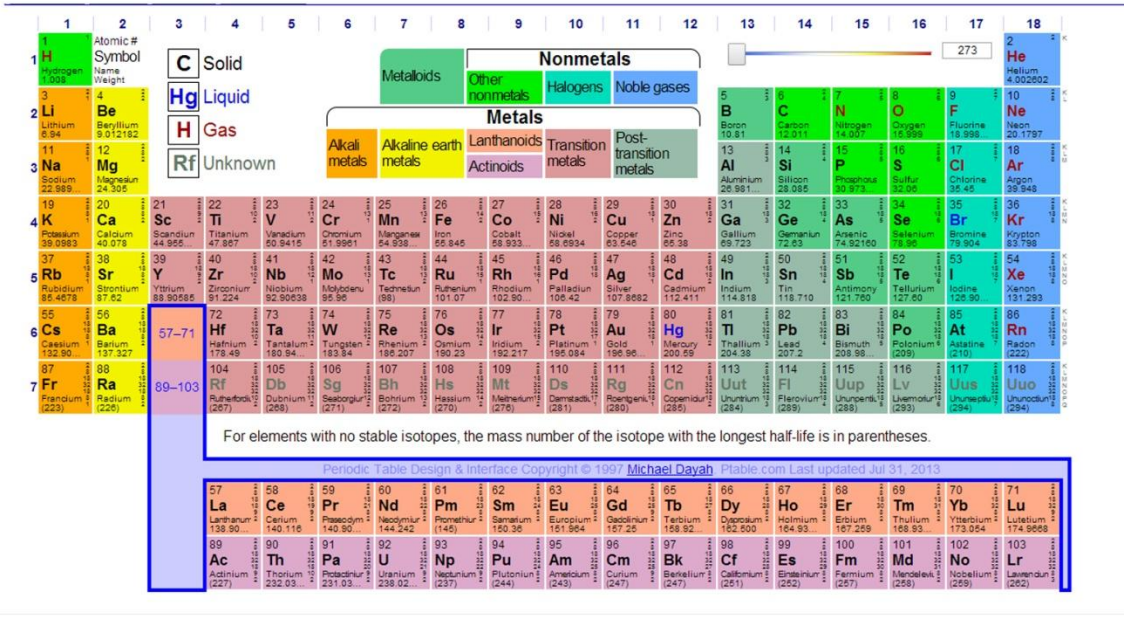
PERIODIC TABLE



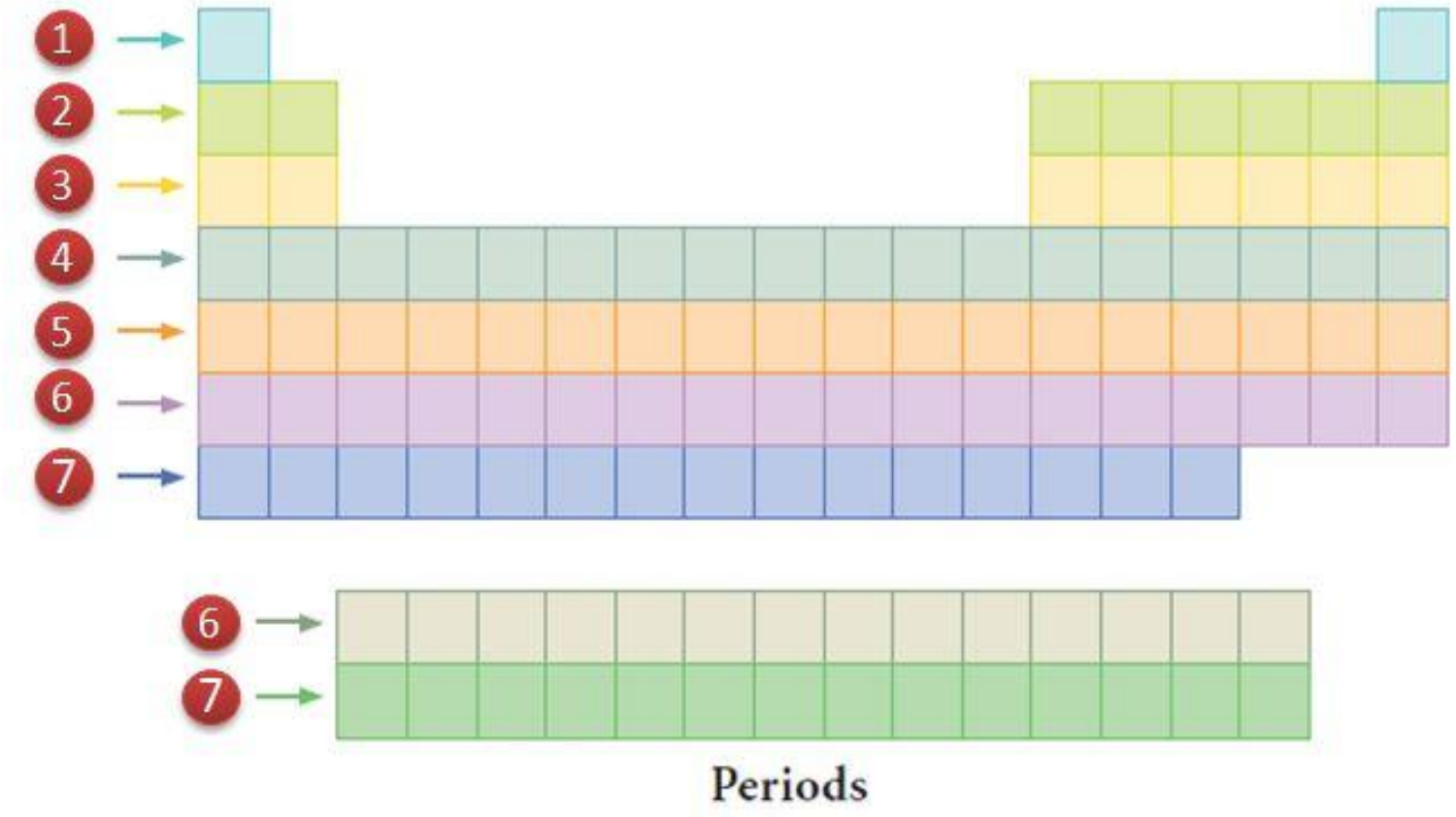
Arrangement

- Mendeleev arranged the first periodic table.
  - Arranged by increasing atomic mass
  - Why is this not useful now? Think about isotopes.

- **Periodic Law**: arranged in order of increasing atomic number.
  - Repetition of properties in each group
  - “Periodically” repeats with each new period

