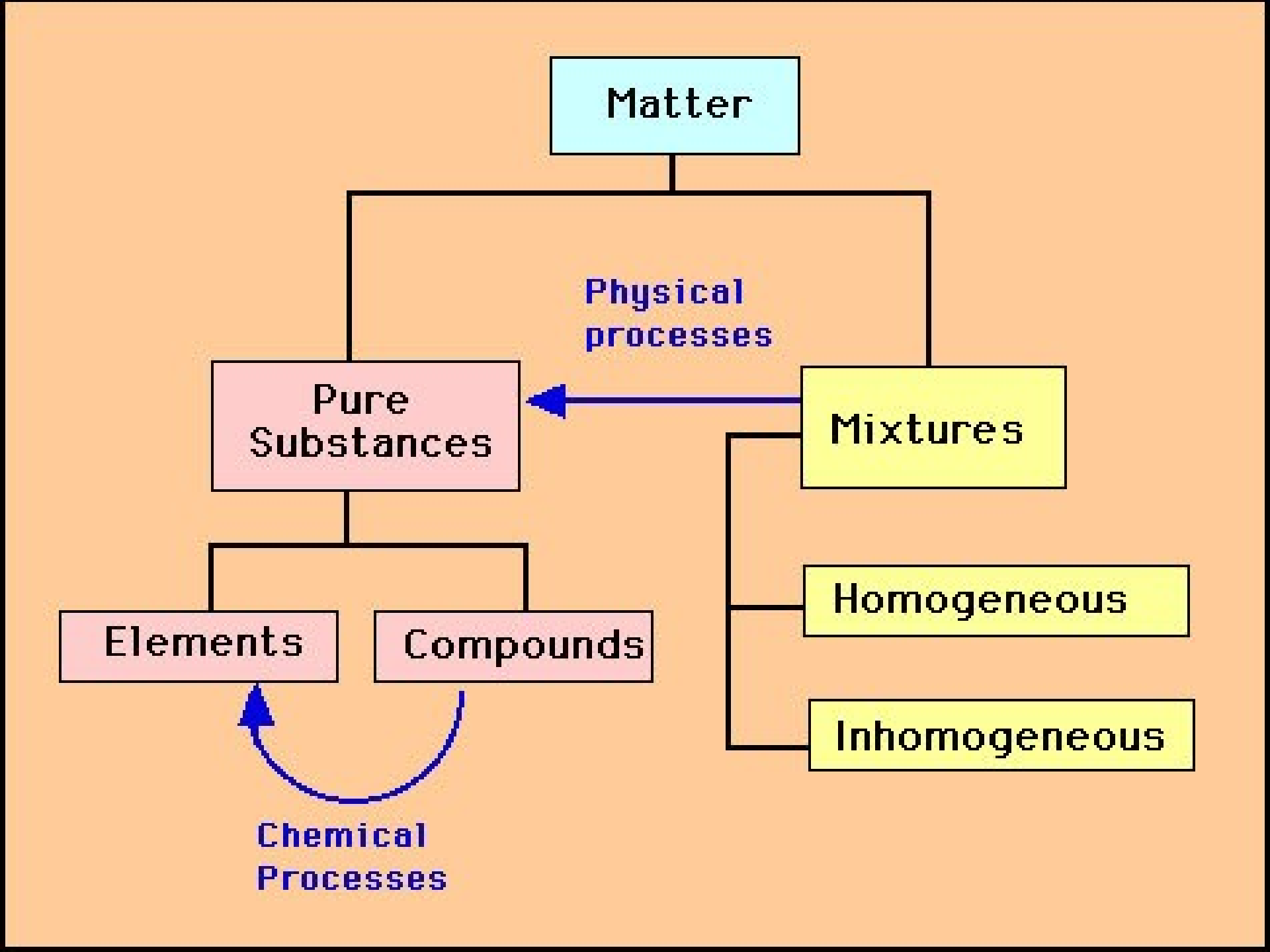
Properties of Matter

Matter is divided into 4 components:

