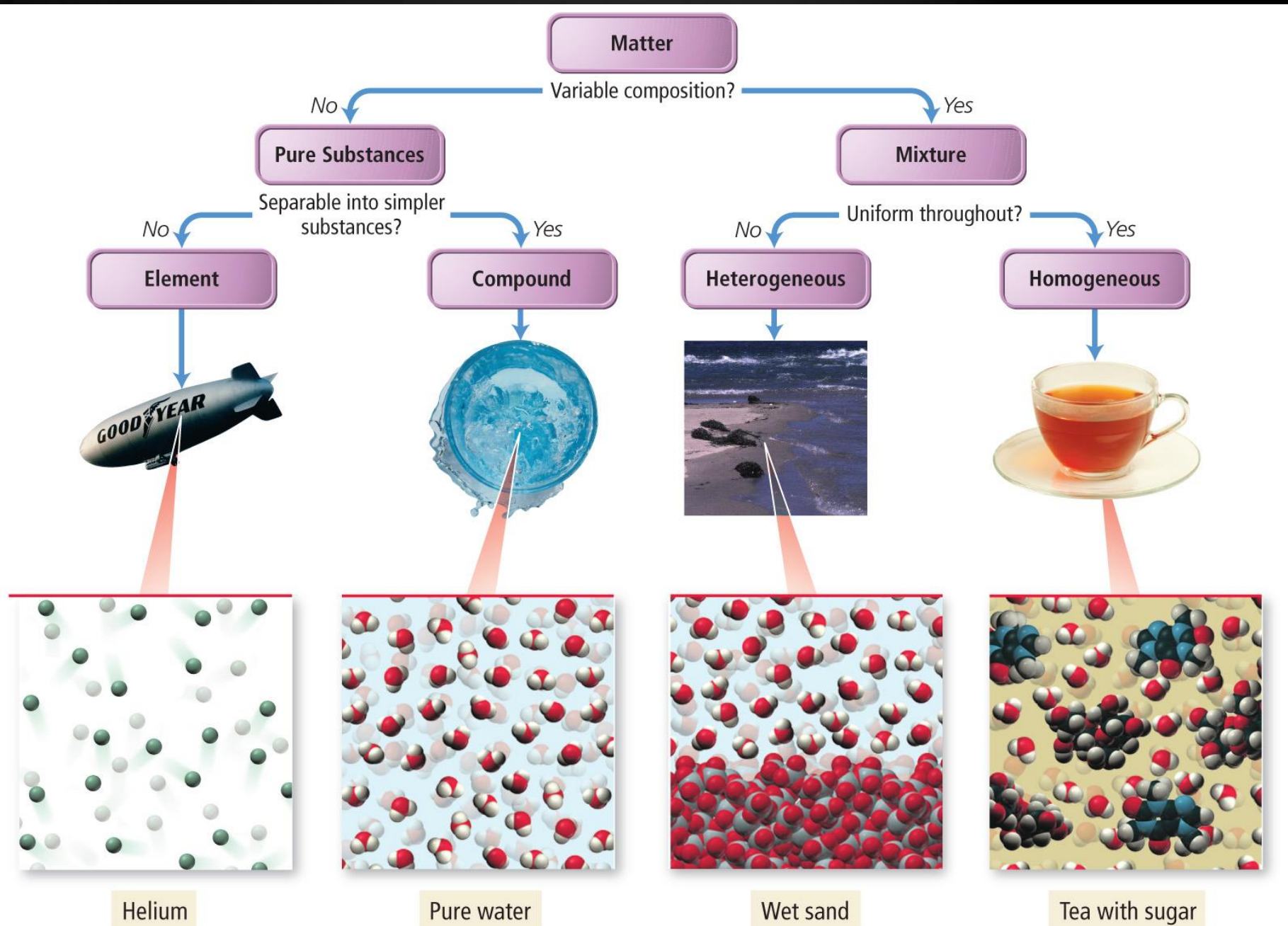


# **MATTER**

**Anything that occupies space and has mass. It includes all materials found in nature.**

# Classifying Matter by Composition

- Another way to classify matter is to examine its **composition**.
- composition includes:
  - types of particles
  - arrangement of the particles
  - attractions and attachments between the particles



Helium

Pure water

Wet sand

Tea with sugar

## PURE SUBSTANCE

Matter whose composition DOES NOT change from one sample to another

made of a single type of atom or molecule

Because the composition of a pure substance is always the same, all samples have the same characteristics.

## MIXTURE

Matter whose composition may vary from one sample to another

two or more types of atoms or molecules combined in variable proportions

Because composition varies, different samples have different characteristics.

# *Classification of Matter*

**Element, Compound and Mixture**





## **Atoms** - *Extremely small building blocks of matter*

- All matter is composed of atoms
- Atoms cannot be broken down into smaller pieces by chemical means
- The smallest distinct units in a sample of matter

## **Elements** *are made up the same atoms.*

- Elements cannot be decomposed into other substances.

- **Molecule** – a combination of 2 or more atoms (same or different) that are covalently bonded.
- A molecule is the smallest particle of a substance which exhibits the physical and chemical characteristics of the substance.
- **Diatomic molecules of elements :**  
 $H_2$   $O_2$   $Cl_2$   $N_2$   $F_2$   $Br_2$   $I_2$

# MATTER

CAN BE CLASSIFIED INTO

*Pure Substance and Mixtures*



PURE SUBSTANCE CAN BE ...

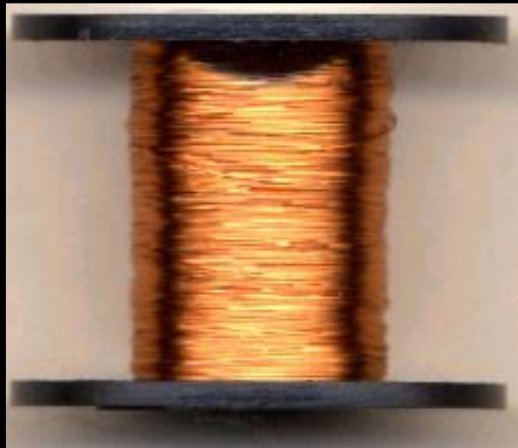
 ***ELEMENT***

**COMPOUND**

# Pure Substances

## ✦ Element

- ◆ composed of identical atoms
- ◆ EX: copper wire, aluminum foil



# ELEMENTS can be.....

**METAL** - An element that is shiny, malleable, and a good, conductor of heat and electricity; located to the left of the zigzag line in the periodic table.

**METALLOID** - An element with properties that lie between metal and non-metal. They are sometimes called semi-conductors.

**NON METAL** - An element with little or no luster and a poor conductor of heat and electricity; located on the right of the zigzag line of the Periodic Table.

# SUBSTANCES: ELEMENT OR COMPOUND

- **Elements**- simplest kind of matter
  - cannot be broken down any simpler and still have properties of that element!
  - all one kind of atom.
- **Compounds** are substances that can be broken down only by chemical methods
  - when broken down, the pieces have completely different properties than the original compound.
  - made of two or more atoms, chemically combined (not just a physical blend!)

