SO FAR, we've seen that ...

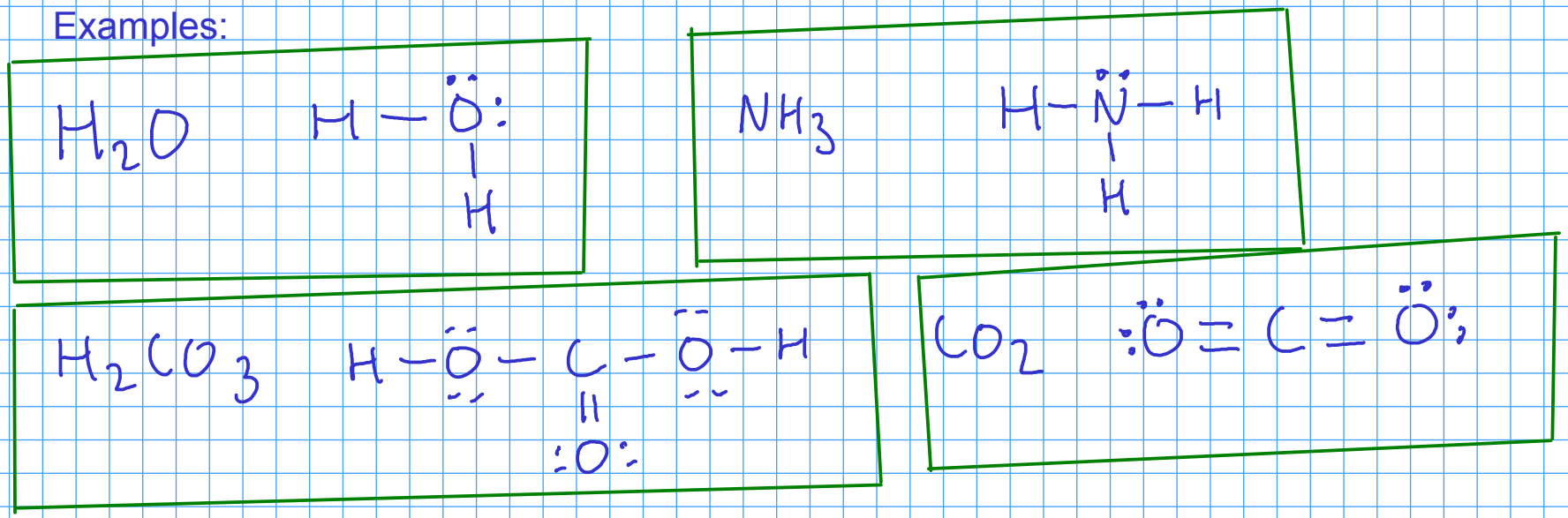
1. Atoms may share one, two, or three pairs of electrons.

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 ... but we won't worry about those in CHM 100!

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

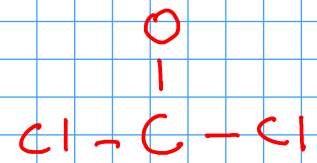
$COCl_2$

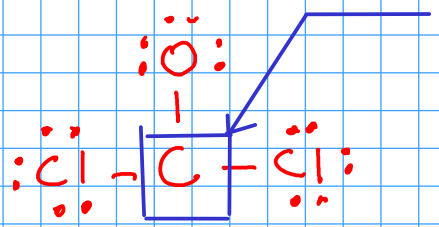
C : 4
O : 6
Cl : 2×7 = 14
24 electrons

1. Count valence electrons

2. Pick central atom and draw skeletal structure

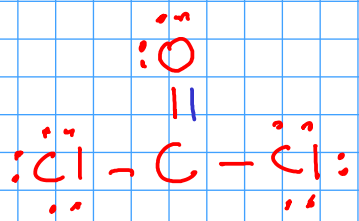
   - central atom is usually the one that needs to gain the most electrons!
   - skeletal structure has all atoms connected to center with single bonds





This carbon atom has only six valence electrons!

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



Where to put double bond? Oxygen needed two more electrons, so it's more likely than chlorine to share two pairs.

