Chapter 7

Properties of Atoms and the Periodic Table

Chapter 7

Section1: Structure of the Atom

You will learn how to…..

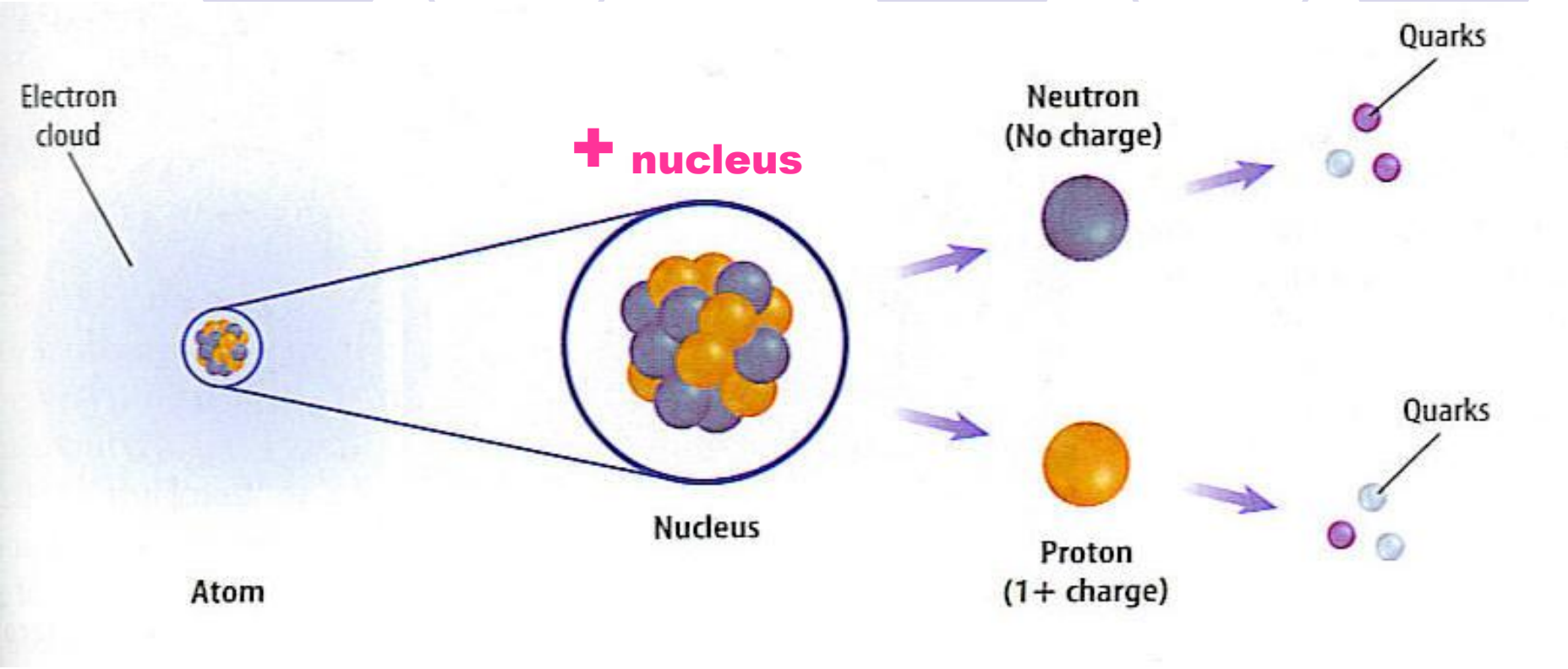
- Compute the atomic mass and mass number of an atom
- Identify isotopes of common elements
- Interpret the average atomic mass of an element

This is important because everything you see, touch, and breathe is composed of tiny atoms.

Scientific Shorthand

- Scientist use chemical symbols to represent each element on the periodic table.
- The chemical symbol consists of one capital letter or a capital letter plus one or two lower case letters

Atomic Components



The nucleus of the atom contains protons and neutrons. The proton has a positive charge and the neutron is neutral (no charge). The protons and neutrons are made up of smaller particles called quarks. The cloud of negatively charged electrons surrounds the nucleus of the atom.

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The changing atomic model

- Scientists use **models** to represent things that are difficult to visualize ---or picture in your mind.

Question: Could you give me 3 examples of models?

The changing atomic model

- RECALL…..**Matter** is anything that has mass and takes up space….

EVERYTHING is matter!

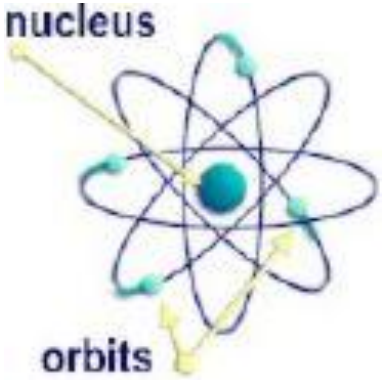
Matter is composed of atoms…..So EVERYTHING is composed of atoms!

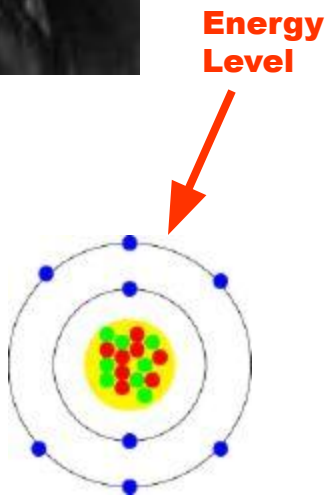
The changing atomic model

- **John Dalton (1800s)**
  - **Dalton's Atomic Theory**:
    - All matter is made up of tiny particles called atoms that cannot be split into smaller particles
    - Atoms cannot be created or destroyed
    - All atoms of the same element have the same properties, and the atoms of different elements have different properties
    - Atoms of different elements can combine to form new substances.

The changing atomic model

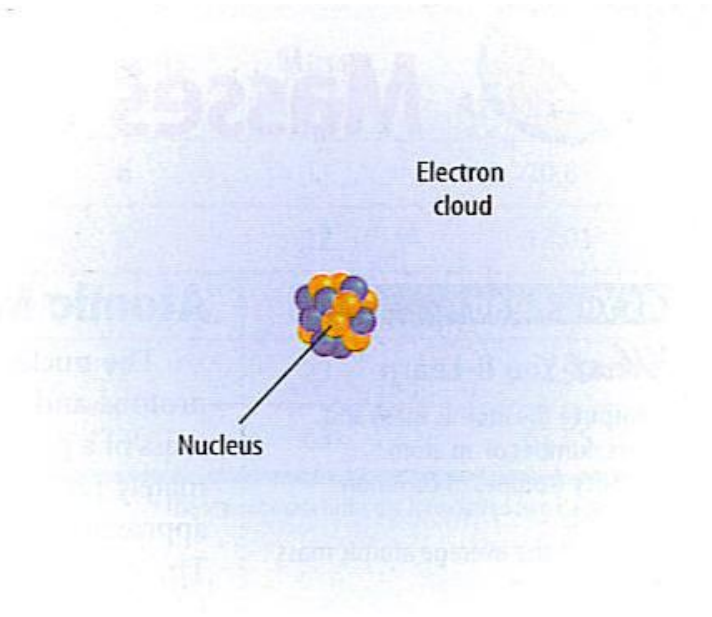
- **Niels Bohr (1913)**
  - Hypothesized that electrons traveled in **FIXED PATHS** around the atom's nucleus called **energy levels**.



