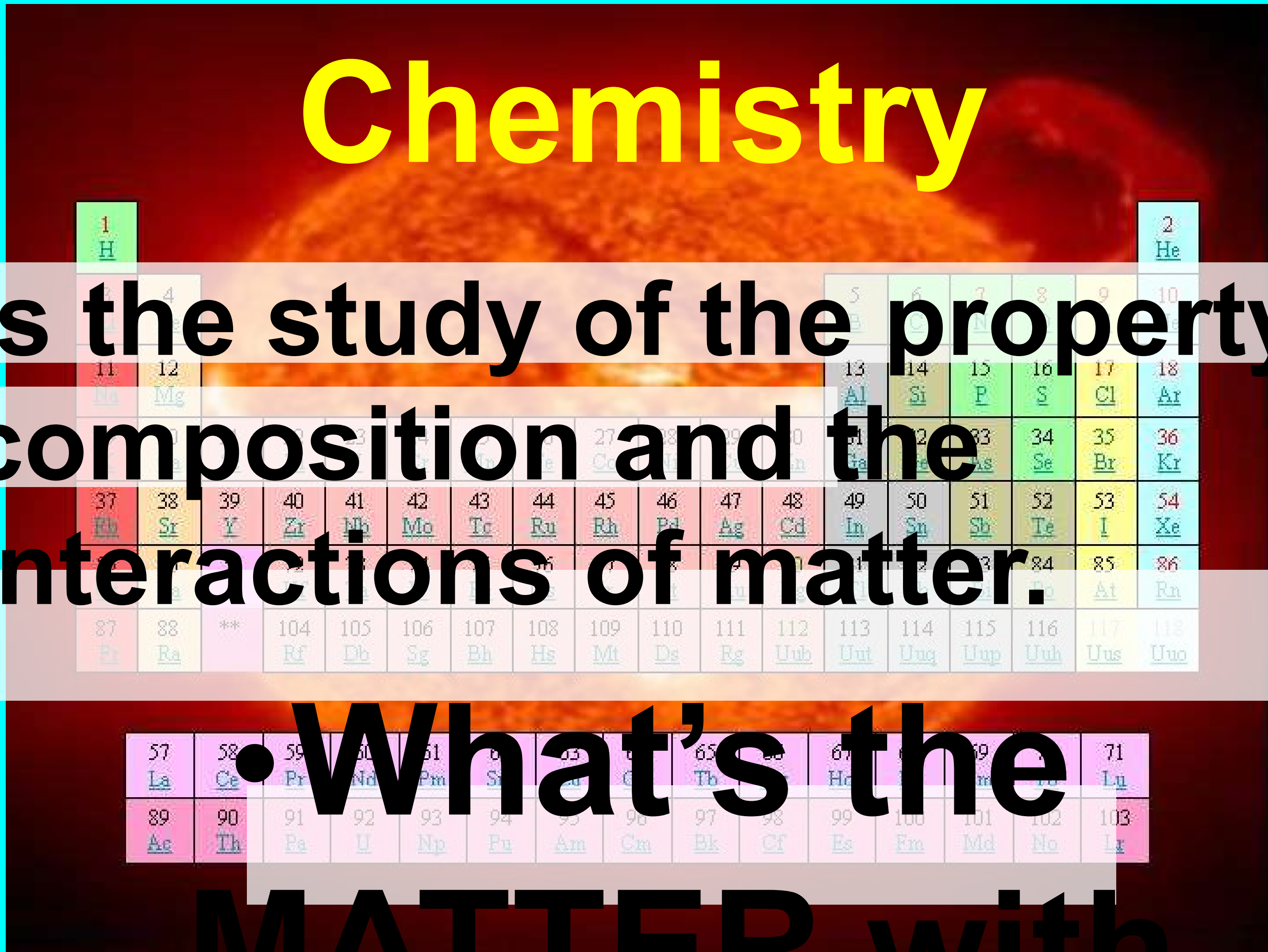
Chemistry

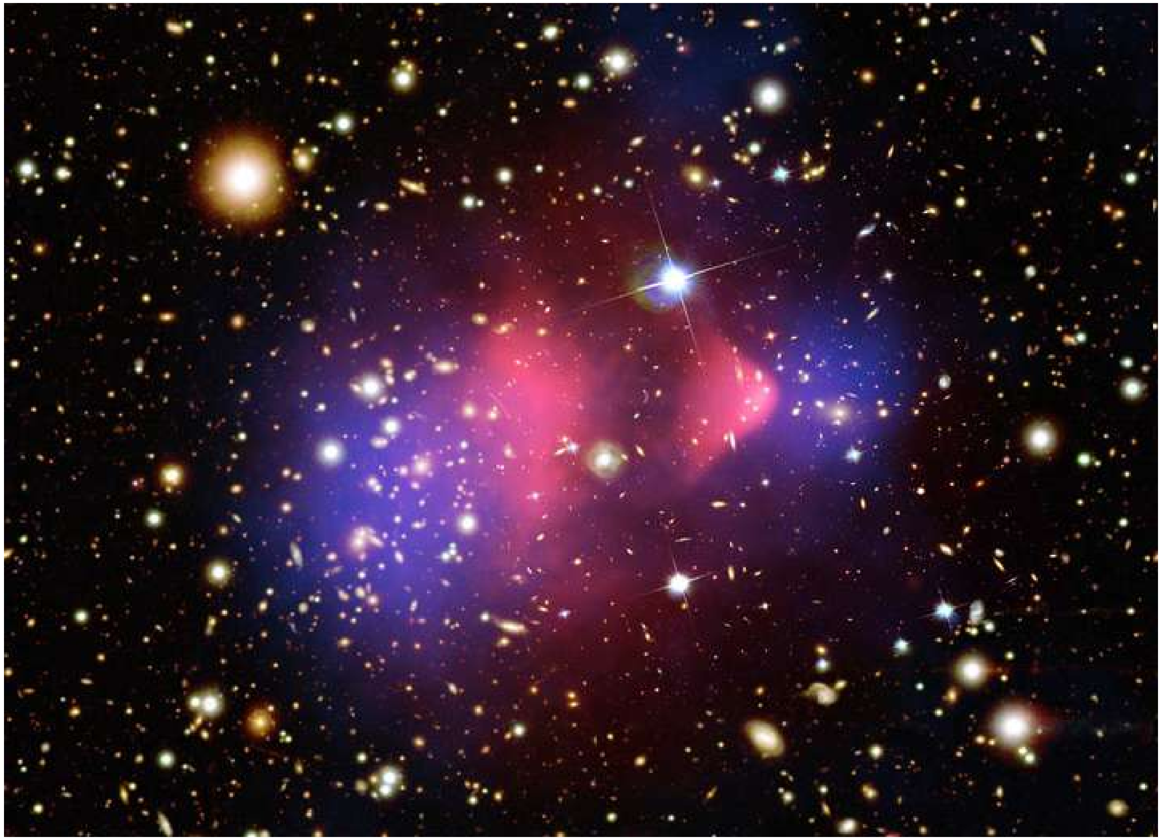


- Is the study of the property, composition and the interactions of matter.

- What's the MATTER with YOU?

Matter and Mixtures

Our entire physical world is made of ***matter***. Matter is **anything that occupies space and has mass**.



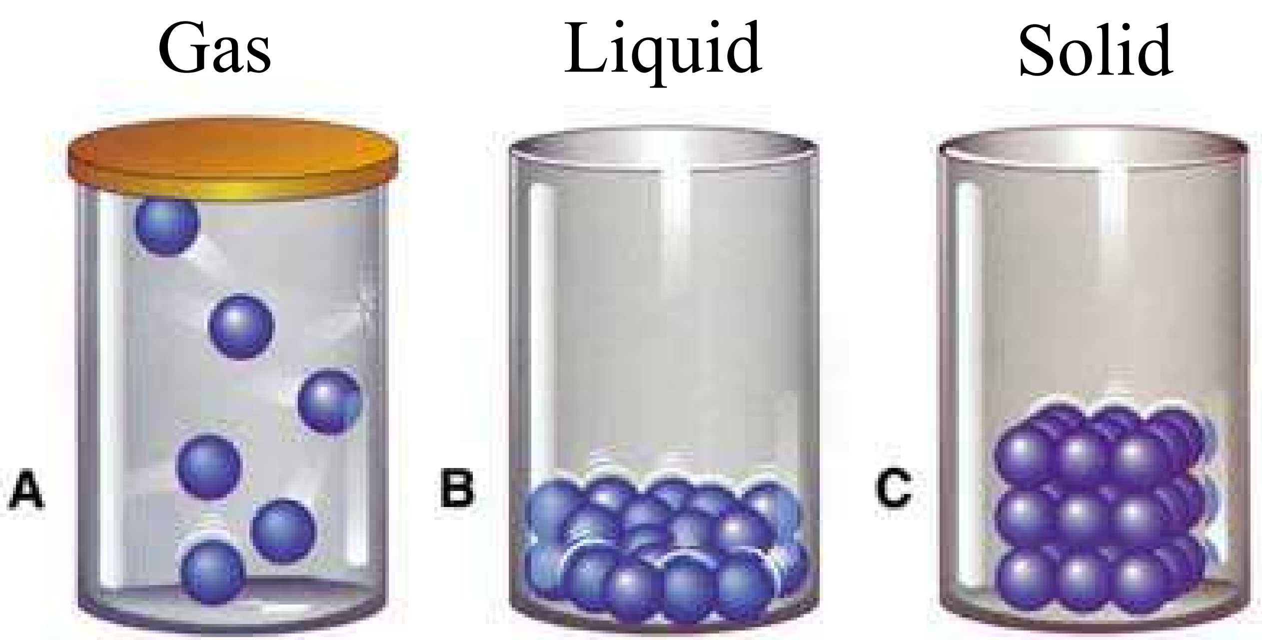
- Over time, we have developed the idea that every large lump of matter is **made out of tiny particles** invisible to the human eye.
- This idea of matter is called ***the particle theory of matter***. The particle theory states that…
- all matter is made from particles **(atoms/molecules)**
- different particles have different properties
- particles are constantly in motion **(energy)**