# COMPOUNDS can be.....

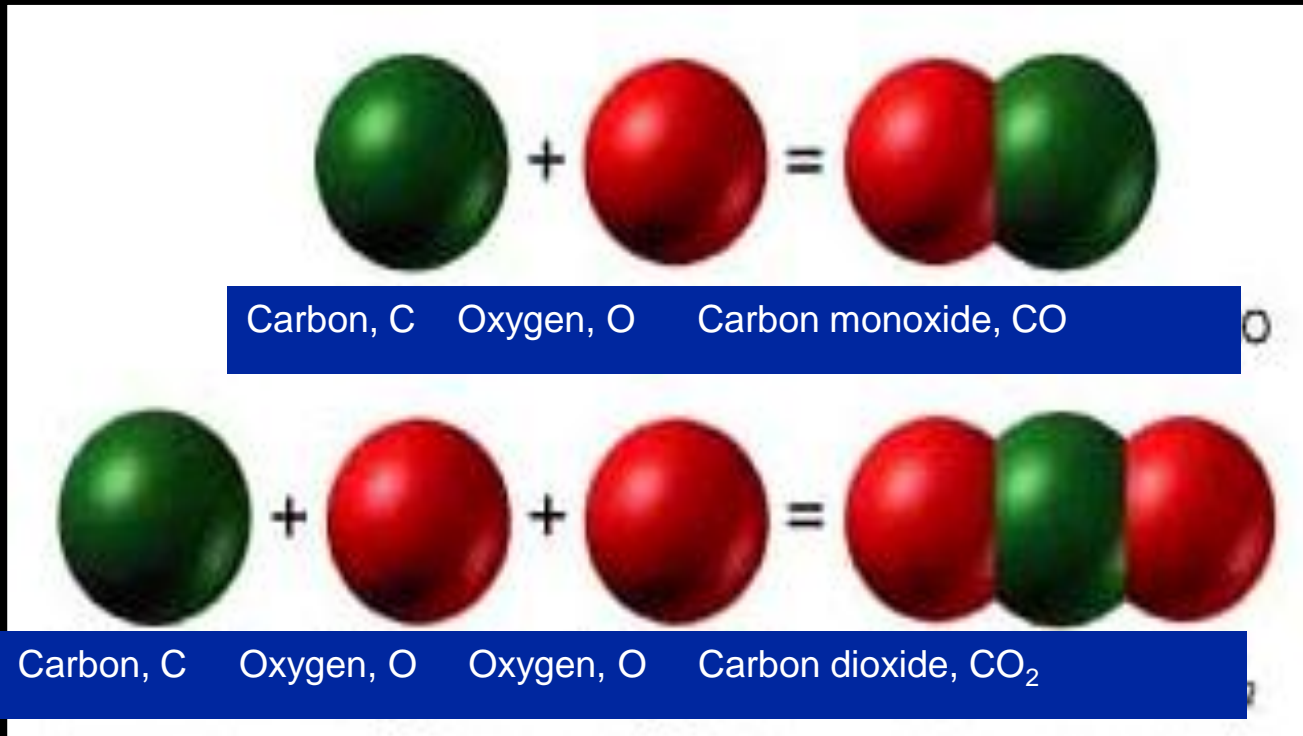
***INORGANIC***

Compound doesn't have Carbon

***ORGANIC***

Compound that has Carbon

***For example...***



**Two different compounds,  
each has a definite composition.**

# Pure Substances

## *Law of Definite Composition*

- A given compound always contains the same, fixed ratio of elements.

## *Law of Multiple Proportions*

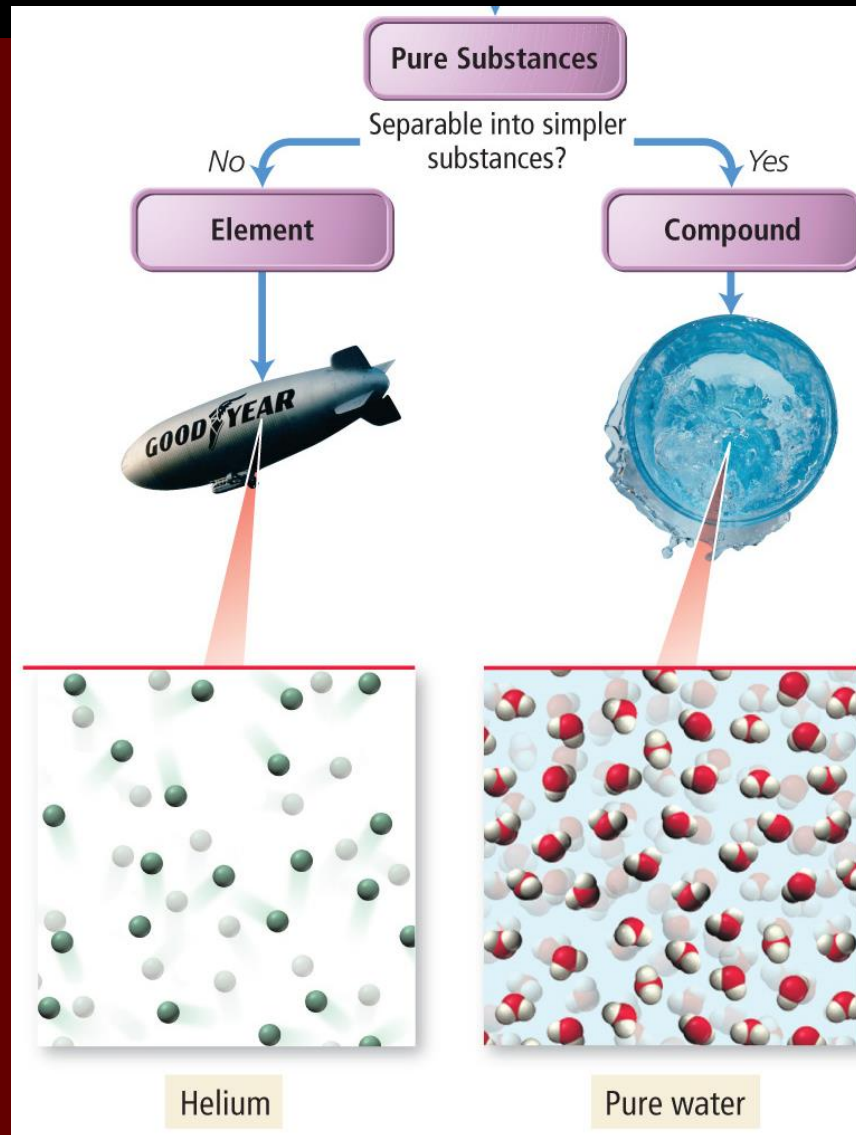
- Elements can combine in different ratios to form different compounds.



# Pure Substances

made of one type of atom (some elements found as multi-atom molecules in nature)

combine together to make compounds



made of one type of molecule, or array of ions

units contain two or more different kinds of atoms

Periodic Table  
with two bottom  
rows added.

