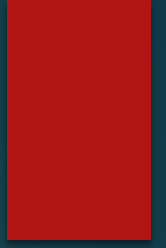


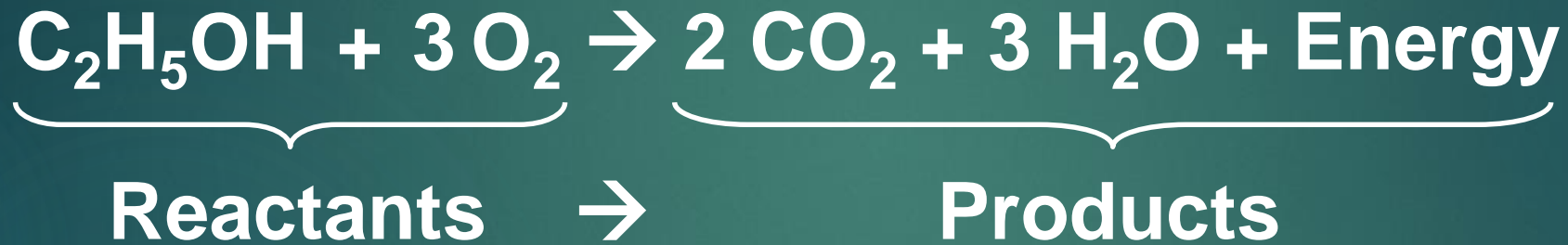
Introduction to Chemistry



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

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

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

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

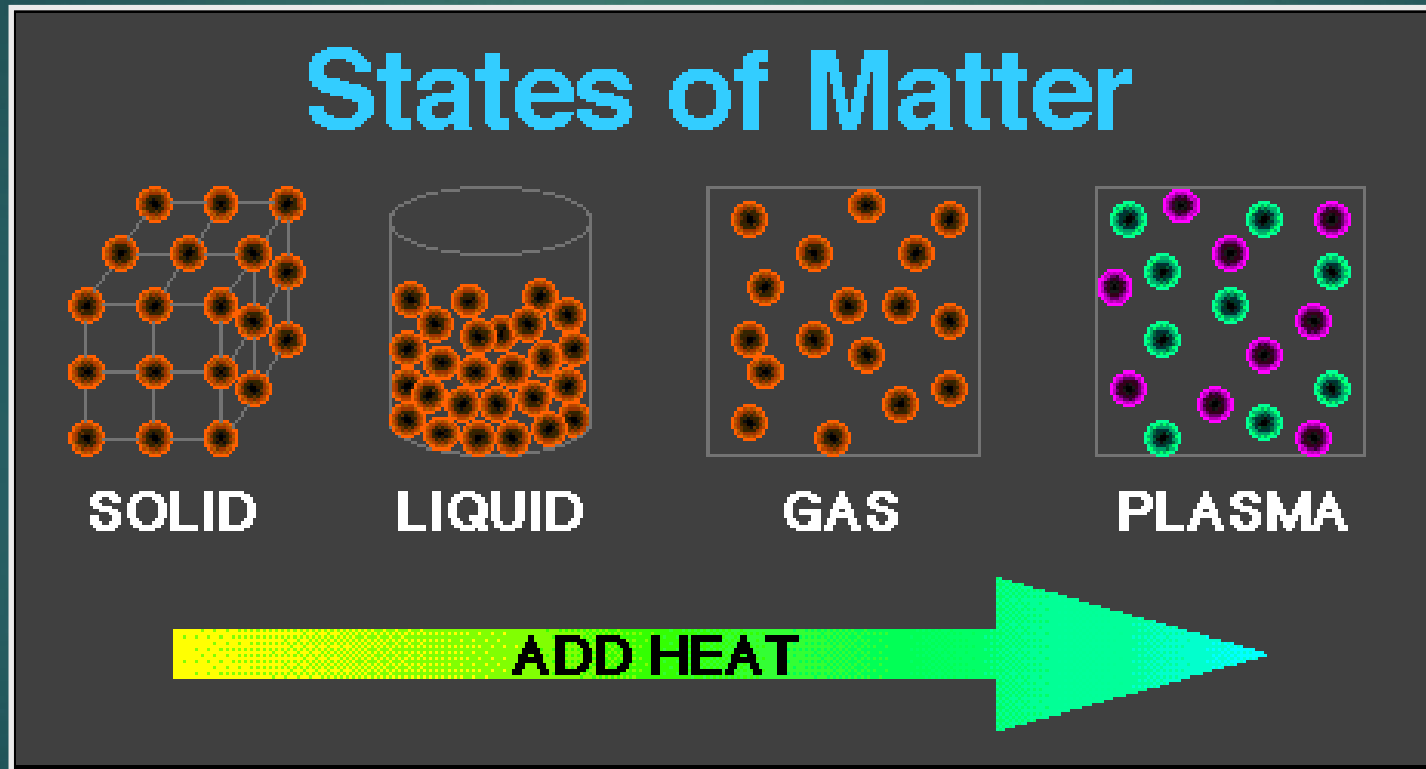
States of Matter

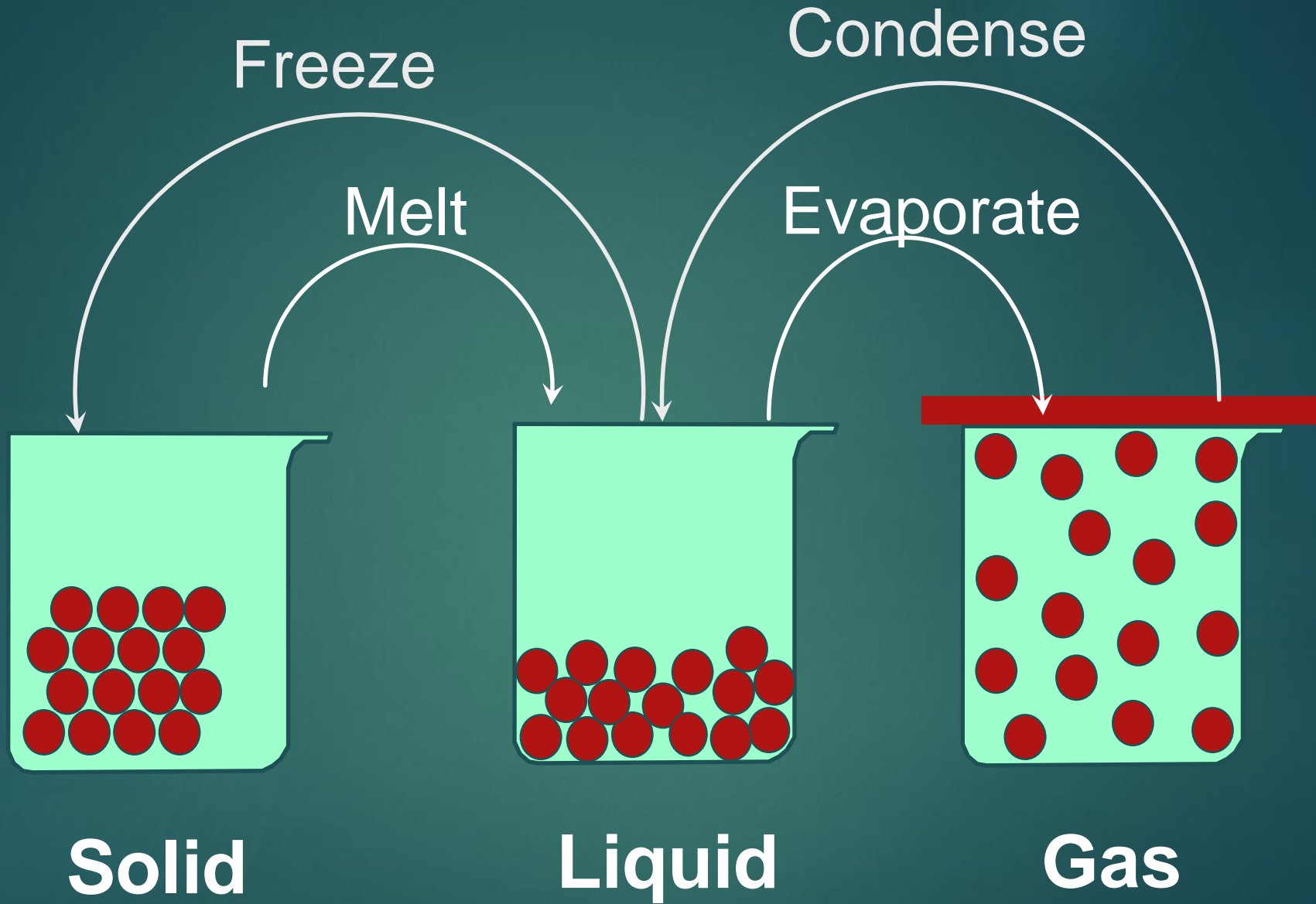
The simulation interface includes the following components:

- Atoms & Molecules:** A list of elements with checkboxes: Helium, Argon, Oxygen, Water, and Adjustable Attraction.
- Interaction Potential:** A graph showing Potential Energy on the y-axis and Distance Between Molecules on the x-axis.
- Phase Diagram:** A graph showing Pressure on the y-axis and Temperature on the x-axis, with regions for solid, liquid, and gas.

Navigation icons at the bottom include: States of Matter, Home, Play, Phase Changes, and PhET.

4th state: Plasma - formed at high temperatures; ionized phase of matter as found in the sun





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

Test Review Questions

- ▶ Page 42 #s 1 – 8.
- ▶ Page 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. 2.2: 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.

