Sketching Chair Configurations of Cyclohexane and Its Derivatives

Transcript

Instructor: Brett McCollum

00:00:00:04 - 00:00:39:47
Instructor: In this video, we're going to get practice on identifying the stereochemical label associated with the chiral compound. So, here's the compound that we're going to start with, and we need to begin by identifying the priority of the four groups about our center of chirality, our stereochemical carbon, based on the priorities identified by the Cahn-Ingold-Prelog rules. Let's start by recognizing we have a hydrogen, carbon, a carbon, and a carbon. Already, we know that that hydrogen is lowest priority. It's group number four.

00:00:39:47 - 00:01:23:99
Instructor: Of our three other options, we have to see what is attached to the carbon to continue down the chain and determine priority. We can start here and we see that we have a carbon that is bonded to an oxygen. Now because it's a double bond, there's another oxygen, and then we have the hydrogen attached to it. We have an ethyl group, and that is going to be a carbon that is bonded to another carbon and two hydrogens. Then we have a methyl group that is a carbon attached to three hydrogens.

00:01:23:99 - 00:02:07:00
Instructor: We can clearly see that oxygen is higher priority than carbon or hydrogen, so this is priority group one. Priority group two is up here because a carbon is higher priority than hydrogen, and that makes this the methyl group, priority group three, with the hydrogen that we already identified as group four. So if we want to identify our stereochemical label, we need group number four to be in the back positioned away from us. But at the moment, this bond is coming out of the plane toward us. We need to reorient this molecule.

00:02:07:00 - 00:02:53:95
Instructor: There's a couple of ways you could do this. One is, you could try to mentally position yourself over here, looking at the molecule, so that the methyl is on one side of you, the ethyl is on the other side of you, the aldehyde is below you, and then we have the

hydrogen going away from you. If you're going to find that challenging to say, I've got aldehyde, ethyl group methyl group, that's a clockwise rotation. That's an R group, R stereochemical label. That's one way you could do it, but if you find that challenging, I'm going to give you a little bit of a trick.

00:02:53:95 - 00:03:25:78
Instructor: We could grab those two bonds mentally and rotate the molecule to another orientation. Let's try and do that. In that case, I'm going to keep that aldehyde down at the bottom. But I'm grabbing this methyl and I'm pulling it around, moving the ethyl to this side. Now I've got the ethyl group over here.

00:03:25:78 - 00:04:07:77
Instructor: I've got my methyl group has come forward, and as a result of swinging around, that hydrogen has been pushed behind the back side of the molecule. We could put it there, we could mark it over here. Either of those is going to work for us. Now if we identify our priorities, we have Group one, Group two, Group three, and we see that is, in fact, a clockwise rotation, and this is an R stereoisomer. Now, that still may not be your favorite way to solve this.

00:04:07:77 - 00:04:46:13
Instructor: I'm going to give you one more technique. The third approach is to generate the enantiomer of our compound and identify its stereochemistry, and then we'll know what the original compound is because it's the opposite. To generate the enantiomer, you need to choose two of your groups from this original representation that you're going to switch. Since we want to put the hydrogen at the back, let's switch the hydrogen and the methyl group. I'm going to leave my ethyl group up here.

00:04:46:13 - 00:05:33:83
Instructor: I'm going to put my aldehyde at the bottom, and I've switched the methyl, and the hydrogen. This is not the same compound. This is its mirror image. With the hydrogen at the back, we can now determine what is the priority groups. We have priority one, priority two, and priority three, and now it's a counterclockwise rotation, meaning that we have generated the S enantiomer.

00:05:33:83 - 00:06:30:63
Instructor: Since this is S, we therefore know that the original compound before we switch to pair is the R enantiomer. Now we're going to try a more complicated example where we have more than one stereochemical center. We're going to draw the compound out, identify our stereochemical labels at all locations, and name the compound, including that designation. We look at this, and we can see we have five carbons, three of them are not chiral centers, but we have a chiral center here, and a chiral center there. Let's start with the one at position two.

00:06:30:63 - 00:06:53:88
Instructor: What's attached at this position? We have an alcohol, a hydrogen, a carbon and a carbon. We know that this is priority one. This is priority four, and now we have to compare our two carbons. The carbon over here is a carbon that is bonded to an H, an H, and an H.

00:06:53:88 - 00:07:40:39
Instructor: Where as this carbon right there, is bonded to an oxygen, a carbon, and a hydrogen. Oxygen, carbon, hydrogen, listing them in order of priority based on the Cahn-Ingold-Prelog rules and we can see that the oxygen is higher priority. This is going to be group two, where this is group three about that carbon. We can draw our circle going this direction, and we see that that's clockwise. This is an R for its stereochemical label.

00:07:40:39 - 00:08:13:68
Instructor: Now let's consider the other center of chirality. This carbon has a hydrogen, and oxygen, a carbon, and a carbon very similar to the one we just did, and we can assign our priorities as being priority one, priority four. We compare this is a carbon with a carbon and two hydrogens on it. This is a carbon that has an oxygen, carbon, and a hydrogen on it. This is actually going to be lower priority than that.

00:08:13:68 - 00:08:52:53
Instructor: We have group priority two and three for this center of chirality. One to two to three goes in that direction. That looks clockwise. But before you assign that stereochemical label as R, notice that our lowest priority group, the hydrogen is not pointing away, rather our highest priority group is pointing away. We're on the wrong side of the molecule to be able to label it stereochemistry.

00:08:52:53 - 00:09:26:82
Instructor: If we swap two groups, we generate the inverted stereochemistry center. Swapping those two groups, putting the hydrogen here and the OH here, is still going to end up with that R stereochemical label. Our original compound is the inversion of that. Therefore, it's actually S. We can now name our compound.

00:09:26:82 - 00:10:25:91
Instructor: We have a five carbon chain, pentane. On that, we have an alcohol at position two and at position three. It's a two, three, diol, and we need our stereochemical label at the start of the name, which is going to be two R, three S, Pentane. And because we have the prefix of diol, and we want to avoid having two consonants beside one another, we're going to maintain that E in pentane, whereas normally we would have dropped it off if it was a single alcohol group. This is a two, three, diol, and there's the name of our compound, including its stereochemical label.