We can classify matter into **3 broad categories** (there's a fourth) called ***states of matter***—solids, liquids, and gasses.

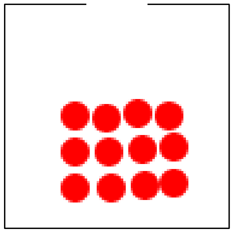
•A ***solid*** has a definite *shape and volume*.

•A ***liquid*** has a definite volume but *no definite shape.*

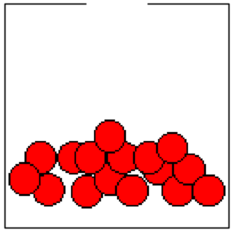
•A ***gas*** has *neither a **definite** volume nor shape*.



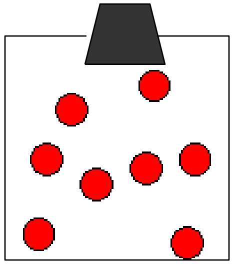
There are attractive forces between particles.



In a solid, the attraction between particles is **strong so the matter holds its shape**. The particles are still moving, but they are **not able to slide past** each other. **They just vibrate.**



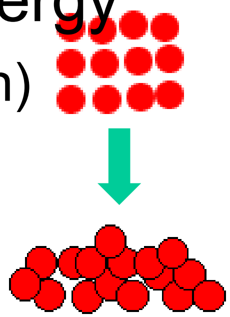
In a liquid the attractive forces are **not as strong**. The particles are **able to move past each other and slide around**. The forces are strong enough to keep the particles from flying away.



In a gas, the **attraction between particles is so weak** that they fly in every direction filling the container that they are held.

- Phases can interchange. Matter can go from solid to liquid, liquid to solid, gas to liquid, etc…
- Phase changes are physical properties that can occur during both **physical and chemical changes**, which will be explained in detail later.

- **Heat is a big factor of physical change.**
  - Heat makes things move faster, increasing energy
    - matter is moving faster, attractive forces break (burn)
    - Before the forces break, the particles expand

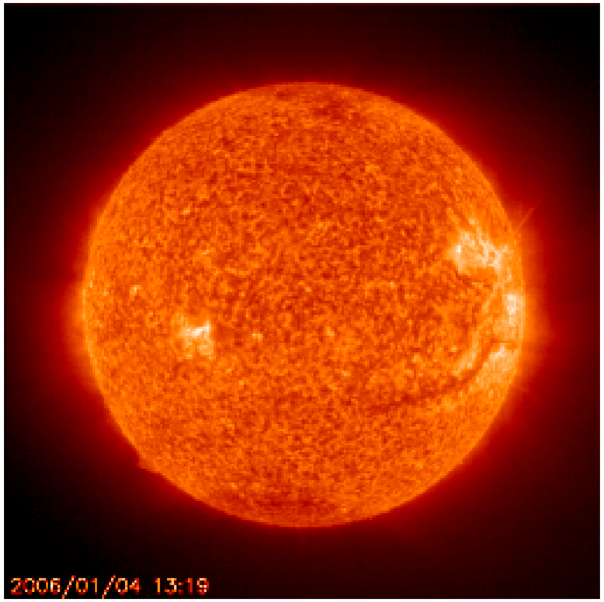


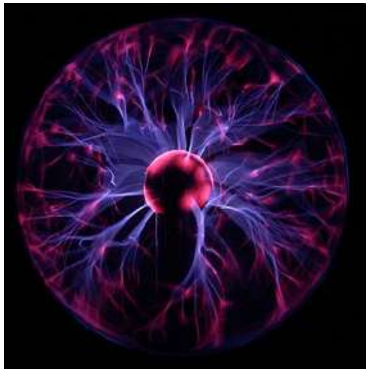
  - Different particles have different properties
    - Some matter breakdown faster than others
    - Plastic will loose it shape faster than metal

Fourth State of Matter

- **Plasma**: a high energy gaseous state of matter.
- **It is very unstable**.
- Particles are **moving extremely fast, free energy**
- Most abundant phase of matter
- Only present under extremely hot/energetic situations

Example: Sun





•As well as classifying matter as solids, liquids, and gasses, we can classify matter as either a **mixture or a pure substance**.