- Elements
- Compounds
- Mixtures
- Solutions


Matter
Physical processes
Pure Substances
Mixtures
Elements
Compounds
Homogeneous
Inhomogeneous
Chemical Processes

PURE SUBSTANCES

Elements and Compounds

ELEMENT

All elements are on the Periodic Table

- All matter is made of an element or a combination of elements
- **Hydrogen, Oxygen, Gold**

- **A substance that consists of only one kind of atom and that cannot be chemically separated into other substances.**
- **All elements are made up of atoms**

Compounds:

- substances that can be broken down by chemical methods
  - **When they are broken down, the pieces have completely different properties than the compound.**
  - **Made of molecules- two or more atoms**

Mixtures

Mixtures and solutions

Heterogeneous and Homogeneous

MIXTURE

- **Matter that can be physically separated into component parts**
- **It is two or more kinds of matter that have separate identities because of their different properties.**
- **NOT CHEMICALLY BONDED**

When different parts of a mixture can no longer be separated into simpler substances, we call each component a PURE SUBSTANCE

There are two types of mixtures:

- Heterogeneous- mixture is not the same from place to place.
  - Chocolate chip cookie, gravel, soil.

- Homogeneous- same composition throughout.
  - Kool-aid, air.

- Every part keeps its properties.

Solutions:

- **S o l u t i o n s -** A special mixture formed when one substance dissolves into another.

Solutions:

- **S o l v e n t** - the most abundant substance in a solution. The solvent dissolves the solute.
- **S o l u t e** - the least abundant substance in a solution. The solute dissolves into the solvent.
- **In a sugar water solution. Water is the solvent. Sugar is the solute.**
- **In steel (a solution which becomes a solid) iron is the solvent and**

Solutions

- Homogeneous mixture
- Mixed molecule by molecule
- Can occur between any state of matter.
  - Solid in liquid- Kool-aid
  - Liquid in liquid- antifreeze
  - Gas in gas- air
  - Solid in solid - brass
  - Liquid in gas- water vapor

Conductivity of Solutions

- Pure water does not conduct electricity, but particular solutes which produce ions as they dissolve will add conductivity to the solution
- An ionically conducting solution is called an electrolyte solution and the compound, which produces the ions as it dissolves, is called an electrolyte. A strong electrolyte is a compound that will completely dissociate into ions in water.
- Correspondingly, a weak electrolyte dissolves only partially. The conductivity of an electrolyte solution depends on the concentration.

Concentration of Solution

- Shows level of solute in the solvent
- Can be Expressed in several ways
  - Relative Concentrations
    - Dilute – small amounts of solute compared to solvent
    - Concentrated – large amounts of solute compared to solvent
  - Levels of Concentration
    - Unsaturated solution – is able to dissolve more solute
    - Saturated solution – has dissolved the maximum amount of solute
    - Supersaturated solution – has dissolved excess solute (at a higher temperature). Solid crystals generally form when this solution is cooled.

Percent Composition (by mass)

