



INTRODUCTION TO CHEMISTRY

WHAT IS CHEMISTRY?

- Chemistry is the study of the composition of “matter” — (matter is anything with mass and occupies space), its composition, properties, and the changes it undergoes.
- Has a definite affect on everyday life - taste of foods, grades of gasoline, etc.
- Living and nonliving things are made of matter.

- **Chemistry** is the study of the composition, structure, and properties of matter and the changes it undergoes – such as burning fuels.



5 MAJOR AREAS OF CHEMISTRY


- 1) Analytical Chemistry- concerned with the composition of substances.
- 2) Inorganic Chemistry- primarily deals with substances without carbon
- 3) Organic Chemistry- essentially all substances containing carbon
- 4) Biochemistry- Chemistry of living things
- 5) Physical Chemistry- describes the behavior of chemicals (ex. stretching); involves lots of math!

WHAT IS CHEMISTRY?

- Pure chemistry- gathers knowledge for the sake of *knowledge*
- Applied Chemistry- is using chemistry to *attain certain goals*, in fields like medicine, agriculture, and manufacturing – leads to an application
 - * Aspirin ($C_9H_8O_4$) - to relieve pain

WHY STUDY CHEMISTRY?

- Everyone and everything around us involves chemistry – explains our world
- What in the world isn't Chemistry?
- Helps you make choices; helps make you a better informed citizen
- A possible career for your future
- Used to attain a specific goal
- What did we describe as “pure” and “applied” chemistry?



UNIT 1: FROM STRUCTURES TO PROPERTIES

CLASSIFICATION OF MATTER

Properties of Matter: Chapter 2, pages 38 – 52.

The Periodic Table: Chapter 6.1 – 6.2, pages 154 - 169

UNIT 1: LEARNING TARGETS

CMLT1	Define and classify matter according to its composition, distinguish between chemical and physical properties.
CMLT2	Define and classify matter as elements, compounds, heterogeneous mixtures and solutions. Use the periodic law to identify and distinguish metals and non-metals, periods and groups, representative and transition elements, and families.

LEARNING TARGET GUIDE

CMLT1: Define and classify matter according to its composition, distinguish between chemical and physical properties.

Be able to define, explain, identify or provide examples of the following:

- matter
- chemical property/change
- physical property/change
- intrinsic property
- extrinsic property

Textbook:

- Page 42 #s 1 – 8
- Pages 58 – 60 #s 35 – 43, 57 - 64

LEARNING TARGET GUIDE

CMLT2: Define and classify matter as elements, compounds, heterogeneous mixtures and solutions. Use the periodic law to identify and distinguish metals and non-metals, periods and groups, representative and transition elements, and families.

Be able to define, explain, identify or provide examples of the following:

- elements
- compounds
- heterogeneous mixture
- homogenous mixture
- periodic law
- metals/non-metals
- periods/groups
- representative/transition elements
- families of elements

Textbook:

- Page 47 #s 11 – 17
- Page 52 #s 20 – 27
- Page 58 #s 44 - 52
- Page 160 #s 1 – 7
- Page 181 #s 24, 26 – 31

CH. 2.1: PROPERTIES OF MATTER

- Matter is anything that: a) has mass, and b) takes up space
- Mass = a measure of the amount of “stuff” (or material) the object contains (don’t confuse this with weight, a measure of the force of gravity)
- Volume = a measure of the space occupied by the object

DESCRIBING MATTER

- Properties used to describe matter can be classified as:
 - 1) Extensive – depends on the *amount* of matter in the sample
 - Mass, volume, calories are examples
 - 2) Intensive – depends on the *type* of matter, not the amount present
 - Hardness, Density, Boiling Point