•A ***pure substance (element)*** is made from only one type of particle. These specific particle types give the substance its physical characteristics such as odor, color, hardness.

•Water always exist has H2O whether found in fruit juice, blood, or the ocean.

•A ***mixture*** contains two or more substances.

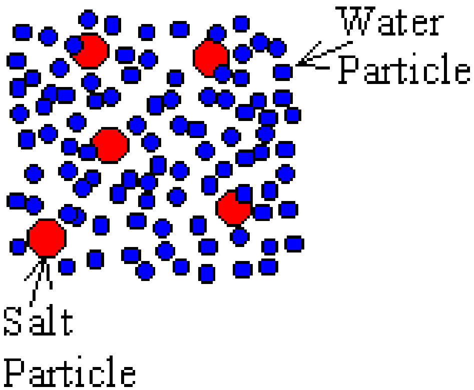
There are two types of mixtures:

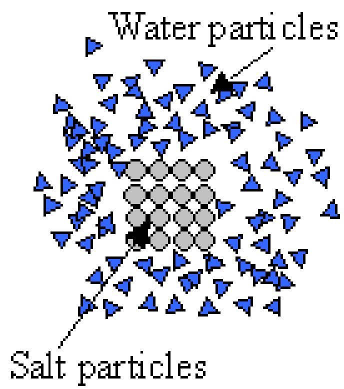
•Homogenous:“homo” same or alike

•Heterogeneous:“hetero” different

Particle size distinguishes homogeneous solutions from other heterogeneous mixtures.

•A ***homogeneous*** mixture has two substances where particles the size of atoms and molecules are **blended completely**. (most mixed)

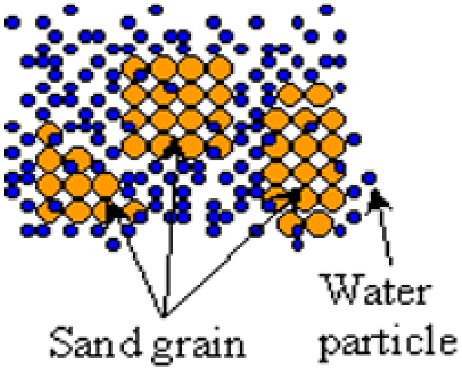




• To the eye, **the mixture appears to be pure substance**. When the particles stay intermixed and don't settle into layers we call the homogeneous mixture a ***solution***.

•Homogeneous mixture results from the process of ***dissolving***. The sugar particles are completely separated from the clumps of other sugar particles. The attractive forces between the sugar particles and the water particles is strong enough to pull the sugar particles away from the main clump.

•In fact, when water vaporizes, the water particles are being dissolved into the air.



- A ***heterogeneous*** mixture has **large clumps of particles** that don't fully separate and doesn't get intermixed with the other substance.
- The difference in particles can be seen in the texture, color, shape and size.
- A *suspension* is a heterogeneous mixture that has clumps that stay floating..

Example: fine sand or silt in water or tomato juice.

•A mixture that is obviously heterogeneous is called a ***mechanical** mixture*. A mechanical mixture has separate parts called ***phases***.

•These phases can be separated into layers that are distinct and visible. Oil forming layers in water is another mechanical mixture with visible phases.

Other examples: Salads, mixed nuts

•Some mixtures are **in-between** homogeneous solutions and heterogeneous mixtures.

- A ***colloid*** has **very small clumps that almost make a solution**.

Examples:Milk, fog, and jello

Review Mixture:

Heterogeneous Mixture

- large________ in size
- mechanical________ mixture has phases
- Fine sand in water is an example of a suspension________

Homogeneous Mixture

- Small________ in size
- Also know as a solution________
- Made by the process of dissolving________

Both

This type of mixture has intermediate size particle. An example is milk: colloid________

Separating Mixtures

Heterogeneous mixtures are usually easier to separate than homogeneous mixture.

- Separating mechanical mixtures is usually quite simple.
- The difference in color, shape and texture can easily be seen.
- Most of us can usually pick out the cashews from a bowl of mixed nuts and gravy separators can easily skim off oil.

- Suspensions like coffee are easily filtered to take out the tiny solid clumps floating in the liquid.