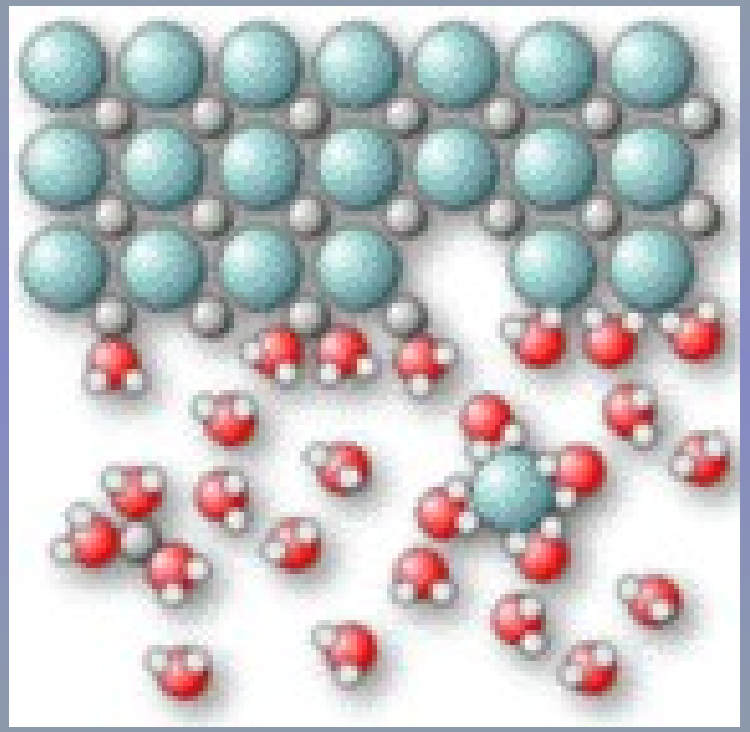
- We can consider percent by mass (or weight percent, as it is sometimes called) in two ways:
- The parts of solute per 100 parts of solution.
- The fraction of a solute in a solution multiplied by 100.
- We need two pieces of information to calculate the percent by mass of a solute in a solution: The mass of the solute in the solution.
- The mass of the solution.
- Use the following equation to calculate percent by mass: (Write the equation)

$$\text{Percent by mass} = \frac{\text{mass of solute}}{\text{mass of solution}} \times 100$$

Rate of Dissolving

Factors Affecting How Fast a Solute Dissolves

1. Temperature
2. Stirring or Shaking
3. Crushing (Surface Area)
4. Pressure

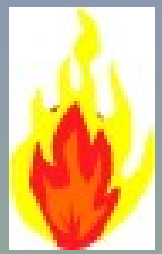


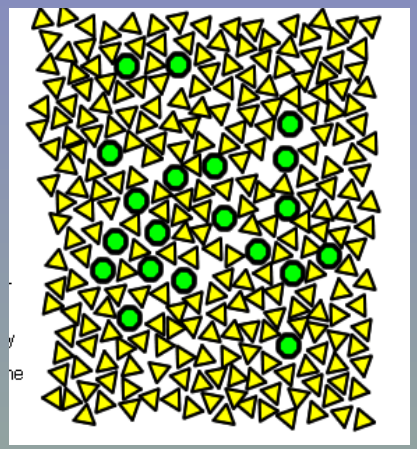
1. Temperature

If we heat particles they will **move faster**

The solvent will carry the solute particles away faster

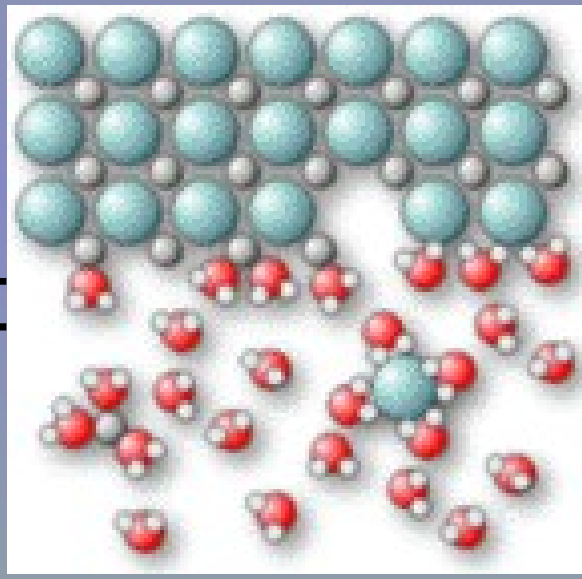
Hotter = Dissolve Faster





2. Agitating

Stirring or shaking a solution *moves the solute particles* around so that they are closer to the solvent. The solvent particles can then attract them easily and carry them away!



