

Illustration (C): The plane of the ring is drawn in a pseudo-perspective. The intent is to show what a triangular shape would look like if it were lying face down on a table that you were standing above and looking down at from a high angle. In (C), the wedged lines are used to try and give a few more spatial cues for the drawing. As represented, it is as though the triangular shape was propped up on one of its sides and then fell forward, and now has that top vertex pointed at you.

Illustration (D): As in (B), there is a hydrogen atom group pointed above the plane of the ring at each vertex, and also one below. If you now imagine that triangular object falling forward onto a tabletop, then three of the bonding sites, with their hydrogen atoms, will be directed upwardly, while the other three will be directed downwardly. At the front vertex, closest to you, the upwardly directed bond sits in front of the back bond of the ring, from your viewpoint. A standard drawing convention used to better convey the three-dimensional spatial cue is to put a break in the line that sits behind your point of view. The placement of the six hydrogen atoms and their bonds is illustrated in (D). The three that are “up” are all cis to each other; the three that are “down” are all cis to each other; and grabbing any one of the hydrogens defines the two on its opposite side, on the other two atoms of the ring, as trans.

Illustration (E): The hydrogen atoms have been highlighted. The three on the top face are outlined with circles, while the three on the bottom face are outlined with squares. The open shapes are in the front, with respect to the viewer, and both projected towards the viewer, while the fully shaded and dotted line shapes are attached to one of the carbon atoms along the back edge.

Illustration (F): By defining the point of view shown on the left, in (F), a Newman projection for cyclopropane can be drawn. Because of the planar structure, the carbon-carbon bonds are fixed into an eclipsed form, and so is any pair of adjacent carbon-hydrogen bonds.

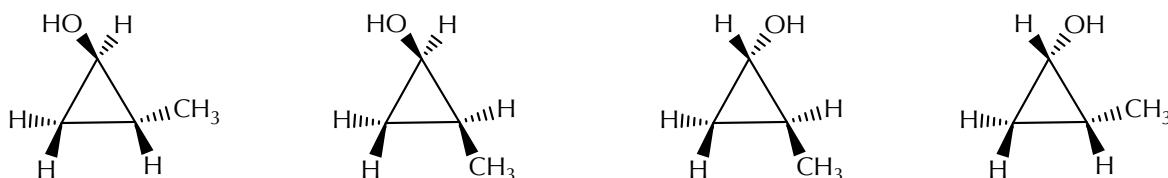
The drawings in Figure 0616 are foundational. The perspective drawings (e.g., (D)) are intended to convey the spatial relationships you might see in a physical model (yet another reminder for you to get models and to ensure you see, in your mind’s eye, the spatial relationships that are coded into these drawings). This set of drawings can not only be used as templates for 3D illustrations of other three-membered rings, but the principles used in these visualizations can be extrapolated to rings of any size.

The rest of this section draws upon your prior understanding of stereoisomerism.

Figure 0617 provides drawings of the four stereoisomers for 2-methyl-1-cyclopropanol. Translating any of these drawings into the pseudoperspective views used in Figure 0616 is an important skill. Just as when you draw a tetrahedron with line/dash/wedge notation, there are many different equally correct translations for any of the 2-methyl-1-cyclopropanol stereoisomers. There is no rule governing how to represent the translated structure beyond making sure that you have actually represented the molecule you intend to redraw.

Figure 0617

Stereoisomers of 2-methyl-1-cyclopropanol.



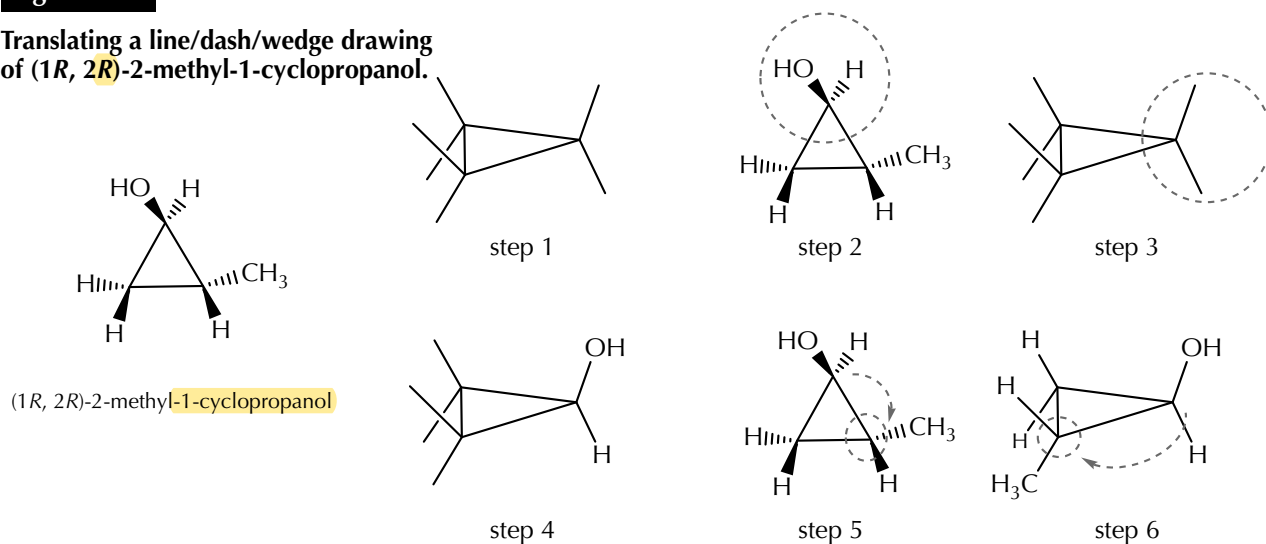
(1*R*, 2*R*)-2-methyl-1-cyclopropanol (1*R*, 2*S*)-2-methyl-1-cyclopropanol (1*S*, 2*S*)-2-methyl-1-cyclopropanol (1*S*, 2*R*)-2-methyl-1-cyclopropanol