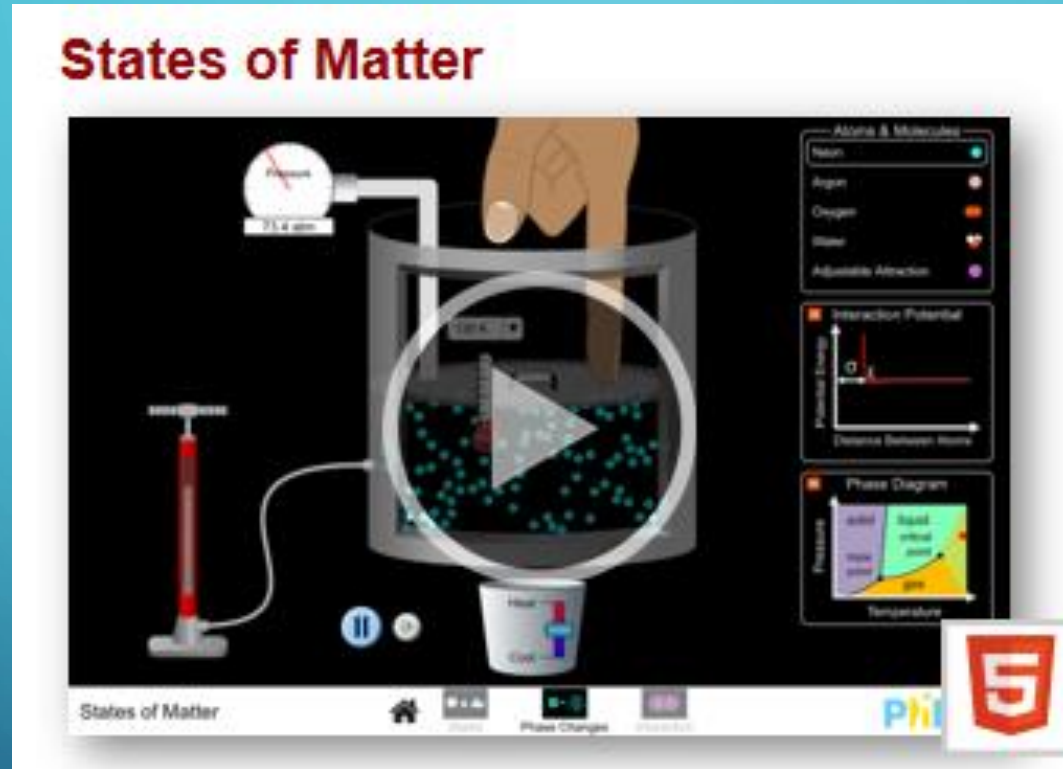
PROPERTIES ARE...

- Physical Properties- a property that can be observed and measured without changing the material's composition.
- Examples- color, hardness, m.p., b.p.
- Chemical Properties- a property that can only be observed by changing the composition of the material.
- Examples- ability to burn, decompose, ferment, react with, etc.

