IPC Unit 8

Lecture 1: States of Matter

Terms we need to know first...

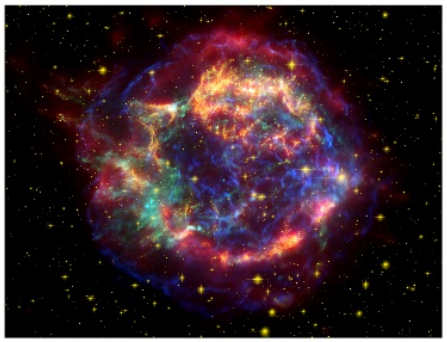
Elastic Collisions

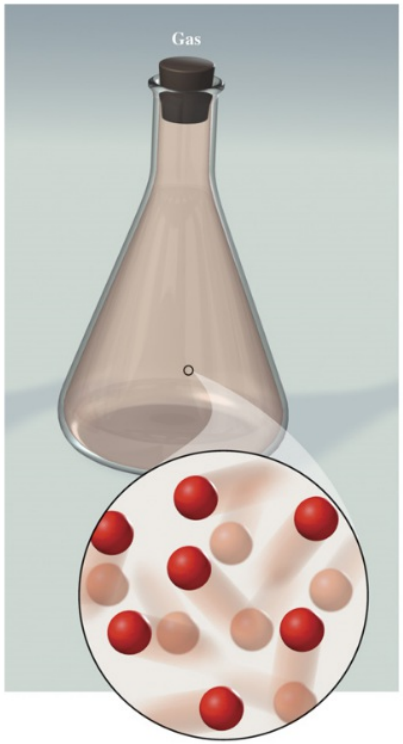
- no kinetic energy is lost during the collisons

Inelastic Collisions

- we lose kinetic energy of the collisions typically to heat / friction

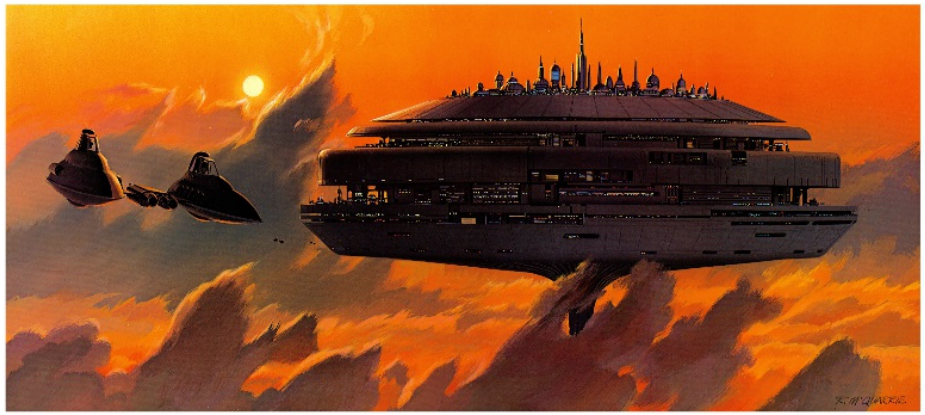
Gas State





Particles of a Gas...

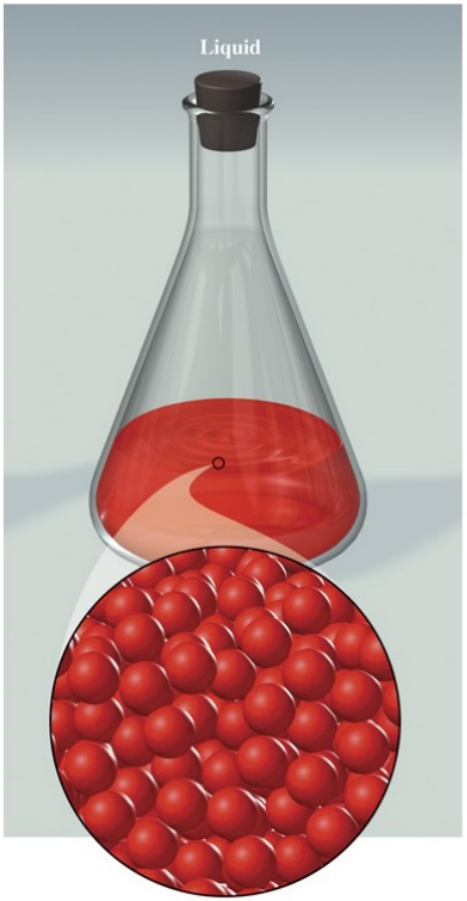
- are in constant, random, straight-line motion
- have completely elastic collisions
- are not attracted to each other
- spread out to fill the volume of the container they are in
- take the shape of the container they are in



Liquid State

Particles of a Liquid...