In Figure 0618, a possible stepwise process for translating the (1*R*, 2*R*)-stereoisomer is presented. The process shown in Figure 0618:

- Step 1.** Draw the ring in its pseudo-perspective form.
- Step 2.** Select the vertex on the line/dash/wedge drawing you will place first (the one with the OH).
- Step 3.** Identify the vertex on the pseudo-perspective drawing that you want to use as one selected in Step 2 (it does not matter which one).
- Step 4.** Make the easy decision: the upwardly directed bonding site on the line/dash/wedge drawing (the one with the OH) is the one pointed upwardly at the vertex you selected in Step 3 (draw in the OH up and the H down)
- Step 5.** Be internally consistent: starting from the upwardly pointed OH in the line/dash/wedge drawing, you move clockwise around the perimeter of the ring by one atom to get to the vertex with the methyl group, and it is pointed downwardly; so this is exactly what you need to translate onto the other drawing: start with the OH up and move clockwise to the next atom.
- Step 6.** The methyl is directed downwardly, in the same direction as the OH. Add the last Hs.

Figure 0618

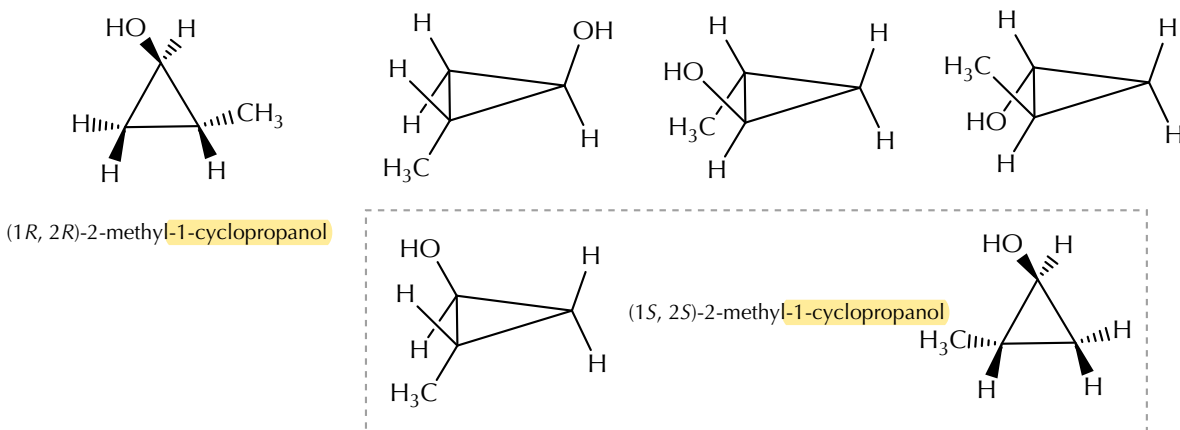
Translating a line/dash/wedge drawing of (1*R*, 2*R*)-2-methyl-1-cyclopropanol.



A few more drawings for the (1*R*, 2*R*)-2-methyl-1-cyclopropanol are given in Figure 0619. If you are **inconsistent** in the translation, you could easily draw the enantiomer by mistake (one example of that is also shown).

