



Review Notes: Chapter 1

Chemistry and Matter

■ Chemistry-

- is the study of matter and the changes that it undergoes.
- Chemistry is the central science.

■ Matter-

- is anything that has mass and takes up space.
- Not everything is made up of matter
- Matter has many different forms



**Can you think of things that are matter
and things that are not matter?**

Matter	Not Matter

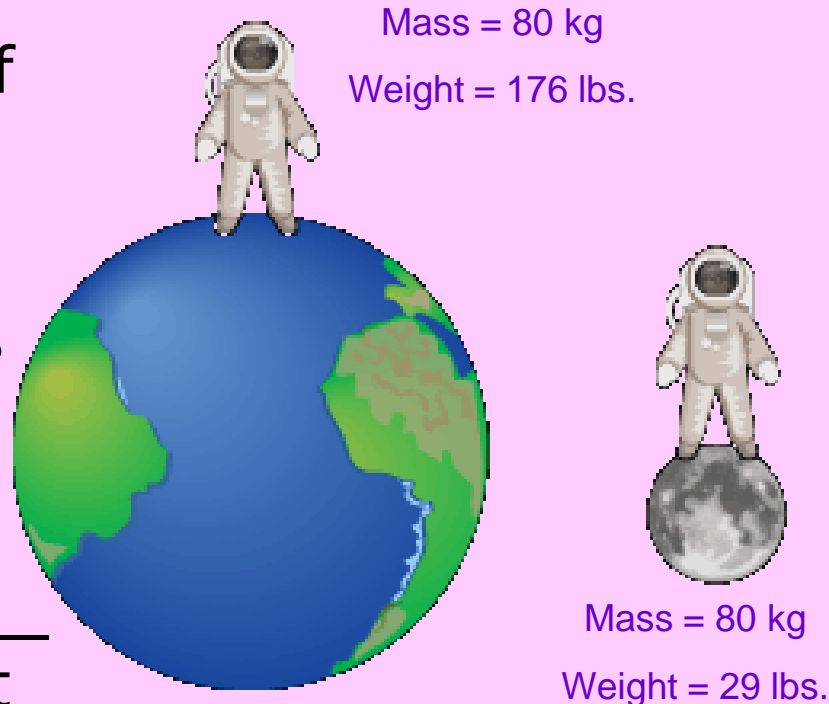
Mass vs. Weight

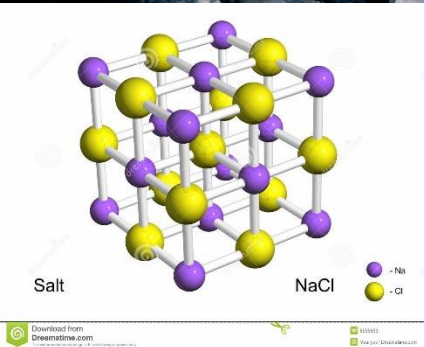
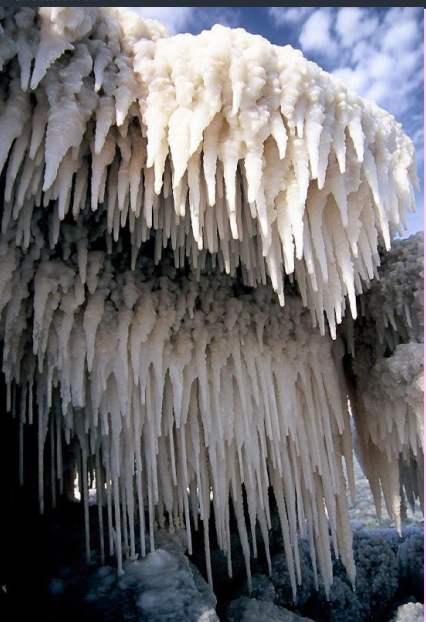
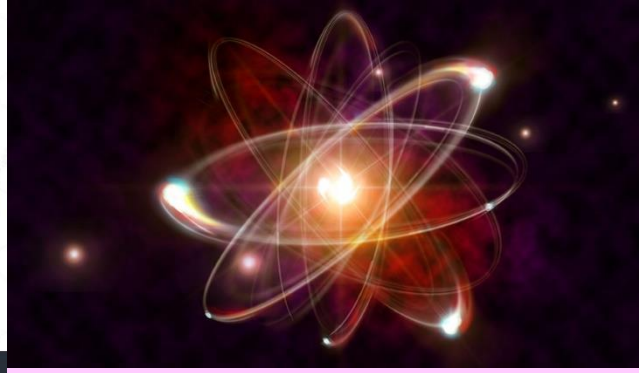
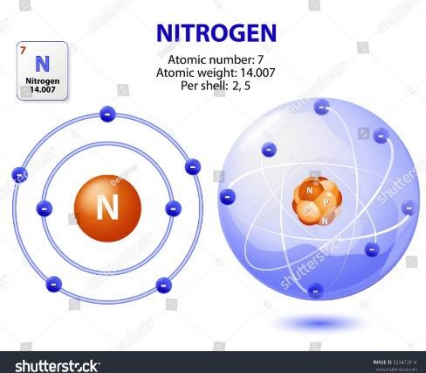
Mass depends on the amount of matter in the object.

Weight depends on the force of gravity acting on the object.

Weight may change as you move from one location to another; mass will not.

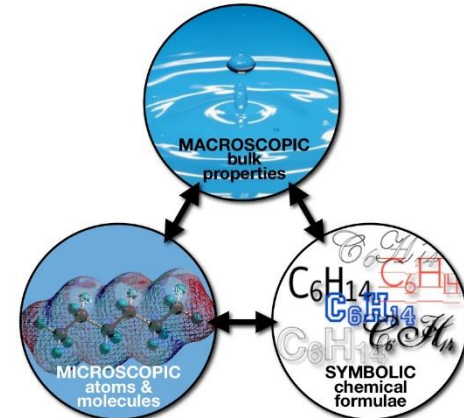
You have the same mass on the moon as on the earth, but you weigh less since there is less gravity on the moon.