- are constantly moving, but not as fast a gases
- have less kinetic energy than particles in gases
- are unable to overcome their attrations to one another, therefore they cling together and give the liquid a definate volume



Liquid State (cont.)

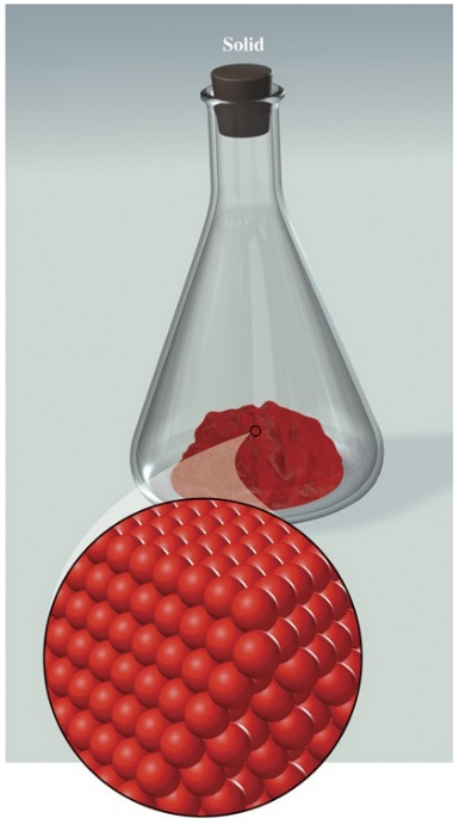
Particles of a Liquid...

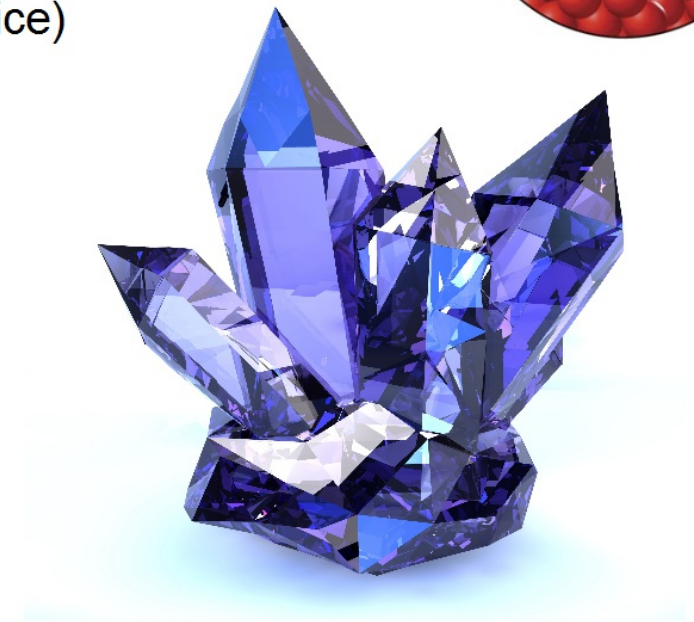
- cannot be compressed because the particles are close together
- are able to slide past one another which allows liquids to flow and take on the shape of their container

Solid State

Particles in Solids...

- have definate shape and volume
- are in constant motion, they are vibrating
- do not have enough energy to overcome their attration to one another
- cannot be compressed
- many form in crystalline patterns, meaning they have specific geometric arrangements (ex. ice)





Thermal Energy and Temperature

Thermal Energy

- is the total energy of a material's particles (both kinetic and potential energy)
- energy from the motion of individual particles as well as the energy from forces that act within or between particles are both forms of thermal energy

Temperature

- is the term used to explain how hot or cold and object is
- represents the average kinetic energy of the particles that make up a substance

Changes of State

Melting

- the temperature at which a solid becomes a liquid

Freezing

- the temperature at which a liquid becomes a solid

Changes of State (cont.)