The diagram shows a periodic table layout with two additional rows at the bottom highlighted in orange. The table is composed of several rows of rectangular blocks representing elements. The top two rows are single blocks on the left and right. The next two rows have two blocks on the left and a long block on the right. The next two rows have three blocks on the left and a long block on the right. The next two rows have four blocks on the left and a long block on the right. The next two rows have five blocks on the left and a long block on the right. The final two rows at the bottom are highlighted in orange and each have six blocks on the left and a long block on the right.

Two rows below table are  
orange.



COMPOUNDS  
CAN ALSO BE

ACID

base

SALT

# ACID

- tastes sour
- reacts with some metals
- changes blue litmus paper to red
- Reacts with base to form salt

# BASE

- Has bitter and biting taste
- Feels slippery
- Changes red litmus to blue
- Reacts with acid to form salt

# AMPHOTERIC

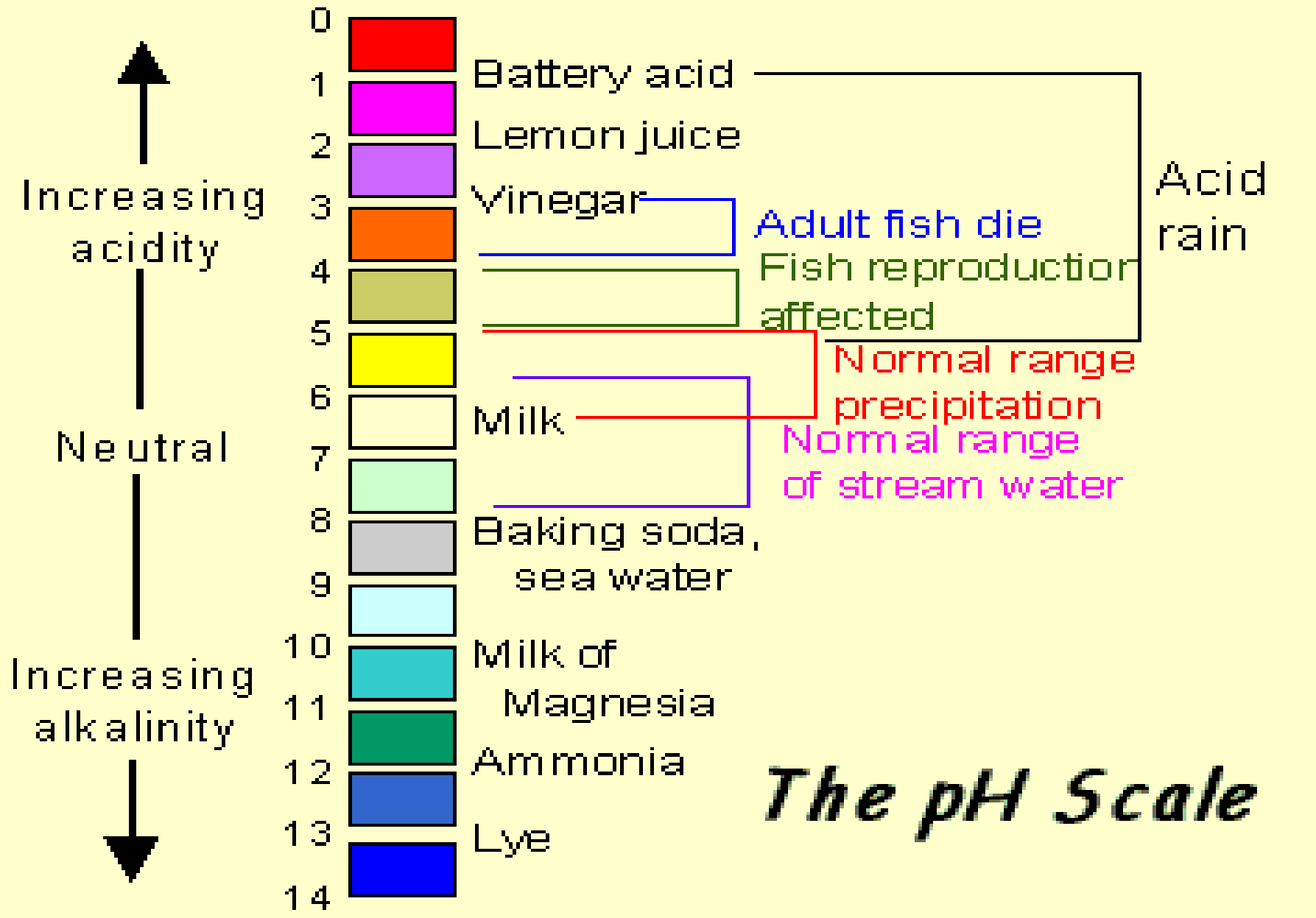
A substance that is both an acid and a base

# SALT

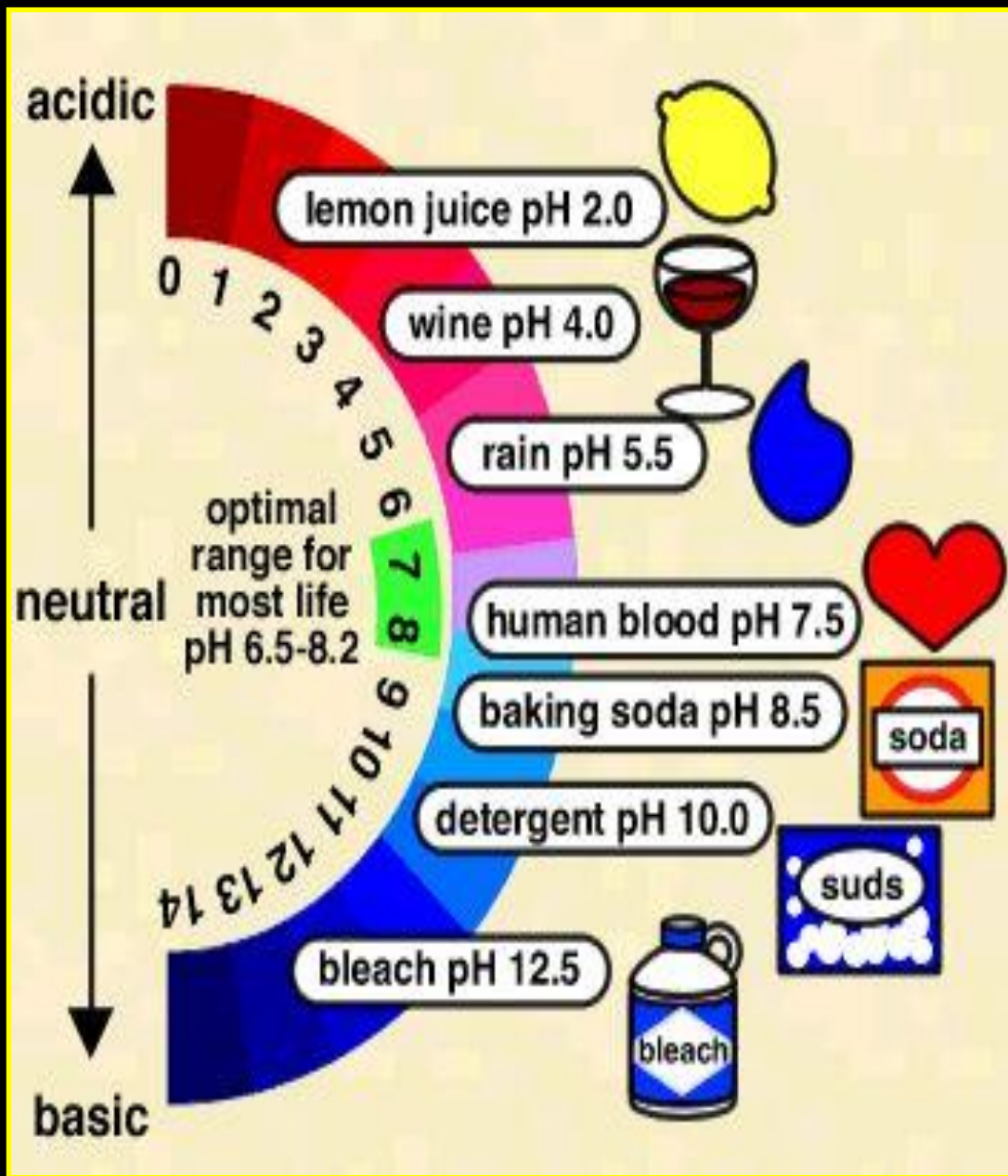
When acid and base react together, a reaction called neutralization occurs and salt is formed







