# Module 2: What is a "Chemical Species"?

## The Periodic Table

Fundamentals of Chemistry Open Course

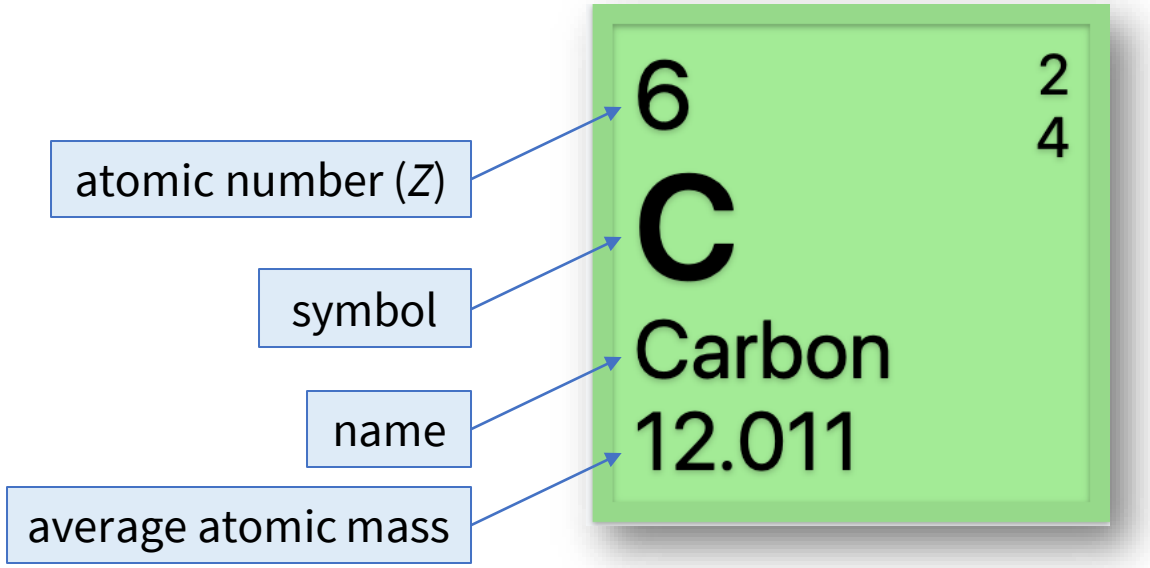
# Learning Objectives | Module 2

1. State and apply the laws of chemical combination.
2. State and apply the tenets of the modern atomic theory.
3. Visualize the subatomic particles that constitute the atom using a simple planetary model; count subatomic particles using atomic number (*Z*) and mass number (*M*).
4. Represent an atom or ion using an atomic symbol.
5. Represent the number ratios of atoms in a compound using a chemical formula.
6. Visualize and distinguish between submicroscopic models of molecular and ionic compounds.
7. Use the periodic table to efficiently find information about a chemical element.
8. Recognize key collections of elements on the periodic table.
9. Determine the name of a binary ionic compound from the chemical formula and *vice versa*.
10. Determine the name of a simple molecular compound from the chemical formula and *vice versa*.