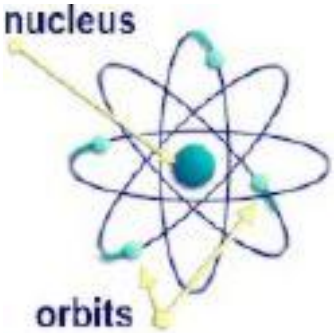


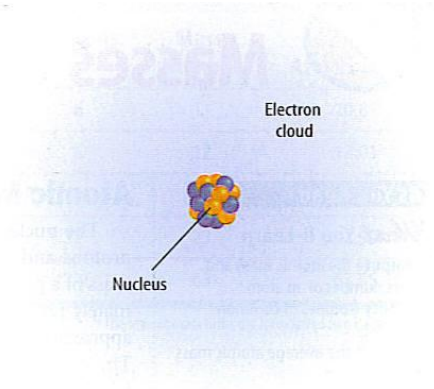
The changing atomic model

- **Erwin Schrodinger (1926)**
  - Electron Cloud Model
    - The accepted model of the atomic structure
    - Electrons DO NOT follow fixed orbits but occur more frequently in certain areas around the nucleus at any given time



The changing atomic model





Dalton → **Bohr** → **Schrodinger**

Chapter 18

Section 2: Masses of Atoms

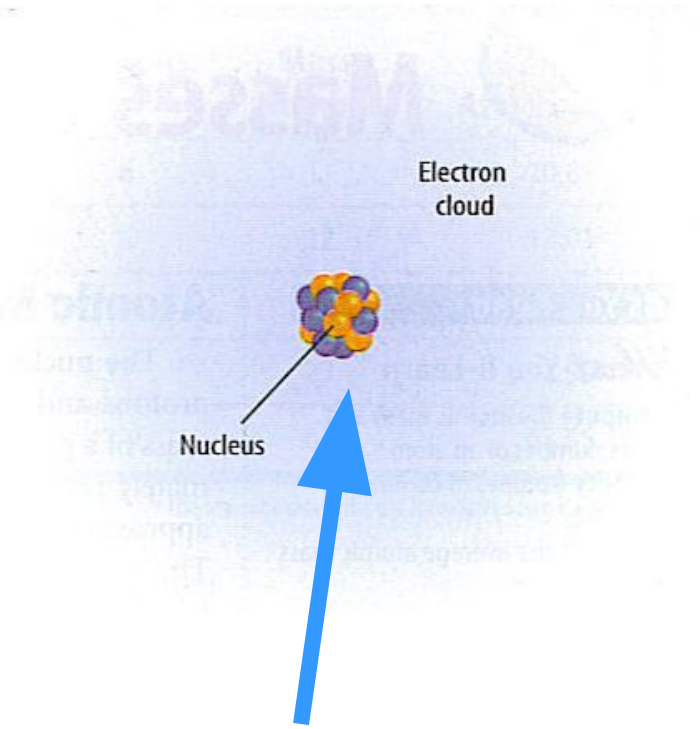
You will learn how to……..

- Compute the atomic mass and mass number of an atom.
- Identify isotopes of common elements
- Interpret the average atomic mass of an element

This is important because most elements exist in more than one form. Some are radioactive, and others are not.

Atomic Mass

- The nucleus contain most of the mass of the atom because protons and neutrons are more massive than electrons.

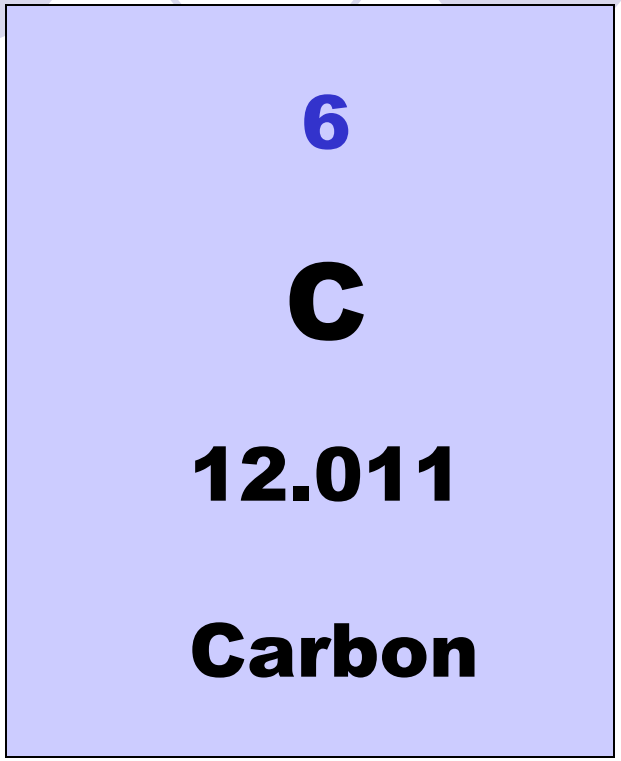


Nucleus

Atomic Mass Number = protons + neutrons

Atomic Mass Unit

- The mass of a proton or neutron is almost equal to 1 atomic mass unit (amu).
- The atomic mass unit is based on the mass of a CARBON atom.



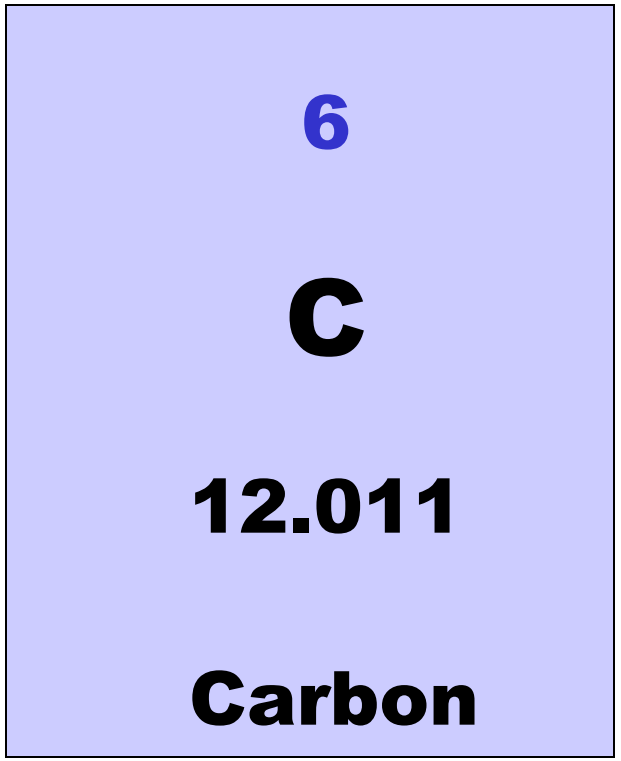
Atomic Mass Number = protons + neutrons

12 = 6 protons + 6 neutrons

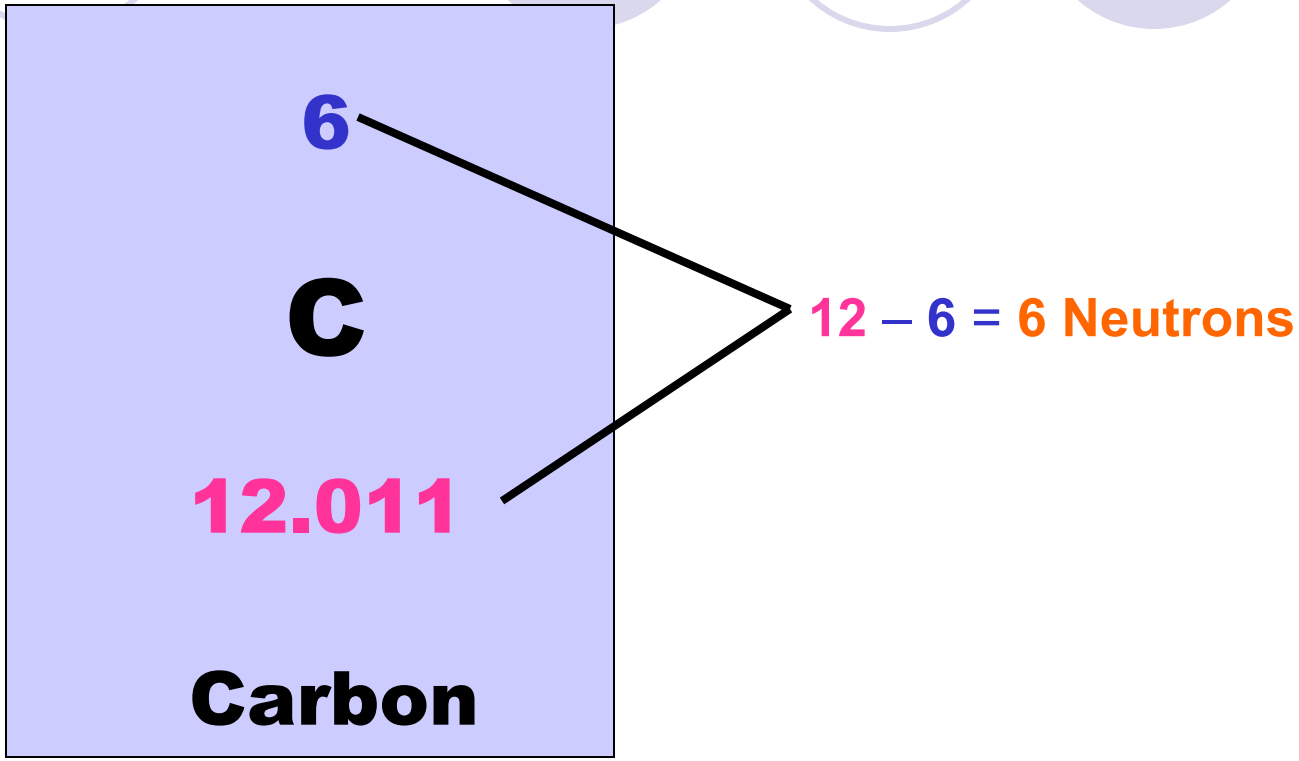
Protons Identify the Element

- The number of **protons** in an atom is equal to the **atomic number.**

The element CARBON has 6 protons because the atomic number is 6.