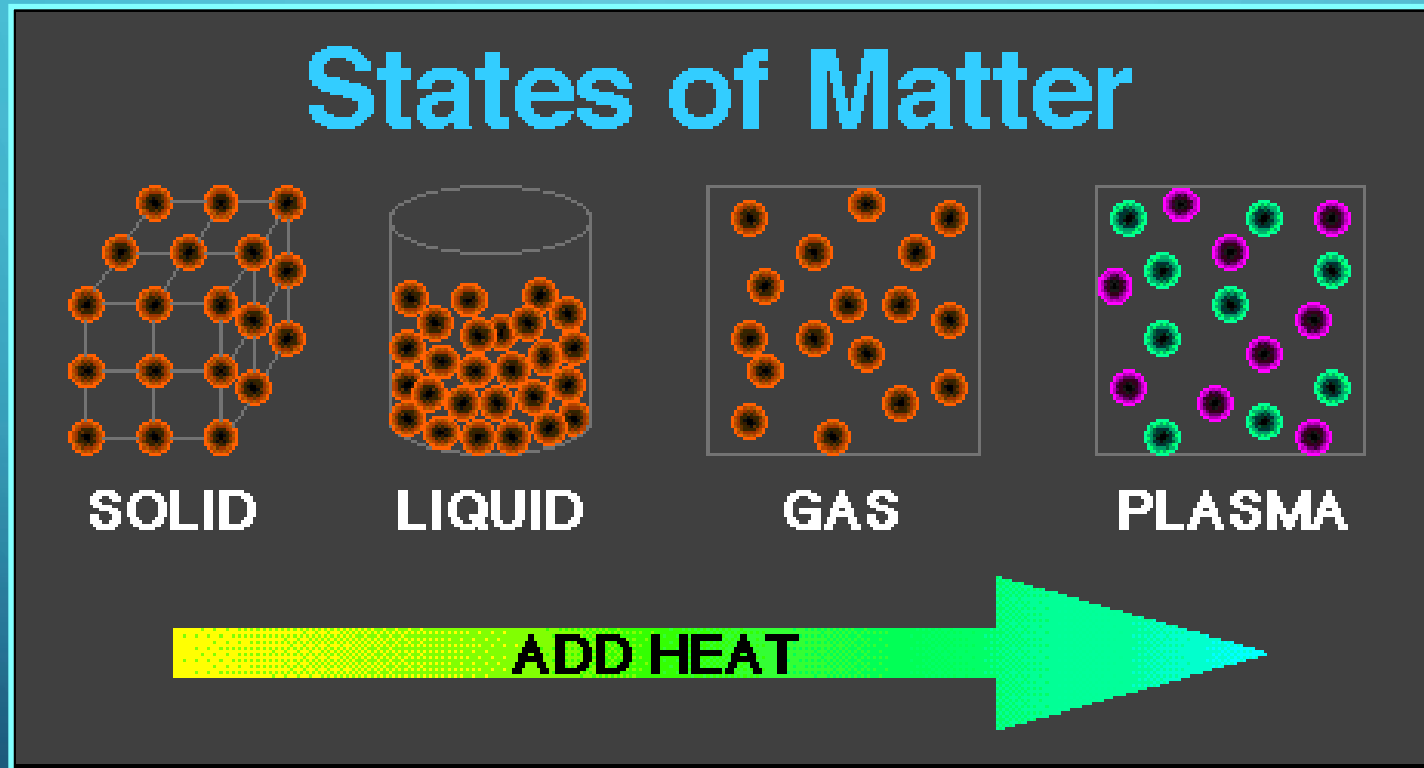
STATES OF MATTER

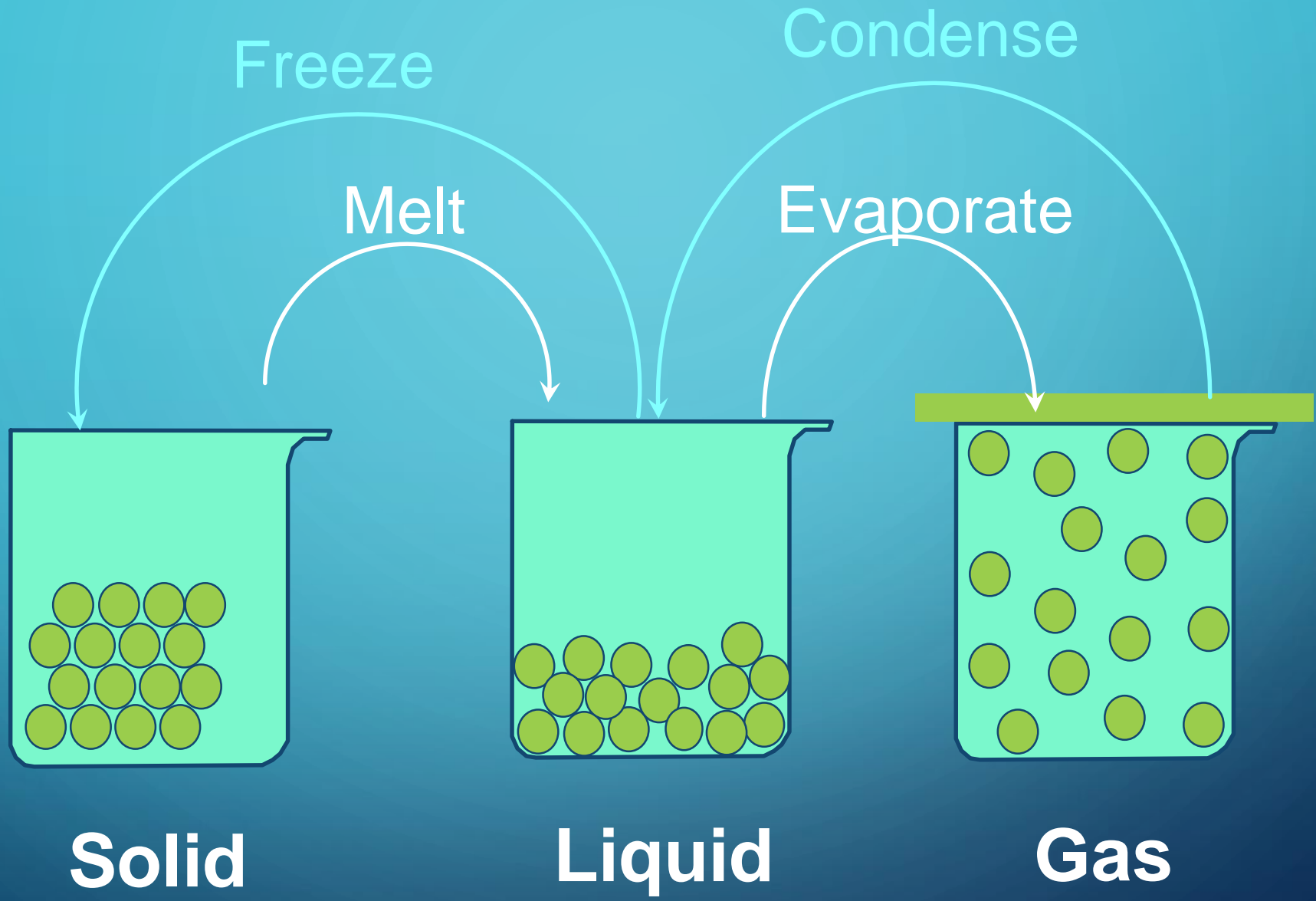
- 1) Solid- matter that can not flow (definite shape) and has definite volume.
- 2) Liquid- definite volume but takes the shape of its container (flows).
- 3) Gas- a substance without definite volume or shape and can flow.
 - Vapor- a substance that is currently a gas, but normally is a liquid or solid at room temperature. (Which is correct: “water gas”, or “water vapor”?)