# *The pH Scale*

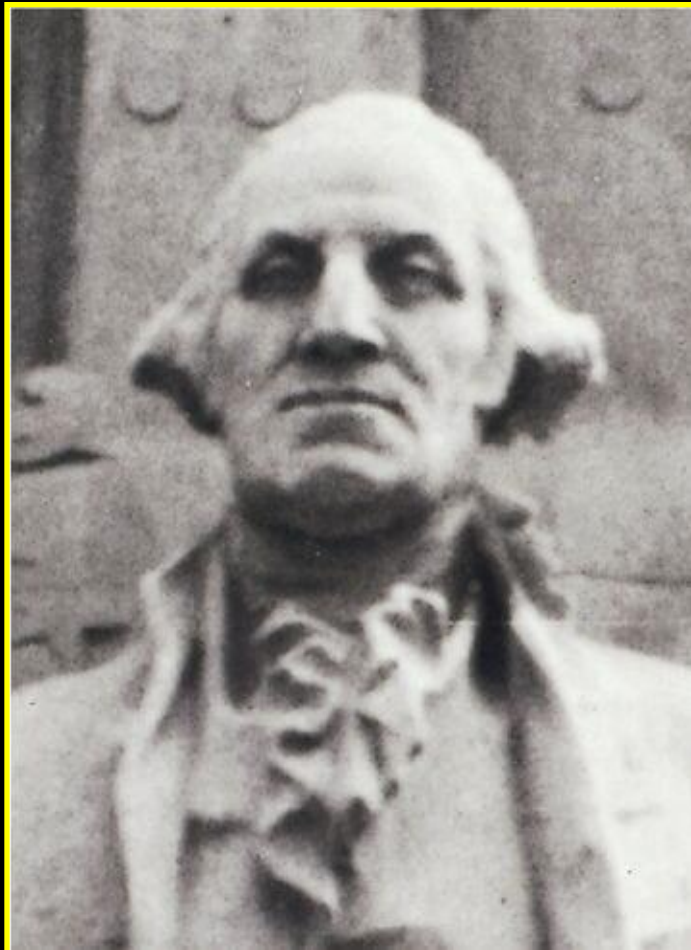


SUBSTANCES	LEVEL
Hydrochloric acid	0.1
Sulfuric acid	0.3
Gastric Acid	1.0
Lemon juice	2.5
Vinegar	3.0
Oranges	3.5
Grapes	4.0
Sour milk	4.4
Black Coffee	5.0
Acid Rain	5.6
Urine	6.0
Fresh milk	6.5
neutral	<b>PURE WATER 7.0</b>
Blood Plasma	7.4
Seawater	7.9
Baking soda solution	8.5
Toothpaste	9.0
Borax solution	9.2
Milk of magnesia	10.5
Limewater	11.0
Ammonia water	11.6
Sodium hydroxide	14.0

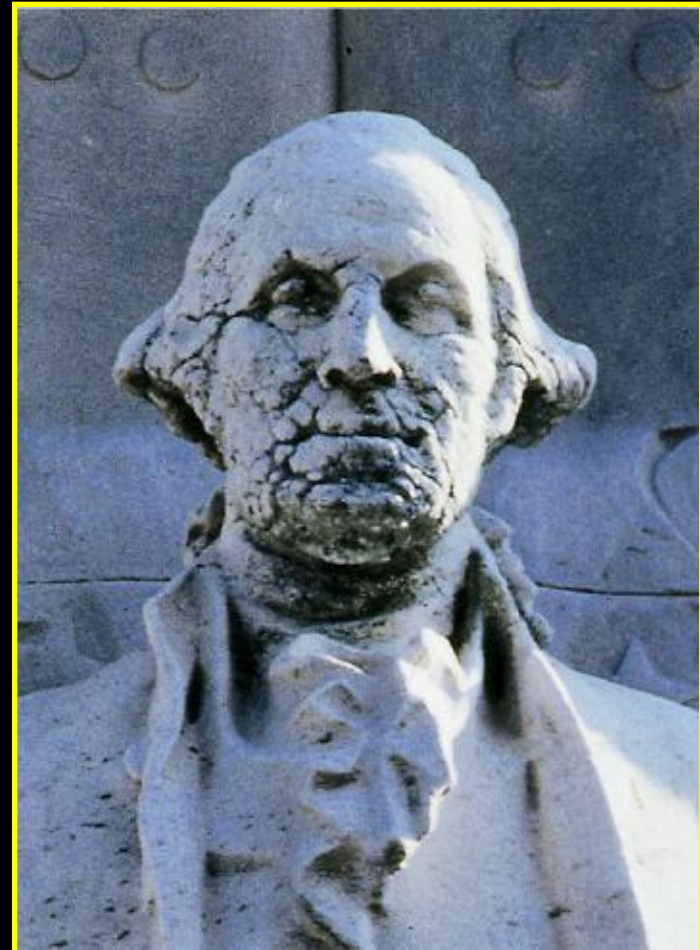
# Effects of *Acid Rain* on Marble

(marble is calcium carbonate)

