DRAWING DOT STRUCTURES FOR SIMPLE MOLECULES

1. Count valence electrons

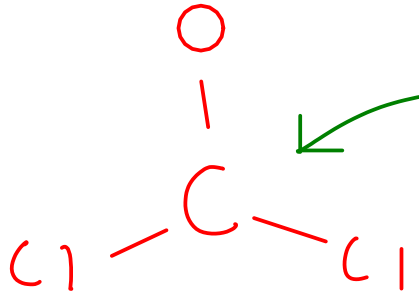
2. Pick central atom and draw skeletal structure
   - central atom is usually the one that needs to gain the most electrons!
   - skeletal structure has all atoms connected to center with single bonds

3. Distribute remaining valence electrons around structure, outer atoms first. Follow octet rule until you run out of electrons.

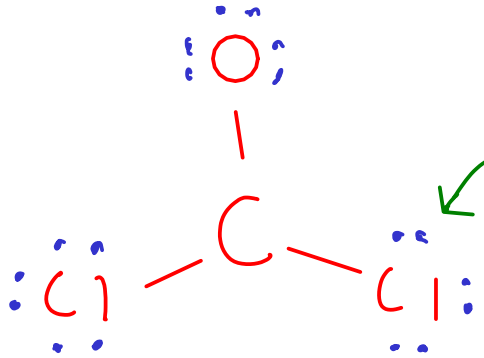
4. Check octet rule - each atom should have a share in 8 electrons (H gets 2). if not, make double or triple bonds.

$COCl_2$

C: 1 x 4
O: 1 x 6
Cl: 2 x 7 = 14
24 electrons

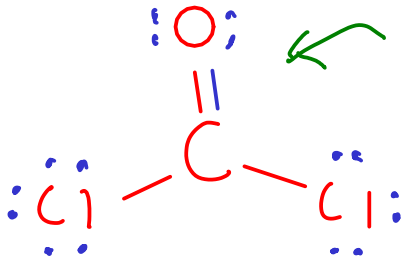


Choose CARBON as the central atom since it needs to gain more electrons than either O or Cl ...



Distribute remaining electrons, stop when we run out (24 valence electrons in this molecule!)

... but CARBON has a share in only SIX outer shell elecrrons. How do we get more electrons on carbon? Make a double bond! But with which atom? Choose OXYGEN, since it needs more electrons than chlorine.



This structure works ... all atoms have share in eight valence electrons!

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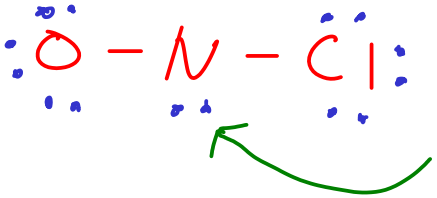
NOCl

N : 1 x 5
O : 1 x 6
Cl : 1 x 7
18 e⁻

We pick NITROGEN as the central atom since it needs more electrons than O or Cl.



We ran out of outer atoms before running out of electrons, so the last pair goes on the central N ...

Even with the lone pair of electrons on N, we still need more electrons for N ... Let's try a double bond!

As before, we choose OXYGEN for the double bond (same reason as last example), and now all atoms have a share in eight valence electrons.

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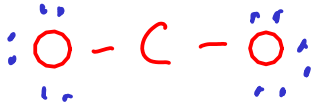
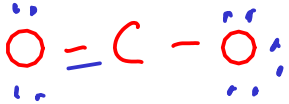
CO_2

C: 1 x 4
O: 2 x 6
16 e⁻

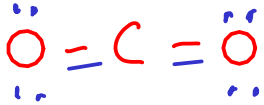
Carbon is the central atom.



... but carbon has a share in only four outer electrons!



... now six



Adding a second double bond gives carbon enough outer electrons!

Why not this structure? The two oxygen atoms are in identical environments and should bond the same way!

In addition, experimental evidence (from x-ray diffraction) suggests that the two oxygen atoms are the same distance from the carbon, which does NOT agree with the triple bond/single bond structure.

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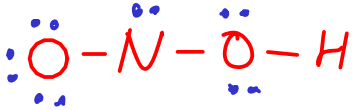
HNO_2 "nitrous acid"

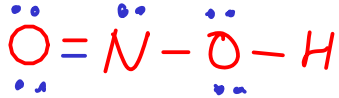
In oxyacids, the acidic hydrogen atoms are attached to OXYGEN atoms in the structure!

H : 1 x 1
N : 1 x 5
O : 2 x 6 = 12
18 electrons

← Since this is an OXYACID, we know that at least one hydrogen atom is attached to an oxygen atom.



We run out of electrons after putting a pair on nitrogen. As drawn, N only has a share in six outer electrons. We'll make a double bond.



Unlike the carbon dioxide molecule, these oxygen atoms are NOT in identical environments and may bond differently.

A DOT STRUCTURE FOR A LARGER MOLECULE

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4. Check octet rule - each atom should have a share in 8 electrons (H gets 2). if not, make double or triple bonds.

CH_3CH_2OH ETHANOL!

C : 4 x 2 = 8
H : 1 x 6 = 6
O : 6 x 1 = 6
| 20

This formula gives us a hint to the structure of ethanol. Ethanol has THREE central atoms chained together.

$CH_3 \quad CH_2 \quad OH$