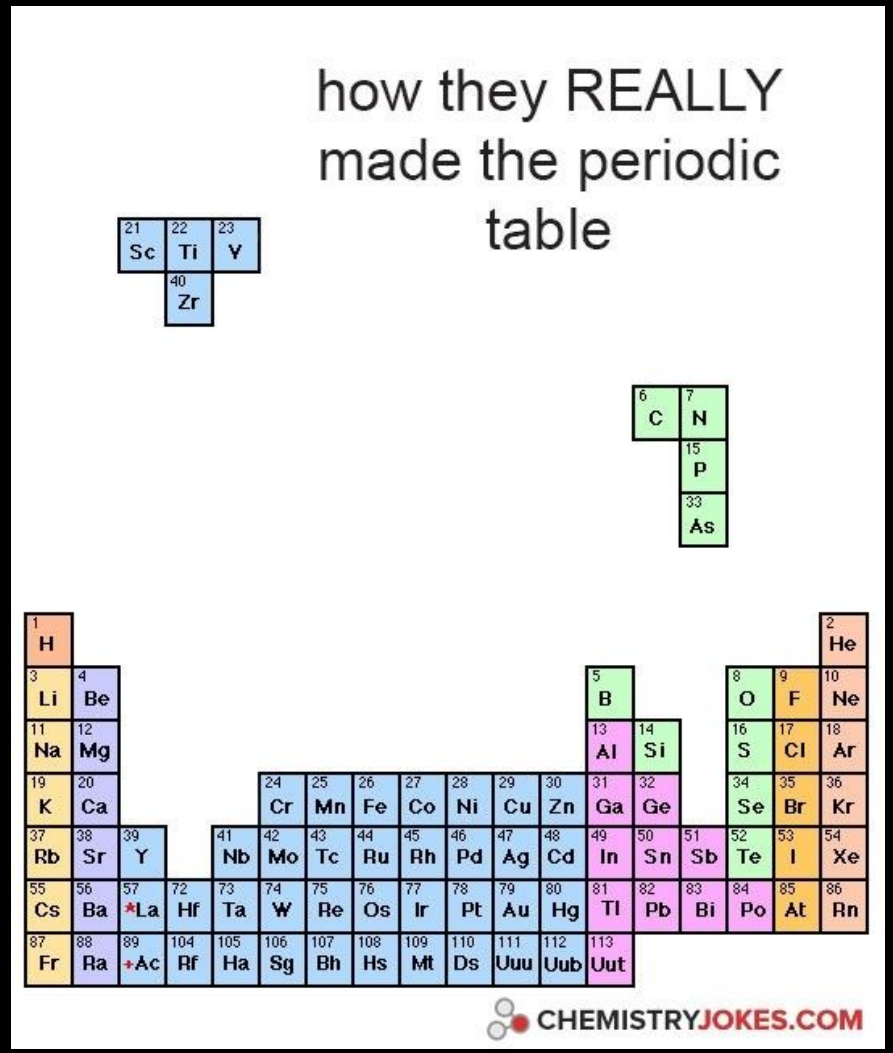
