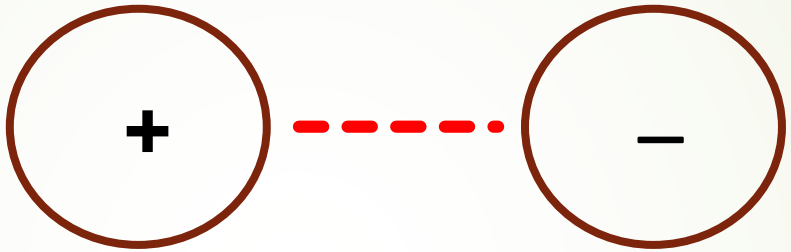
Naming Ionic Compounds

Part 1: Cations, Anions, and Ionic Bonds

By Shawn P. Shields, Ph.D.

What are Ionic Bonds?

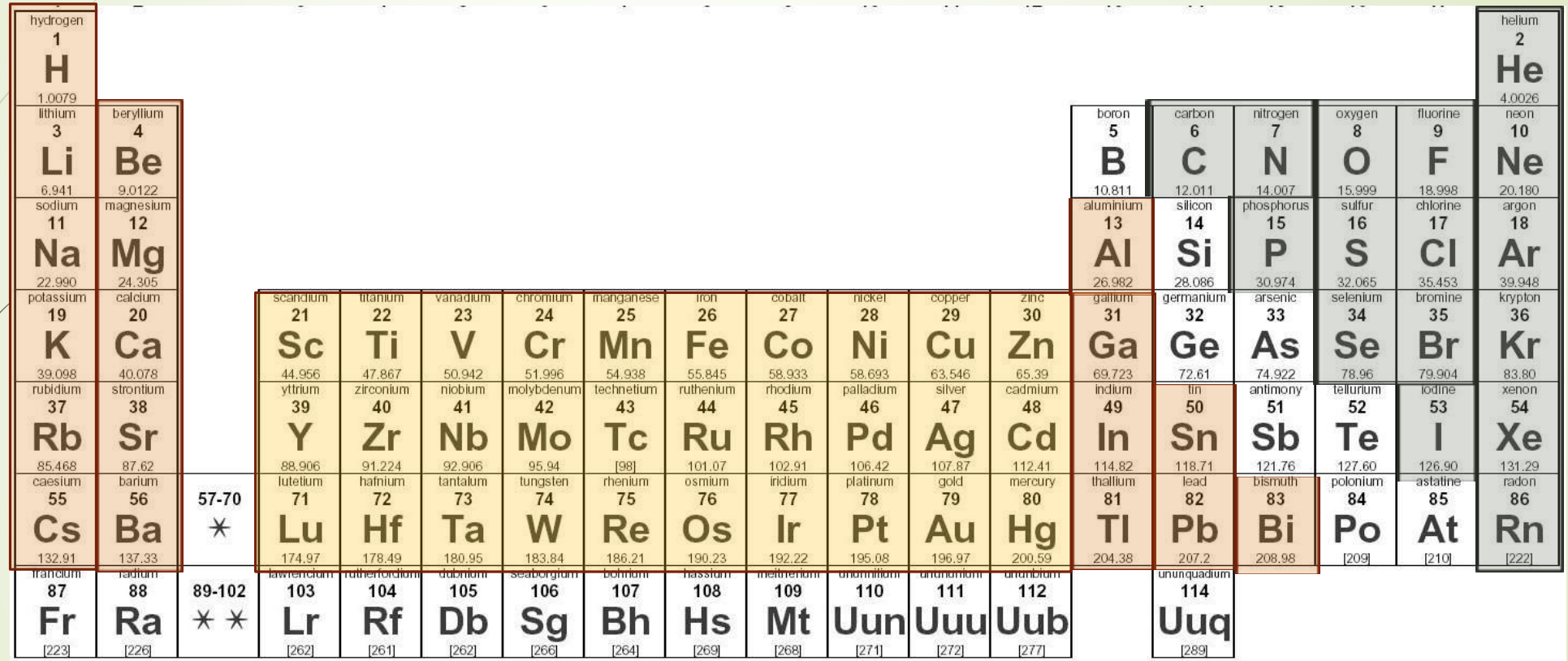
- Ionic bonds are formed by electrostatic attractions between oppositely-charged ions



Recall:

- **<u>Cations</u>** are formed when an atom **loses electrons** to form a ***positively-charged ion.*** **(X^{n+})**
- **<u>Anions</u>** are formed when an atom **gains electrons** to form ***a negatively-charged ion.*** **(X^{n-})**
- Ionic bonds are generally formed between metals and nonmetals.

