SO FAR, we've seen that ...

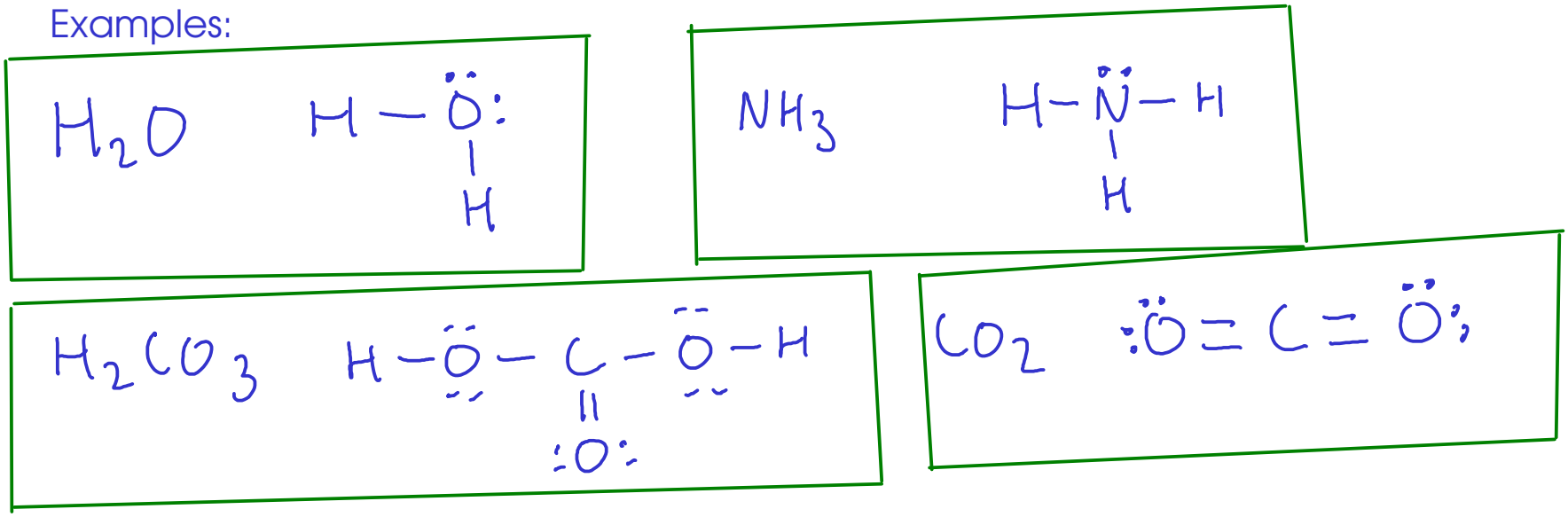
1. Atoms may share one, two, or three pairs of electrons with a single other atom.

2. Atoms will usually share enough electrons so that each atom ends up with a share in EIGHT electrons - the "octet rule"

   - HYDROGEN will only end up with two electrons!
   - Some other atoms may end up with more or less than eight electrons.

NOW, how could we come up with dot structures for some more complicated (and therefore, more interesting) molecules?

Examples:



DRAWING DOT STRUCTURES FOR SIMPLE MOLECULES

1. Count valence electrons

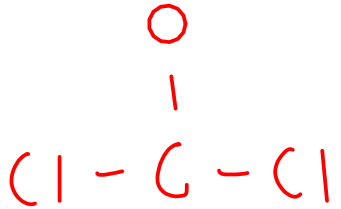
2. Pick central atom and draw skeletal structure
   - central atom is usually the one that needs to gain the most electrons!
   - skeletal structure has all atoms connected to center with single bonds

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

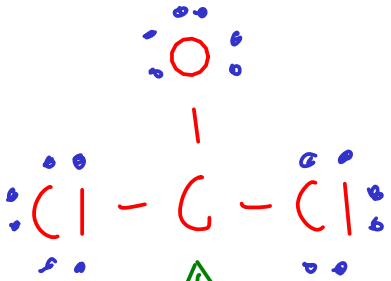
4. Check octet rule - each atom should have a share in 8 electrons (H gets 2). if not, make double or triple bonds.

$COCl_2$

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

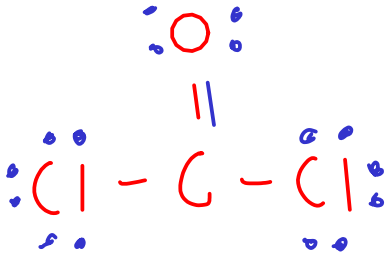


Choose CARBON as central atom, since it needs to gain 4 more electrons (more than either oxygen or chlorine)



Distribute remaining electrons, stop when we've used them all (in this case, that's 24..)