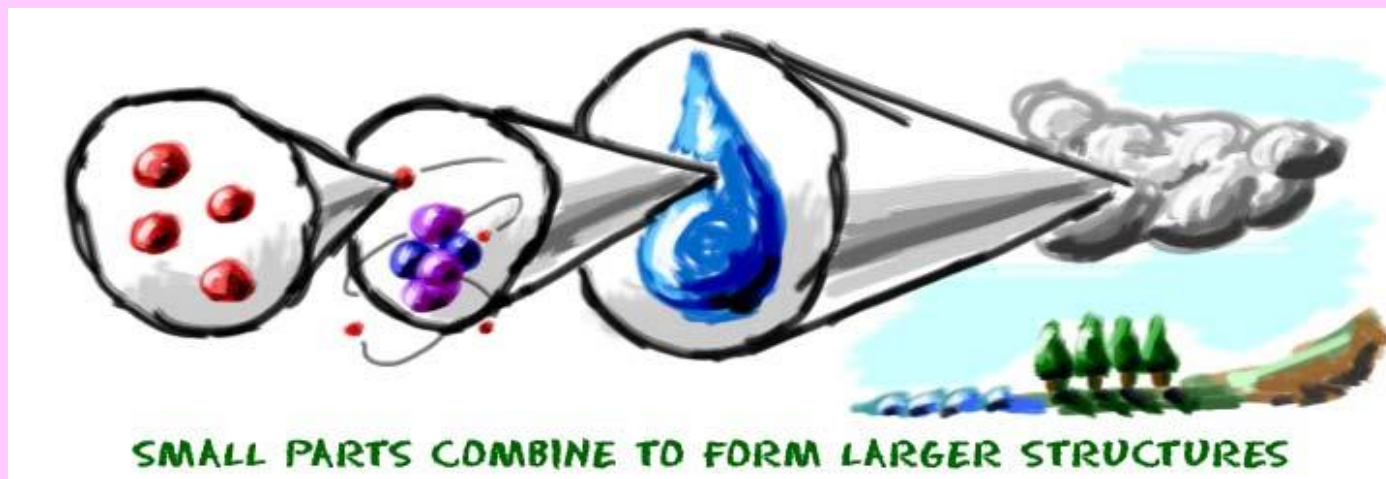
- The structure, composition, and behavior of matter is explained at a atomic level
- All that we observe about matter depends on atoms and the changes they undergo.
- Chemistry seeks to explain these changes by making models

Chemistry and Matter



- Much of matter and its behavior is macroscopic (Large enough to see).
- Matter → elements → atoms

(too small to see)







Ch 1.3 Scientific Method

- A **scientific method** is a systematic approach used in scientific study.
 - used by scientists to do research
 - provides a method to verify the work of others.
- Observation → Hypothesis →
Experiment → Conclusion



Scientific Method

- **Observation** is the act of gathering information.
 - **Qualitative data**- anything that relates to the five senses (look, feel, sound, taste, smell).
 - **Quantitative data** is numerical information such as temperature, pressure, volume, and quantity.



Scientific Method

- **Hypothesis** is a *tentative* explanation for what has been observed.
- **Experiment** is a set of *controlled* observations that test the hypothesis.
 - experiments test **one variable** at a time.



Scientific Method

- A **variable** is a quantity or condition that can have more than one value.
 - **Independent variable** - *controlled*.
 - Example: temperature, force, distance, amount...
 - only condition that affects the experiment
 - **Dependent variable** - *responds*.
 - we have no control over it
 - we measure this response
 - **Control** is separate from the experiment
 - the ind. variable is held constant.



Question 1a

A student tests the ability of a given chemical to dissolve in water at three different temperatures.

Answer 1a

independent variable: temperature;

dependent variable: ability to dissolve in water



Scientific Method

- **Conclusion** - *a judgment based on the information obtained*
- A **theory** is an ***explanation*** that has been supported by many, many experiments
 - **All theories can be changed.**
 - Make useful predictions
- A **Scientific law** is a relationship in nature that is uncovered by many experiments.
 - **No exceptions!**



Question 1b

A farmer compares how his crops grow with and without phosphorous fertilizers.

Answer 1b

independent variable: presence of phosphorous fertilizer;

dependent variable: crop growth

Review Notes 3.1: Substances

- **Pure Substance** – uniform and unchanging composition.

- *Examples:*

- Table salt - NaCl
- Water - H_2O
- Sugar - $\text{C}_6\text{H}_{12}\text{O}_6$
- Gold - Au .



Physical properties of matter

- **Physical property** – can be observed or measured without changing the sample's composition

- Density
- Color
- Odor
- Taste
- Hardness
- Melting point
- Boiling point



Chemical properties of Matter

- The ability of a substance to combine with or change into one or more other substances is called a **chemical property**.
 - Ex. The ability of iron to form rust when combined with air.



Observing properties of matter

- Every substance has its own physical and chemical properties.
- Chemical and physical properties depend on temperature and pressure.
 - At room temp. water is a liquid with a density of 1.00 g/mL

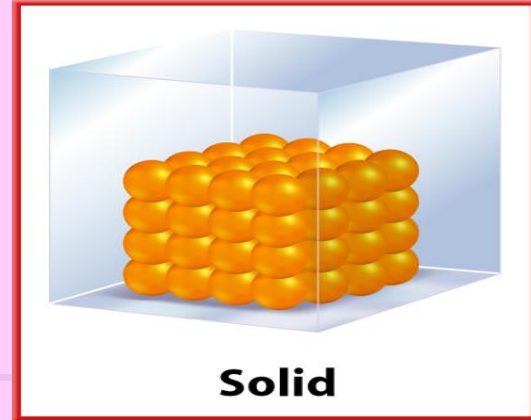


States of Matter

- All matter that exists on Earth can be classified as one of these physical forms (s, l, g) called **states of matter**.
- States of matter – Physical property

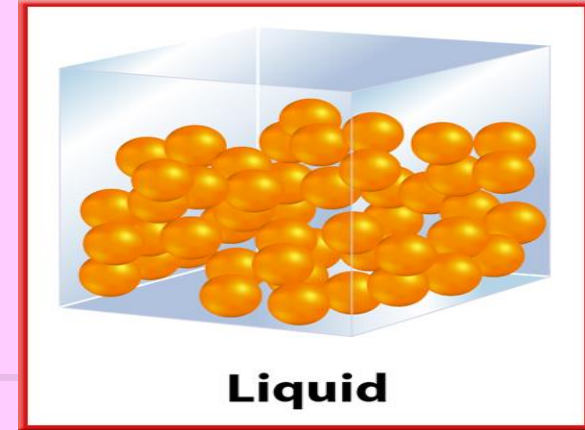


Solids



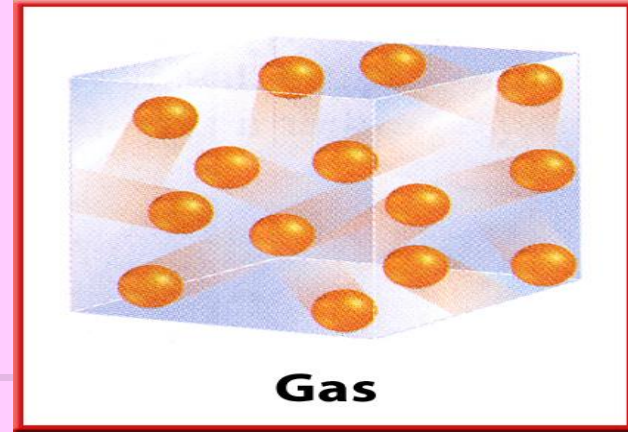
- Definite shape and volume
 - *Ex. Wood, paper, iron, and sugar.*
- Solids...
 - Very tightly packed
 - Expand only slightly when heated
 - Do not conform to the shape of container
 - **Incompressible** = *cannot be pressed into a smaller volume.*

