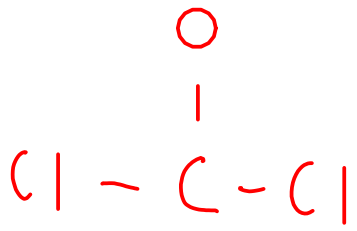
DRAWING DOT STRUCTURES FOR SIMPLE MOLECULES

$COCl_2$

C: 1 x 4
O: 1 x 6
Cl: 2 x 7 = 14
24 valence e⁻

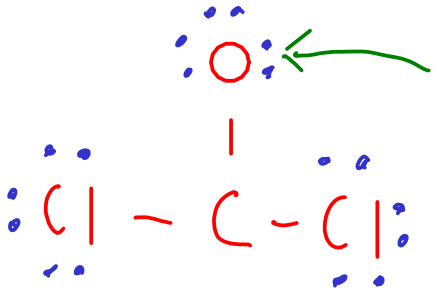
1. Count valence electrons

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



Pick C as central atom, since it needs to gain more electrons (4 more) than either O (2 more) or Cl (1 more)

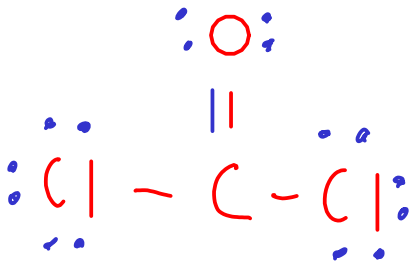
3. Distribute remaining valence electrons around structure, outer atoms first. Follow octet rule until you run out of electrons.



Distribute electrons, stop when we reach the total count (24, in this case)

... but carbon has a share in only SIX valence electrons? How to fix? Try a double bond! But with which atom? Pick O, since it needs to gain more electrons and should form more bonds than Cl.

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



Creating a double bond between C and O gives each atom a share in eight valence electrons!

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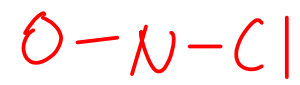
NOCl

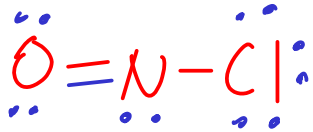
N : 1 x 5
O : 1 x 6
Cl : 1 x 7
18 e⁻



Choose N as central atom, since it needs to gain 3 more electrons (more than O or Cl).

Distribute electrons. The last pair goes on the central N atom.

... but N still has a share in only 6 valence electrons! Fix with double bond to O (same reason as before!)



Adding a double bond between O and N gives each atom a share in eight valence electrons.

1. Count valence electrons

2. Pick central atom and draw skeletal structure
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   - 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.

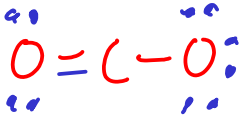
4. Check octet rule - each atom should have a share in 8 electrons (H gets 2). if not, make double or triple bonds.

CO_2

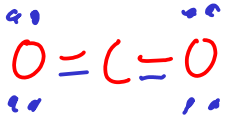
C: 1 x 4
O: 2 x 6
16 e^-

Pick C for central atom...

Distribute ... but C only has a share in 4!



... now 6



... a second double bond gives each atom a share in eight valence electrons!

Why not this structure? Because atoms of the same element under the same conditions should behave the same way! This structure suggests that the two oxygen atoms would bond DIFFERENTLY ... which is unlikely!

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   - 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.

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⁻

Pick N as central atom, BUT we also know that an H must be bonded to an O (oxyacid), so we draw H here.

Distribute ... remember that H can only have 2 electrons (fills first shell)

Making a double bond with the oxygen on the left gives each atom a share in eight valence electrons (except H, which can never have more than 2)

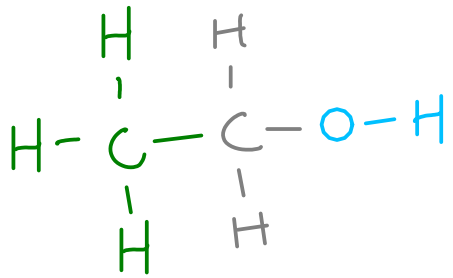
A DOT STRUCTURE FOR A LARGER MOLECULE

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

CH_3CH_2OH ETHANOL!

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

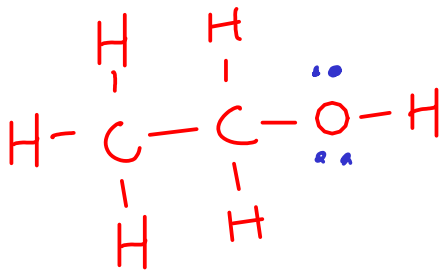
CH_3 CH_2 OH



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.

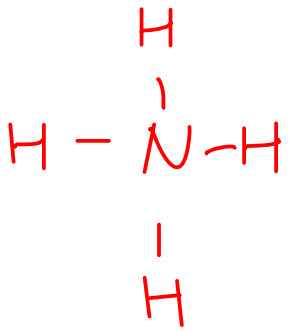
A DOT STRUCTURE FOR A POLYATOMIC ION

NH_4^+

1. Count valence electrons

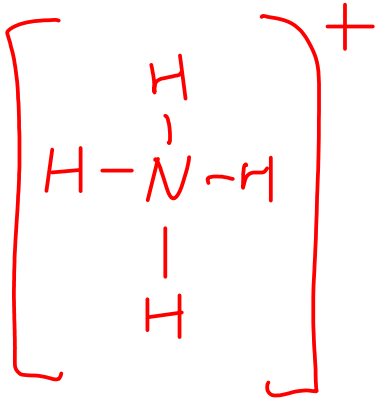
N: 1 x 5 = 5
H: 4 x 1 = 4
9 valence e⁻
−1 (+1 charge)
8 valence e⁻

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



Adjust electron count, then pick N for central atom. Draw as usual ...

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



To indicate charge, draw brackets around the structure and put charge on upper right.

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