Science 8

Unit 3: Mixtures and Solutions

Science 7

Unit 3: Solution and Mixture

Topic 1: How Are Mixtures Different from Pure Substances

What is Chemistry

- **Chemistry** is the study of matter, its properties, and the changes or chemical reactions that matter can undergo

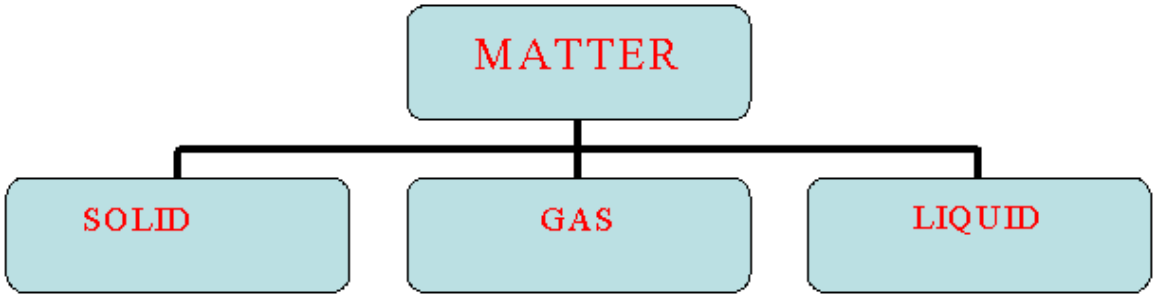
Rusting of metal (oxidation of iron) is one example of a relatively slow chemical reaction that unfortunately occurs all around

CHEMISTRY…

IS THIS WHAT YOU THINK?

Matter

- **Matter=>** anything that occupies space and has mass.



Things that are not matter Gravity, light, electricity, heat

Why isn't it a good idea to classify matter by its phases?

- Because one kind of substance can exist in more than one phase – such as H_20. And matter changes phases rather easily.

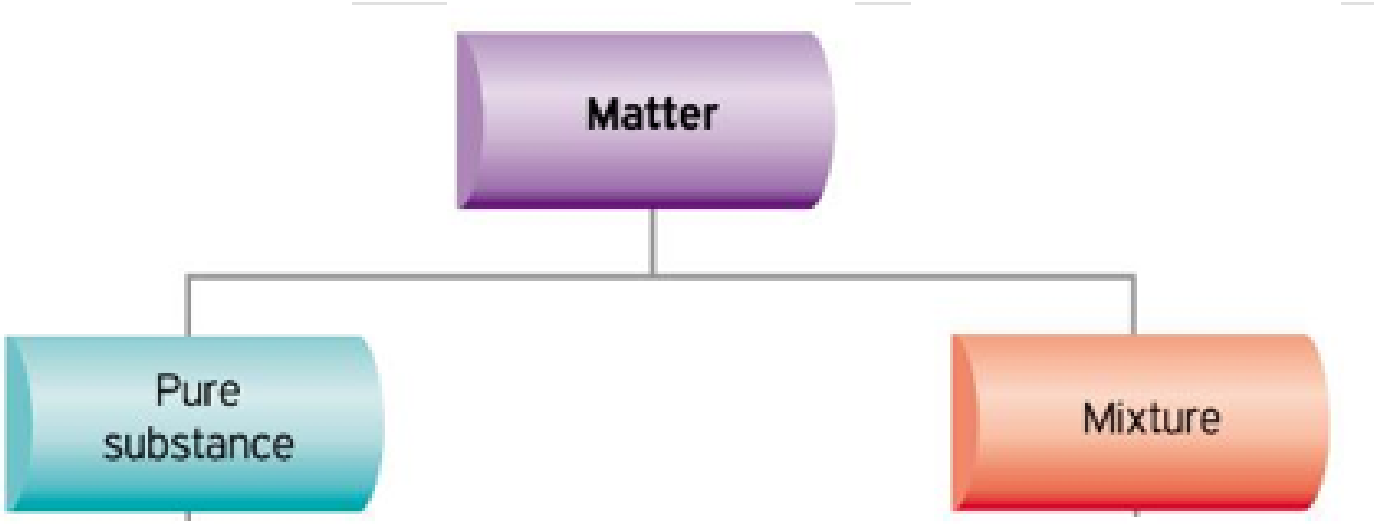
Questions: Do you know another way to classify matter?

Remember the Particle Theory of Matter

1. **All matter is made up of tiny particles.**
2. **All particles in a thing are the same**
3. **The particles of one substance differ from the particles of other substances.**
4. These particles are always moving… they have energy.
5. There are spaces among particles.
6. There are attractive forces between the particles.

A New Way of Classifying Matter

One way that scientists classify matter is by its composition

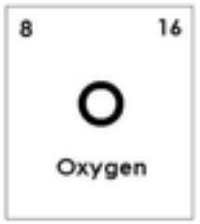


1. What Is A Pure Substance

Pure Substance: contains only one kind of particle and are the same throughout.

- **ALWAYS appear as uniform throughout**
- **They contain either:**
  1. Only one type of particle
     Gold and Oxygen.

  2. Two or more particles chemically combined to form a different substance.
     Water is H_2O which is
     2 hydrogen's and 1 oxygen



Pure Substances In Nature

- Pure substances don't usually occur in their pure form in nature, so in order to obtain pure substances, people must refine raw materials.

Bauxite	makes	Aluminum foil

Examples of Pure Substances

- sugar ($C_{12}H_{22}O_{11}$)
- copper (Cu)
- distilled water (H_2O)
- carbon dioxide (CO_2)
- oxygen (O_2)

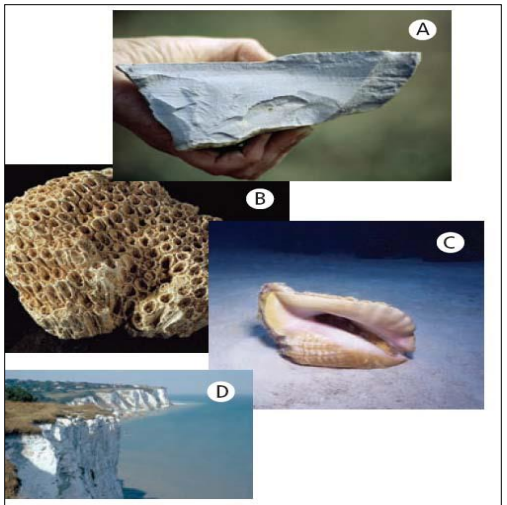
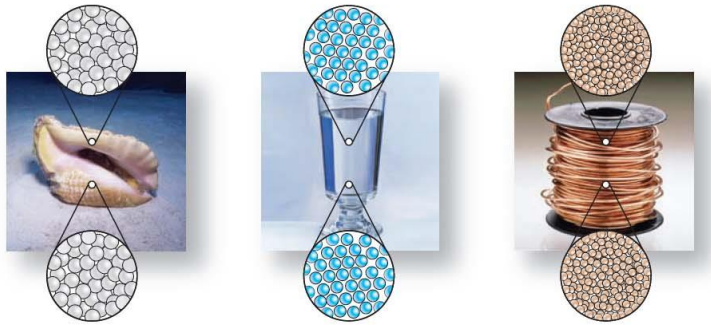


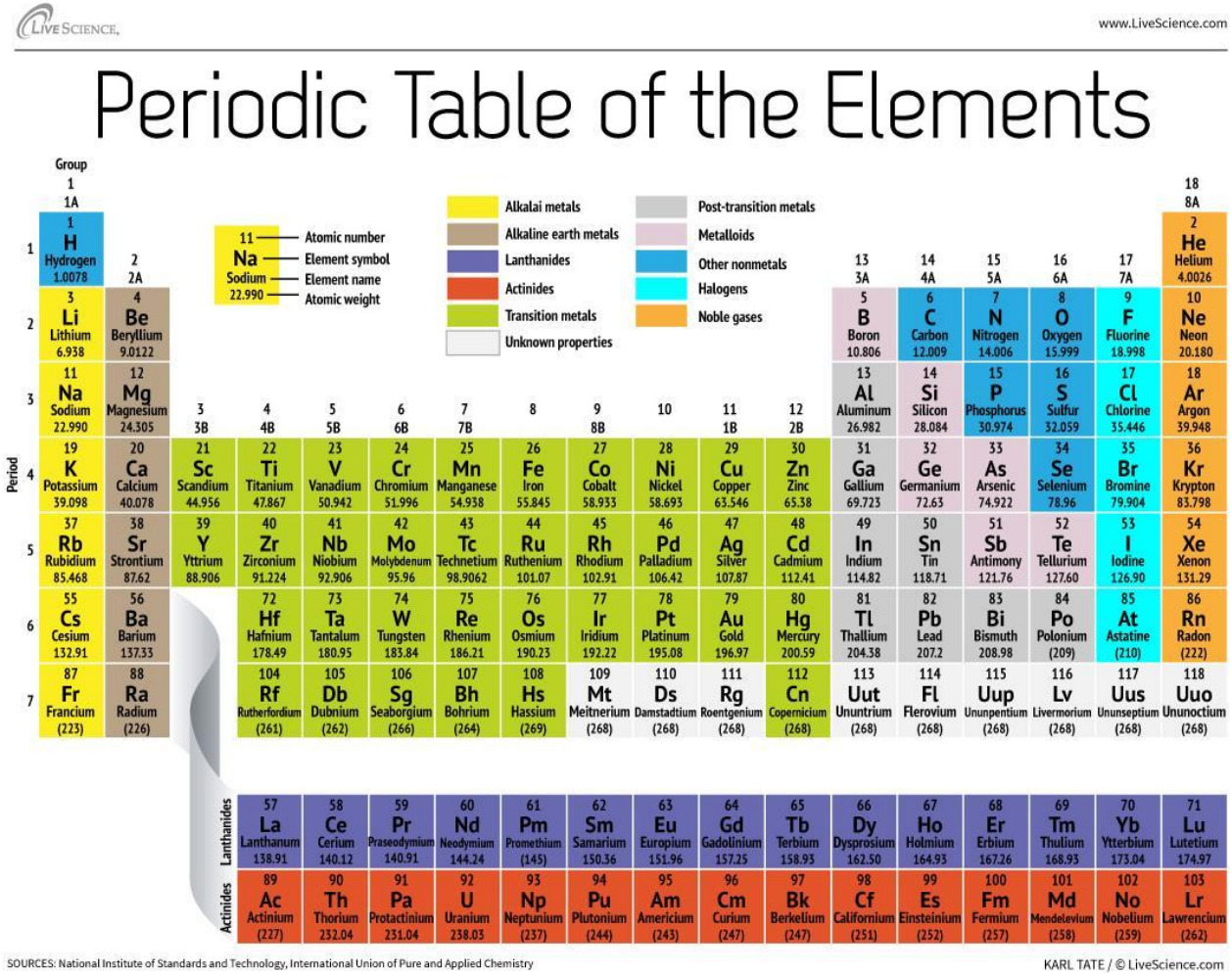
Figure 7.4 Limestone is a common name for a chemical called calcium carbonate. In nature, calcium carbonate (A) is found in many forms. For example, you may find it as coral (B), seashells (C), and the chalky white cliffs of Dover in England (D).

NOTE: pure substances covered are not limited to elements.

Figure 7.5 Calcium carbonate, pure (distilled) water, and copper are pure substances. See how any part of pure calcium carbonate is made up of only calcium carbonate particles. Any part of pure water is made up of only water particles. Any part of pure copper is made up of only copper particles.

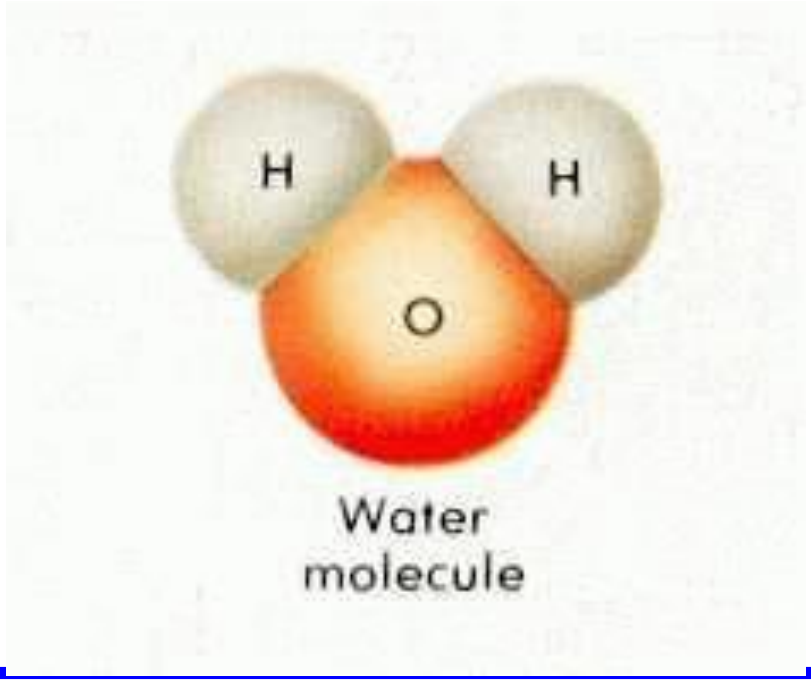


Elements are pure substances that cannot be broken down into simpler substances.

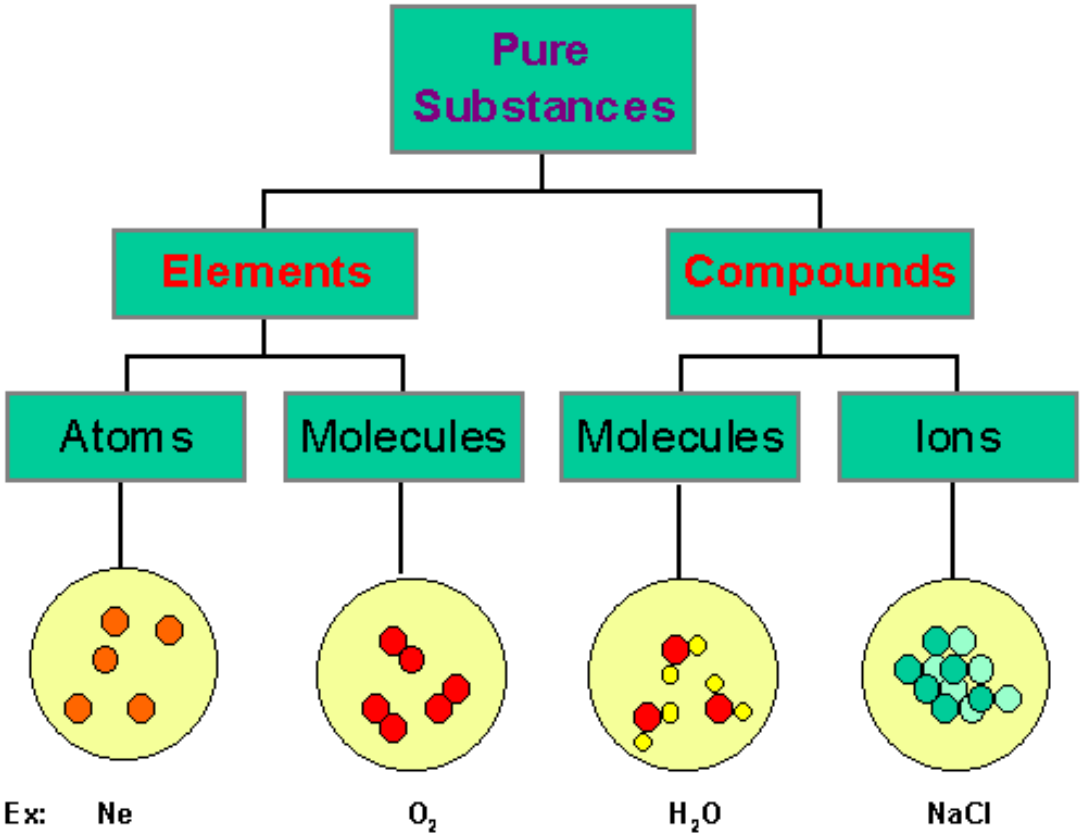


Compounds are pure substances that contain two or more elements combined in fixed proportions. Compounds not easily separated from each other

ex: water, CO_2

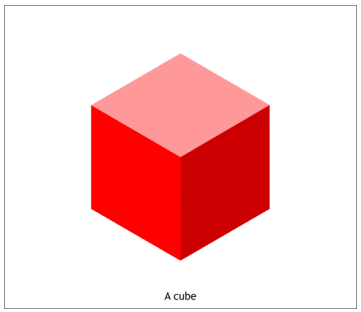


Pure substances



2. What are Mixtures

- They are the physical combination of two or more pure substances.



\+

= ?

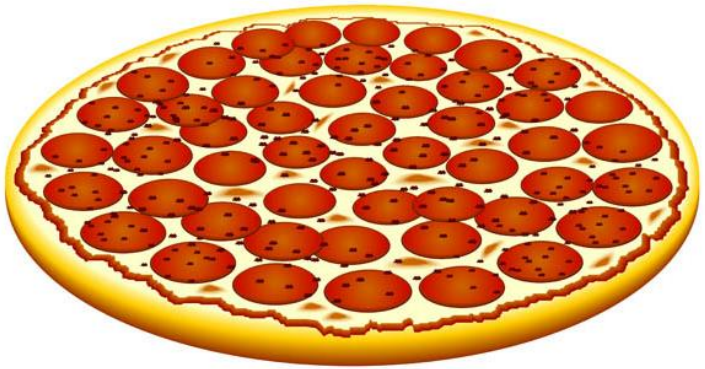
Sugar Water

- MAY have distinct visible components.

- MAY appear uniform throughout.

- A **mixture** is a **combination** of two or more substances - that are **NOT chemically** combined

- A pizza is a perfect example of a **mixture**.



The ingredients in a pizza are all mixed together, but you still have separate ingredients.

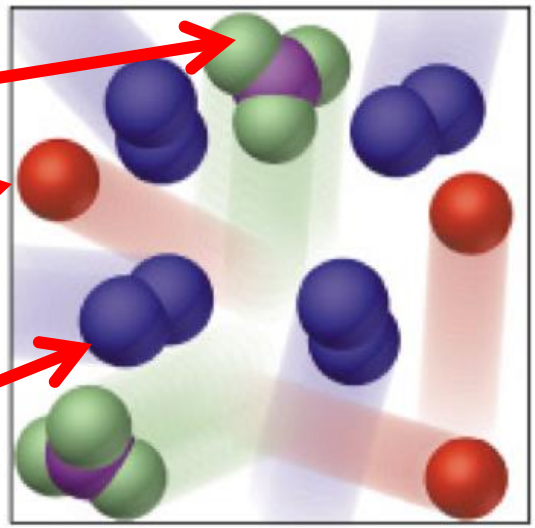
The cheese and sauce haven't combined to make a brand new substance.

Six of the possible kinds of mixtures are:

A. a mixture of gases
B. a mixture of liquids
C. a mixture of gases in a liquid
D. a mixture of solids
E. a mixture of solids in a liquid
F. a mixture of solids and gases

Soft drinks are mixtures made from:

- liquid water
- Solid sugar
- Carbon dioxide gas

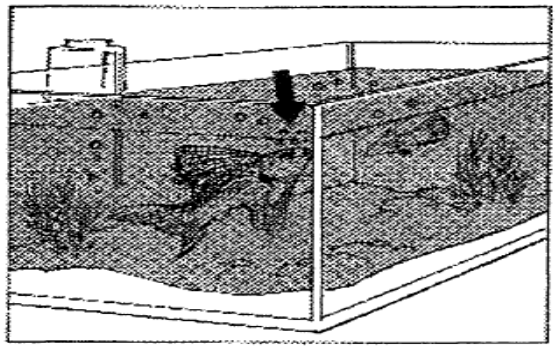


Examples of Mixtures…

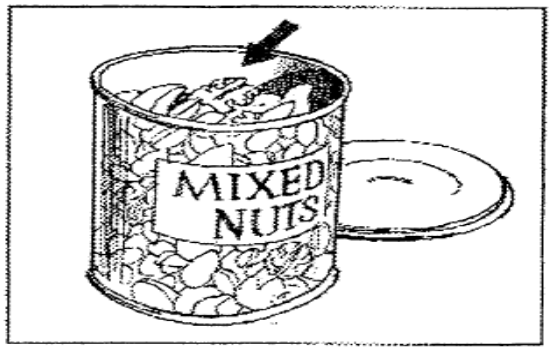
- kool-aid
- chocolate chip cookie
- concrete
- salad dressing
- Air
- Bread

Figure 7.1 What evidence do you see that each of these products is a mixture?