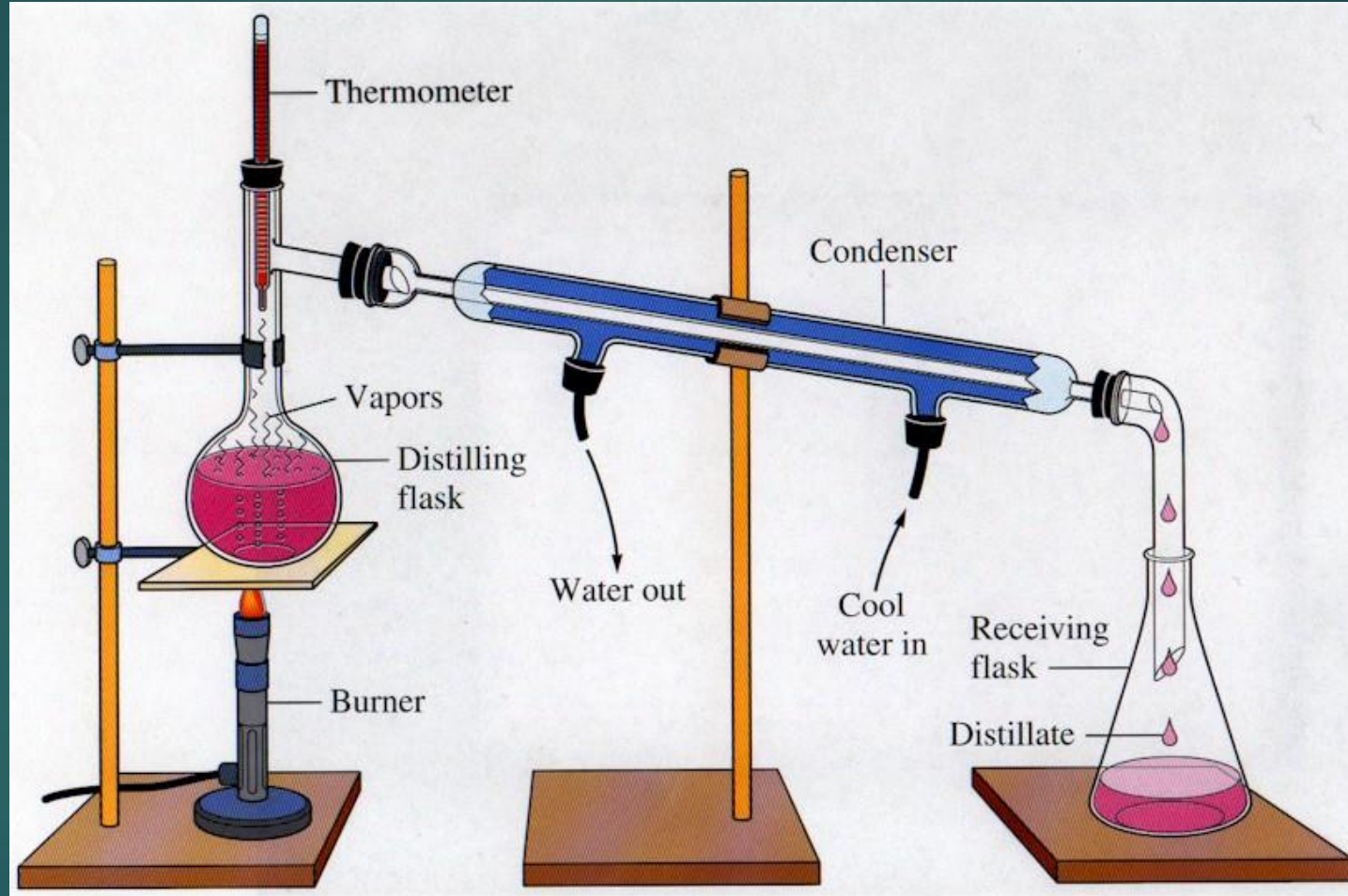
Solutions are homogeneous mixtures

- ▶ 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.

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

Review Questions

- ▶ Page 52 #s 20 – 27.

Organizing Elements: The Periodic Table



The Periodic Table: Crash Course Chemistry

CrashCourse

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.

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)

The Periodic Table of the Elements

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18					
1	1 H Hydrogen 1.00794	<div style="display: flex; justify-content: space-between;"> <div style="width: 15%;"> <p>Atomic #</p> <p>Symbol</p> <p>Name</p> <p>Atomic Mass</p> </div> <div style="width: 30%;"> <p>C Solid</p> <p>Hg Liquid</p> <p>H Gas</p> <p>Rf Unknown</p> </div> <div style="width: 30%;"> <p>Metals</p> <p>Alkali metals</p> <p>Alkaline earth metals</p> <p>Lanthanoids</p> <p>Actinoids</p> <p>Transition metals</p> <p>Poor metals</p> </div> <div style="width: 15%;"> <p>Nonmetals</p> <p>Other nonmetals</p> <p>Noble gases</p> </div> </div>																	2 He Helium 4.002602				
2	3 Li Lithium 6.941	4 Be Beryllium 9.012182																5 B Boron 10.811	6 C Carbon 12.0107	7 N Nitrogen 14.0067	8 O Oxygen 15.9994	9 F Fluorine 18.9984032	10 Ne Neon 20.1797
3	11 Na Sodium 22.98976928	12 Mg Magnesium 24.3050																13 Al Aluminum 26.9815386	14 Si Silicon 28.0855	15 P Phosphorus 30.973762	16 S Sulfur 32.065	17 Cl Chlorine 35.453	18 Ar Argon 39.948
4	19 K Potassium 39.0983	20 Ca Calcium 40.078	21 Sc Scandium 44.955912	22 Ti Titanium 47.867	23 V Vanadium 50.9415	24 Cr Chromium 51.9961	25 Mn Manganese 54.938045	26 Fe Iron 55.845	27 Co Cobalt 58.933195	28 Ni Nickel 58.6934	29 Cu Copper 63.546	30 Zn Zinc 65.38	31 Ga Gallium 69.723	32 Ge Germanium 72.64	33 As Arsenic 74.92160	34 Se Selenium 78.96	35 Br Bromine 79.904	36 Kr Krypton 83.796					
5	37 Rb Rubidium 85.4678	38 Sr Strontium 87.62	39 Y Yttrium 88.90585	40 Zr Zirconium 91.224	41 Nb Niobium 92.90638	42 Mo Molybdenum 95.94	43 Tc Technetium (97.9072)	44 Ru Ruthenium 101.07	45 Rh Rhodium 102.90550	46 Pd Palladium 106.42	47 Ag Silver 107.8682	48 Cd Cadmium 112.411	49 In Indium 114.818	50 Sn Tin 118.710	51 Sb Antimony 121.760	52 Te Tellurium 127.60	53 I Iodine 126.90447	54 Xe Xenon 131.290					
6	55 Cs Cesium 132.90545196	56 Ba Barium 137.327	57-71 Lanthanoids	72 Hf Hafnium 178.49	73 Ta Tantalum 180.94788	74 W Tungsten 183.84	75 Re Rhenium 186.207	76 Os Osmium 190.23	77 Ir Iridium 192.222	78 Pt Platinum 195.084	79 Au Gold 196.966569	80 Hg Mercury 200.59	81 Tl Thallium 204.3833	82 Pb Lead 207.2	83 Bi Bismuth 208.98040	84 Po Polonium (209.9824)	85 At Astatine (209.9871)	86 Rn Radon (222.0176)					
7	87 Fr Francium (223)	88 Ra Radium (226)	89-103 Actinoids	104 Rf Rutherfordium (261)	105 Db Dubnium (262)	106 Sg Seaborgium (266)	107 Bh Bohrium (264)	108 Hs Hassium (277)	109 Mt Meitnerium (268)	110 Ds Darmstadtium (271)	111 Rg Roentgenium (272)	112 Uub Ununbium (285)	113 Uut Ununtrium (284)	114 Uuq Ununquadium (289)	115 Uup Ununpentium (288)	116 Uuh Ununhexium (282)	117 Uus Ununseptium	118 Uuo Ununoctium (286)					

