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CLAIRE HALLORAN: Today we're going to do Goodie Bag 4, VSEPR. Our objective is to visualize the three dimensional structure of some simple chemical compounds. The only thing you'll need is a molecular modeling kit. A conceptual question you should think about today is, what factors determine how bonds rotate in a molecule?

So the first thing we're going to do is draw the Lewis structure for this molecule. So we know that Si, S, and CN, since they have between three and five valence electrons, make up the backbone of this molecule. And then we're going to add all of the atoms around each of these backbone atoms.

Then counting valence electrons, we're going to make sure that we have the correct number of non-bonding pairs in bonds. And this will allow us to identify the geometry at each atom in the backbone. So this silicon bond here has four bonding domains, and all of them are bonded to another atom. So we know that this is going to be a test tetragonal geometry.

This bond here, centered around the sulfur, has five body domains, and one of them is a non-bonding pair. We know that this will be a seesaw geometry. And then, finally, this carbon has two bonding domains with atoms in each of those domains, so this will be a linear geometry. And now we're ready to build our model.

So first, we're going to draw the Lewis structure for this molecule. As with before, we're going to identify the backbone atoms in this molecule. So in this case, the backward atoms are C, B, and O. And now we're going to attach the other atoms to them. And now we're going to check and make sure that there are the proper number of valence electrons around each atom.

Next, we're going to identify the geometry at each of the backbone atoms. So the first geometry centered around this carbon atom here has four bonding domains, all of which contain bonds to other atoms. So that's going to be tetragonal. The second geometry has three boding domains, all of which are bonded to other atoms. So this is going to be a trigonal planar geometry.

And, finally, the geometry around this oxygen atom has four bonding domains, two of which are bonded to atoms, and two of which are occupied by lone pairs. So that's going to be a bent geometry. And now we're ready to construct our model.

The Goodie Bag 4 worksheet asks us, whether some different bonds can be in the same place? So first, it asks, whether this H, Si, Si, S, and CN bond can be in the same plane? Remember that the CN bond cannot rotate, because it's a triple bond. But we can rotate around this S, Si bond, and get all three of the bonds to be in the same plane. The plane shown with my hand here. So here is our first bond. Here's our second bond. And here's our third bond. All on the same plane.

Next, it asks if we can have this H, Si, S, F, and CN bond in the same plane? And so we can try to rotate to achieve this. But we notice that this isn't possible, because these two bonds are always in the same plane, and we can't get any of these bonds into that plane, because of the seesaw geometry.

So for our second molecule here, the Goodie Bag worksheet asks a different question. We notice that this central CB bond can rotate, and the Goodie Bag asks, which configuration is the lowest energy? So remember that the entire VSEPR model is centered around the idea that we want to minimize repulsion between electron clouds by maximizing the distance between them.

So we're going to rotate this so that the repulsion between these groups in the molecules are minimized. So as we rotate this, we notice that there are two different possibilities. Remember that these green atoms are CL, and this yellow atom is oxygen. These are the largest atoms in our model, and also the ones that have the most repulsive electron clouds. So we're going to want to maximize the distance between them.

So one way that this can be achieved is by rotating the model so that the oxygen is aligned with the hydrogen, which has a very small electron cloud, and thus is capable of only very slight propulsion. So this configuration is low energy, because the very repulsive chlorine atoms are far from the repulsive oxygen atom. However, there's also a different possibility.

If we rotate, we can put the oxygen atom in a plane in between the two chlorine atoms, so that the oxygen is not directly facing an atom. However, this configuration

puts the oxygen atom spatially closer to a chlorine atom, as shown here, and this hydrogen atom is very close to this chlorine atom. So the first configuration is lower energy.

Today, we used our molecular modeling kids to visualize the 3D structure of some simple molecules using the VSEPR model. By playing with these bonds and rotating them, we were able to understand how repulsion between atoms gives rise to the lowest energy configurations of these molecules.