1. _____



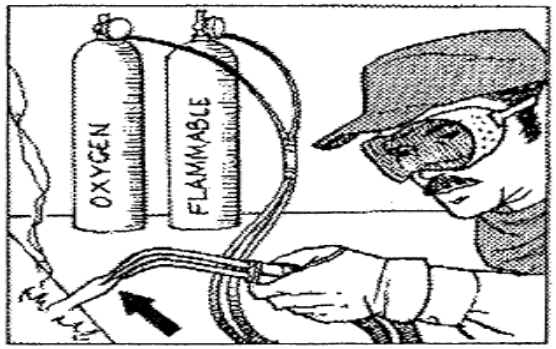
2. _____



3. _____

4. _____

5. _____



6. _____

- For each picture find the arrow and state the kind of mixture.
- Ex: <u>mixture of gases in a liquid</u>

Apply:The particle theory of matter

#1: All matter is made up of tiny particles.
#5: The particles of one substance differ from the particles of other substances.

1 type of particle

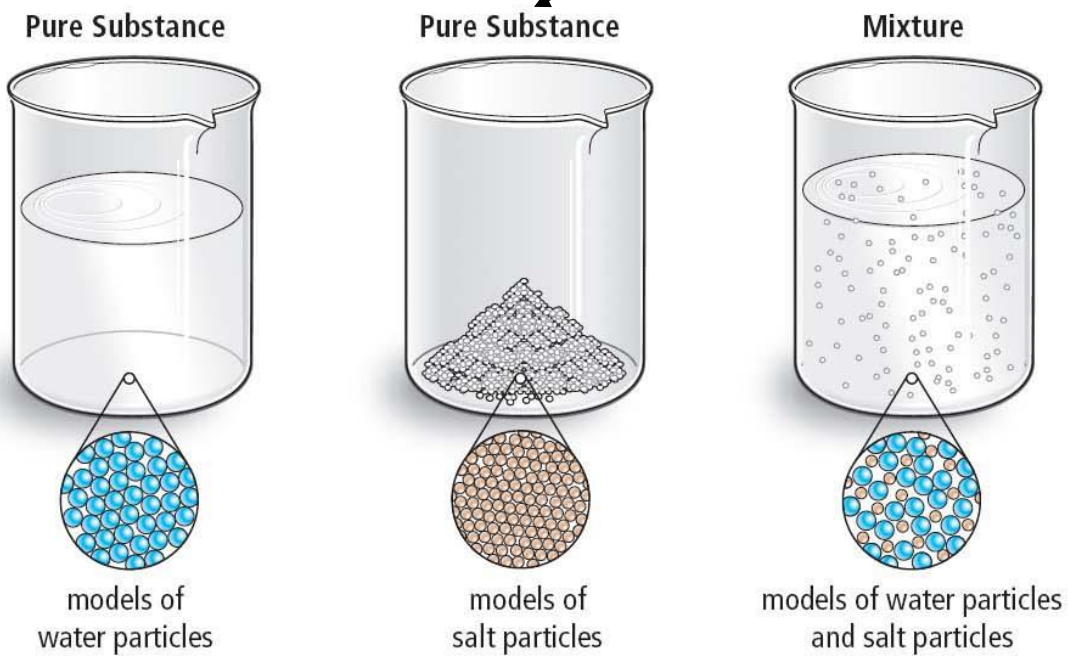
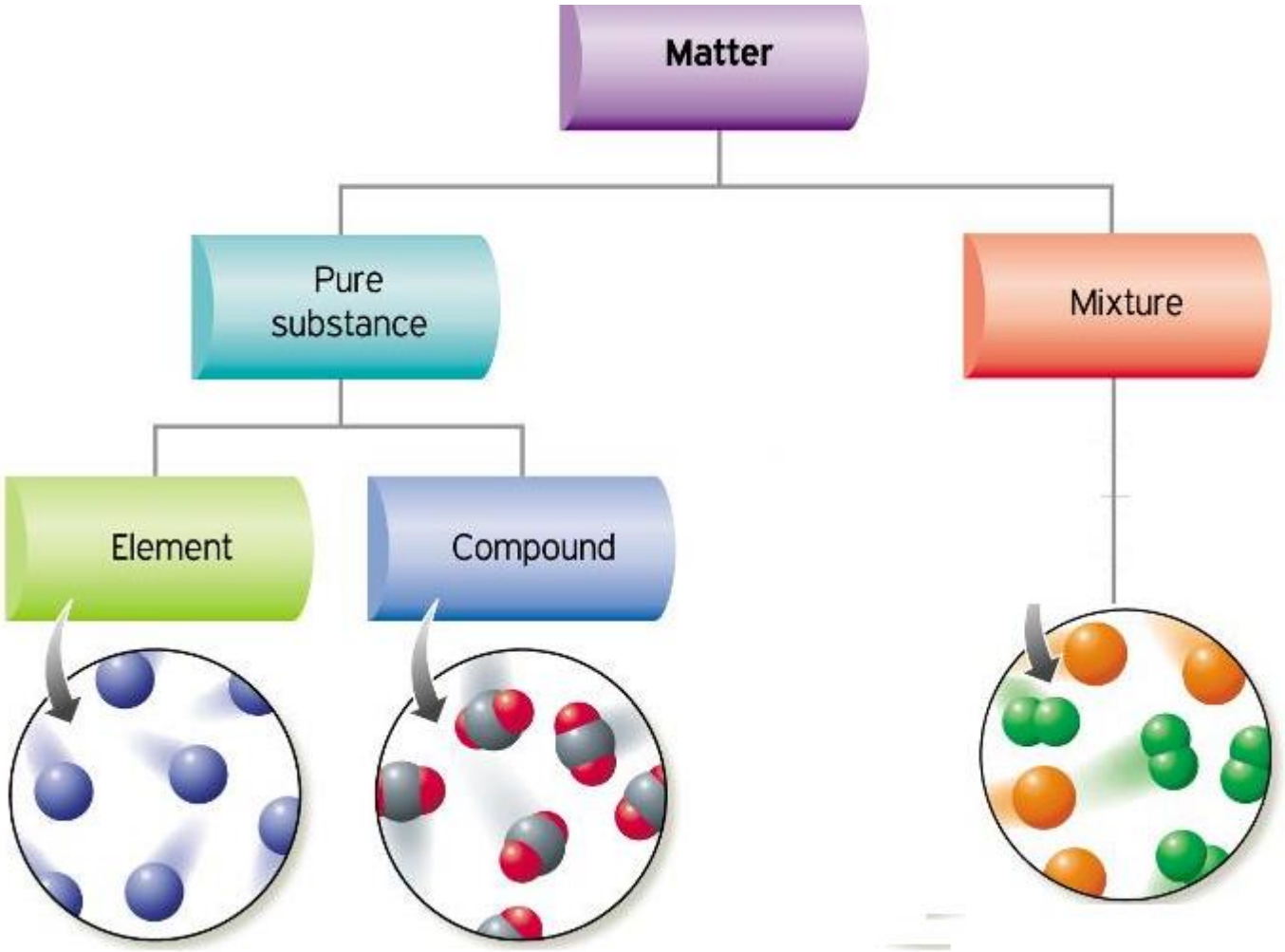
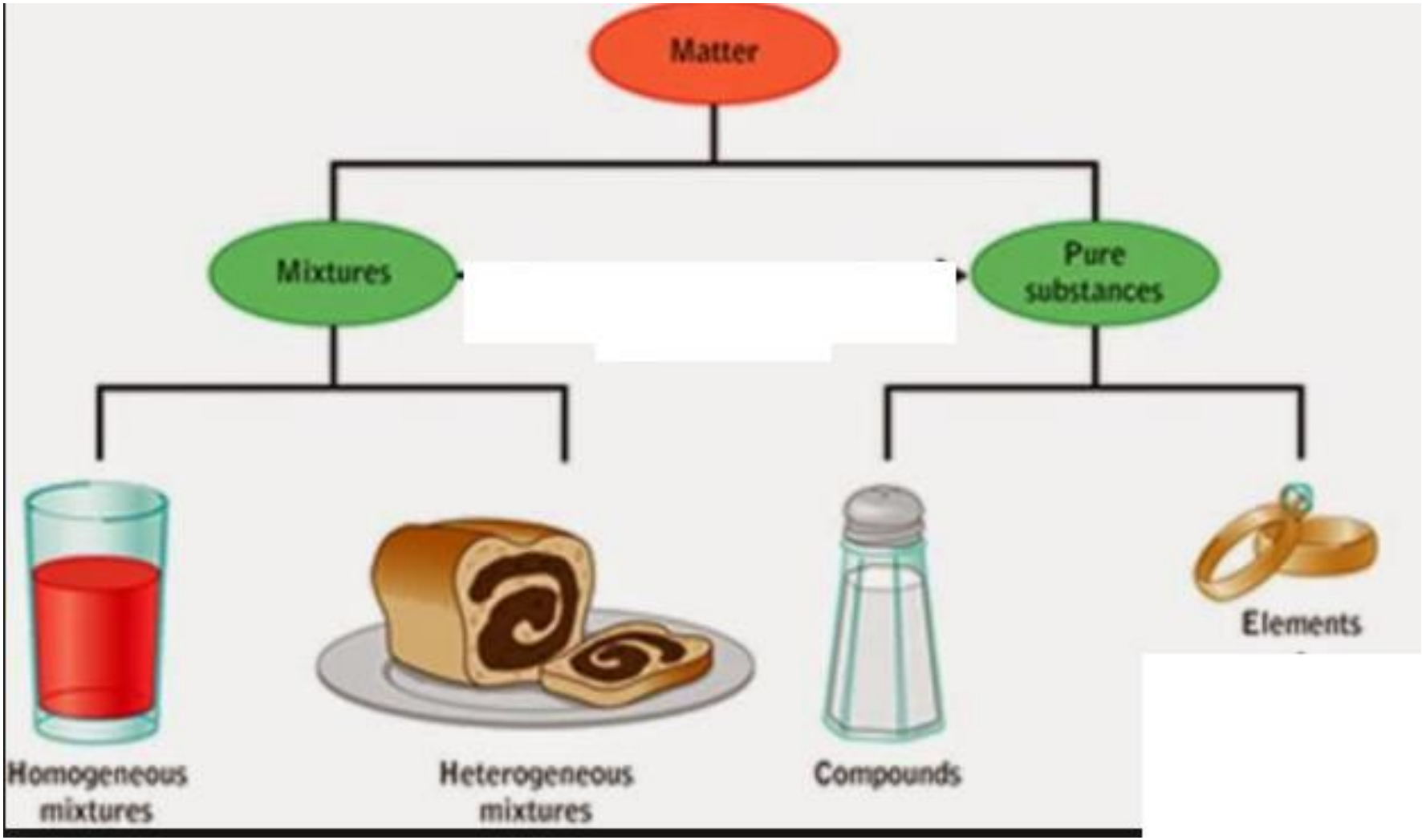


Figure 7.7 Pure substances have only one type of particle, while mixtures have two or more types of particles.

IS WATER A PURE SUBSTANCE OR MIXTURE?

PURE SUBSTANCE	MIXTURE
	
When you see distilled water, it's a pure substance. That fact means that there are just water molecules in the liquid	**Mixture** of water with other things dissolved inside, maybe salt.

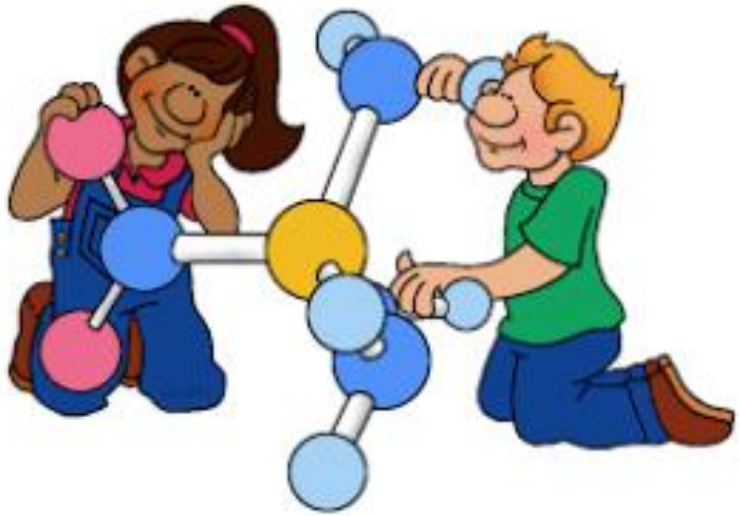

Matter
Pure substance
Mixture
Element
Compound


Matter
Mixtures
Pure substances
Homogeneous mixtures
Heterogeneous mixtures
Compounds
Elements

Science 7

Unit 3: Solution and Mixture

Topic 2: What Kind of Mixture?



Mixtures

- A mixture is a combination of two or more substances where there is **no** chemical combination or reaction.

Mixtures combine physically in no specific proportions. They just mix

- There are two types of Mixtures:

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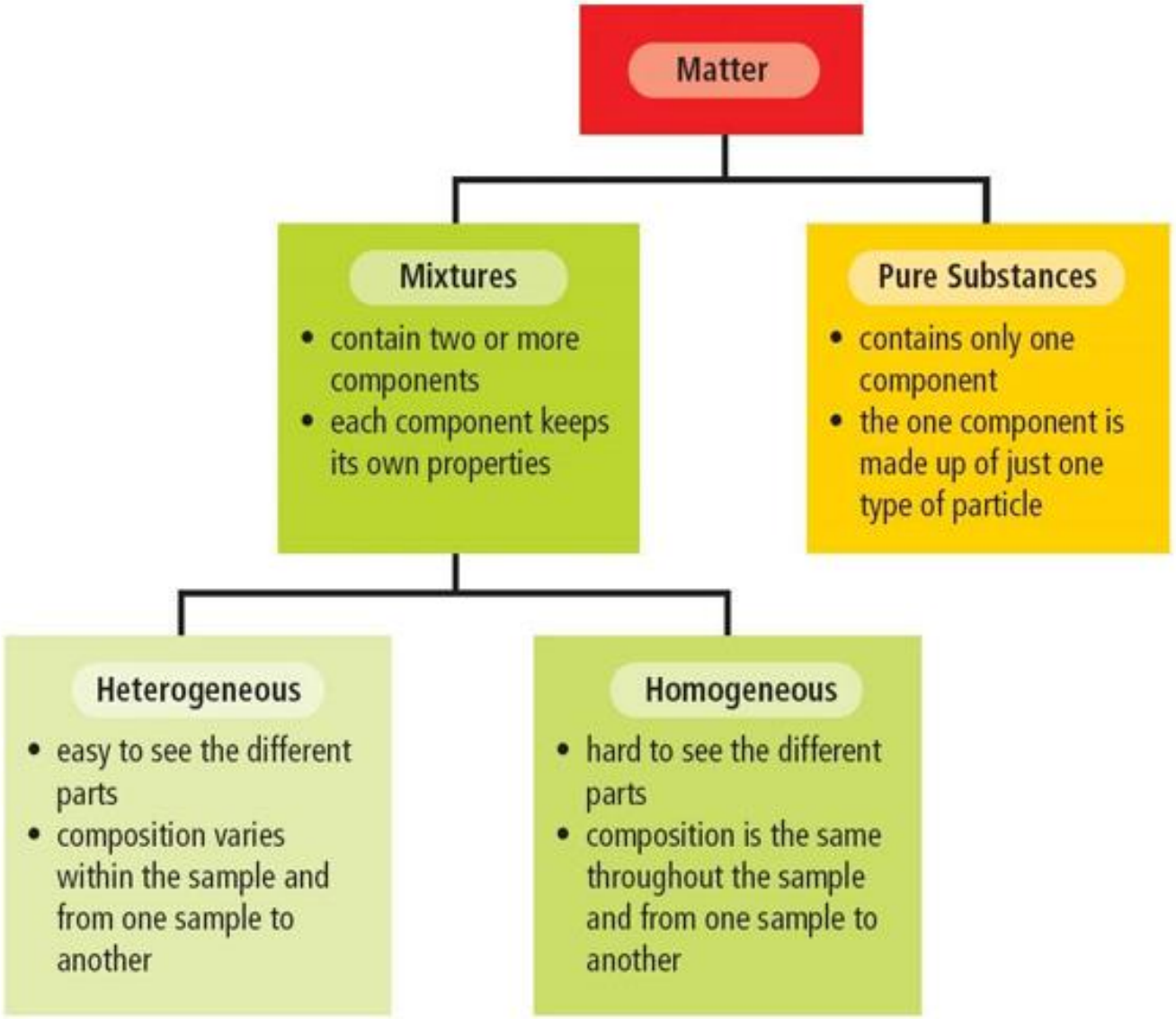


Homogeneus Mixtures

Homogeneous mixtures : is a mixture in which the components are evenly distributed among each other. You can't see the component parts.

Homo means the same throughout.

It has a constant composition throughout.

- **Homogenous mixtures are also called SOLUTIONS**

Examples: Salt dissolved in water, sugar dissolved in water, apple juice, tea, copper (II) sulfate solution in water, alloys....

C Copper(II) sulfate ($CuSO_4$) in water, a homogeneous mixture (solution)

Homogeneous Mixture

- The particles are evenly mixed so that none of the original substances are visible.

Stainless steel

Kool-aid

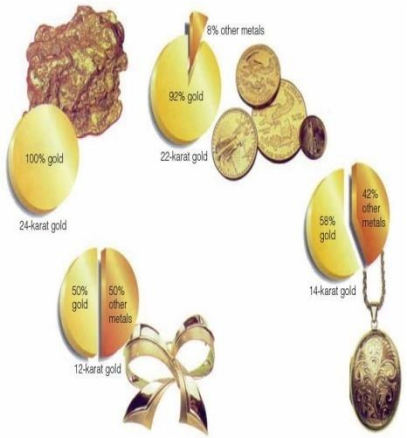


Figure 7.11 The pie graphs show the percentages of gold and other metals in different "gold" objects. Which of the objects shown here are pure substances? Which are homogeneous mixtures (solutions)?

Figure 7.10 Window cleaners are solutions of ammonia (or vinegar, in some cases) and other substances in water.

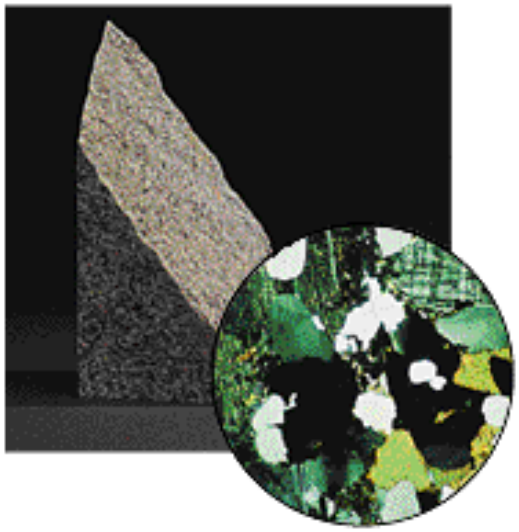
States of matter in solution	Example of solutions
gas in gas	air (N_2, O_2 , Ar, CO_2 , other gases)
gas in liquid	soda pop (CO_2 in water)
liquid in liquid	gasoline (a mixture of hydrocarbon compounds)
solid in liquid	Filtrated sea water (NaCl and other salts in water)
gas in solid	H_2 in platinum or palladium
liquid in solid	dental amalgams (mercury in silver)
solid in solid	alloys (brass, (Cu/Zn), solder (Sn/Pb), Steel (Fe/C))

Heterogeneous Mixtures

Heterogeneous mixture : the components are not evenly distributed among each other. An heterogeneous mixture has two or more distinct phases that are usually detectable. This type of mixture does NOT have uniform properties.