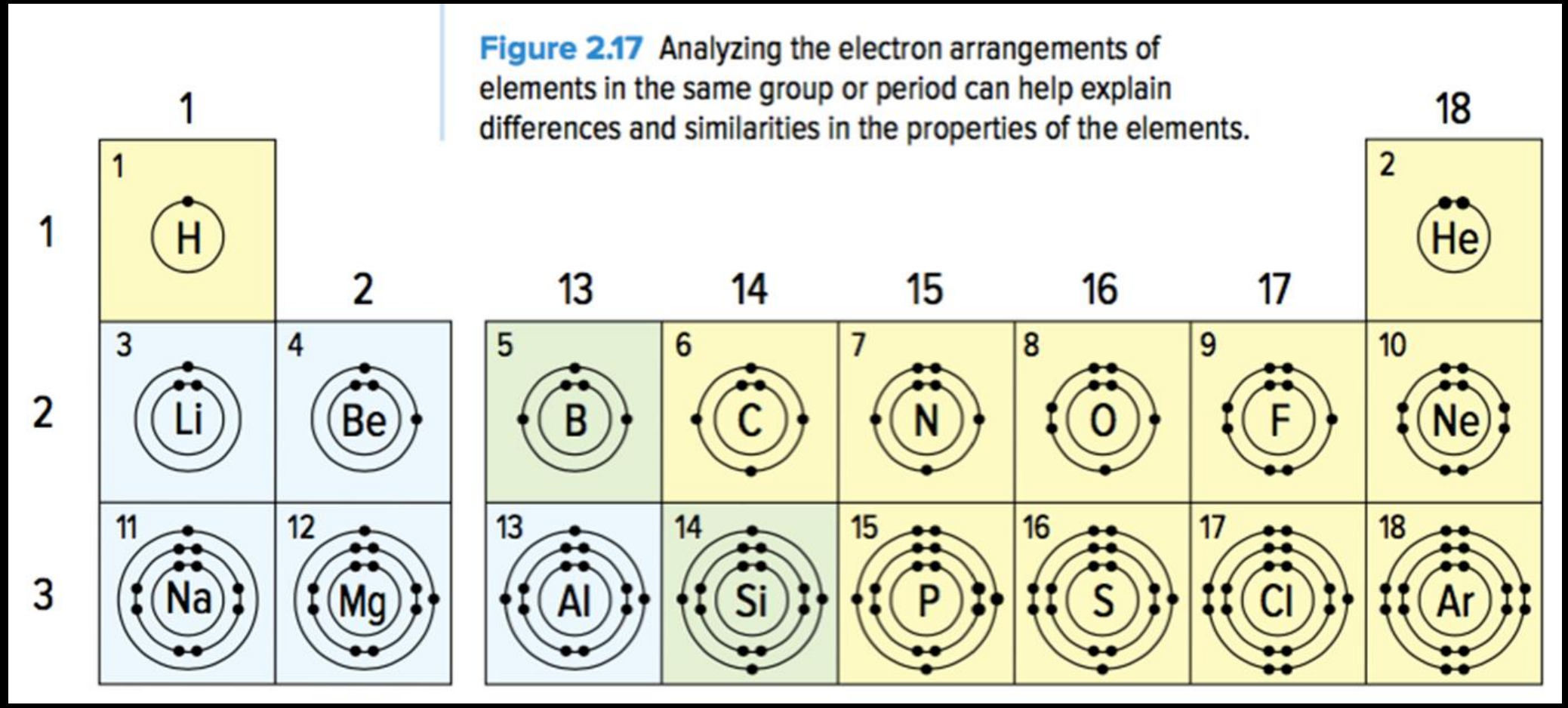