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

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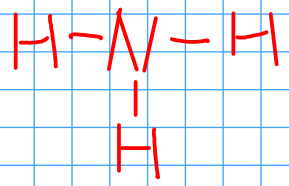
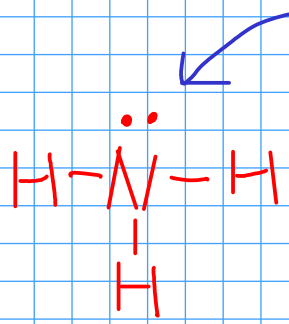
4. Check octet rule - each atom should have a share in 8 electrons (H gets 2). if not, make double or triple bonds.

NH_3

N : 1 x 5
H : 3 x 1
8 electrons





Remaining electrons must be placed on the NITROGEN atom, since the outer shell of hydrogen is full with only TWO electrons!

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

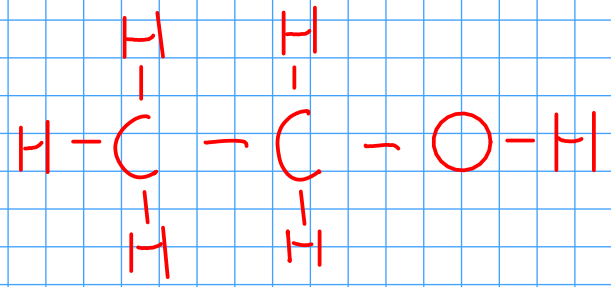
3. Distribute remaining valence electrons around structure, outer atoms first. Follow octet rule until you run out of electrons.

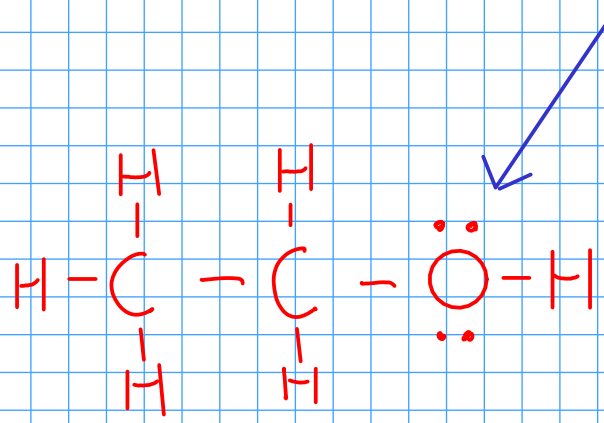
4. Check octet rule - each atom should have a share in 8 electrons (H gets 2). if not, make double or triple bonds.

CH_3CH_2OH

This molecule has THREE centers!

C $2 \times 4 = 8$
H $6 \times 1 = 6$
O $6 = 6$
20 electrons





The remaining electrons go on oxygen since all the other atoms have full outer shells.

A DOT STRUCTURE FOR A POLYATOMIC ION

NH_4^+

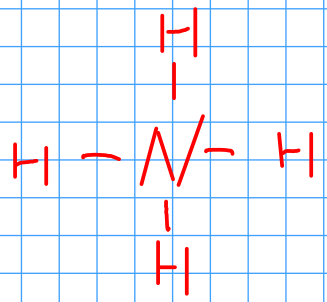
1. Count valence electrons

N : 1 x 5
H : 4 x 1
9 electrons
−1
8 electrons

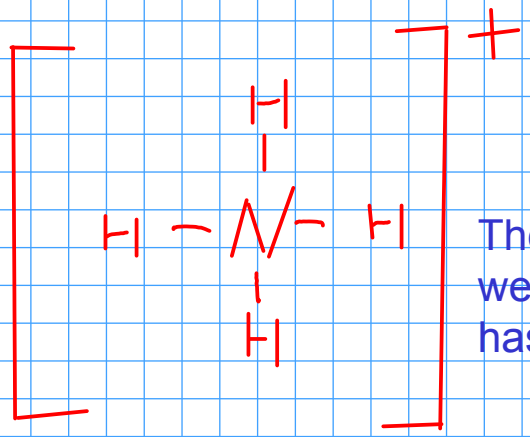
To get a +1 charge, the ammonium ion must have lost one of its valence electrons. So we subtract one from the total.

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.



The brackets are used so that we know the overall structure has a positive charge.

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

X