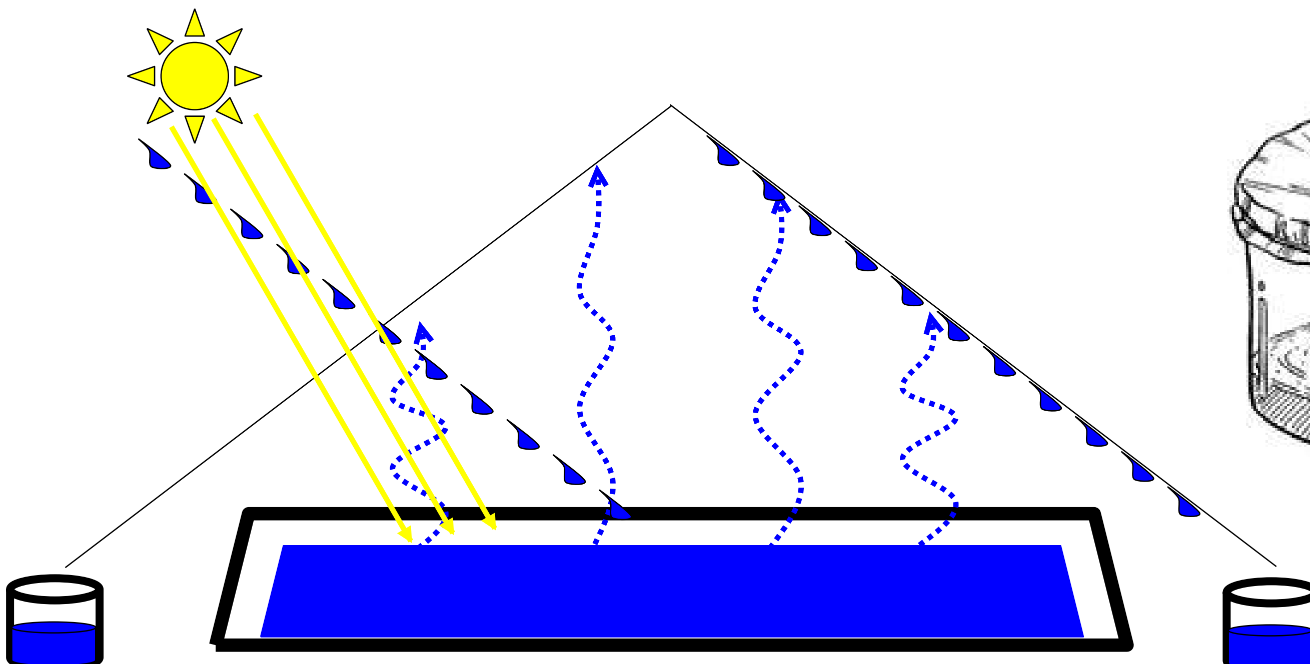
- In colloids and many homogeneous mixtures have clumps that are so small they pass through most filters.

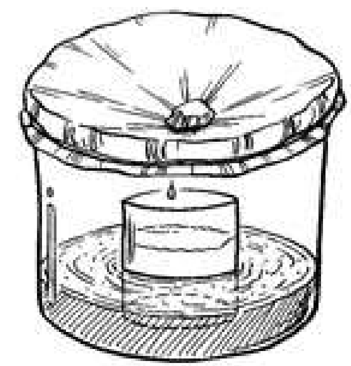
- These mixtures can be separated by **freezing, heating (distillation), aging, centrifuging, and adding other chemicals.**

•If necessary, **solar energy** can be used to evaporate water.

•The vapor rises, hits a clear plastic sheet, condenses, and slides along the edges to outside collection disks.