For elements with no stable isotopes, the mass number of the isotope with the longest half-life is in parentheses.

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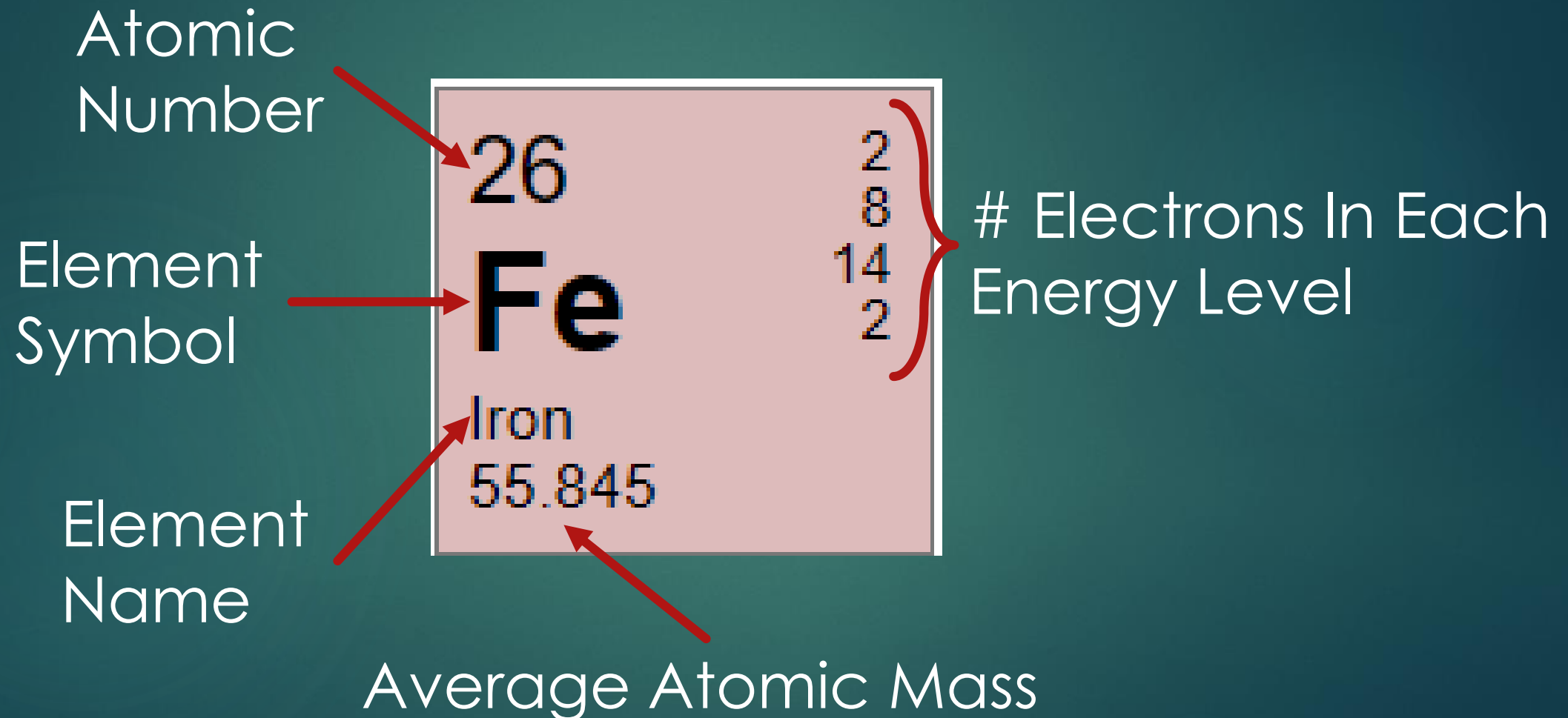
57 La Lanthanum 138.90547	58 Ce Cerium 140.116	59 Pr Praseodymium 140.90768	60 Nd Neodymium 144.242	61 Pm Promethium (145)	62 Sm Samarium 150.36	63 Eu Europium 151.964	64 Gd Gadolinium 157.25	65 Tb Terbium 158.92535	66 Dy Dysprosium 162.500	67 Ho Holmium 164.93032	68 Er Erbium 167.259	69 Tm Thulium 168.93421	70 Yb Ytterbium 173.054	71 Lu Lutetium 174.9668
89 Ac Actinium (227)	90 Th Thorium 232.03806	91 Pa Protactinium 231.03688	92 U Uranium 238.02891	93 Np Neptunium (237)	94 Pu Plutonium (244)	95 Am Americium (243)	96 Cm Curium (247)	97 Bk Berkelium (247)	98 Cf Californium (251)	99 Es Einsteinium (252)	100 Fm Fermium (257)	101 Md Mendelevium (258)	102 No Nobelium (259)	103 Lr Lawrencium (262)

