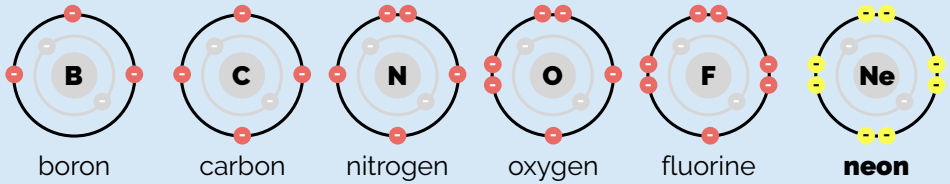
Lewis structures

1. Introduction

Organic chemistry is about making molecules, creating bonds. To do this, we must understand *where* the electrons are in a molecule.

The simplest representations are based on **Lewis structures**. These show the **valence electrons**. These form the underlying *code* on which we build everything else. Organic chemists use a cleaner cartoon representation & we'll introduce this later.

2. Atoms

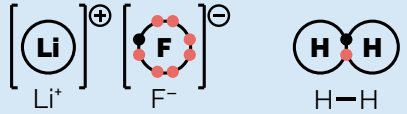


boron carbon nitrogen oxygen fluorine **neon**

For Lewis structures, we are only interested in the outer shell or the **valence electrons**. The rest of the atom is ignored. The number of electrons in the valence shell is given by the **group number (-10)**. So boron, group 13, has 3 valence electrons.

All atoms are reactive except the **noble gases** (group 18). These are stable due to a **full** outer shell. For organic chemistry is **NEON** or **8 valence electrons** is key.

3. Bonds



Molecules form bonds so that their atoms have full outer shells like a noble gas.

Ionic bonds - the metal loses electrons & the other element gains electrons.

Covalent bonds - atoms share electrons to gain noble gas configuration.
Each **covalent bond** is **2 electrons**.

4. Drawing a Lewis structure

step 1 - atoms

Draw out all the atoms & their valence electrons.

step 2 - skeleton

Join all atoms that form more than one bond.

step 3 - hydrogen atoms

Add the hydrogen atoms (& halogens). Start by adding them to the atoms with the most single electrons.

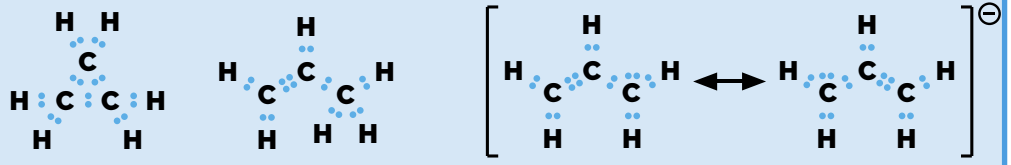
step 4 - multiple bonds

Check all atoms to ensure they obey the octet rule (outer shell). If they do not share electrons with adjacent atoms to make multiple bonds.

step 5 - the molecule

Final structure can be simplified by adding lines to represent bonds (two electrons). The full Lewis structures are your training wheels. Line diagrams the goal.

5. Isomers (& resonance)

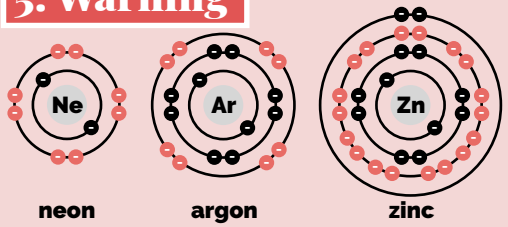


It will often be possible to create more than one valid Lewis structure.

These show that **structural isomers** are possible, such as cyclopropane & propene (above).

If the valid Lewis structures only differ by the position of multiple bonds and/or lone pairs of electrons they could be examples of **resonance structures** or **delocalization** (*more in a later summary*).

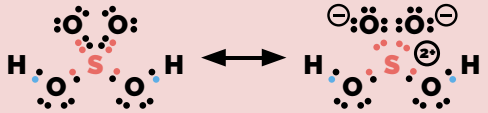
5. Warning



neon argon zinc

The **octet rule**, 8 electrons in the outer shell, is **true** for atoms of the **2nd** row of the periodic table.

The 3rd row atoms aim for 8 (Ar) but can have more.



This is apparent if you draw the Lewis structure of sulfuric acid. There are two resonance structures; one has 12 valence electrons on sulfur, & the other has 8 (as we would predict) but has formal charges.