Take notes while watching the following video tutorials to prepare for the "Solids, Liquids, & Gases Activity".

Solids, Liquids, and Gases Part 2: Energy & Phase Changes

Energy – the capacity to do work

Energy is Conserved - Energy can neither be created nor destroyed.

Units of Energy:

Kinetic energy:

Potential energy:

Electrostatic interactions:
attraction or repulsion that occurs between charged particles

Interplay of KE and PE to determine States of Matter

Solids:

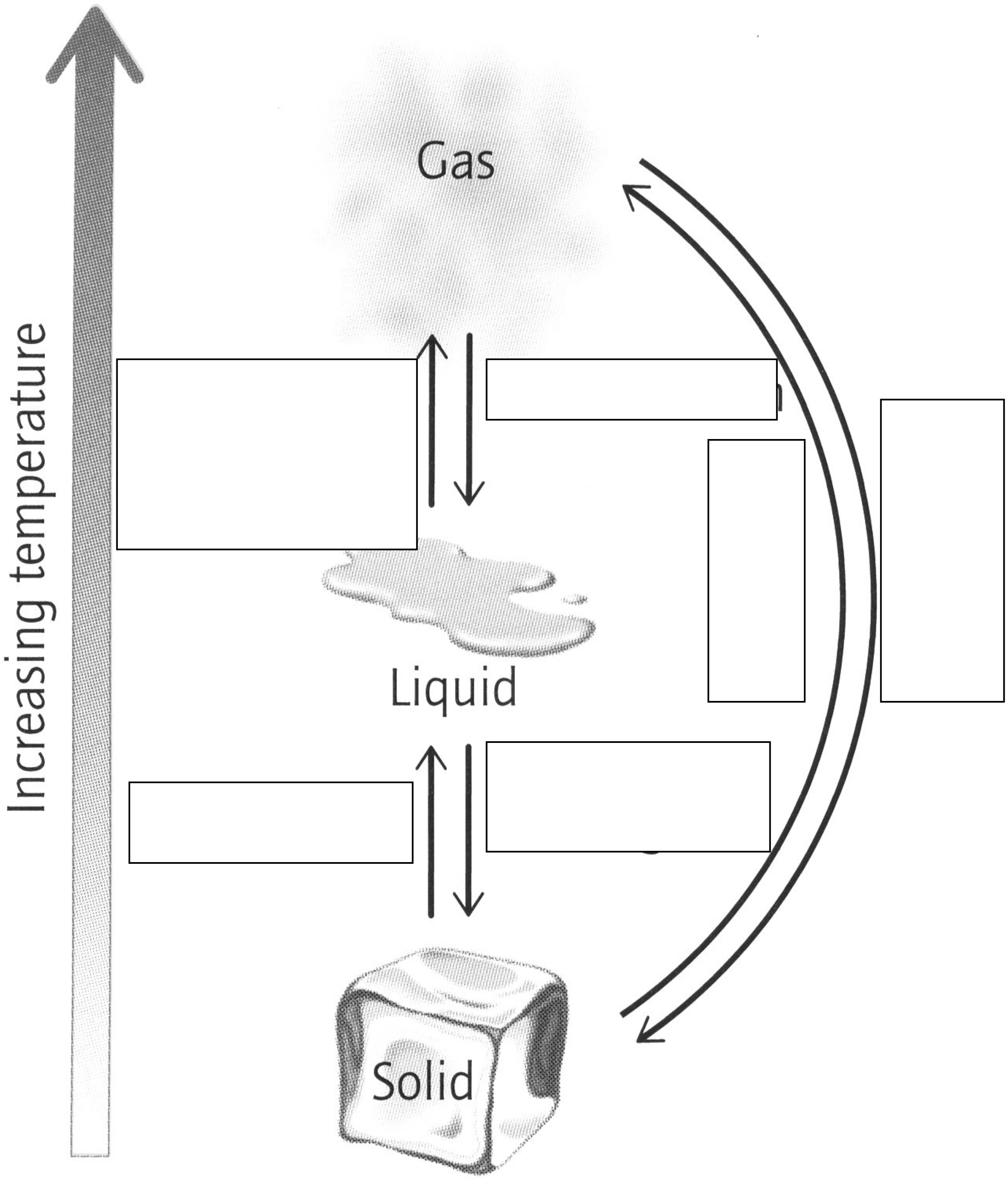
Liquids:

Gases:

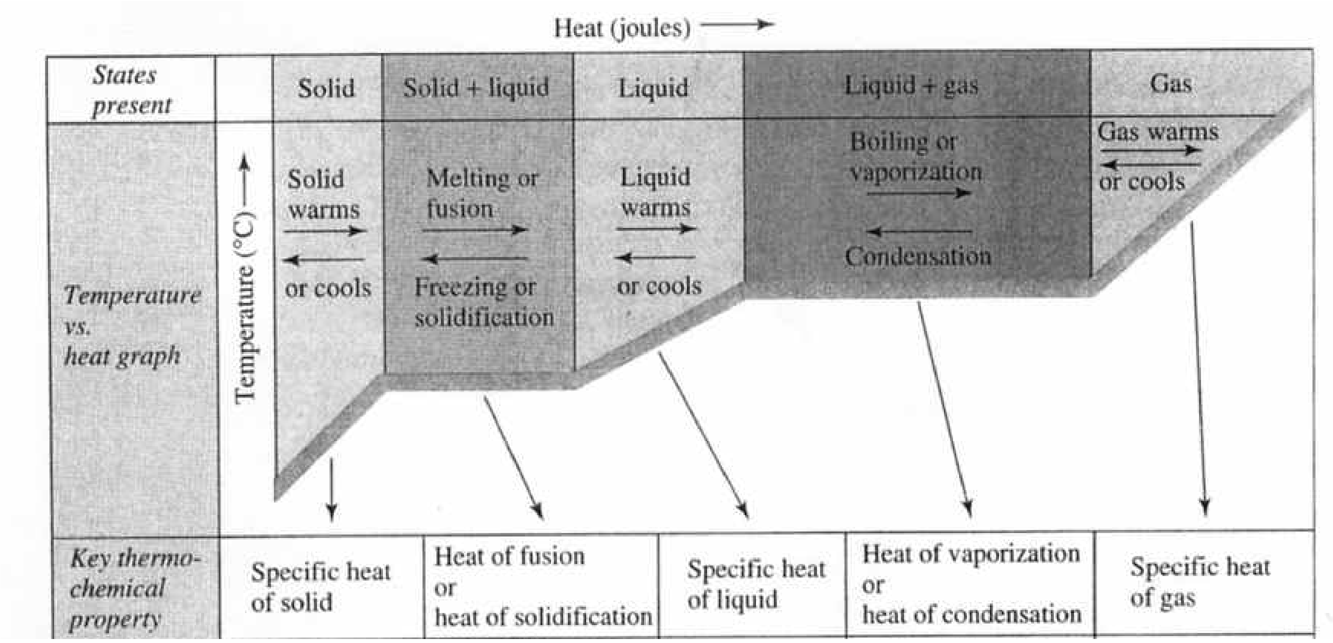
Heat – a form of energy

Temperature – a measure of the hotness or coldness of an object

Heat vs Temperature


Increasing temperature
Gas
Liquid
Solid

Heating Curves



As we increase the temperature, we increase the ________________ energy.

Melting point:

Solids melt into liquids when the ____________________ overcomes the ____.

