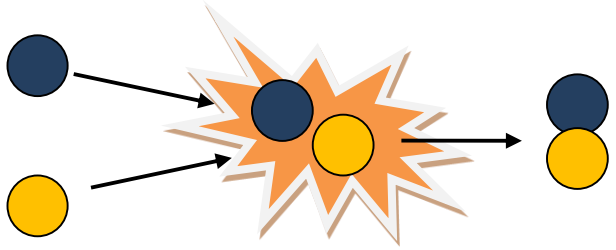
5.4 - Trends in the Periodic Table

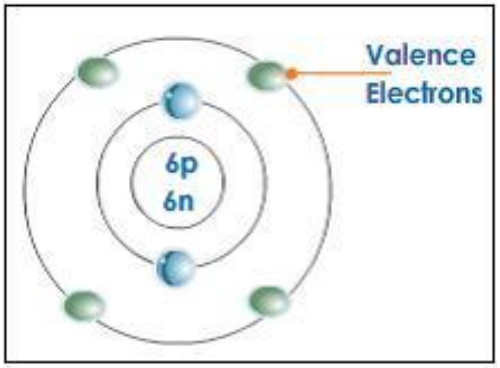
SNC1D

Explaining Chemical Reactivity

For atoms to react, they must **collide** with each other.



- When they collide, only the electrons in the **outermost** shell will come into contact.
  - This shell is called the **valence shell**, and the outermost electrons are called the **valence electrons**.



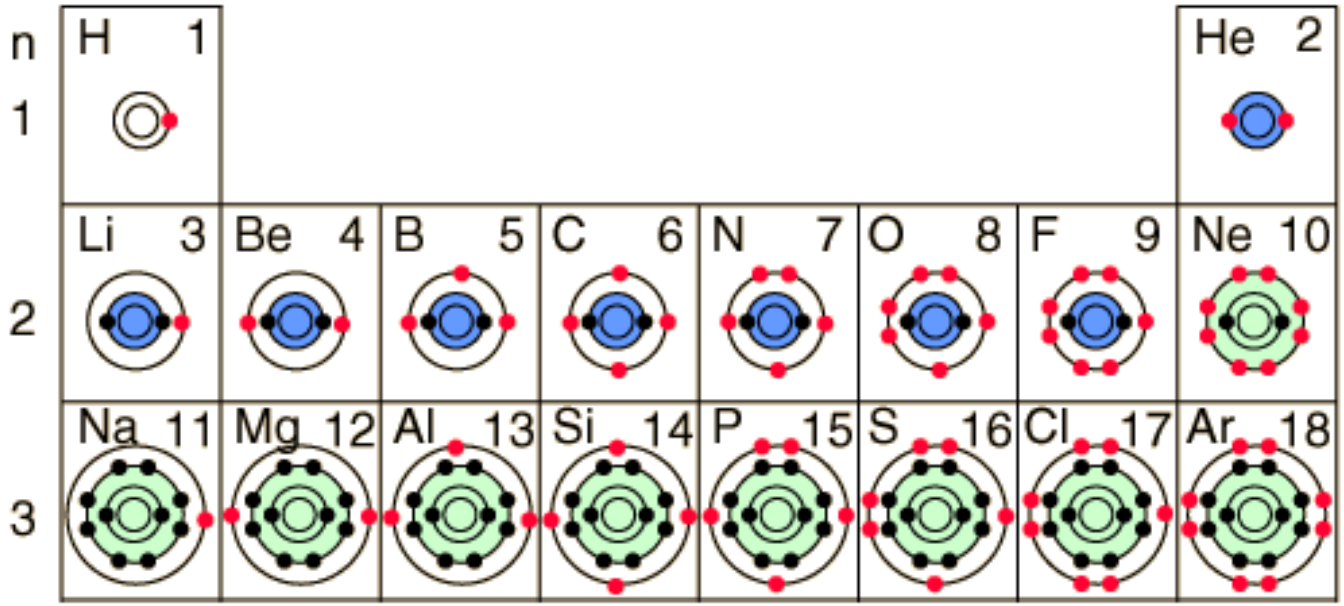
Since only the valence electrons are involved in reactions, the **arrangement of valence electrons determines an atom's reactivity.**