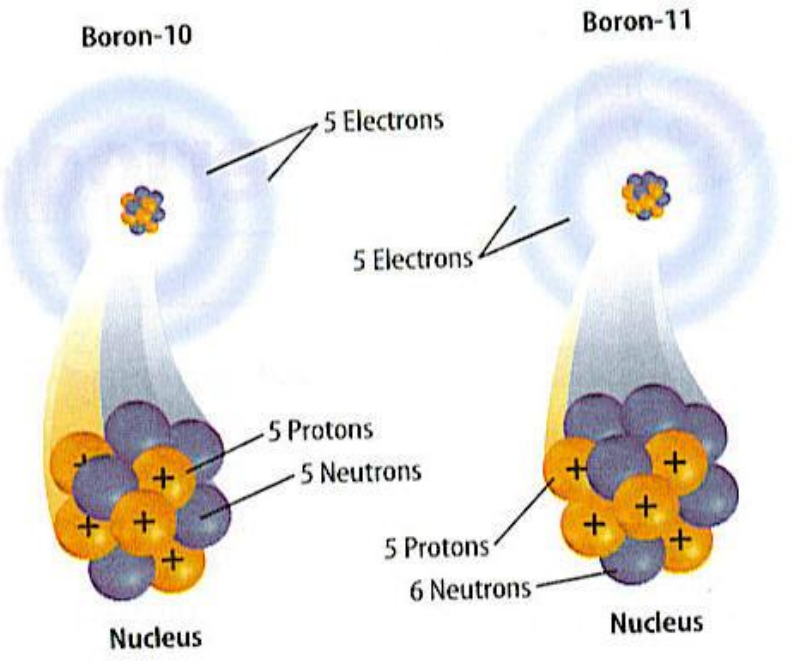
Calculating Neutrons



# of Neutrons = Atomic Mass Number – Atomic number

Isotopes

- **Isotopes**- atoms of the SAME element that have **DIFFERENT numbers of neutrons**



Element: Boron - 10

Atomic # : 5

# of Proton: 5

# of Electrons: 5

Atomic Mass: 10

# of Neutrons: 5

Element: Boron - 11

Atomic # : 5

# of Proton: 5

# of Electrons: 5

Atomic Mass: 11

# of Neutrons: 6

Chapter 18

Section 3: The Periodic Table

You will learn how to……

- Explain the composition of the periodic table.
- Use the periodic table to obtain information.
- Explain what the terms *metal, nonmetal*, and *metalloid* mean.

This is important because the periodic table is an organized list of the elements that compose all living and nonliving things that are known to exist in the universe.

The Periodic Table

- **Periodic** means "repeated in a pattern"
  - Ex. The calendar: the days repeat every 7 days, months repeat every 12 months

Dmitri Mendeleev (1834-1907)

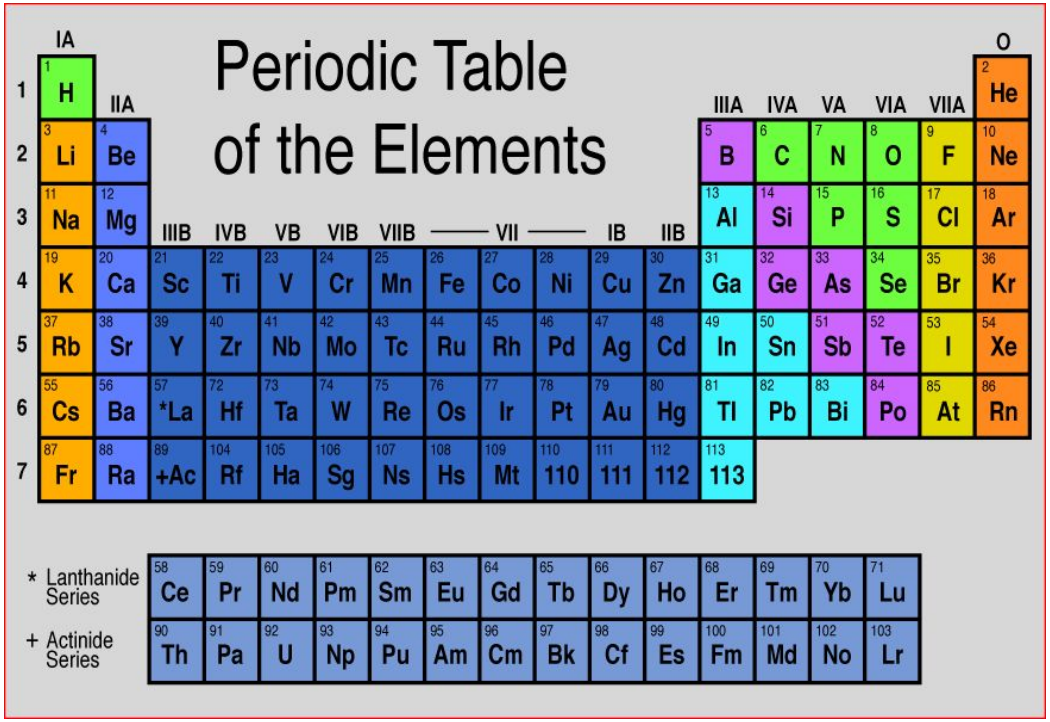
- constructed the **FIRST** periodic table
- he listed the elements in **columns** in order of **increasing atomic mass**
- he arranged the elements according to **similarities** in their properties

Henry Moseley (1913)

- a British physicist who determined the **atomic number** of the atoms of the elements
- he arranged the elements in a table by **order of atomic** number instead of atomic mass

The Modern Periodic Table

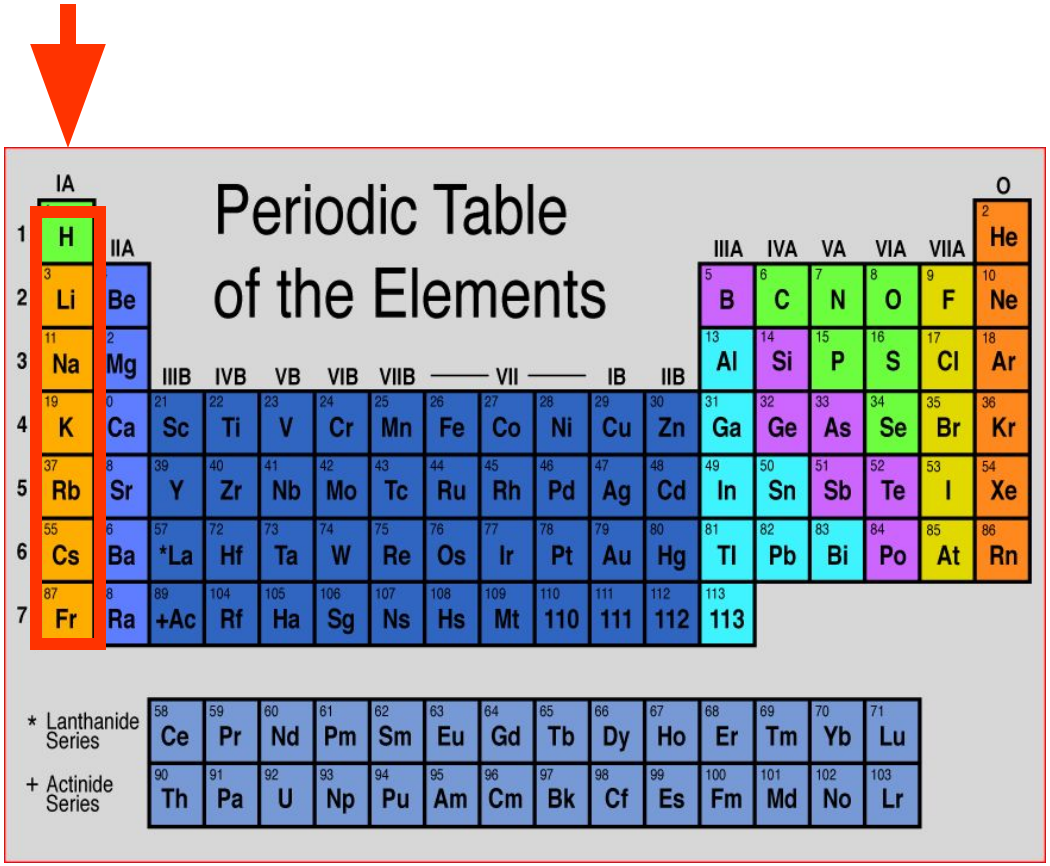
- The modern periodic table is arranged by increasing **atomic number** and by changes in **physical and chemical properties**.