Heat of fusion: energy to transform a solid to a liquid or vice versa

Boiling point

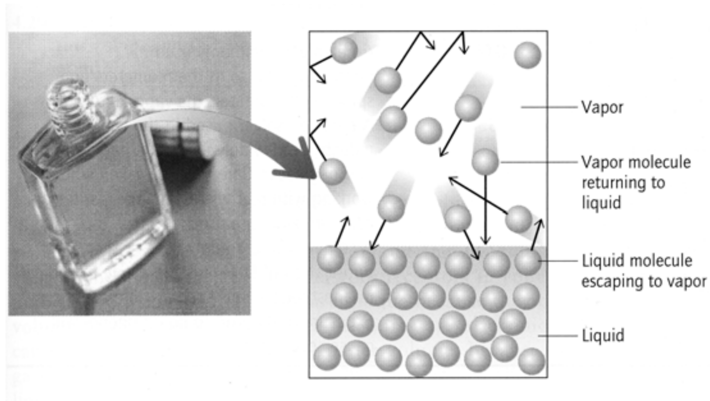
Liquids boil into gases when the ____________________ overcomes the ____.

Heat of vaporization: energy to transform a liquid to a gas or vice versa

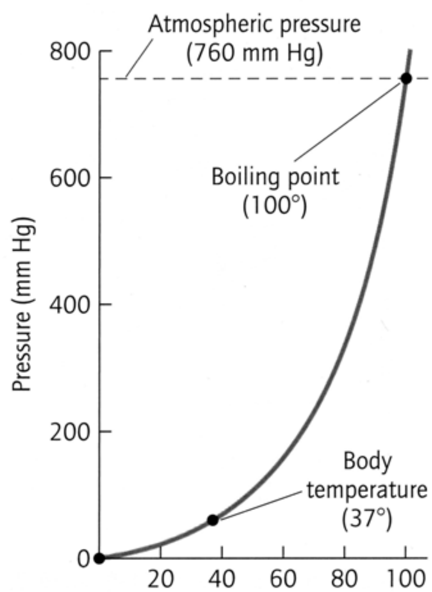
Steam burns: water and steam are both at 100°C, BUT steam undergoes a phase change which releases additional heat to the skin – ouch!

IMFs and Boiling Points

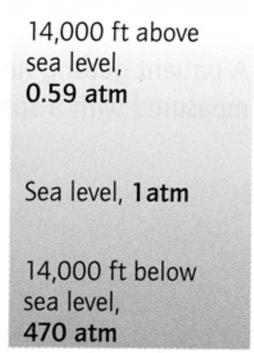
Vapor Pressure – the pressure exerted by molecules in the gas phases in contact with molecules in the liquid phase



Boiling Point:
Temperature at which the vapor pressure of the liquid equals the atmospheric pressure