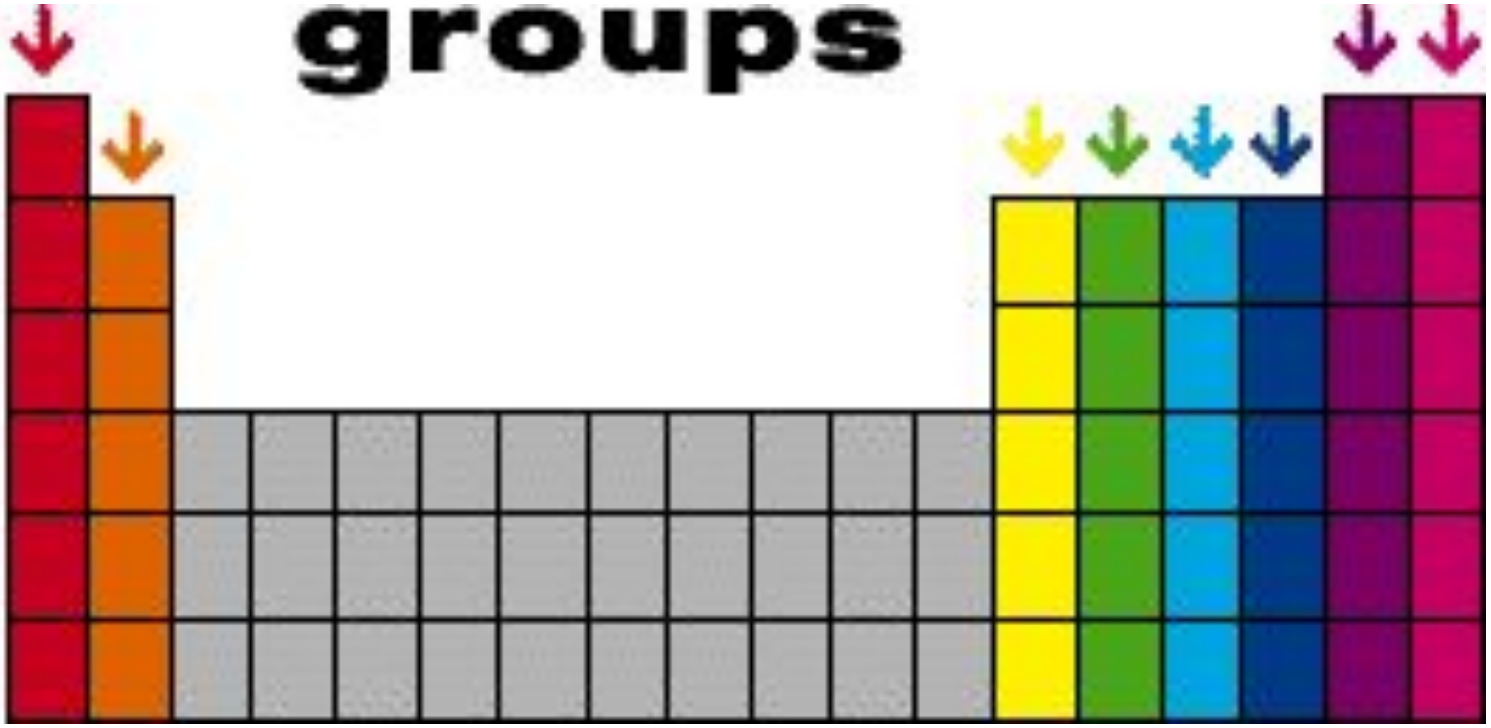
Arrangement

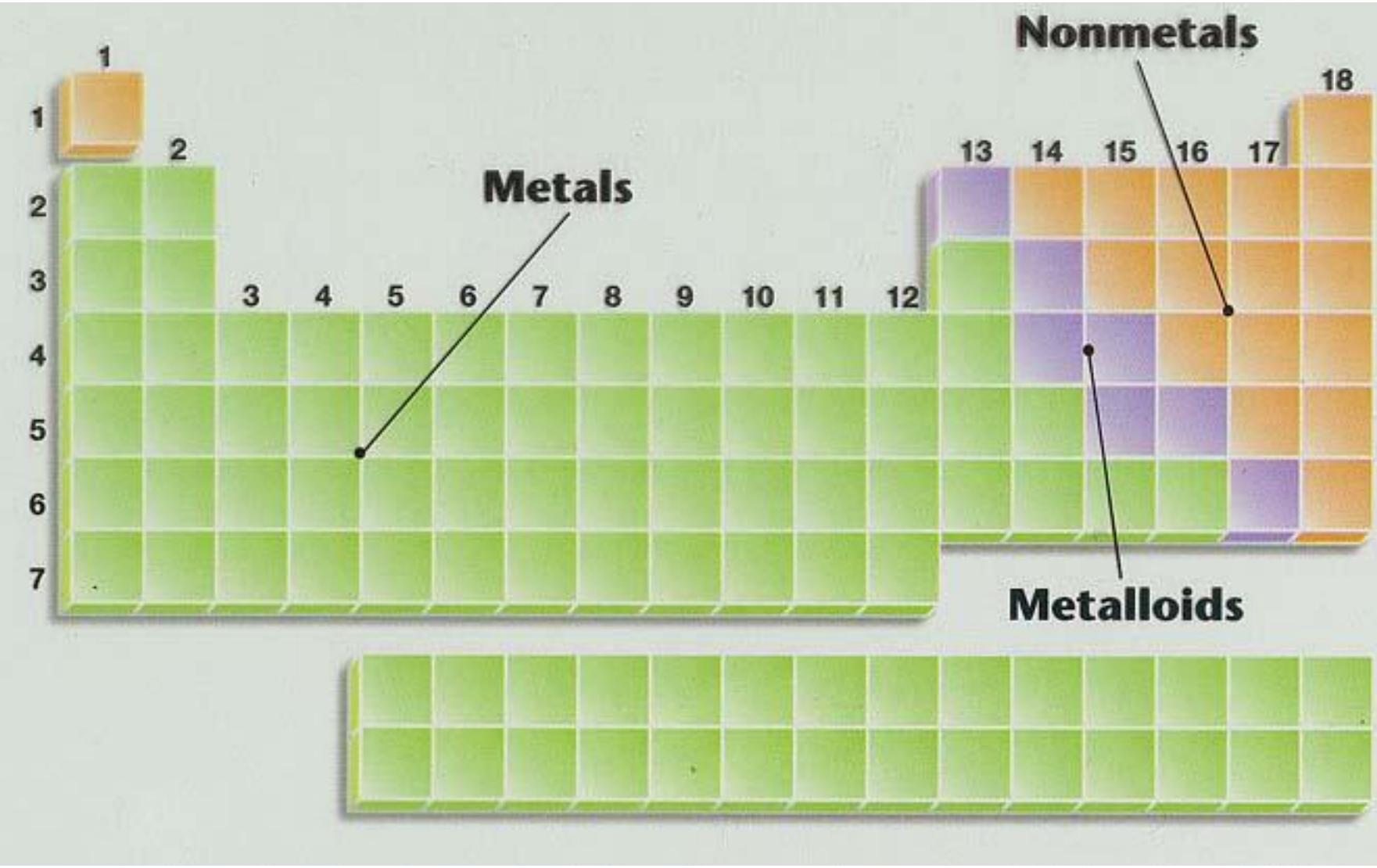
- Periods/Series: horizontal rows



Arrangement

- Groups/Families: vertical columns




Nonmetals
Metals
Metalloids
1
2
3
4
5
6
7
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18