Problem: CARBON only has a share in SIX valence electrons! How to fix? Try making a double bond...



Which atom to choose to make the double bond? Pick OXYGEN, because oxygen needs more electrons than chlorine, and usually the atoms that need the most electrons form more bonds!

Making a double C=O bond "fixes" this structure!

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.

NOCl

N : 1 x 5
O : 1 x 6
Cl : 1 x 7
16 e⁻

O - N - Cl

Pick NITROGEN as central atom, since it needs to gain more electrons than the other two!

We ran out of outer atoms before we ran out of electrons, so the last pair goes on the central nitrogen. Still not enough electrons on central atom. Double bond?

Choose oxygen to make the double bond, for same reasons as last example!

Making the O=N double bond "fixes" this structure!

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

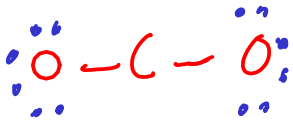
3. Distribute remaining valence electrons around structure, outer atoms first. Follow octet rule until you run out of electrons.

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

CO_2

C: 1 × 4
O: 2 × 6
16 e⁻

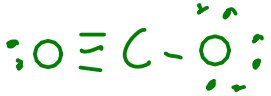
Pick CARBON as central atom.



... carbon only has a share in four valence electrons! Double bond?

... now six.

... the second double bond give carbon a share in eight valence electrons!



Why not this structure? It suggests that two atoms of the same element (oxygen) will bond in different ways when put into the same chemical situation ... and that shouldn't happen with atoms of the same element that are supposed to be chemically IDENTICAL!

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

1. Count valence electrons

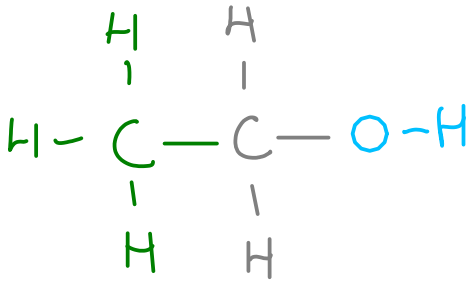
2. Pick central atom and draw skeletal structure
   - central atom is usually the one that needs to gain the most electrons!
   - skeletal structure has all atoms connected to center with single bonds

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

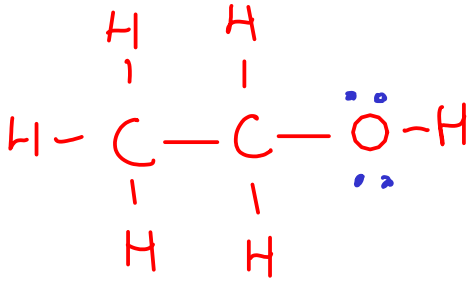
4. Check octet rule - each atom should have a share in 8 electrons (H gets 2). if not, make double or triple bonds.

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

$CH_3 \quad CH_2 \quad OH$



Skeletal structure.



A DOT STRUCTURE FOR A POLYATOMIC ION

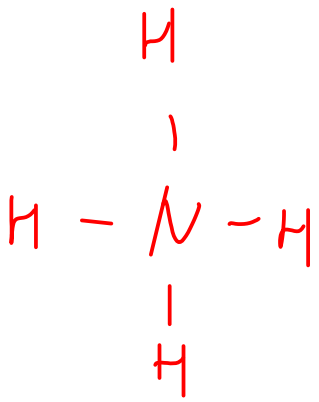
NH_4^+

1. Count valence electrons

N: 1 x 5
H: 4 x 1
9 valence e⁻
−1 e⁻ for +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

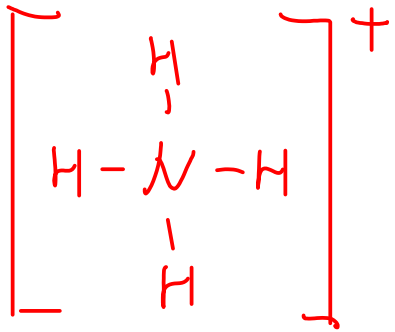
For an ion, adjust the electron count based on the charge. Add electrons for "-" charge, take electrons away for "+" charge.



Choose N as central atom.

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

All eight electrons accounted for!



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

Indicate charge by drawing brackets around the structure and putting the charge at the upper right (as usual).