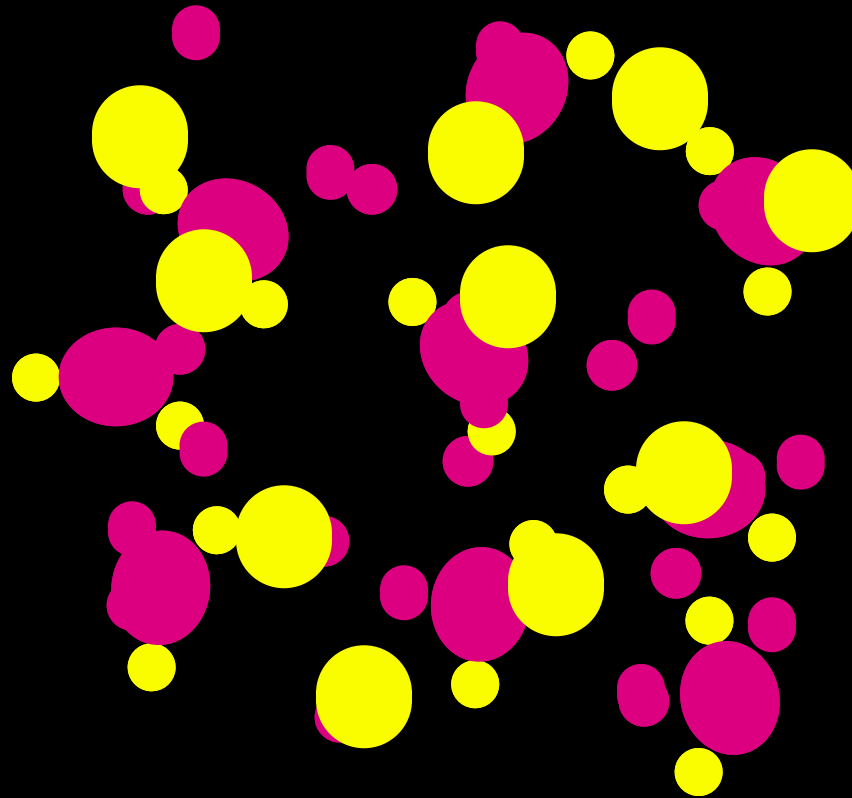
George Washington:  
BEFORE acid rain



George Washington:  
AFTER acid rain



# WHICH IS IT?



Co-Mixture  
Co-empirical

MIXTURES CAN BE ...

 **HETEROGENEOUS**

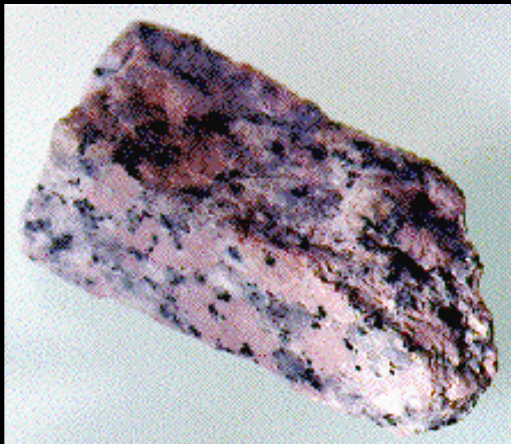
homogeneous

# Mixture

- ✦ **May be separated into pure substances by physical methods**
- ✦ **Mixtures of different compositions may have widely different properties.**

# MIXTURES

- ✦ Variable combination of 2 or more pure substances.



Heterogeneous



Homogeneous



Mixtures are a physical blend of at least two substances; have variable composition. They can be either:

**1) HETEROGENEOUS** – the mixture is not uniform in composition

- Chocolate chip cookie, gravel, soil.

**2) HOMOGENEOUS** - same composition throughout; called "solutions"

- Kool-aid, air, salt water
- Every part keeps it's own properties.

# Classification of Mixtures



# Chart Examining Some Components of Air

Nitrogen consists of molecules consisting of two atoms of nitrogen:

Oxygen consists of molecules consisting of two atoms of oxygen:

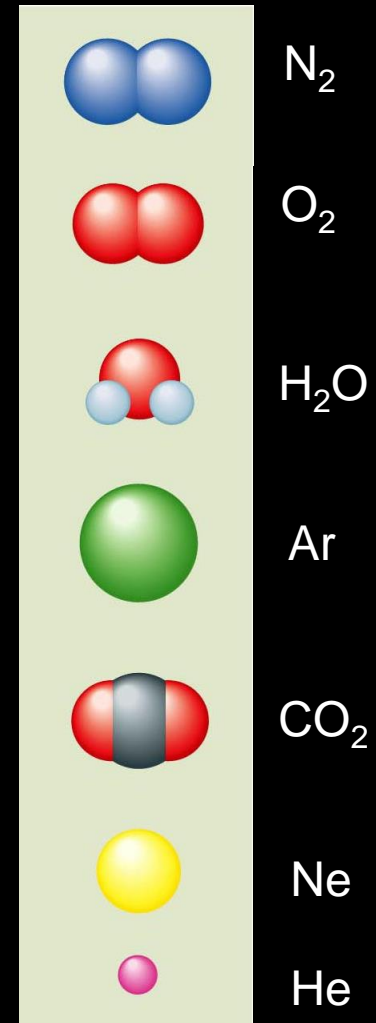
Water consists of molecules consisting of two hydrogen atoms and one oxygen atom:

Argon consists of individual argon atoms:

Carbon dioxide consists of molecules consisting of two oxygen atoms and one carbon atom:

Neon consists of individual neon atoms:

Helium consists of individual helium atoms:



# MIXTURES CAN BE ...

SOLUTION

colloid

SUSPENSION

# MIXTURES

## Solution

- homogeneous
- very small particles
- no Tyndall effect



Tyndall Effect

*The phenomenon in which light is scattered by very small particles in its path; it makes a beam of light visible; the scattered light is mainly blue*



- ✓ **Solute** is something dissolved in a solvent to make solution.
- ✓ **Solvent** is a medium, usually a liquid into which a solute is dissolved to make a solution.

- particles don't settle
- EX: rubbing alcohol

# MIXTURES

## ➤ Colloid

- heterogeneous
- medium-sized particles
- Tyndall effect
- particles don't settle
- EX: milk



# MIXTURES

## ➤ Suspension

- heterogeneous
- large particles
- Tyndall effect
- particles settle
- EX: fresh-squeezed lemonade



