DRAWING DOT STRUCTURES FOR SIMPLE MOLECULES

1. Count valence electrons

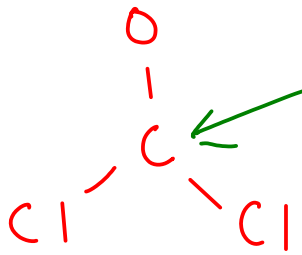
2. Pick central atom and draw skeletal structure
   - central atom is usually the one that needs to gain the most electrons!
   - skeletal structure has all atoms connected to center with single bonds

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

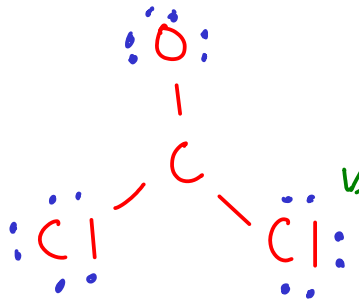
4. Check octet rule - each atom should have a share in 8 electrons (H gets 2). if not, make double or triple bonds.

$COCl_2$

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

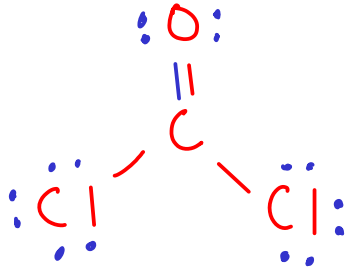


We pick CARBON as the central atom since it needs to gain more electrons than Cl or O, so it should form more bonds.



Distribute valence electrons, stop when we run out...

... but CARBON only has a share in SIX valence electrons. We need two more electrons for carbon. How do we get them? Make a double bond. Which atom? Choose OXYGEN since it needed more electrons than Cl, and is therefore likely to form more bonds.



With a double bond, all atoms now have a share in eight valence electrons (octet rule).

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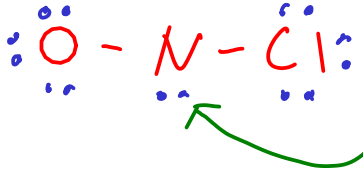
NOCl

N : 1 x 5
O : 1 x 6
Cl : 1 x 7
18 e⁻

O - N - Cl

Pick NITROGEN as central atom, since it needs more valence electrons than O or Cl.



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

Even with the lone pair, N has a share in only six valence electrons. So, double bond. Like last time, we'll pick oxygen for the double bond - for the same reason as the last example.

With the double bond, N now has a share in eight valence electrons.

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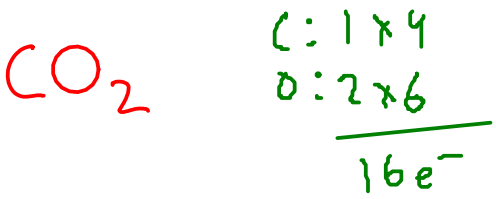
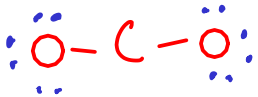
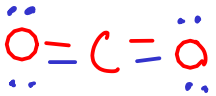


Choose C as central atom



... but C only has a share in four valence electrons

... now six



With a second double bond, C has a share in eight valence electrons.

What's wrong with this structure? We have two oxygen atoms in the same environment bonding in different ways. Since atoms of the same element should be chemically identical ,this shouldn't happen!

Experimentally (via x-ray diffraction), it's been discovered that there is only one bond distance between C and O in carbon dioxide. That's consistent with the double bond structure, but not the triple/single structure.

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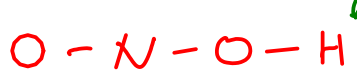
HNO_2 "nitrous acid"

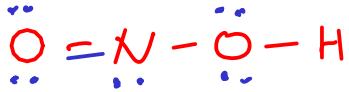
In oxyacids, the acidic hydrogen atoms are attached to OXYGEN atoms in the structure!

H: 1 x 1
N: 1 x 5
O: 2 x 6
18 e⁻



Since this molecule is an oxyacid, we know that at least one hydrogen atom must be bonded to an oxygen atom.

N has only six valence electrons here, so ...



We choose the oxygen atom on the left for the double bond since the one on the right is already bonded to H...

A DOT STRUCTURE FOR A LARGER MOLECULE

CH_3CH_2OH ETHANOL!

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

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

CH_3 CH_2 OH