BASIC CONCEPTS ABOUT MATTER

CONTENTS-

- MATTER
- PHYSICAL STATES AND PROPERTIES OF MATTER
- CHANGES IN MATTER
- PURE SUBSTANCES AND MIXTURES
- HOMOGENEOUS AND HETEROGENEOUS MIXTURES
- ELEMENTS AND COMPOUNDS

CHEMISTRY IS THE SCIENCE DISCIPLINE WHICH STUDIES THE CHARACTERISTICS, COMPOSITION AND TRANSFORMATION OF MATTER.

WHAT IS **MATTER**?

- MATTER IS ANYTHING THAT HAS MASS AND OCCUPIES SPACE.
- THE MASS OF AN OBJECT IS MEASURE OF THE AMOUNT OF MATTER. METRIC UNIT OF MASS IS GRAMS.
- THE VOLUME OF AN OBJECT IS MEASURE OF SPACE OCCUPIED BY THE OBJECT. METRIC UNIT OF VOLUME IS LITERS.

MATTER

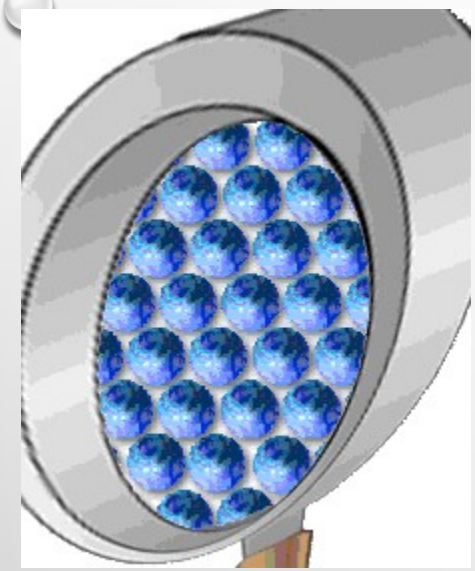
- MATTER INCLUDES BOTH LIVING AND NONLIVING THINGS AS WELL THINGS THAT CANNOT BE SEEN.
- EXAMPLES:
  -
  - WOOD, ROCKS, GASOLINE, AIR, BACTERIA, PARTICLES THAT RESULT IN A SMELL.
  - MATTER CAN BE MATERIAL THAT EXIST IN NATURE NATURALLY OR CAN BE MAN MADE.
  - MATERIALS LIVING AND NON-LIVING

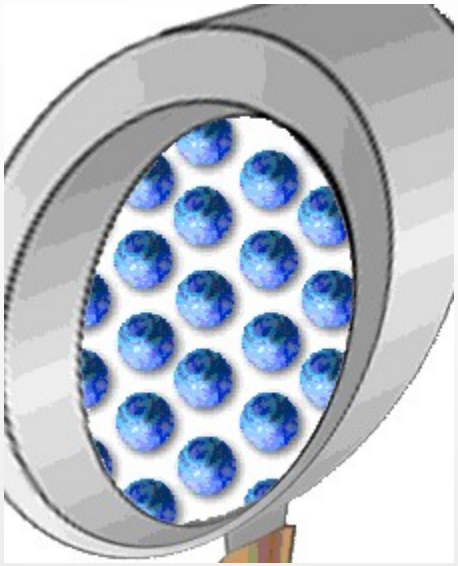
STATES OF MATTER

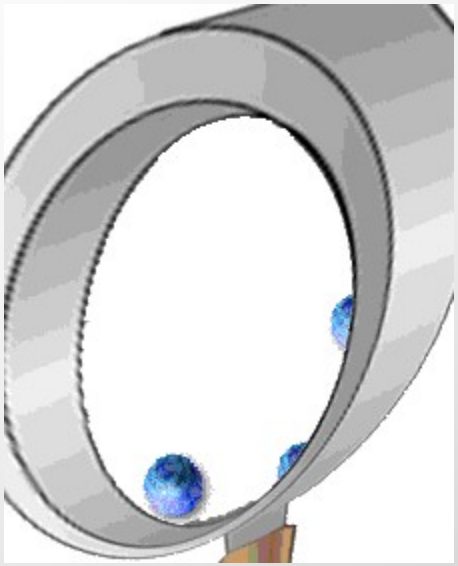
- **SOLID** – HAS A **DEFINITE** SHAPE AND **DEFINITE** VOLUME.
- SOLIDS HAVE THE LEAST ENERGY OF THE THREE STATES OF MATTER.