# MIXTURES

## ➤ EXAMPLES:

– mayonnaise

colloid

– muddy water

suspension

– fog

colloid

– saltwater

solution

– Italian salad  
dressing

suspension



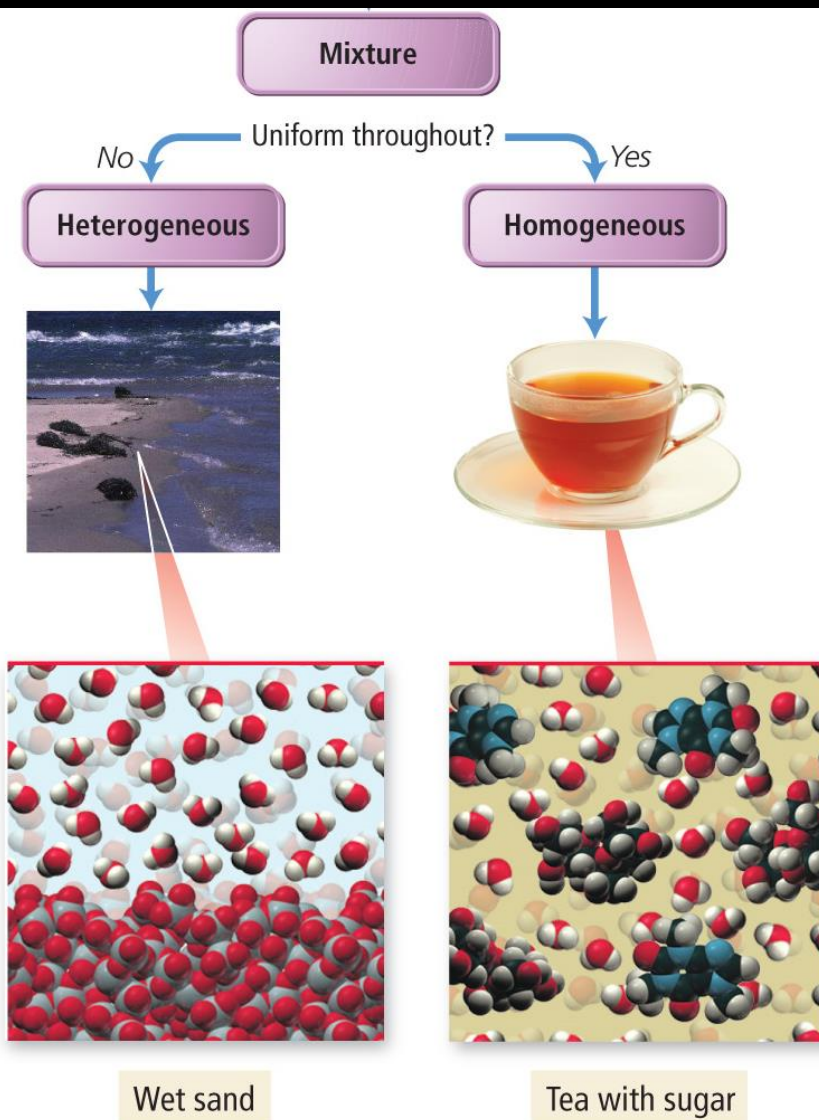
# Compound vs. Mixture

Compound	Mixture
Made of one kind of material	Made of more than one kind of material
Made by a chemical change	Made by a physical change
Definite composition	Variable composition

# Classification of Mixtures

made of multiple substances, whose presence can be seen

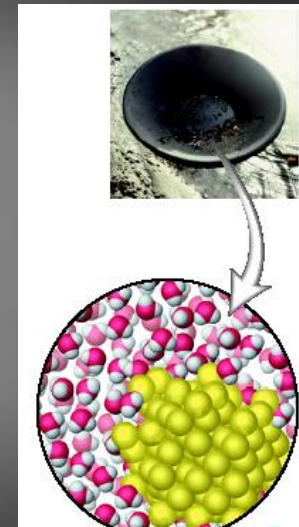
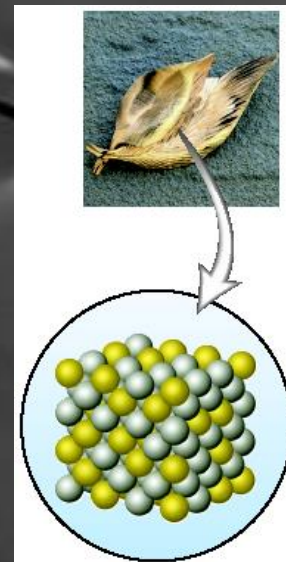
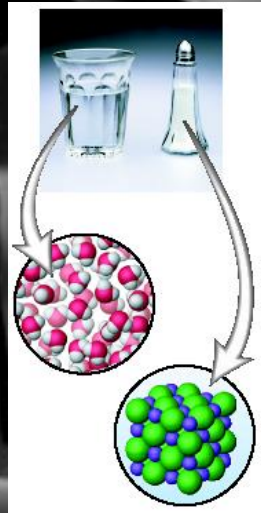
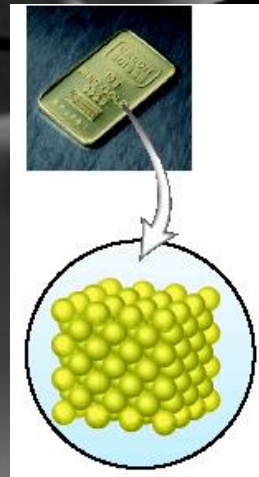
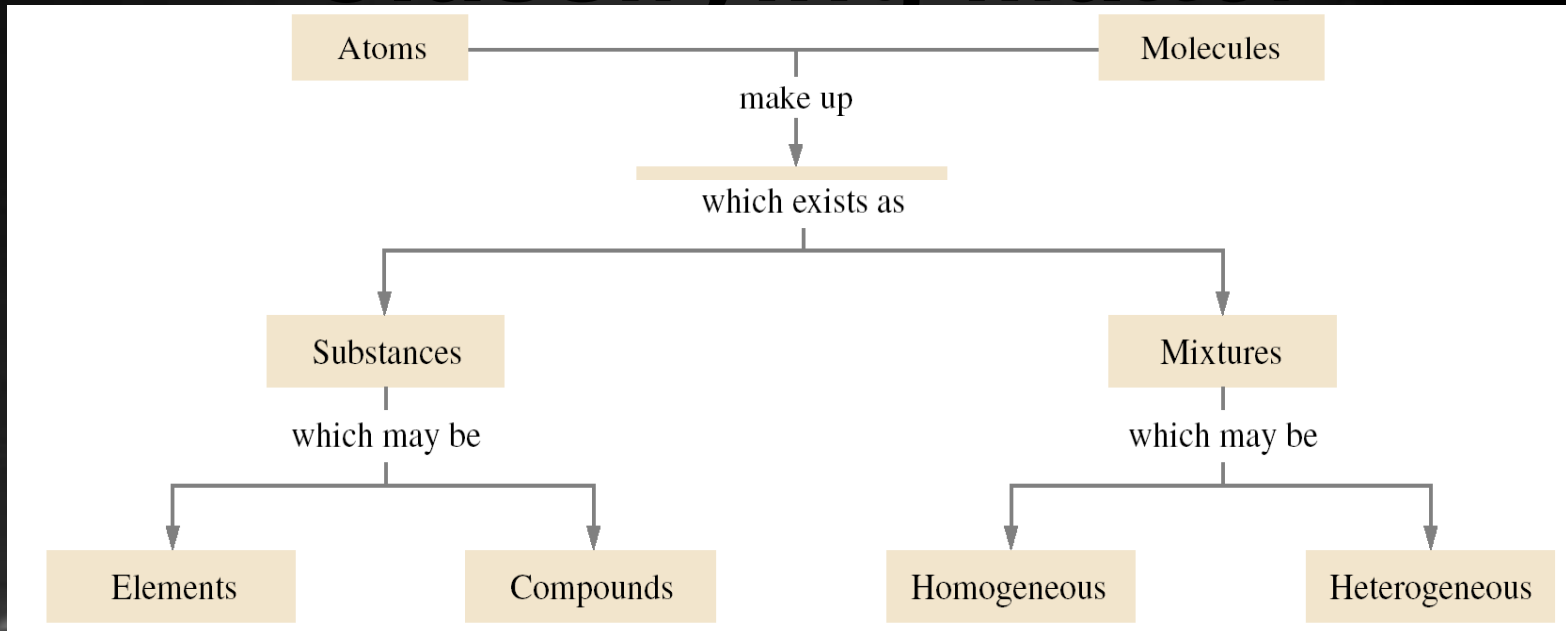
Portions of a sample have different composition and properties.