Michael Dayah For a fully interactive experience, visit www.ptable.com. michael@dayah.com

Periodic Table

- ▶ 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

Our Periodic Table



Periodic Table: Element Information

- ▶ **Element Symbol**: First letter is always a capital letter. If there is a second letter it is lower case. Two letters maximum.
- ▶ **Atomic Number**: The number of *protons* in the nucleus; how the table is organized. The number of protons defines the element.

Periodic Table: Element Information

- ▶ **Average Atomic Mass**: The mass of the element taking into account its various **isotopes** (atoms of the same element but a different number of neutrons). The unit is the *atomic mass unit, amu*.
- ▶ 1 amu is defined as exactly one-12th (1/12) the mass of the Carbon-12 atom (6 protons and 6 neutrons).
- ▶ Rounded Atomic Mass – Atomic Number \approx # of Neutrons

The Periodic Law

- ▶ When elements are tabled in order of increasing atomic number, there is a periodic repetition of chemical and physical properties.
- ▶ **Groups**: The vertical columns; elements in the same column have similar chemical and physical properties (boiling points, luster, conductivity, reactivity, etc.).
- ▶ **Periods**: The horizontal rows. As you read left to right, elements get properties of non-metals.

The Periodic Table of the Elements

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18					
1	1 H Hydrogen 1.00794	<div style="display: flex; justify-content: space-between;"> <div style="width: 15%;"> <p>Atomic #</p> <p>Symbol</p> <p>Name</p> <p>Atomic Mass</p> </div> <div style="width: 30%;"> <p>C Solid</p> <p>Hg Liquid</p> <p>H Gas</p> <p>Rf Unknown</p> </div> <div style="width: 30%;"> <p>Metals</p> <p>Alkali metals</p> <p>Alkaline earth metals</p> <p>Lanthanoids</p> <p>Actinoids</p> <p>Transition metals</p> <p>Poor metals</p> </div> <div style="width: 15%;"> <p>Nonmetals</p> <p>Other nonmetals</p> <p>Noble gases</p> </div> </div>																	2 He Helium 4.002602				
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For elements with no stable isotopes, the mass number of the isotope with the longest half-life is in parentheses.

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Using the Periodic Table

- ▶ What element is atomic number 74?
- ▶ What is the symbol for the element with atomic number 82?
- ▶ What is the atomic mass of cesium (located in group 1)?
- ▶ How many electrons in the 3rd energy level of cadmium?
- ▶ What element has the most electrons in group 2?
- ▶ What element is located in period 4 group 11?
- ▶ How many protons in an atom of carbon?
- ▶ How many electrons in the highest energy level of group 1? 17? 18?

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

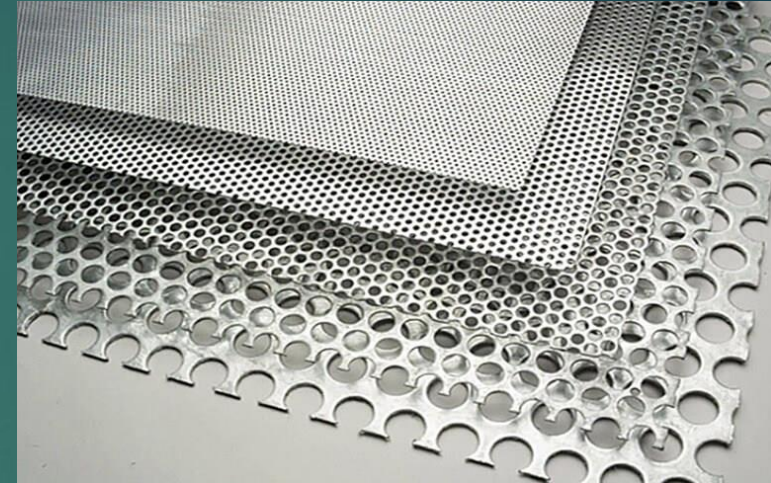
Metals, Nonmetals & Metalloids

- ▶ The periodic table classifies/divides elements into one of three groups: **metals**, **non-metals** and **metalloids**.
- ▶ Scanning across the periodic table (from left-to-right), the properties of elements becomes less metallic and more nonmetallic.