Periodic Trends

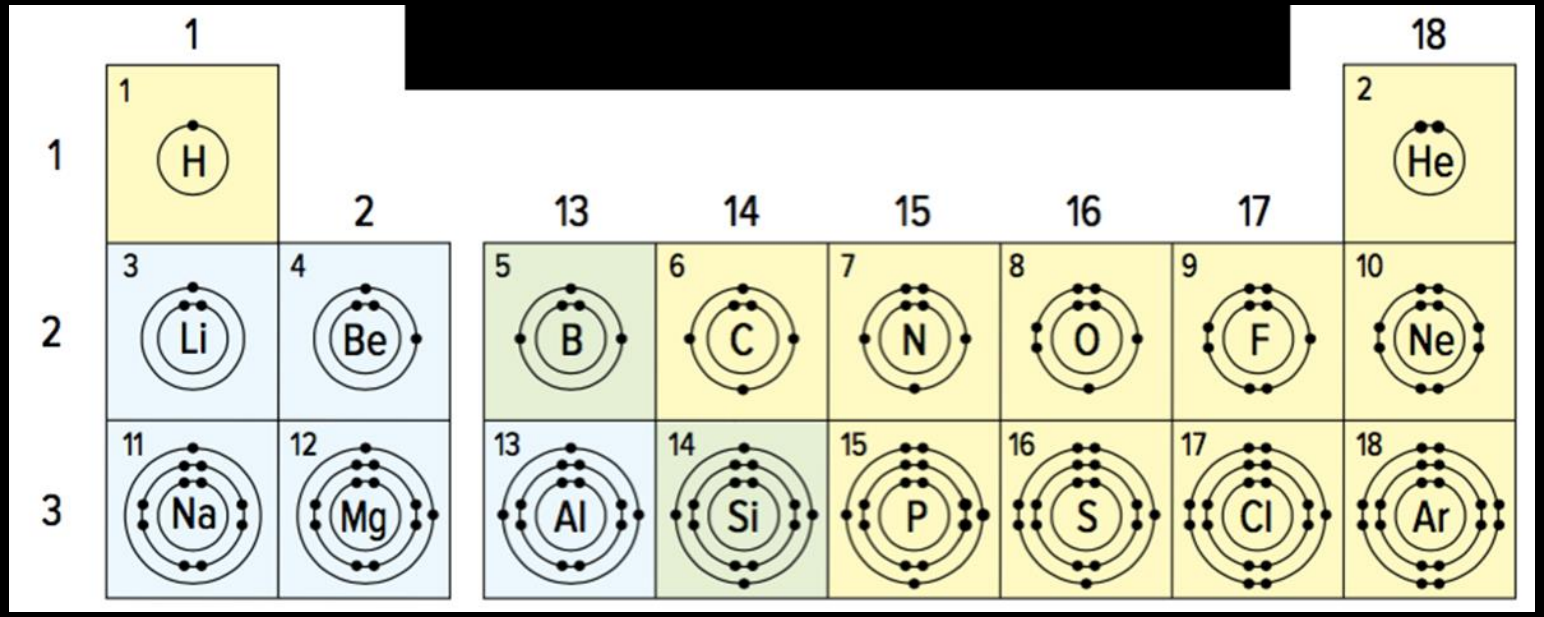
Continued

Elements in chemical groups have similar electron arrangements



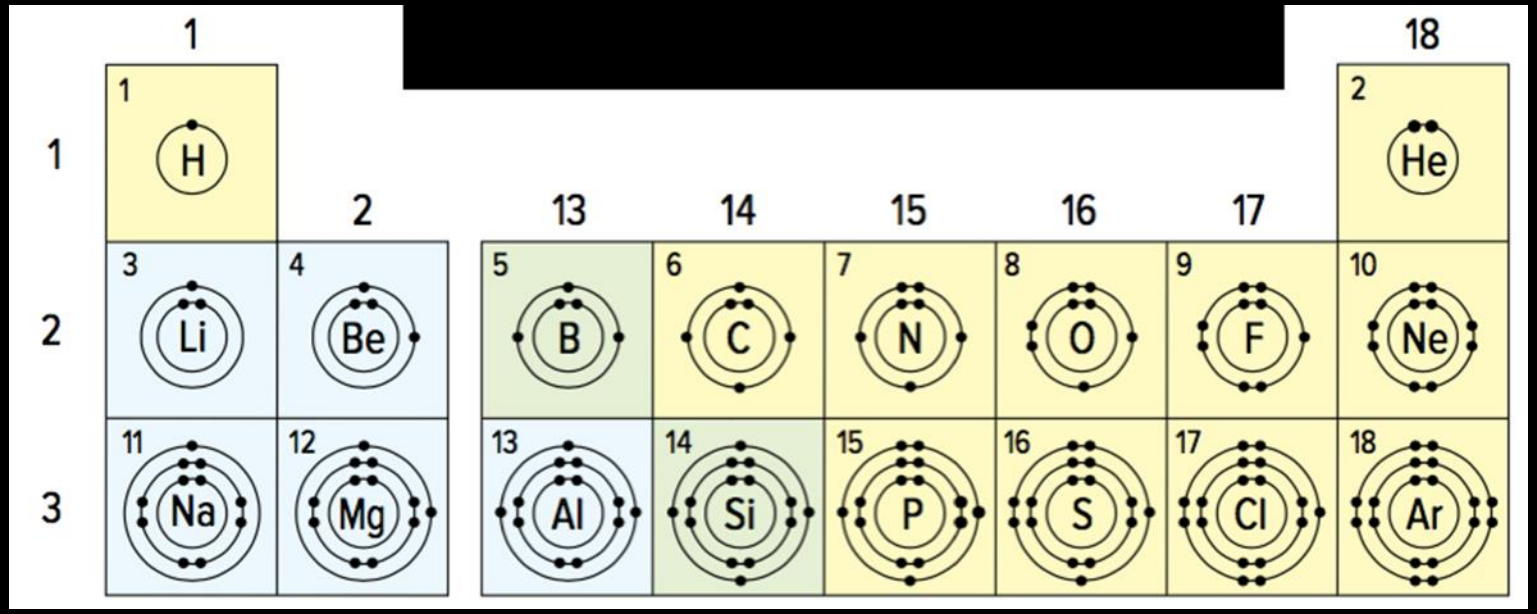
Atoms in the same group have the same number of valence electrons

- Group 1: One valence electron
- Group 2: Two valence electrons
- Groups 13-18: 3, 4, 5, 6, 7, 8 valence electrons
- Exception: Helium has 2 valence electrons (other noble gases have 8 valence electrons)