Metals
Physical Properties

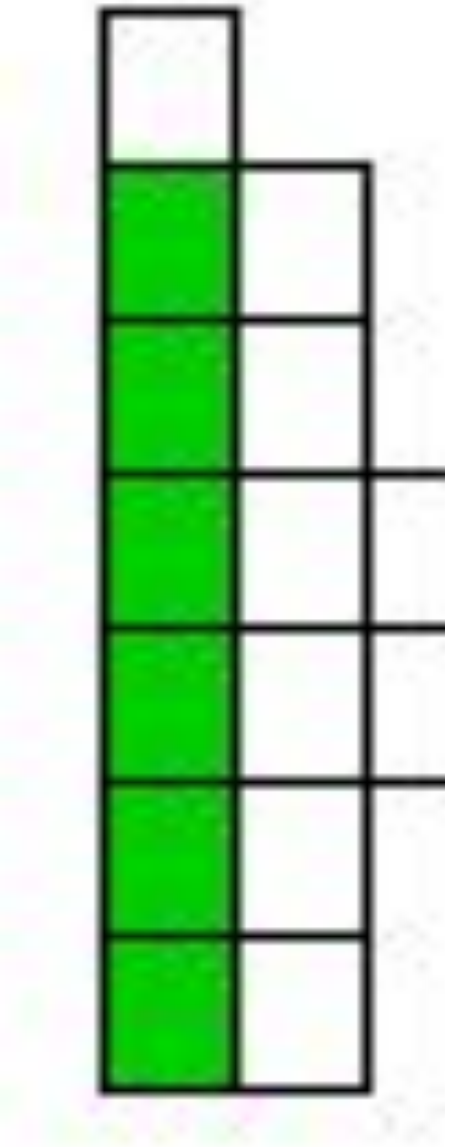
- Good electrical conductors
- Good heat conductors
- Lustrous
- Ductile and malleable
- Solids at room temperature
- High melting point and boiling point
- High density