STATES OF MATTER – SIMULATION



4TH STATE: **PLASMA** - FORMED AT HIGH TEMPERATURES; IONIZED PHASE OF MATTER AS FOUND IN THE SUN





Solid

Liquid

Gas

PHYSICAL VS. CHEMICAL CHANGE

- Physical change will change the visible appearance, without changing the composition of the material.
 - Boil, melt, cut, bend, split, crack
- Can be **reversible**, or **irreversible**
- Chemical change - a change where a new form of matter is formed.
 - Rust, burn, decompose, ferment

CMLT1

Define and classify matter according to its composition, distinguish between chemical and physical properties.

TEST REVIEW QUESTIONS

- Page 42 #s 1 – 8.
- Page 58 – 60 #s 35 – 43, 57 – 64.

CH. 2.2: MIXTURES

- 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.

SOLUTIONS ARE HOMOGENEOUS MIXTURES

- Mixed molecule by molecule, thus too small to see the different parts.
- Can occur between any state of matter: gas in gas; liquid in gas; gas in liquid; solid in liquid; solid in solid (alloys), etc.
- Thus, based on the distribution of their components, mixtures are called homogeneous or heterogeneous.

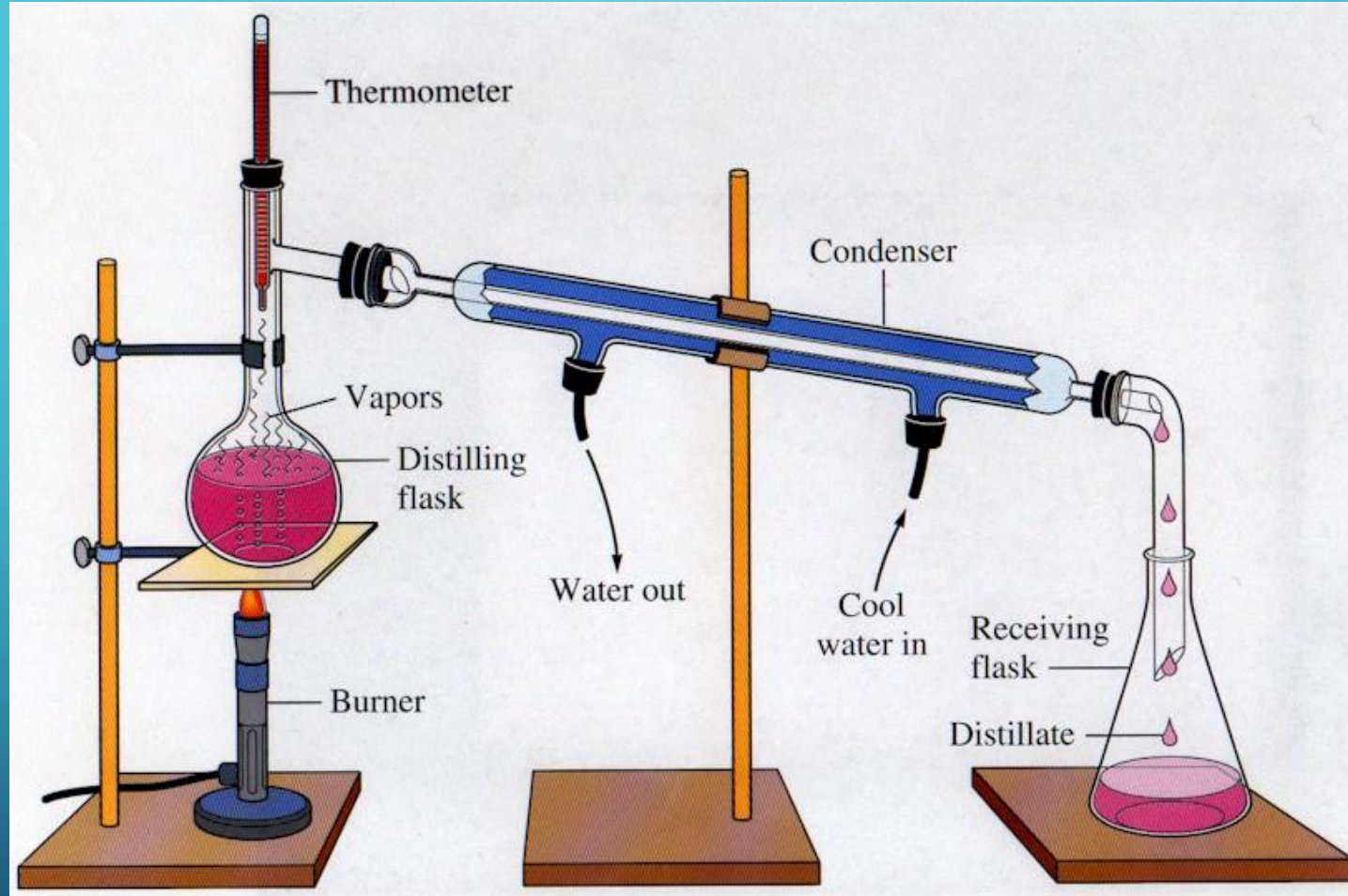
PHASE

- The term “phase” is used to describe any part of a sample with uniform composition of properties.
- A homogeneous mixture consists of a single phase.
- A heterogeneous mixture consists of two or more phases.

SEPARATING MIXTURES

- Some can be separated easily by physical means: rocks and marbles, iron filings and sulfur (use magnet)
- Differences in physical properties can be used to separate mixtures.
- Filtration - separates a solid from the liquid in a heterogeneous mixture (by size) – Figure 2.7, page 46

SEPARATION OF A MIXTURE



REVIEW QUESTIONS

- Page 47 #s 11 – 17.

CH. 2.3 ELEMENTS AND COMPOUNDS

Substances are either:

- a) elements, or
- b) compounds

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!)

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

ELEMENTS VS. COMPOUNDS

- Compounds can be broken down into simpler substances by chemical means, but elements cannot.
- A “*chemical change*” is a change that produces matter with a different composition than the original matter.
- $\text{CH}_3\text{COOH} + \text{NaHCO}_3 \rightarrow \text{NaCH}_3\text{COO} + \text{CO}_2 + \text{H}_2\text{O}$

CHEMICAL CHANGE

- A change in which one or more substances are converted into different substances.