Atoms in the same period have the same number of occupied energy shells

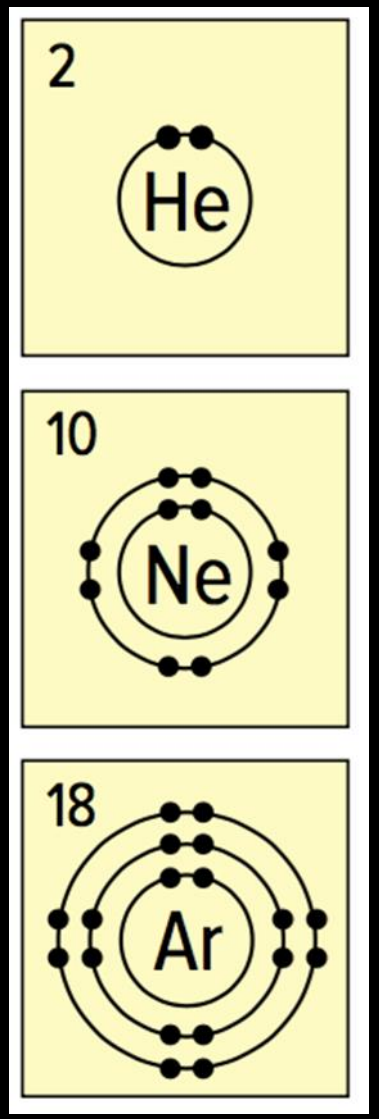
- First period (hydrogen and helium): One occupied energy shell
- Second period: Two occupied energy shells
- Third period: Three occupied energy shells



Noble Gas Stability: A Full Valence Shell

- During a chemical reaction, atoms lose, gain or share valence electrons with other atoms

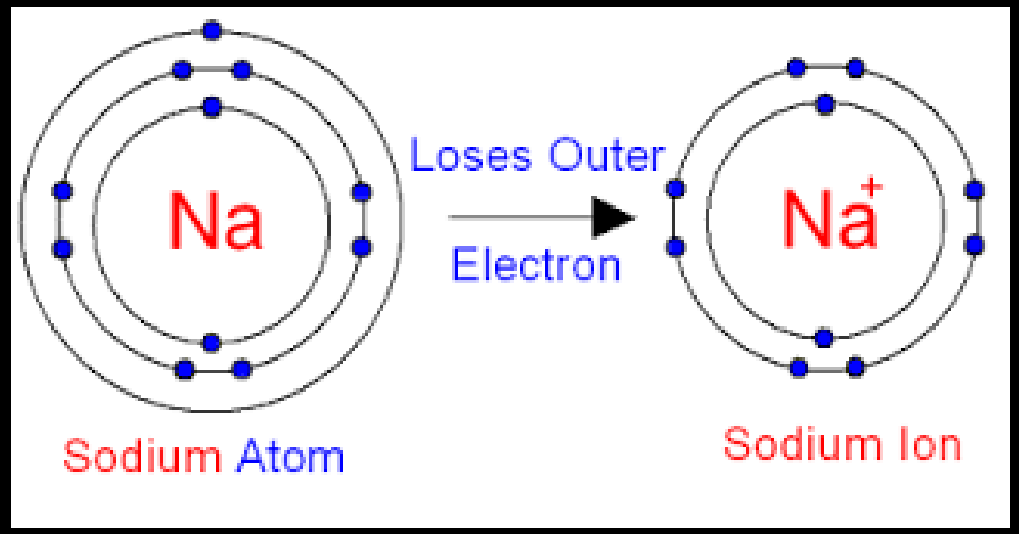
- Noble gases are stable (unreactive) because they have full valence shells
  - Their atoms do not tend to gain, lose, or share electrons



How Other Elements Achieve Full Valence Shells

Other elements can achieve a full valence shell by gaining or losing <u>electrons</u> during a chemical reaction

- When a neutral atom gains or loses an electron, it becomes an **<u>ion</u>**
  - Loses an electron: becomes positively charged ion
  - Gains an electron: becomes a negatively charged ion



Reactivity of an element is linked to how close it is to having a full valence shell

- Most reactive elements: Groups 1 and 17 (elements are only one electron away from a full valence shell)

- Example: Sodium (group 1) easily gives up an electron
- Example: Fluorine (group 17) readily gains an electron to complete their valence shell