Liquids



- Definite volume, indefinite shape.
 - *Ex. Water, blood, mercury are liquids*
- Liquids:
 - Not rigidly held in place
 - Less closely packed
 - Flow
 - Take the shape of the container
 - Virtually incompressible

Gases



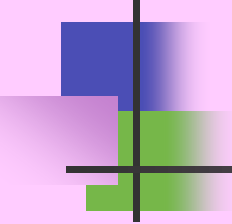
- Indefinite volume, indefinite shape
 - *Ex. Neon, methane, carbon dioxide, and air are gases*
 - Gas particles:
 - Far apart
 - Easily compressed
 - Flow to fill the container
 - Fills the entire volume of its container

Gases

■ Vapor

- gas state of a solid or liquid
- *Ex. Steam is a vapor*
 - at room temperature water is a liquid.





Pop Quiz

Question 1:

Identify each as a property of a **solid, liquid, or gas.**

May include more than one state of matter.

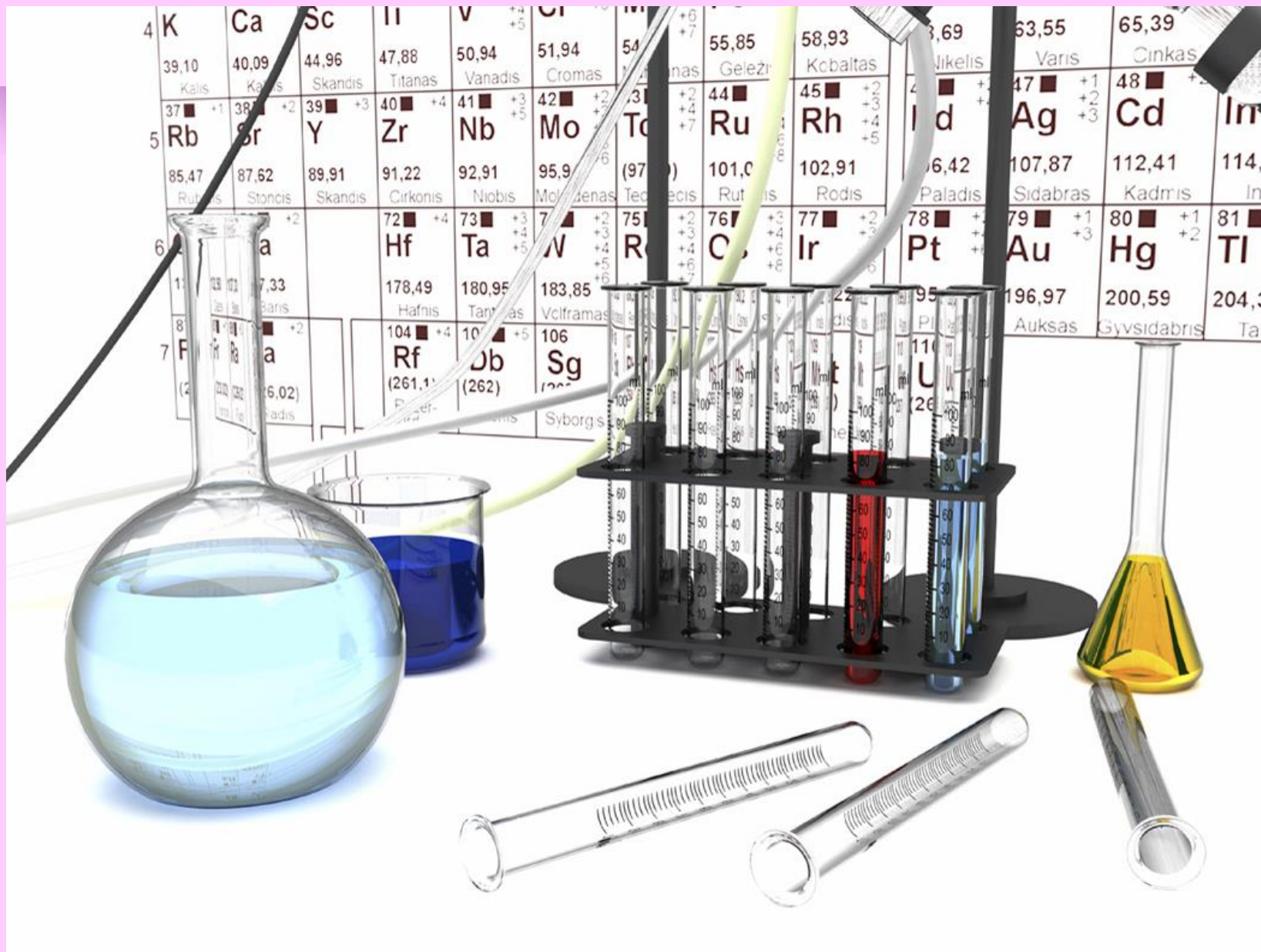
- A. flows and takes the shape of a container
- B. compressible
- C. made of particles held in a specific arrangement
- D. has definite volume
- E. always occupies the entire space of its container
- F. has a definite volume but flows



Question 1 Answers

- | | |
|--|---------------------|
| A. flows and takes the shape of a container | A. Liquid and gas |
| B. compressible | B. Gas |
| C. made of particles held in a specific arrangement | C. Solid |
| D. has definite volume | D. Solid and liquid |
| E. always occupies the entire space of its container | E. Gas |
| F. has a definite volume but flows | F. Liquid |

Review Notes 3.2



Physical change

- Alters without changing its composition
- *Ex: bend, grind, crumple, split, melt, boil, freeze, condense, vaporize, and crush*



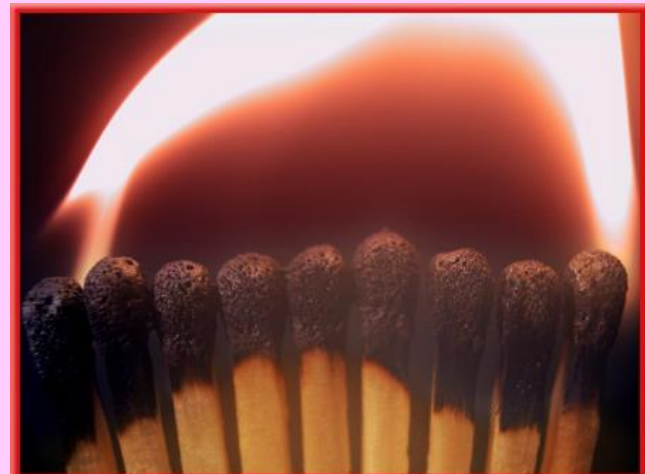
Chemical changes

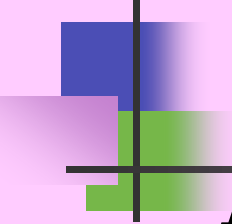
- Forms NEW substances
 - with different compositions and properties