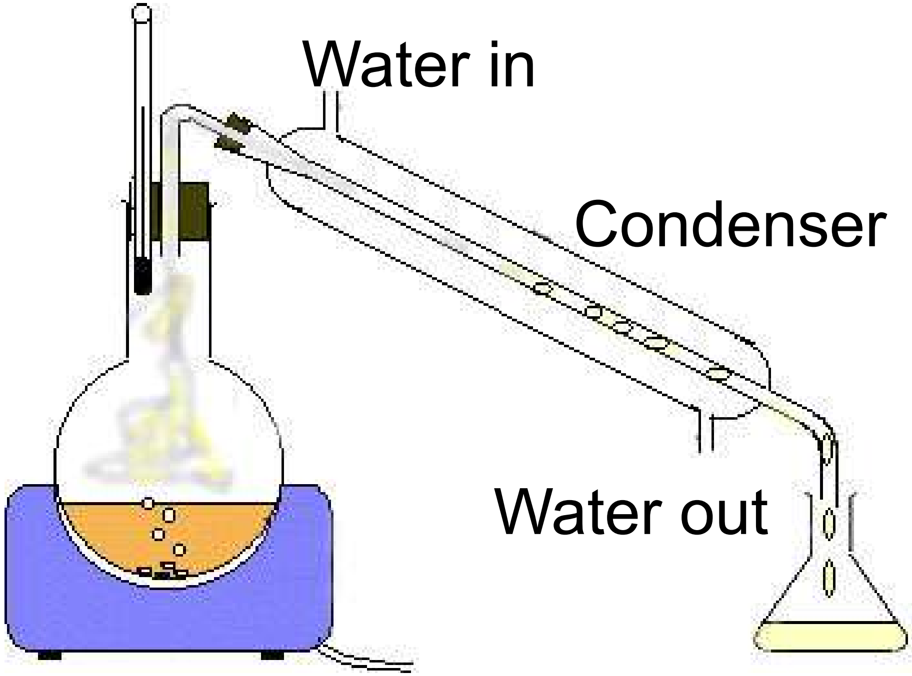
• A simpler design uses a plastic wrap around a large container and a smaller container inside. A small pebble leads the condensed water to the center container.

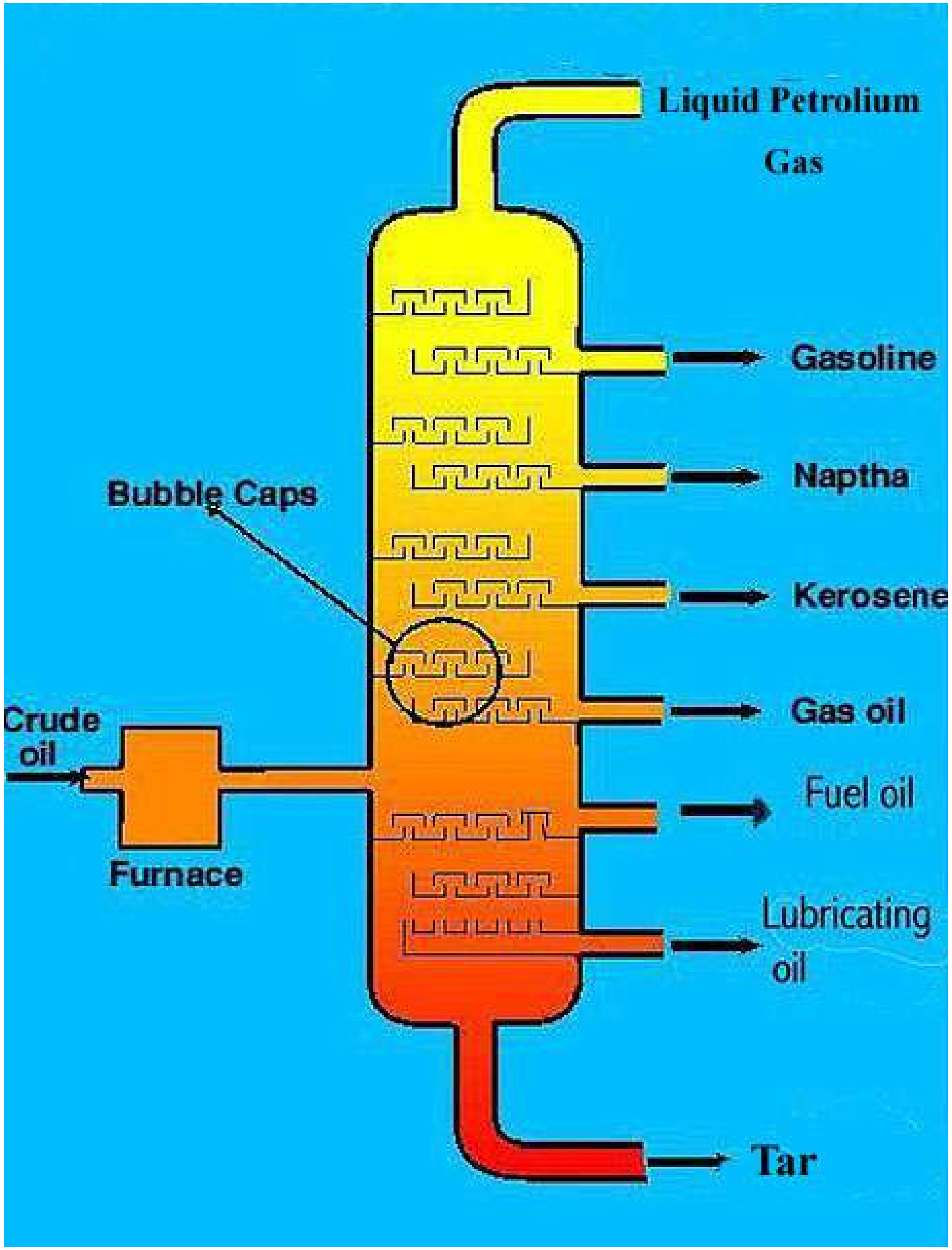




•Separating a homogeneous solution is much more difficult. One of the most basic techniques of purifying water from dissolved solids is called **distillation**.