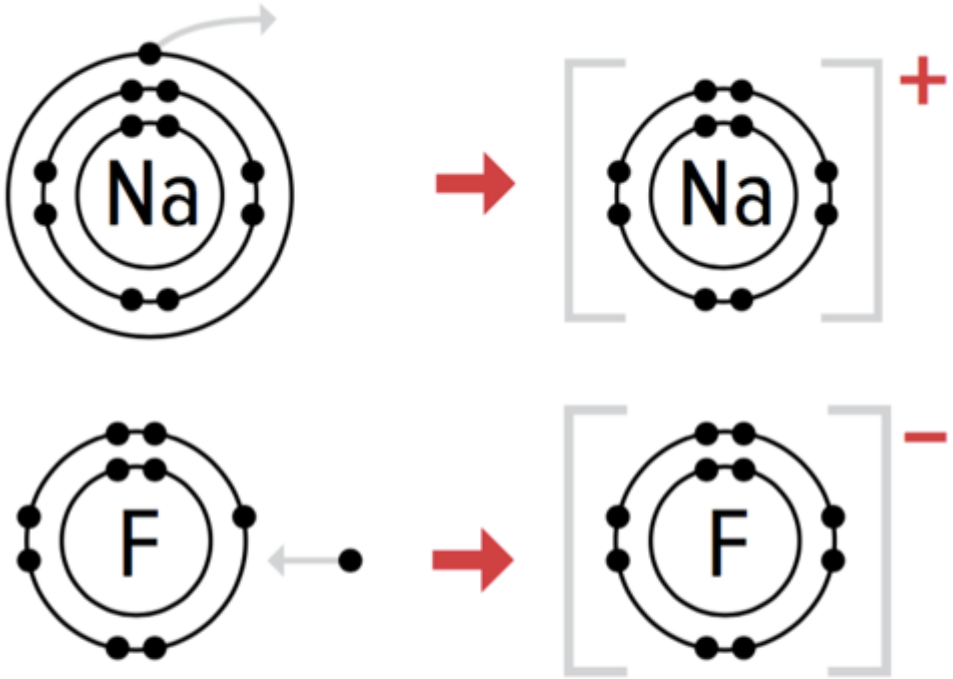
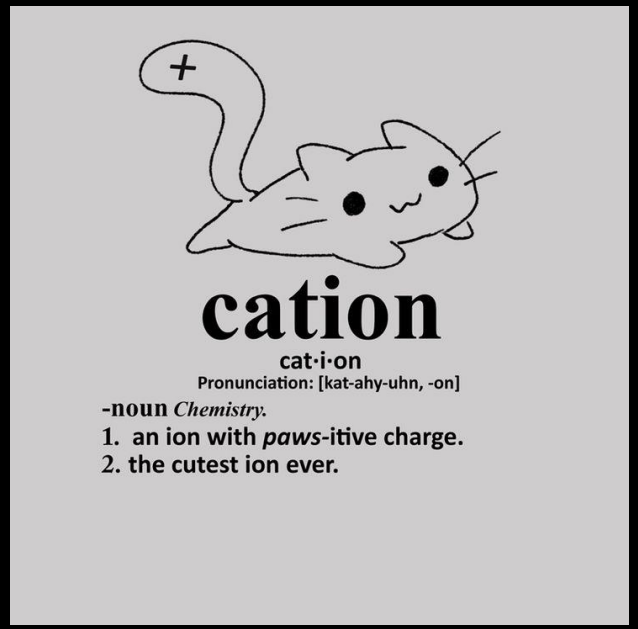


Figure 2.19: Formation of sodium (Na, top) and fluorine (F, bottom) ions.