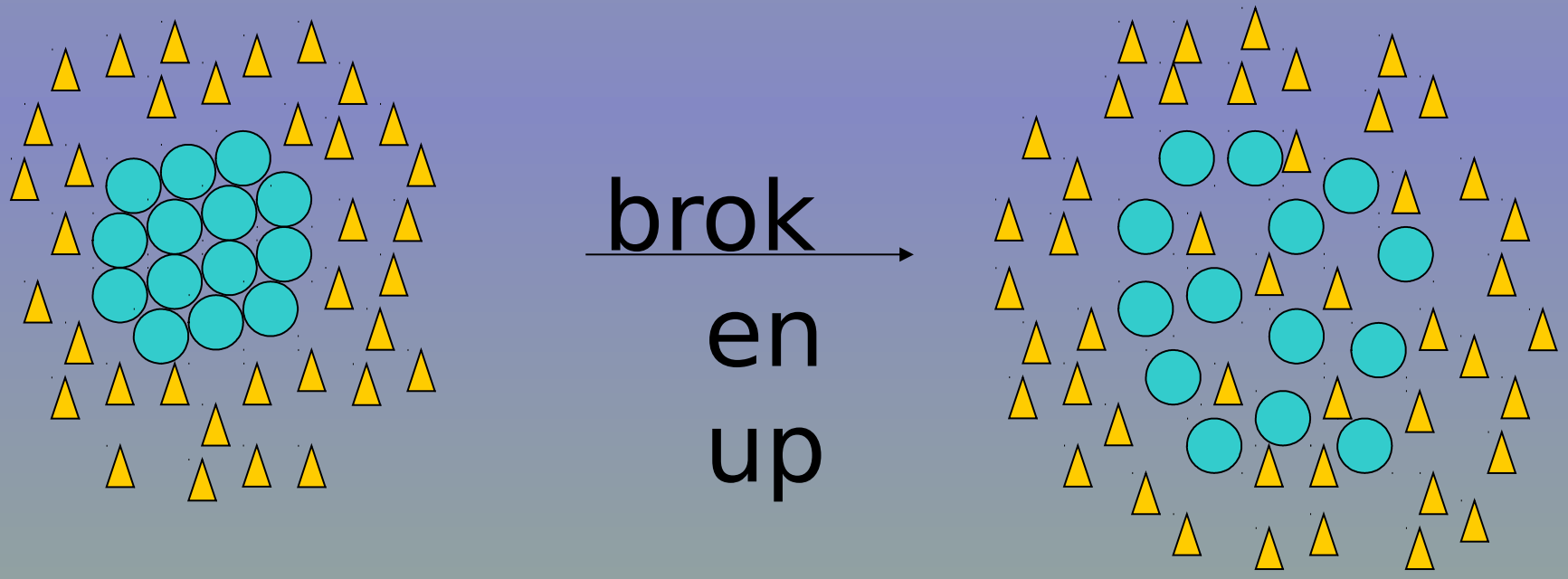
Stir or Shake = Dissolve Faster

3. Crushing (More Surface Area)

When a solute is broken into small pieces, the individual particles can get closer to solvent particles so they can be easily dissolved