- **LIQUID** – HAS AN **INDEFINITE** SHAPE AND A **DEFINITE** VOLUME. A LIQUID TAKES THE SHAPE OF ITS CONTAINER.
- LIQUIDS HAVE LESS ENERGY THAN GASES BUT MORE ENERGY THAN SOLIDS.

- **GAS** – HAS AN **INDEFINITE** SHAPE AND AN **INDEFINITE** VOLUME. A GAS ASSUME THE SHAPE AND VOLUME OF ITS CONTAINER.
- GASES HAVE THE MOST ENERGY OF THE THREE STATES OF MATTER







Solid

Liquid

Gas

As the temperature of matter increases, particles move faster because they have more energy. Decreases in temperature cause the particles to move slower. These changes in energy cause the changes of states of

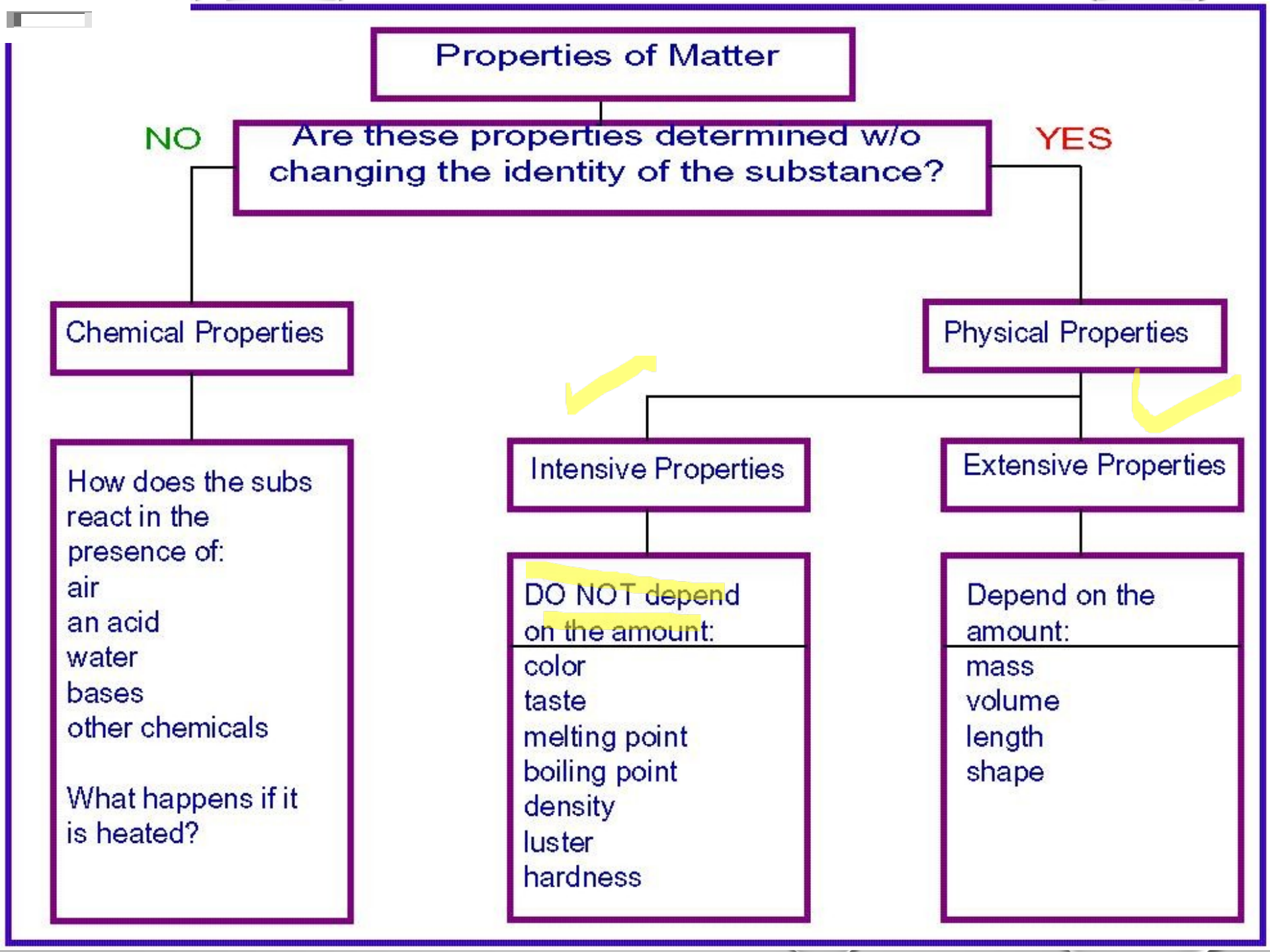
PROPERTIES OF MATTER

- PROPERTIES ARE THE DISTINGUISHING CHARACTERISTICS OF A SUBSTANCE.
- PROPERTIES OF THE SUBSTANCE ARE USEFUL IN
  - IDENTIFICATION OF UNKNOWN SUBSTANCE.
  - DISTINGUISHING BETWEEN DIFFERENT SUBSTANCES.
  - CHARACTERISING A NEWLY DISCOVERED SUBSTANCE.
  - PREDICTING THE USEFULNESS OF A SUBSTANCE FOR SPECIFIC APPLICATION.
- PROPERTIES ARE CLASSIFIED AS EITHER ***PHYSICAL*** OR ***CHEMICAL***.

MATTER

- **<u>PHYSICAL PROPERTY</u> – A CHARACTERISTIC OF A SUBSTANCE THAT CAN BE OBSERVED WITHOUT CHANGING THE SUBSTANCE INTO ANOTHER SUBSTANCE**
- A PROPERTY ASSOCIATED WITH A SUBSTANCE'S PHYSICAL EXISTENCE. CAN BE DETERMINED WITHOUT REFERENCE TO ANY OTHER SUBSTANCE AND WITHOUT CHANGING IDENTITY OF SUBSTANCE.