Discussion Questions

1. Explain why metals tend to lose electrons and non-metals tend to gain them.

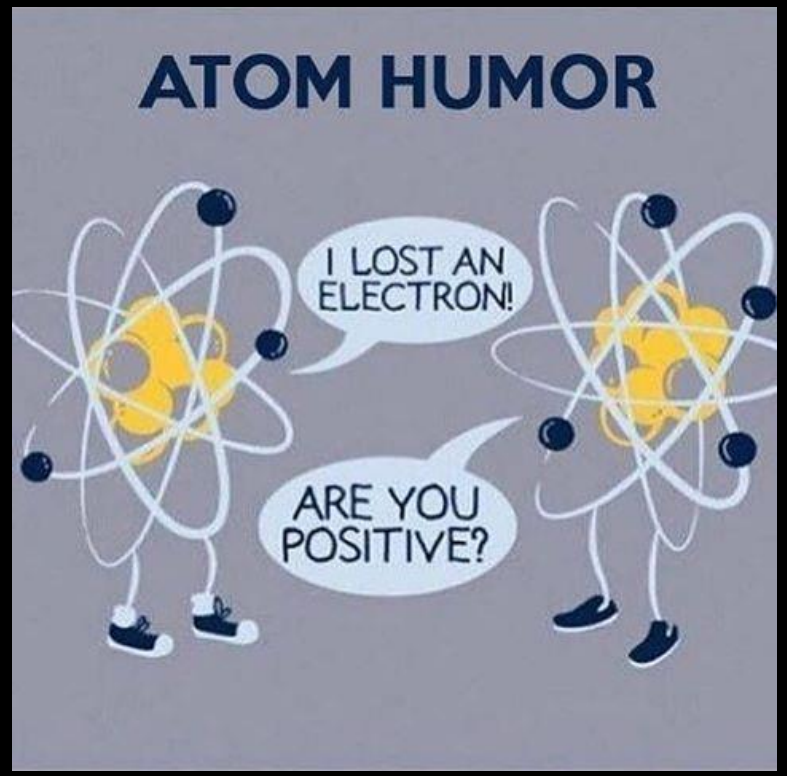


2. Draw a chlorine atom/chloride ion
3. Draw a potassium atom/ion
4. Draw an argon atom

5. Use diagrams to compare the electron arrangements of a chloride ion, a potassium ion, and an argon atom.

Time Out

- Complete pages 74-75 in workbook



The periodic table shows how properties of elements change in predictable ways

Periodic trend:

- A regular variation in the properties of elements based on their atomic structure
- Periodic table can analyze these trends because it can help you compare variations in groups and periods

Atomic Size Trends: Atomic Size Increases Moving Down a Group

Atomic size increases moving down a group

- As you move down a group, elements have atoms with increasing numbers of energy shells
- The greater the number of shells, the farther the valence electrons are from the nucleus, and the larger the atom

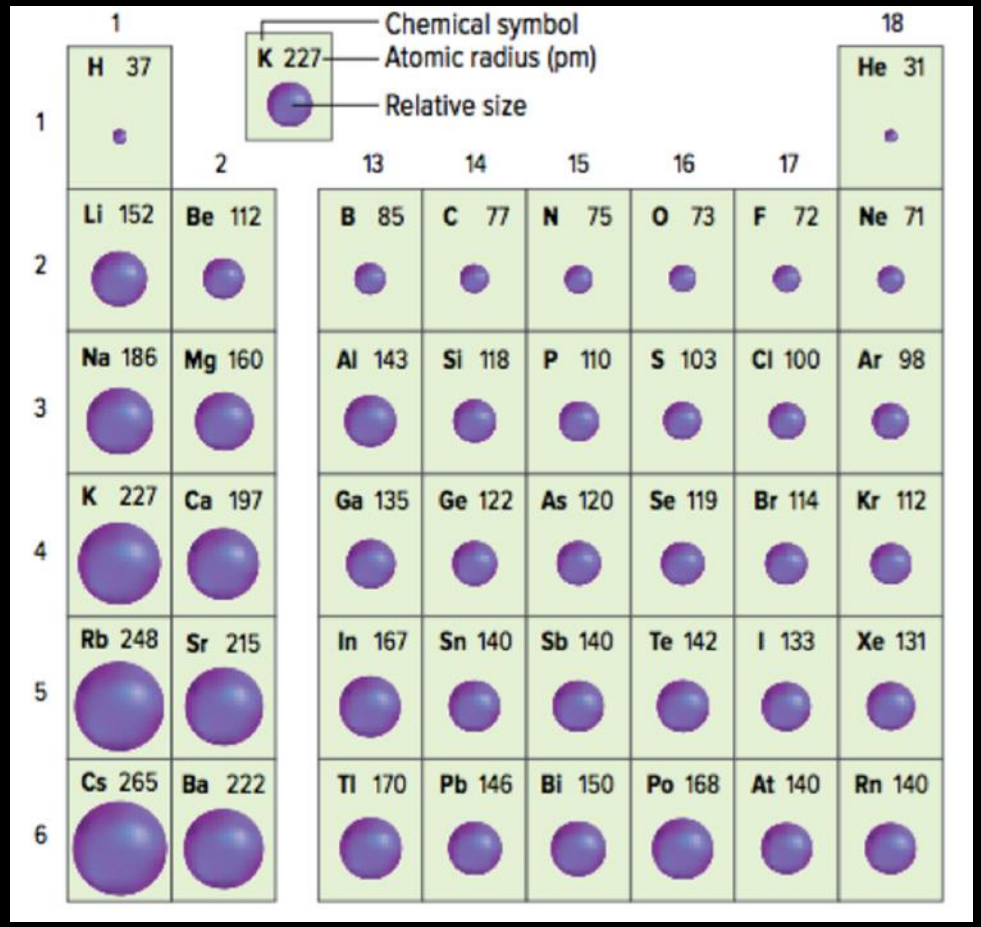


Figure 2.20: Atomic size is represented by the spheres. The number under each element is the radius of the atom in picometres (pm).

