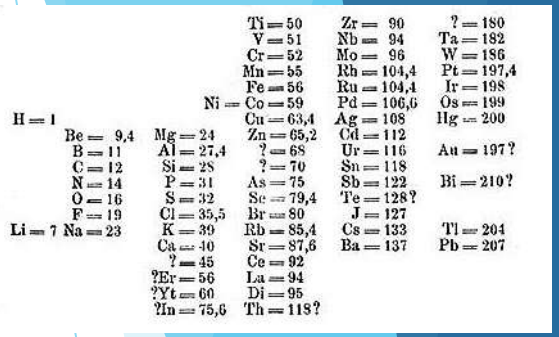
# Physical Science Unit 5 Crash Course

Chapter 5 and 6

(The Periodic Table and Chemical Bonds)

# Chapter 5 – The Periodic Table

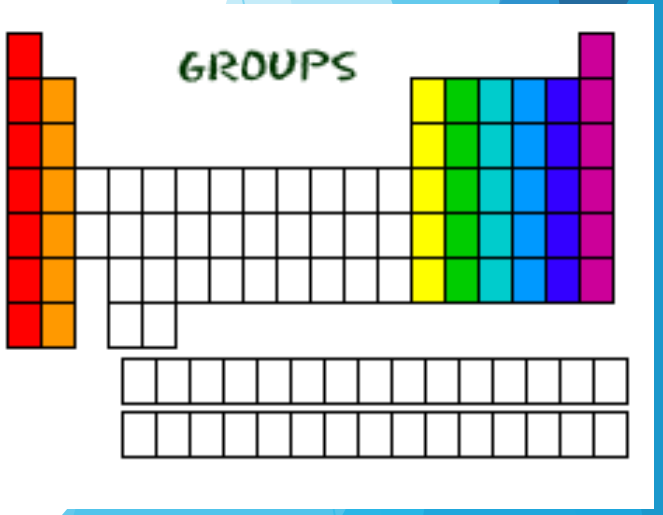


| | | | | | |
|---|---|---|---|---|---|
| | | | Ti = 50 | Zr = 90 | ? = 180 |
| | | | V = 51 | Nb = 94 | Ta = 182 |
| | | | Cr = 52 | Mo = 96 | W = 186 |
| | | | Mn = 55 | Rh = 104,4 | Pt = 197,4 |
| | | | Fe = 56 | Ru = 104,4 | Ir = 198 |
| | | Ni = | Co = 59 | Pd = 106,6 | Os = 199 |
| H = 1 | | | Cu = 63,4 | Ag = 108 | Hg = 200 |
| | Be = 9,4 | Mg = 24 | Zn = 65,2 | Cd = 112 | |
| | B = 11 | Al = 27,4 | ? = 68 | Ur = 116 | Au = 197? |
| | C = 12 | Si = 28 | ? = 70 | Sn = 118 | |
| | N = 14 | P = 31 | As = 75 | Sb = 122 | Bi = 210? |
| | O = 16 | S = 32 | Se = 79,4 | Te = 128? | |
| | F = 19 | Cl = 35,5 | Br = 80 | J = 127 | |
| Li = 7 | Na = 23 | K = 39 | Rb = 85,4 | Cs = 133 | Tl = 204 |
| | | Ca = 40 | Sr = 87,6 | Ba = 137 | Pb = 207 |
| | | ? = 45 | Ce = 92 | | |
| | | ?Er = 56 | La = 94 | | |
| | | ?Yt = 60 | Di = 95 | | |
| | | ?In = 75,6 | Th = 118? | | |

- A periodic table is an arrangement of elements in columns, based on a set of properties that repeat from row to row.
- Mendeleev arranged the elements into rows in order of increasing mass so that elements with similar properties were in the same column.
- He used the properties of elements located near the blank spaces in his table to predict properties for undiscovered elements.
- The close matches between Mendeleev's predictions and the actual properties of new elements showed how useful his periodic table could be.