Vaporization

- particles move fast enough to escape the attractive forces of other partilces
- occurs in three ways: evaporation, boiling, and sublimation
- Evaporation: particles must be at the surface of a liquid and have enough kinetic energy to escape the attractive forces of the liquid (can happen at almost any temperature)
- Boiling: occurs throughout a liquid at a specfic temperature, depending on the pressure on the surface of the liquid

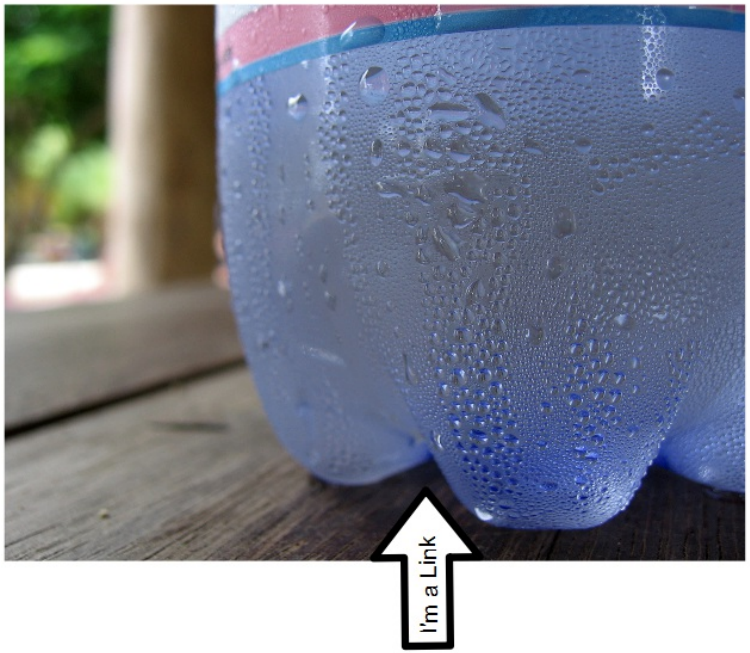
Changes of State (cont.)

Vaporization (cont.)

- Sublimation: the process of a solid changing directly to a gas without forming a liquid (happens to certain substances at certain pressures)