•During this process, a homogeneous mixture is **heated "vaporizing"** some of the liquid. The vapor rises and is then condensed in a special tube called a condenser. The solvent becomes liquid again and is recollected. The result is a **pure substance.**





- Crude oil is separated into different chemicals in a process called ***fractional distillation***.
- The crude is heated to about 400°C and then allowed to pass through a large column.
- Lighter gases are collected at the top while heavier liquids fall further to the bottom.
- At different locations, the fractions are collected and piped away.

•Solid mixtures also require a great amount of work to separate. This is iron ***ore***.

•An ore is a rock contains a useful substance, like iron or gold, and some other substances.

•To separate the useful substance from the ore, first it is crushed and then mixed with water to make a suspension. Chemicals are added to dissolve the iron but not other chemicals. The suspension is filtered.

•The pure iron can then be extracted from the water using chemicals and distillation.

•This pill is being dissolved in water. The pill is called the ***solute*** because it is the substance being dissolved.

•The water is called the ***solvent (dissolver)*** because it is the substance that is doing the dissolving. In general, the solvent is in much higher quantity than the solute. These are the two main parts of a solution.

•Another way to say that the pill dissolves in water is to say that the pill is ***soluble*** in water. If a particular solute is soluble in a solvent, that means that the solute will dissolve in the solvent and make a homogeneous solution.

•For example, nail polish does not dissolve in water, but if we use a different solvent like acetone (nail polish remover) the polish does dissolve.

•On Earth, water is the most common solvent. Most animals and plants need water to dissolve nutrients to help carry them through the body.

•Our blood is over half water. Water will dissolve anything given enough time.

•So, why don't we dissolve away from the water in our own bodies?

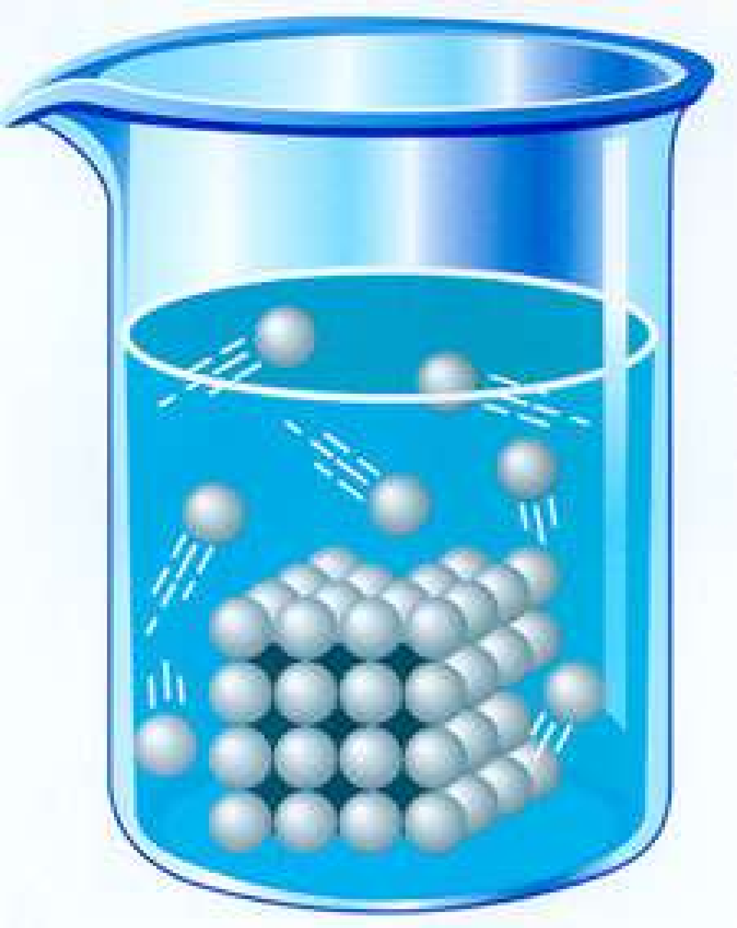
•The ***rate of dissolving*** for many substances is very slow. Even rocks will dissolve in water if given a few million years.