Dissolving happens on the surface of particles

When solute is broken up, there is more surface area where dissolving can occur



4. Pressure

Pressure forces solute particles into the spaces between the solvent particles

More pressu Dissolve Faster

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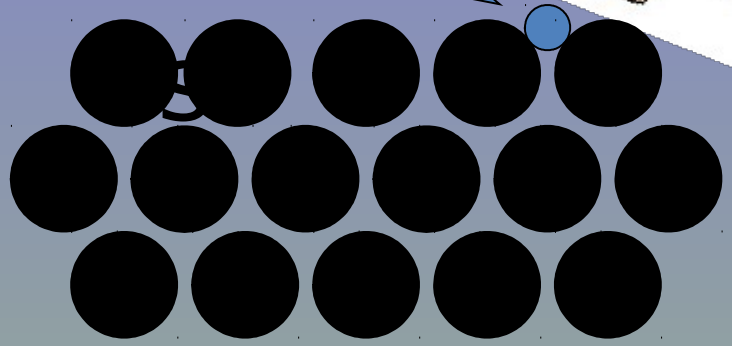
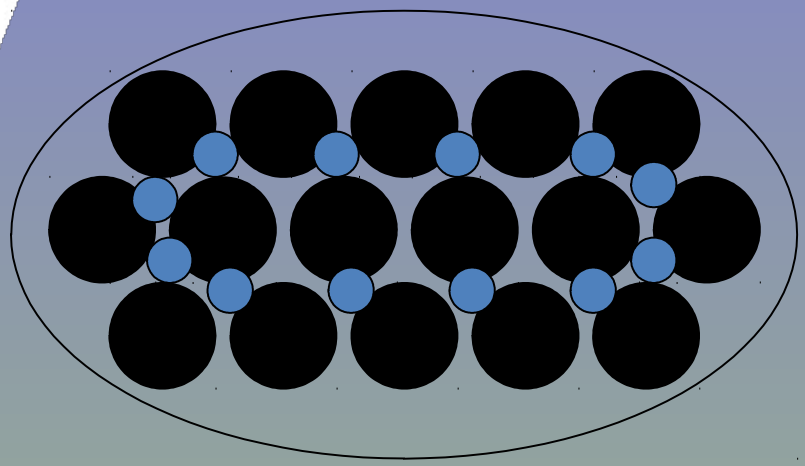
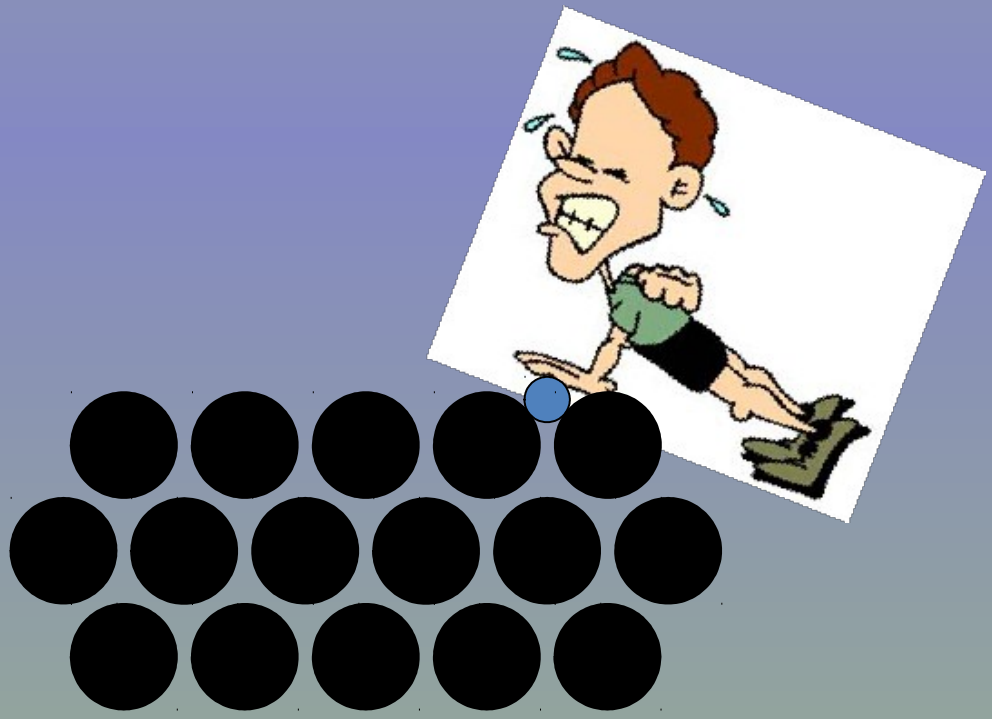