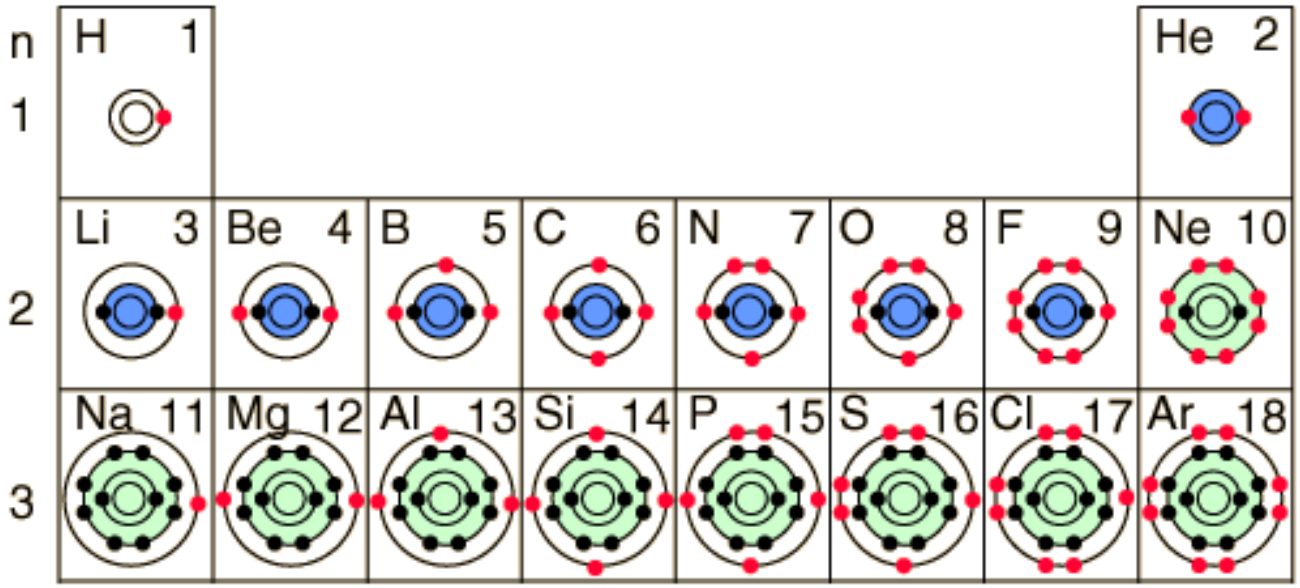
- All elements will react in ways that allow them to obtain the most _____ * arrangement of electrons.

- For an atom, the most stable electron arrangement is one in which the atom has a _____ ** valence shell of electrons:
  - This rule is known as the **octet rule**.

(a) What is an **octet**? Why is the stability rule called the *octet rule*?

(b) Which two elements obtain stability by having a *duet* instead of an octet? Why?





Across a period (L-R):

What happens to the number of electron shells?

The number of valence electrons?

Down a group (Top to bottom):

What happens to the number of electron shells?

The number of valence electrons?