Sodium + Chlorine → Table salt

Change in color, odor, energy, forms a solid or gas

- Examples:
 - explode, rust, oxidize,
 - corrode, tarnish, ferment
 - burn, rot





Pop Quiz

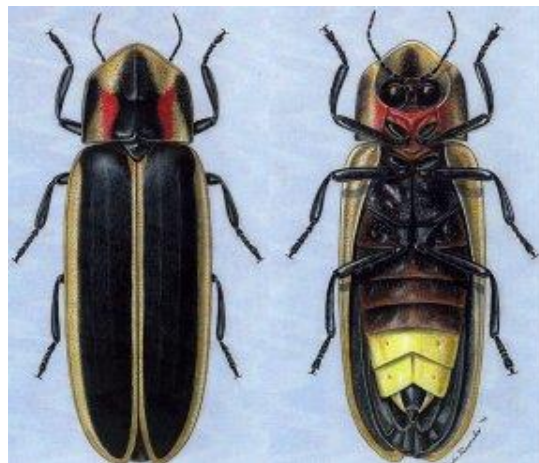
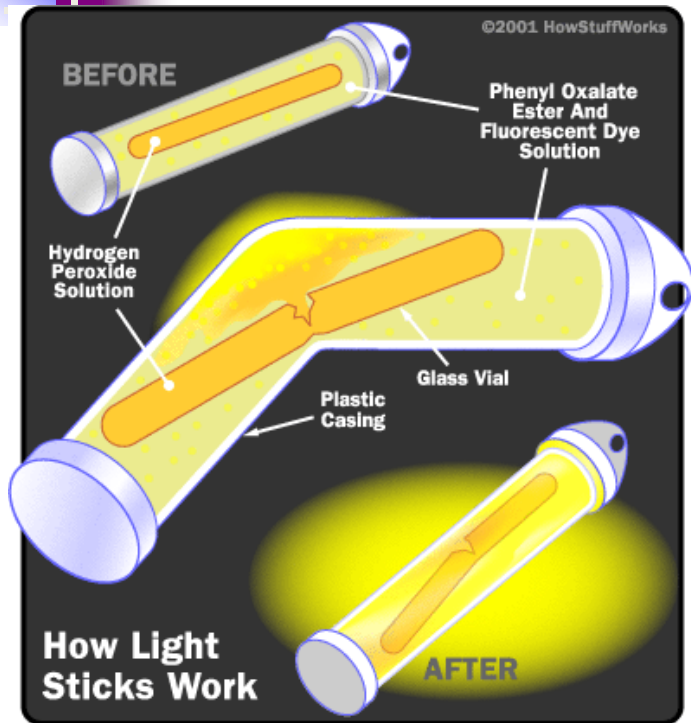
Identify each of the following as an example of a chemical change or a physical change.

- A. Moisture in the air forms beads of water on a cold windowpane.
- B. An electric current changes water into hydrogen and oxygen.
- C. Yeast cells in bread dough make carbon dioxide and ethanol from sugar.

5 Indications of a Chemical Reactions

1) Heat is produced or absorbed: (matches)

2) Light is produced: (lightning bugs/fireflies)



3) Electricity is produced:
(batteries)



Indications of Chemical Reactions

4) Precipitate forms: (soap scum)



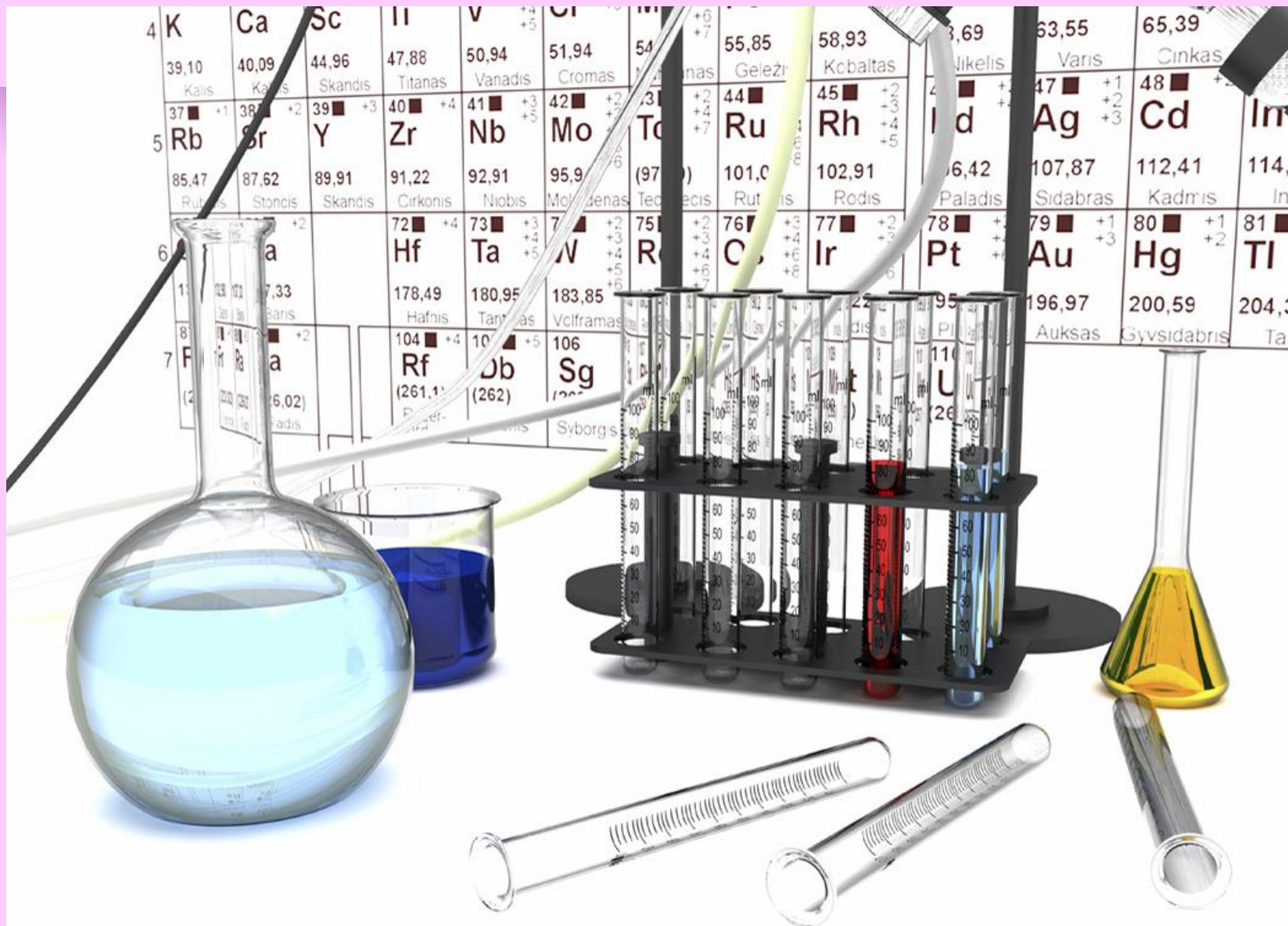
Two liquids chemically
react to form a solid.

