Lewis Video Example
“double and triple bonds” script

In this video we will be drawing Lewis structures with double and triple bonds, assigning formal charge to a Lewis structure, and drawing resonance structures.

The first structure we are going to look at is carbon dioxide. Carbon dioxide has a total of sixteen valence electrons. To begin, draw the structure with the carbon atom located at the center, and the two oxygens as terminal atoms. Connect the carbon atoms with bonds and subtract four electrons from your total valence electron count. There are now twelve electrons remaining to distribute around the structure. With only twelve electrons remaining, there are only enough electrons to satisfy the octet for the oxygen atoms. According to this structure carbon does not have a full octet.

Move a pair of electrons from each of the oxygen atoms. Draw an additional bond between the carbon atom and each of the oxygen atoms to form double bonds. This structure now satisfies the octet rule for carbon and each oxygen.

For carbon monoxide, a compound with ten valence electrons, a triple bond must be formed between carbon and oxygen to satisfy the octet rule.

How do we know that we are drawing the correct structure? This nitronium cation has two Lewis structures, both structures seem correct, the octets of the individual atoms are satisfied in each case. However, only one of these Lewis structures is accurate.

We need to assign formal charge to each atom to determine the true Lewis structure for nitronium. The formula for formal charge is, valence electrons, minus, one half of the bonding electrons, minus, the lone electrons.

Let’s calculate the formal charge of the first structure, this structure has one single bond between the nitrogen and an oxygen, and one triple bond between the nitrogen and an oxygen. For the singly bonded oxygen, the formal charge is: six valence electrons, minus one half the bonding electrons, one, minus the six lone electrons on the oxygen. This gives a formal charge of negative one on the singly bonded oxygen atom. We can apply this formula to each of the other atoms in the two Lewis structures for nitronium. The second Lewis structure has two doubly bonded oxygens to the nitrogen. The formal charges for the first nitronium structure are: negative one on the singly bonded oxygen, and positive one on both the nitrogen and the triply bonded oxygen. The second Lewis structure has formal charges of: zero on both doubly bonded oxygens, and positive one on nitrogen. This lower formal charge makes the second Lewis structure the correct one.

Often, when you are drawing Lewis structures you will find there is more than one acceptable representation. An example is the nitrate anion, there are three accurate and equivalent Lewis structures that can be drawn for this molecule. The way to represent multiple correct Lewis structures is to draw all of the correct structures with a double headed arrow between them. The term resonance is used to describe this phenomenon of having multiple equivalent Lewis structures for a single molecule.

This concludes the second video on drawing Lewis structures, you should be comfortable with: drawing structures for molecules with double and triple bonds, assigning formal charge to atoms in a Lewis structure, and indicating resonance in a molecule.