The Modern Periodic Table

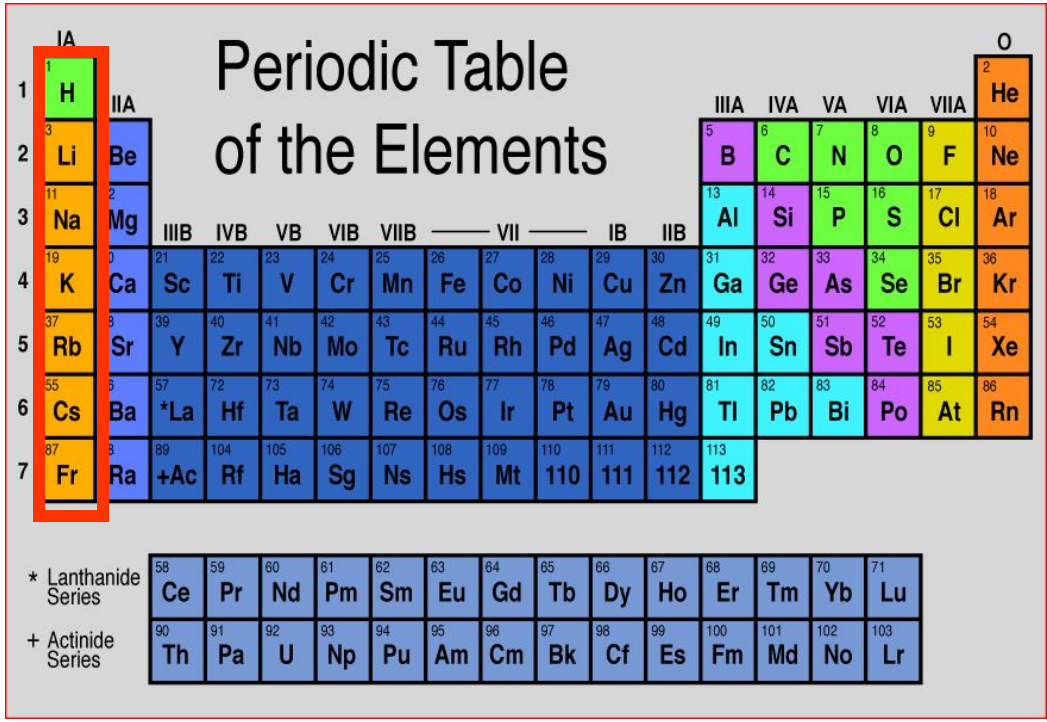
The vertical columns of the periodic table are called ***GROUPS, or FAMILIES (IA, IIA, IIIA, IVA, VA, VIA, VIIA, VIIIA)***.

The group number tells you the number of **valence electrons** = electrons on the outermost energy level.

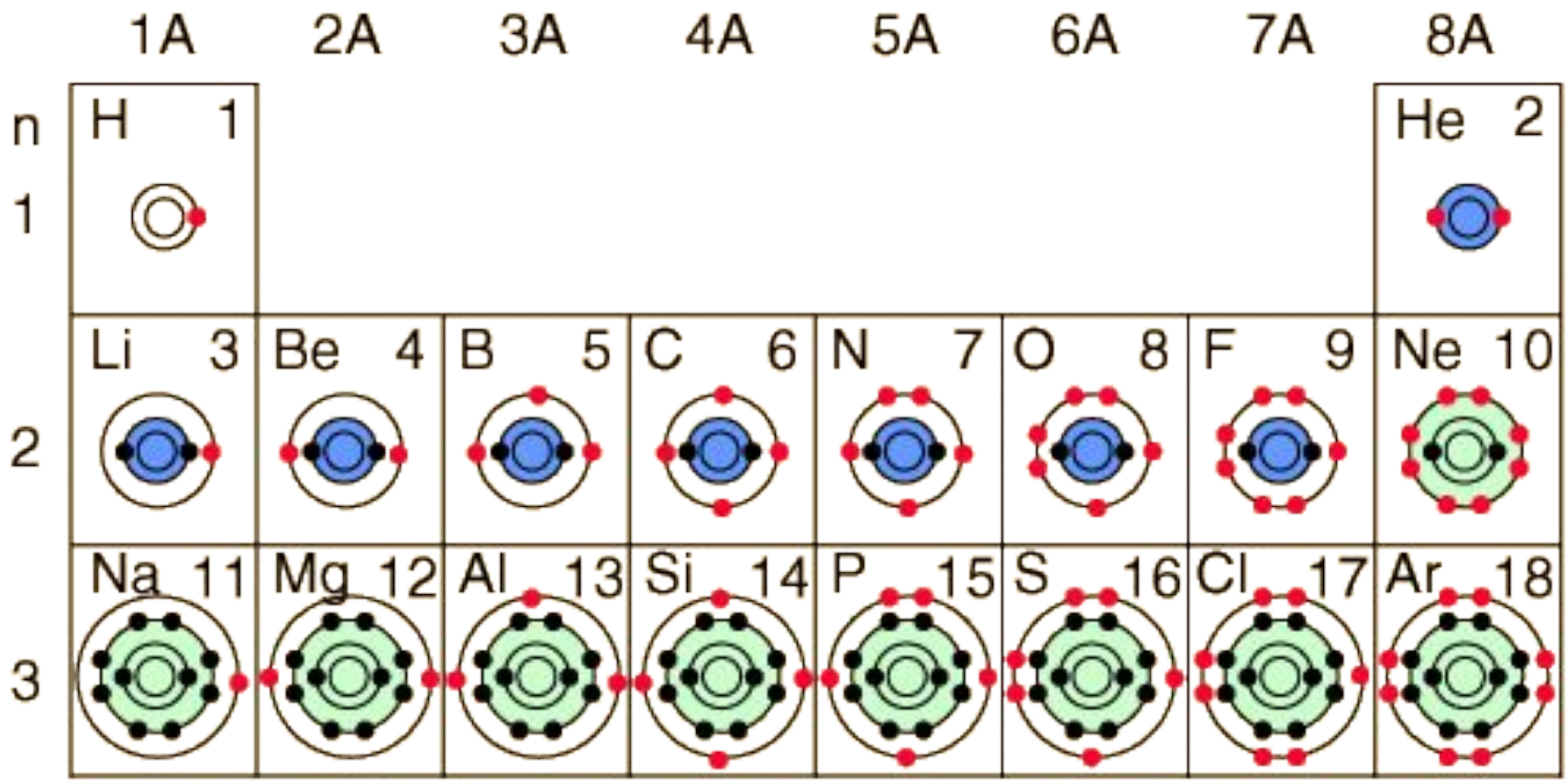


How do I figure out how many valance electrons an element has?

- You look at the column number.
  - 1A, 2A, 3A
  - Count the boxes from left to right (skipping the transition metals)
- All elements in a **column** have the same number of **valence electrons**
  - Thus they behave the same.

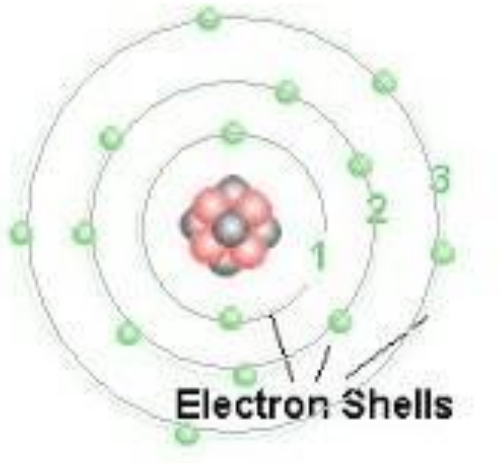


How many **valance electrons** do **alkali metals** have?



Why do elements in a group have similar properties?

