>> Now we're going to look at some three electron group molecules. And we're going to use VSEPR to figure out what shape these molecules are in. Ok, let's start with BF3. Again, this should look familiar to you because this has been something we talked about before. BF3, there's your Lewis dot structure. Ok? Remember that's just two-dimensional. Central is your boron. You've got three electron groups. Let's take a look at them. There's one here. There's one here. There's one here. So we've got three electron groups around the boron. Obviously this is not going to maximize the distance between them because look what we have. We have, what is that? Ninety degrees, 90 degrees, 180 degrees. That's not maximizing and spacing evenly. So in order to space these evenly, we're actually going to form 120-degree angles. If you look at the boron, here's your 120-degree angles here, each one of these. Don't even worry about the fluorines yet. Just the electron groups are going to be arranged 120 degrees apart from each other. We call that arrangement trigonal planar because it's actually still in the plane of the board, but it makes the triangle, so it's trigonal planar. Ok? The next question, remember, is how many atoms are attached to our central atom? One, two, three. So again, we have three atoms. So we have electron groups of three and three atoms. Remember what we said before. If those numbers are both the same, then whatever the shape the electrons are in will be the shape of the molecule itself. And so when you put on those fluorines, you can see that that molecule is trigonal planar. Ok? Now I want you to take a look at this second situation. Here we have SO2. Again, this is, again, a really important reason why we want to do electron dot structures. Just looking at that, you might look at that and go, oh, two electron groups. There's the two oxygens. No brainer, that's a linear molecule. And if you say that, you're going to be wrong. Ok? Let's see why. If we figure out all our electrons and then put it in, we find that this is the Lewis dot structure. We're going to have a multiple bond. We're going to have lone pairs. And look what we have. Around the sulphur, which is our central atom, we have one, two, three electron groups. One of them is the lone pair. You don't see that lone pair when you just look at the formula here. So that's why we have to write the electron dot structure so we get the right number of electron groups around sulphur. Ok, so we have three electron groups. Again, it's going to be 120-degree angles, and here's our sulphur with the 120-degree angles. Ok? This arrangement of our electron groups is trigonal planar, so it's the same as what we had over here. But now, the next question is how many atoms are attached? One, two. So let's go ahead and put those in. Here's an oxygen, and here's an oxygen. Ok? So we have our two oxygens. What's up here? Well, that's your electron pair that's non-bonding. Ok? So now we come to the last question, and we're going to find this is a different answer than we have been seeing. Even though the electron pairs are 120 degrees apart from each other, and they are, if you look at that molecule, you do not see this here because these electrons are so tiny this is all you see. Now what shape is that? Well, it kind of looks like the top of a coat hanger, doesn't it? We refer to this as being bent. So this is a bent molecule. Ok? One other thing I want to mention is polarity. Is this a polar molecule or is it a non-polar molecule? Ok? So what we have to do now is we have to look

at our electronegativity table. And what we do, what we find is that the oxygen has electronegativity of 3.5, and sulphur has an electronegativity of 2.5. So this is 2.5, this is 3.5, and this is 3.5. Ok? Well, what does that tell us? Well, any time you can take this and subtract that and it's greater than .4, then there are going to polar bonds. So let's go ahead and erase these just to get them out of the way. There's going to be polar bonds, and those polarities are going to be aiming at the oxygen. Ok? Same with over here. The electrons are going to shift away from sulphur and toward the oxygen. So remember, electronegativity means these oxygens are grabbing those electrons and taking them closer to the oxygen, and that means that the sulphur doesn't have as much electron density, so sulphur becomes a little bit positively charged. Oxygens become a little bit negatively charged. And so we have these two bands going, these two arrows going this way. When you take these vectors and you average them, they will actually average going straight down. Ok? It's kind of like if you had something, you know, directly in front of you, you have wire attached to both, you know, and you have a wire attached to it from here, a wire attached from it here, and you pulled. As you pull, it would come straight at you. Ok? So as you're pulling this way, pulling at, this way, those electrons go in this direction. So you've got this negative cloud right here. Ok? That means that this molecule right here is polar because you have a negative end down here and a partial positive end up here. Ok? How about this one here? Would that be negative? Would that polar or non-polar? Well, fluorine has a 4.0 electronegativity and the boron has a 2.0. So four minus two is two. Again, those are polar bonds. And because fluorine is so much stronger in electronegativity, this is what you're going to see. You're going to see the electrons are being pulled away from boron and toward the fluorines. So is that polar? Well, just looking atoms individually, this is a polar bond, this is a polar bond, this is a polar bond. But because they are exactly 120 degrees apart from each other, they cancel each other out. So even though these are polar bonds, this is considered a non-polar substance because all those bonds will cancel out. It's kind of like having two very strong people in a tug of war. If they're pulling in opposite directions, yeah, they each might be strong, but if they're equally strong, they cancel each other out. Ok? And this arrangement will cancel each other out also.