>> Here we see two examples of resonance. When you have resonance, you have a molecule that can be shown in more than one way. It can be drawn in more than one way, and the reason why it can be drawn in more than one way is because it has a multiple bond and it has a lone pair. And it could even have more than one multiple bond and more than one lone pair. Let's take, first off, ozone. O3 is ozone. Three oxygens give us 18 electrons to work with. So it's going to be oxygen, oxygen, oxygen. When we put them in without forming any multiple bonds, this is what we see. Two, four, six, eight, ten, 12, 14, 16, 18. Octet, octet, missing two electrons. If it's only missing two electrons, that means it's got to have somebody share one pair of electrons. Question is, should we share a pair of electrons from this oxygen, or should we share a pair of electrons from this oxygen? And so here's where we have our choice. Remember we said resonance means there's more than one way to draw it. In this situation over here, we've decided to go ahead and share a pair of electrons from the oxygen on the left, and so these have gone up, and you see now they're missing here but there's that double bond here, and this second bond is from this pair of electrons here. Now, this oxygen has an octet, this one has an octet, this one does. This is a very stable molecule. But, remember we said there was the other possibility, this oxygen here also has a pair of electrons that it can– matter of fact, it's got three pairs of electrons, it can share any of those. And so let's go ahead and figure that this isn't going to happen, let's go ahead and figure this oxygen on the right now is going to share electrons. So, in that case then down here you'll see these electrons going up here to form the second bond, now this oxygen over here only has two lone pair, and this one here because we do not have to form the second bond here, this one will have all six of its nonbonding electrons. So, there's two ways we can draw it with the double bond going to the left oxygen, and with the double bond going to the right oxygen. These are not the same molecule. You might say, well, what's the difference, they're all oxygen. Remember, oxygens can come in isotopes too, so you can't assume that this oxygen is the same isotope as this one; it may not be. Okay, so these are actually two different molecules. We put the double-headed arrow between that. Anytime you see a double-headed arrow between two molecules like this, that means that there's resonance. In other words, some of the times you see this, some of the times you see this, and so we're saying that both of those molecules exist at the same time. Now, in the second example, we're looking at a polyatomic ion. Twenty-four electrons, nitrogen and oxygens give you 23, the negative one charge gives you that 24th electron. So, here's our bare bones again. No, that's not the bare bones, sorry. This isn't supposed to be here, okay, there we go. Okay, this is our bare bones now, we've got eight, eight, and eight for 24 electrons. This nitrogen is missing the pair that I tried to give it, I shouldn't have. Okay, and so this one needs one pair of electrons, where is it going to get it from? Well, look what it's surrounded by. This oxygen has three nonbonding pairs, this one has three nonbonding pairs, same with this one. There's nine different possibilities, really, of where those electrons can come from. So, there's three different areas that can donate those electrons. Okay, so let's take a look at this first possibility. The oxygen on the

left donating these electrons, which would make a double bond here. And that's what you see, they're no longer here, they're being shared, there's your double bond. Now the nitrogen has two, four, six, eight electrons, and it's very stable. But what about this oxygen here, what if this oxygen is the one that shares the electrons? Well, look at these two black electrons, they're going to end up right here as a double bond, now you only have the four down here and the two pairs here. Again, everything is an octet. Third example, we have the electrons from this oxygen on the right coming over and forming a double bond there, and so we have this third possibility with the double bond on this oxygen here. So in this case, and we've got our double-ended arrows, in this case we actually have three resonance structures. Sometimes you can have two, sometimes you can have three, you could even have five or six depending upon what molecule you have. You know, it's wide open. Okay, so these are two excited of resonance. And in actuality, neither one of these exists, none of these three exists. There's actually a composite of all three of them that they average out together. And in a situation like this, instead of having a single bond and a double bond, you actually have this extra pair kind of dispersed all among here. So this actually turns out to be a bond and half, and a bond and a half, it's kind of neat. But how do you draw that? Well, it's easier sometimes just to say here's our two structures, you can figure out the average of that yourself in your head, but here's the two structures, here's the three structures, those are our resonance structures.