- **<u>CHEMICAL PROPERTY</u> – A CHARACTERISTIC OF A SUBSTANCE THAT DESCRIBES THE WAY THE SUBSTANCE UNDERGOES A CHANGE TO FORM A NEW SUBSTANCE.**
- DESCRIBES THE ABILITY OF A SUBSTANCE TO FORM NEW SUBSTANCES EITHER BY REACTION WITH OTHER SUBSTANCES OR BY DECOMPOSITION.


Properties of Matter
Are these properties determined w/o changing the identity of the substance?
NO
YES
Chemical Properties
Physical Properties
How does the subs react in the presence of:
air
an acid
water
bases
other chemicals
What happens if it is heated?
Intensive Properties
DO NOT depend on the amount:
color
taste
melting point
boiling point
density
luster
hardness
Extensive Properties
Depend on the amount:
mass
volume
length
shape

MATTER-PHYSICAL CHANGE

- PHYSICAL CHANGE – PROCESS IN WHICH A SUBSTANCE CHANGES ITS PHYSICAL APPEARANCE BUT NOT ITS CHEMICAL COMPOSITION.
- MELTING ICE
- CLOUD FORMATION
- MAKING ROCK CANDY
- CUTTING INTO SMALLER PIECES

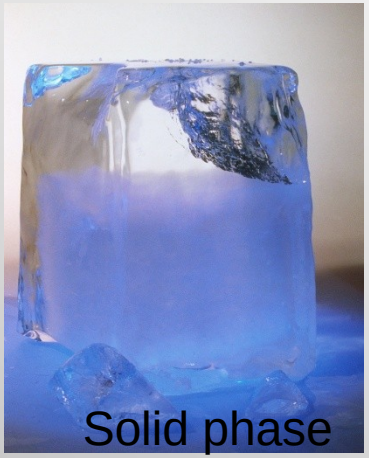
Gas phase

Evaporation

Condensation

Sublimation

Deposition



Solid phase

Melting

Freezing

Liquid phase

MATTER-CHEMICAL CHANGE

- <u>CHEMICAL CHANGE</u> – PROCESS IN WHICH A SUBSTANCE UNDERGOES A CHANGE IN CHEMICAL COMPOSITION**. A NEW SUBSTANCE IS FORMED.**