Heterogeneous Mixtures are also called **Mechanical Mixtures**

Examples: Sand water, oil and water, milk, sulfur and iron, granite, blood...



A Granite, a heterogeneous mixture

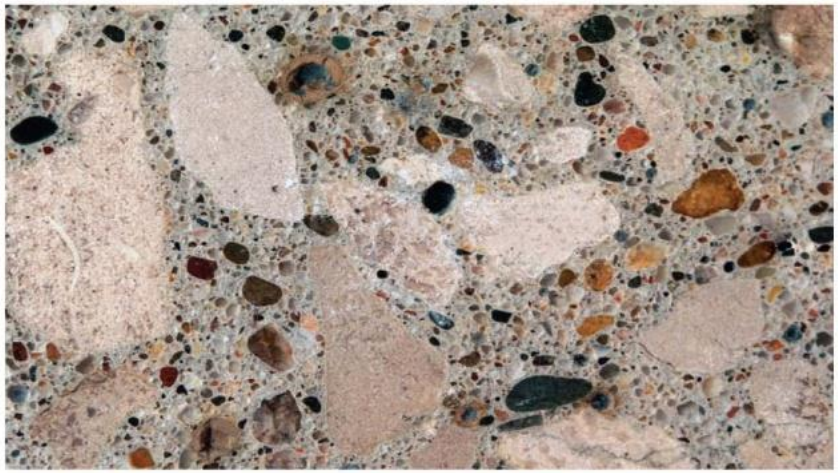
B Human blood, a heterogeneous mixture

Heterogeneous Mixtures

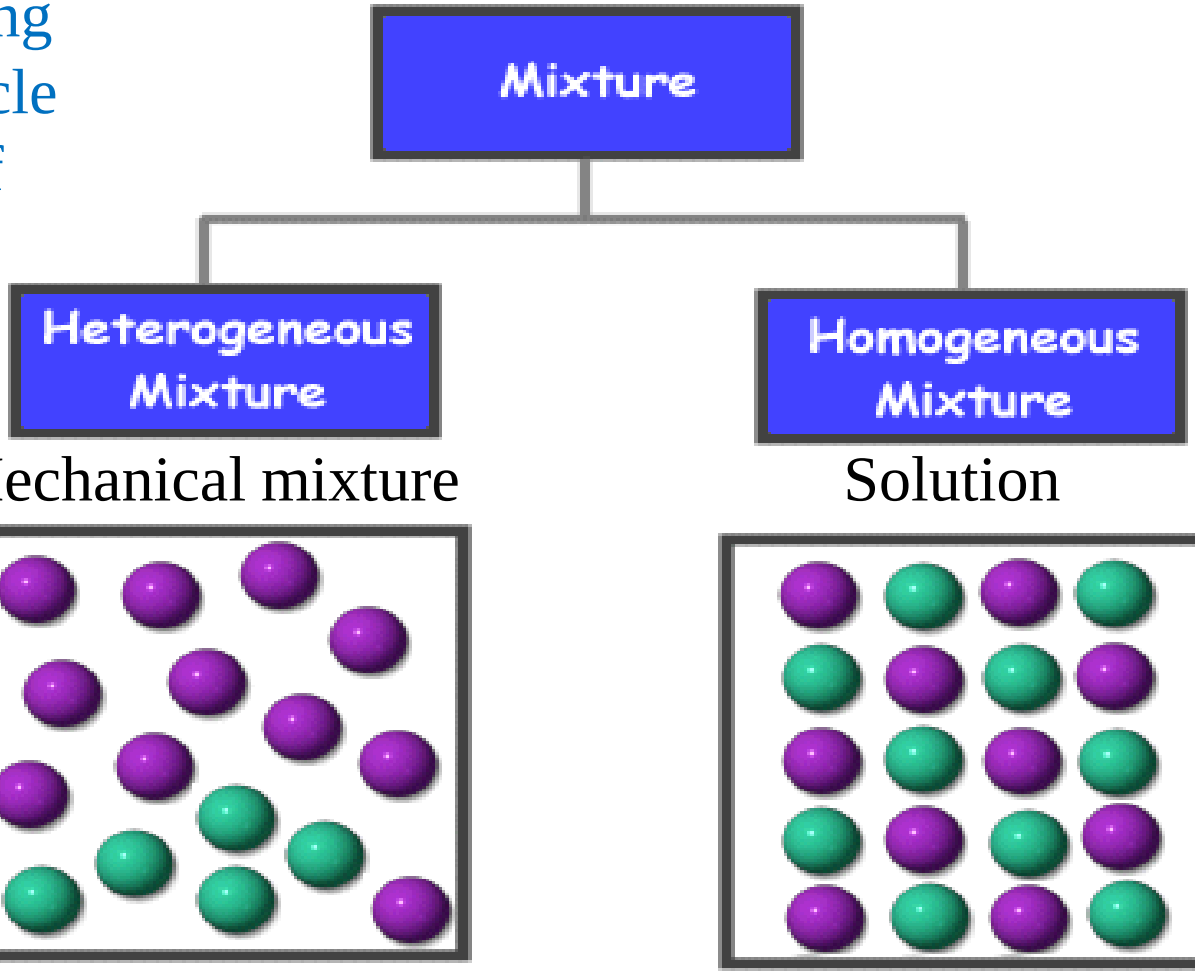
Figure 7.9 A pizza is a mechanical mixture because you can easily see the different parts: the crust, sauce, cheese, and toppings.

Granola bar

Figure 7.2 Concrete is an example of a heterogeneous mixture. You can easily see the different types of matter. Each type of matter in the mixture has its own distinct set of properties such as colour, size, and shape.

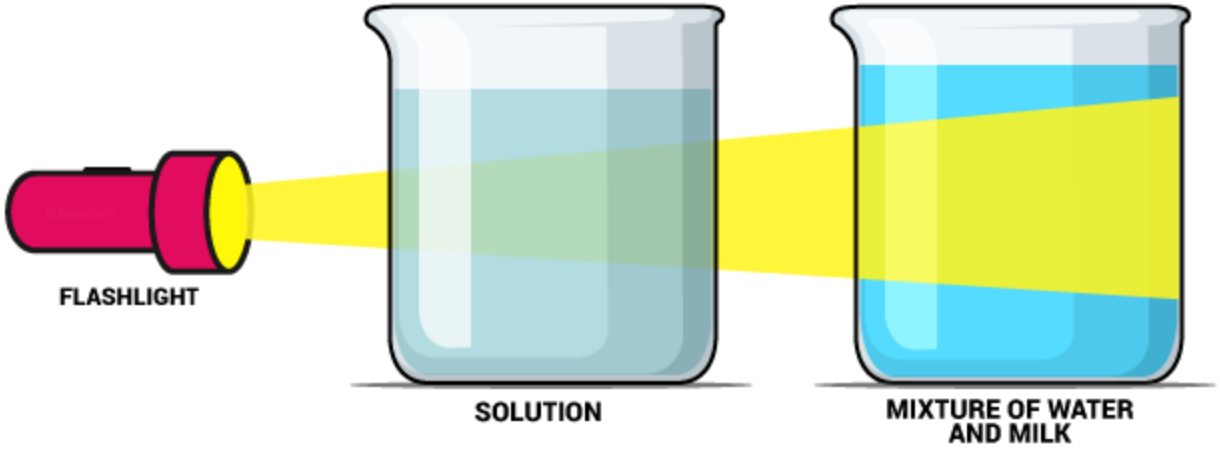


Illustrating the particle theory of matter.



Tyndall effect

Sometimes you cannot tell whether something is homogeneous or heterogeneous just by looking at it.



Tyndall effect is an easy way of determining whether a mixture homogenous or heterogeneous . When light is shined through a homogenous solution, the light passes cleanly through the solution, however when light is passed through a heterogenous, the substance in the dispersed phases scatters the light in all directions, making it readily seen.

Using the Tyndall Effect, distinguish the mixtures?

Using the Tyndall Effect, distinguish the mixtures?

Using the Tyndall Effect, distinguish the mixtures?

Tyndall Effect…

Homogeneous mixture

1. copper (II) sulfate solution
2. salt water
3. sugar water

Heterogeneous mixtures

- vegetable oil and water
- Pepper and water
- sugar & vegetable oil
- vinegar and salad oil

Some mixtures are combinations of heterogeneous and homogeneous mixtures

- Milk
- Orange juice
- Soft drink

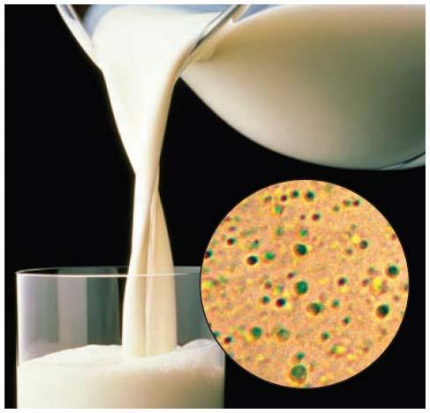


Figure 7.14A The round photograph shows how milk looks under a microscope. The milk is magnified about 400 times. How can you tell, from this image, that milk is not homogeneous?

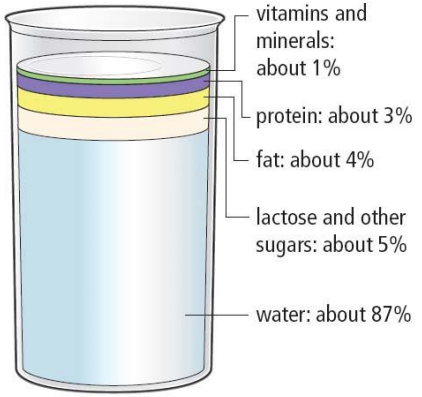


Figure 7.14B Milk is a mixture of different mixtures. The liquid part of milk is mostly water. The solid parts of milk are either dissolved in the liquid (homogeneous), or they are suspended in it (heterogeneous).

- Ex: <u>Orange juice:</u>
  - Homogeneous: sugars with water
  - Heterogeneous: is a combination of solid orange pulp and water.

Summary:Mixtures can be classified into 2 types:p.234

1. **Heterogeneous**
   - A non-uniform mixing
     - Particles create layers or parts
     - May also appear as one substance
     - Light will scatter as it passes through
     - May or may not need a microscope to see parts
2. **Homogeneous**
   - A uniform mixing
     - Appear as one substance
     - Particles are evenly spread out
     - Light will pass through unaffected
     - Cannot see parts with a microscope

MATTER

Is it uniform throughout?

No → **Heterogeneous mixture**

Yes → **Homogeneous**

Can it be separated by physical means?

No → **Pure Substance**

yes → **Homogeneous Mixture (solution)**

Can it be decomposed into other substance by a chemical process?

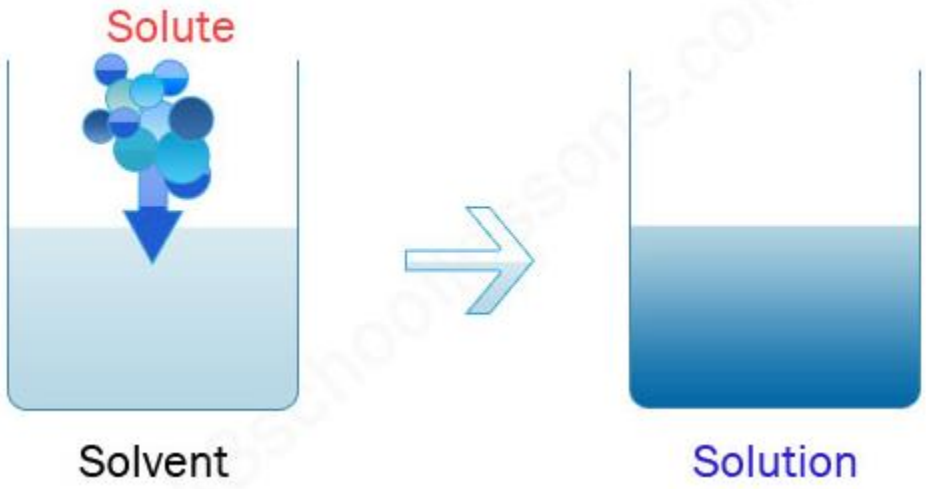
No → **Element**

yes → **Compound**

Science 7

Unit 3: Solution and Mixture

Topic 3: Making A Solution



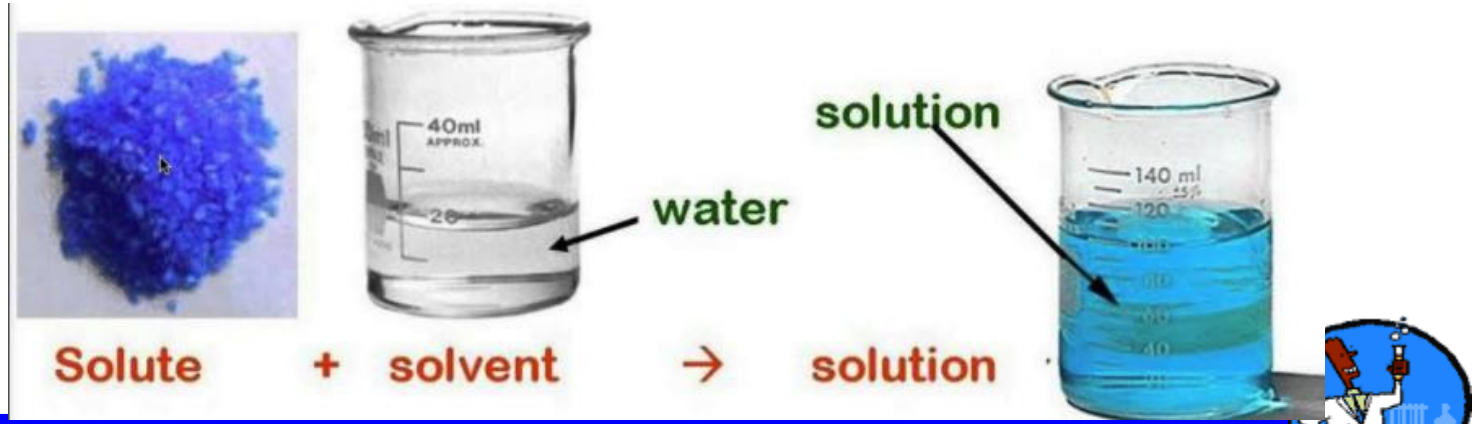
What Is A Solution?

Solutions: is a homogeneous mixture that they appear as ONE substance.

Examples:
tap water
Vinegar
gold jewelry

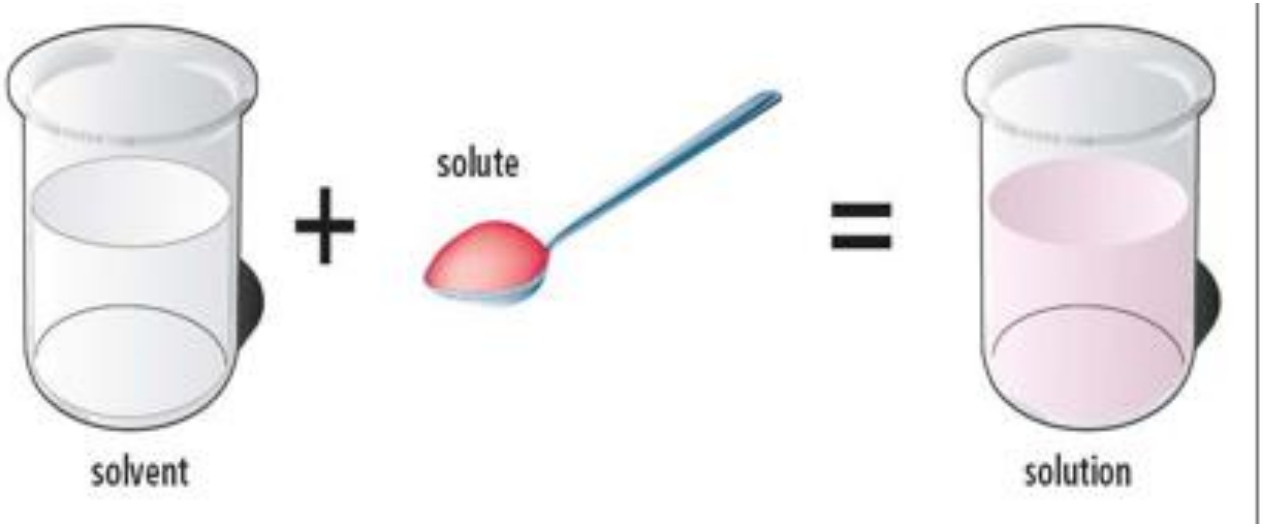
A solution consist of two parts:

1) **Solvent**
2) **Solute**



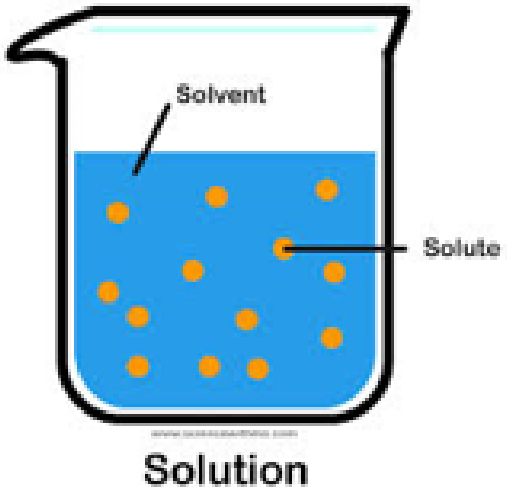
What Is A Solute?

Solute is the substance in a solution that is present in lesser amount?



What Is A Solvent?

Solvent refers to the substance in a solution that is present in greater amount?



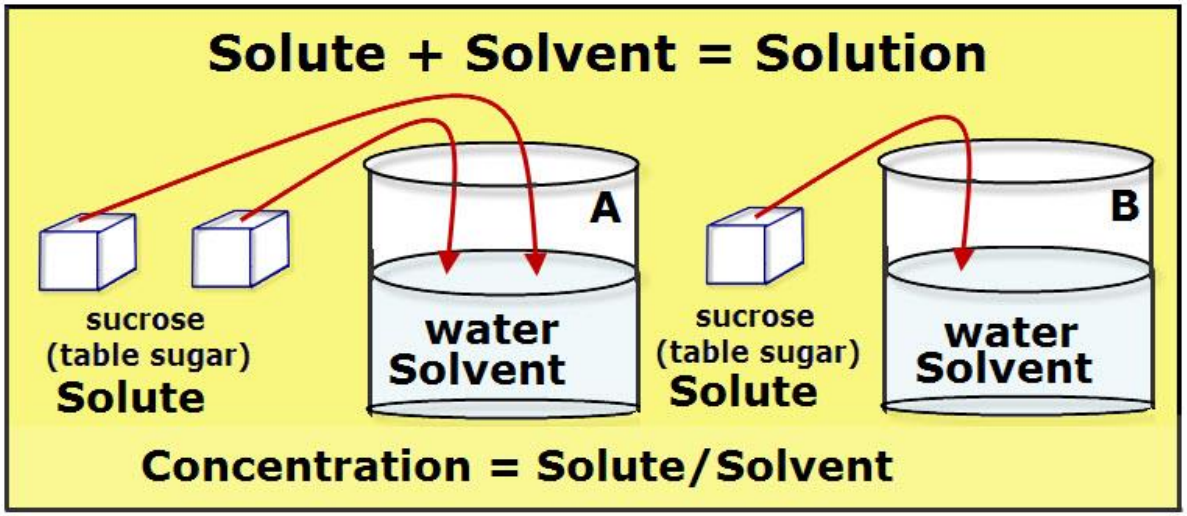
Different States Of Solutes And Solvents

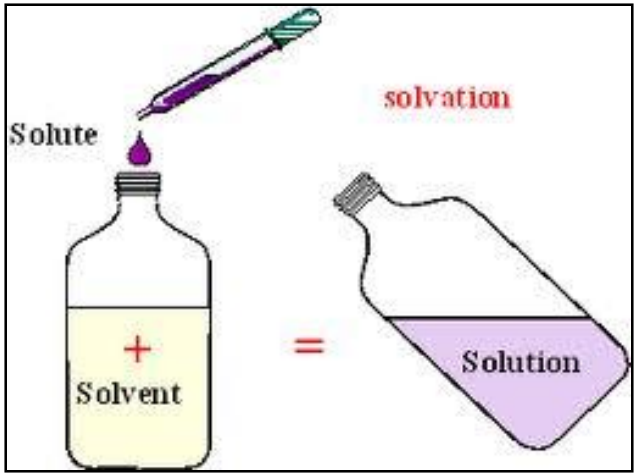
- Solvents can be either:
  - Solid, Liquid, Gas
- Solutes can be either:
  - Solid, Liquid, Gas

Solution	Solute	Solvent	State of solute	State of solvent
Air	Oxygen, carbon dioxide and other gases	Nitrogen	Gas	Gas
Soda water	Carbon dioxide	Water	Gas	Liquid
Vinegar	Acetic acid	Water	Liquid	Liquid
Filtered ocean water	Sodium chloride (salt) and other minerals	Water	Solid	Liquid
Brass	Zinc	Copper	Solid	Solid
antifreeze	Alcohol	water	Liquid	Liquid

Dissolving?

