

- *What force makes a rubber duck float in a bathtub?*
- All fluids exert an upward buoyant force on matter.
- ____________ is an ____________ force that keeps an object immersed in or floating on a fluid
- If the buoyant force is ____________ than the object's weight, the object will ____________ .

## Buoyant Force

- Go to page 90 and look at Figure 3
- Discuss this figure with the person next to you.
  - You have 1 minute… Go
- Explain it to me

## Buoyant Force

- ___________ is used to find buoyant force
- His principle states: that the buoyant force on an object is equal to the ___________by the object.
  - Think of the ___________
  - If we measure the weight of the water "pushed out" we would know the buoyant force because they are =

## Buoyant Force

- You can also determine if an object will float by comparing their ___________
  - ___________ dense objects float in more dense objects
- Which is **MORE** dense?
  - Stick : water
  - Rock : water
  - Gasoline : water
  - Helium : air

## Pascal's Principle

- *What happens when pressure in a fluid changes?*
- ___________ states that that a change in pressure at any point in an enclosed fluid will be transmitted equally to all parts of the fluid
- So, if you ___________ the pressure at one point, it ___________ at all point by the same amount.
  - Squeezing toothpaste tube

## Pascal's Principle

- The principle means…

$$P_1 = P_2$$

- And we already know the pressure equation so we can substitute and get the following equation

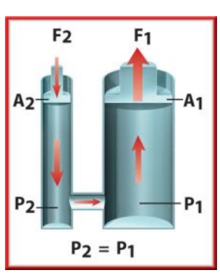
$$\frac{F_1}{A_1} = \frac{F_2}{A_2}$$

## Applying the Principle

- Hydraulic machines are machines that move heavy loads in accordance with Pascal's principle.
- Maybe you've seen a car raised using a hydraulic lift in an auto repair shop.

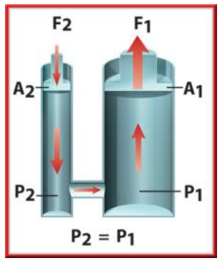
## Applying the Principle

- A pipe that is filled with fluid connects small and large cylinders.
- Pressure applied to the small cylinder is transferred through the fluid to the large cylinder.



## Applying the Principle

- Because pressure remains constant throughout the fluid, according to Pascal's principle, more force is available to lift a heavy load by increasing the surface area.




## Applying the Principle

- It should be noted that the side with the smaller force, moves a larger distance

## Practice

- A hydraulic lift uses Pascal's principle to lift a 19,000 N car. If the area of the small piston equals 10.5 $cm^2$ and the area of the large piston equals 400 $cm^2$, what force needs to be exerted on the small piston to lift the car?
  - As long as the labels are the same, you are fine
- Try page 93, #1

## Fluids in Motion

- *What affects the speed of a fluid in motion?*

- Fluids move ___________ through ___________ areas than through larger areas, if the overall flow rate remains constant. Fluids also vary in the rate at which they flow.
  - Think about what happens when you place your thumb over the end of a hose

## Fluid in Motion

- ___________ Is the resistance of a fluid to flow
- When something flows <u>slowly</u>, it has a ___________ viscosity
  - Examples

- When something flows <u>quickly</u>, it has a ___________ viscosity
  - Examples

## Bernoulli's principle

- According to ___________ , as the velocity of a fluid increases, the pressure exerted by the fluid ___________ .
- One way to demonstrate Bernoulli's principle is to blow across the top surface of a sheet of paper.
- The paper will ___________ .

## Bernoulli's principle

- The velocity of the air you blew over the top surface of the paper is ___________ than that of the quiet air below it.
- As a result, the air pressure pushing ___________ on the top of the paper is ___________ than the air pressure pushing up on the paper.
- The net force below the paper pushes the paper ___________ .

## Assignment

- 3.3 CR
- EOSQ (4-6,8,9)
- MS – Pascal's Principle (in class tomorrow)
  - Check #'s

## Behavior in Gases

Section 3.4

## Key Ideas

- What are some properties of gases?
- How can you predict the effects of pressure, temperature, and volume changes on gases?

## Properties of Gases

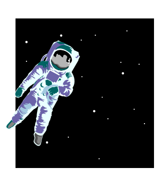
- *What are some properties of gases?*
- Gases have no ____________
- Gases expand to ____________
- Gas particle move ____________
- Gases are ____________

Some of these are not in the book!

## Properties of Gases

- Gas molecules are in ____________ and often collide with ____________ and in to the walls of the ____________
- Gases have a ____________
- Gases are ____________
- Gases are ____________

Some of these are not in the book!



## Gas Laws

- *How can you predict the effects of pressure, temperature, and volume changes on gases?*
- The Gas laws will help explain this question…
- The **gas laws** are mathematical equations that relate temperature, volume, pressure, and quantity of a gas

## Gas Laws

- If you blow a bubble 10 meters underwater, it will have doubled in size by the time it gets to the surface!

## Gas Laws

- Robert Boyle (1627-1691), a British scientist, described this property of gases.
- ____________ states that for a fixed amount of gas at a constant temperature, the volume of a gas increases as the gas's pressure ____________ .
- The opposite is true also…the volume of a gas decreases as the gas's pressure ____________ .

## Boyle's Law

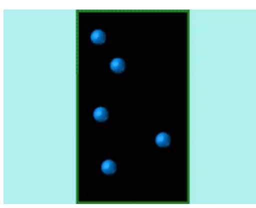
- Boyle's law states that as pressure is decreased the volume increases.

Demo

Vacuum Pump and balloon

What would happen to a balloon as it gets higher into the atmosphere?

## Boyle's Law



## Boyle's Law

Equation

$P_1V_1 = P_2V_2$

Pressure 1 * Volume 1 = Pressure 2 * Volume 2
* The pressure must be in **kPa**
* 101.3 Kpa in 1 atm

Practice Problem on page 98

## Gay-Lussac's Law

- Gay-Lussac's Law states the pressure of a gas ____________ as the temperature increases, if the ____________ of the gas does not change.
- The opposite is true also… the pressure goes ____________ when the temp goes down

## Charles's law

- Jacques Charles (1746-1823) was a French scientist who studied gases.
- According to Charles's law, the volume of a gas ____________ with increasing temperature, as long as ____________ does not change
- Again, the opposite it true

## Charles's Law

<u>Equation</u>

$$V_1/T_1 = V_2/T_2$$

Volume 1 / Temp 1 = Volume 2 / Temp 2

**This is not in your book!**

## Charles's Law

- The temperature must be in Kelvin (the SI unit for temperature)
- Degrees Celsius + 273 = Kelvin

## Assignment

- 3.4 CR
- EOSQ (1,2,4-7,9,10)
- MS – Boyles Law (in class)
- 3.4 wkst