Metals
Chemical Properties

- Lose valence e^- easily (have less than 4 ve^-)
- Low Electronegativity (trend)
- Corrode easily (react with water, acids)
- Ionic bonding
- Metallic bonding (alloys)

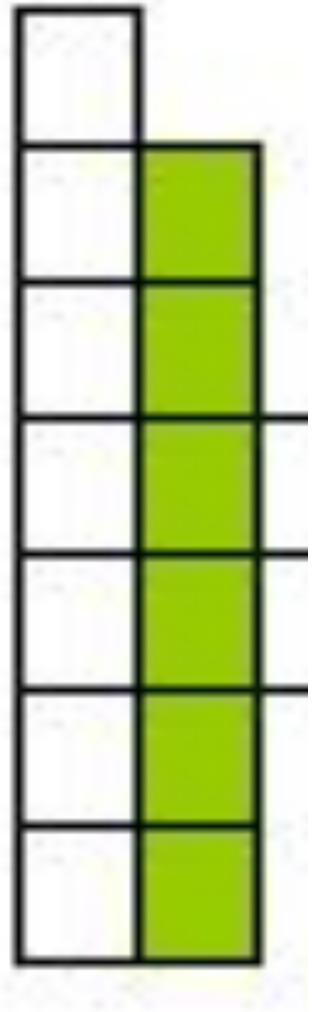
Alkali Metals

- React with water VIOLENTLY
- Not found in nature (elemental form)
- Soft
- 1 valence e^- (+1)
- Loses 1 e^- to form bonds



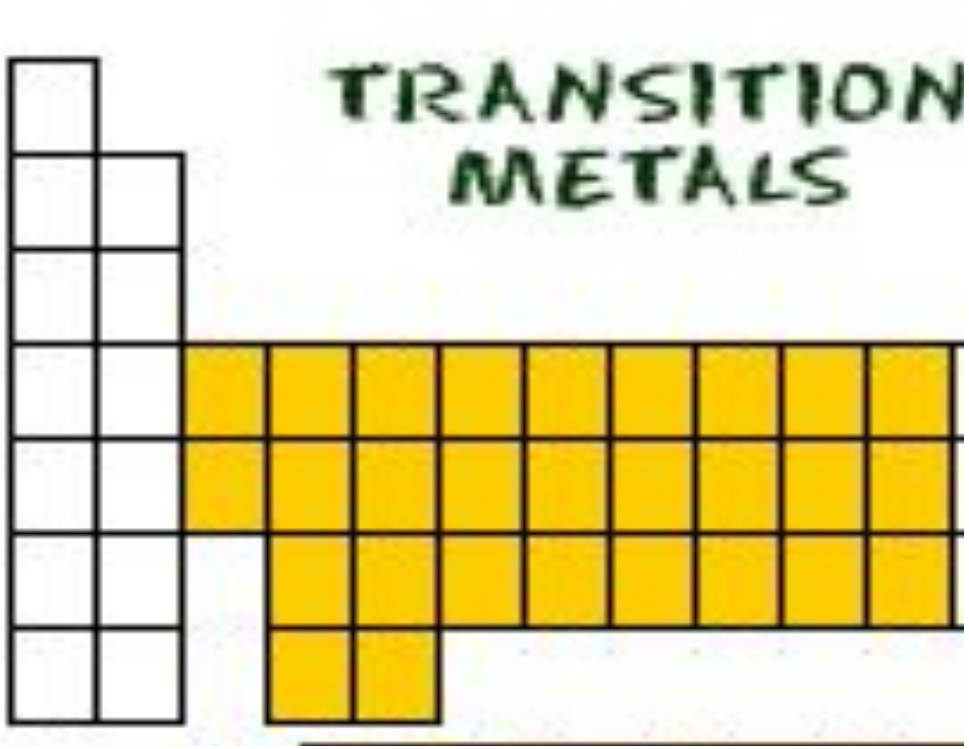
Alkaline Earth Metals

- React with Halogens to form salts
- Not found in nature (elemental form)
- Found in molecules within earth's crust
- 2 valence electrons (+2)
- Loses 2 electrons to form bonds