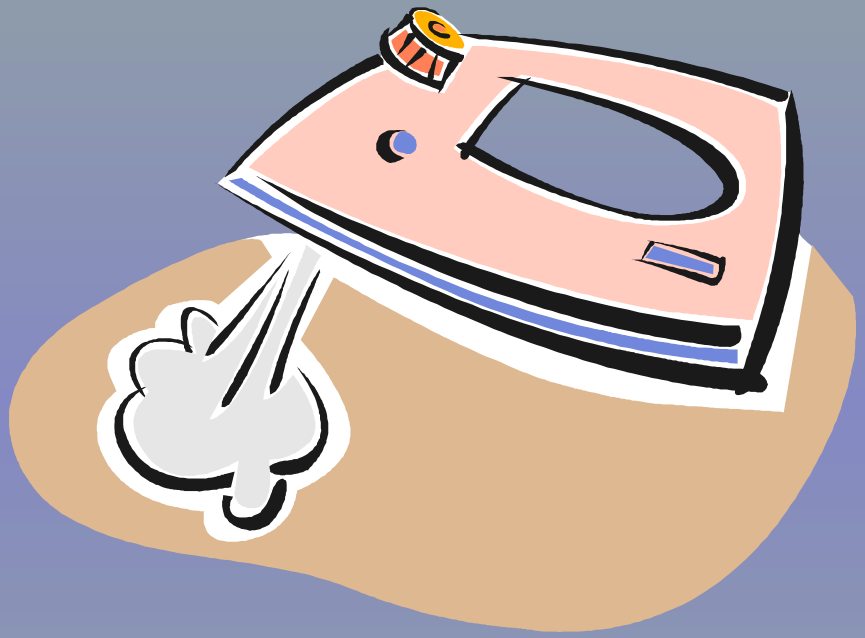
So…



Two techniques for separating solutions:

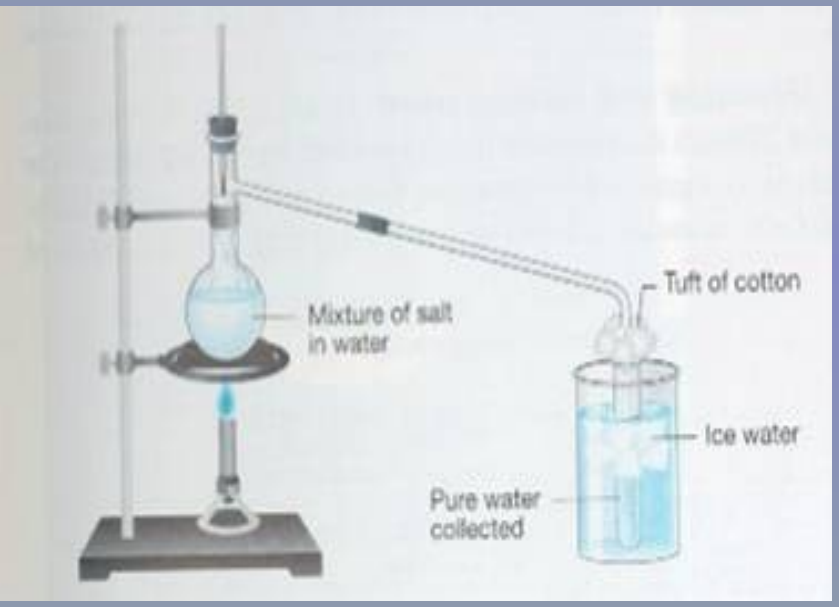
#1. Evaporation: changing from a liquid to vapor state– leaves behind the other component.

If you evaporate the water from a NaCl solution, the salt will remain. This is a method of purifying water.