1																	2
H																	He
3	4											5	6	7	8	9	10
Li	Be											B	C	N	O	F	Ne
11	12											13	14	15	16	17	18
Na	Mg											Al	Si	P	S	Cl	Ar
19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36
K	Ca	Sc	Ti	V	Cr	Mn	Fe	Co	Ni	Cu	Zn	Ga	Ge	As	Se	Br	Kr
37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54
Rb	Sr	Y	Zr	Nb	Mo	Tc	Ru	Rh	Pd	Ag	Cd	In	Sn	Sb	Te	I	Xe
55	56	57-71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86
Cs	Ba		Hf	Ta	W	Re	Os	Ir	Pt	Au	Hg	Tl	Pb	Bi	Po	At	Rn
87	88	89-103	104	105	106	107	108	109	110	111	112	113	114	115	116	117	118
Fr	Ra		Rf	Db	Sg	Bh	Hs	Mt	Ds	Rg	Cn	Uut	Fl	Uup	Lv	Uus	Uuo
57	58	59	60	61	62	63	64	65	66	67	68	69	70	71			
La	Ce	Pr	Nd	Pm	Sm	Eu	Gd	Tb	Dy	Ho	Er	Tm	Yb	Lu			
89	90	91	92	93	94	95	96	97	98	99	100	101	102	103			
Ac	Th	Pa	U	Np	Pu	Am	Cm	Bk	Cf	Es	Fm	Md	No	Lr			

Physical Properties of Metals

- ▶ Most elements are metals.
- ▶ Good conductors of heat and electricity.
- ▶ High luster and sheen; shiny.
- ▶ Malleable – hammered into thin sheets.
- ▶ Ductile – drawn into wires.
- ▶ Solids at room temperature (except for mercury).



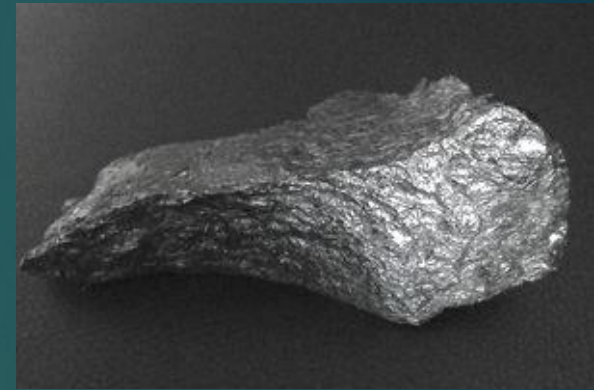
Physical Properties of Nonmetals

- ▶ State at room temperature varies as many are gases but some are liquids and a few are solids.
- ▶ Properties opposite of metals.
- ▶ Not good conductors of electricity and heat (carbon is an exception to this)
- ▶ Not shiny, so they are dull.
- ▶ Not malleable.
- ▶ Not ductile.



Physical Properties of Metalloids

- ▶ There is a heavy staircase, bolded line that separates metals and nonmetals.
- ▶ The metals that border the line are the metalloids.
- ▶ Metalloids tend to have some properties of metals and nonmetals; this depends on the conditions the element is under.
- ▶ For example, silicon is a poor conductor of electric current, but mix in a small amount of boron and the mixture is a good conductor of electricity (used in electronics).



Groups on the Periodic Table

- ▶ Many groups on the periodic table are given a unique name, based on the properties of the elements in that group.

The image shows a standard periodic table with various groups highlighted in different colors. A legend in the top left identifies these groups: Alkali metals (yellow), Alkaline earth metals (orange), Lanthanides (purple), Actinides (red), Transition metals (green), Post-transition metals (grey), Metalloids (pink), Other nonmetals (light blue), Halogens (cyan), and Noble gases (dark blue). A callout box for Sodium (Na) shows its atomic number (11), symbol (Na), name (Sodium), and atomic weight (22.990). The table includes element symbols, names, and atomic weights for all elements from Hydrogen (1) to Oganesson (118), plus the Lanthanide and Actinide series at the bottom.