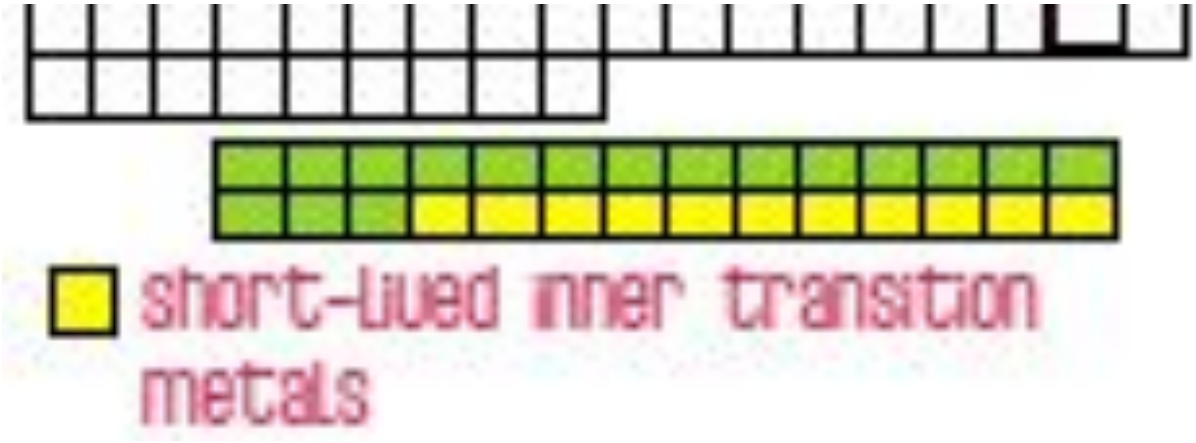


Transition Metals

- Vary in oxidation states (no specific charge)
- Different number of ve^-



Inner Transition Metals



- Lanthanides
- Actinides
- Also called “rare-earth” metals
- “Pull out” rows in periods 6 and 7
- Trans-uranium: elements larger than U that are man-made

Nonmetals
Physical Properties

- Mostly gas at room temperature
- Poor conductors of heat and electricity
- Brittle
- Non-lustrous
- Low melting and boiling points

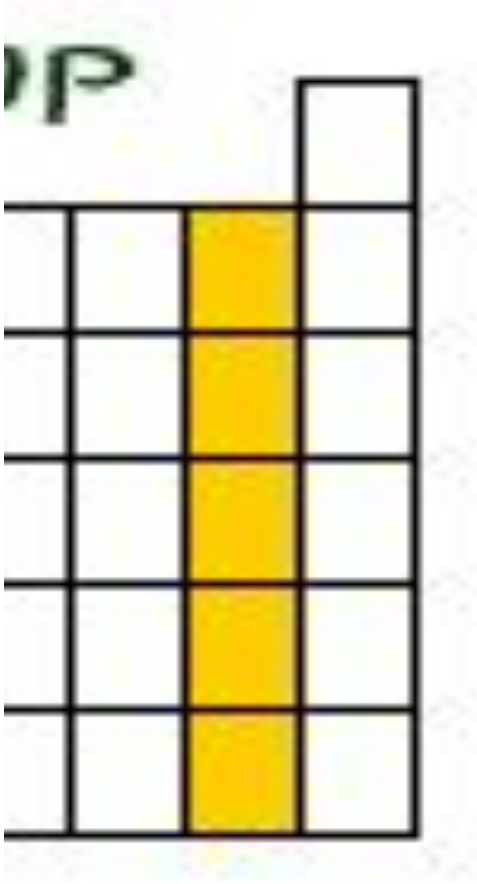
Non-metals
Chemical Properties

- Gain valence electrons
  - Ionic bonding

- Shares valence electrons
  - Covalent bonding

Halogens (Nonmetals)

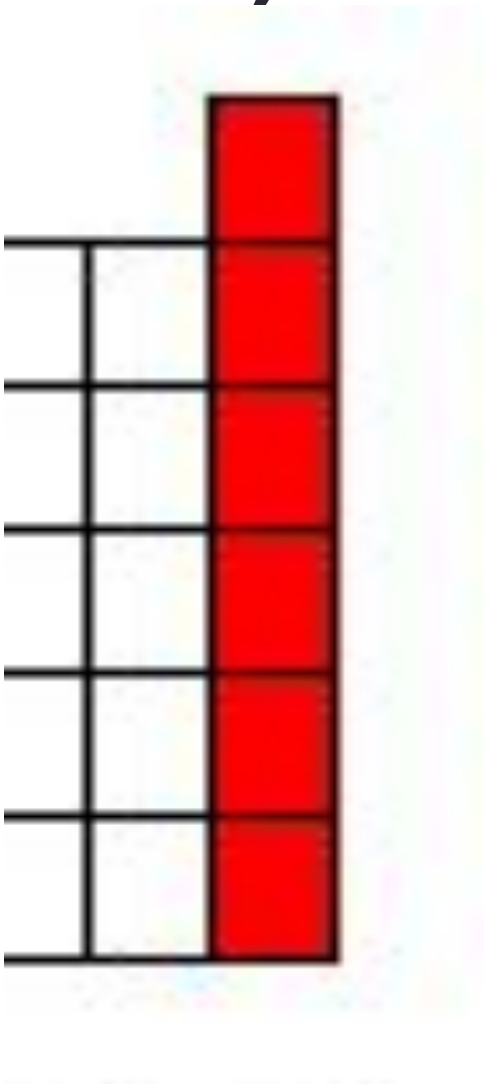
- Form salts when bonded to alkaline earth metals
- Form acids when bonded to Hydrogen
- 7 valence electrons (-1)
- Gains one ve^- (ionic bonding)