Recall: Identifying Metals and Nonmetals on the Periodic Table

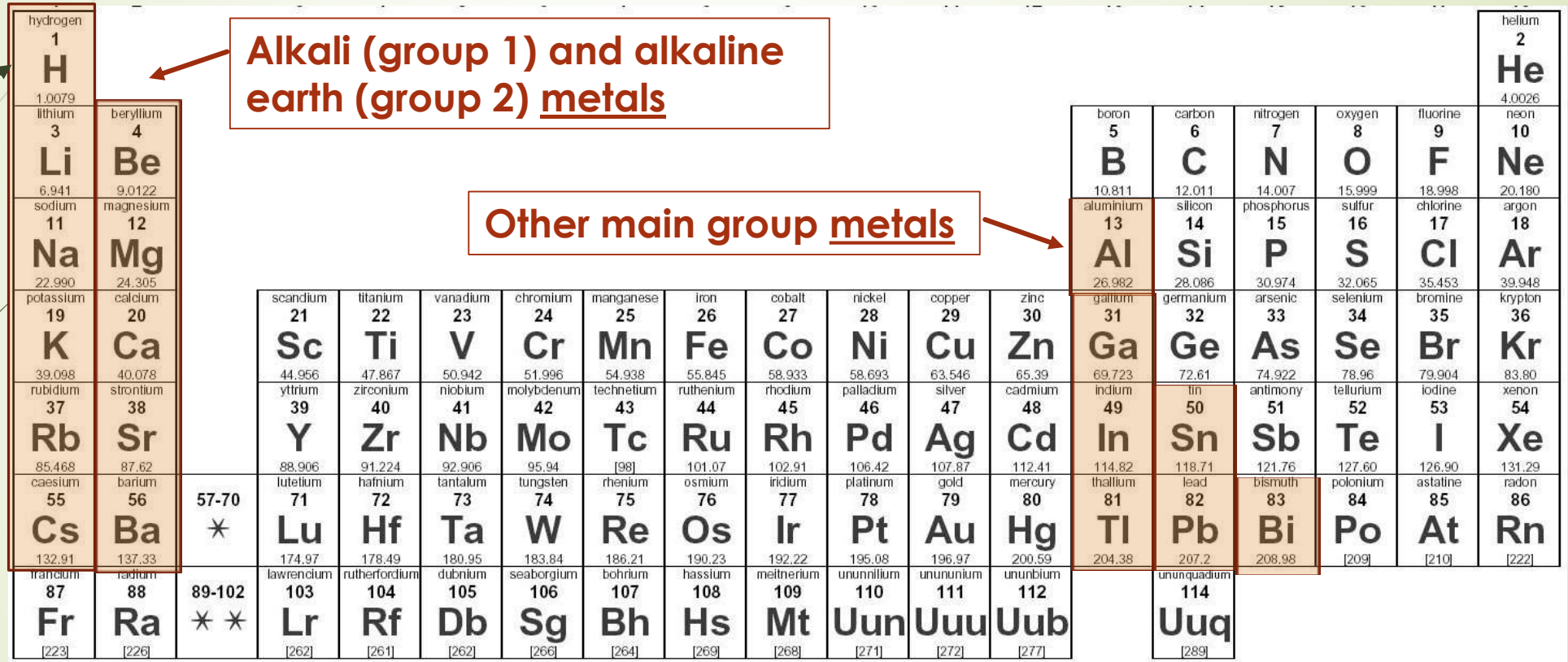


Main Group Metals

Hydrogen (H) is considered a nonmetal, even though it is in group 1. H usually forms H+ ions.

