Drawing Lewis Dot Structures

Purpose: To instruct the student on how to draw the Lewis dot structures for simple, covalent compounds.

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Example I: Water(H_2O)
Step 1: Determine the total number of valence electrons for the formula.

- The hydrogen atoms each have 1 valence electron, and the oxygen atom has 6 valence electrons.
  - (2 x 1) + (1 x 6) = 8 total valence electrons

Step 2: Determine the number of "octet electrons" needed by the atoms in the formula.

- Example: Using the example of H_2O
  - Each of the hydrogen atoms needs a total of 2 electrons to make its "octet"
  - The oxygen atom needs a total of 8 electrons to complete its "octet"
  - The water molecule therefore has a total of 12 "octet" electrons (2 x 2) + (1x 8)= 12

Step 3: Subtract the valence electron total from the octet electron total. The difference is the number of bonding electrons.

- For the water molecule example,
- The octet electron total – the valence electron total

$$12 - 8 = 4$$

- Therefore, there will be 4 bonding electrons in this molecule.

Step 4: Determine the number of bonding electrons to determine the number of bonds and lay out a basic shape.

- Since the covalent bond consist of two electrons, divide the bonding electrons by two to determine the number of covalent bonds.

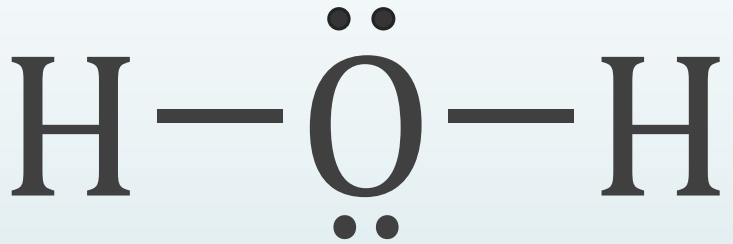
For the water, one would divide 4 by 2 to obtain 2 covalent bonds.

If you lay out the basic shape of the molecule, it would look like this:

$$H-O-H$$

The lines each represent a shared pair of electrons.

Step 5: Add lone pairs so that each atom has its "octet"



Example II: Carbon dioxide (CO_2)
Step 1: Determine the total number of valence electrons for the formula.

- The oxygen atoms each have 6 valence electron, and the carbon atom has 4 valence electrons.
- (2 x 6) + (1 x 4) = 16 total valence electrons

Step 2: Determine the number of "octet electrons" needed by the atoms in the formula.

- Each of the oxygen atoms needs a total of 8 electrons to make its "octet"
- The carbon atom needs a total of 8 electrons to complete its "octet"
- The carbon dioxide molecule therefore has a total of 24 "octet" electrons

  (2 x 8) + (1x 8)= 24

Step 3: Subtract the valence electron total from the octet electron total. The difference is the number of bonding electrons.

- The octet electron total – the valence electron total

$$24 - 16 = 8$$

Therefore, there will be 8 bonding electrons in this molecule.

Step 4: Determine the number of bonding electrons to determine the number of bonds and lay out a basic shape.

- Since the covalent bond consist of two electrons, divide the bonding electrons by two to determine the number of covalent bonds.

  For the carbon dioxide, one would divide 8 by 2 to obtain 4 covalent bonds.

  If you lay out the basic shape of the molecule, it would look like this:

  O – C – O

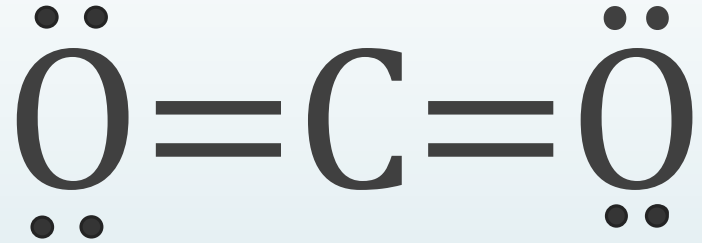
- The lines each represent a shared pair of electrons.

  Since we need to represent 4 covalent bonds, we will "double up" the single bonds and make two double bonds.

  O = C = O

  Now, we have drawn our structure with 4 covalent bonds.

Step 5: Add lone pairs so that each atom has its "octet"



We have now accounted for all 16 valence electrons.

Let's try one more example: molecular nitrogen or N_2

- Step 1: Determine the total number of valence electrons for the formula.

- Each nitrogen atom has 5 valence electrons, so molecular nitrogen would have 10 valence electrons.

Step 2: Determine the number of "octet electrons" needed by the atoms in the formula.

- Molecular nitrogen would require 8 octet electrons, 8 for each nitrogen atom.

- 2 atoms of nitrogen x 8 electrons each =

  16 octet electrons

Step 3: Subtract the valence electron total from the octet electron total. The difference is the number of bonding electrons.

- 16 octet electrons — 10 valence electrons = 6 bonding electrons

Step 4: Determine the number of bonding electrons to determine the number of bonds and lay out a basic shape.

- We divide the number of bonding electrons by 2 in order to determine the number of bonds.

- 6 electrons divided by 2 = 3 covalent bonds between the nitrogen atoms

N≡N

Step 5: Add lone pairs so that each atom has its "octet"

Since we had 10 electrons to place, and the triple bond accounts for 6, place a lone pair on each nitrogen atom and your Lewis dot structure is complete.