- To mix completely:
  - –the solute dissolves into the solvent.





What is Solubility?

Solubility refers to the amount of solute that will dissolve in a given amount of solvent at a given temperature:

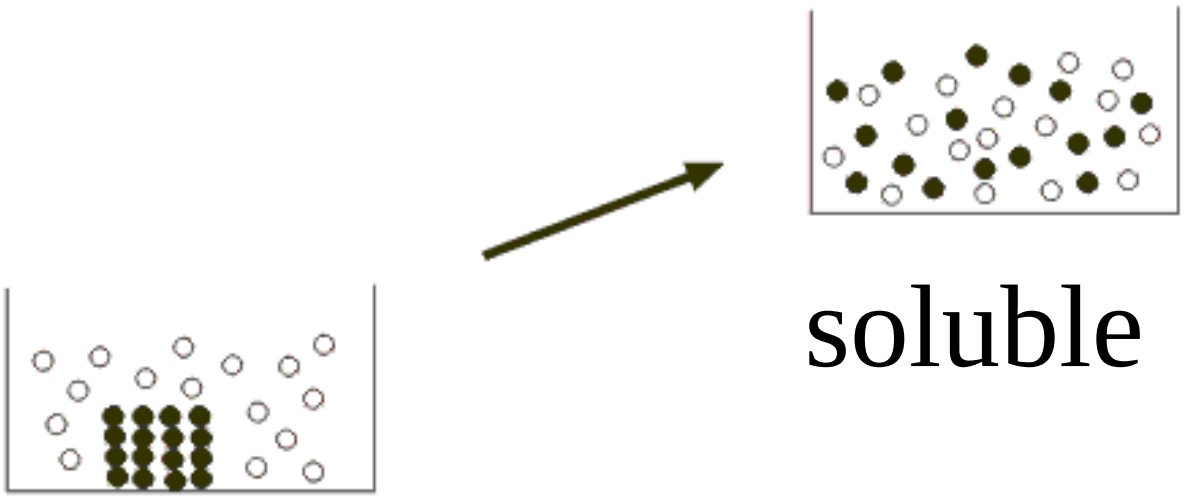
Soluble:

If the particles of the solute are more attracted to the particles of the solvent. Dissolving occurs. The solute is said to be soluble in that solvent. (ie. Solution)

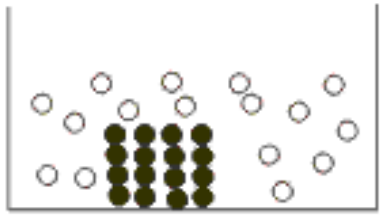
Insoluble

If the particles of the solute are more attracted to their own particles than the solvent particles. Dissolving does NOT occur. The solute is said to be insoluble in that solvent. (ie. Mechanical)

Soluble or Insoluble?



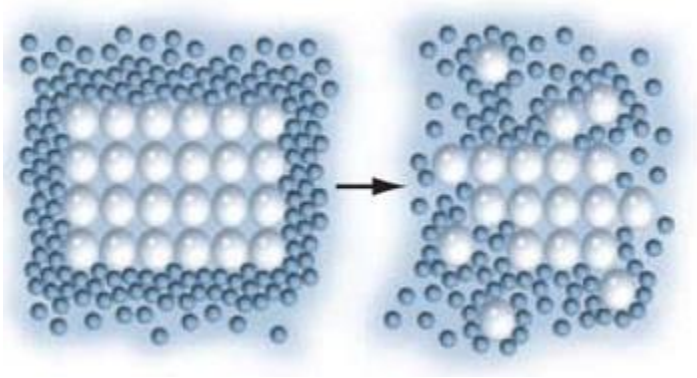
soluble



insoluble

Why Some Substances Dissolve?

1. Solute becomes attracted to the solvent.
   - Solute particles are attracted to solvent particles - so they mix.
     - Example: sugar particles are attracted to the water particles, mixing with the water particles.



2. Movement

- Mixing causes movement. When 2 substances are mixed, the weak attractions are broken by the motion of the particles.
  - Example: oil is mixed with gasoline. Both have very weak attractions that are broken by the motion.

Why Some Substances Do Not Dissolve?

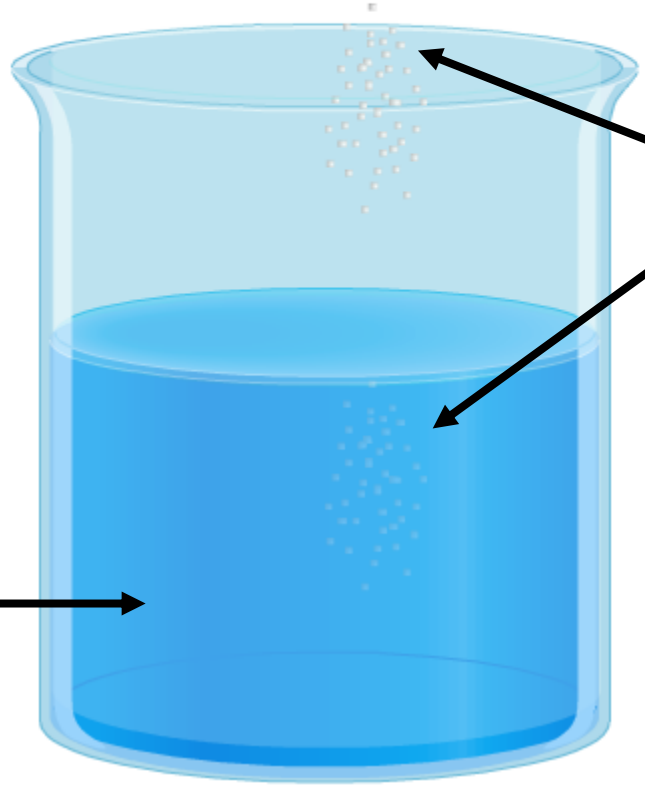
- Solute is NOT attracted to the solvent.
  - For fat particles to dissolve in water, the milk fat particles would have to be more attracted to the water particles.
    - Fat particles are not more attracted to the water particles.
    - Fat particles stay together and form insoluble globules in the liquid

Milk

Review Solutions

A Salt Water Solution

Animation



In A Salt Water Solution…

- Is salt the solute or the solvent?
  - Solute
- Is water the solute or the solvent?
  - Solvent
- What does the solute do?
  - Gets dissolved
- What does the solvent do?
  - Does the dissolving

Review Solutions

- Can you see two parts in solutions or are they mixed together so well you only see one thing?
  - you only see one thing
- Are solutions mixtures or pure substances?
  - Mixtures
- What kind of states can a solution be?
  - Solid, liquid, or gas
- What are the two “s” words that every solution must have?
  - A solute and a solvent

Matter (Solid, Liquid, Gas)

Pure Substances

You can only see one thing because there is only one kind of particle in it.

Mixtures

- can see two parts

Mechanical Mixture

- can see two parts

Solutions

They're mixed together so well you only see one thing – it looks pure but it isn't

A **solute** is the substance to be dissolved (sugar).

The **solvent** is the one doing the dissolving (water).

Science 7

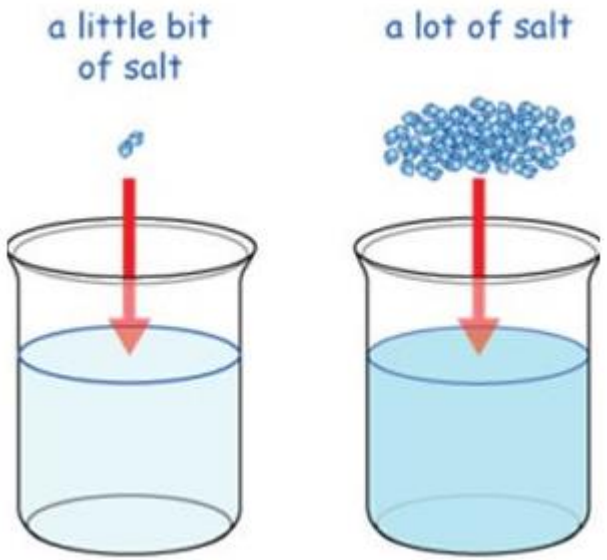
Unit 3: Solution and Mixture

Topic 4: Concentration and Solubility

What is Concentration?

- Concentration: The quantity of solute that is dissolved in a certain quantity of the solvent.

- Can be described qualitatively or quantitatively.

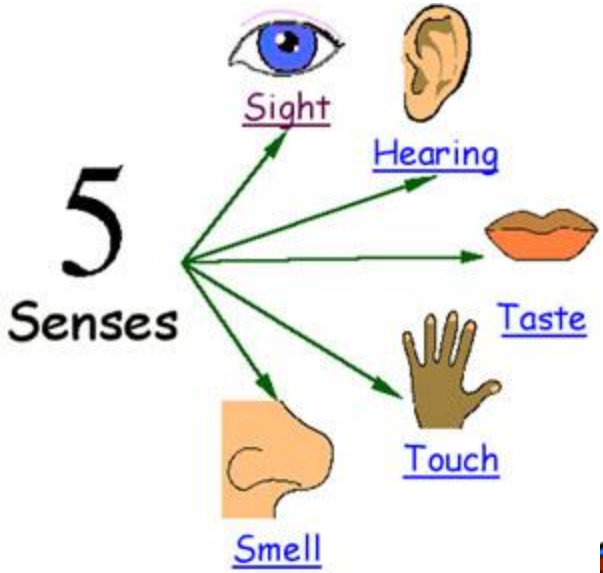


Qualitative and Quantitative Descriptions 0)

- **QUALITATIVE DESCRIPTIONS**

  are descriptions made by observing with the 5 senses, such as the smell of a flower or the colour of someone's eyes. They include observations which cannot be measured.

This bird has a large wingspan



- **QUANTITATIVE DESCRIPTIONS**

  are descriptions that are based on measurements or counting (i.e. they are numerical), such as the number of petals a flower has or how tall a person is. They deal with quantities.

This bird has a wingspan of two meters.

Student Practice

Qualitative or Quantitative?

#1(a). Food coloring made the water blue.

Qualitative

(b). Adding 3 mL of food coloring turned 250 mL of water blue.

Quantitative

#2(a). The water became warmer.

Qualitative

(b). The water's temperature increased by 5 degree Celsius.

Quantitative

#3(a). We needed just over a dozen floor tiles for our model room.

Qualitative

(b). We needed 14 floor tiles for our model room.

Quantitative

#4(a). The liquid boiled In 5 min.

Quantitative

(b). The liquid took only a few minutes to boil.

Qualitative

#5(a). The mass of this solid is 5g more than that one.

Quantitative

(b). This solid is heavier than that one.

Qualitative

#6(a). He drinks eight glasses of water each day.

Qualitative

(b). He drinks 2L of water each day.

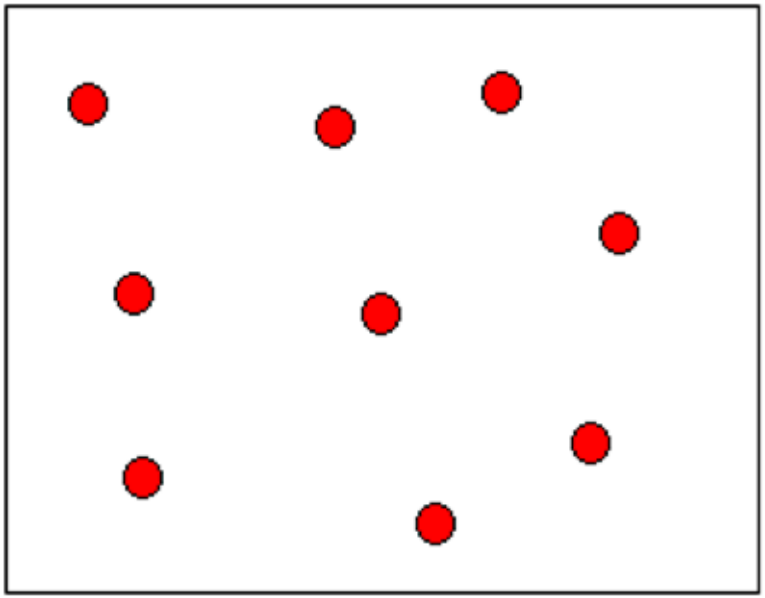
Quantitative

Qualitative Description Of Concentration

- **Concentrated solution**
  - Darker tea
  - Large mass of dissolved solute for a certain quantity of solvent.

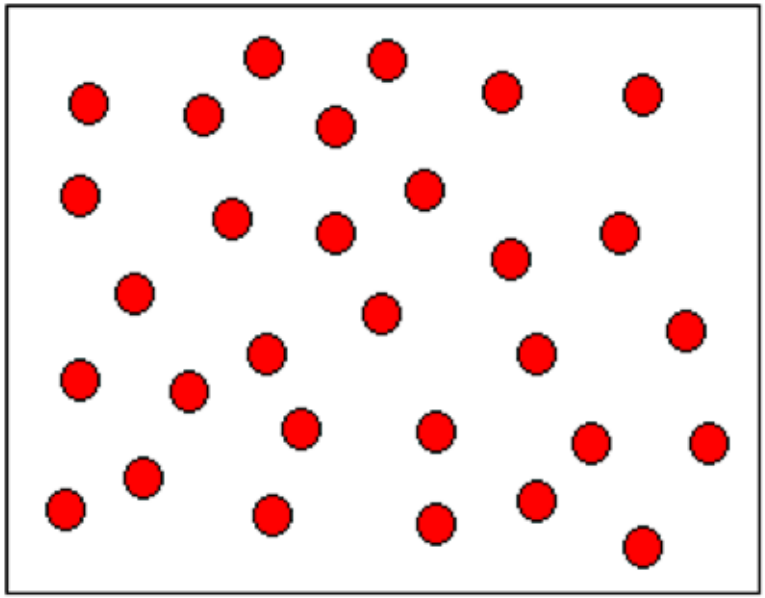
- **Dilute solution**
  - Lighter tea
  - Small mass of dissolved solute for a certain quantity of solvent

Dilute



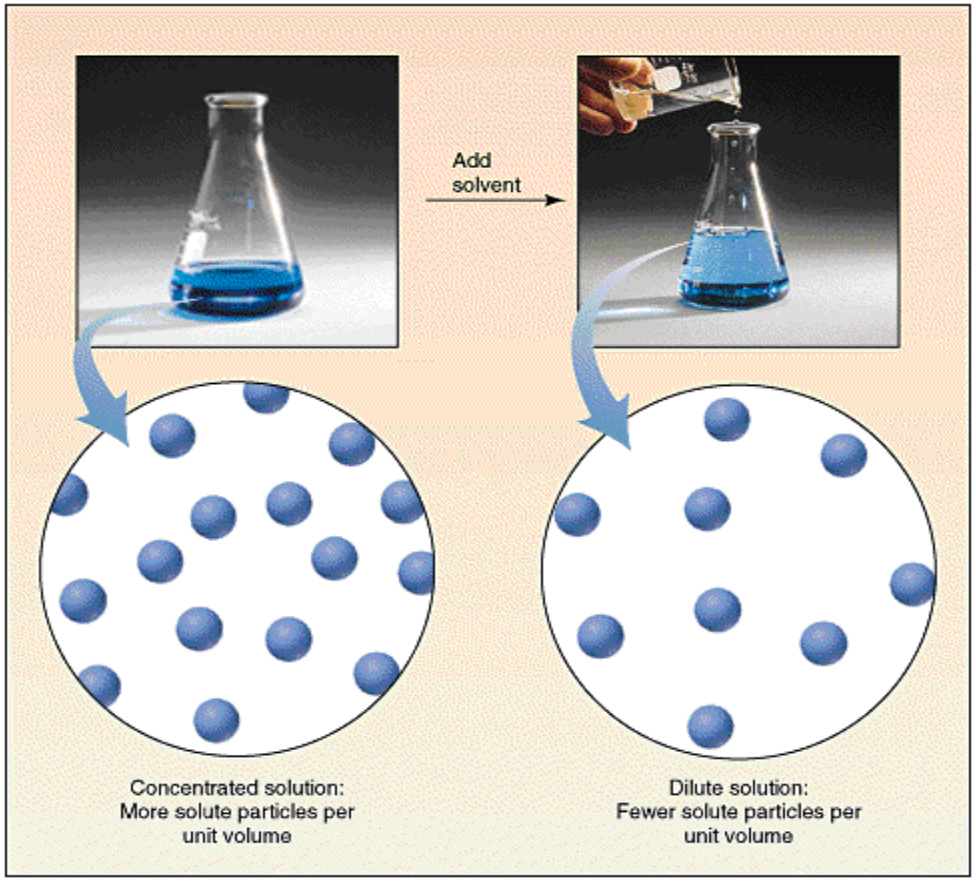
Describes a solution that contains less solute than compared to another solution.

Concentrated



Describes a solution that has more solute than compared to another solution.

Diluted ⟷ **Concentrated**



Dilute Concentrated

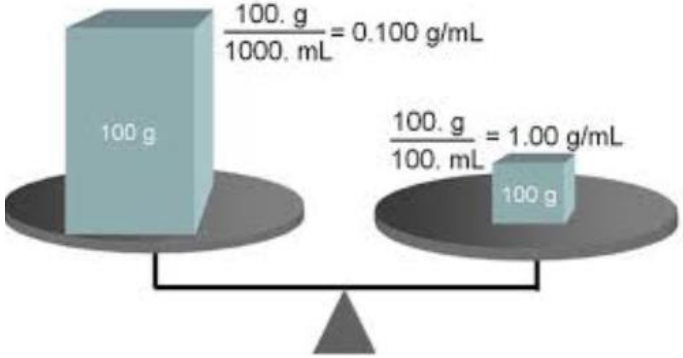
Quantitative Description Of Concentration

Expressed as the amount of solute per unit volume.