# Organization of the Chemical Elements | 1 of 2

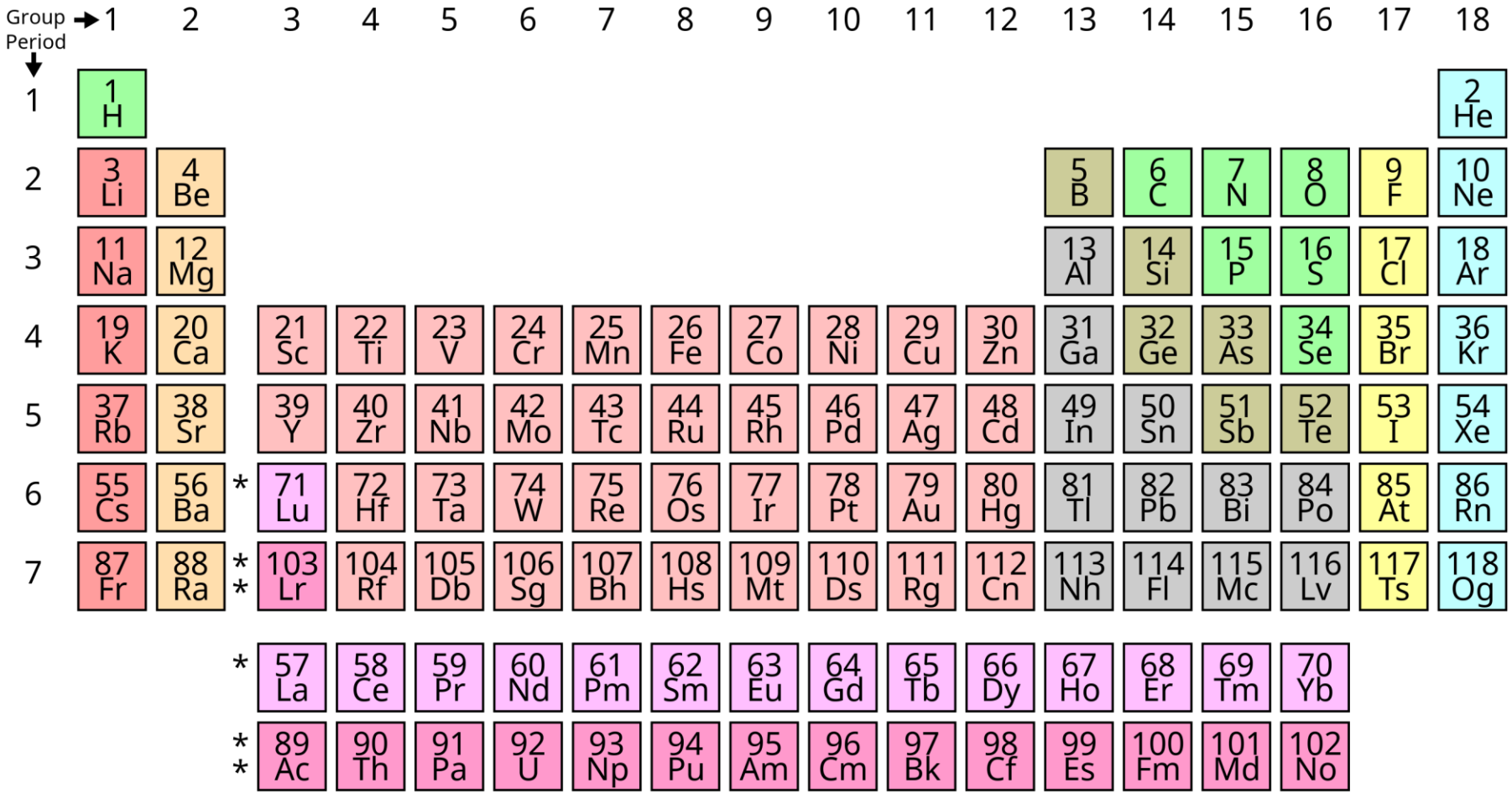
- Trends in the properties and chemistry of the elements observed throughout the 19th century led Mendeleev to organize them into a table, which has evolved to become the modern **periodic table**.

- Each entry in the table includes information about a single chemical element:
  - Name
  - Symbol
  - Atomic number
  - **Average atomic mass:** a weighted average of the masses of naturally occurring isotopes
  - …and sometimes more!



# Organization of the Chemical Elements | 2 of 2

- Each column (**group**) includes elements with analogous properties and reactivity.
- Across each row (**period**), consistent trends in properties such as the size of the atom are generally observed.



# Metals, Nonmetals, and Metalloids | 1 of 2

- Most of the elements are **metals:**
  - Silver-colored or dark-colored solids
  - Electrically and thermally conductive
  - Malleable
  - Oxidizable (cation forming)
  - Found mostly in ionic compounds