Changes in Atmospheric Pressure with Altitude

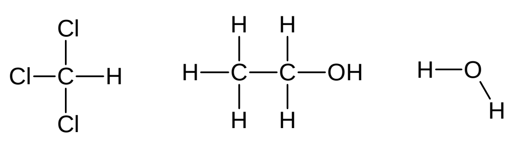


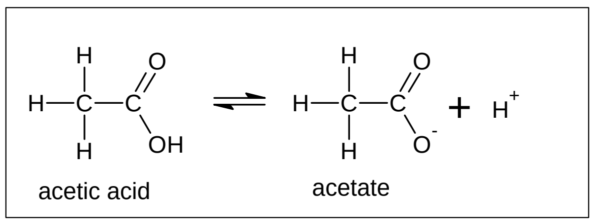
Vapor pressure: tendency to evaporate

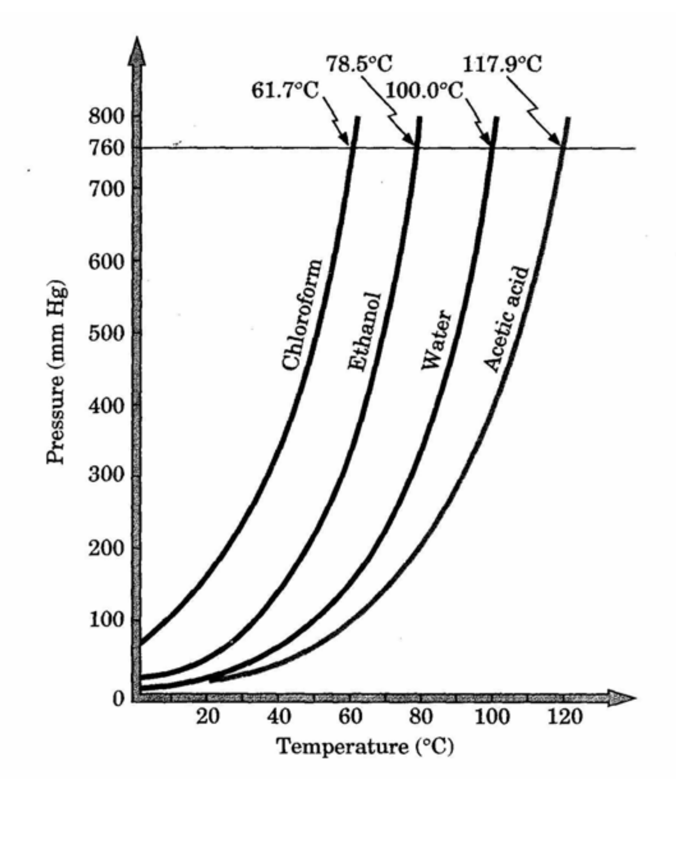
What happens when a liquid boils?

Molecules of a liquid are in constant motion. If a molecule near the surface has enough energy, it can escape into the gas state as vapor.

Boiling point (bp) – the temperature at which the vapor pressure of a liquid equals the external (atmospheric) pressure exerted on the liquid







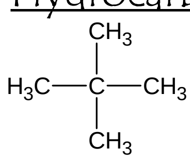
Predicting Relative bp's

Relative strength of IMF's

H-bonding Dipole-dipole London

Tie Breakers - Other factors affecting boiling points (bp's)

Halogen	bp
F_2	-187°C
Cl_2	-35°C
Br_2	59°C
I_2	184°C

Hydrocarbons	bp
	9°C
$CH_3CH_2\ CH_2\ CH_2\ CH_3$	36°C

Practice predicting relative bp's

What is the dominant IMF of the following molecules?

O_2

HCl

CO_2

NH_3

Arrange the molecules above in order of decreasing bp.

Determine the dominant IMF for each compound. For each pair, predict which compound has the higher bp.

CO_2 vs SO_2

CH_4 vs CCl_4

Solids, Liquids, and Gases Part 4: Pressure

Pressure

Barometers

Various Pressure Units

1.000 atm = 760.0 mmHg = 760.0 torr = 29.92 inHg = 14.68 psi = 1.013×10^5 Pa

Blood Pressure: the pressure exerted by blood on the walls of blood vessels.

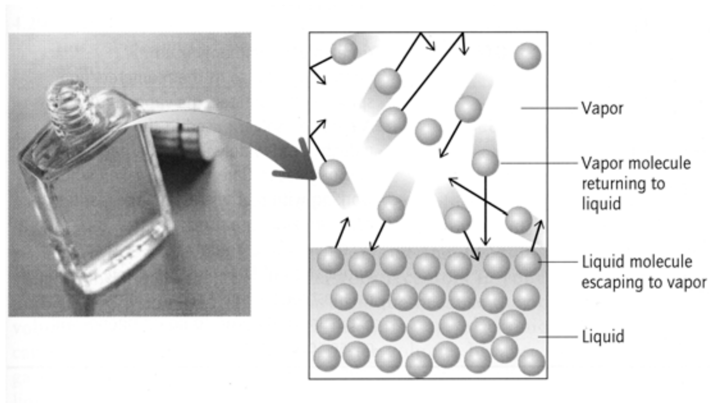
Systolic Pressure: the maximum blood pressure