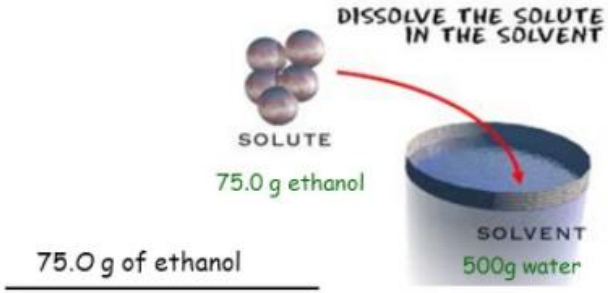
Examples:

1) ppm (parts per million)

2) g/L
g/mL



3) percentage by mass



$$\frac{75.0\text{ g of ethanol}}{500\text{g water} + 75.0\text{ g of ethanol}}$$

=13.0 %

ppm		% mass		g/L	
Item	Chemical	Item	Chemical	Item	Chemical
multivitamin	iron	vinegar	acetic acid	salt water	salt
etc…					

Insert pictures for these

Converting g/mL to g/L

**Remember there are 1000mL in 1 L.

1g/mL = ? g/L

1 x 1000 = 1000

therefore 1000g/L

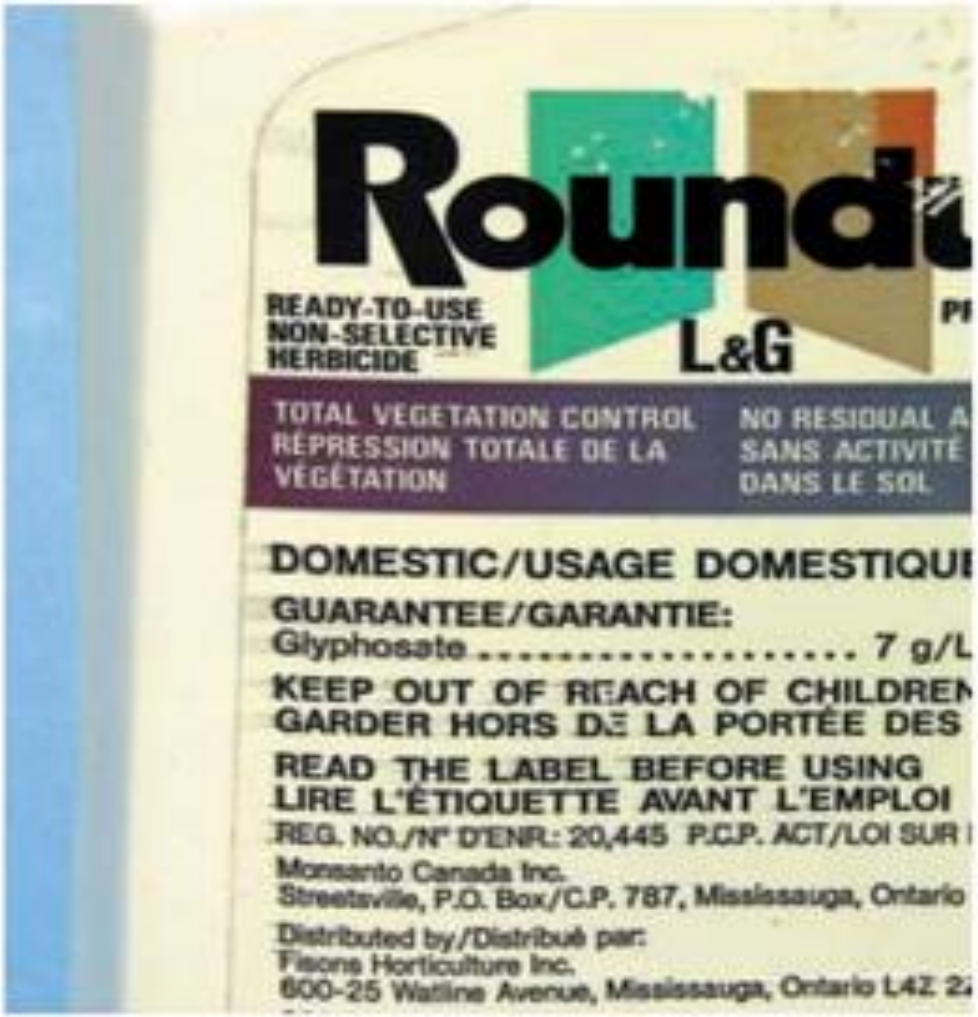
Practice Problems…

0.3g/mL = ? g/L

300g/L

8.9g/mL = ? g/L

8900g/L


Round
READY-TO-USE
NON-SELECTIVE
HERBICIDE
L&G
TOTAL VEGETATION CONTROL
RÉPRESSION TOTALE DE LA
VÉGÉTATION
NO RESIDUAL A
SANS ACTIVITÉ
DANS LE SOL
DOMESTIC/USAGE DOMESTIQU
GUARANTEE/GARANTIE:
Glyphosate ..... 7 g/L
KEEP OUT OF REACH OF CHILDRE
GARDER HORS DE LA PORTÉE DES
READ THE LABEL BEFORE USING
LIRE L'ÉTIQUETTE AVANT L'EMPLOI
REG. NO./N° D'ENR.: 20,445 P.C.P. ACT/LOI SUR
Monsanto Canada Inc.
Streetsville, P.O. Box/C.P. 787, Mississauga, Ontario
Distributed by/Distribué par:
Fisons Horticulture Inc.
600-25 Watline Avenue, Mississauga, Ontario L4Z 2

Qualitative Versus Quantitative For Concentration

Qualitative

- Using words such as "dilute" or "concentrated"

Quantitative

- Using numbers. This is especially important when safety is an issue!

A Limit To Concentration

- Make a salt solution:
  - Add a spoonful… dissolved!
  - Add a second spoonful… dissolved!
  - Add a third, fourth and more… It becomes more concentrated!
- Eventually you reach a point where salt will **NOT** dissolve any more.

Notice the lump of undissolved solid that is left on the spoon

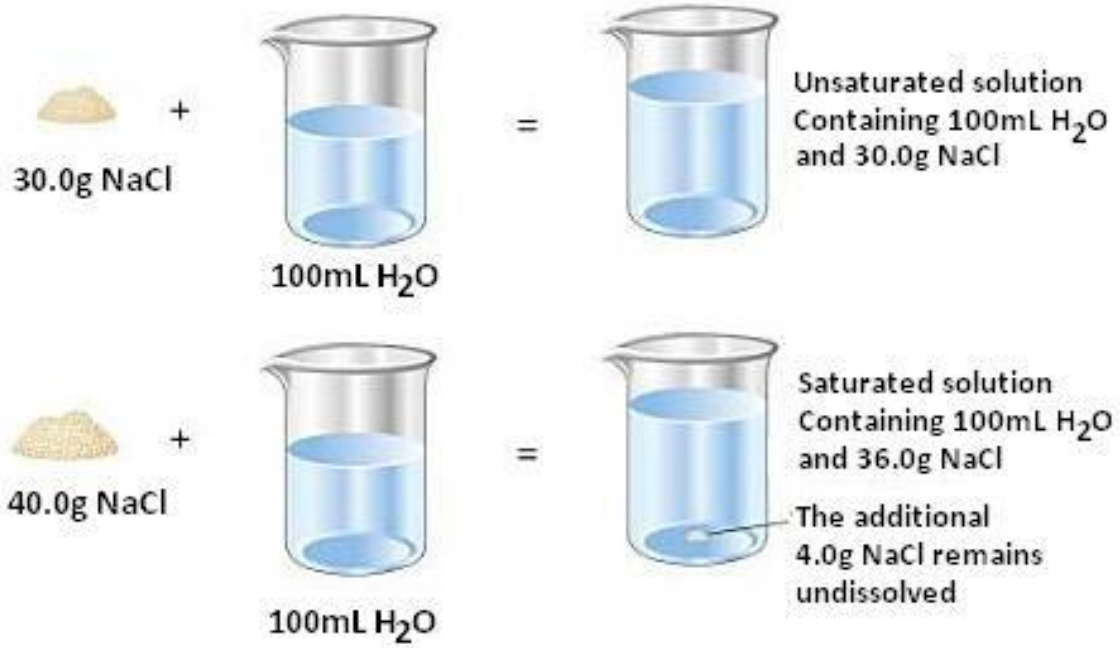
Saturated vs. Unsaturated

Saturated

- Will form when no more solute will dissolve at a certain temperature

Unsaturated

- More solute is able to dissolve at a certain temperature



Time to think…

- Concentrated solutions can be:

1. Adding more solute and keeping the amount of solvent the same.
2. Keeping the amount of solute the same and reducing the amount of solvent.
   - Example
     - boiling off the water while making jam

- a solution could be considered "concentrated" and still be unsaturated.

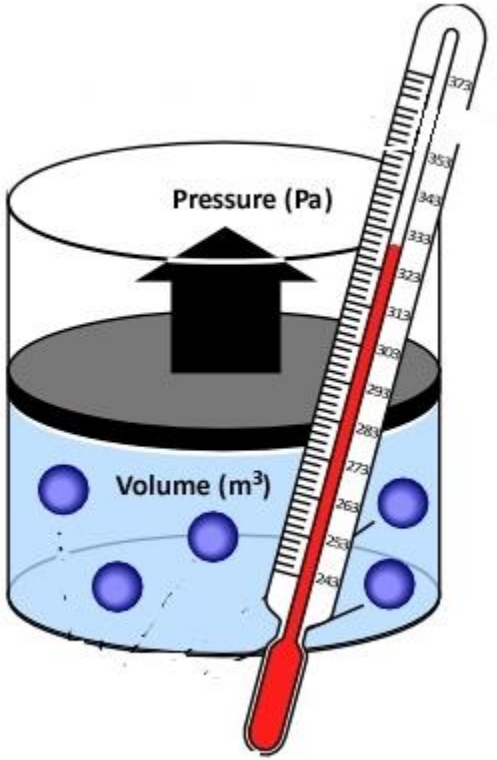
Factors that affect Solubility And Rate of Dissolving

Solubility refers to the amount of solute that will dissolve in a given amount of solvent at a given temperature

Rate of dissolving refers to how quickly a solute dissolves in a solvent.

Solubility and dissolving is affected by:

1. Stirring
2. Temperature
3. Size of solute
4. Pressure



1. Stirring

- A solute will dissolve more quickly if you stir it.
- Example: fruit drink with drink crystals.
  - Stir the mixture to increase the rate of dissolving.

Figure 8.10 Why might stirring or shaking a mixture make a solute dissolve faster?

Stirring: Particle Theory

p

A: Before mixture is stirred.

- Movement depends on the natural movement of the nearby water particles.
- The solution close to the crystal is more concentrated and the solution farther from the crystal is more dilute.

B: While stirring mixture

- The solute and solvent interact more quickly.
- The concentrated solution is pushed away from the crystal at the same time it pushes dilute solution closer to the crystal.

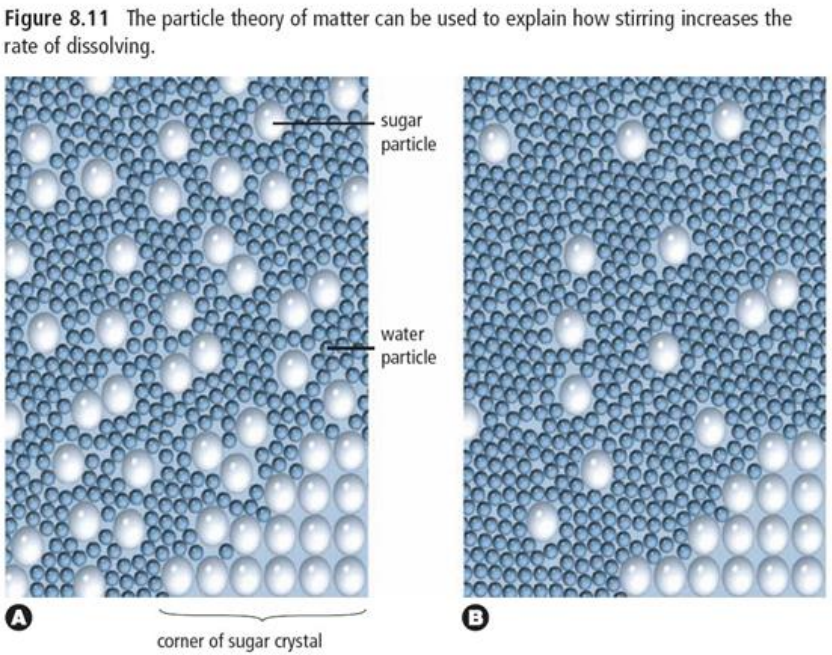


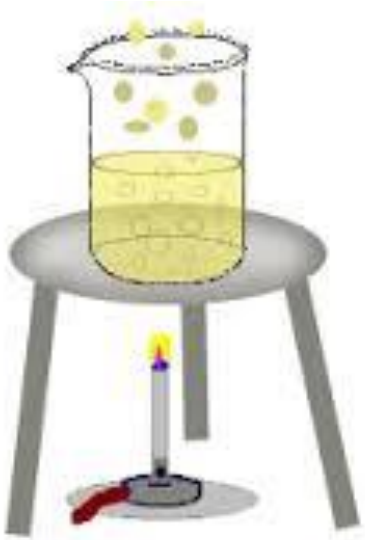
Figure 8.11 The particle theory of matter can be used to explain how stirring increases the rate of dissolving.

2. Temperature - SOLID

- As temperature increases:
  - The faster the solute will dissolve.

Temperature - GAS

- As temperature increases:
  - The solubility of a gas generally decreases.
  - It will taste: “flat” - warm pop if left open for a period of time



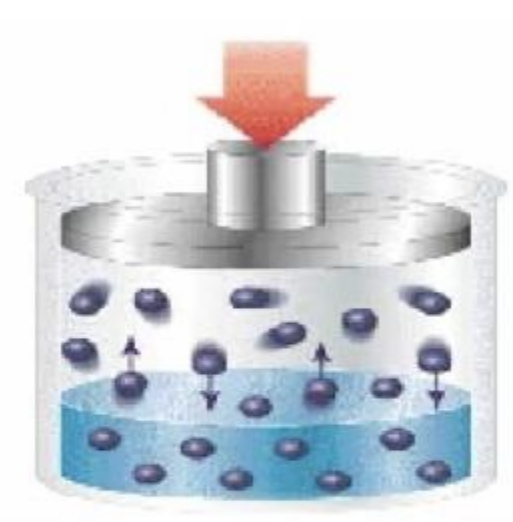
Adding heat decreases the solubility of gases

3. Size Of Solute

- Smaller pieces of solute will dissolve more quickly than larger pieces.
  - Dissolving a solid in a liquid takes place at the surface of the solid.
  - Breaking a large solid into smaller pieces, expose more surfaces - creating a larger surface for the solvent to interact with.

4. Pressure

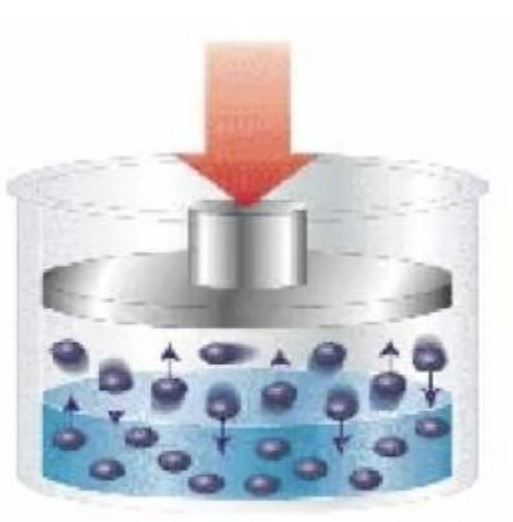
- Gases are more soluble in liquids under higher pressure.



LESS PRESSURE

....

LESS SOLUBILITY



MORE PRESSURE

....

MORE SOLUBILITY

Pressure:
Open a bottle or can of pop!

- As pressure increases, the solubility of a gas generally increases.
  - Higher pressure forces extra gas particles into the spaces between the water particles.
- As pressure decreases, the solubility of a gas generally decreases.
  - Open the can and the pressure inside lowers quickly. Gas solute comes out of the solution. IE: bubbles

Science 7

Unit 3: Solution and Mixture

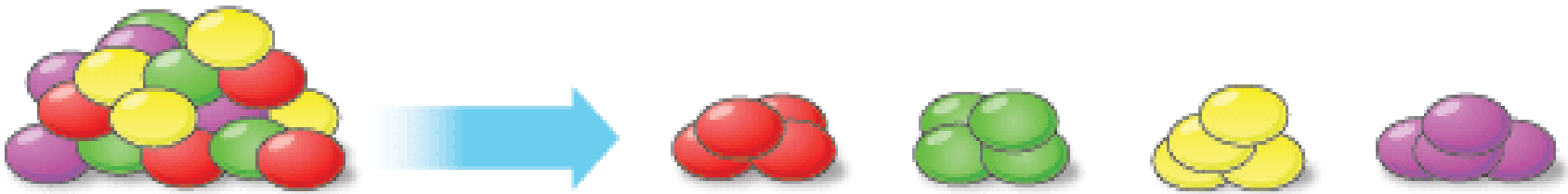
Topic 5: Separating Mixtures and Solution

Separating Mixtures

When two or more materials or substances are mixed together but do not chemically combine.

This means they retain their original properties.

This means they can be separated by physical means.

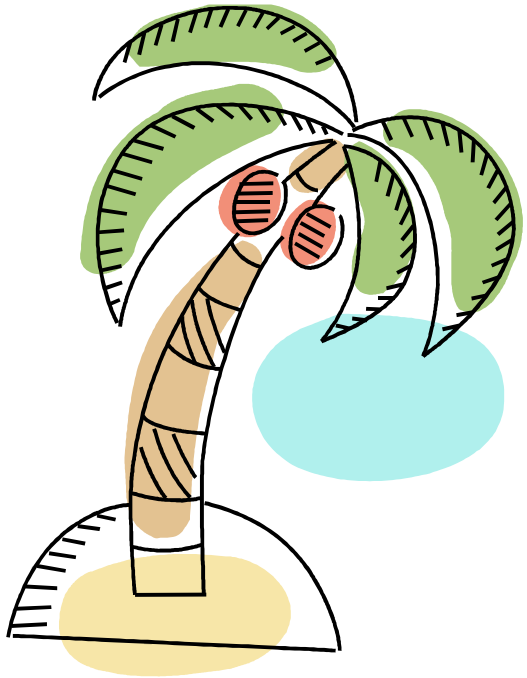


Mixture

Separated

Separating Mixtures

You're **stranded** on a desert island surrounded by sea water, sadly your **science teacher is lost** at sea but luckily all your **science equipment has washed up**...



...how could you separate a mixture of sand, salt and water to get drinking water?

Why Separate Mixtures?

straining spaghetti

skimming fat off soup

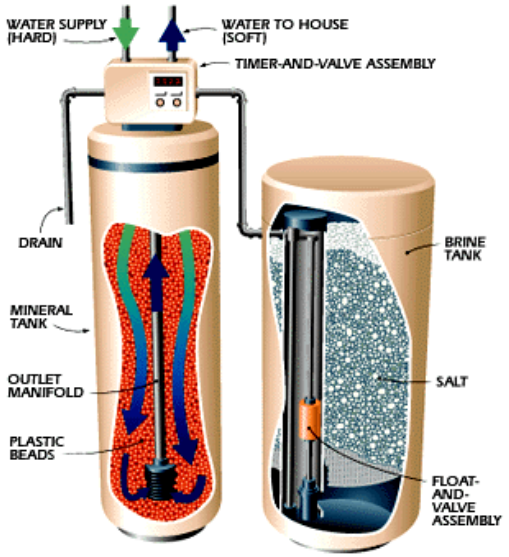
drying clothes (separating water from fabric)

window screens allowing air in while keeping insects out

making coffee using ground coffee beans

Separation Of Mixtures Occur In Many Branches Of Science:

- Food science
  - Tea bags
- Chemistry
  - Water softeners
- Engineering
  - Oil and gas fi
- Life science
  - Bogs



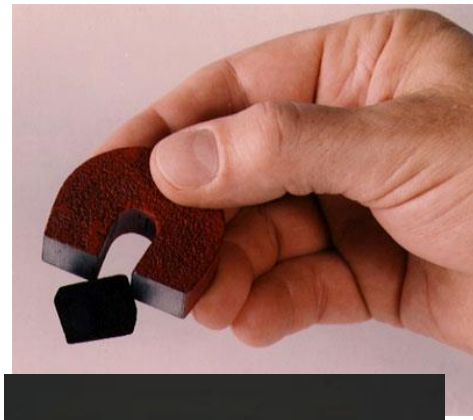
Different separation techniques

- Are there mixtures that can not be separated?
- Are there mixtures in and around your home that you do not want to separate?
- Why can one mixture be separated with a filter while another can not?