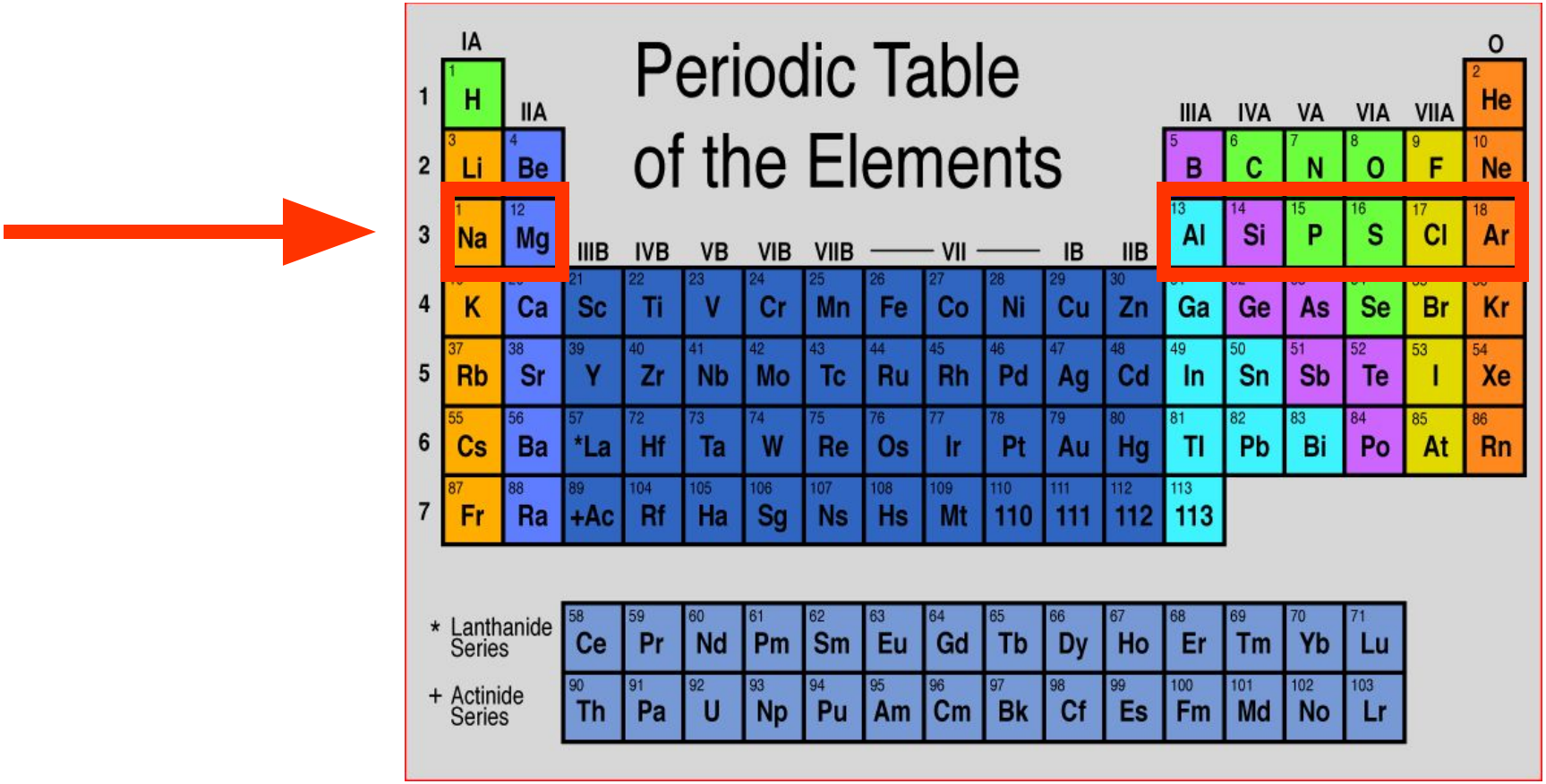
- Elements in a group have similar electron configurations.
  - Electron configuration- refers to how electrons are arranged around the nucleus.



The Modern Periodic Table

The horizontal rows of the periodic table are called ***PERIODS (1-7).***

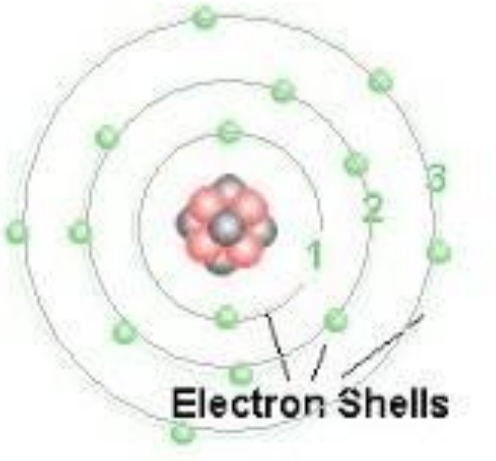
The **period** tells you the number of energy levels.



Energy levels

Energy Level- a layer or blanket of electrons

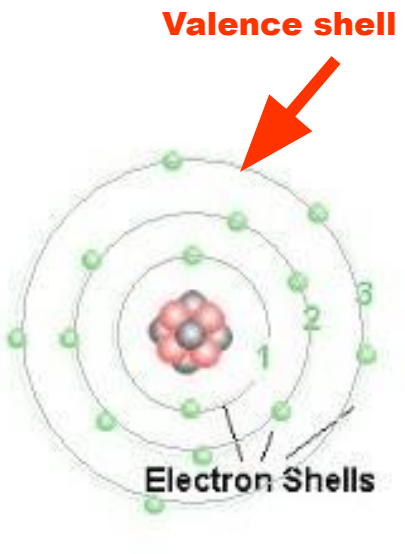
- Also referred to as an electron shell.
- Shells near the nucleus have less energy.
- Shells further away have more energy.



How are shells filled

- Shells with lower energy fill up first. Followed by outer shells.
  - **1st shell** = space for 2 electrons
  - **2nd shell**= space for 8 electrons
  - **3rd shell**= space for 8 electrons

RULE: 2:8:8

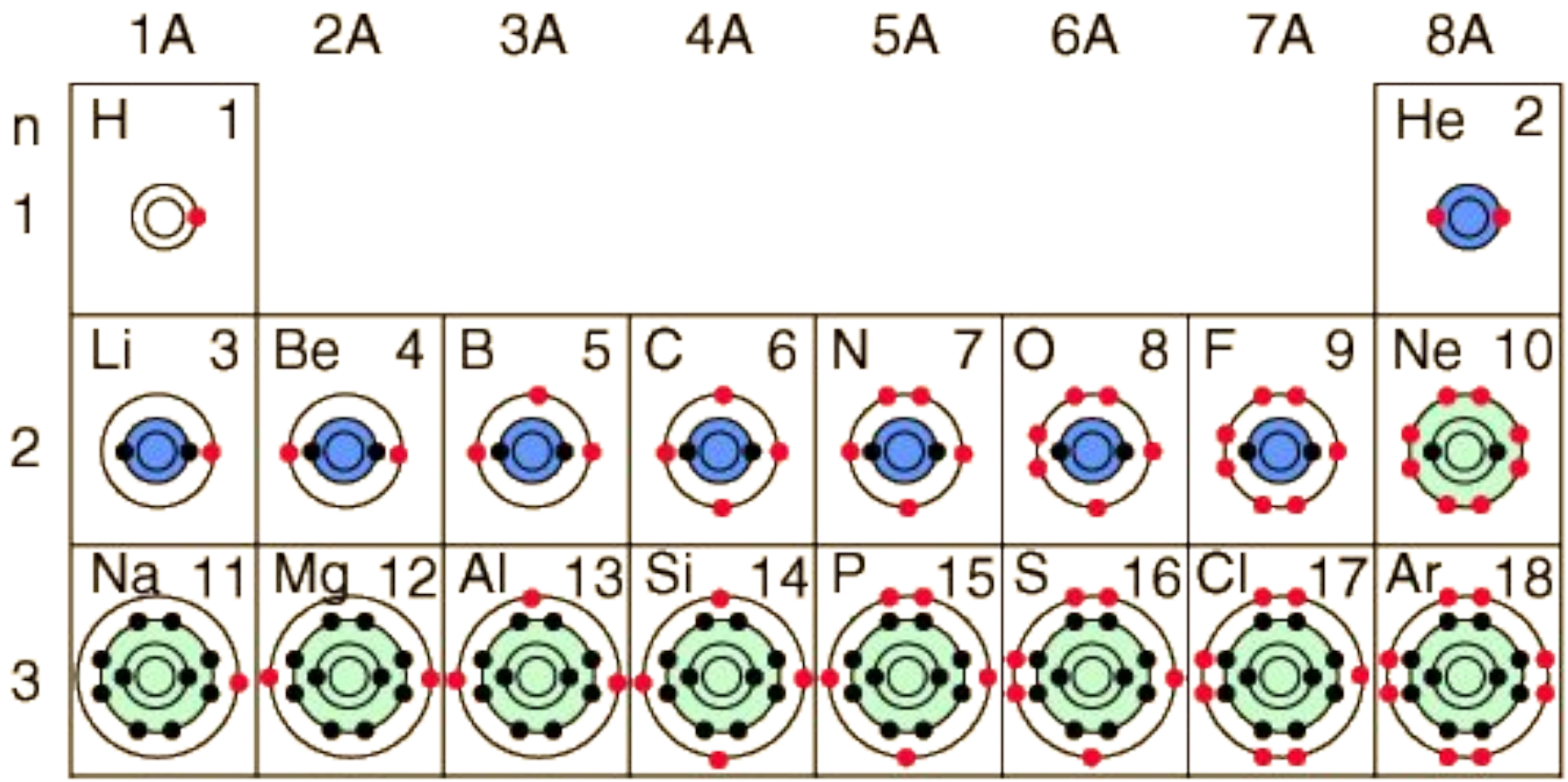


- Valence shell- the outermost energy level of an atom.
  - Contains the electrons that form chemical bonds

How do I figure out the number of shells on an atom?