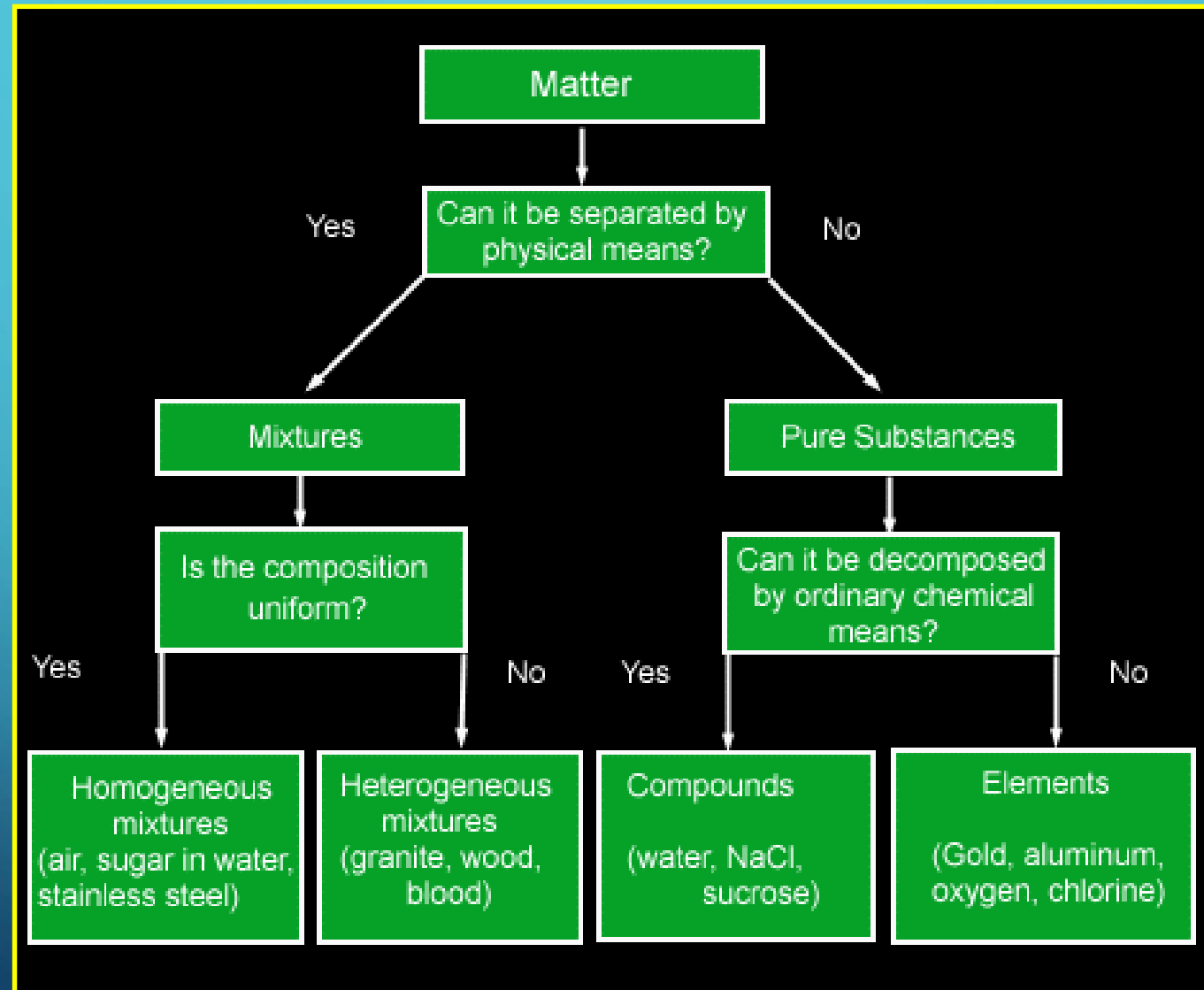


Heat and *light* are often evidence of a chemical change.

PROPERTIES OF COMPOUNDS

- Quite different properties than their component elements.
- Due to a **CHEMICAL CHANGE**, the resulting compound has new and different properties:
 - Table sugar – carbon, hydrogen, oxygen
 - Sodium chloride – sodium, chlorine
 - Water – hydrogen, oxygen

CLASSIFICATION OF MATTER



SYMBOLS & FORMULAS

- Currently, there are **118** elements
- Elements have a 1 or two letter symbol, and compounds have a **formula**.
- An element's first letter always capitalized; if there is a second letter, it is written lowercase: B, Ba, C, Ca, H, He

REVIEW QUESTIONS

- Page 52 #s 20 – 27.