lithium

Group #____

Family: _____

_____

valence e$^-$'s _____

beryllium

Group #____

Family: _____

_____

valence e$^-$'s _____

fluorine

Group #____

Family: _____

_____

valence e$^-$'s _____

neon

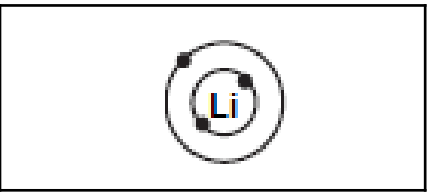
Group #____

Family: _____

_____

valence e$^-$'s _____

lithium

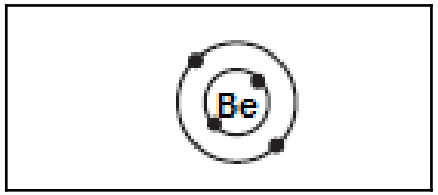


Group #**1**

Family: **Alkali metals**

valence e$^-$'s **1**

beryllium

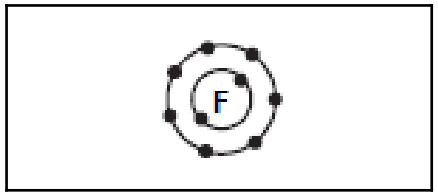


Group #**2**

Family: **Alkali Earth Metals**

valence e$^-$'s **2**

fluorine

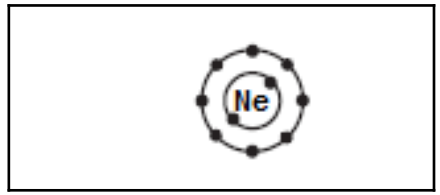


Group #**17**

Family: **Halogens**

valence e$^-$'s **7**

neon



Group #**18**

Family: **Noble gases**

valence e$^-$'s **8**

Group 18: Noble Gases

- All noble gases have _____ valence shells.
- They have *stable* electron arrangements → they are _____.

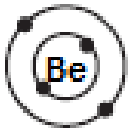
lithium

Group #**1**

Family: **Alkali metals**

valence e$^-$'s **1**

beryllium



Group #**2**

Family: **Alkali Earth Metals**

valence e$^-$'s **2**

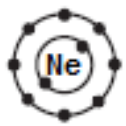
fluorine

Group #**17**

Family: **Halogens**

valence e$^-$'s **7**

neon



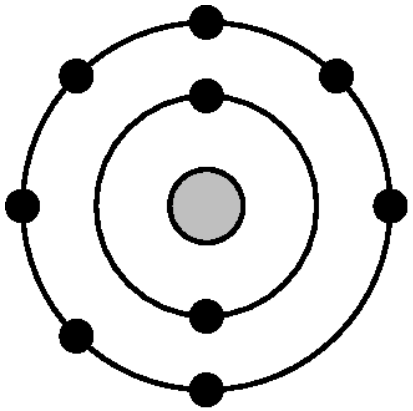
Group #**18**

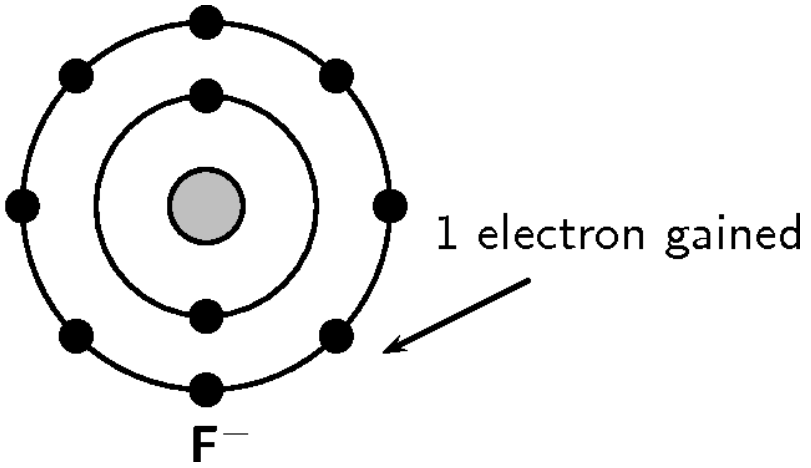
Family: **Noble gases**

valence e$^-$'s **8**

Group 17: Halogens: One electron short of stability

- All halogens have _____ valence electrons.
- Halogens are extremely reactive → we can infer that having seven valence electrons is an _____ arrangement.
- Gaining an electron would make these atoms stable.
- Fluorine is **the** most reactive non-metal.