Group	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
Label	1A	2A	3A	4A	5A	6A	7A	8A	9A	10A	11A	12A	13A	14A	15A	16A	17A	8A
1	H Hydrogen 1.0079																	He Helium 4.0026
2	Li Lithium 6.938	Be Beryllium 9.0122																Ne Neon 20.180
3	Na Sodium 22.990	Mg Magnesium 24.305																Ar Argon 39.948
4	K Potassium 39.098	Ca Calcium 40.078	Sc Scandium 44.956	Ti Titanium 47.867	V Vanadium 50.942	Cr Chromium 51.996	Mn Manganese 54.938	Fe Iron 55.845	Co Cobalt 58.933	Ni Nickel 58.693	Cu Copper 63.546	Zn Zinc 65.38	Ga Gallium 69.723	Ge Germanium 72.63	As Arsenic 74.922	Se Selenium 78.96	Br Bromine 79.904	Kr Krypton 83.798
5	Rb Rubidium 85.468	Sr Strontium 87.62	Y Yttrium 88.906	Zr Zirconium 91.224	Nb Niobium 92.906	Mo Molybdenum 95.96	Tc Technetium 98.9062	Ru Ruthenium 101.07	Rh Rhodium 102.91	Pd Palladium 106.42	Ag Silver 107.87	Cd Cadmium 112.41	In Indium 114.82	Sn Tin 118.71	Sb Antimony 121.76	Te Tellurium 127.60	I Iodine 126.90	Xe Xenon 131.29
6	Cs Cesium 132.91	Ba Barium 137.33		Hf Hafnium 178.49	Ta Tantalum 180.95	W Tungsten 183.84	Re Rhenium 186.21	Os Osmium 190.23	Ir Iridium 192.22	Pt Platinum 195.08	Au Gold 196.97	Hg Mercury 200.59	Tl Thallium 204.38	Pb Lead 207.2	Bi Bismuth 208.98	Po Polonium (209)	At Astatine (210)	Rn Radon (222)
7	Fr Francium (223)	Ra Radium (226)		Rf Rutherfordium (261)	Db Dubnium (262)	Sg Seaborgium (266)	Bh Bohrium (264)	Hs Hassium (269)	Mt Meitnerium (268)	Ds Darmstadtium (268)	Rg Roentgenium (268)	Cn Copernicium (284)	Uut Ununtrium (288)	Fl Flerovium (288)	Uup Ununpentium (288)	Lv Livermorium (288)	Uus Ununseptium (288)	Uuo Ununoctium (288)
Lanthanides	La Lanthanum 138.91	Ce Cerium 140.12	Pr Praseodymium 140.91	Nd Neodymium 144.24	Pm Promethium 144.91	Sm Samarium 150.36	Eu Europium 151.96	Gd Gadolinium 157.25	Tb Terbium 158.93	Dy Dysprosium 162.50	Ho Holmium 164.93	Er Erbium 167.26	Tm Thulium 168.93	Yb Ytterbium 173.04	Lu Lutetium 174.97			
Actinides	Ac Actinium (227)	Th Thorium 232.04	Pa Protactinium 231.04	U Uranium 238.03	Np Neptunium 237.04	Pu Plutonium 244.04	Am Americium (243)	Cm Curium (247)	Bk Berkelium (247)	Cf Californium (251)	Es Einsteinium (252)	Fm Fermium (257)	Md Mendelevium (258)	No Nobelium (259)	Lr Lawrencium (260)			

Periodic Table: Group Names

Periodic Table of the Elements

Group	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
	1A	2A	3B	4B	5B	6B	7B	8B	8B	10	11B	12B	3A	4A	5A	6A	7A	8A
1	1 H Hydrogen 1.0078																	2 He Helium 4.0026
2	3 Li Lithium 6.938	4 Be Beryllium 9.0122											5 B Boron 10.806	6 C Carbon 12.009	7 N Nitrogen 14.006	8 O Oxygen 15.999	9 F Fluorine 18.998	10 Ne Neon 20.180
3	11 Na Sodium 22.990	12 Mg Magnesium 24.305											13 Al Aluminum 26.982	14 Si Silicon 28.084	15 P Phosphorus 30.974	16 S Sulfur 32.059	17 Cl Chlorine 35.446	18 Ar Argon 39.948
4	19 K Potassium 39.098	20 Ca Calcium 40.078	21 Sc Scandium 44.956	22 Ti Titanium 47.867	23 V Vanadium 50.942	24 Cr Chromium 51.996	25 Mn Manganese 54.938	26 Fe Iron 55.845	27 Co Cobalt 58.933	28 Ni Nickel 58.693	29 Cu Copper 63.546	30 Zn Zinc 65.38	31 Ga Gallium 69.723	32 Ge Germanium 72.63	33 As Arsenic 74.922	34 Se Selenium 78.96	35 Br Bromine 79.904	36 Kr Krypton 83.798
5	37 Rb Rubidium 85.468	38 Sr Strontium 87.62	39 Y Yttrium 88.906	40 Zr Zirconium 91.224	41 Nb Niobium 92.906	42 Mo Molybdenum 95.96	43 Tc Technetium 98.9062	44 Ru Ruthenium 101.07	45 Rh Rhodium 102.91	46 Pd Palladium 106.42	47 Ag Silver 107.87	48 Cd Cadmium 112.41	49 In Indium 114.82	50 Sn Tin 118.71	51 Sb Antimony 121.76	52 Te Tellurium 127.60	53 I Iodine 126.90	54 Xe Xenon 131.29
6	55 Cs Cesium 132.91	56 Ba Barium 137.33		72 Hf Hafnium 178.49	73 Ta Tantalum 180.95	74 W Tungsten 183.84	75 Re Rhenium 186.21	76 Os Osmium 190.23	77 Ir Iridium 192.22	78 Pt Platinum 195.08	79 Au Gold 196.97	80 Hg Mercury 200.59	81 Tl Thallium 204.38	82 Pb Lead 207.2	83 Bi Bismuth 208.98	84 Po Polonium (209)	85 At Astatine (210)	86 Rn Radon (222)
7	87 Fr Francium (223)	88 Ra Radium (226)		104 Rf Rutherfordium (261)	105 Db Dubnium (262)	106 Sg Seaborgium (266)	107 Bh Bohrium (264)	108 Hs Hassium (269)	109 Mt Meitnerium (268)	110 Ds Darmstadtium (268)	111 Rg Roentgenium (268)	112 Cn Copernicium (268)	113 Uut Ununtrium (268)	114 Fl Flerovium (268)	115 Uup Ununpentium (268)	116 Lv Livermorium (268)	117 Uus Ununseptium (268)	118 Uuo Ununoctium (268)
			Lanthanides															
			57 La Lanthanum 138.91	58 Ce Cerium 140.12	59 Pr Praseodymium 140.91	60 Nd Neodymium 144.24	61 Pm Promethium (145)	62 Sm Samarium 150.36	63 Eu Europium 151.96	64 Gd Gadolinium 157.25	65 Tb Terbium 158.93	66 Dy Dysprosium 162.50	67 Ho Holmium 164.93	68 Er Erbium 167.26	69 Tm Thulium 168.93	70 Yb Ytterbium 173.04	71 Lu Lutetium 174.97	
			Actinides															
			89 Ac Actinium (227)	90 Th Thorium 232.04	91 Pa Protactinium 231.04	92 U Uranium 238.03	93 Np Neptunium (237)	94 Pu Plutonium (244)	95 Am Americium (243)	96 Cm Curium (247)	97 Bk Berkelium (247)	98 Cf Californium (251)	99 Es Einsteinium (252)	100 Fm Fermium (257)	101 Md Mendelevium (258)	102 No Nobelium (259)	103 Lr Lawrencium (262)	