#2: Distillation:

- Process used to drive vapor from liquid by heating
- Great for separating two or more liquids which have different boiling points.
- This is a method for processing gasoline into Diesel and different octane gas. They all have differing boiling



States of Matter

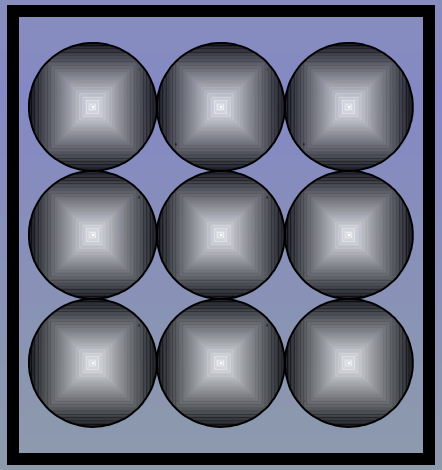
Anything that has mass and takes up space (volume)

4 Physical States of Matter

- Solid
- Liquid
- Gas
- Plasma

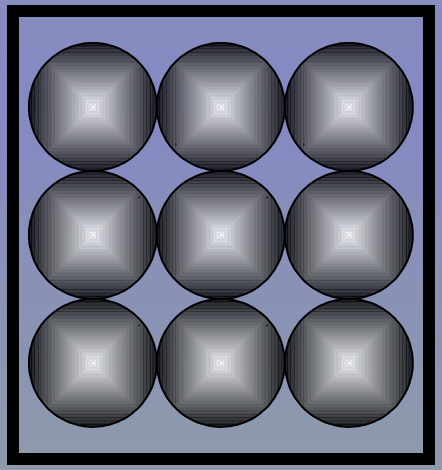
Solid

- Particles are tightly packed
- Particles vibrate and cannot move freely
- Low energy level
- Definite shape and volume
- Solid Animation



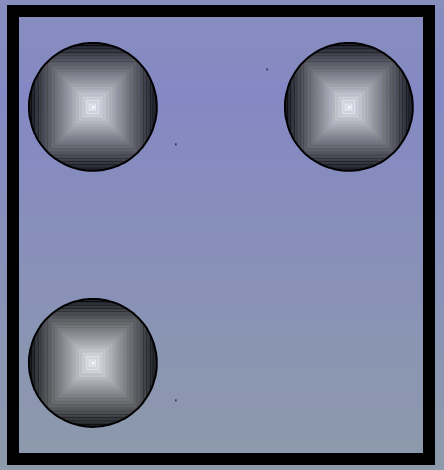
Liquid

- Particles are tightly compact, but able to move around close to each other
- More energy than a solid
- No definite shape, but definite volume
- Liquid Animation



Gas

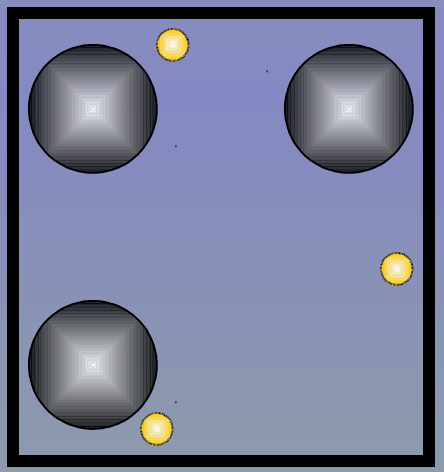
- Particles can easily spread out or move close together
- Particle move freely and with a lot of energy
- No definite shape or volume
- Gas Simulation



Plasma

- Exist at extremely high temperatures (several million degrees Celsius)
- Particles are broken apart
- Particles move freely and with extremely high energy
- Electrons are broken loose from their atoms
- No definite shape or volume?
- Examples: Florescent and neon lights, lightning, aurora borealis

Why do you think this is the most common form/state of matter in the universe?