5) gas/smoke/odor/bubbles produced:

(baking soda and vinegar)



Review Notes 3.3



Ch 3.3 Mixtures

Mixtures are a physical blend of two or more substances mixed together.” The parts can be separated by physical means.

There are 2 types of mixtures:

(1) Heterogeneous **Mixtures**: NOT uniform in composition.

Examples: chicken soup, fruit salad, dirt, sand in water, milk

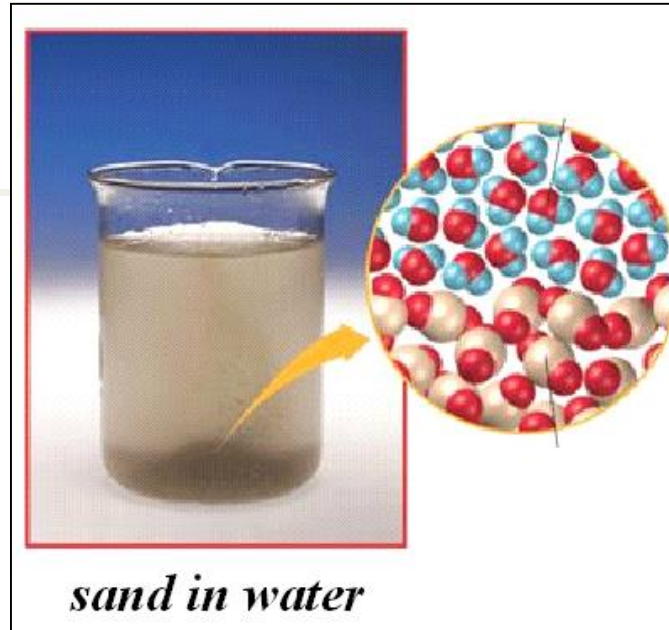
(2) Homogeneous **Mixtures**: completely uniform in composition.

Examples: Air, Kool-aid, brass, salt water

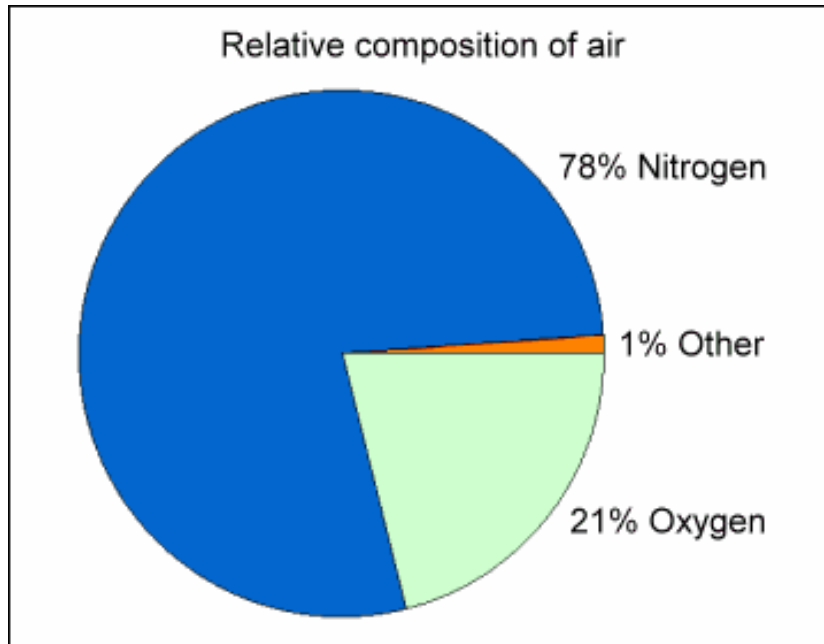


Another term for a homogeneous mixture is a “solution.”

Heterogeneous Mixtures



Homogeneous Mixtures



Pop Quiz



Identify each of the following as an example of a homogeneous mixture or a heterogeneous mixture.

- A. 70% isopropyl rubbing alcohol **A. Homogeneous**
- B. Pile of rusty iron filings **B. Heterogeneous**
- C. Concrete **C. Heterogeneous**
- D. Saltwater **D. Homogeneous**
- E. Gasoline **E. Homogeneous**
- F. Bread **F. Heterogeneous**



Separating Mixtures

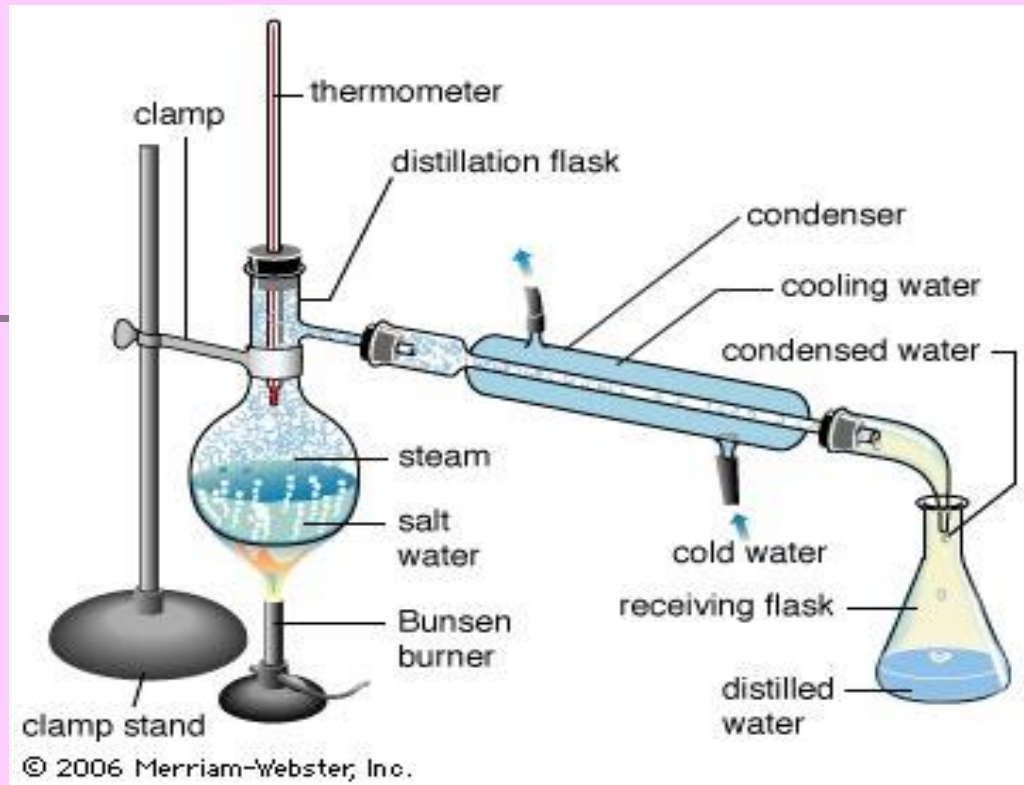
- Mixtures are physically combined
 - Separated using the **difference in physical properties** of the substances.