Group 1: Alkali Metals

- ▶ All shiny, soft, and silvery metals.
- ▶ Very violently reactive with water, releasing H₂ gas – which also burns!
- ▶ Forms basic compounds with water (baking soda, soaps are bases)
- ▶ Form compounds that are mostly white solids and those compounds are very soluble in water (table salt – NaCl).
- ▶ Francium is so large an atom it has weakest hold on its valence e⁻, so its very reactive.

3 Li Lithium 6.938
11 Na Sodium 22.990
19 K Potassium 39.098
37 Rb Rubidium 85.468
55 Cs Cesium 132.91
87 Fr Francium (223)



Reactivity Increases

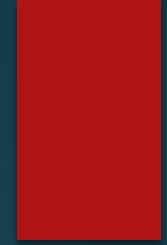
Group 2: Alkaline Earth Metals

- ▶ Also shiny, soft, silvery metals.
- ▶ Reactive with water.
- ▶ Forms solids, most of which won't dissolve in water.

4	Be Beryllium 9.0122
12	Mg Magnesium 24.305
20	Ca Calcium 40.078
38	Sr Strontium 87.62
56	Ba Barium 137.33
88	Ra Radium (226)



Reactivity Increases



Groups 3 – 12: Transition Metals

21 Sc Scandium 44.956	22 Ti Titanium 47.867	23 V Vanadium 50.942	24 Cr Chromium 51.996	25 Mn Manganese 54.938	26 Fe Iron 55.845	27 Co Cobalt 58.933	28 Ni Nickel 58.693	29 Cu Copper 63.546	30 Zn Zinc 65.38
39 Y Yttrium 88.906	40 Zr Zirconium 91.224	41 Nb Niobium 92.906	42 Mo Molybdenum 95.96	43 Tc Technetium 98.9062	44 Ru Ruthenium 101.07	45 Rh Rhodium 102.91	46 Pd Palladium 106.42	47 Ag Silver 107.87	48 Cd Cadmium 112.41
	72 Hf Hafnium 178.49	73 Ta Tantalum 180.95	74 W Tungsten 183.84	75 Re Rhenium 186.21	76 Os Osmium 190.23	77 Ir Iridium 192.22	78 Pt Platinum 195.08	79 Au Gold 196.97	80 Hg Mercury 200.59
	104 Rf Rutherfordium (261)	105 Db Dubnium (262)	106 Sg Seaborgium (266)	107 Bh Bohrium (264)	108 Hs Hassium (269)	109 Mt Meitnerium (268)	110 Ds Darmstadtium (268)	111 Rg Roentgenium (268)	112 Cn Copernicium (268)

- ▶ Contains many of our common, every day metals like iron, copper, tungsten, platinum, gold, silver, mercury, etc.
- ▶ These elements *transition* towards having properties less metallic.

Group 17: The Halogens

- ▶ Nonmetallic elements.
- ▶ Poisonous
- ▶ React easily with group 1, alkali metals, forming “salts”.
 - ▶ Which is what the word “*halogen*” comes from – meaning salt forming.

9	F	Fluorine	18.998
17	Cl	Chlorine	35.446
35	Br	Bromine	79.904
53	I	Iodine	126.90
85	At	Astatine	(210)

Reactivity Decreases

Group 18: The Noble Gases

- ▶ They are all inert, or non-reactive.
- ▶ Their atoms contain just the right amount of electrons so they do not want to lose, gain or share them.
 - ▶ Chemical reactions happen by atoms gaining, losing, or sharing electrons.
 - ▶ They have 8 valence electrons (in the highest energy level). Which is the goal of all atoms in chemical reactions.

2 He Helium 4.0026
10 Ne Neon 20.180
18 Ar Argon 39.948
36 Kr Krypton 83.798
54 Xe Xenon 131.29
86 Rn Radon (222)



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.

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