- A CHEMICAL REACTION IS A CHEMICAL CHANGE.
  - WHAT YOU FINISH WITH IS NOT THE SAME AS WHAT YOU STARTED WITH.

$$CaO + CO_2 \rightarrow CaCO_3$$

CHEMICAL CHANGES

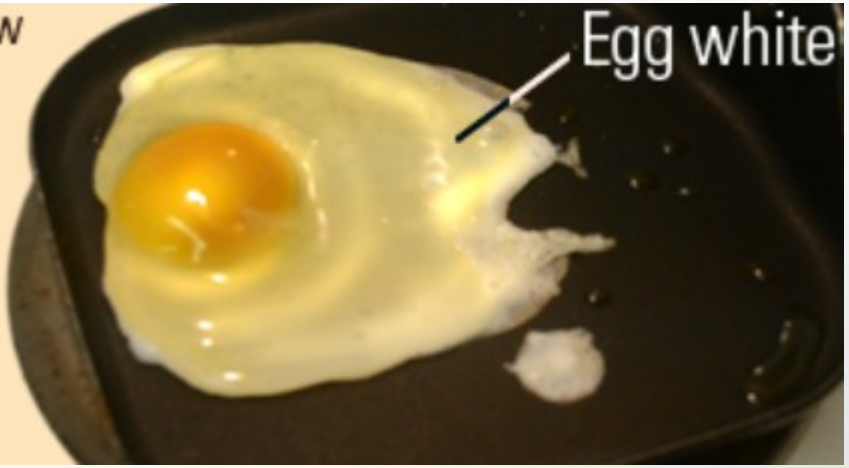
- FOOD DIGESTION
- PLANT GROWTH
- HEALING OF A WOUND
- RUST
- FERMENTATION

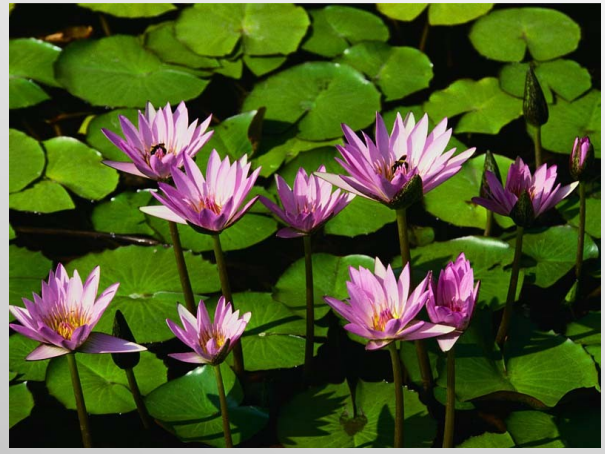
Others?

CHEMICAL REACTIONS

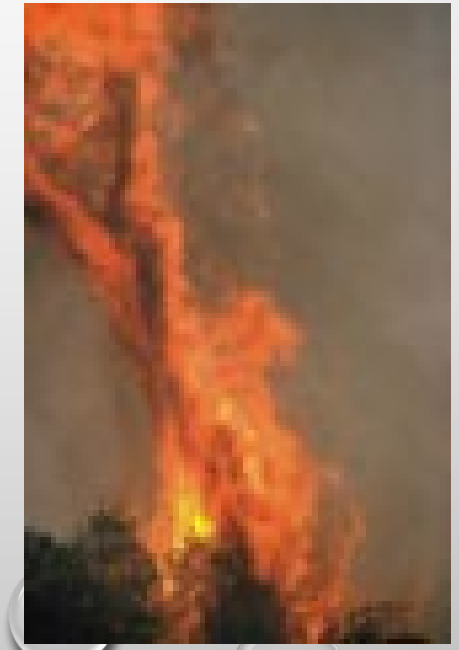
Some Natural Chemical Change Examples

When you fry an egg, notice how the liquid egg-white part becomes solid and changes to pure white colour.
The fried egg's properties are different from that of the uncooked egg.