made of multiple substances, but appears to be one substance

All portions of an individual sample have the same composition and properties.

# Classifying Matter



# MATTER

Can it be physically separated?

yes

no

## MIXTURE

## PURE SUBSTANCE

Is the composition uniform?

yes

no

Can it be chemically decomposed?

yes

no

### Homogeneous Mixture (solution)

### Heterogeneous Mixture

### Compound

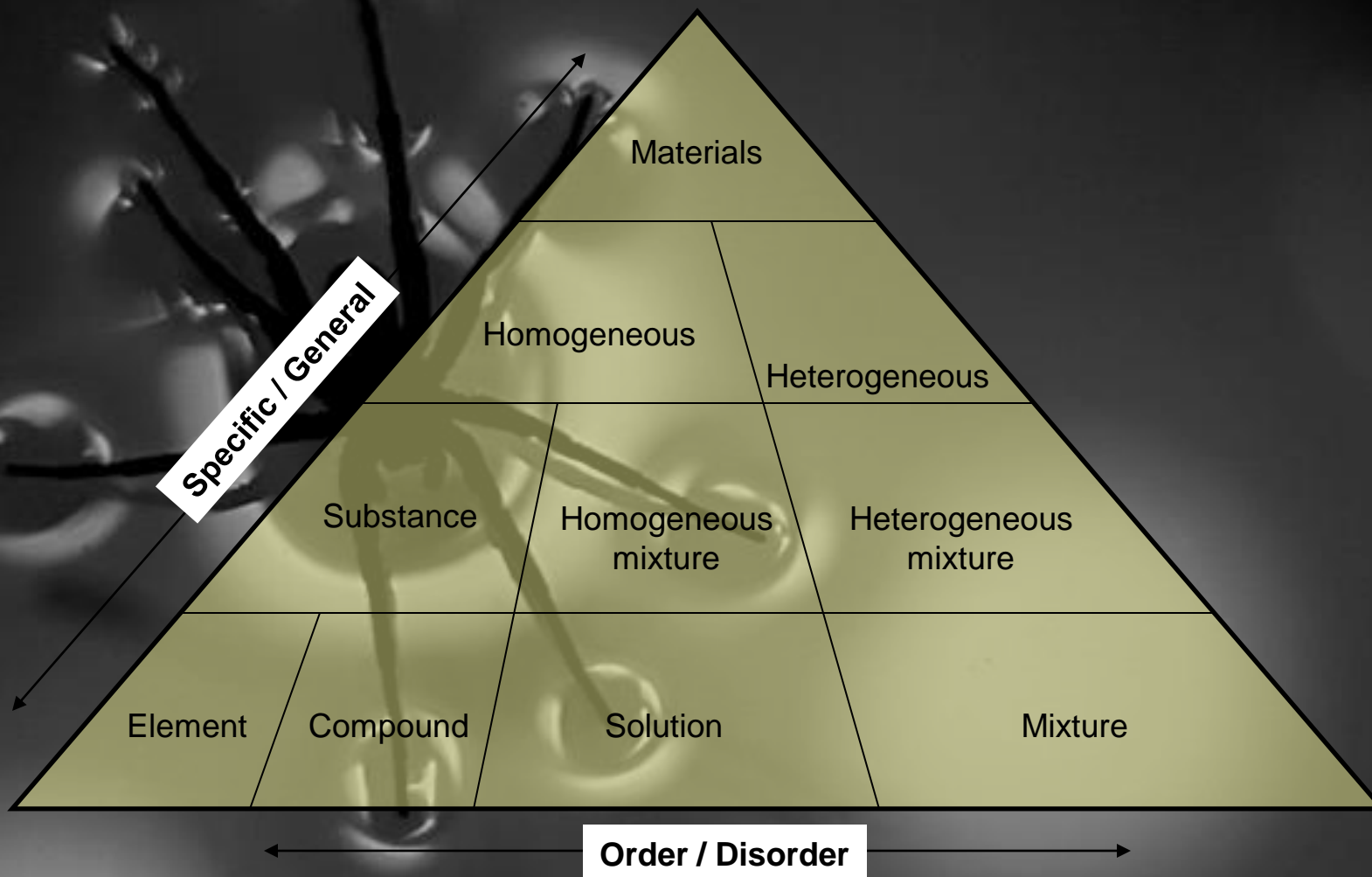
### Element

### Colloids

### Suspensions



# Classification of Matter



# PRACTICE PROBLEMS #4

1. Classify the following as an element, compound, or mixture (heterogeneous or homogeneous).

- |                           |                      |
|---------------------------|----------------------|
| ✦ <u>HO</u> air           | <u>E</u> oxygen      |
| ✦ <u>E</u> tin can        | <u>C</u> sugar       |
| ✦ <u>HO</u> salt solution | <u>HE</u> crude oil  |
| ✦ <u>HE</u> suntan lotion | <u>HO</u> gummi bear |

2. A white solid is dissolved in water. The resulting colorless, clear liquid is boiled in a beaker until dryness. White crystals remain in the beaker. The liquid can be classified as a(n) Homogeneous mixture.

3. Classify the following as physical or chemical changes.

- |                                 |                   |
|---------------------------------|-------------------|
| ✦ <u>CC</u> photosynthesis      | <u>CC</u> baking  |
| ✦ <u>PC</u> writing with pencil | <u>PC</u> snowing |



CO<sub>2</sub>





**Salad**





**silicon**



**Butter**



**Air**





**Oxygen molecule ( $O_2$ )**

A wide-angle photograph of the ocean under a clear blue sky. The sun is low on the horizon, creating a bright, shimmering reflection on the water's surface. The water transitions from a deep blue in the foreground to a lighter, hazy blue near the horizon. The overall scene is serene and expansive.

# Seawater

A top-down view of a dark brown wooden bowl filled with white, crystalline salt. The salt crystals are small and irregular, creating a textured surface. The bowl has a smooth, polished finish and is set against a plain white background.