Neutral fluorine atom

#p = 9

#e = 9

unstable

Charged fluoride ion

#p = 9

#e = 10

Overall charge: 1-

stable

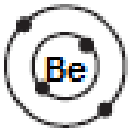
lithium

Group #**1**

Family: **Alkali metals**

valence e-'s **1**

beryllium



Group #**2**

Family: **Alkali Earth Metals**

valence e-'s **2**

fluorine

Group #**17**

Family: **Halogens**

valence e-'s **7**

neon

Group #**18**

Family: **Noble gases**

valence e-'s **8**

Group 1: Alkali Metals: One electron beyond stability

- All alkali metals have _____ valence electron.
- These are the most reactive metals → their electron arrangement is also _____.
- Losing an electron would make these atoms stable.
- The most reactive alkali metals are the _____ ones (_____ and _____)

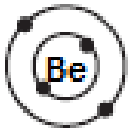
lithium

Group #**1**

Family: **Alkali metals**

valence e$^-$'s **1**

beryllium



Group #**2**

Family: **Alkali Earth Metals**

valence e$^-$'s **2**

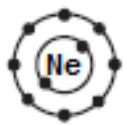
fluorine

Group #**17**

Family: **Halogens**

valence e$^-$'s **7**

neon



Group #**18**

Family: **Noble gases**

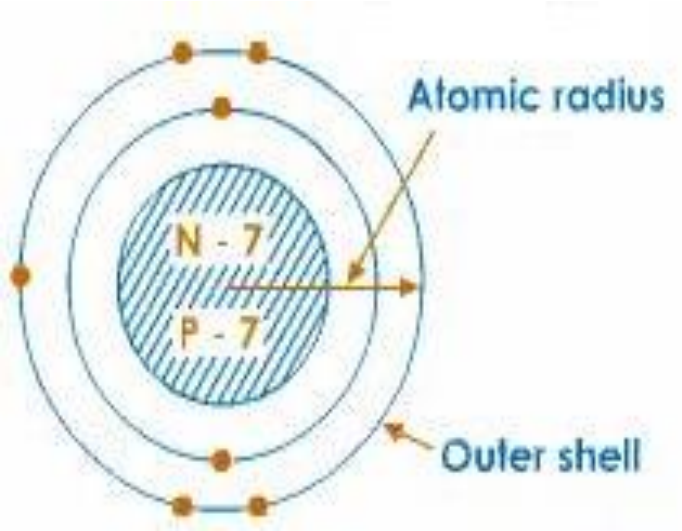
valence e$^-$'s **8**

Group 2: The Alkaline Earth Metals: Two electrons beyond stability

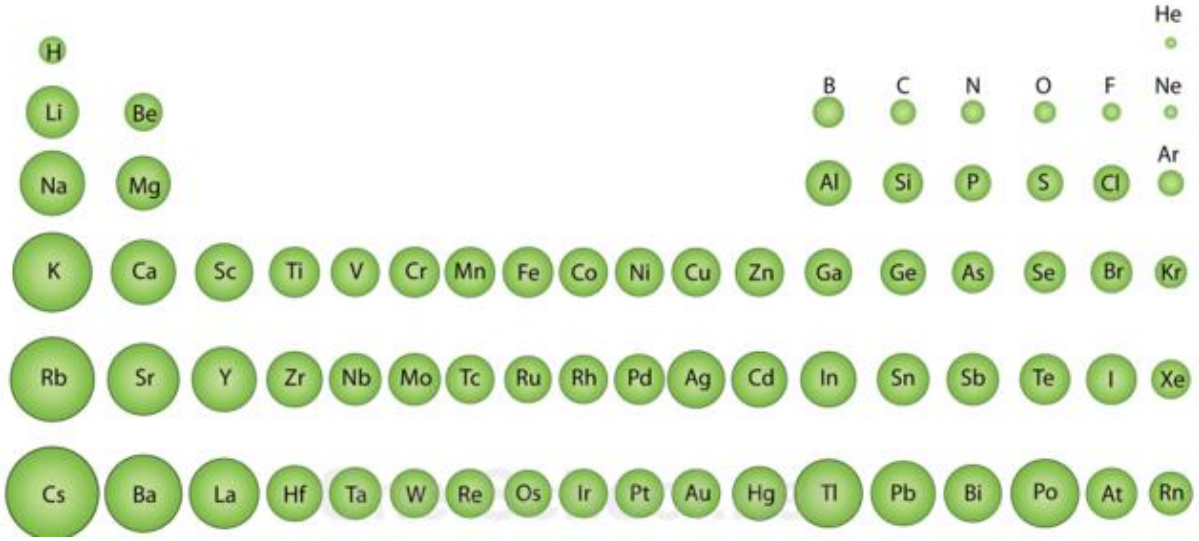
- All alkaline earth metals have _____ valence electrons.
- Losing _____ electrons would make these atoms stable.