Plant growth



Burning of wood

PHYSICAL OR CHEMICAL?

Remember
-

- IF THE COMPOSITION DOES NOT CHANGE, THE CHANGE IS PHYSICAL.

- IF THE COMPOSITION DOES CHANGE, THE CHANGE IS CHEMICAL. IT CAN BE VERY DIFFICULT TO RECOVER THE ORIGINAL MATERIAL IN A CHEMICAL CHANGE.

CLASSIFICATIONS OF MATTER

- MATTER CAN BE DIVIDED INTO TWO CLASSES:
  - MIXTURES
  - PURE SUBSTANCES
- PURE SUBSTANCES ARE COMPOSED OF ONLY ONE SUBSTANCE AND CANNOT BE PHYSICALLY SEPARATED.
- MIXTURES ARE COMPOSED OF MORE THAN ONE SUBSTANCE AND CAN BE *PHYSICALLY* SEPARATED INTO ITS COMPONENT SUBSTANCES.

Matter

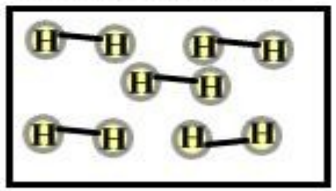
Pure Substance

-1 type of particle

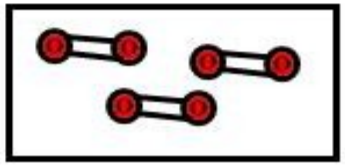
Element

-molecules have 1 type of atom

hydrogen gas (H_2)

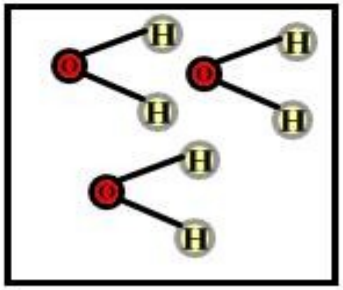


oxygen gas (O_2)



Compound

-molecules have 2 or more types of atoms joined together



water (H_2O)

Mixture

-2 or more pure substances joined together

Homogeneous Mixture (Solution)

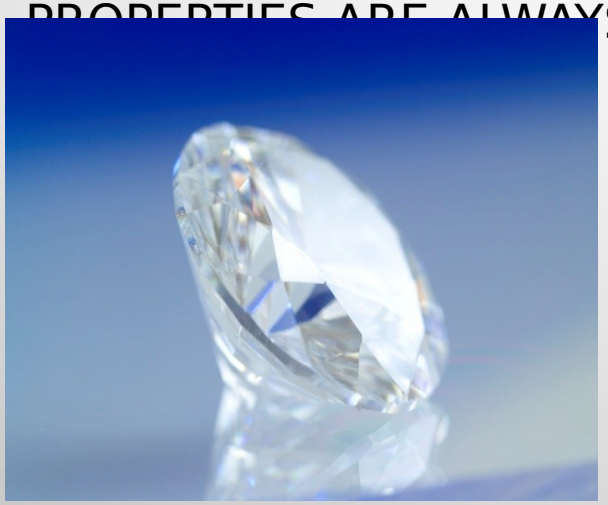
-only 1 phase
-one substance (solute) dissolves in another (solvent)