Because of Particle size and the type of mixture!

What are the different ways of separating mixtures?

- (i) Mechanical sorting(flotation, magnetism)
- (ii) Filtration
- (iii) Evaporation
- (iv) Distillation
- (v) Paper chromatography



Separating Mixtures

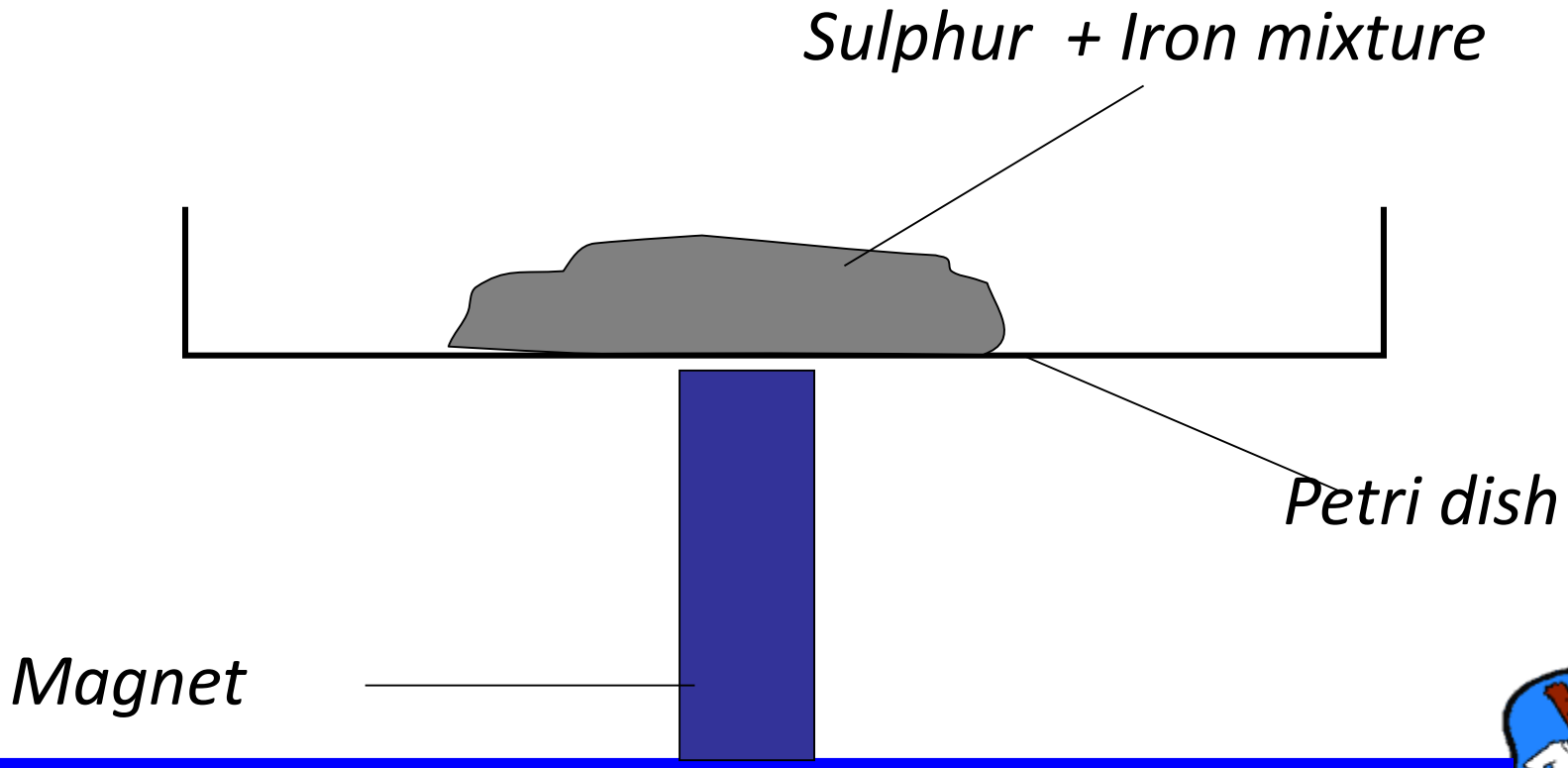
Mixing sulphur and iron...

...how could you separate this mixture?

Separating Mixtures

Do not put magnetic directly on iron

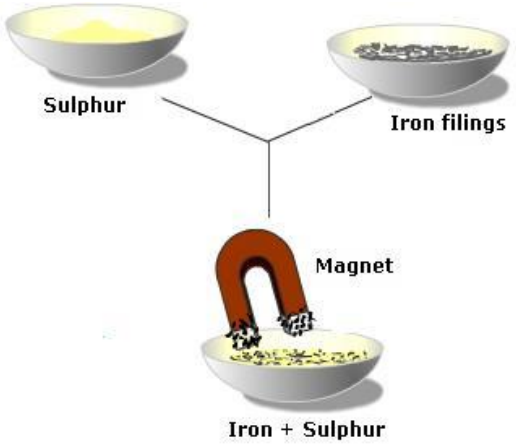
Hold the magnet **below** the Petri dish



1. Mechanical Sorting

Used to separate the parts of a mixture based on properties such as particle size, colour, shape..etc.

Examples:



Magnetism :Can be used to separate a magnetic substance from a non-magnetic substance

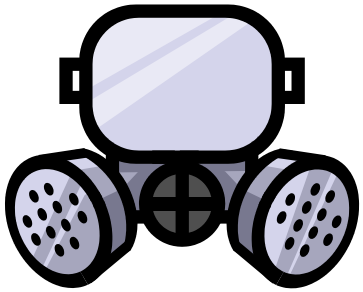
Floatation: used to separate substances by whether they float or sink.

Figure 9.4 When you separate a mixture such as sand mixed with iron filings, you can use the property of magnetism to separate one substance (the iron filings) from another substance in the mixture. Why is the magnet inside a plastic bag?

Figure 9.5 The density of fat is lower than the density of soup liquid, so the fat floats. When it cools and hardens, fat is easy to remove from the surface of the soup.

magnetism

floatation



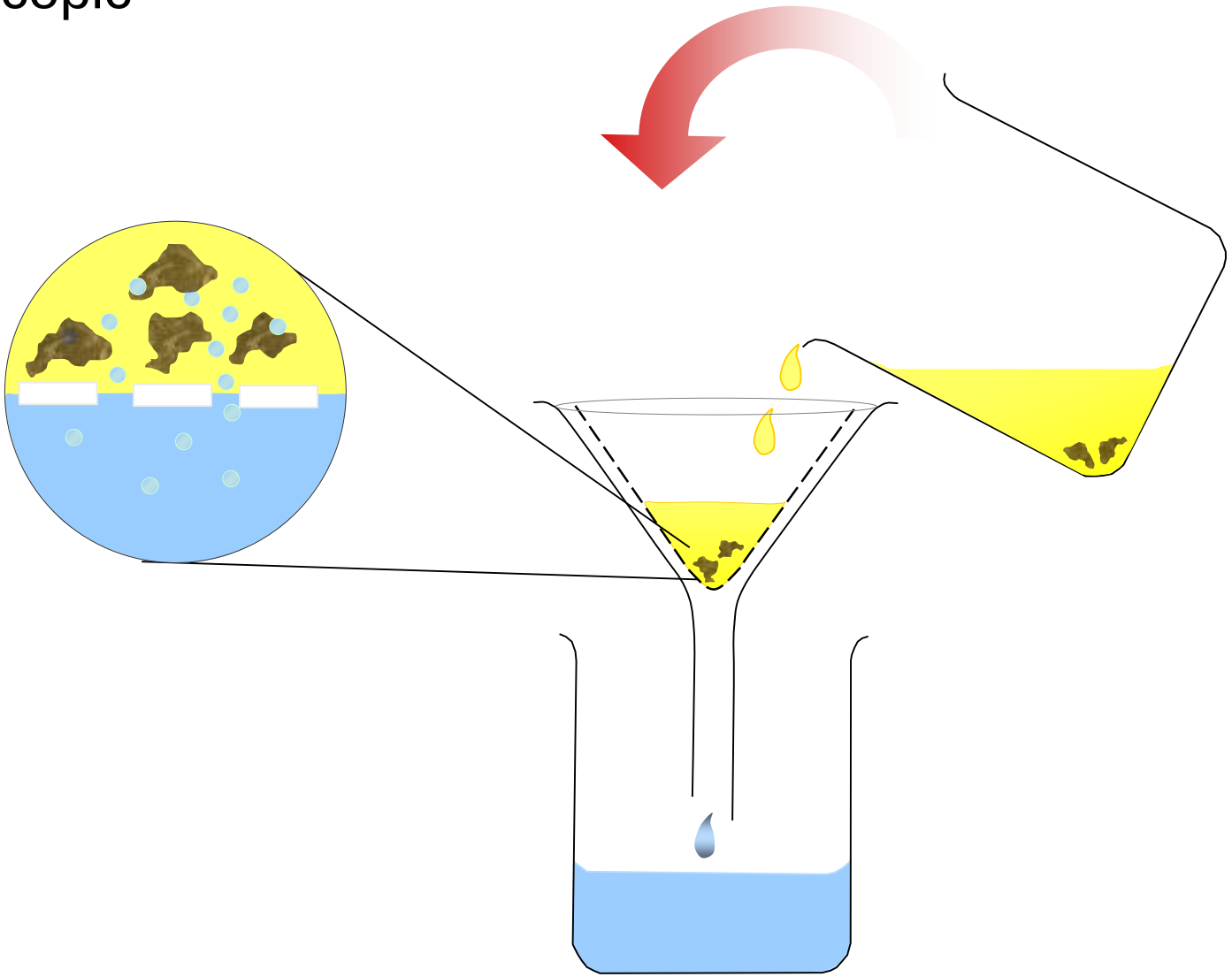
2. Filtration

- Used when separating a solid substance from a fluid (a liquid or a gas) by passing a mixture through a porous material such as a type of filter.

- Works by letting the fluid pass through but not the solid.

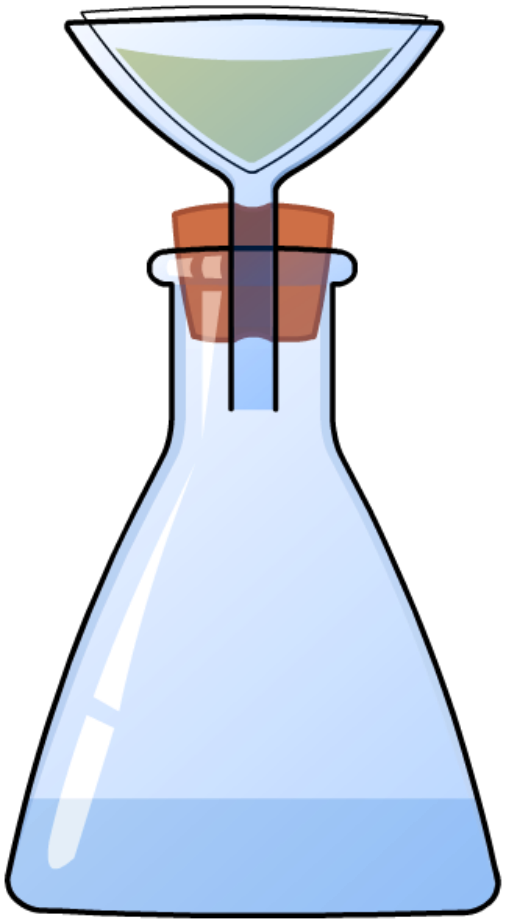
- Examples of filters: coffee filter, cloth, oil filter, even sand!

The filters can have holes of varying sizes… small to microscopic



A **filter** can also be used to **separate solid particles of different sizes**.

(ex. a window screen, an air filter, a sand sieve)

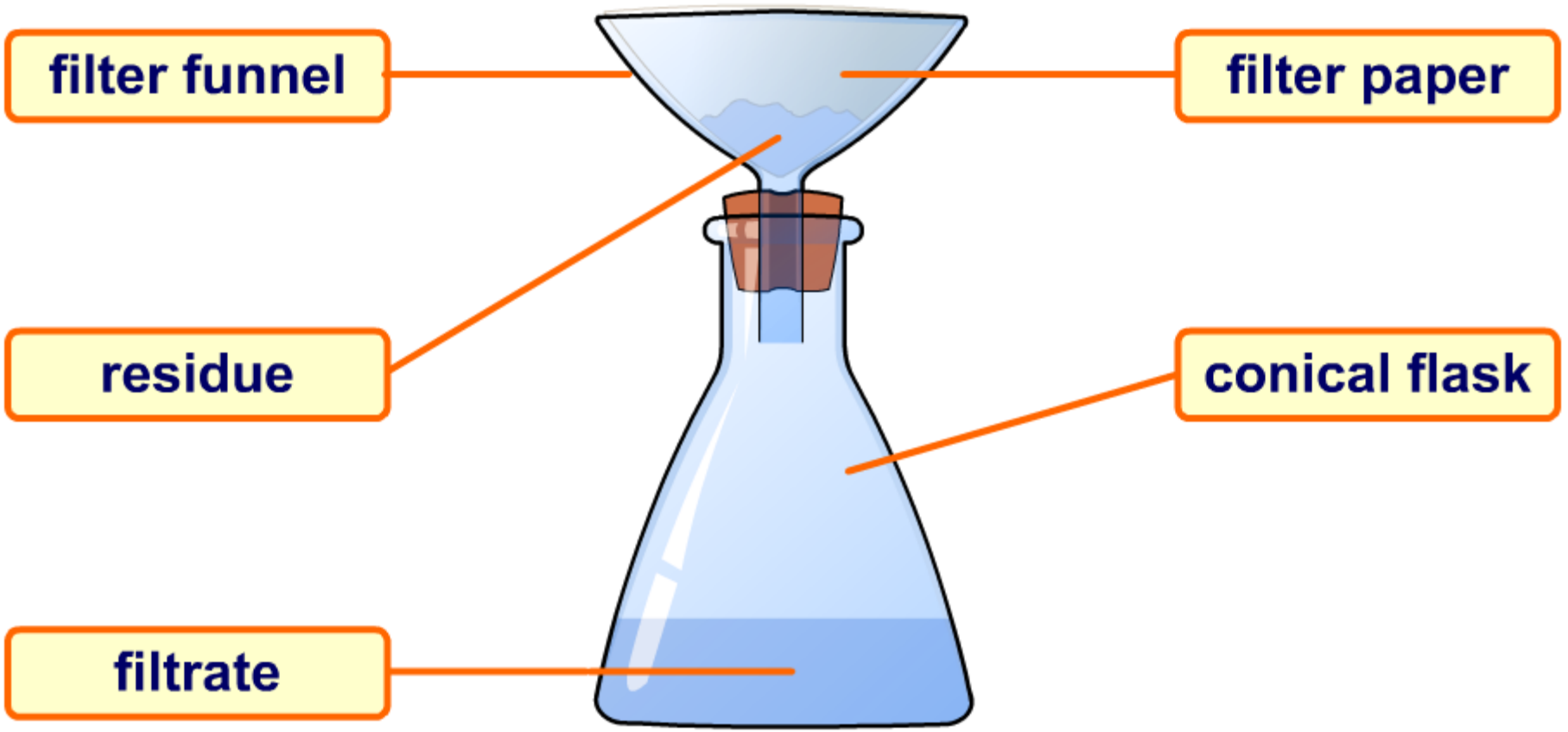


It is easy to separate an insoluble solid by **filtering** the mixture.

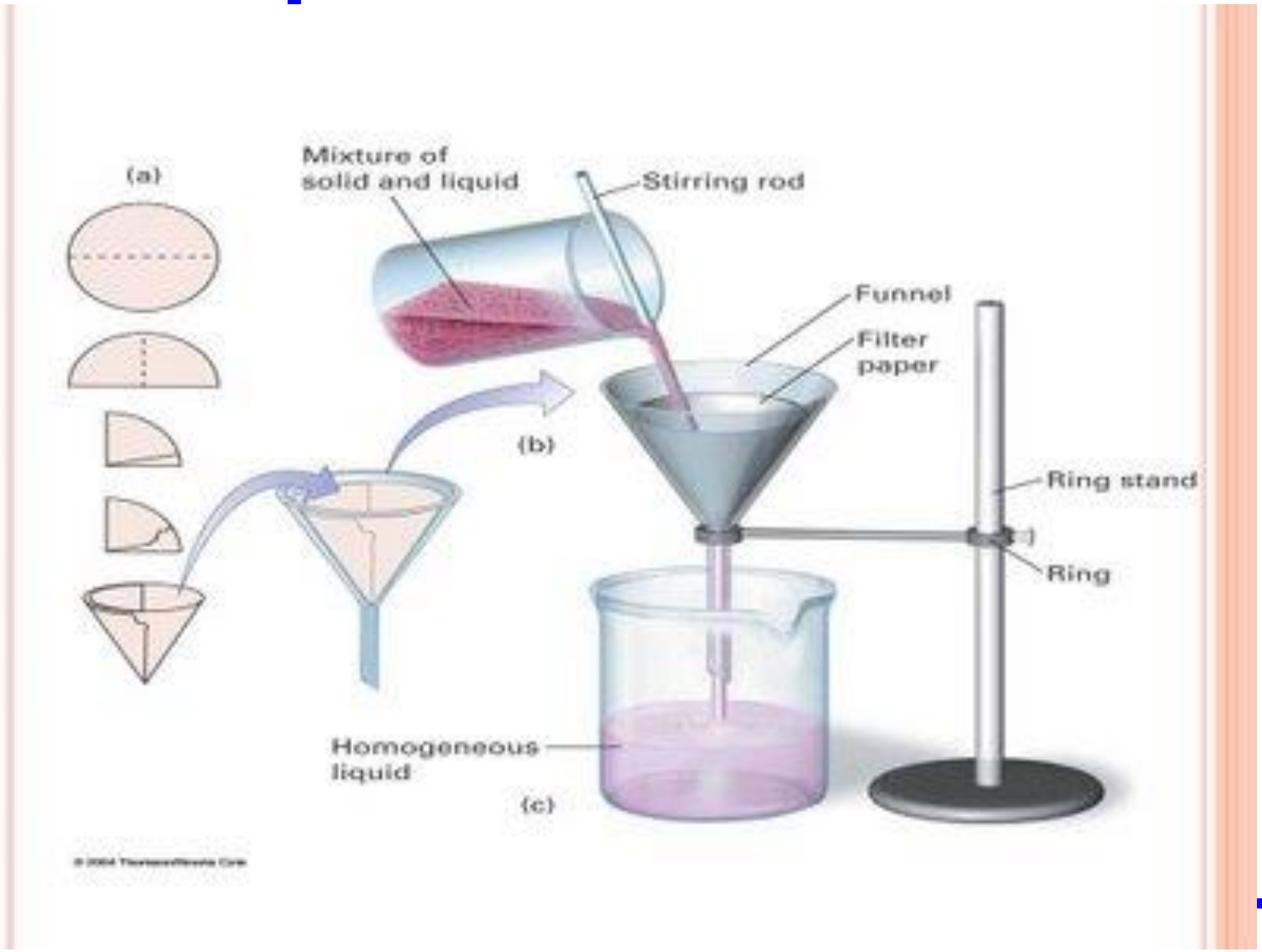
The insoluble solid cannot pass through the filter paper but the water can.

The sand that is trapped by the filter paper is called the **residue**. The water that passes through the filter paper is called the **filtrate**.

What Apparatus Is Used For Filtering Substances?