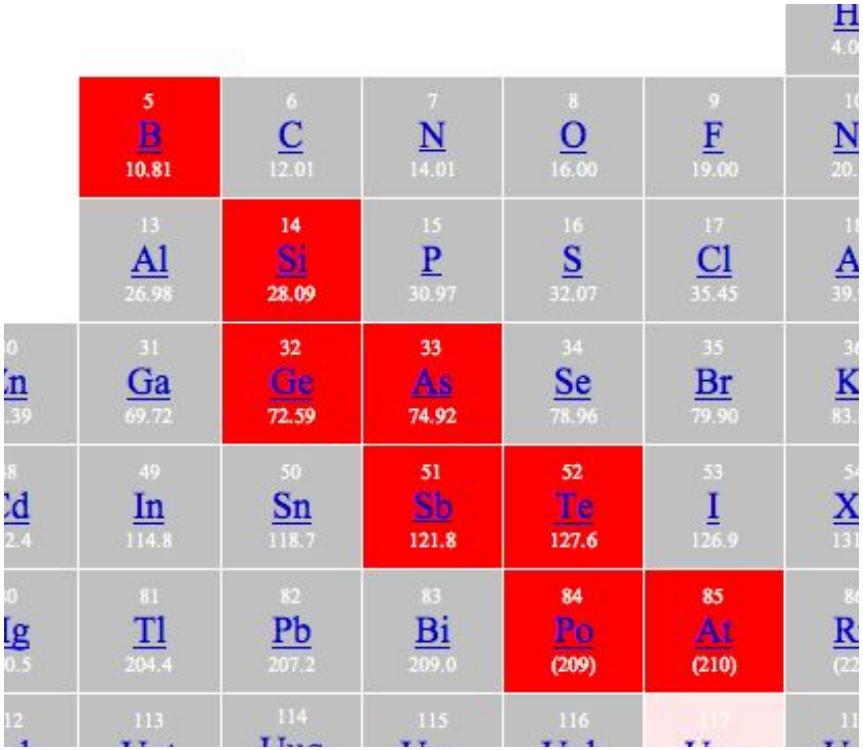
Noble Gases (Nonmetals)

- Unreactive/inert
- Odorless and colorless (unless e^- are excited

- 8 valence electrons (2 for He)
- Full octet (outer shell) or duet (for He)



Metalloids



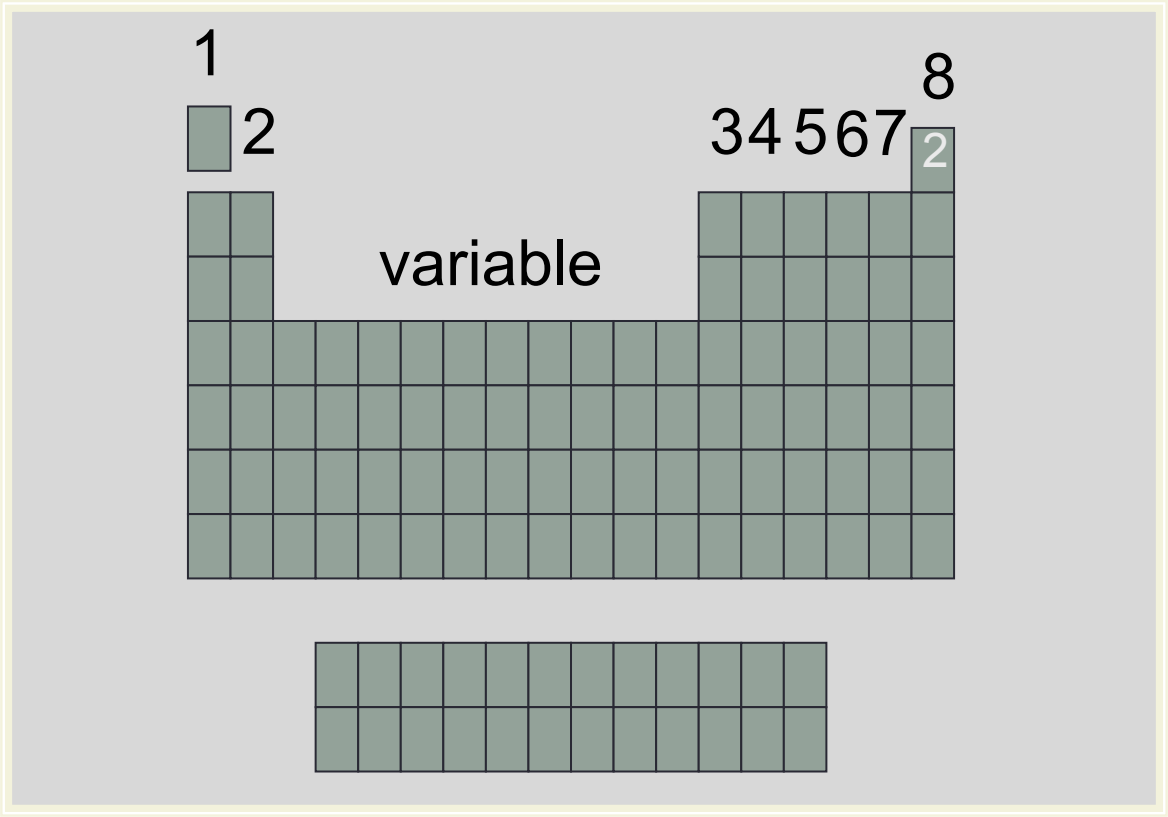
- Similar to both metals and nonmetals.
- Different conditions change properties.
- Form alloys with metals.
- “Stair-step” elements

VALENCE AND TRENDS

Valence Electrons

- **Valence electrons** – Electrons in an atom's highest-numbered energy level.
  - How many are in each of the groups on the periodic table?