Heterogeneous Mixture

-can see 2 or more phases

PURE SUBSTANCES

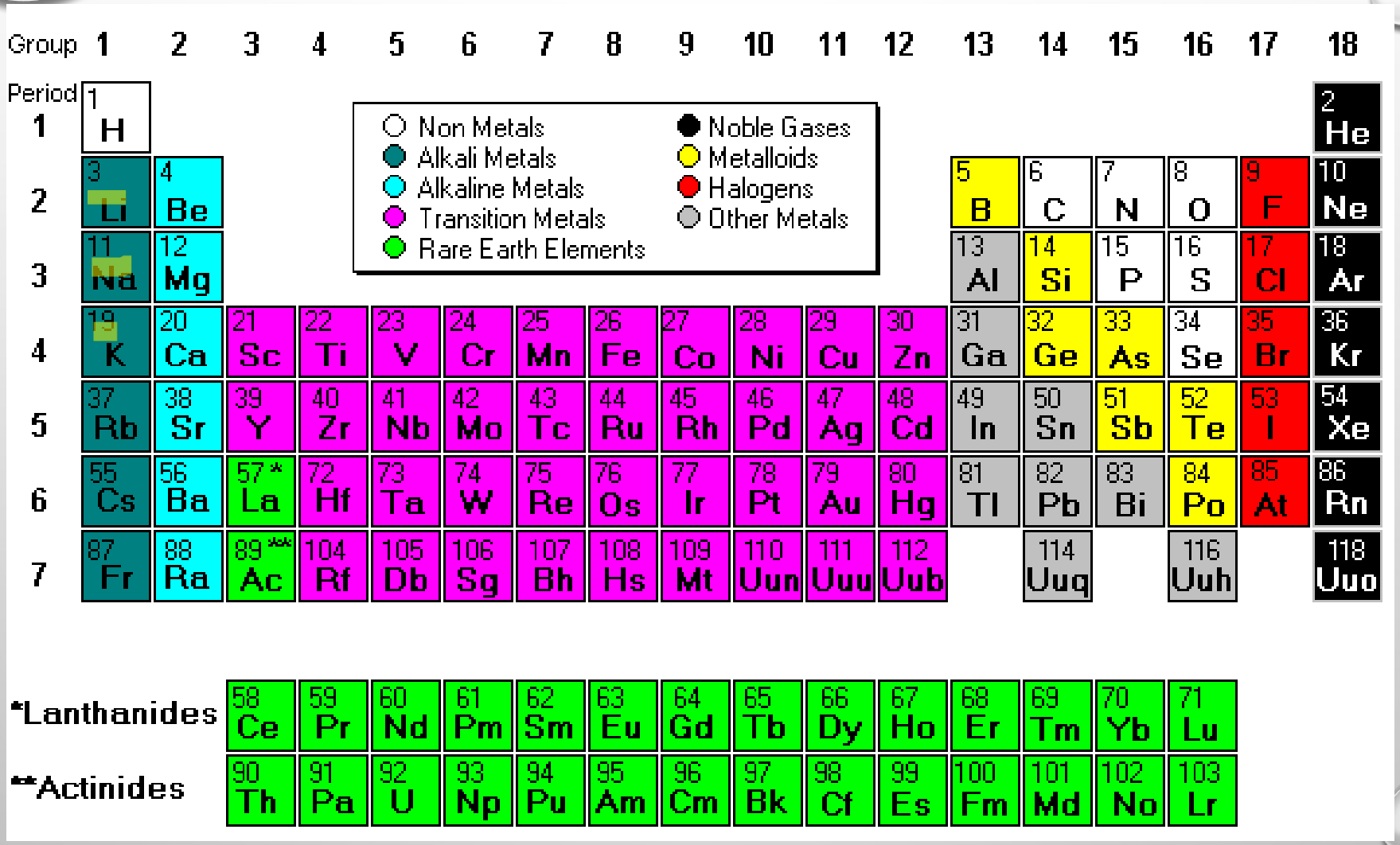
- PURE SUBSTANCE :
  - ONLY ONE **SUBSTANCE** PRESENT, CAN BE AN ELEMENT OR A COMPOUND
  - DEFINITE AND CONSTANT COMPOSITION
  - PROPERTIES ARE ALWAYS THE SAME UNDER A GIVEN SET OF



Another example?

PURE SUBSTANCES

- **ELEMENTS** ARE PURE SUBSTANCES.
  - ELEMENTS ARE MADE FROM ATOMS.
  - CANNOT BE BROKEN DOWN INTO SIMPLER SUBSTANCES BY CHEMICAL OR PHYSICAL MEANS.
  - BUILDING BLOCKS FOR ALL OTHER TYPES OF MATTER.
  - 118 KNOWN ATOMS. (90 OCCUR NATURALLY)
  - EACH HAS ITS OWN NAME, SYMBOL, AND UNIQUE CHARACTERISTICS.