Diastolic Pressure: the minimum blood pressure

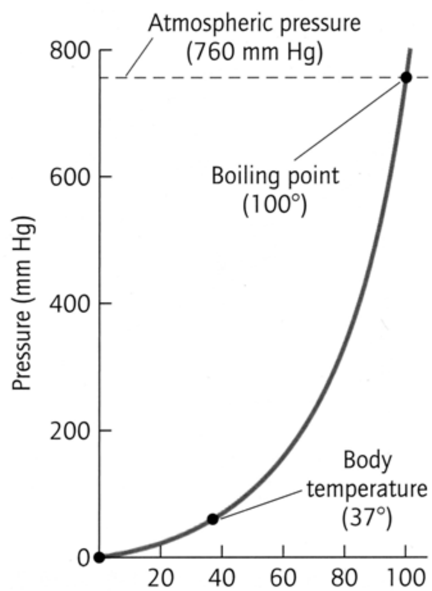
Ranges of Blood Pressure

Condition	Systolic (mmHg)	Diastolic (mmHg)
Hypotension (low)	< 90	< 50
Normal	90 – 130	50 -90
Pre-hypertension	130 – 140	90 - 100
Hypertension	> 140	> 100

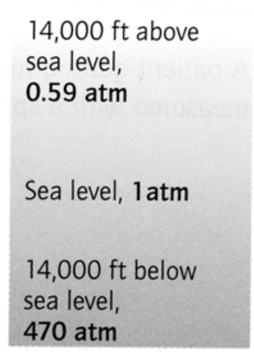
Vapor Pressure – the pressure exerted by molecules in the gas phases in contact with molecules in the liquid phase



Boiling Point:
Temperature at which the vapor pressure of the liquid equals the atmospheric pressure



Changes in Atmospheric Pressure with Altitude



Solids, Liquids, and Gases Part 5: Gas Laws

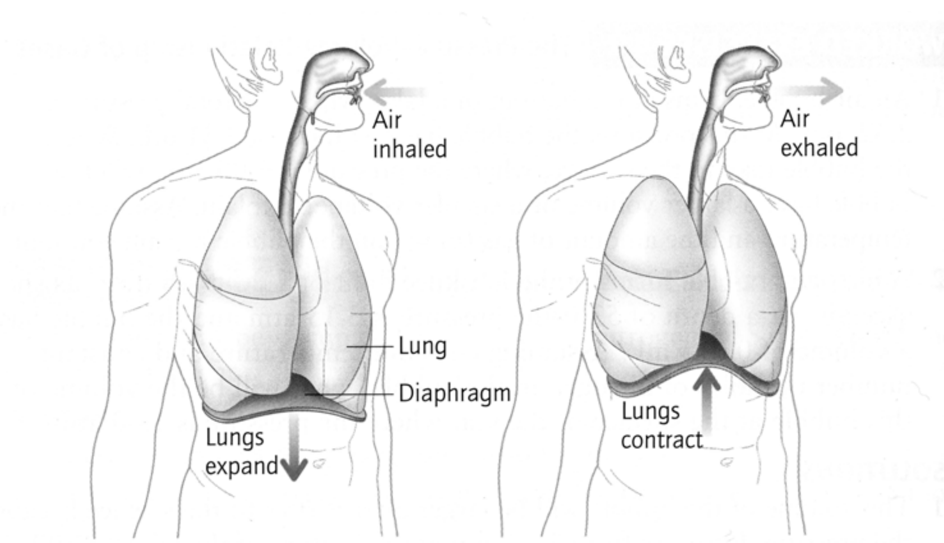
Gases & the Kinetic Theory of Matter

1. A gas consists of small particles (atoms or molecules) that move randomly with rapid velocities.
2. The attractive forces between the particles of a gas can be neglected.
3. The actual volume occupied by gas molecules is extremely small compared to the volume that the gas occupies.
4. The average kinetic energy of gas molecules is proportional to the Kelvin temperature.
5. Gas particles are in constant motion, moving rapidly in straight paths.

Gas Laws:

Boyle's Law: The Pressure- Volume Relationship of Gases

The volume of air in a person's lungs is 615 mL at a pressure of 760 mmHg. Inhalation occurs as the pressure in the lungs drops to 752 mmHg. To what volume did the lungs expand?