Atomic Size Decreases Moving Left to Right Across a Period

Atomic size decreases moving left to right across a period

- Elements have increasing numbers of electrons across a period
- Number of occupied valence shells stay the same, but the number of protons in the nucleus increases
- How does this result in decreasing atomic size across a period?

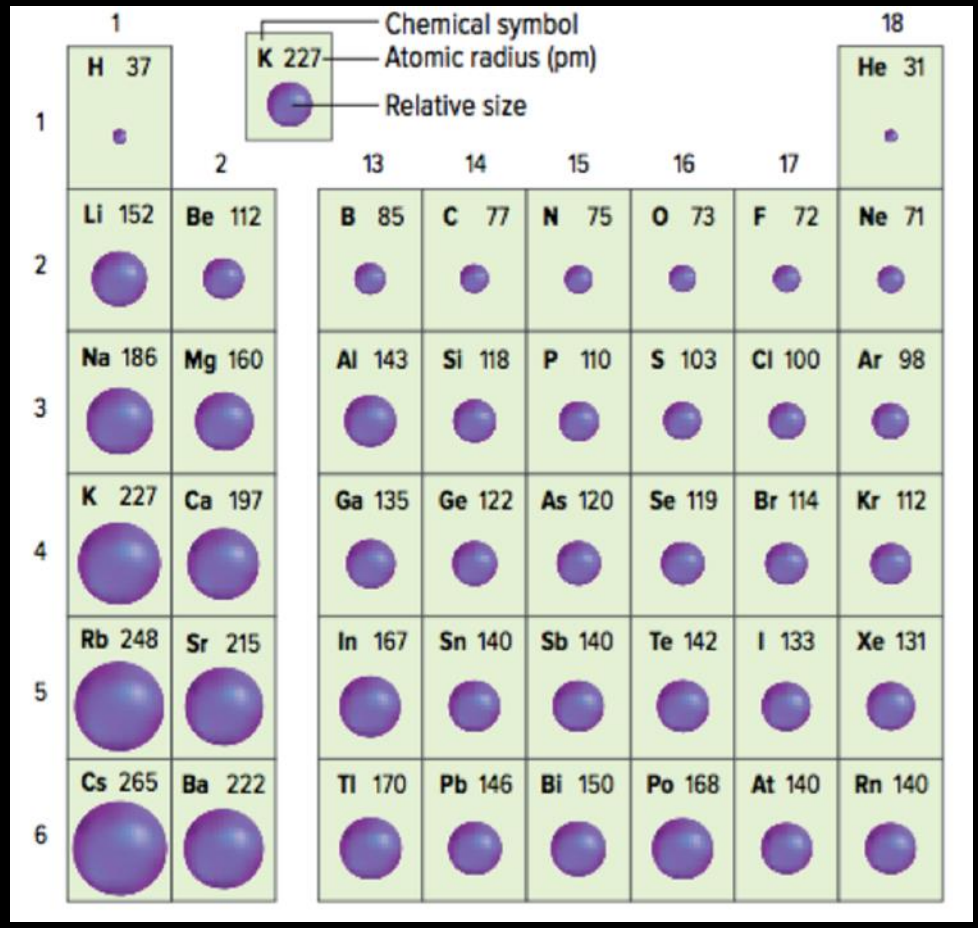


Figure 2.20: Atomic size is represented by the spheres. The number under each element is the radius of the atom in picometres (pm).

- Attraction between valence electrons and the nucleus increases because a greater positive charge on the nucleus pulls more strongly on the electrons

- Therefore, the electrons are pulled more tightly towards the nucleus, leading to decreasing atomic size