1) Filtration

Separates heterogeneous mixtures composed of solids and liquids.



2) Distillation



Distillation is a separation technique that is based on differences in the boiling points.

Step 1: Boil the solution.

Step 2: Condense the vapor as it escapes and collect it.

www.edumedia-sciences.com/a438_12-distillation.html

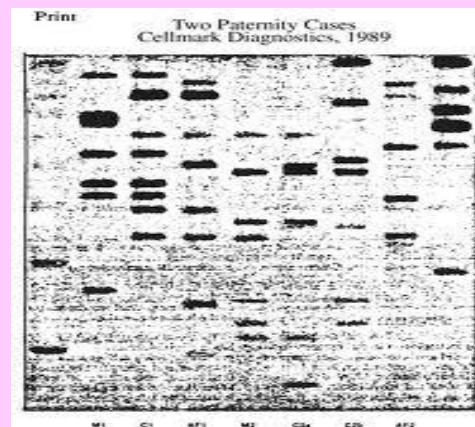
3) Crystallization

- **Crystallization** is a separation technique that results in the formation of pure solid particles from a solution containing the dissolved substance.
 - Rock candy, pop rocks, suckers

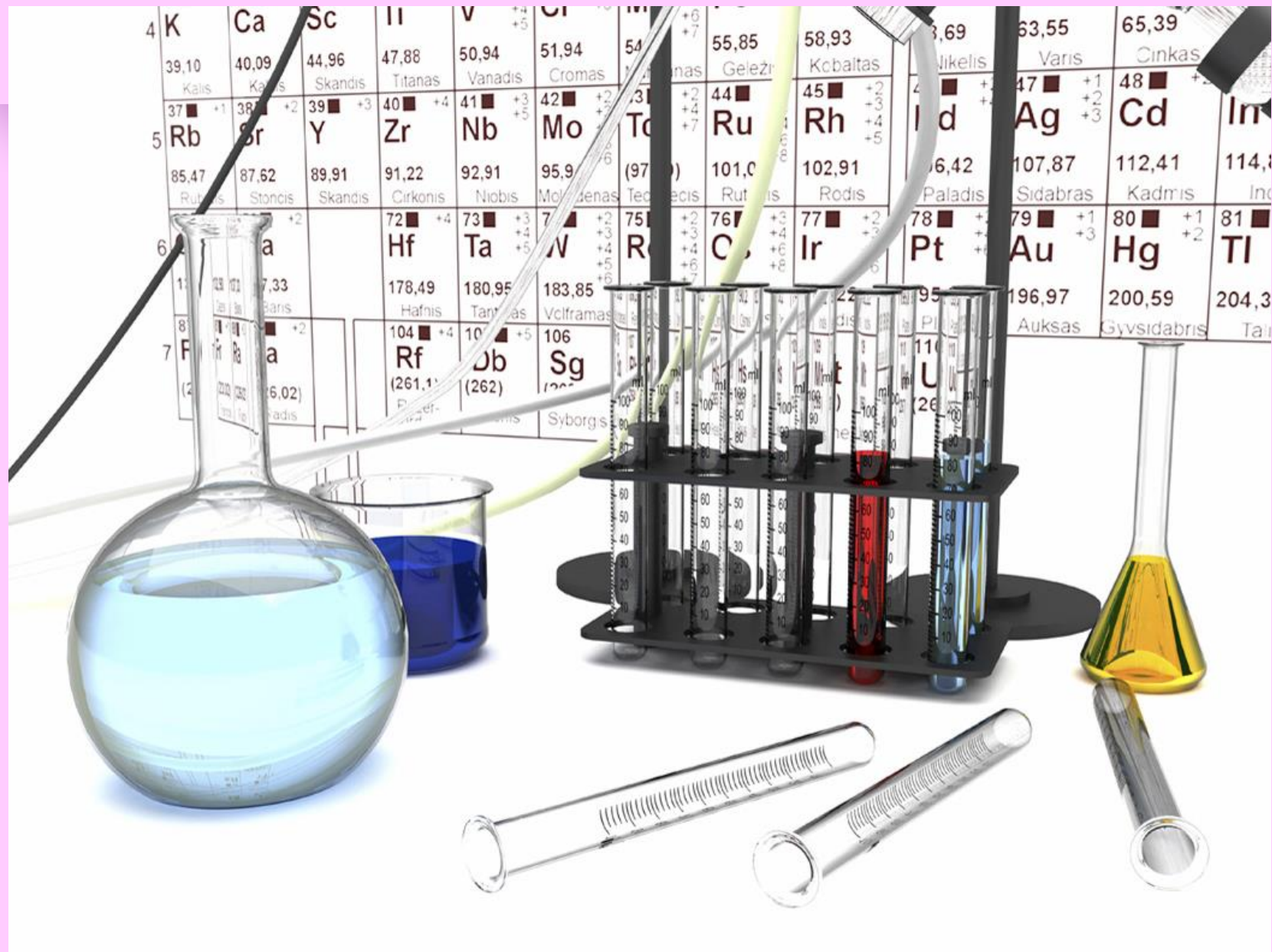


4) Chromatography

- **Chromatography** is a technique that separates the components of a mixture on the basis of how they travel or drawn across the surface of another material.
- The separation occurs because the various components of the ink spread through the paper at different rates.