http://modelscience.com/PeriodicTable.html

Symbol	Element Name	Symbol	Element Name	Symbol	Element Name
Ag	Silver*	Be	Beryllium	Cr	Chromium
Al	Aluminum	Br	Bromine	Cu	Copper*
Ar	Argon	C	Carbon	F	Fluorine
Au	Gold*	Ca	Calcium	Fe	Iron*
B	Boron	Cl	Chlorine	H	Hydrogen
Ba	Barium	Co	Cobalt	He	Helium

Symbol	Element Name	Symbol	Element Name	Symbol	Element Name
Hg	Mercury*	Na	Sodium*	Pt	Platinum
I	Iodine	Ne	Neon	S	Sulfur
K	Potassium*	Ni	Nickel	Si	Silicon
Li	Lithium	O	Oxygen	Sn	Tin*
Mg	Magnesium	P	Phosphorus	U	Uranium
N	Nitrogen	Pb	Lead*	Zn	Zinc

* Latin name

OTHER ELEMENT SYMBOLS

- FOR SOME ELEMENTS, THE CHEMICAL SYMBOL IS DERIVED FROM THE ORIGINAL LATIN NAME.

Gold – Au

Silver – Ag

Copper – Cu

Mercury – Hg

Potassium – K

Sodium – Na

Antimony – Sb

Tin – Sn

Iron – Fe

Tungsten – W

ELEMENTS

PURE SUBSTANCES

- **<u>COMPOUNDS</u>** ARE ALSO PURE SUBSTANCES.
  - THEY ARE A CHEMICAL COMBINATION OF TWO OR MORE ATOMS.
  - CHEMICAL CHARACTERISTICS OF A COMPOUND VARY GREATLY FROM INDIVIDUAL ELEMENTS.
  - *CAN BE* BROKEN DOWN INTO CONSTITUENT ATOMS USING *CHEMICAL* BUT <u>NOT</u> *PHYSICAL* MEANS.
  - HAVE A DEFINITE, CONSTANT ELEMENTAL COMPOSITION. $C_{12}H_{22}O_{11}$
  - RULES EXIST FOR COMBINING

    ATOMS INTO COMPOUNDS.

COMMON COMPOUNDS

Common Names	FORMULA	Chemical Names
BAKING SODA	$NaHCO_3$	SODIUM BICARBONATE
EPSOM SALT	$MgSO_4$	MAGNESIUM SULFATE
CLOROX	NaClO	SODIUM HYPOCHLORITE
LIME WATER	$Ca(OH)_2$	CALCIUM HYDROXIDE
VINEGAR	CH_3COOH	ACETIC ACID
TABLE SALT	NaCl	SODIUM CHLORIDE
CHALK	$CaCO_3$	CALCIUM CARBONATE
ETHYL ALCOHOL	C_2H_5OH	ETHANOL
AMMONIA	NH_3	

MIXTURES

- **<u>MIXTURE</u>** – PHYSICAL COMBINATION OF TWO OR MORE PURE SUBSTANCES *IN WHICH EACH SUBSTANCE RETAINS ITS OWN CHEMICAL IDENTITY.*

MIXTURE OR PURE SUBSTANCE

MIXTURE

1. PHYSICAL COMBINATION OF TWO OR MORE SUBSTANCE
2. VARIABLE COMPOSITION
3. PROPERTIES VARY AS COMPOSITION VARIES
4. COMPONENTS CAN BE SEPARATED USING PHYSICAL MEANS.

PURE SUBSTANCE

1. ONLY ONE SUBSTANCE IS PRESENT
2. DEFINITE AND CONSTANT COMPOSITION.
3. PROPERTIES ARE ALWAYS THE SAME UNDER A GIVEN SET OF CONDITIONS.
4. CANNOT BE SEPARATED BY PHYSICAL MEANS.

MIXTURE OR PURE SUBSTANCE?

- CRYSTALLINE SUGAR
- SUGAR WATER SOLUTION
- SOLID GOLD BULLION
- STEEL
- MILK

TYPES OF MIXTURES OR PURE SUBSTANCES

HETEROGENEOUS

- TWO OR MORE VISIBLY DISTINCT PHASES.
- EACH PHASE HAS DIFFERENT PROPERTIES.
- EXAMPLES?

