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!

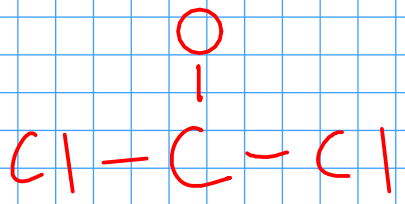
   - skeletal structure has all atoms connected to center with single bonds

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

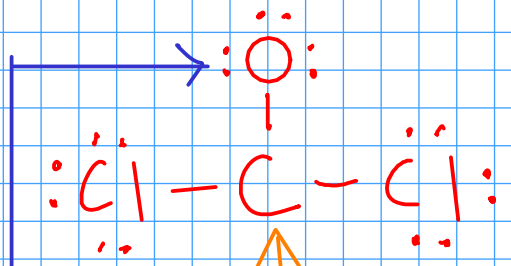
4. Check octet rule - each atom should have a share in 8 electrons (H gets 2). if not, make double or triple bonds.

$COCl_2$

C : 4
O : 6
Cl : 7 x 2
24



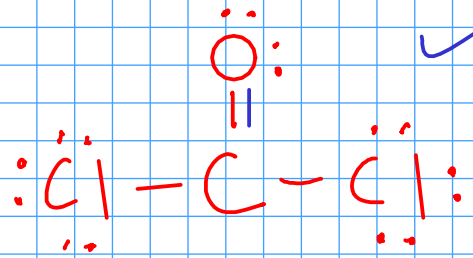
Choose carbon as the central atom, and draw skeleton



Distribute electrons - have to stop here because we've used all 24!

Carbon only has six electrons!

We'll pick OXYGEN to share two pairs of electrons. It's likely to be able to share two pairs since it needs to gain two electrons anyway!



This structure looks better - all atoms have a share in the correct number of electrons!

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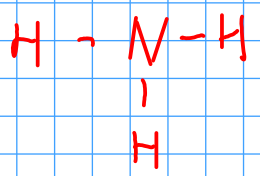
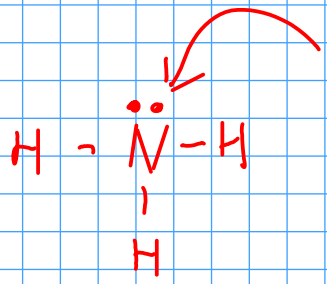
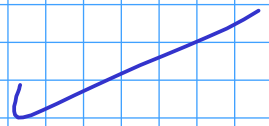
NH_3

N: 5 x 1
H: 1 x 3
8 e⁻





Since the hydrogen atoms can only take two electrons, the remaining electrons must go to the nitrogen atom.



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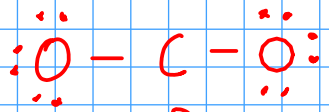
CO_2

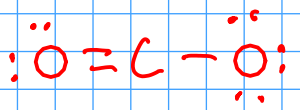
C: 4
O: 6 x 2
16 e⁻

O – C – O

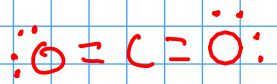


16 electrons used!

.. but carbon only has a share in FOUR.



carbon still has only SIX electrons



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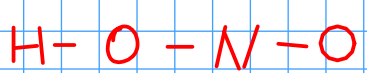
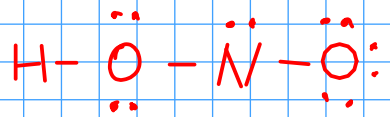
HNO_2 "nitrous acid"

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

H: 1 x 1
N: 5 x 1
O: 6 x 2
] 18 e⁻





... used 18 electrons

The oxygen on the right is more likely to share a second pair of electrons with the nitrogen, since the one on the left is ALREADY sharing two pairs - one with hydrogen, and one with nitrogen.

A DOT STRUCTURE FOR A LARGER MOLECULE

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

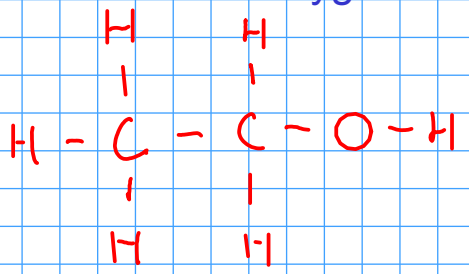
3. Distribute remaining valence electrons around structure, outer atoms first. Follow octet rule until you run out of electrons.

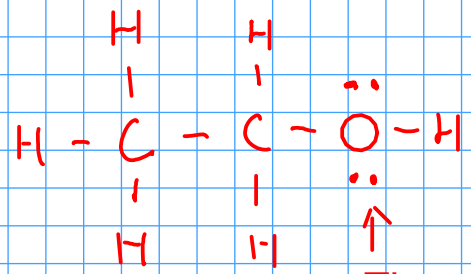
4. Check octet rule - each atom should have a share in 8 electrons (H gets 2). if not, make double or triple bonds.

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 the molecule. Ethanol has THREE centers: the two carbon atoms and the oxygen atom.





The oxygen is the only place left for the remaining four electrons

A DOT STRUCTURE FOR A MOLECULE WITH DELOCALIZED BONDS

O: 3 x 6 = 18

O_3 (OZONE)

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

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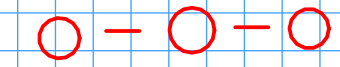
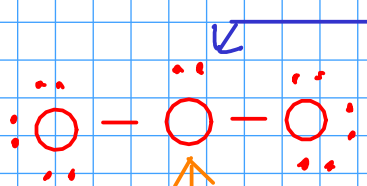
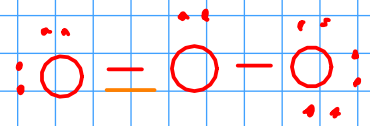
4. Check octet rule - each atom should have a share in 8 electrons (H gets 2). if not, make double or triple bonds.





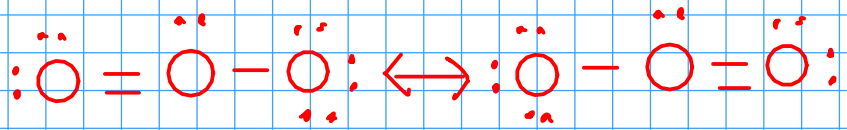


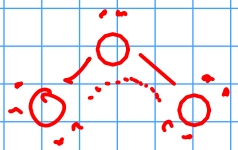
All atoms have a share in eight electrons here.

This structure suggests that one of the outer oxygen atoms is closer to the central oxygen atom than the other one!

Experimentally, we observe that both outer oxygen atoms are the SAME distance from the center.

In the molecule, electrons are actually being shared between ALL THREE oxygen atoms. This is a DELOCALIZED bond!





These are RESONANCE structures. The real structure is an "average" of these two. The "double bond"'s electrons are shared between all three oxygen atoms!