Filtration Separates A Liquid From A Solid



Coffee filter

Oil filter

Furnace filter

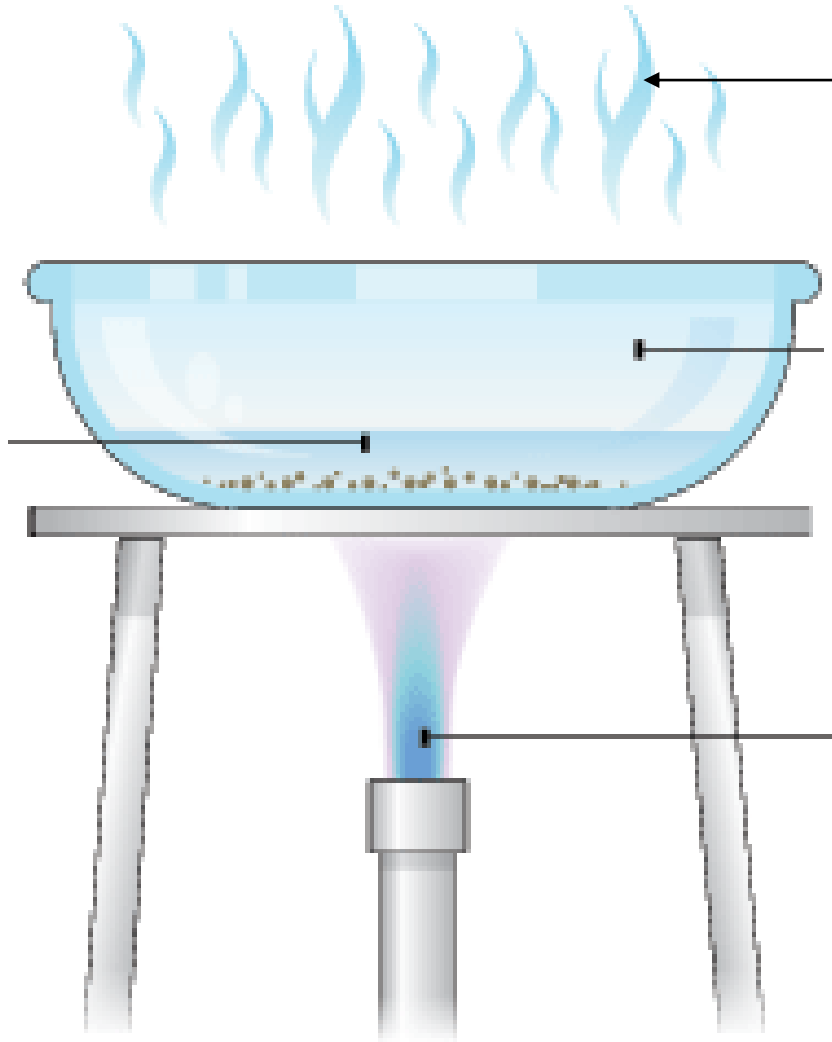
Colander

3. Evaporation

-Change of state from a liquid to a gas.

-Used to recover a solid solute from a solution.

Evaporation



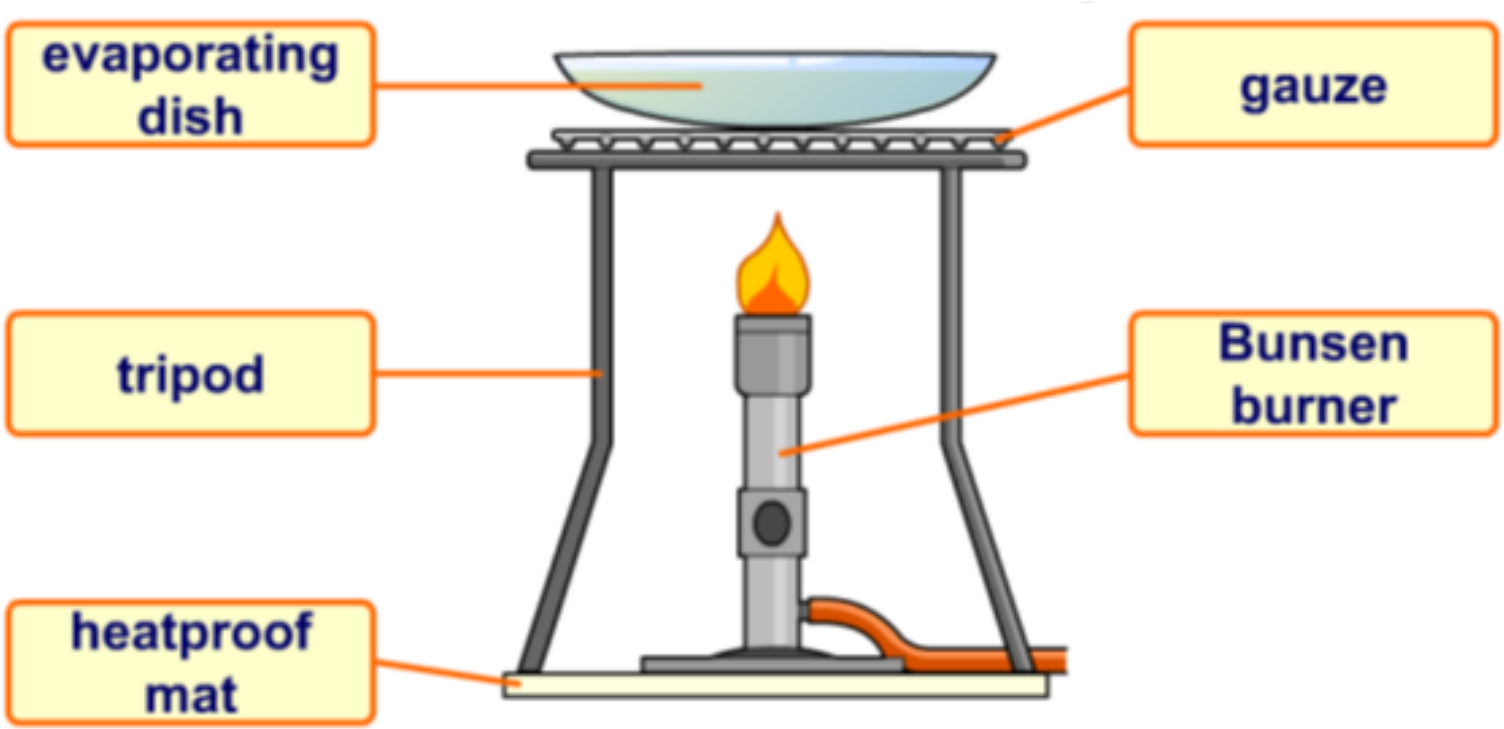
Water

Evaporating dish

Mixture
(salt and water)

Bunsen burner

What Apparatus Is Used For Evaporating Substances



4. Distillation

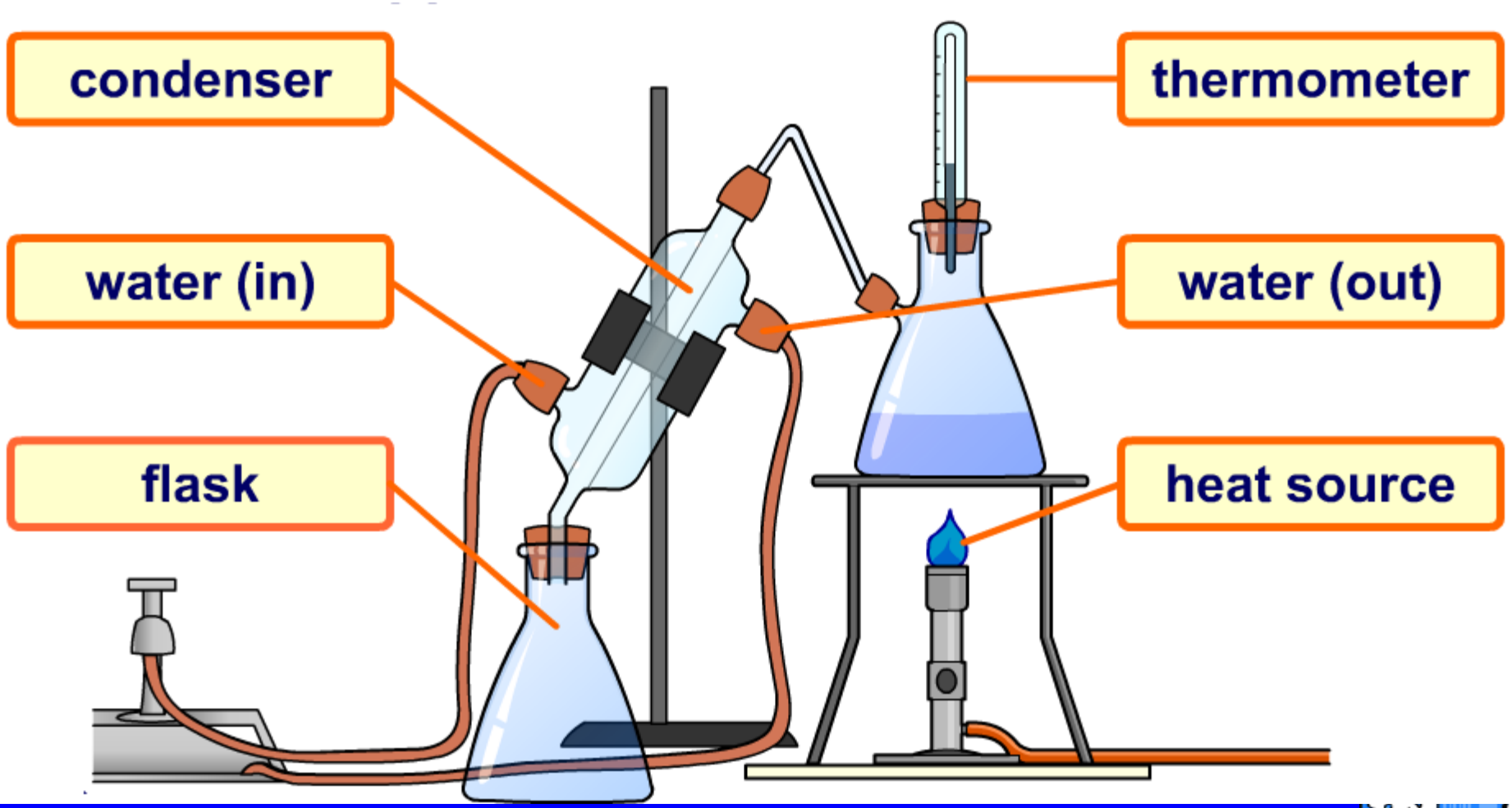
-Is a method that you can use to separate and recover a single solute *and* a single solvent from a solution.

-Uses the property of the boiling point to separate two components of a solution (solvent and solute)

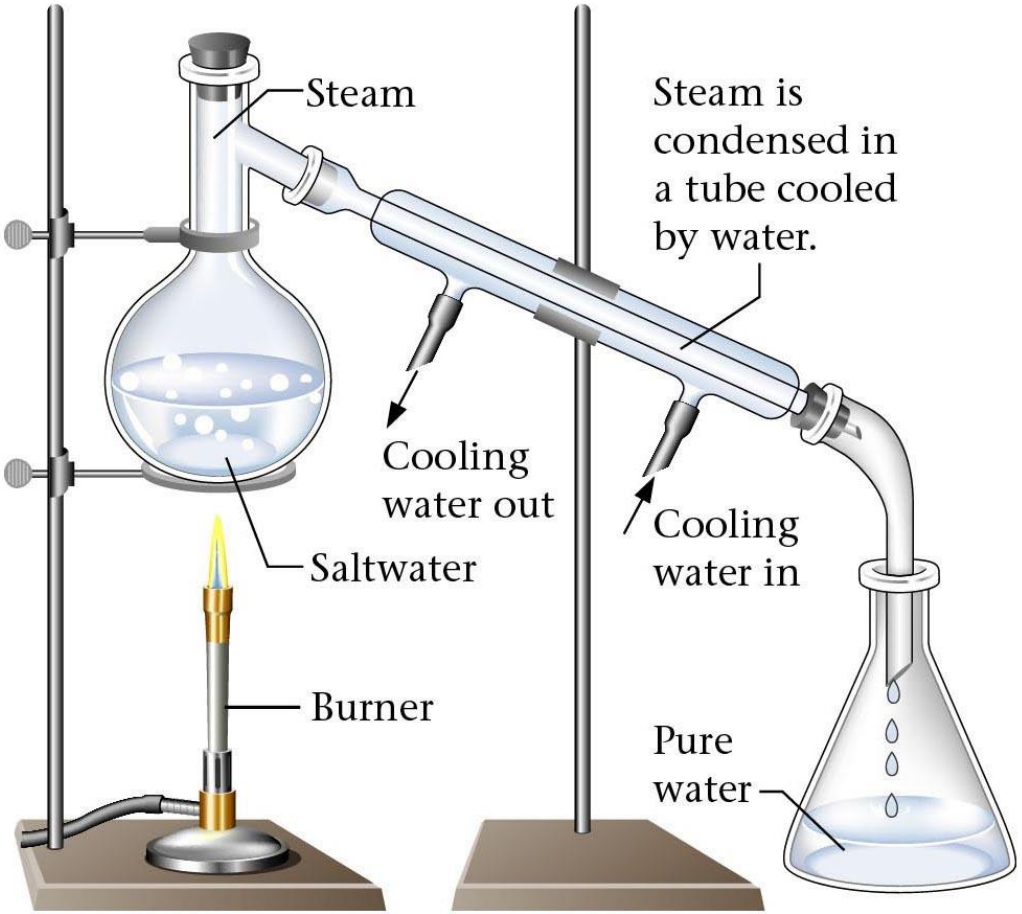
-Three key stages to distillation:

1) Evaporation
2) Condensation
3) Collection

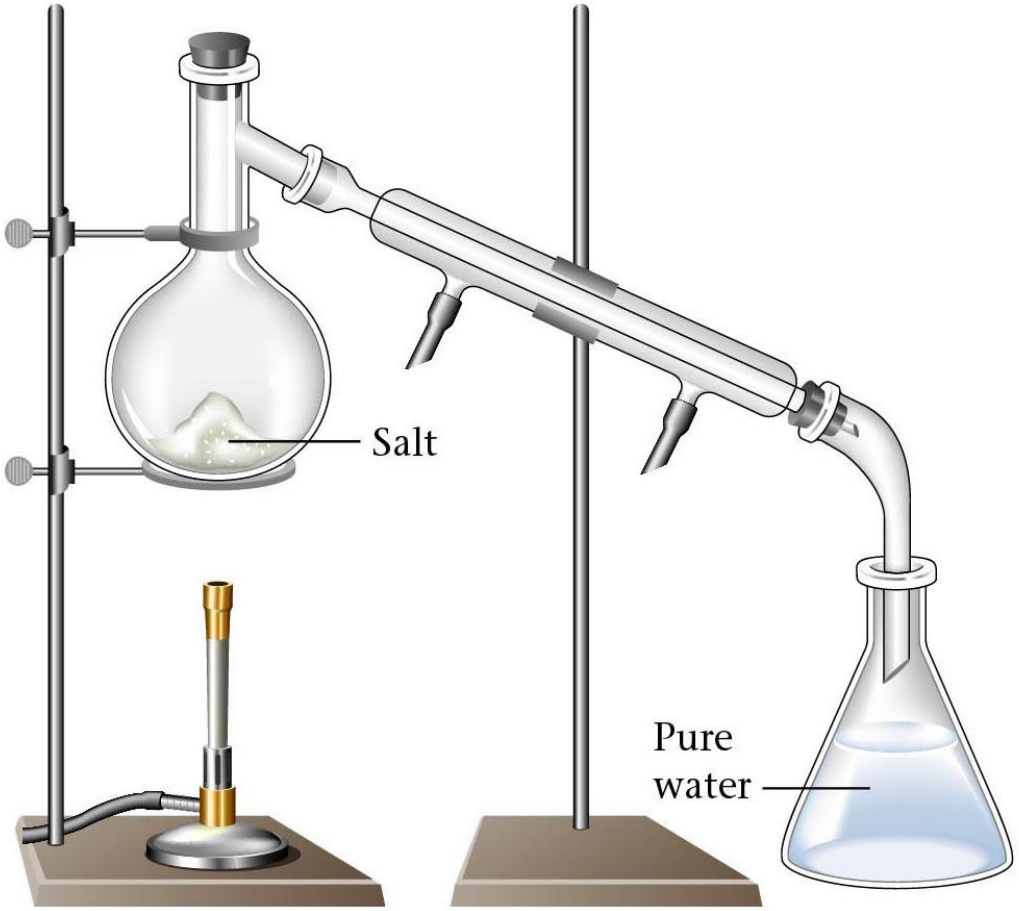
What Apparatus Is Used For Distillation?



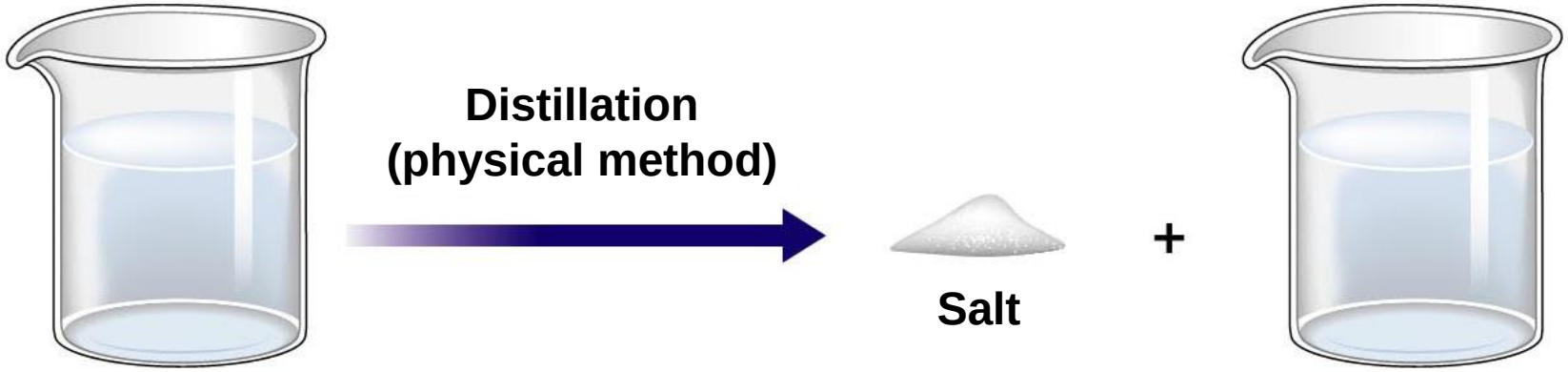
The solution is boiled and steam is driven off.



Salt remains after all water is boiled off.



No chemical change occurs when salt water is distilled.



http://www.youtube.com/watch?v=zW3C1RRulmg

Figure 9.10 This method for distilling drinkable water from salt water requires simple materials and plentiful heat from the Sun.

Two types of Distillation

1. Simple Distillation

- Simple distillation generally separates a single solute from its solvent.