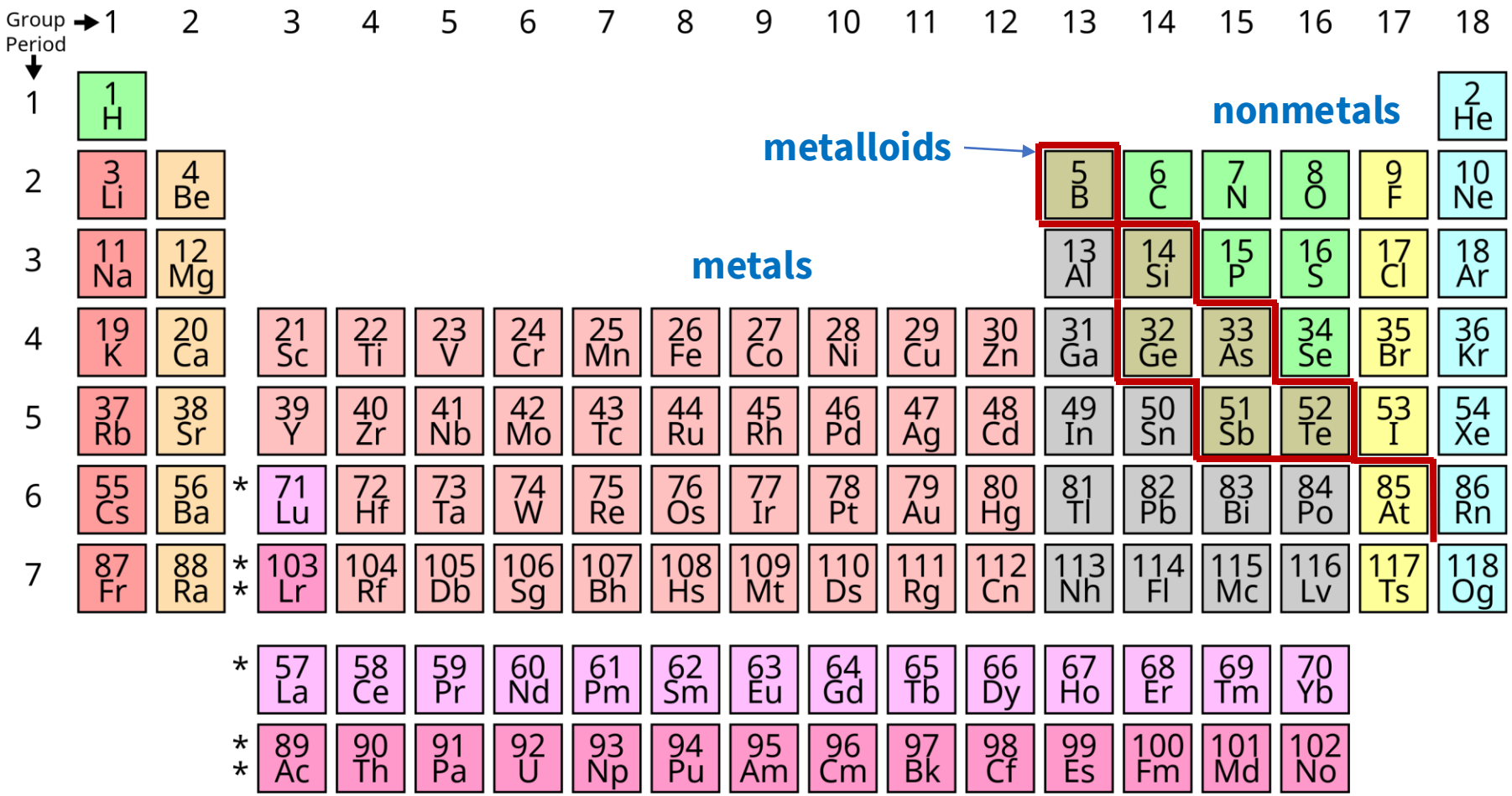

- A much smaller number are **nonmetals:**
  - Solids, liquids, or (most commonly) gases with various colors
  - Electrical insulators
  - Reducible (anion forming)
  - Found in molecular or covalent compounds

- A few elements are **metalloids**, with properties of both metals and nonmetals:
  - Electrically semiconductive
  - Found in both ionic and molecular or covalent compounds

Images from Wikipedia: metal, chlorine, carbon, bromine, and boron.