•We can **speed up** the process of dissolving by ***agitation*** (mixing) or by heating the solvent (more energy). Both agitation and heating will increase the speed of the solvents particles and allow them to break up the solute faster.

According to the particle theory, every pure substance is made from different particles with different properties. This means that some particles have a strong attraction with each other and different particles may have weak attractions. This means that some substances are more soluble in different solvents that others because their particles break away more easily.

Substance	Solubility (g/100g of water at 0°C)
Baking soda	6.9
Canola oil	Insoluble
Ethyl alcohol	Unlimited
Limestone	0.0007
Oxygen	0.007
Salt	35.7
Sugar	179.2

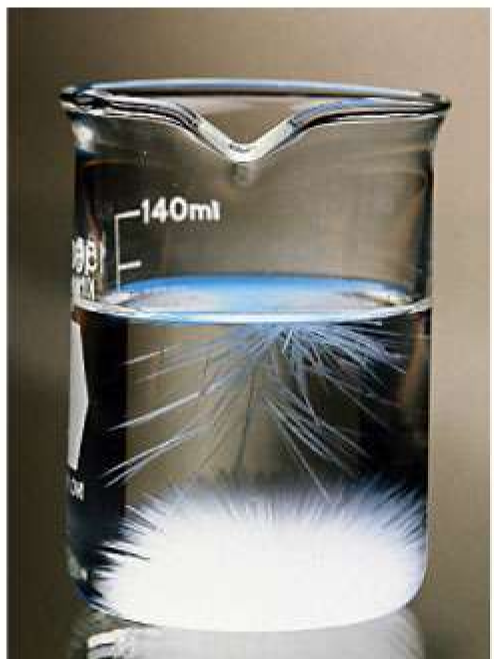
- When a particular solvent has dissolved as much solute as possible, the homogeneous mixture is called ***saturated***.
- A saturated solution will still have some visible solid not yet dissolved.

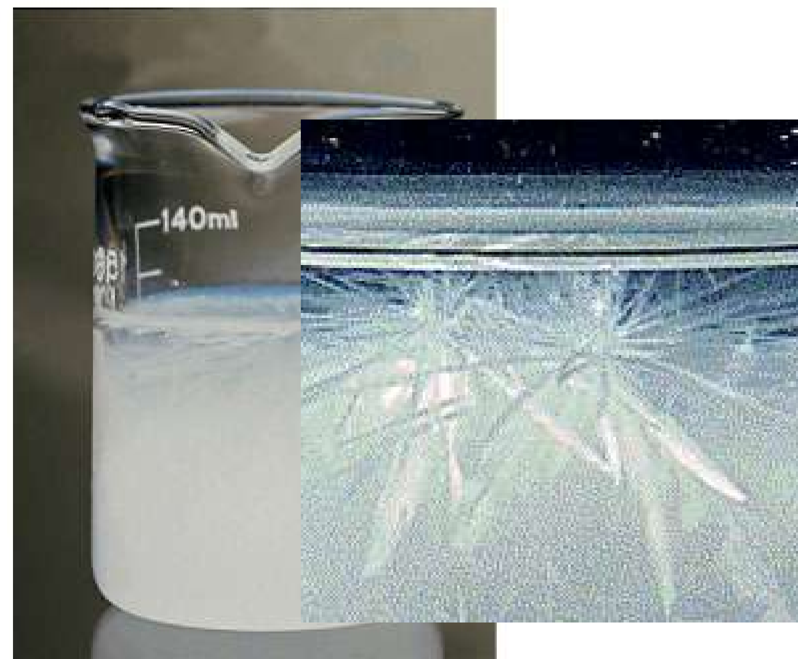


- If the solvent can still dissolve more solute, the solution is said to be ***unsaturated***.
- The point of saturation will define the solubility of the solute in the solvent. It is possible to go beyond the saturation point.

•A **heated solvent** <u>will dissolve more solute</u> than a **cool solvent**. If a heated solvent is saturated and then slowly left to cool, the amount of solute in the cool solvent is beyond the saturation point.

•The mixture is said to be ***supersaturated***. With any small disturbance, like adding a small piece of solid solute, crystals of solute will form. This is called ***crystallization***.





•The fact that solvents have different solubilities with different solutes is very helpful to us. When we get a stain on our clothes, the stain is usually ***insoluble*** in water.

•By using a detergent, the particles of the stain can be removed. The difficulty is that often a solvent that removes the stain will also remove the pigment that gives your clothes their color. Therefore, the trick is try to find a detergent that dissolves the stain but not the pigment.

•Restoring artwork is particularly difficult. Oils and dirt over time collect on the oil painting.

•It is difficult to remove only the dirty oil and leave behind the paint. The left side of this painting has been cleaned.