Ch 3.4





Ch 3.4: Elements vs. Compounds

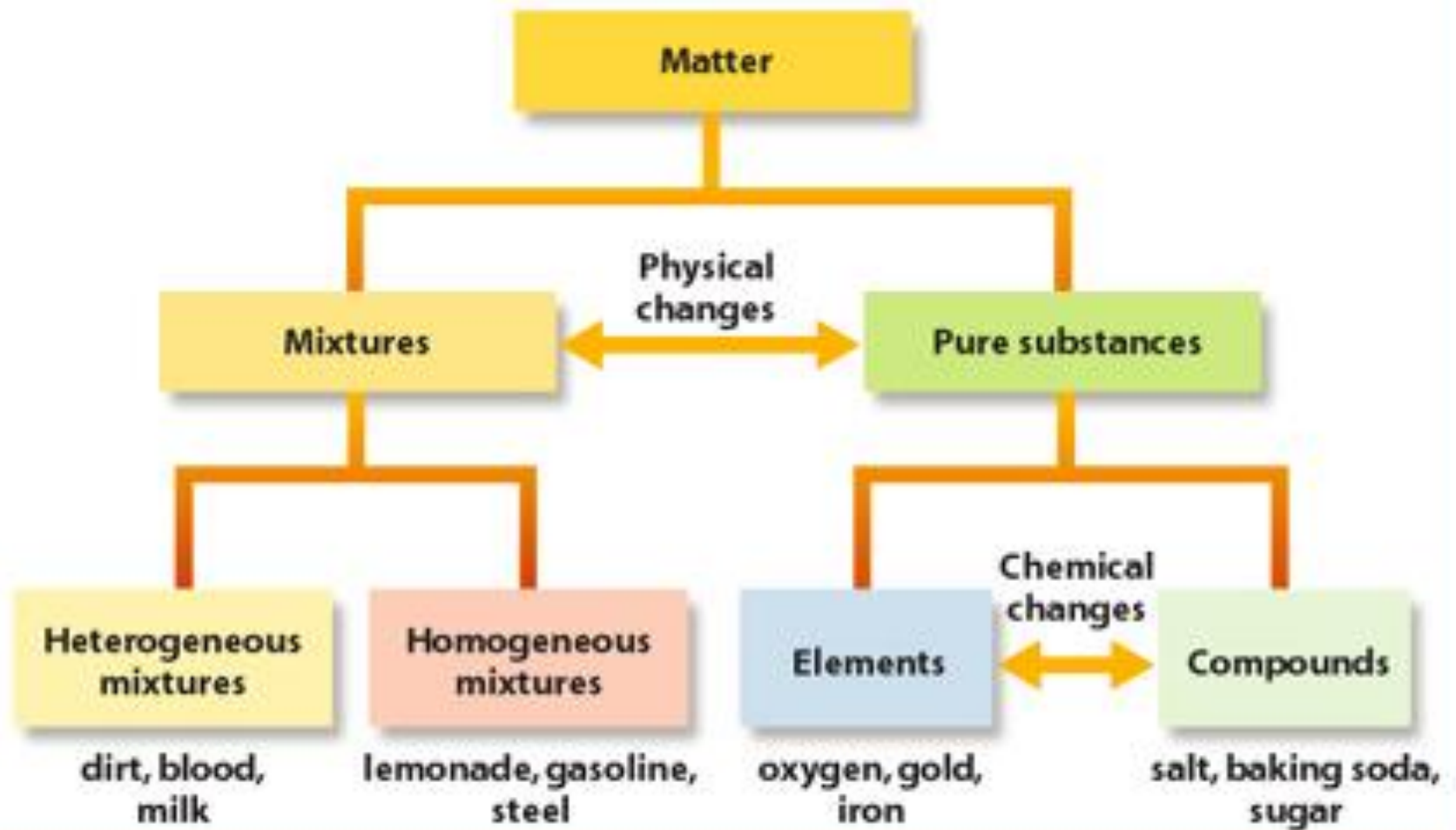
- An element cannot be broken down or changed into simpler substances by **chemical means**.
- Elements are the simplest forms of matter that can exist in normal laboratory conditions.

Examples: Gold, Helium, Mercury

- A compound is made up of 2 or more elements chemically **bonded** together.
- Compounds can only be broken down into simpler substances by chemical changes.

Examples: Water, Sand, NaCl (table salt)

Classification of Matter





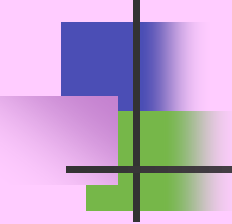
Chemical Symbols

germanium 32 Ge 72.64	nickel 28 Ni 58.693	uranium 92 U 238.028	sulfur 16 S 32.065
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- Chemists use **chemical symbols** to represent elements.
- The chemical symbol consists of **1 or 2 letters**.
- The first letter of the chemical symbol is always **capitalized**.
- The next letter, if needed, is **lowercase**.

Examples: H, Ne, Hg, S, NaBr, H₂O, LiC₂H₃O₂

A first look at the periodic table



- Dmitri Mendeleev organized all of the elements that were known at the time into rows and columns based on their similarities and their masses.

Periodic Table

- The table is called “periodic” because the pattern of similar properties repeats as you move from period to period.

