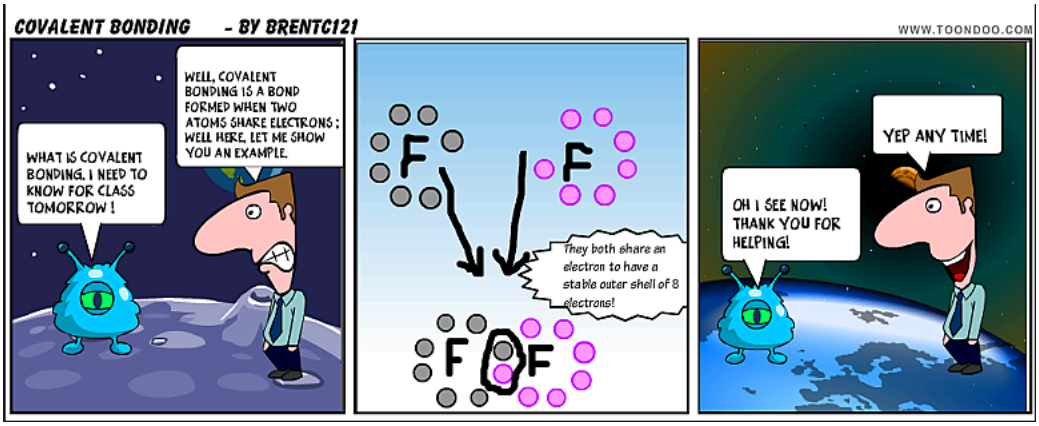
Activity 6: The Lewis Structure



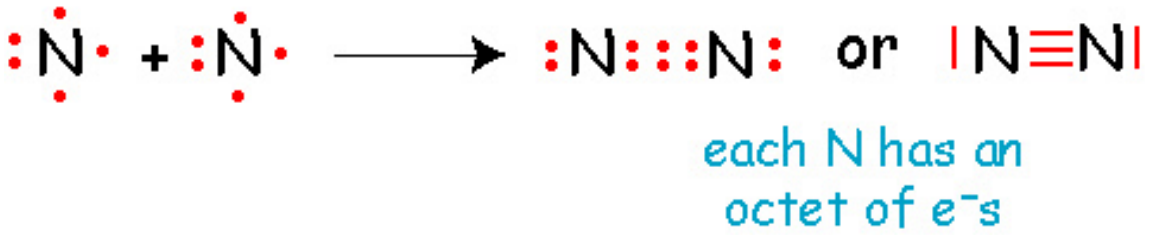
From the Wikipedia article on Lewis Structures:

> Lewis structures, also called electron-dot structures or electron-dot diagrams, are diagrams that show the bonding between atoms of a molecule, and the lone pairs of electrons that may exist in the molecule. A Lewis structure can be drawn for any covalently bonded molecule, as well as coordination compounds. The Lewis Structure was named after G.N. Lewis, who introduced it in his 1916 article, *The Molecule and the Atom*.
>
> Lewis structures show each atom in the structure of the molecule using its chemical symbol. Lines are drawn between atoms that are bonded to one another (to represent two shared electrons). Excess electrons that form lone pairs are represented as a pair of dots, and are placed next to the atoms on which they reside.

Now, let's take a closer look at electron distributions in molecules and learn how to draw Lewis electron dot diagrams. Lewis structures are a pre-quantum understanding of bonding. The basis of the Lewis electron dot diagram is electron sharing, which stabilizes the molecule by distributing their electrons in such a way that results in a filled valence orbital for each atom in the molecule.

Although these molecular diagrams can't answer the question "why does bonding occur?" (wait until we address with **QUANTUM MECHANICS** !!) they do provide an accurate model for electron distributions in molecules.

For example, the nitrogen atom has the electron configuration: N: $[He]2s^2 2p^3$. Under normal conditions, nitrogen exists as N_2 gas. The Lewis structure predicts that 6 electrons are shared in a triple bond, allowing both nitrogen atoms to satisfy the 'octet' rule and benefit from the added stability.



In some cases, two or more Lewis structures can be formed. We can predict whether they represent the same or different configurations by calculating the formal charge for each atom in the molecule.

In this activity we will complete parts of three problems from HW 5. These problems use Marvin JS to draw electron dot structures directly into WebAssign. After solving several types of problems in this activity, you should feel confident with your HW assignment.

1. HW problem 36: In your WebAssign account, draw a Lewis structure that **obeys the octet rule** for each of the following molecules and ions. In each case the first atom listed is the central atom.
   a. PO_4^{3-}
   b. XeO_4

2. HW problem 39: In your WebAssign account, draw Lewis structures that obey the octet rule for the following species (as in problem 36). Now assign **formal atomic charges** to each of the atoms (MarvinJS only displays non-zero charges).
   a. PO_4^{3-}
   b. XeO_4

3. HW problem 40: Draw Lewis structures for the following species that involve minimum formal charges recognizing that the molecules contain central atoms from the 3rd and 5th rows. Assign any remaining formal atomic charges (non-zero) where appropriate.

   a. PO_4^{3-}
   b. XeO_4

4. HW problem 37: Draw the resonance structures for the polyatomic ion, nitrate.

   a. NO_3^-