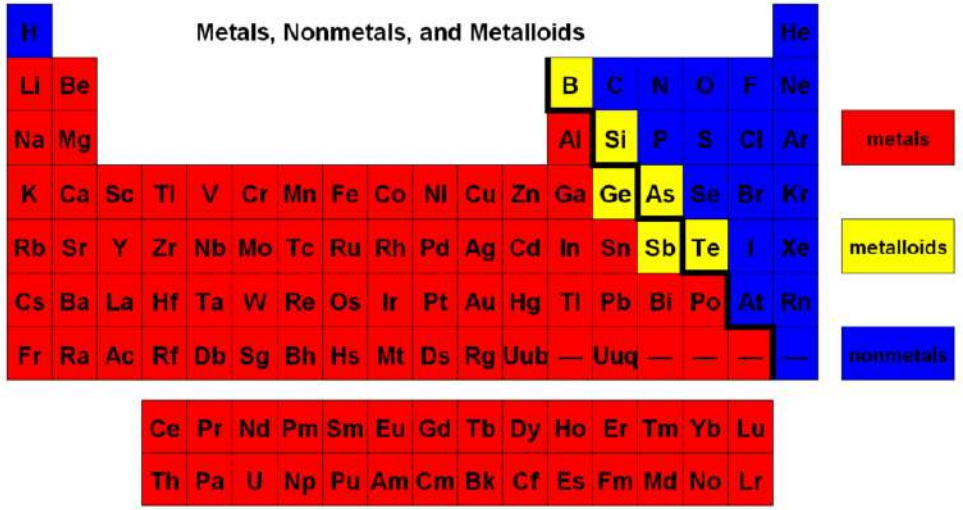
# Chapter 5 – The Periodic Table

- In the modern periodic table, elements are arranged by increasing atomic number (number of protons).
- Each row in the table of elements is a period.
- The number of elements per period varies because the maximum number of electrons increases from energy level to energy level.
- Each column on the periodic table is called a group.
- The elements within a group have similar properties.



# Chapter 5 – The Periodic Table

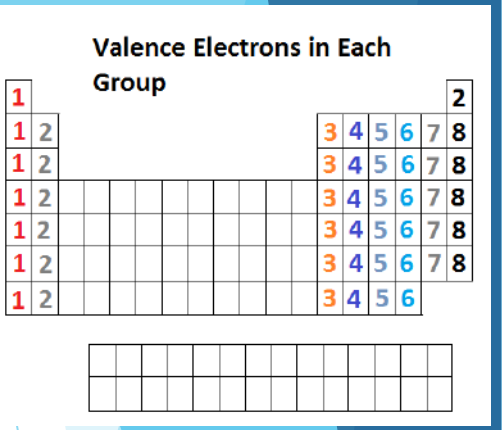
- The pattern of repeating properties across a period when the elements are arranged in order of increasing atomic number is called the periodic law.
- Atomic mass is a value that depends on the distribution of an element's isotopes in nature and the masses of those isotopes.
- Elements are classified as metals, nonmetals, and metalloids.



# Chapter 5 – The Periodic Table

- The majority of the elements on the periodic table are classified as metals.
- Metals are elements that are shiny, good conductors of electric current and heat, solid at room temperature (except mercury), malleable, and ductile (they can be drawn into wires).
- Nonmetals are elements that are poor conductors of heat and electric current, have low boiling points, are brittle, and tend to be gases.