Atomic Size

Atomic radius - the distance from the nucleus to its valence electrons.



In general, the following trends are observed:



(1) Moving **down** a group:

The atomic radius **increases**.

- More electron **shells** = Larger radius

(2) Moving **across** a period :

The atomic radius **decreases**.

- more **protons** in the nucleus = stronger **attraction** to electrons
- all electrons are pulled in tighter

Reactivity Within a Group

Demo: Alkali Metals and Water

A. What trend was observed for reactivity?

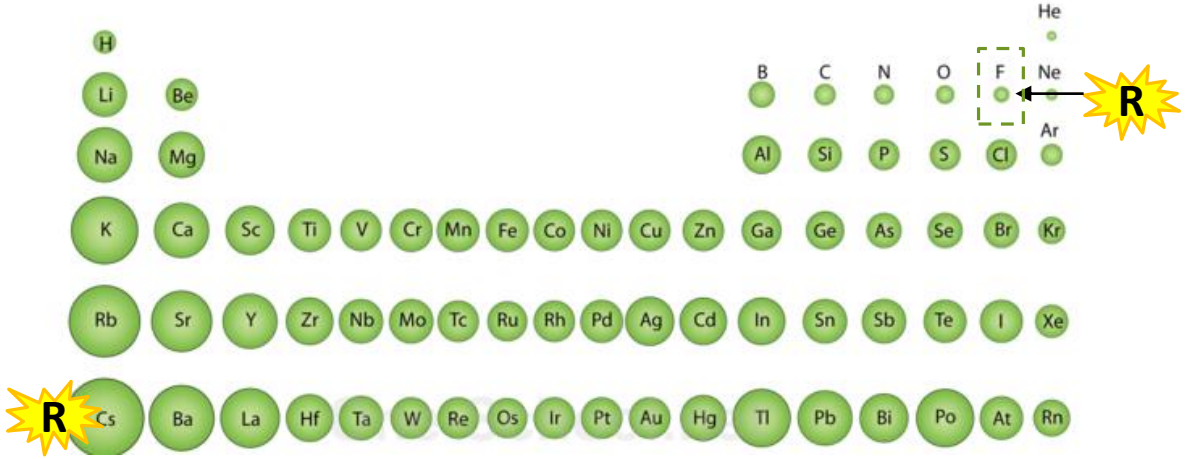
B. An element's ability to react is related to how easily it is able to form a stable charged ion. When metals form ions, do they gain or lose electrons?

C. Based on what you observed, which metals (top or bottom) will more easily form ions? How can this be explained, using what you know about atomic structure?

D. Which metal will be the **most** reactive in the group?

E. Will this same trend be observed for non-metals? Explain why or why not.

The **ability of a nucleus to attract electrons** influences not only atomic size, but the **reactivity** as well.



*For a **metal**,*

- metals **lose** electrons to achieve stability
- larger radius= more reactive
  - the positive nucleus can't hold on as tightly to the negative electrons

*For a **non-metal**,*

- non-metals **gain** electrons to achieve stability
- smaller radius = more reactive
  - the positive nucleus has a better chance at attracting negative electrons

Homework

Read 5.4 (pg. 207-210)

Complete package (pg. 3&4 – Summary)