**Salt**





**SULFUR**



# RUBS

[WWW.DESIGNFREEBIES.ORG](http://WWW.DESIGNFREEBIES.ORG)



A close-up photograph of several chocolate chip cookies. The cookies are golden-brown with numerous dark chocolate chips embedded in them. The text "Chocolate chip cookies" is written in a bold, white, sans-serif font, slanted diagonally across the center of the image.

**Chocolate chip cookies**



Pure  
**Baking Soda**  
For Baking, Cleaning & Deodorizing





# **METHODS OF SEPARATING MIXTURES**

## **Heterogeneous Mixtures**

### **Decantation**

- **The process is used to separate a mixture containing a liquid and heavy insoluble solid.**  
it is a process for the separation of mixtures, by removing a top layer of liquid from which a precipitate has settled.

### **Filtration**

- **This is used when the mixture is made up of a liquid and slightly soluble solid.**



## **Sedimentation, Decantation and Filtration**

---



## **Mechanical Separation**

- Involves the use of forceps and other similar tools. Gravel and sand are separated by picking the gravel or passing the mixture into a wire screen ---sieving

## **. Magnetic Separation**

- This is used when the mixture contain a metal like iron. Metals are attracted by a magnet and the non-metals are left.





## **Centrifugation**

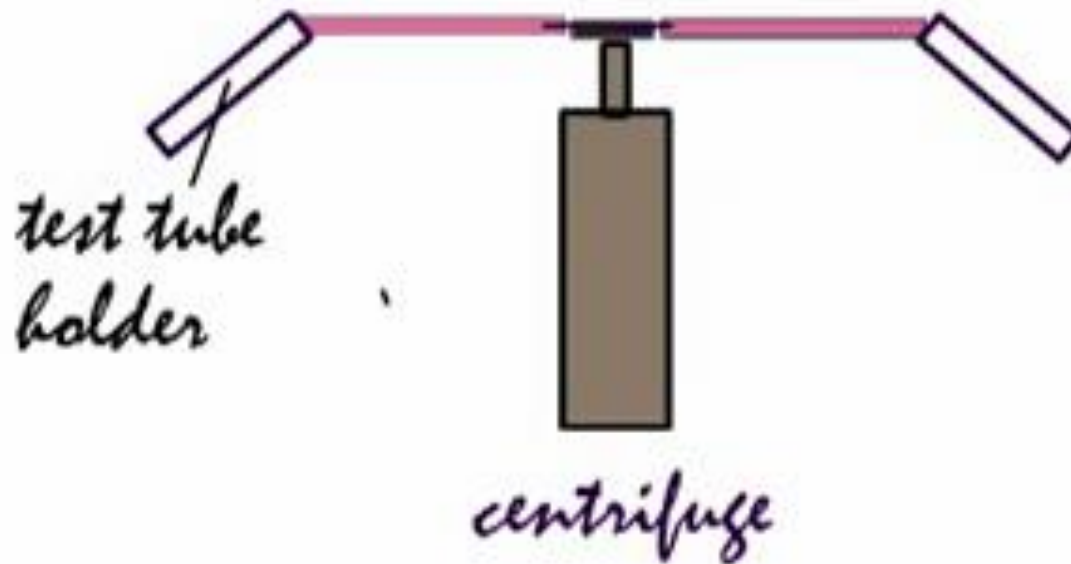
- This process speeds up the setting of the precipitate. The centrifuge is a motor driven apparatus. The centripetal force developed during the rotation brings the precipitate to the bottom of the tube and the centrifuge is round off.

## **Sublimation**

- This process is used when the mixture contains solids which are volatile. The volatile solid is converted to gas without directly passing the liquid state. The solid is called residue.



*balance the test tubes  
opposite one another!*



# METHODS OF SEPARATING MIXTURES

## Homogeneous Mixtures

### Evaporation

- This is used when the mixture contains a solid that is soluble in a given solvent.





## **. Distillation**

- This is used when the components of a mixture have different boiling points. The liquid is changed to vapour and subsequently condenses back to liquid. The condensed liquid is called *Distillate*.
- This is the process that involves the evaporation and condensation of volatile liquid. The more volatile liquid in the mixture boils off first, evaporates then condenses.



## ***Simple Distillation***

this set-up consists only of a distilling flask, a condenser, an adapter, and a receiving flask vessel. This is often used when the boiling points of the components are far from each other.

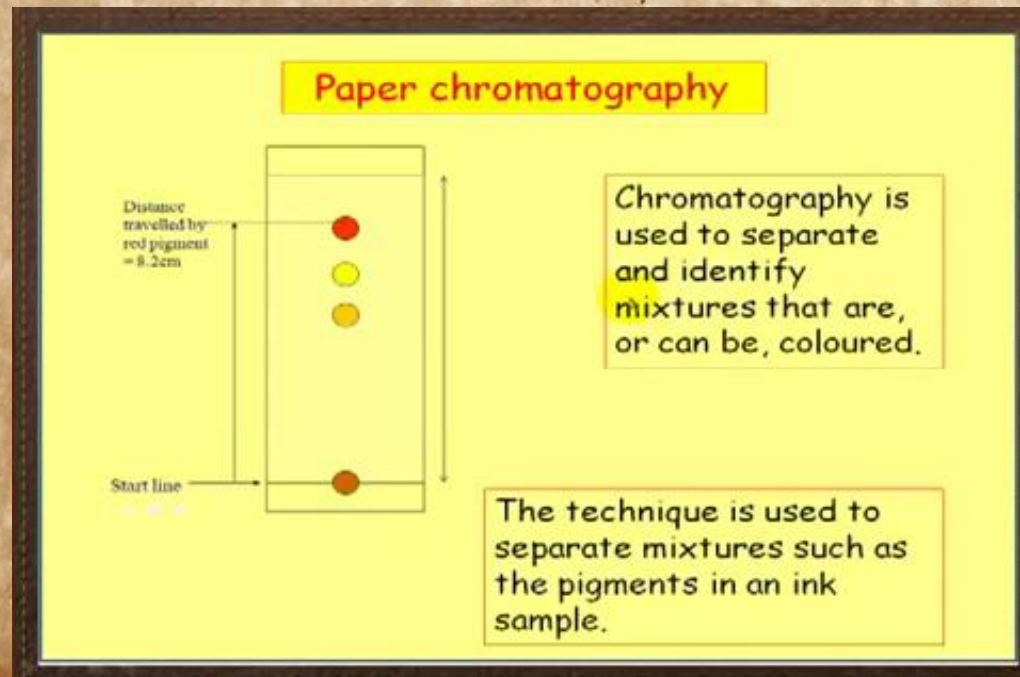
## ***Fractional Distillation*** –

this set-up consists of a distilling flask, a condenser, an adapter, a fractionating column and a receiving flask. This is often used when the boiling points of the components are relatively close to each other.



# Chromatography

the separation of mixtures into their constituents by preferential adsorption by a solid, as a column of silica...column chromatography.. or a strip of filter paper..paper chromatography.. or by a gel.







**CONCEPT MAP  
(CLASSIFICATION OF MATTER)**