Periodic Table of the Elements

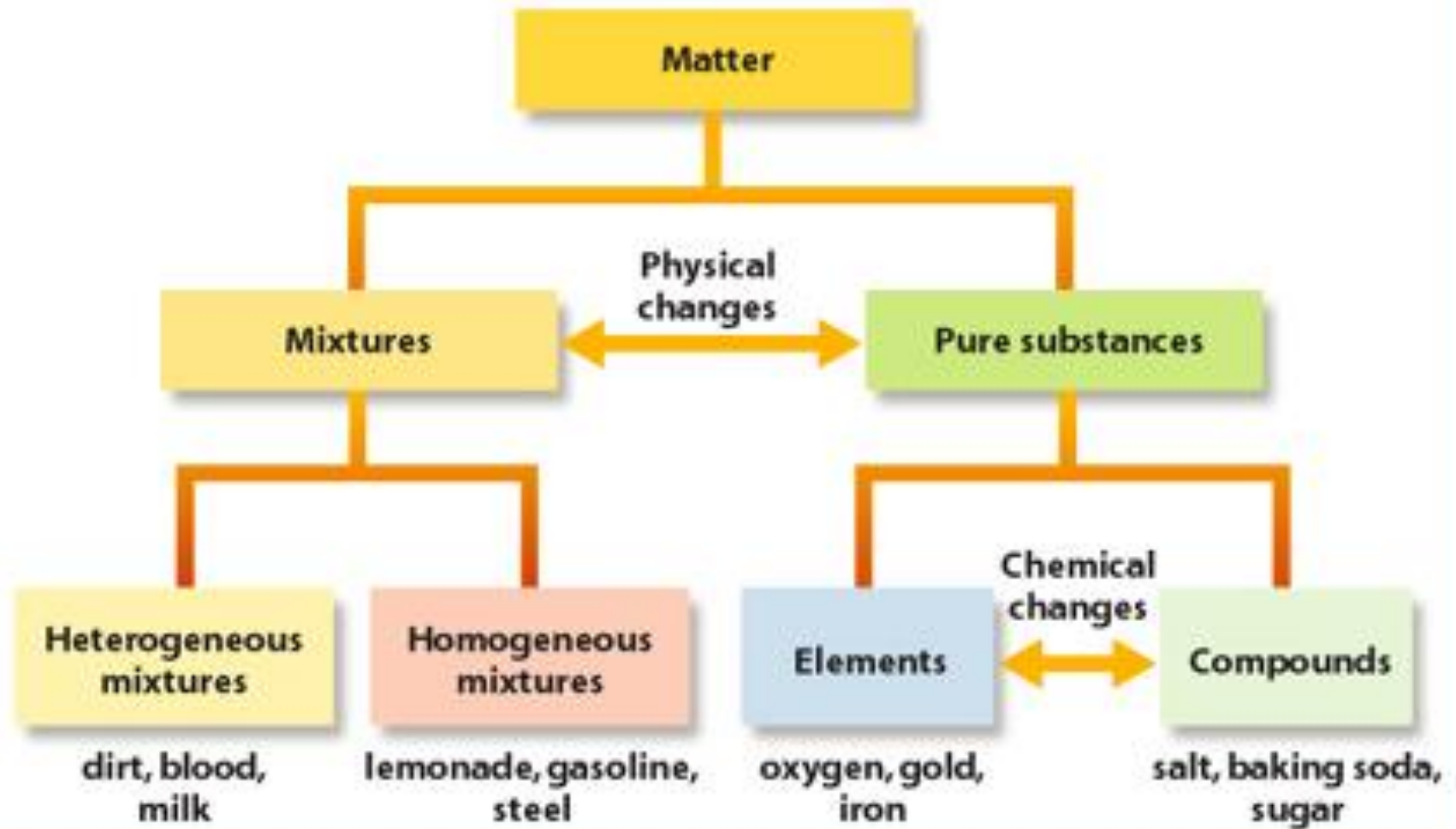
IA 1	IIA 2											IIIA 13	IVA 14	VA 15	VIA 16	VIIA 17	VIIIA 18
1 H																	2 He
2 Li	3 Be											4 B	5 C	6 N	7 O	8 F	9 Ne
3 Na	4 Mg	5 Al	6 Si	7 P	8 S	9 Cl	10 Ar					11 Ga	12 Ge	13 As	14 Se	15 Br	16 Kr
4 K	5 Ca	6 Sc	7 Ti	8 V	9 Cr	10 Mn	11 Fe	12 Co	13 Ni	14 Cu	15 Zn	16 Ga	17 Ge	18 As	19 Se	20 Br	21 Kr
5 Rb	6 Sr	7 Y	8 Zr	9 Nb	10 Mo	11 Tc	12 Ru	13 Rh	14 Pd	15 Ag	16 Cd	17 In	18 Sn	19 Sb	20 Te	21 I	22 Xe
6 Cs	7 Ba	8 La	9 Hf	10 Ta	11 W	12 Re	13 Os	14 Ir	15 Pt	16 Au	17 Hg	18 Tl	19 Pb	20 Bi	21 Po	22 At	23 Rn
7 Fr	8 Ra	9 Ac	10 Rf	11 Db	12 Sg	13 Bh	14 Hs	15 Mt	16 Ds	17 Dt	18 Ug						
		Lanthanide and Actinide Series															
		La Ce Pr Nd Pm Sm Eu Gd Tb Dy Ho Er Tm Yb Lu															
		Ac Th Pa U Np Pu Am Cm Bk Cf Es Fm Md No Lr															



A first look at the periodic table

- In periodic table:
 - horizontal rows = periods
 - vertical columns = groups
- Elements in the same group have similar chemical and physical properties

Classification of Matter





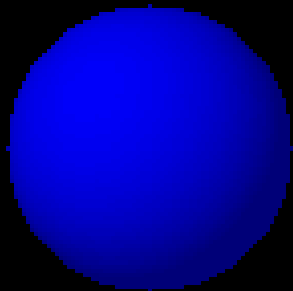
Conservation of Mass

The total mass involved in the reaction remained constant.

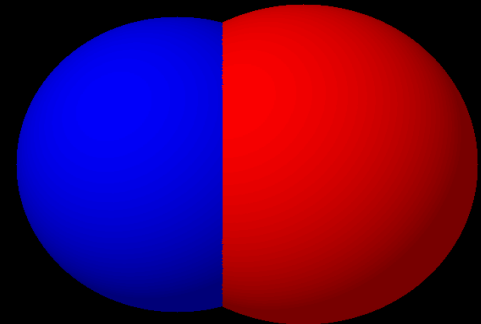
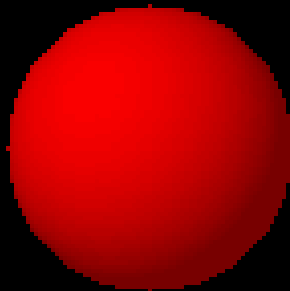
The **law of conservation of mass** states that mass is neither created nor destroyed during a chemical reaction—it is rearranged.

$$\text{Mass}_{\text{reactants}} = \text{Mass}_{\text{products}}$$

Law of Conservation of Mass



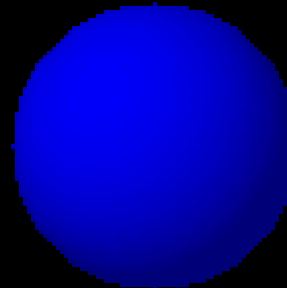
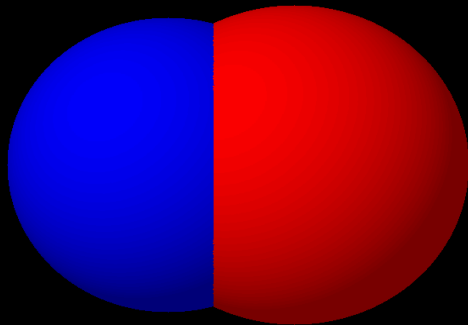
+



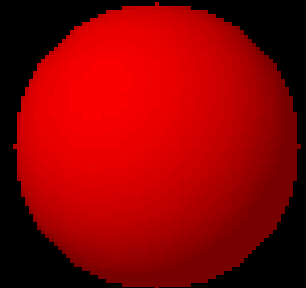
Carbon, C
Mass x

Oxygen, O
Mass y

Carbon Monoxide, CO
Mass x + Mass y



+



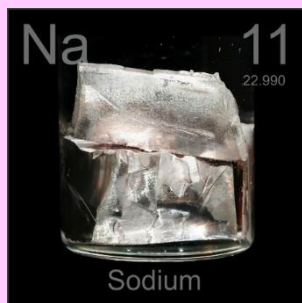
Carbon Monoxide, CO
Mass x + Mass y

Carbon, C
Mass x

Oxygen, O
Mass y

Practice Problem

In the complete reaction of 22.99g of sodium with 34.45g chlorine, what mass of sodium chloride is formed?



22.99g

+



34.45g



???? g

57.44 g



Practice Problem

A 12.2 g sample of X reacts with a sample of Y to form 78.9 g of XY. What is the mass of Y that reacted?



12.2 g

???? g

78.9 g

66.7 g