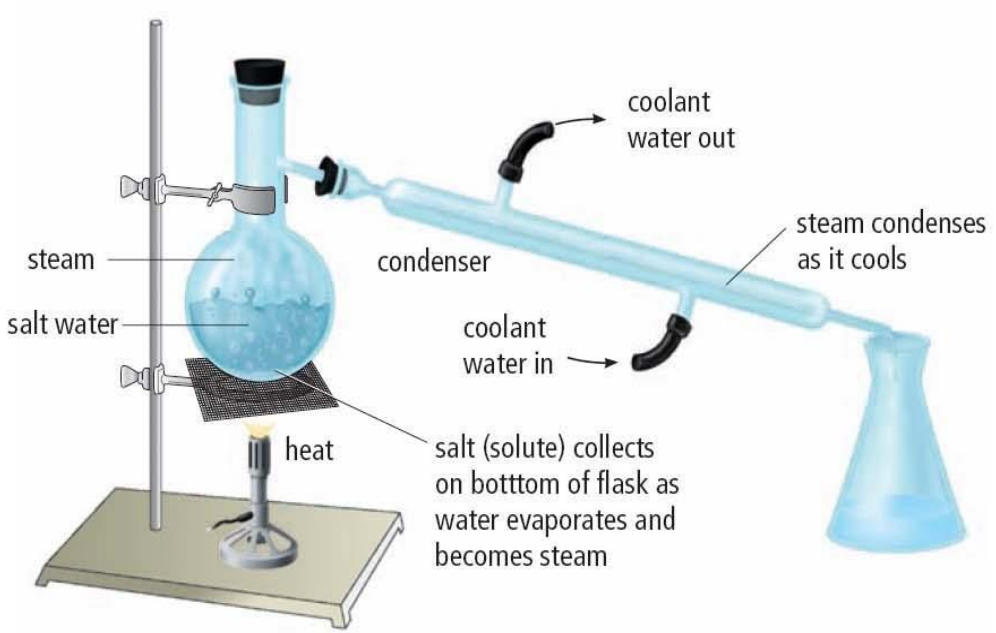


Figure 9.9 Simple distillation equipment. During what parts of this process is the solvent in the gas state? In what parts is it in the liquid state?

2. Fractional Distillation

http://www.youtube.com/watch?v=PYMWUz7TC3A

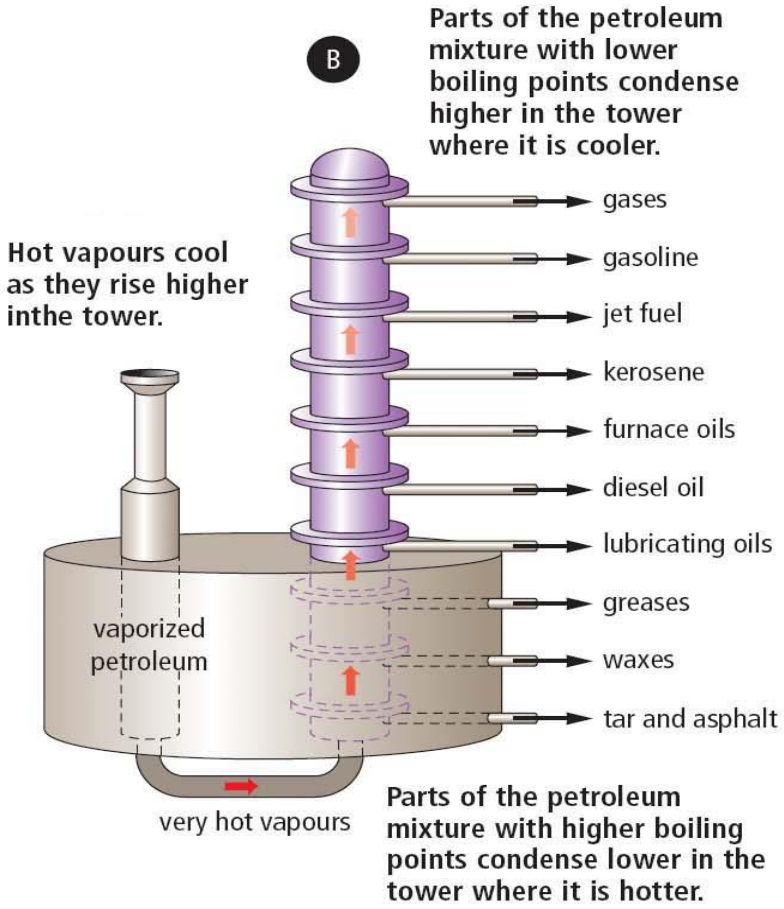
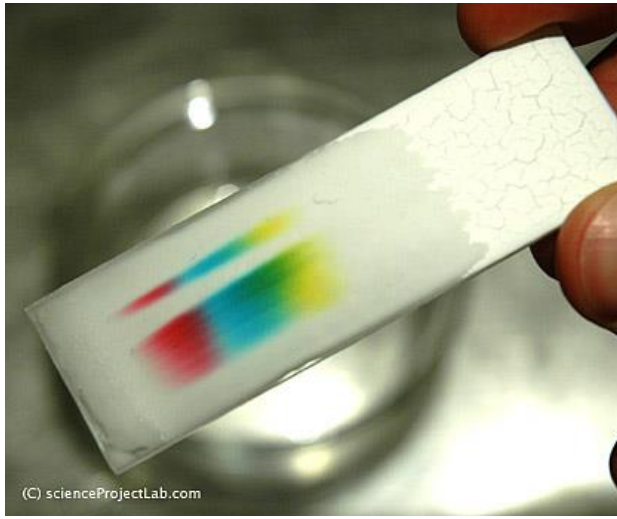


Figure 9.13 Fractional distillation towers (A) are common sights in the oil-producing regions of North America. The diagram (B) shows some of the products that are made from each separated part of the original petroleum mixture.

- Fractional distillation separates a mixture of liquids based on their varying boiling points.

5. Paper Chromatography



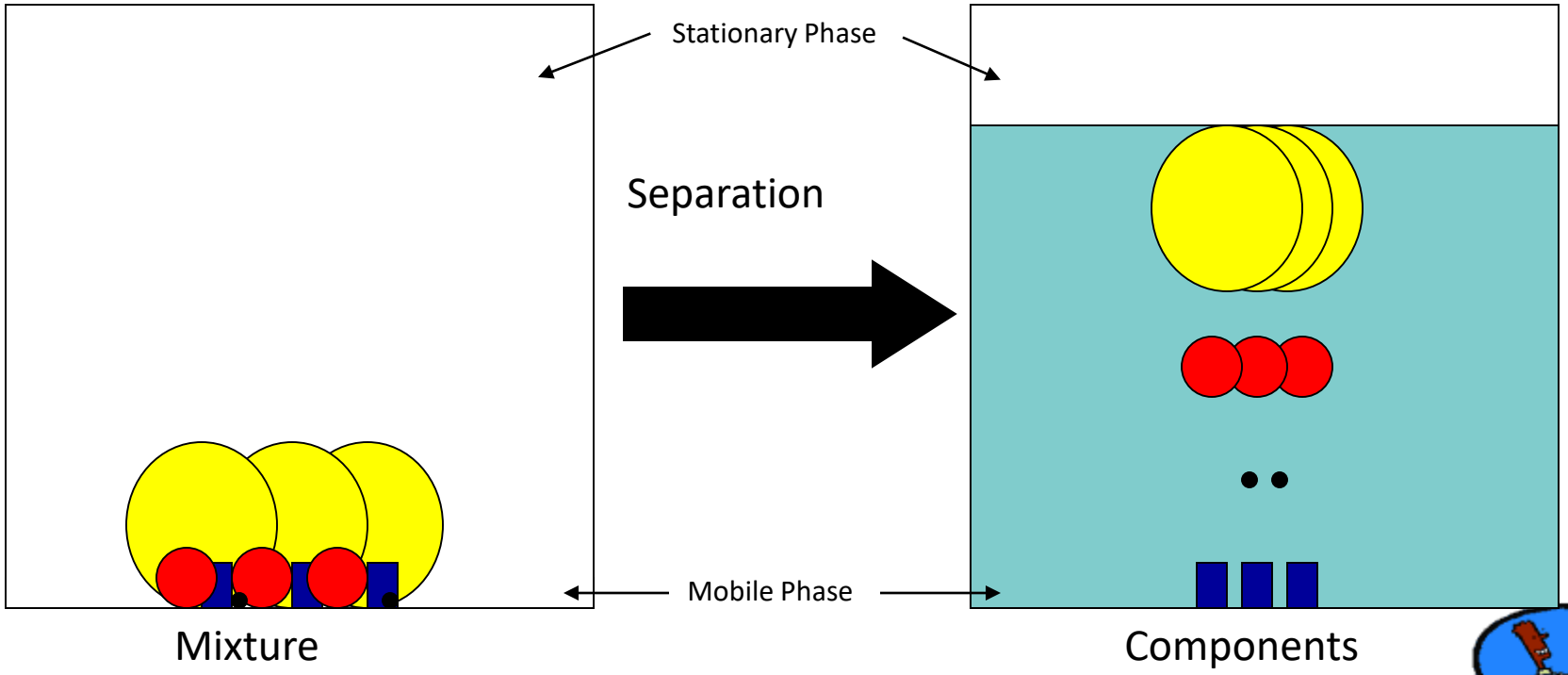
- Separates components of a mixture based on ability of each component to be drawn across the surface of another material
- Mixture is usually liquid and is usually drawn across chromatography paper

- Separation occurs because various components travel at different rates
- Components with strongest attraction for paper travel the slowest

- Different substances or different components move at different speeds through a strip of wet paper a gel or a gas.

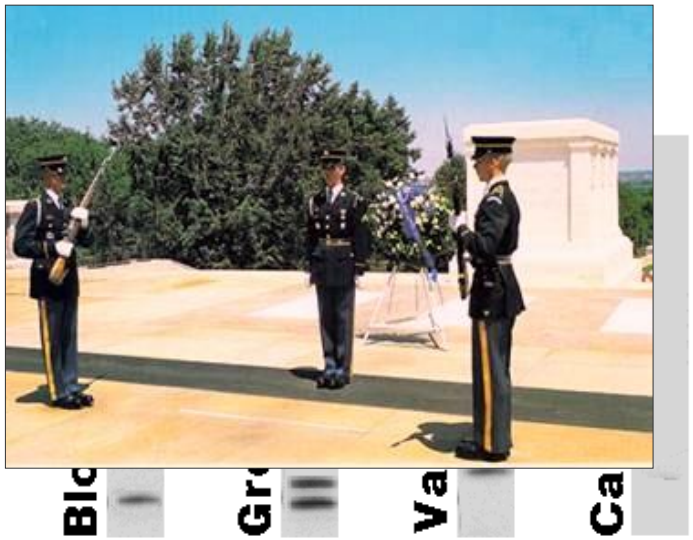
Chromatography

- Used to separate dissolved substances in a solution from each other.

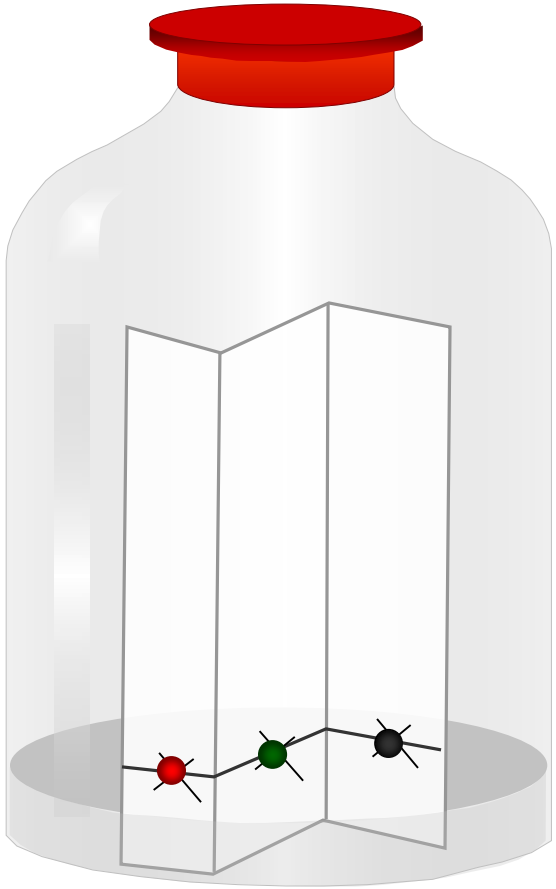


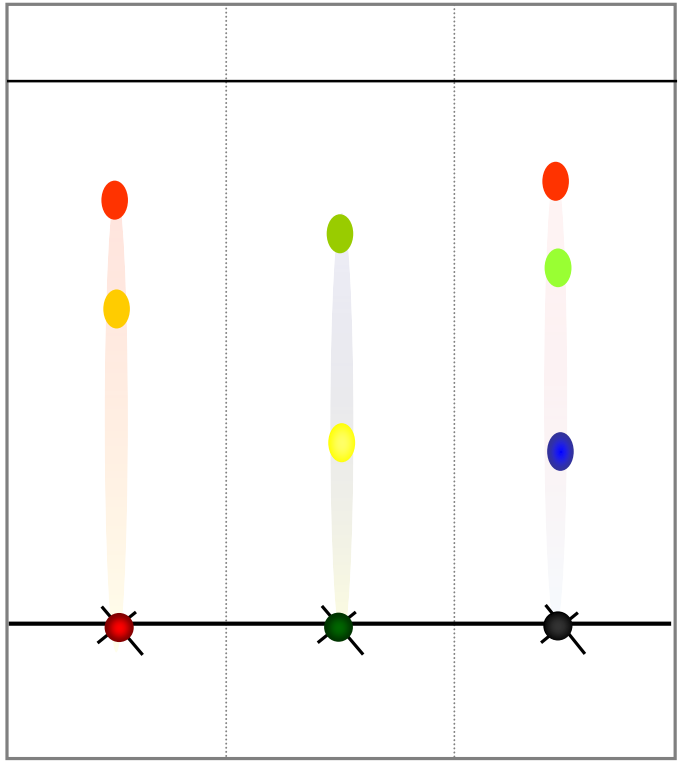
Chromatography

- Tie-dye t-shirt
- Black pen ink
- DNA testing
  - Tomb of Unknown Soldiers
  - Crime scene
  - Paternity testing

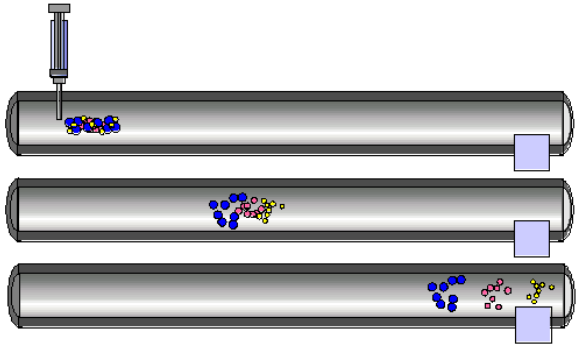


Paper Chromatography



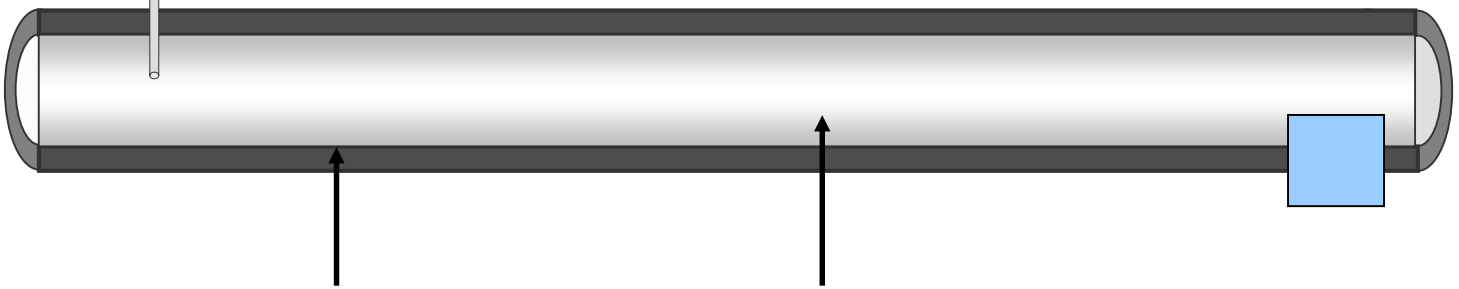


Separation by Chromatography



sample
mixture

a chromatographic column



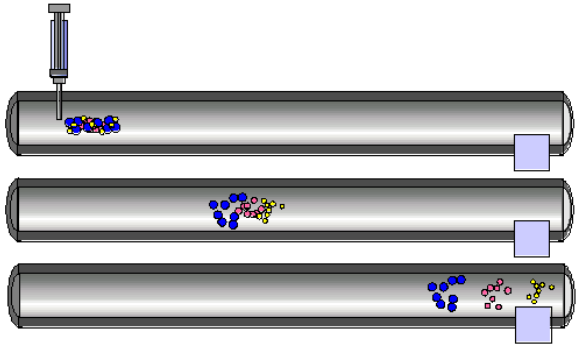
stationary phase
selectively absorbs components

mobile phase
sweeps sample down column

detector

Separation by Chromatography

sample
mixture



a chromatographic column

stationary phase
selectively absorbs components

mobile phase
sweeps sample down column

detector

Choose The Appropriate Separation Technique

Technique	Solvent	Solute	Process
Colander	water	Spaghetti	Filtration
Clothes dryer	Water	Clothes	Evaporation
Window screen	Air	Bugs	Filtration
Coffee percolators	Water	Coffee beans	Filtration
Vacuum cleaners	Carpet	Dust	Filtration
Skimming fat from soup	Soup	Fat	Floatation
Refining oil	Water	Oil	Distillation
Toxic screen	Blood	Alcohol	Chromatography
Separating	Sand	Iron fillings	Magnetism
Drinking apparatus	Water	Salt	Distillation

How you would separate the following mixtures…

- Salt water
- Muddy water
- Nuts and bolts

Salt water

- Evaporation

Used as a separation method when parts of the mixture have different boiling points.

When salty water is warmed the water **evaporates** leaving behind crystals of salt.

Muddy water

- Filtration

Used when there is a liquid and solid parts to the mixture.

Nuts and bolts

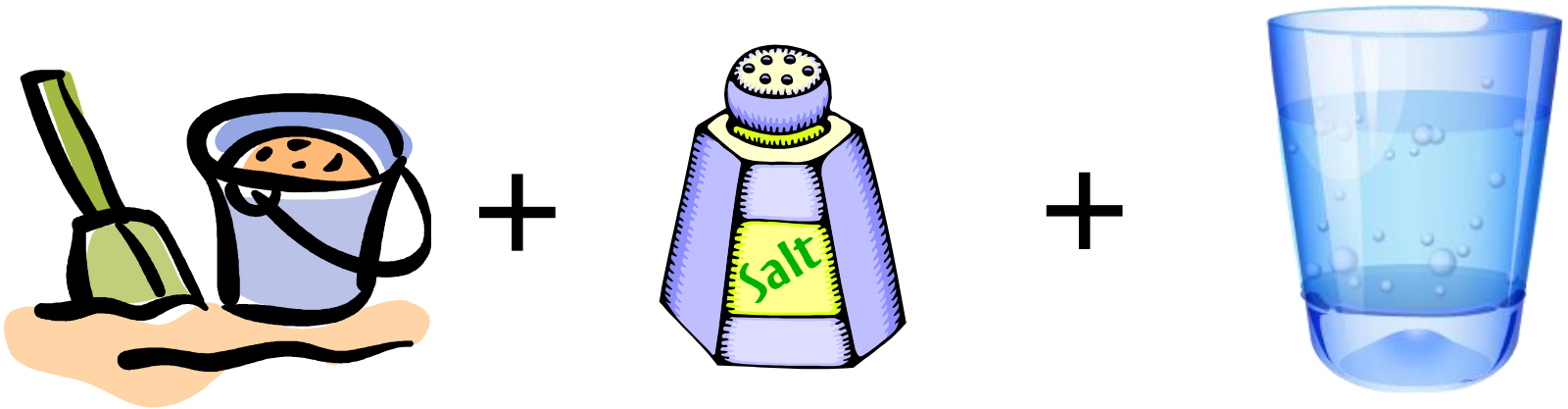
- Mechanical sorting.

- Floating
- Magnetism (the magnet sticks to the iron but not to the sand)
- Using your hands!

http://www.youtube.com/watch?v=bHP1HQHAQrw

Which Method?

- You have been given a mixture of sand, salt, and water. Which method or methods will you use to separate this mixture? Why?



Separating Mixtures And Solutions

- **Separating heterogeneous mixtures**
  1. Mechanical sorting
     a) Magnetism
     b) Floatation
  2. Filtration
- **Separating homogeneous mixtures**
  1. Evaporation
  2. Distillation
- **Separating a solution by paper chromatography**