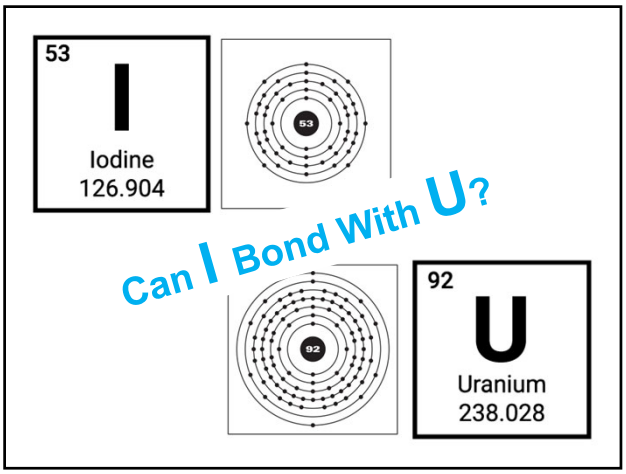
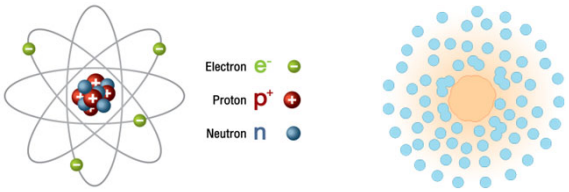
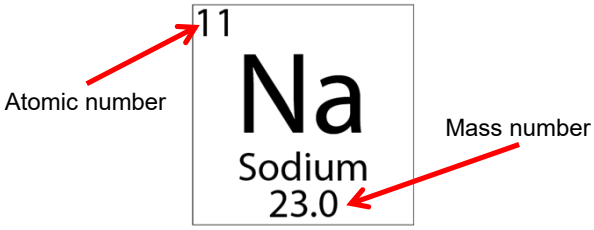


Reviewing Matter

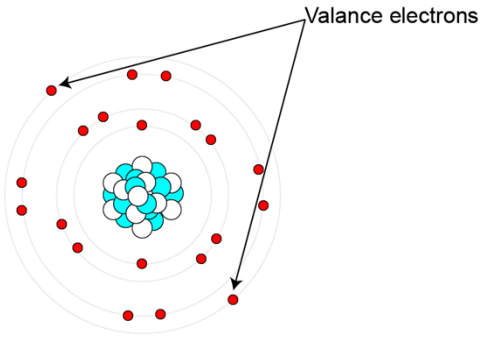
- **Atoms** have a **nucleus** consisting of **protons** and **neutrons**.
- The **nucleus** is surrounded by a cloud of **electrons** in different **energy levels**.



- The number of **protons** is the **atomic number**.
- The number of **neutrons** is the **mass number** subtract the **atomic number**.
- The number of **electrons** is the **atomic number**.



- The **electrons** in the outermost energy level are called **valence electrons**.



- The periodic table is designed such that elements in the **same** group have the **same** number of **valence electrons**.

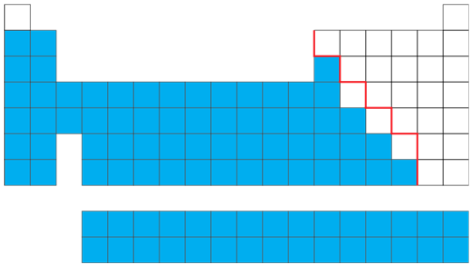
Group	1	2	3	4	5	6	7	8	9	10	11	12
Number of valence electrons	1	2	3	4	5	6	7	8	9	10	11	12

Group	13	14	15	16	17	18
Number of valence electrons	3	4	5	6	7	8

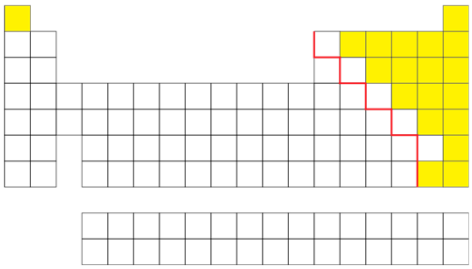
Note: Helium is an exception. It is in Group 18 but has two valence electrons.

- **Atoms** are the smallest form of matter and make up **elements**.
- **Elements** are made of a single type of atom and are represented on the **periodic table**.
- **Elements** combine to form **molecules**.
- When a **molecule** is made of more than one kind of **element** it is called a **compound**.

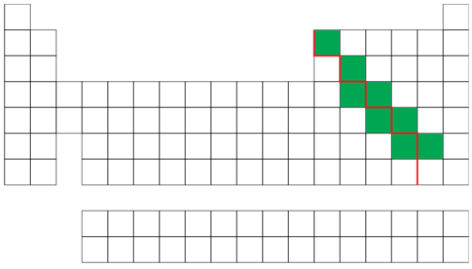
- Elements can be divided into two general categories: metals and nonmetals.
- Metals are to the left of the “staircase.”