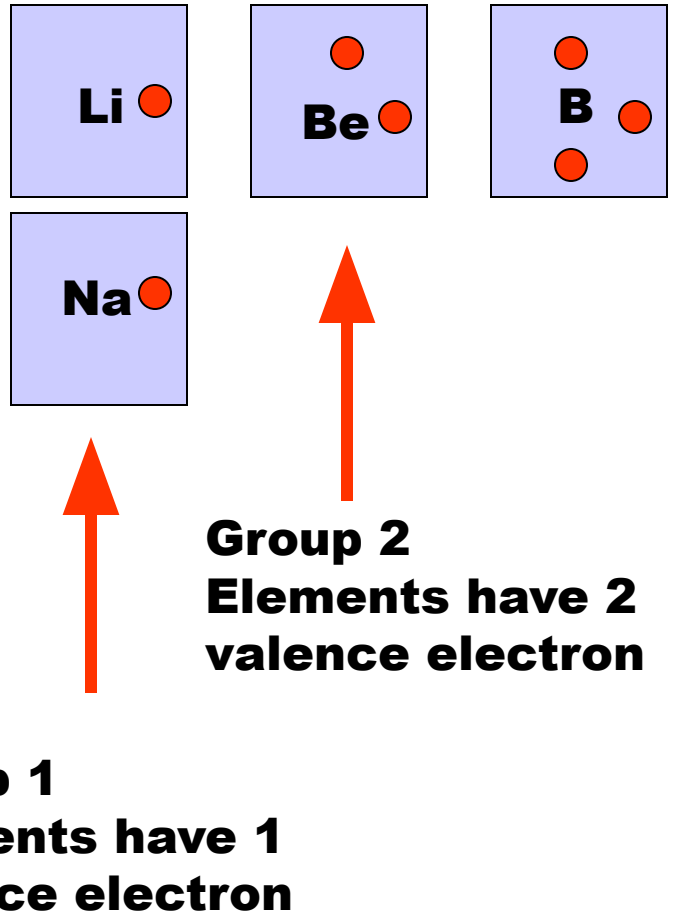
- Each period adds another energy level.
  - Ex: Element in period (row) 3 have three layers of electrons.

How many energy levels does nitrogen have?



Electron Dot Diagram

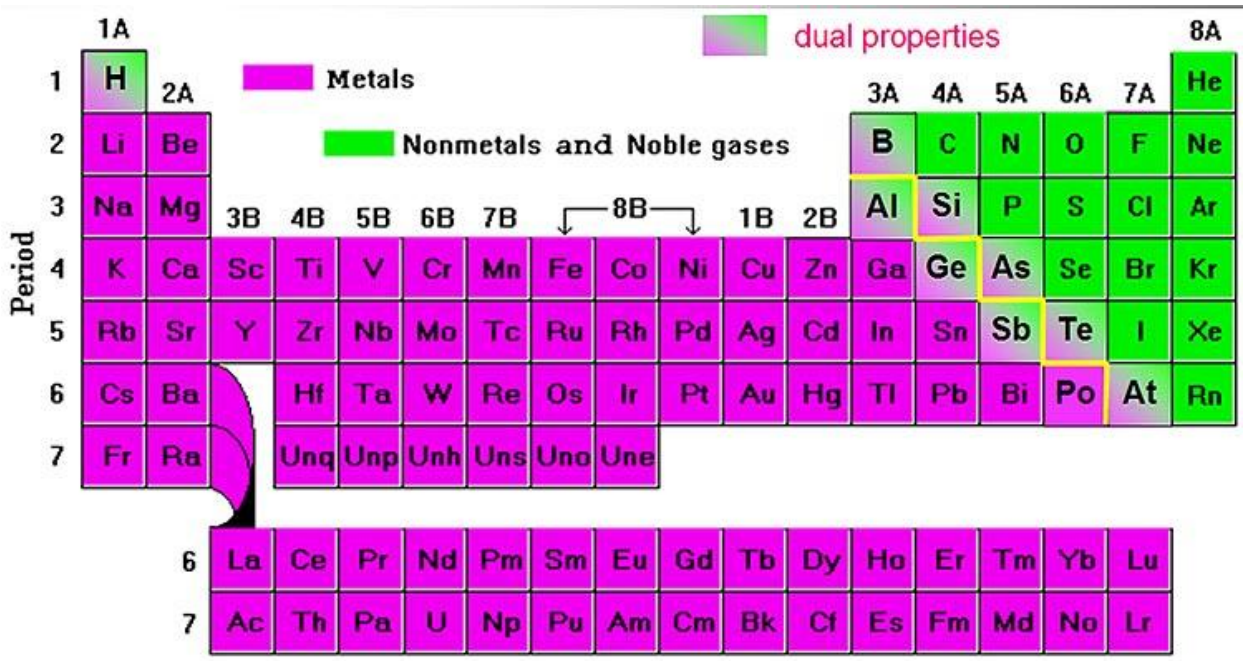
- An **electron dot diagram** uses the symbol of the element and dots to represent the **electrons** in the outer energy level.



Group A elements are called REPRESENTATIVE ELEMENTS divided into 3 broad classes:

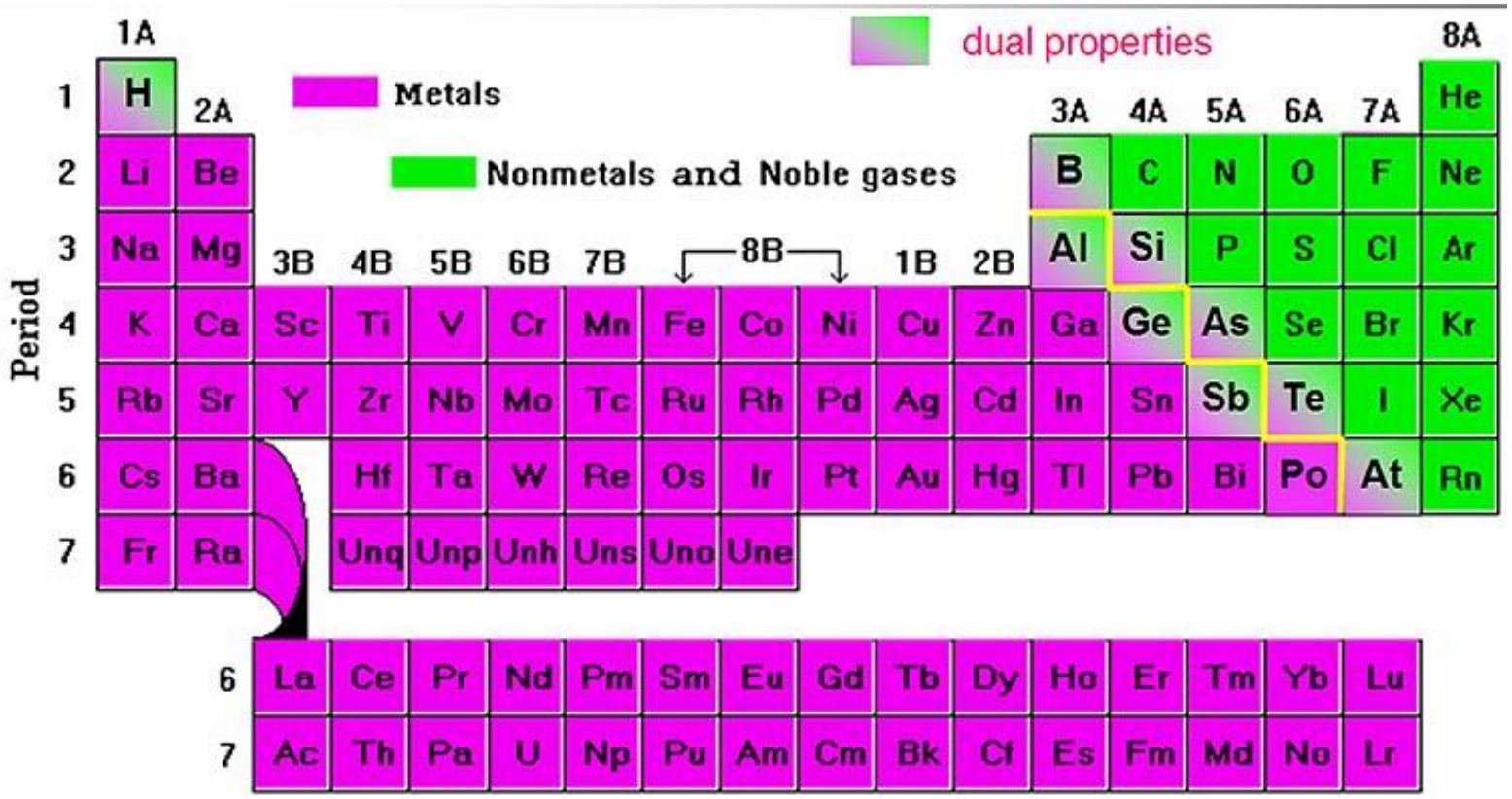
METALS

- have high electrical conductivity
- high luster when clean
- ductile (can be drawn into wires)
- malleable (can be beaten into thin sheets)