Valence Electrons Shortcut

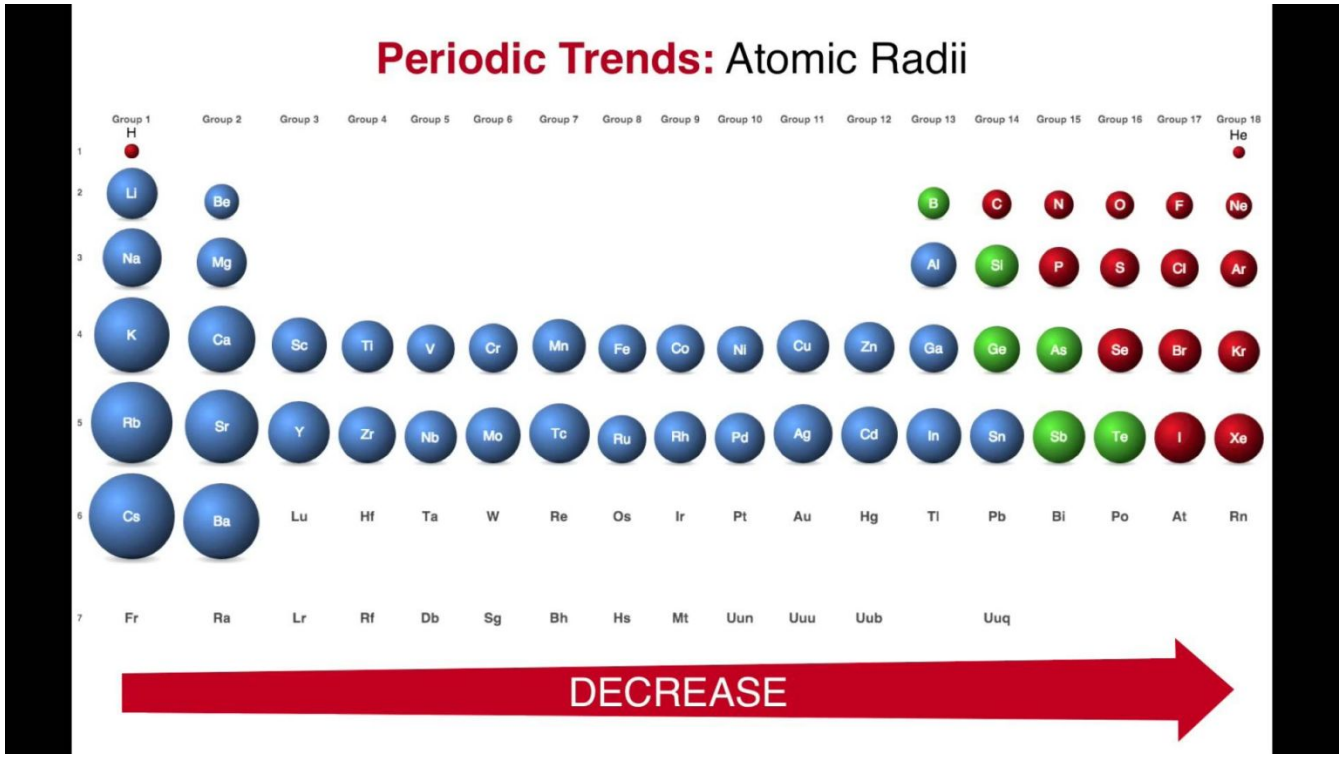


Octet Rule

- 8 electrons in outer shell (or duet= 2 e^-)
- Atoms will combine to make the octet full, giving them the same electron configuration as the closest noble gas.
- How many electrons do elements in each group want to gain/lose to bond?

Atomic Radii (AR)

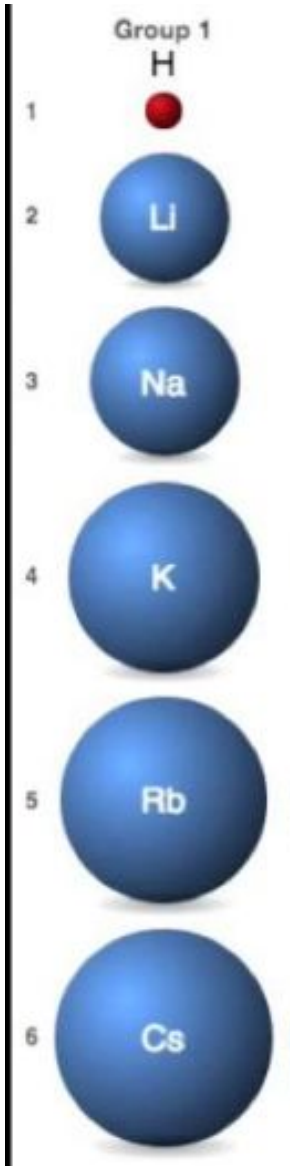
- Center of the nucleus to edge of the electron cloud.