Figure 0619

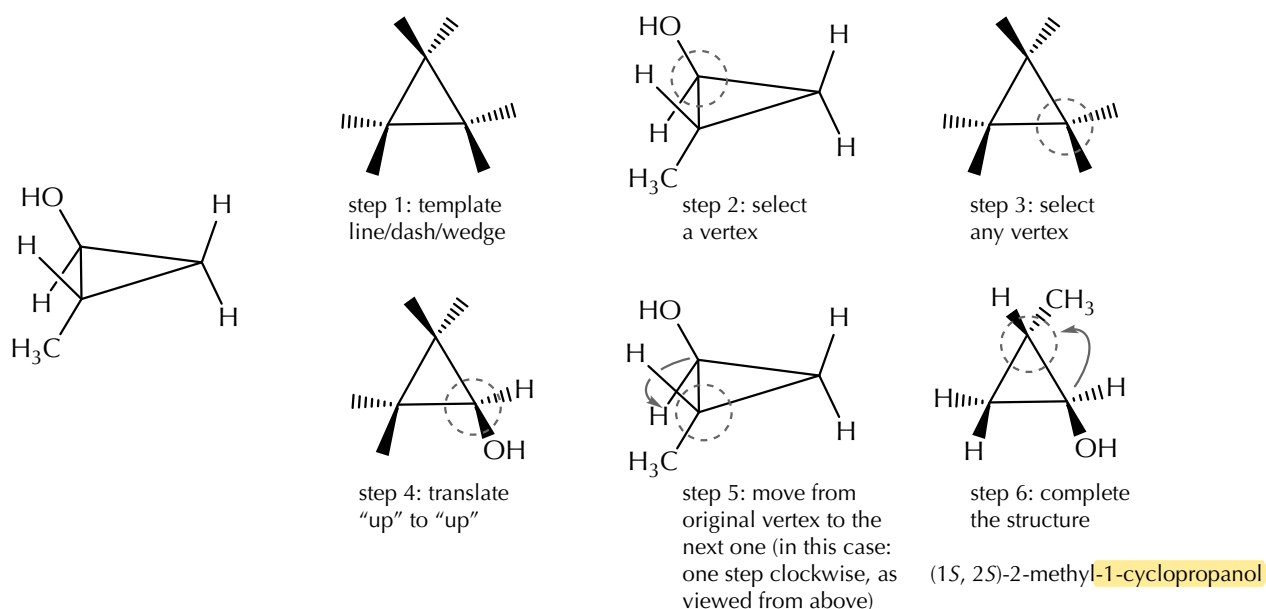
A few other 3D drawings for (1*R*, 2*R*)-2-methyl-1-cyclopropanol.



Being able to read all of these drawings and assign the “R” and “S” configurations can be challenging, and so accurately and rapidly translating them into equivalent drawings is an exceptionally useful skill and worthy of as much practice as it takes to get it right. In Figure 0620, the pseudoperspective form of the (1*S*, 2*S*)-2-methyl-1-cyclopropanol from Figure 0619 is the starting point for a translation to the line/dash/wedge form, where assigning the stereochemical labels is generally easier to do.

Figure 0620

Translating into a line/dash/wedge drawing to assign “R” and “S” labels.



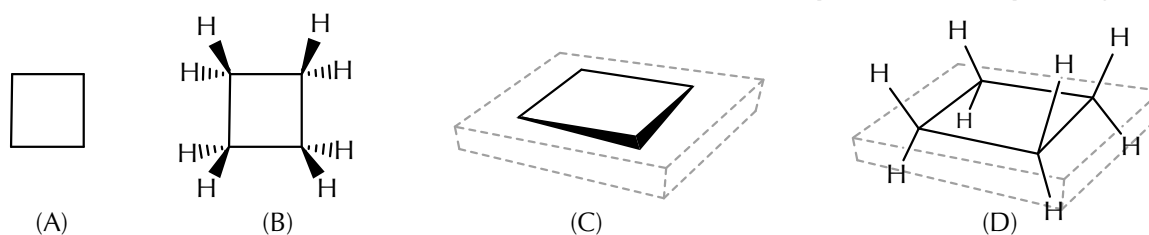
B. Cyclobutane

The drawing principles illustrated for cyclopropane are equally valid for all ring sizes. Every different ring has its own set of pseudoperspective drawings that chemists have developed over time.

Figure 0621 follows directly from Figure 0616. Planar cyclobutane has a slightly less strained ring angle (90° rather than 60° , and closer to the unstrained tetrahedral value). The ring has two faces, each with four bonding sites that are all mutually cis to one another, as well as the trans relationship between groups on different vertices that are on opposite faces. The pseudoperspective drawing for cyclobutane can be shown in a planar form and, as in the cyclopropane case, all of the adjacent bonding sites on the same face would be eclipsing each other. The translation of specific molecules from line/dash/wedge to pseudoperspective also follows directly from the cyclopropane case.

Figure 0621

Representations for planar cyclobutane.



An important difference between cyclopropane and all other saturated rings is that only cyclopropane is restricted to a planar shape. In the planar form, the bonds around the perimeter of the ring are eclipsing