- Nonmetals are to the right of the “staircase.”

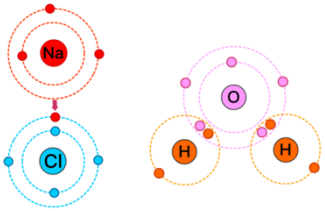


- Some elements right next to the “staircase” are called metaloids.
- They have properties of both metals and nonmetals.

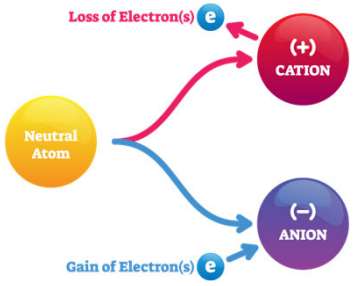


Why do Elements Make Molecules?

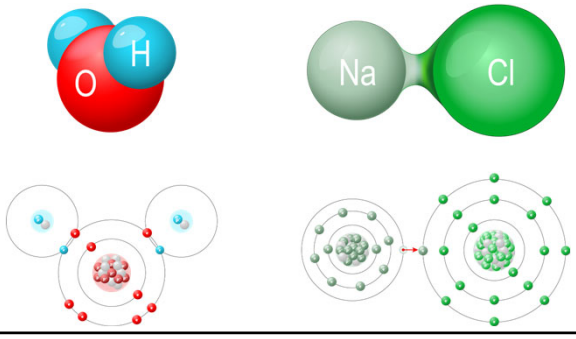
- Atoms of elements retain their nucleus, but **electrons** can be **transferred** or **shared**.



- Atoms form **ions** with a **positive** or **negative** charge.
- They form these **ions** by **gaining** or **losing** electrons.



- The **transfer** and **sharing** of electrons between atoms of different elements is known as a **chemical bond**.

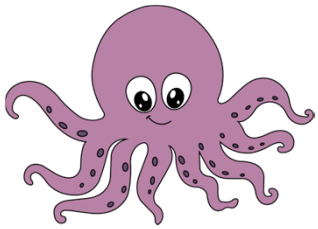


Periodic Table and Compounds

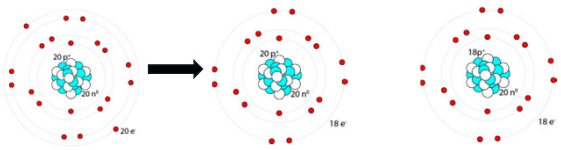
- We can use the periodic table to predict the **charge** on **ions**.
- **Atoms** tend to **gain** or **lose** electrons such that they have the **same** number of electrons as the nearest **Noble gas**.

The Octet Rule

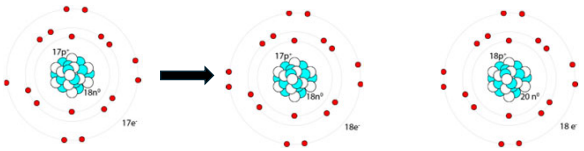
- Atoms prefer to have **eight** electrons in the **valence shell**. When atoms have fewer than eight electrons, they tend to react and form more stable compounds.



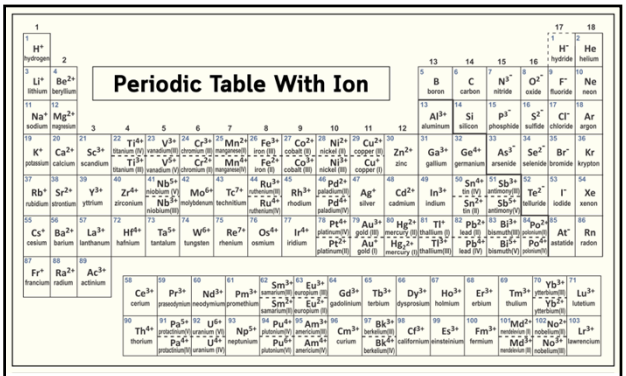
- **Metals** tend to **lose** electrons forming **positively** charged ions called **cations**.
  - Calcium loses **2** electrons so that it has **18** electrons like argon. It therefore has a charge of **2+**.



- **Nonmetals** tend to **gain** electrons forming **negatively** charged ions called **anions**.
  - Chlorine gains **1** electron so that it has **18** electrons like argon. It therefore has a charge of **1-**.



Cl Cl^- Ar



Naming Ions

- Cations do not have a special name.
  - The name is just the name of the element.
    - When calcium forms an ion, it is called a calcium ion.

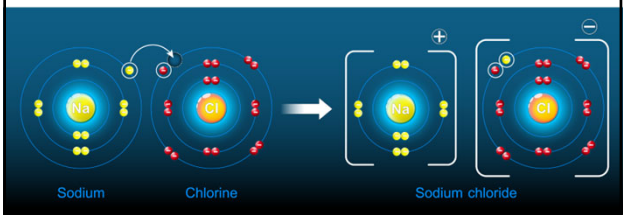
Ca (calcium) → Ca^{2+} (calcium ion)

- Anions are named by using the first syllable of the element name and then adding the suffix “ide.”
  - When oxygen forms an ion, it is called oxide.