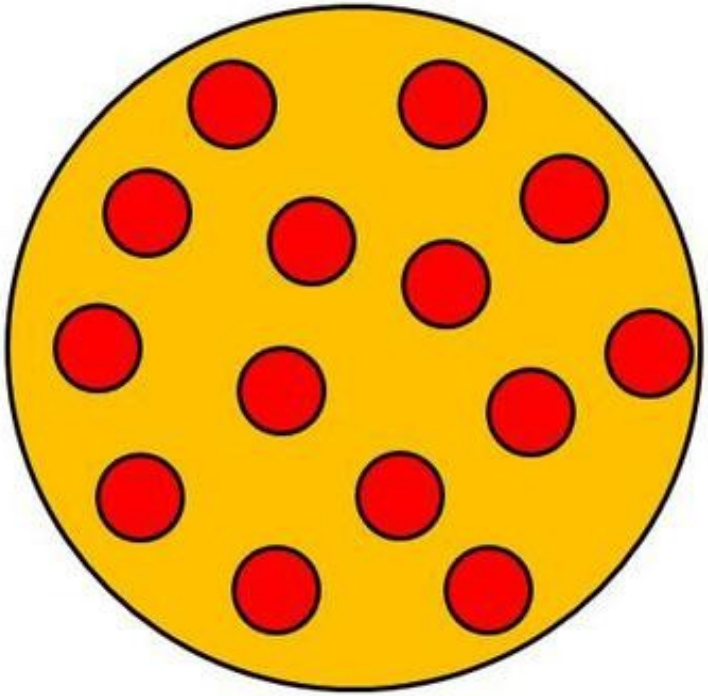
HOMOGENEOUS

- ONLY ONE VISIBLY DISTINCT PHASE.
- THE PHASE HAS THE SAME PROPERTIES THROUGHOUT.
- EXAMPLES?

Homogenous

Peanut butter is a homogenous mixture because even though it has different ingredients they are all evenly mixed and are not noticeable.

Heterogeneous



Pepperoni Pizza is a heterogonous food because it has many ingredients like cheese, sauce, pepperoni and bread but they are noticeable and not evenly mixed.

PURE SUBSTANCE OR MIXTURE

- **SOLUTION** – A HOMOGENEOUS MIXTURE OF TWO OR MORE SUBSTANCES, WITH EACH SUBSTANCE RETAINING ITS CHEMICAL IDENTITY. SOLUTIONS ARE CLEAR.
  - SOLUTIONS CAN BE SOLID, LIQUID OR GAS
  - HOMOGENEOUS MIXTURES ARE POSSIBLE, ONLY WHEN COMPONENTS PRESENT ARE IN THE SAME PHYSICAL STATE.

PURE SUBSTANCES VS. MIXTURES

- APPLY THE TERMS HETEROGENEOUS AND HOMOGENEOUS TO THE CHEMICAL AND PHYSICAL PROPERTIES OF PURE SUBSTANCES AND MIXTURES:
  - PURE SUBSTANCES ARE *CHEMICALLY* HOMOGENEOUS
  - PURE SUBSTANCES CAN BE *PHYSICALLY* HOMOGENEOUS OR HETEROGENEOUS

PURE SUBSTANCES VS. MIXTURES

- APPLY THE TERMS HETEROGENEOUS AND HOMOGENEOUS TO THE CHEMICAL AND PHYSICAL PROPERTIES OF PURE SUBSTANCES AND MIXTURES:
  - MIXTURES ARE ALWAYS *CHEMICALLY HETEROGENEOUS*.
  - MIXTURES CAN BE *PHYSICALLY HOMOGENEOUS* I.E. CONSISTING OF ONLY ONE PHASE OR *PHYSICALLY HETEROGENEOUS*, I.E. CONSISTING OF TWO OR MORE PHASES.

LEARNING CHECK- INDICATE FOLLOWING AS PURE SUBSTANCES, HOMOGENEOUS OR HETEROGENEOUS MIXTURES OR PURE COMPOUND OR ELEMENT

a	**Sugar water**	
b	**Calcium carbonate (s)**	
c	**Oil and water**	
d	**Salt pepper in glass**	
e	**Saline solution**	
f	**Coke**	
g	**Magnesium Sulfate salt**	