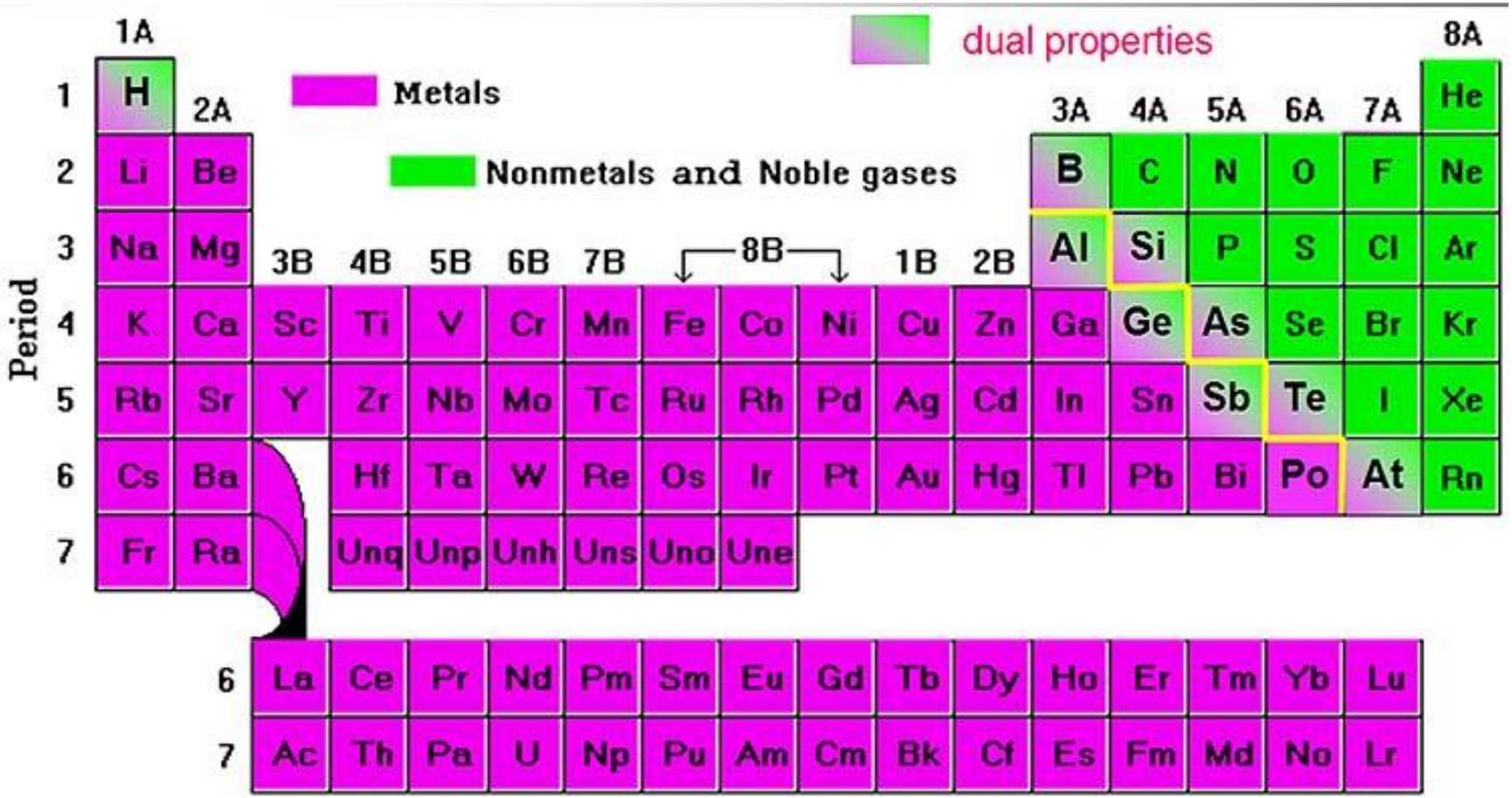
NONMETALS

- occupy the upper-right corner of the periodic table
- they are non-lustrous and poor conductors of electricity



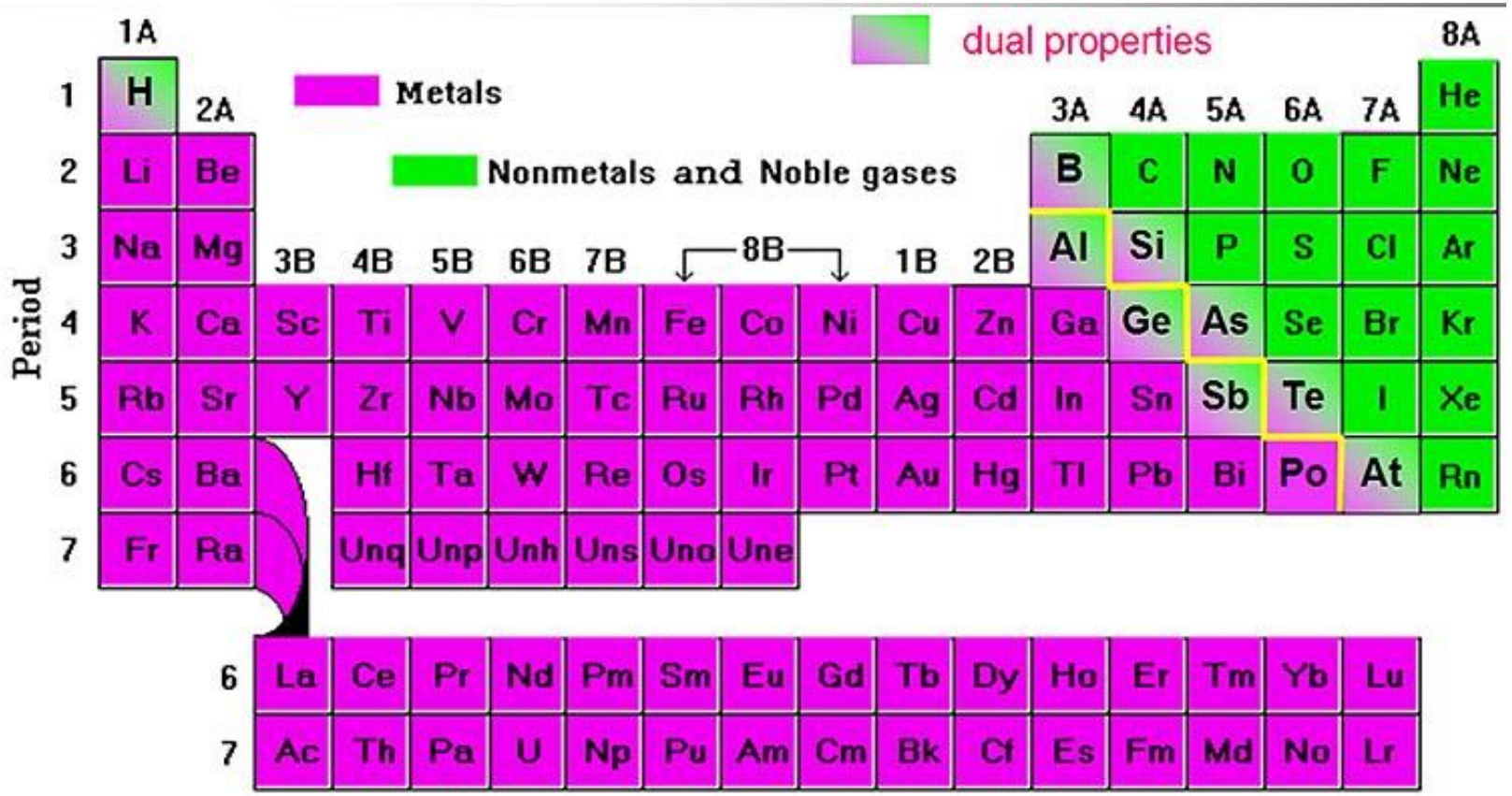
METALLOIDS

- elements that are intermediate between metals and non-metals (Ex. Silicon and Germanium)