SECTION 6.1

ORGANIZING THE ELEMENTS

- A few elements, such as gold and copper, have been known for *thousands of years* - since ancient times.
- Yet, only about 13 had been identified by the year 1700.
- As more were discovered, chemists realized they needed a way to organize the elements.

ORGANIZING THE ELEMENTS

- Chemists used the *properties* of elements to sort them into groups.
- In 1829 J. W. Dobereiner arranged elements into triads – groups of three elements with similar properties
 - One element in each triad had *properties* intermediate of the other two elements

MENDELEEV'S PERIODIC TABLE

- By the mid-1800s, about 70 elements were known to exist
- Dmitri Mendeleev – a Russian chemist and teacher
- Arranged elements in order of increasing atomic mass
- Thus, the first “Periodic Table” (page 156)

A BETTER ARRANGEMENT

- In 1913, Henry Moseley – British physicist, arranged elements according to increasing atomic number
- The arrangement used today.

Alkaline earth metals												Halogens					Noble gases
1 1A	2 2A											13 3A	14 4A	15 5A	16 6A	17 7A	18 8A
1 H	2 He											5 B	6 C	7 N	8 O	9 F	10 Ne
3 Li	4 Be	3	4	5	6	7	8	9	10	11	12	13 Al	14 Si	15 P	16 S	17 Cl	18 Ar
Alkali metals		Transition metals															
11 Na	12 Mg	21 Sc	22 Ti	23 V	24 Cr	25 Mn	26 Fe	27 Co	28 Ni	29 Cu	30 Zn	31 Ga	32 Ge	33 As	34 Se	35 Br	36 Kr
19 K	20 Ca	39 Y	40 Zr	41 Nb	42 Mo	43 Tc	44 Ru	45 Rh	46 Pd	47 Ag	48 Cd	49 In	50 Sn	51 Sb	52 Te	53 I	54 Xe
37 Rb	38 Sr	57 La*	72 Hf	73 Ta	74 W	75 Re	76 Os	77 Ir	78 Pt	79 Au	80 Hg	81 Tl	82 Pb	83 Bi	84 Po	85 At	86 Rn
55 Cs	56 Ba	89 Act†	104 Unq	105 Unp	106 Unh	107 Uns	108 Uno	109 Une	110 Uun	111 Uuu							
87 Fr	88 Ra																
*Lanthanides		58 Ce	59 Pr	60 Nd	61 Pm	62 Sm	63 Eu	64 Gd	65 Tb	66 Dy	67 Ho	68 Er	69 Tm	70 Yb	71 Lu		
† Actinides		90 Th	91 Pa	92 U	93 Np	94 Pu	95 Am	96 Cm	97 Bk	98 Cf	99 Es	100 Fm	101 Md	102 No	103 Lr		

THE PERIODIC LAW SAYS:

- When elements are arranged in order of increasing atomic number, there is a *periodic repetition* of their physical and chemical properties.
- Horizontal rows = periods
 - There are 7 periods
- Vertical column = group (or family)
 - Similar physical & chemical prop.
 - Identified by number & letter (IA, IIA)

AREAS OF THE PERIODIC TABLE

- Three classes of elements are:
- 1) metals, 2) nonmetals, and 3) metalloids
 - 1) **Metals**: electrical conductors, have luster, ductile, malleable
 - 2) **Nonmetals**: generally brittle and non-lustrous, poor conductors of heat and electricity

AREAS OF THE PERIODIC TABLE

- Some nonmetals are gases (O, N, Cl); some are brittle solids (S); one is a fuming dark red liquid (Br)
- Notice the heavy, stair-step line?
- 3) Metalloids: border the line-2 sides
 - Properties are intermediate between metals and nonmetals