Alkali (group 1) and alkaline earth (group 2) metals

Other main group metals

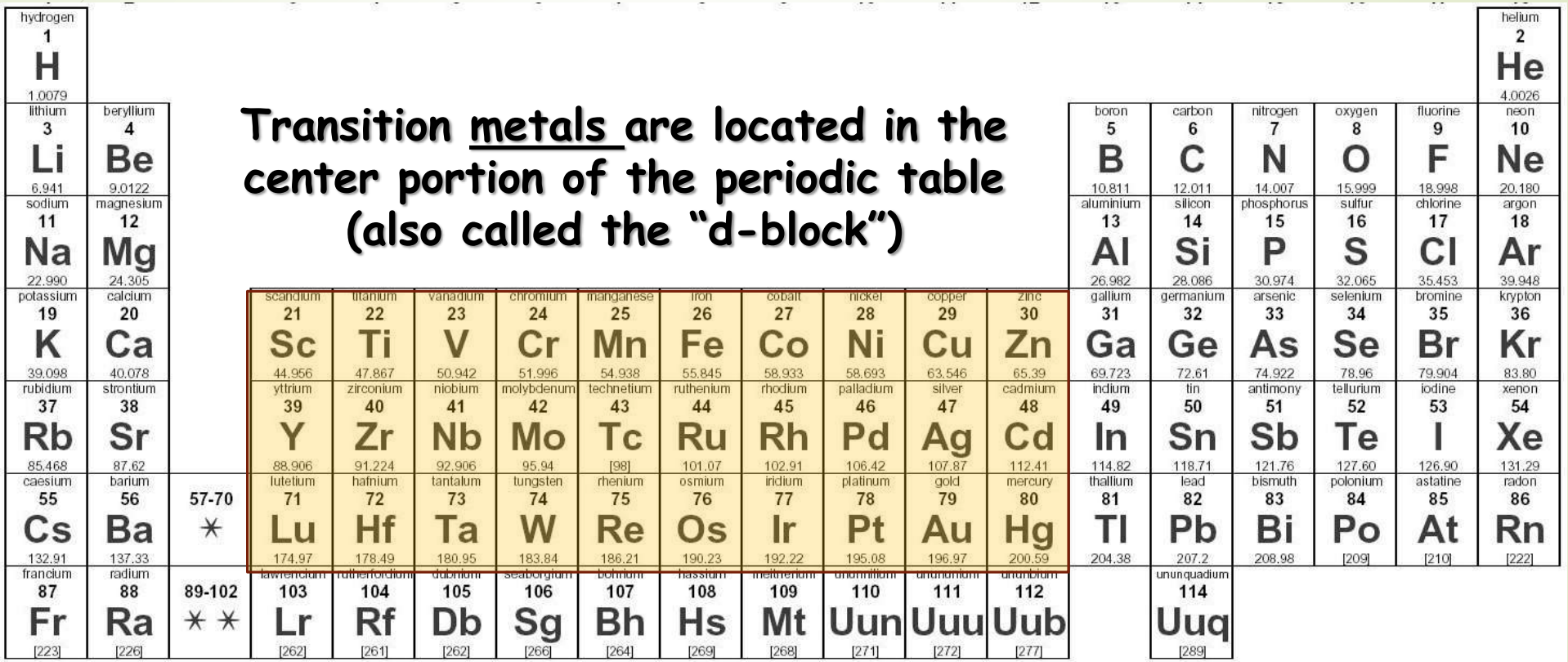


Main Group Metals

- Metals form cations (positively-charged ions).
  - **Examples:**
    - **Sodium cation (Na^+) in Group 1**
    - **Magnesium cation (Mg^{2+}) in Group 2**
    - **Aluminum cation (Al^{3+}) in Group 3**
- Main group metal cations have a **positive charge** equal to the *group number*.
- **Hydrogen (H) is considered a nonmetal, even though it is in group 1.**
- **H usually forms H^+ ions, except when bonded to metals.**

Transition Metals

Transition metals are located in the center portion of the periodic table (also called the "d-block")