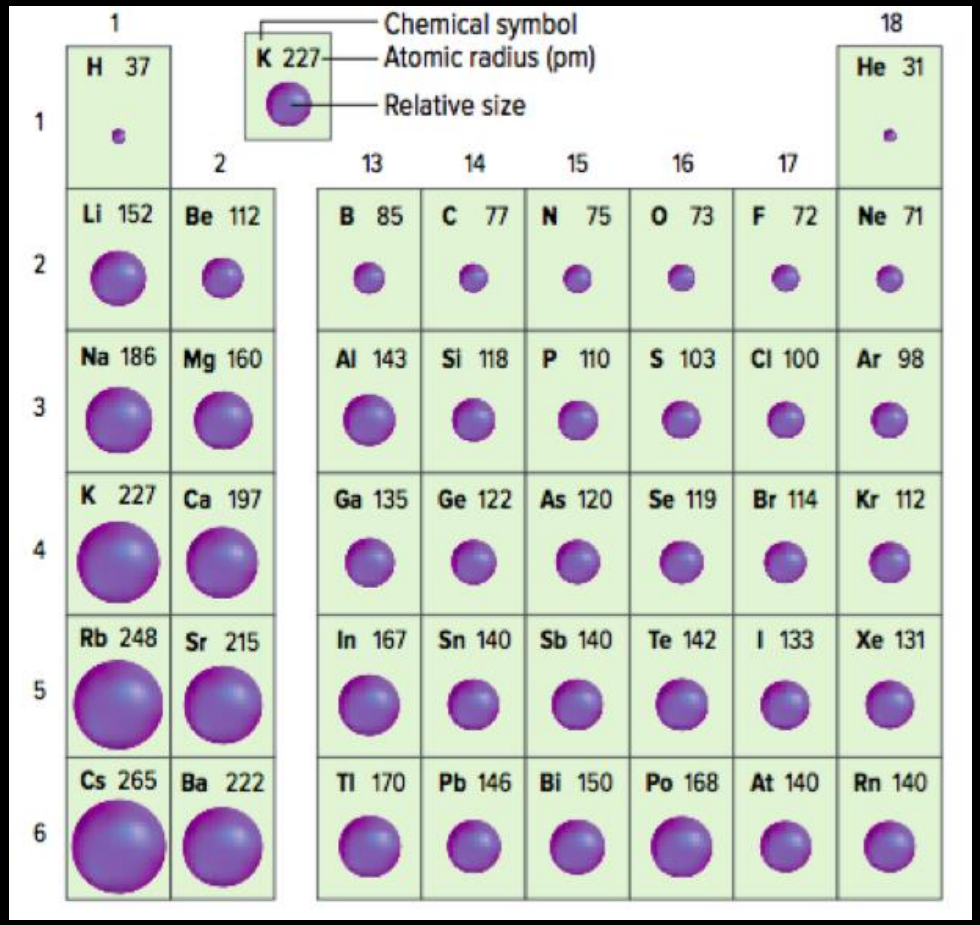


Figure 2.20: Atomic size is represented by the spheres. The number under each element is the radius of the atom in picometres (pm).

Metal Reactivity and Atom Size

Group 1 metals: Potassium is more reactive than sodium

- Both have one valence electron
- Potassium atom is larger than sodium
- Potassium atom's valence electron is farther away from the nucleus
  - Pull of the positive charge on the nucleus is weaker
  - Valence electron is easier to remove (less energy is needed to remove the electron)

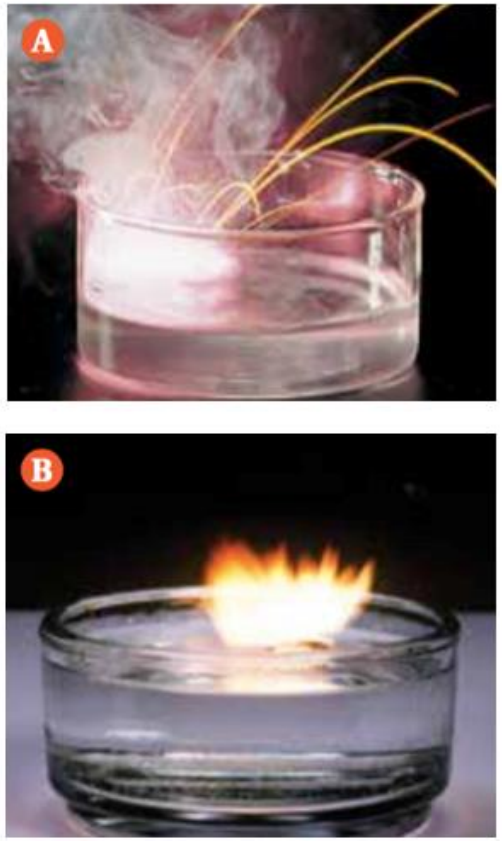


Figure 2.21: Potassium (A) is more reactive than sodium (B) because less energy is needed to remove the valence electron from potassium.

Discussion Questions

1. Explain why atoms get larger down a group on the periodic table.

2. Explain why atoms get smaller from left to right across a period on the periodic table.

3. Explain why an alkali metal is more reactive than an alkaline-earth metal in the same period.

4. Explain why larger atoms are more reactive than smaller atoms

Time Out

- Pages 76-80 in workbook

Reactivity Trends Lab