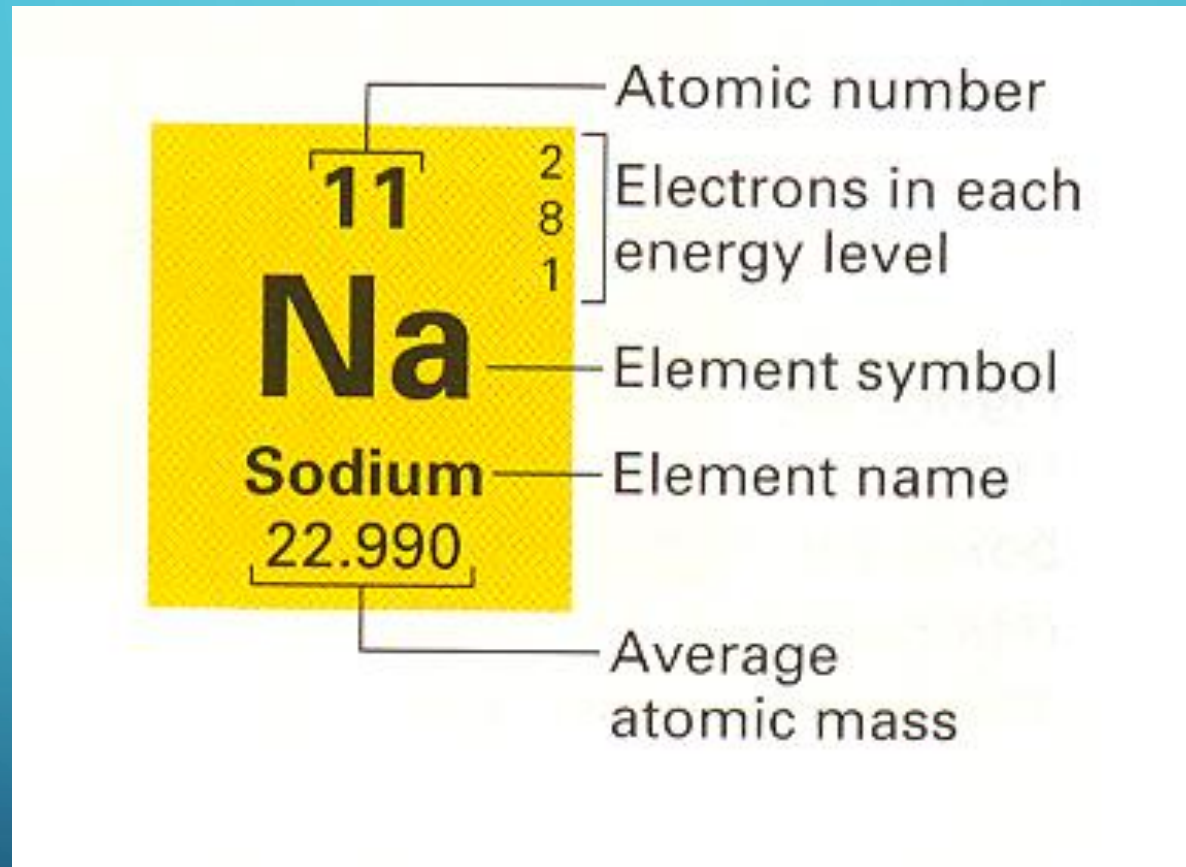
REVIEW QUESTIONS

- Page 160 #s 1 – 7.

SECTION 6.2 CLASSIFYING THE ELEMENTS

- The periodic table displays the symbols and names of the elements, along with information about the structure of their atoms:
 - Atomic number and atomic mass

PERIODIC TABLE IN THE BACK OF YOUR TEXTBOOK AND PAGE 162-163



GROUPS OF ELEMENTS - FAMILY NAMES

- Group 1A – alkali metals
 - Forms a “base” (or alkali) when reacting with water (not just dissolved!)
- Group 2A – alkaline earth metals
 - Also form bases with water; do not dissolve well, hence “earth metals”
- Group 7A – halogens
 - Means “salt-forming”

ELECTRON CONFIGURATIONS IN GROUPS

- Elements can be sorted into 4 different groupings based on their electron configurations:
 - 1) Noble gases
 - 2) Representative elements
 - 3) Transition metals
 - 4) Inner transition metals

CMLT2

Define and classify matter as elements, compounds, heterogeneous mixtures and solutions. Use the periodic law to identify and distinguish metals and non-metals, periods and groups, representative and transition elements, and families.

CMLT2 TEST REVIEW

Pages 58 – 60 #s 44 – 52.

Page 181 #s 24, 26 – 31.