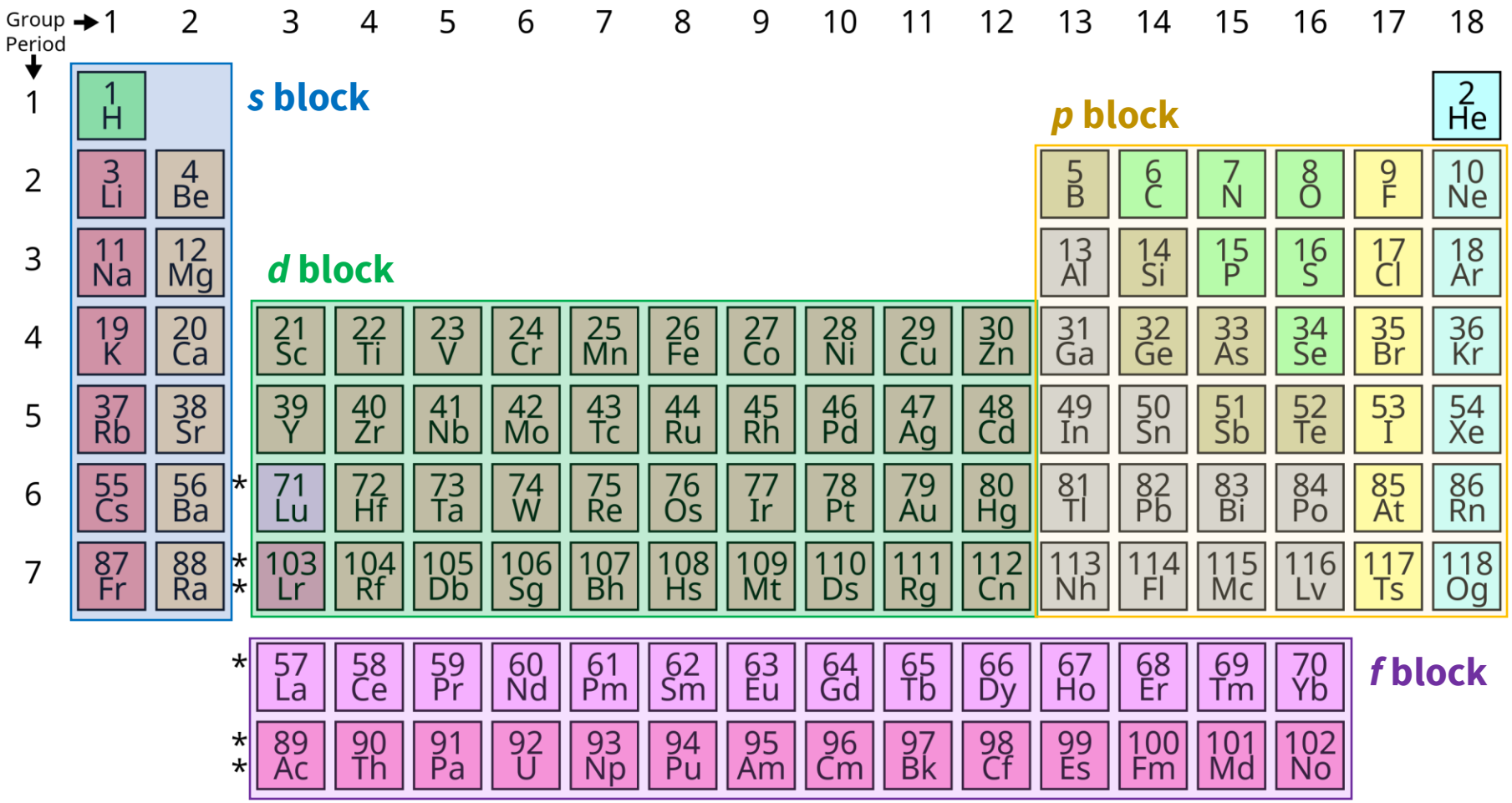
# Metals, Nonmetals, and Metalloids | 2 of 2

- Most of the elements are metals; metals are generally found to the left and at the bottom of the table.
- Nonmetals are found in the top right of the table. Hydrogen is a nonmetal.
- The elements boxed in red along the “diagonal” are metalloids.