Dalton's Law of Partial Pressures

Dalton's law states that a gas mixture (P_{total}) will exert a pressure independent of the other gases (P_n) and each gas will behave as if it alone occupied the total volume.

$$P_{Total} = P_1 + P_2 + P_3 + P_4 + \ldots.. + P_n$$

The partial pressure of each gas can be calculated by multiplying the total pressure (P_{total}) by the gas percentage (%).

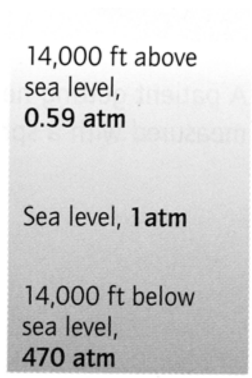
$$P_n = (\text{\% of individual gas}_n)(P_{Total})$$

A mixture of the gases N_2, O_2, and He has a total pressure of 760 mmHg. If the partial pressure of N_2 is 120 mmHg and of He is 240 mmHg. What is the partial pressure of O_2?

What percent of the gas above is O_2?

Henry's Law – the amount of gas dissolved in a liquid is directly proportional to the partial pressure of that gas above the liquid

Two unopened bottles of carbonated water are at the same temperature. If one is opened at the top of a mountain and the other at sea level, which will produce more bubbles? Explain your reasoning.



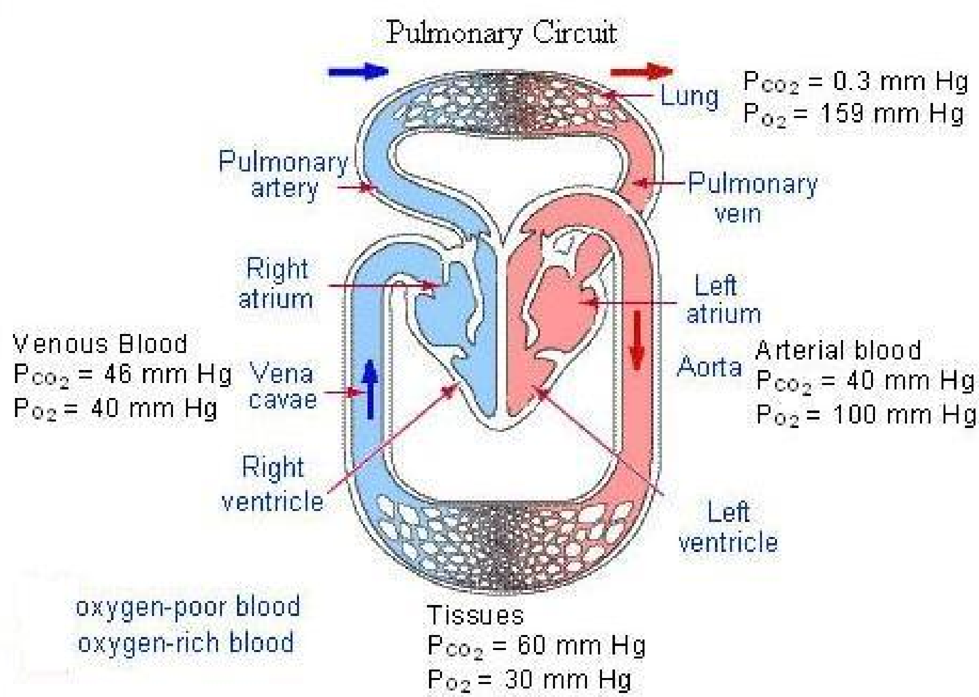
What happens to the solubility of O_2 gas in water in each of the following situations? Explain your reasoning.

a) The pressure of O_2 over the solution is decreased.

b) The temperature of the solution is decreased

Partial Pressures & Dissolved Gases in the Human Body

Henry's law tells us that gases diffuse from areas of high gas concentration to areas of low gas concentration.



Use the diagram above to explain why oxygen diffuses from the alveoli into the blood and from the blood into the tissues of the body.

Use the diagram above to explain why carbon dioxide diffuses from the tissues into the blood and from the blood into the alveoli and then finally out into the atmosphere.