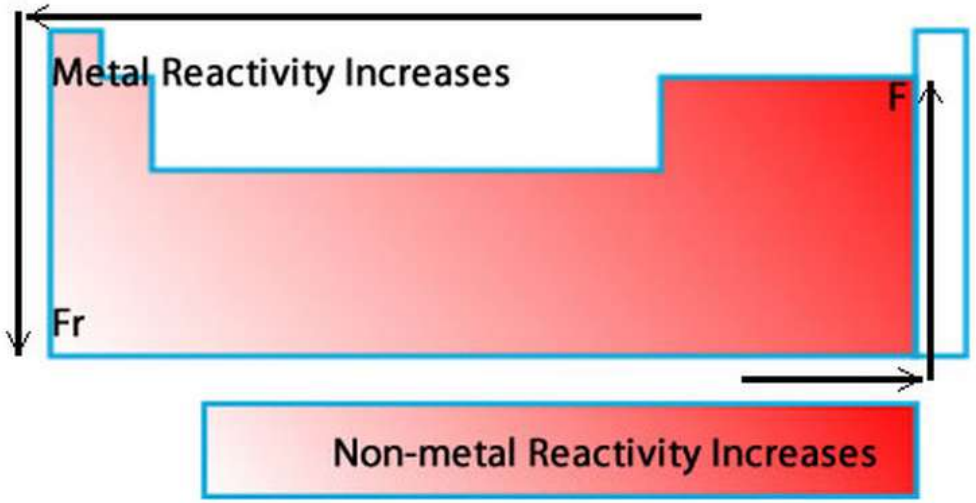
# Chapter 5 – The Periodic Table



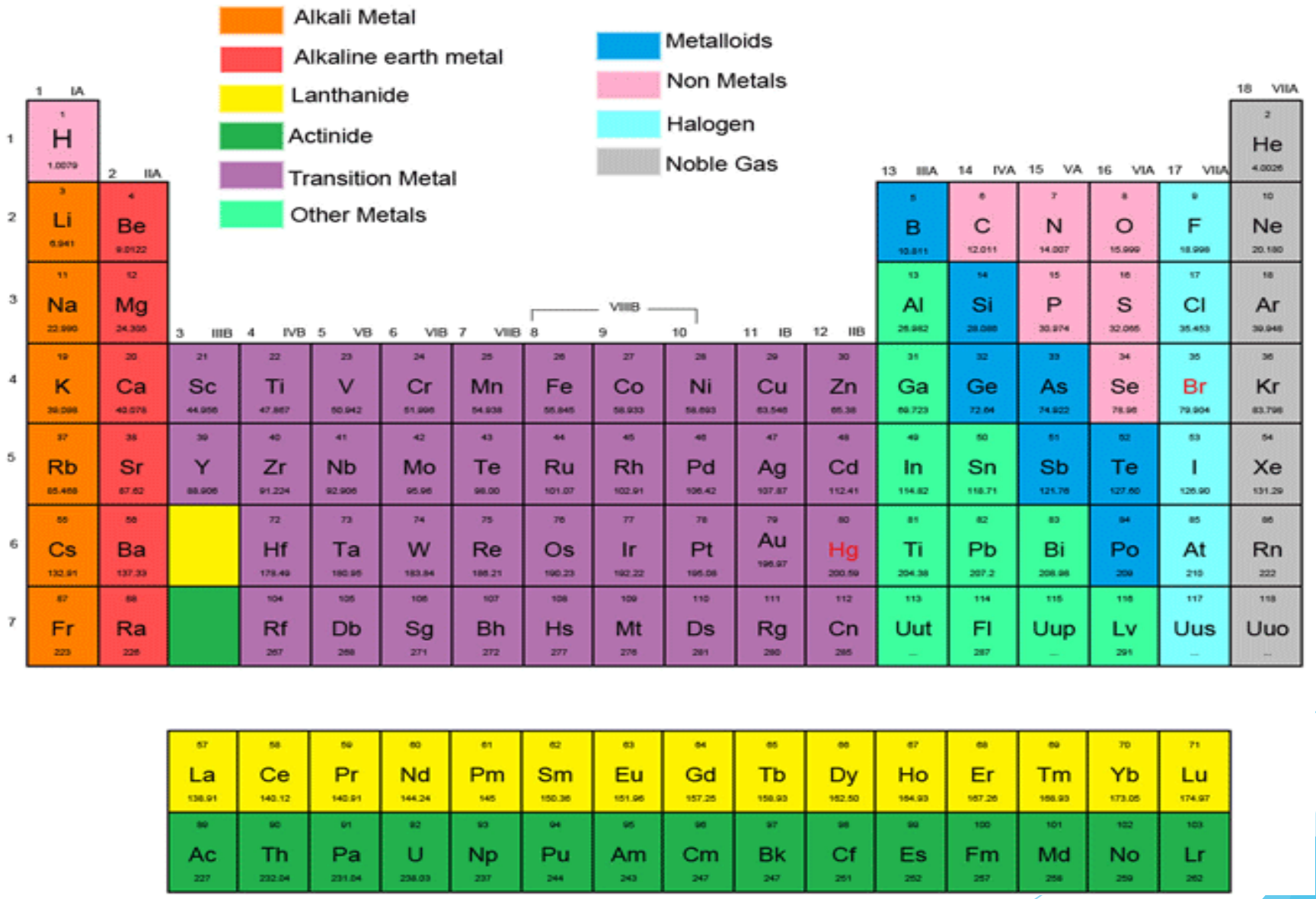

- Metalloids are elements with properties that fall between those of metals and nonmetals.
- Across a period from left to right, the elements become less metallic and more nonmetallic in their properties.
- A valence electron is an electron that is in the highest occupied energy level of an atom. These electrons play a key role in chemical reactions.
- Elements in a group have similar properties because they have the same number of valence electrons.

# Chapter 5 – The Periodic Table

- Reactivity increases to the left in a row across the metals and increases down in a group of the metals.
- Reactivity increases to the right in a row across the nonmetals (except the noble gases are unreactive) and decreases down a group in the nonmetals.

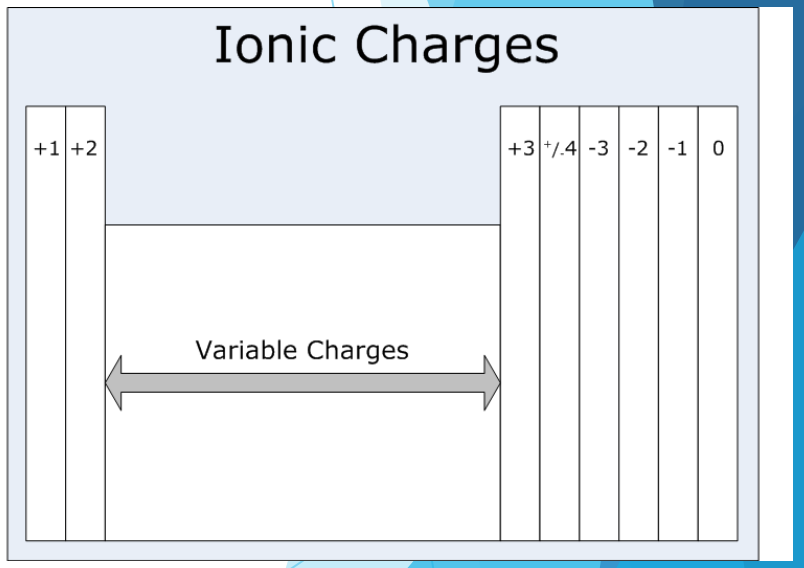


# Chapter 5 – The Periodic Table



# Chapter 6 – Chemical Bonding

- When the highest occupied energy level of an atom is filled with electrons, the atom is stable and not likely to react.
- The noble gases have stable electron configurations with eight valence electrons (or two in the case of helium).
- Some elements achieve stable electron configurations through the transfer of electrons between atoms.
- An atom that has a net positive or negative charge is called an ion.



# Chapter 6 – Chemical Bonding

- When an ionic bond is formed, electrons are transferred until each atom has a full outer energy level.
- Ionic compounds tend to have high melting points (above 300$^{o}$C).
- Ionic compounds are poor conductors in the solid state, but they can conduct heat or electricity when they are melted.
- Ionic compounds are brittle, so they shatter when struck by a hammer.
- The properties of ionic compounds can be explained by the strong attractions among ions within a crystal lattice.

# Chapter 6 – Chemical Bonding

- A covalent bond is a chemical bond in which two atoms share a pair of valence electrons.
- Many nonmetal elements exist as diatomic molecules. Diatomic means two atoms. They are $H_2$, $N_2$, $O_2$, $F_2$, $Cl_2$, $Br_2$, and $I_2$.