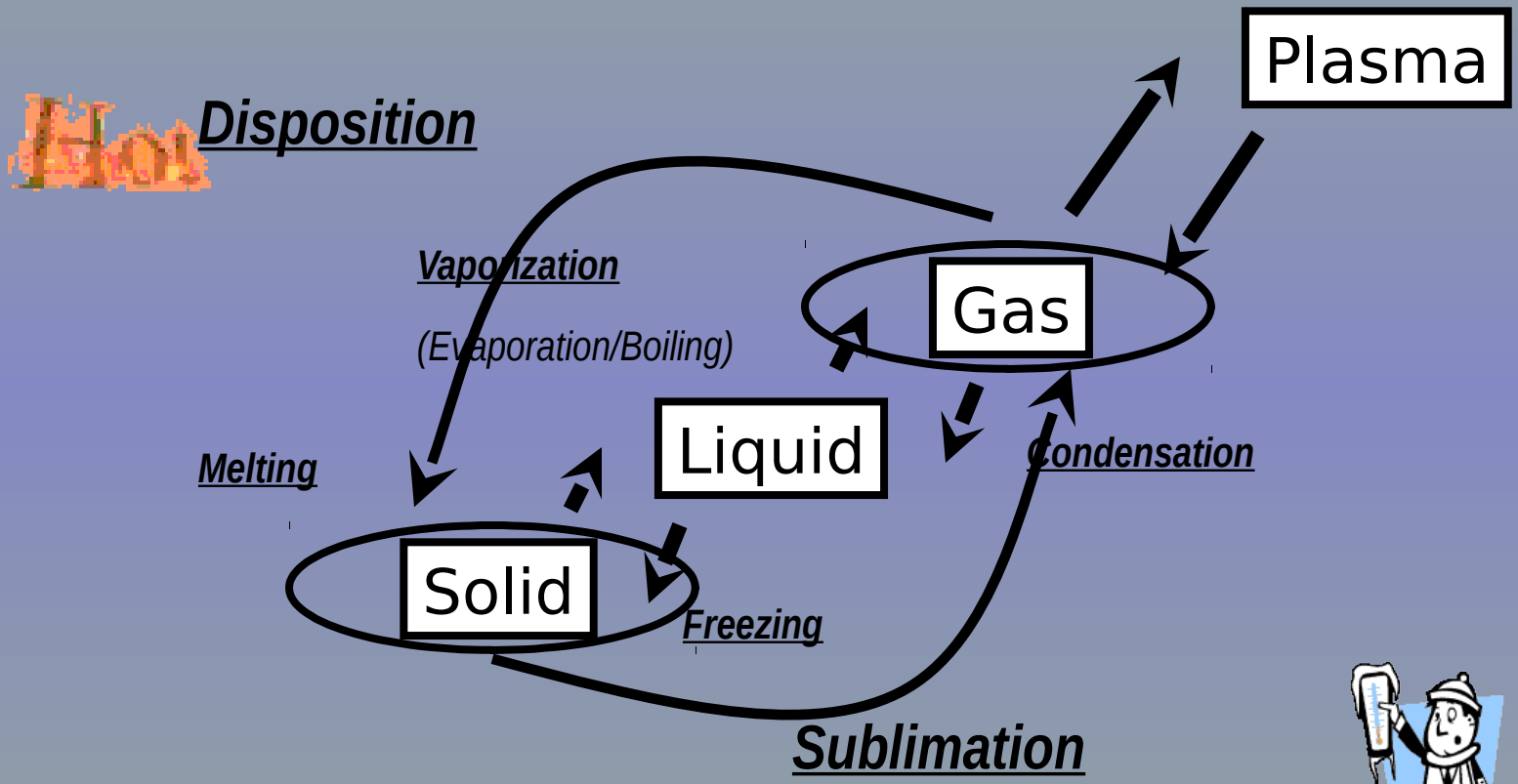


Energy and the States of Matter

- The physical states of matter result from the amount of energy the particles composing the matter have. Basically, more energy means more movement for the particles and less energy means less movement.
- Changing from one state of matter to another requires gaining or losing energy
- Energy/Temperature and Matter

If you were to compare an ice cube and the steam created from boiling water, which would you think has more energy?

Changes in States
(Physical Changes)



All changes in state require a change in energy