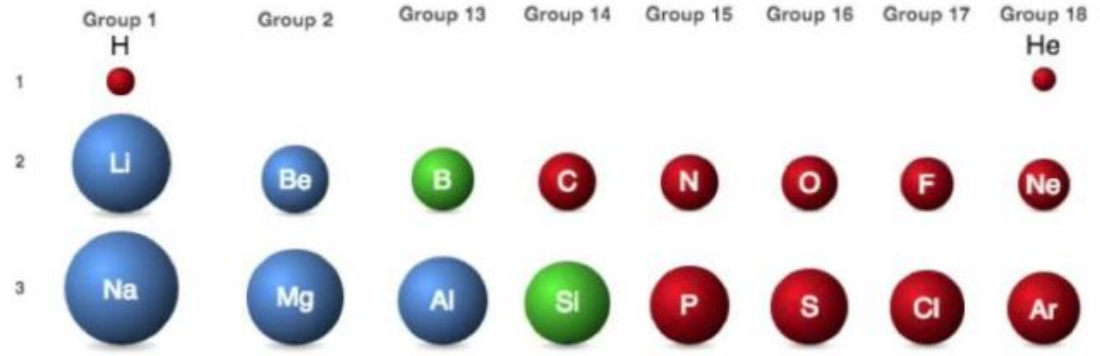
Atomic Radii (AR)

- Increases down a group (new energy levels added)

- The closer the e^- are to the nucleus (p^+), the stronger the pull on the radius (making the atom smaller)



Atomic Radii (AR)



- Decreases across a period
- More p^+ and e^- in the same energy level
- Increased # of subatomic particles cause an increase in attraction between the e- cloud and the nucleus (like magnets)

Electronegativity (EN)

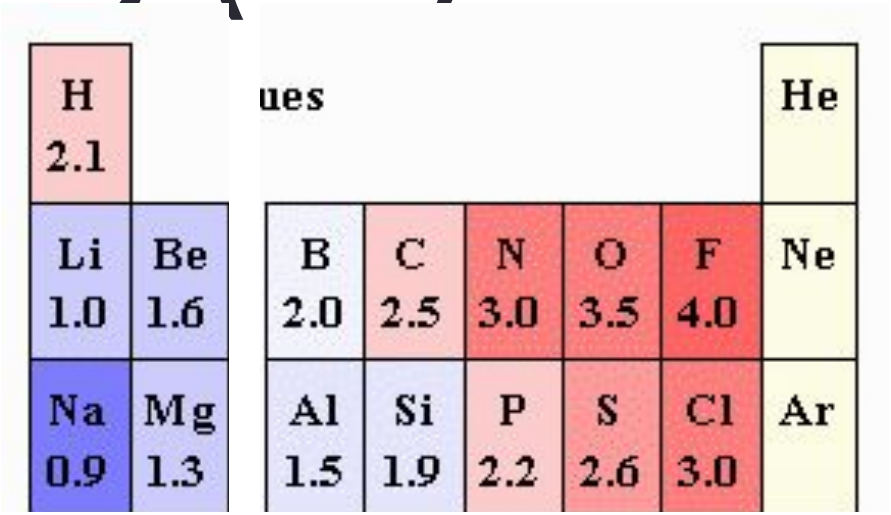
- Ability to hold on to the e^- in an atom
- Forms a negative ion (anion)
- A + e- $\longrightarrow$ A- + E
- Does not include Noble Gases (they do not bond)

Electronegativity (EN)

- Decreases down a group
- As you move down, space is added between e- and nucleus
- Lessens attractive force between p^+ and e^-
- Harder for atom to hold on to its e^-

Electronegativity (EN)

- Increases across a period
- More e^- and p^+
- e^- are held more tightly because of an increase in attractive nuclear force

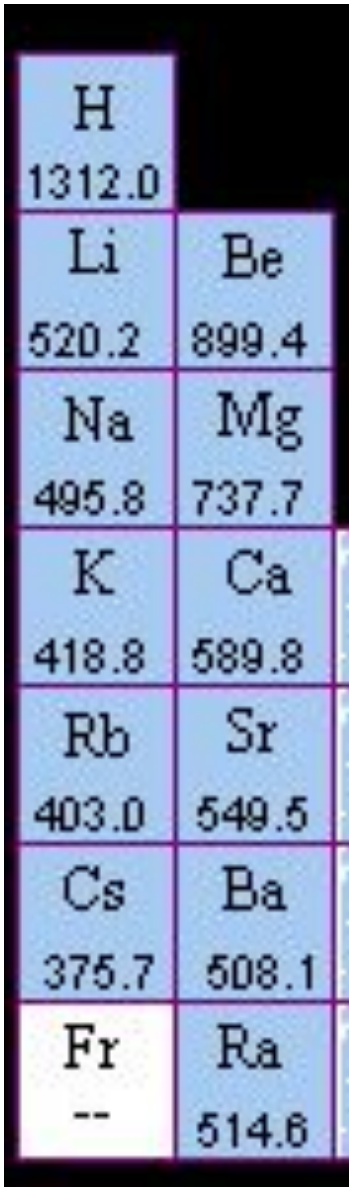


Ionization Energy (IE)

- Energy required to remove valence e^-
- Forms a positive ion (cation)
- $A + E \longrightarrow A^+ + e^-$

Ionization Energy (IE)

- Decreases down a group
- More energy levels, less attractive nuclear force
- Requires less energy to remove e^-



Ionization Energy (IE)

- Increases across a period
- e- are held tighter because of higher attractive nuclear force (increase in # of p^+ and e^-)
- Requires more energy to remove e^-