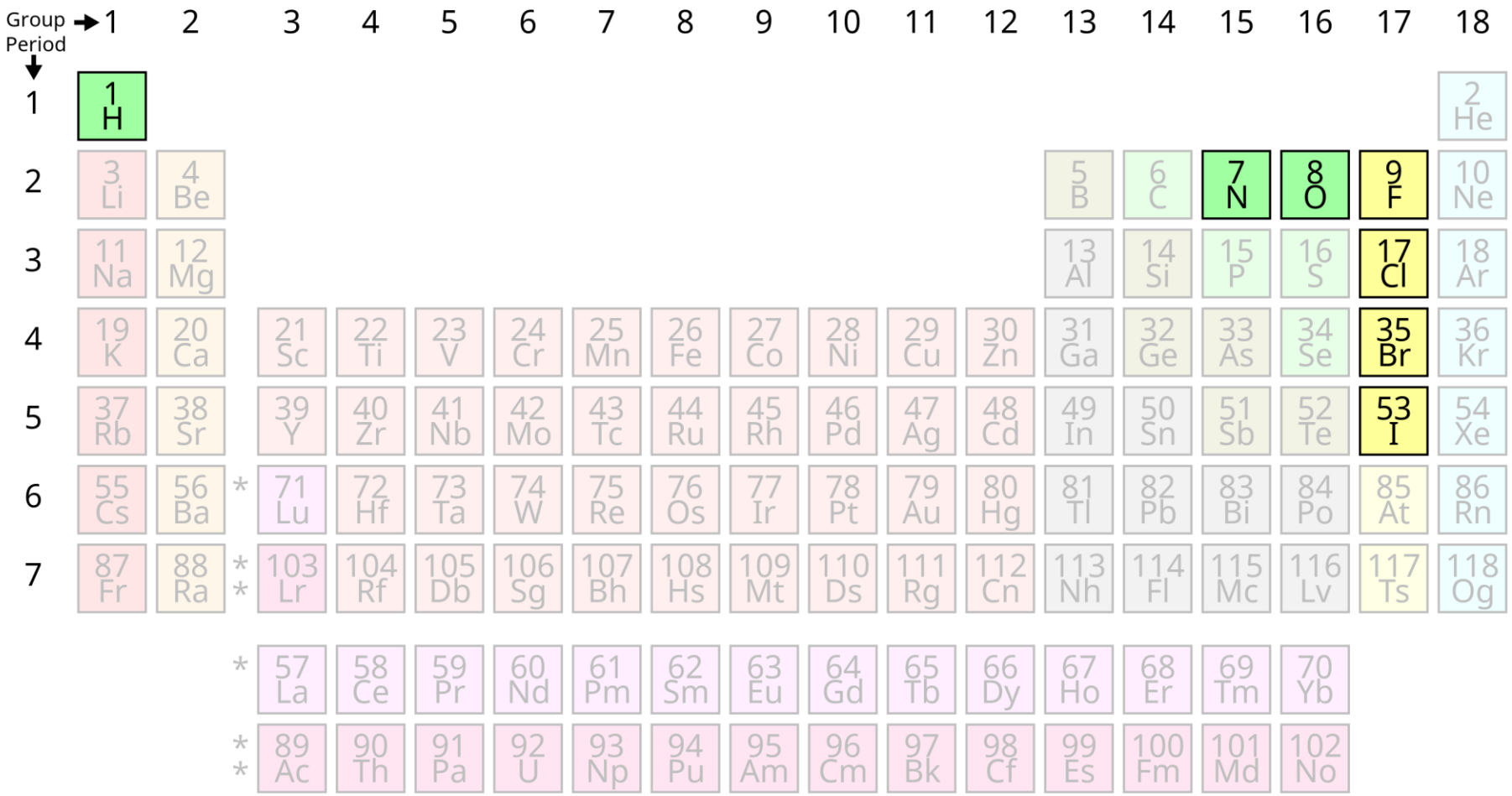
# Blocks of Elements

- The table is divided into four rectangular **blocks**: the *s* block, *p* block, *d* block, and *f* block.



# Diatomic Elements

- Seven nonmetals are diatomic in their elemental forms; these are worth committing to memory.
- $Br_2$, $I_2$, $N_2$, $Cl_2$, $H_2$, $O_2$, $F_2$: "Brinklehoff"



# Lingering Questions

- Why is the periodic table arranged the way it is? For example, why are there two columns in the *s* block, six in the *p* block, ten in the *d* block, and fourteen in the *f* block?

- One reason the periodic table is useful is that the elements display **periodic trends** in their properties. What are these properties and how do they vary across the periodic table?