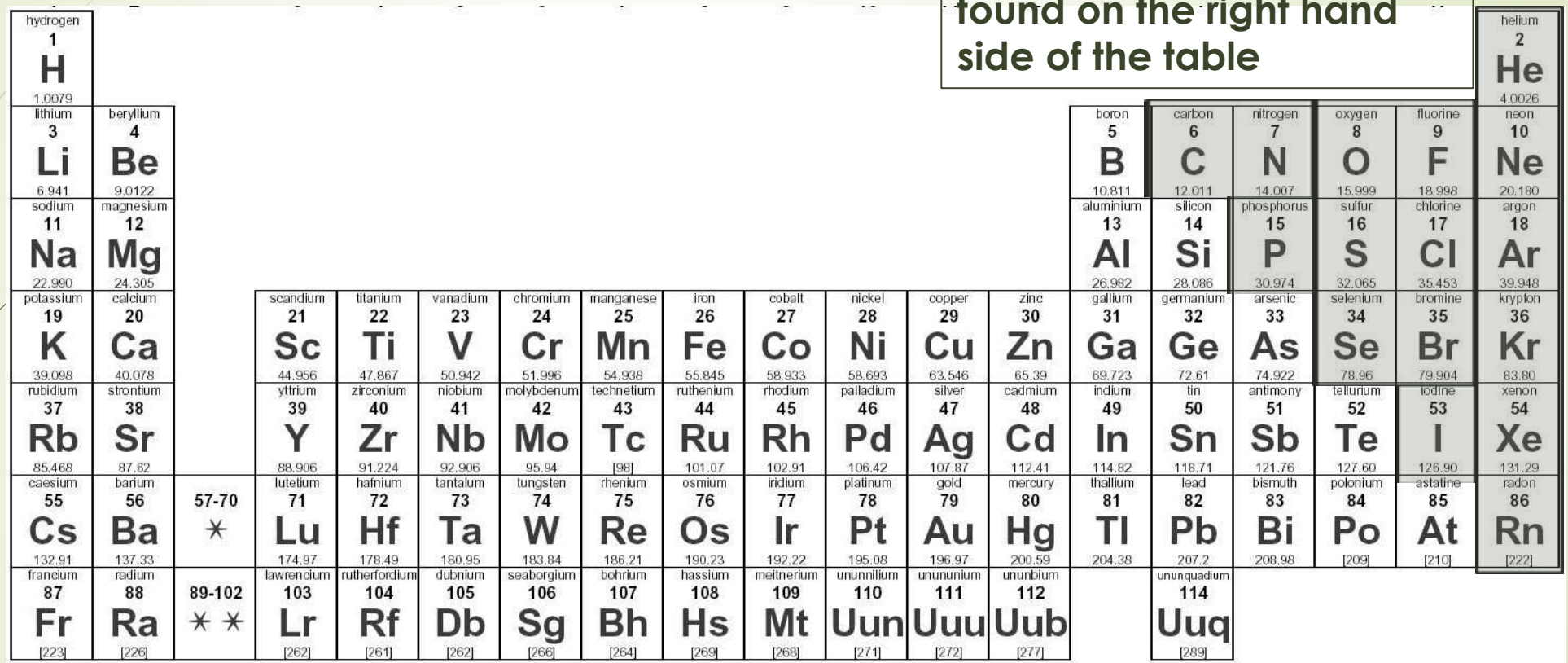


Transition Metals

- Transition metals form cations (positively-charged ions).
- Most have more than one possible charge for the cation.
  - **Examples:**
    - **Iron: Fe^{2+} and Fe^{3+}**
    - **Copper: Cu^{+} and Cu^{2+}**
    - **Gold: Au^{+} and Au^{3+}**