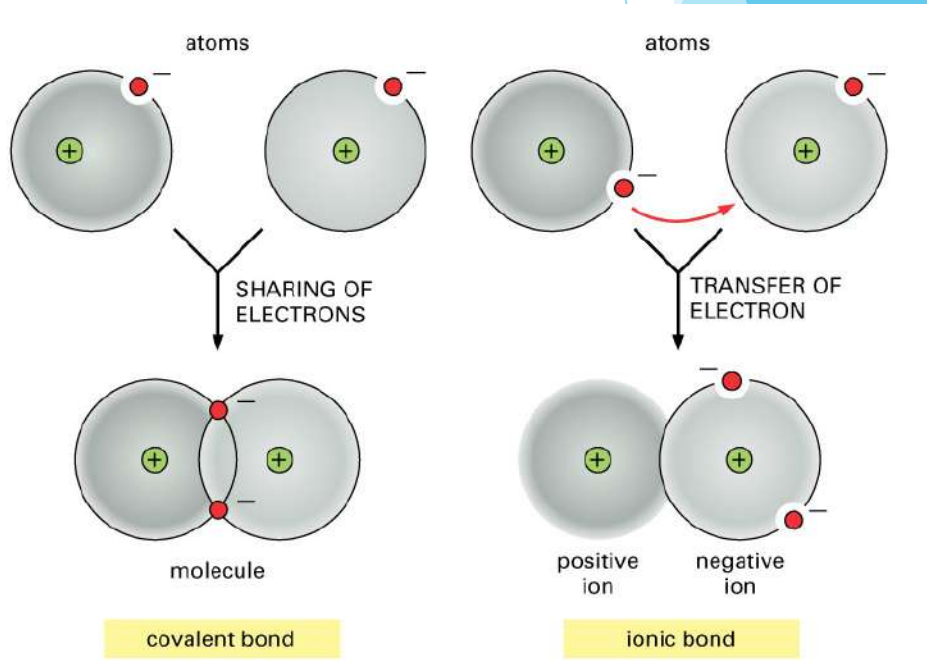
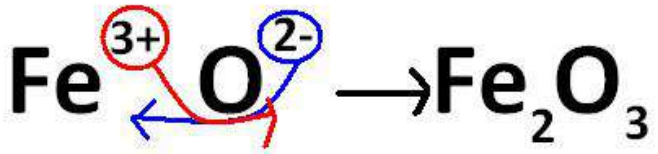



Figure 2.6 Essential Cell Biology, 2/e. (© 2004 Garland Science)

# Chapter 6 – Chemical Bonding

- When naming an ionic compound the name of the metal (cation) does not change and the name of the nonmetal (anion) has the suffix –ide.
- Ex. $MgBr_2$ = magnesium bromide
- To balance the charges in an ionic compound, you can cross the charges if they are not the same.



# Chapter 6 – Chemical Bonding

- Molecular compounds only contain nonmetals.
- The name of the first element is the same. The name of the second element ends in the suffix -ide.
- Prefixes tell the number of atoms of each element. A prefix is not used when the first element only has 1 atom.
- Ex. $CO_2$ = carbon dioxide

| | |
|---|---|
| 1 = mono | 6 = hexa |
| 2 = di | 7 = hepta |
| 3 = tri | 8 = octa |
| 4 = tetra | 9 = nona |
| 5 = penta | 10 = deca |

# Chapter 6 – Chemical Bonding

- Write the symbols for the elements in the order the elements appear in the name. The prefixes indicate the number of atoms of each element in this molecule.
- Ex: diphosphorus pentoxide = $P_2O_5$

# Chapter 6 – Chemical Bonding

- In a metal, valence electrons are free to move among the atoms, so the cations are surrounded by a sea of electrons.
- The more valence electrons an atom can contribute to the shared pool, the stronger the metallic bond will be.
- The mobility of electrons within a metal lattice explains the fact that metals are good conductors and malleable.
- An alloy is a mixture of two or more elements that have metallic properties.