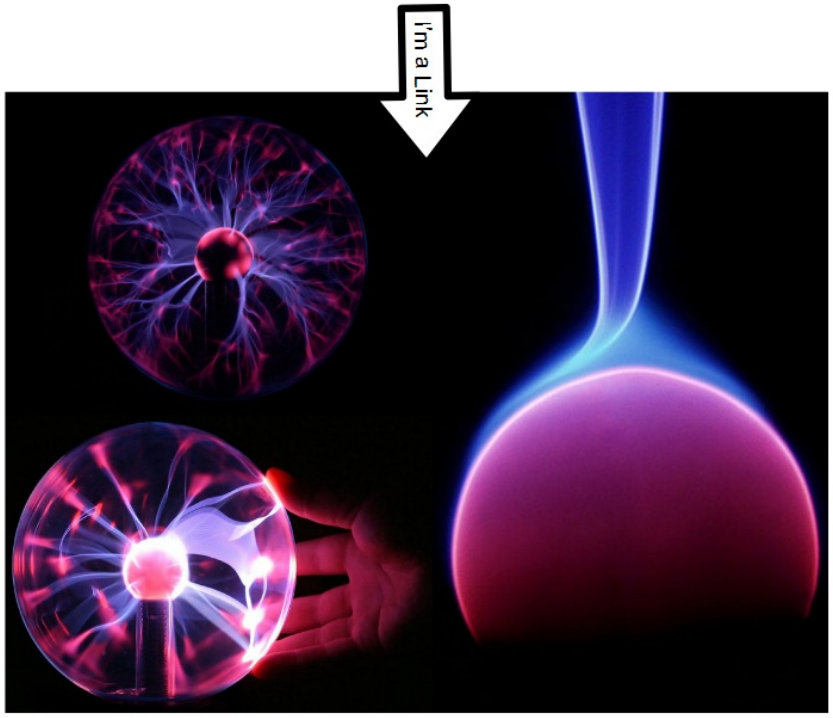
Condensation

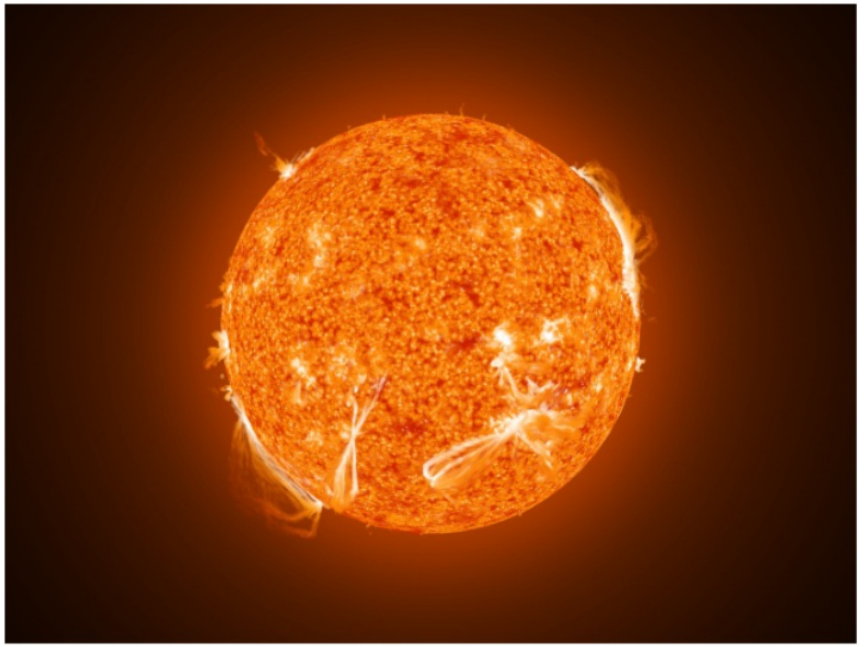
- the process in which a gas becomes a liquid
- Deposition: the process of a gas changing directly to a solid without forming a liquid (ex. how snow forms)



Plasma State

- Occurs when a gas has enough energy to not only overcome the attractive forces between particles, but the attractive forces within the atom itself
- Happens naturally in two ways: lightning and in stars



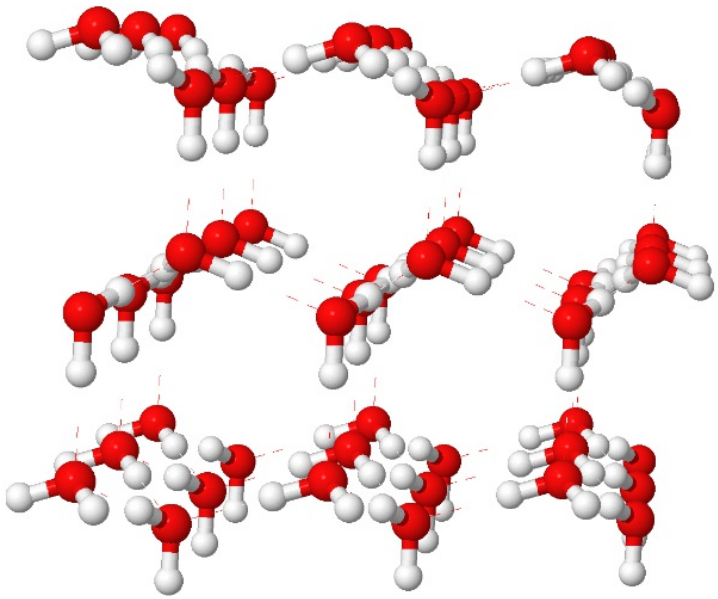


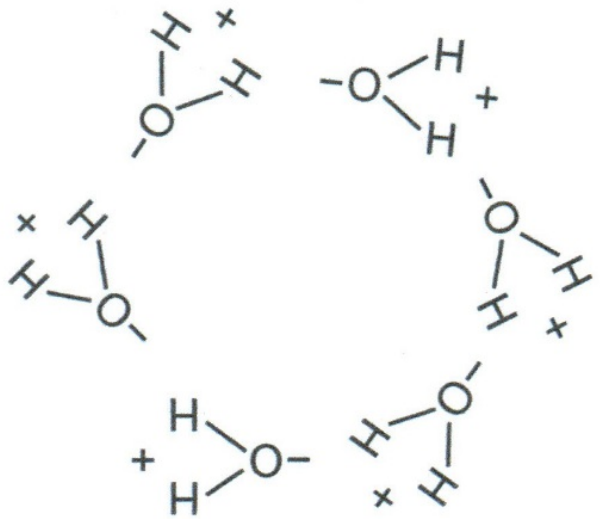
Thermal Expansion

- an increase in the size of a substance when the temperature is increased
- Examples: thermometers and hot-air balloons