Nonmetals

Nonmetals are generally found on the right hand side of the table

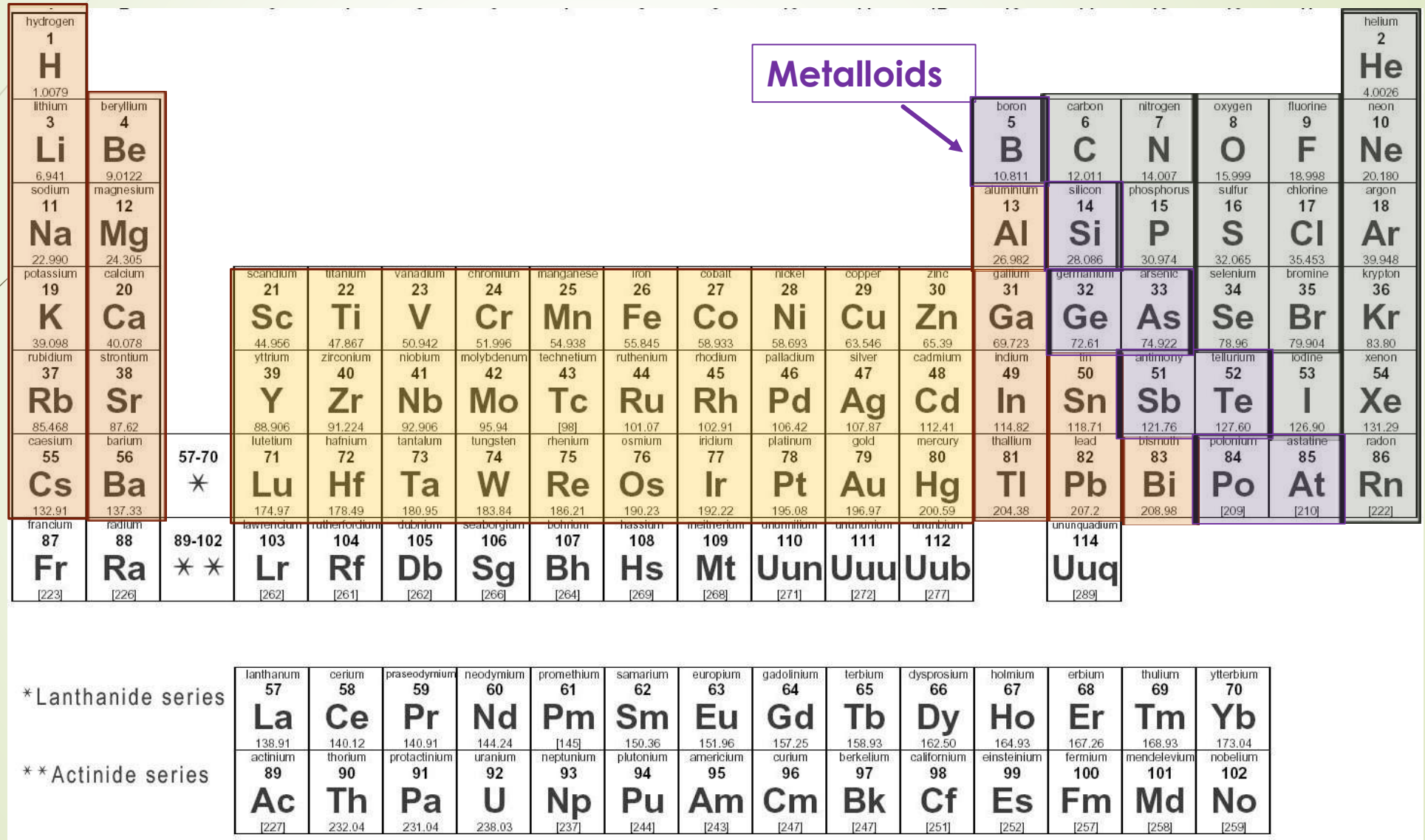


Nonmetals in Ionic Compounds

- Nonmetals generally form anions (negatively-charged ions) when in ionic compounds.
  - **Examples:**
    - **Chloride anion (Cl^-)**
    - **Oxide anion (O^{2-})**
    - **Sulfide anion (S^{2-})**

- Nonmetals form *covalent*, as opposed to *ionic*, bonds when bonded to other nonmetals.
- Noble gases (group 8) do not form ions.

Identifying Metals and Nonmetals on the Periodic Table



Metalloids

- Metalloids (generally) form *covalent* as opposed to ionic bonds in compounds.
- In particular, compounds composed from a nonmetal and a metalloid contain covalent bonds.

Summary

- Metals form cations in ionic compounds.
  - Cations are *positively-charged ions.*
  - When a cation is formed, the atom *loses* electrons.
- Nonmetals form anions in ionic compounds.
  - Anions are *negatively-charged ions.*
  - When an anion is formed, the atom *gains* electrons.
- Ionic compounds form between metals and nonmetals.
  - An ionic bond is an electrostatic attraction between oppositely-charged particles (ions).