Review- group names

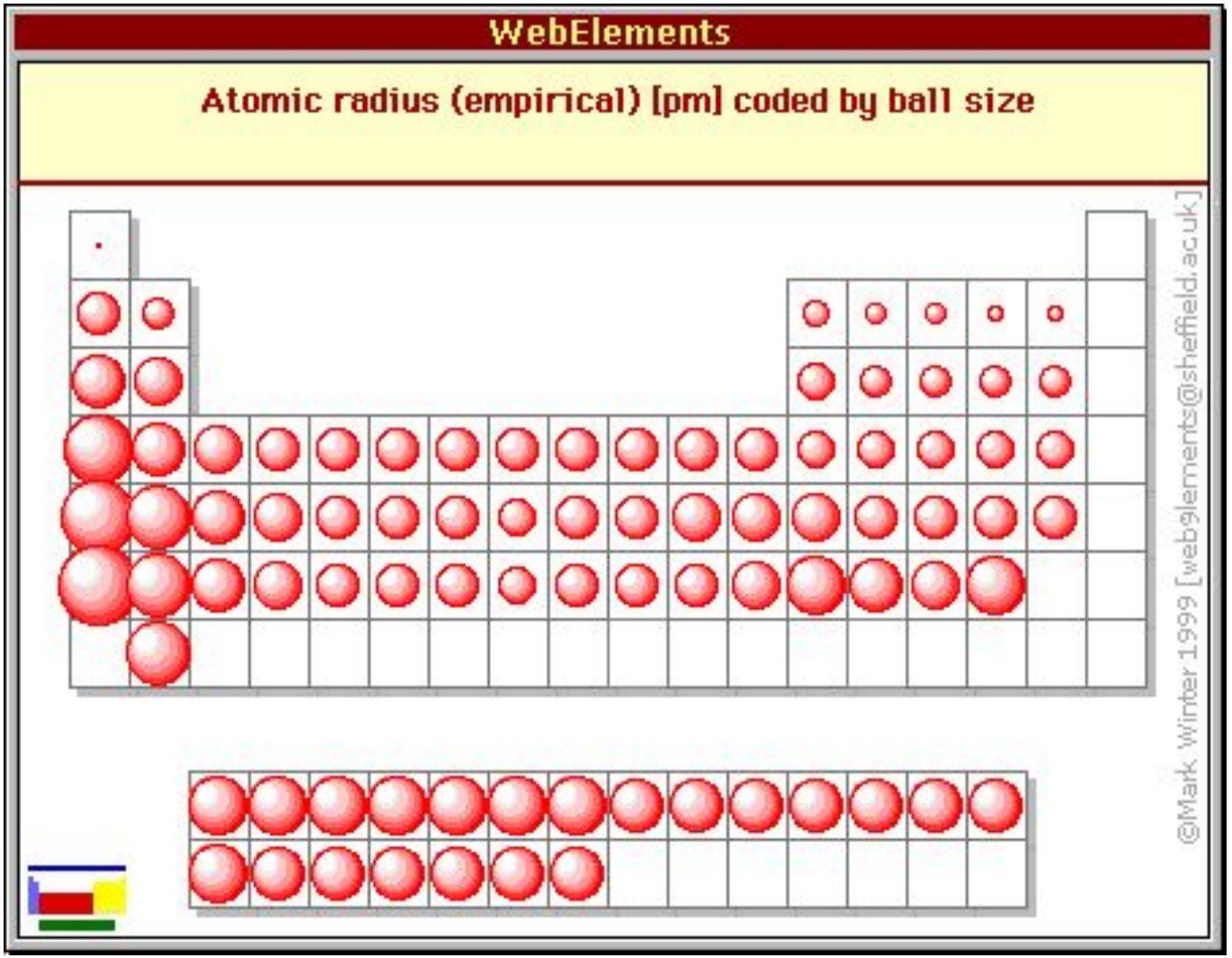
List an element that will have similar properties to Lithium.



Periodic Trends

- Atomic radii- the size of an atom
  - From top to bottom atoms get bigger
    - Why? More layers of electrons
  - From left to right- Get smaller
    - Why? More protons pull the electrons closer.

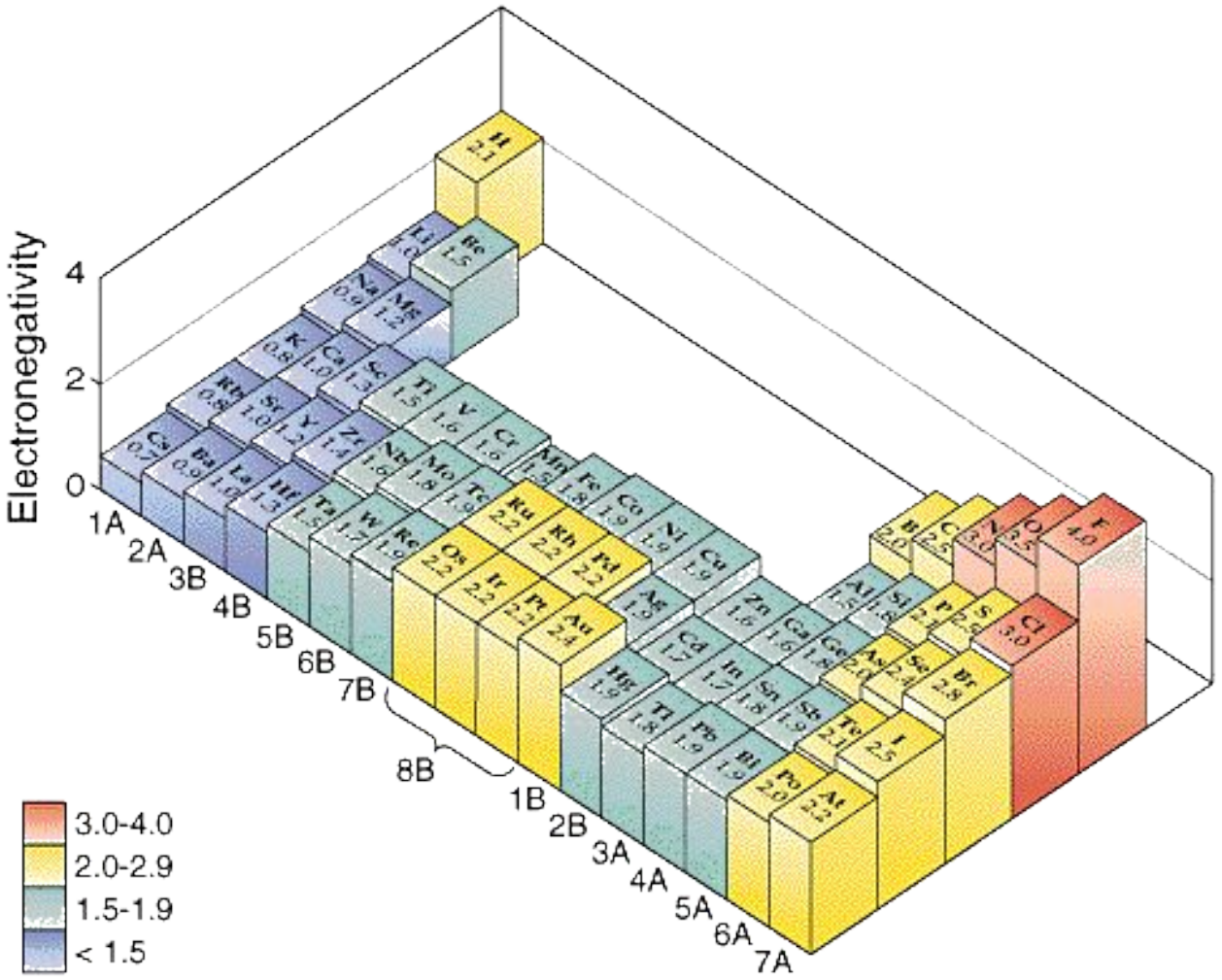
Atomic Radii



Electronegativity

- Electronegativity- ability to take electrons from another atom.
  - From top to bottom- gets weaker
  - From left to right gets stronger-

Electronegativity



Electronegativity

- Why do we care?
  - Metals lose valance electrons
  - Nonmetals take electrons
  - Ionic bonds

- Covalent bonds
  - Atoms near each other share electrons
  - Non-metal with nonmetal