Water's Strange Behavior

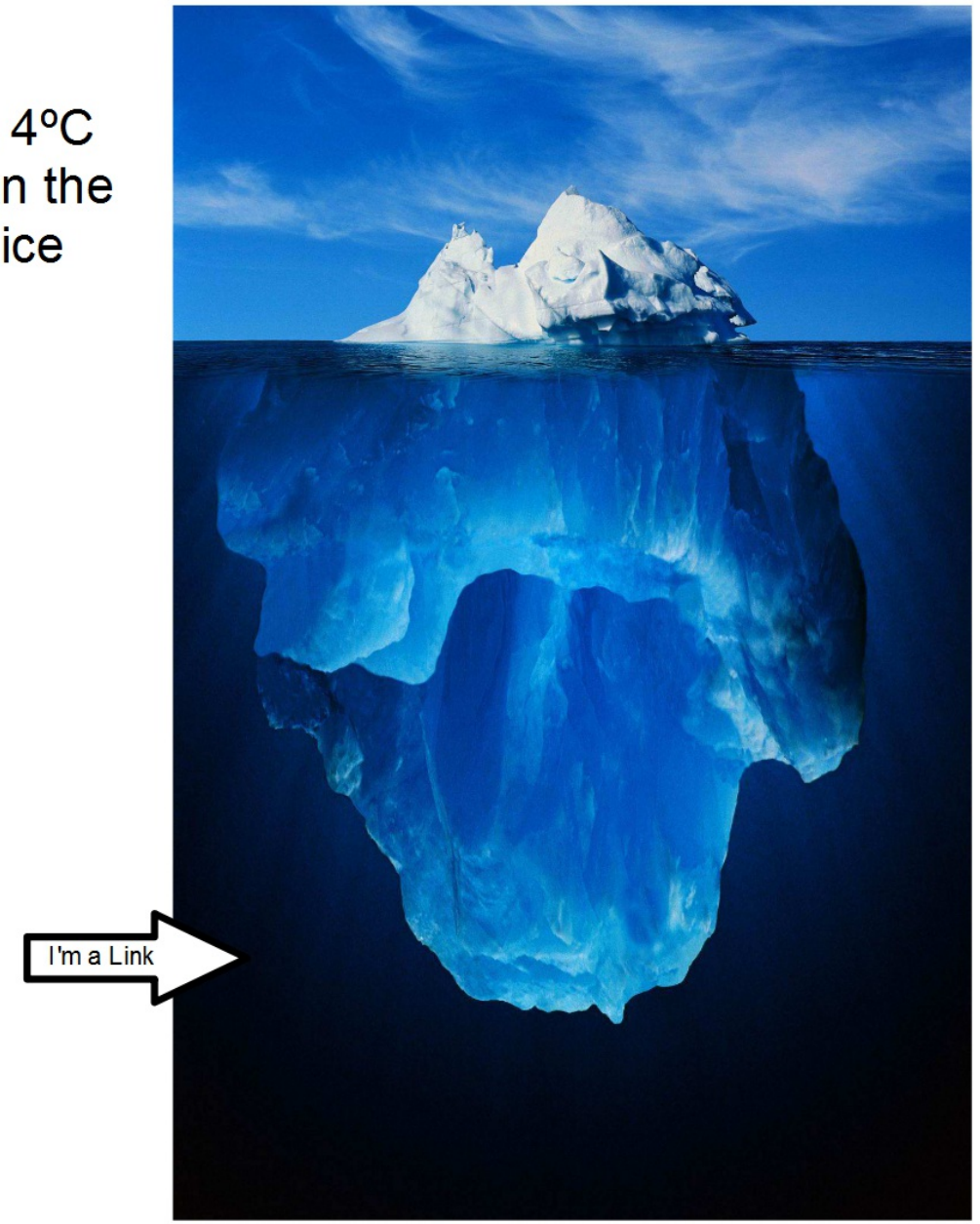
- ordinarily, substances contract as their temperature decreases
- as temperature begins to drop water acts like any other substance; this continues till about 4ºC
- from 4ºC to 0ºC water starts to expand because a water molecule has a highly positive and a highly negative side, the molecules start to align so that only their positive and negative sides are near each other; this leaves empty space between the molecules





Water's Strange Behavior (cont.)

- because water is expanding from 4ºC to 0ºC it becomes less dense than the liquid water around it; this is why ice floats on water



Amorphous Solids

- are solids that gradually become liquid over a range of temperatures rather than a specific temperature
- Examples: butter and glass