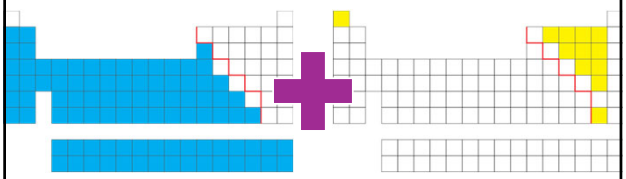
$$\underset{\text{oxygen}}{O} \longrightarrow \underset{\text{oxide}}{O^{2-}}$$

Ionic Compounds

- **Ionic** compounds form when atoms **transfer** electrons producing **ions**.
- The oppositely charged ions are attracted to each other forming an **ionic bond**.



- When a **metal** is combined with one or more **nonmetals**, the compound is usually **ionic**.

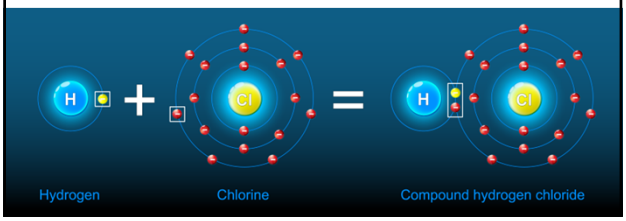


Naming Ionic Compounds

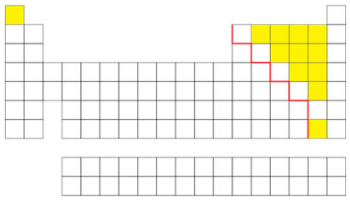
- Chemical compounds are named according to IUPAC (International Union of Pure and Applied Chemistry) rules.
  - Simple ionic compounds are named by using the names of the cation and anion.
    - NaCl is sodium chloride.
    - Al_2O_3 is aluminum oxide.

Molecular Compounds

- **Molecular** or **covalent** compounds form when atoms **share** electrons.
  - Each pair of electrons shared is called a covalent bond.

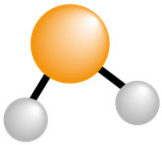


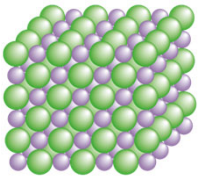
- **Molecular,** or covalent **compounds** are usually formed by a combination of **nonmetals**.



Comparing Ionic and Molecular Compounds

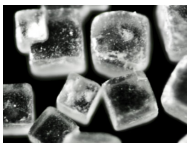
- We can often identify ionic or molecular compounds based on their physical properties.





- Under normal conditions, ionic compounds usually exist as solids and molecular compounds can be either solids, liquids, or gasses.

NaCl (table salt) is an ionic compound.



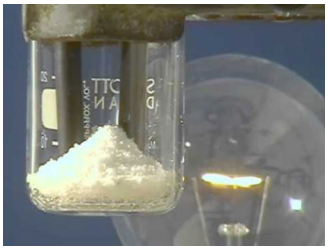
$C_{11}H_{22}O_{11}$ (sugar), H_2O (water), and N_2O (laughing gas) are molecular compounds.

- Ionic compounds tend to have higher **melting points** than molecular compounds.

Ionic Compound	Name	Common Name	Melting Point (°C)
NaCl	Sodium chloride	Table salt	800.7
$MgCl_2$	Magnesium chloride	Road salt	712
KCl	Potassium chloride	No-sodium salt	770

Molecular Compound	Name	Common Name	Melting Point (°C)
H_2O	Dihydrogen monoxide	Water	0
CO_2	Carbon dioxide	Carbon dioxide	-56.5
CH_4	Methane	Natural gas	-182

- **Ionic** compounds will **conduct** electricity when they are a liquid or if dissolved in water. **Molecular** compounds are poor **conductors**.



https://youtu.be/ePzEVPDyJV8

Predicting the Formula of an Ionic Compound

- When a **cation** and **anion** combine to form an ionic compound, the resulting charge must be **zero**.
  - A sodium ion has a charge of **1+** and a chloride ion has a charge of **1-**.
    - Therefore, the resulting compound will have **one** sodium ion (**Na^+**) and **one** chloride ion (**Cl^-**).
    - The resulting formula is **NaCl**.

- A calcium ion has a charge of **2+** and a chloride ion has a charge of **1-**
  - Therefore, the resulting compound will have **one** calcium ion (**Ca^{2+}**) and **two** chloride ions (**Cl^-**).
  - The resulting formula is **$CaCl_2$**.
- A sodium ion has a charge of **1+** and an oxide ion has a charge of **2-**.
  - Therefore, the resulting compounding will have **two** sodium ions (**Na^+**) and **one** oxide ion (**O^{2-}**).
  - The resulting formula is **Na_2O**.