

Method for the Drawing of Newman Projections: Understanding Newman Projections with the Help of Hands

The interconversion between the perspective formulae and Newman projections is illustrated here. The method describes how students can look at their own hands as models for the visualization and interconversion. The procedure is also applicable for drawing Newman projections of chair conformations.

Visualization of molecules in three dimensions is essential for the study of organic chemistry. Molecular models play an important role in the teaching and understanding of three-dimensional structures. However, many times it is not possible to build molecular models either due to time constraints or due to the non-availability of molecular modeling kits. Using our own hands in place of modeling kits has been shown to be an effective and viable alternative [1].

Newman projections are helpful for the conformational analysis of molecules [2]. Textbooks do a good job in describing the position of the front and the back carbons in these drawings relative to that of perspective formulae [3] (also known as hashed-wedged/solid-wedged line notation) [4]. However, students still struggle with the placement of groups around the two carbons. In this article a method is described which addresses this issue. The technique utilizes one's own hands for the visualization of molecules.

Consider the perspective formula **1** (*Scheme 1*). You are required to draw a Newman projection looking from the side 'b' as shown in the scheme.

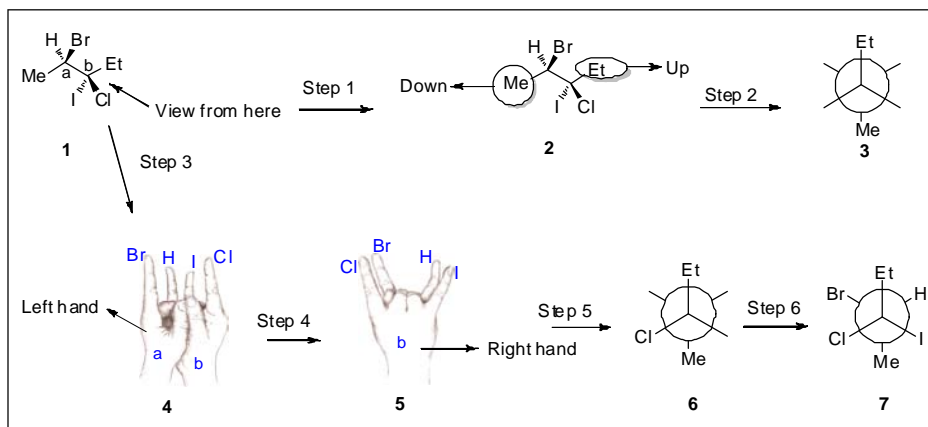
1. Identify the terminal groups that are up and down in the plane (2).
2. Draw a Newman projection skeleton in which the up and down

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Scheme 1.

The interconversion of a perspective formula and the Newman projection.

groups can be seen easily. In this case, the ‘up’ group occupies the north position on the front carbon and the ‘down’ group is attached onto the south position on the carbon in the back (3).

3. Now use your hands as shown in the diagram, and position your hands so that you are viewing your thumbs (4). The hands represent the carbons ‘a’ (hand on the left) and ‘b’ (hand on the right) present in 1. The fingers close to you (your index fingers) indicate the thick wedged groups and the fingers further away from you (your pinky fingers) represent the dashed wedged groups. Identify the group represented by any one of the fingers. For the present case, the index finger of the right hand has been chosen.

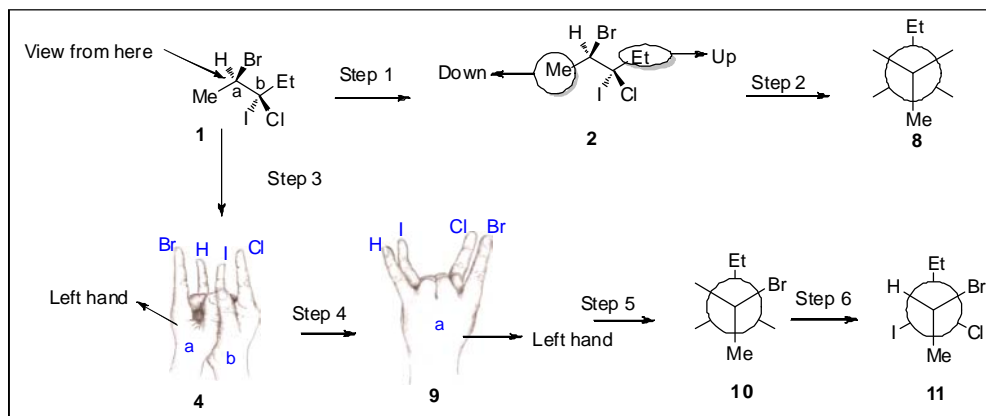
4. Turn your hands so that the fingers are pointing towards the ceiling and the right hand is in front of you (5).

5. The index finger of the right hand will indicate the position of the particular group on the Newman projection (5→6).

6. Using the group identified in point 5 as a reference, place the remaining groups that are on the same side (thick or dashed wedged) in (1) to the same side (right or left) in the Newman projection (6→7).

The perspective formula of a Newman projection can be drawn by reversing the above process. The Newman projection, when





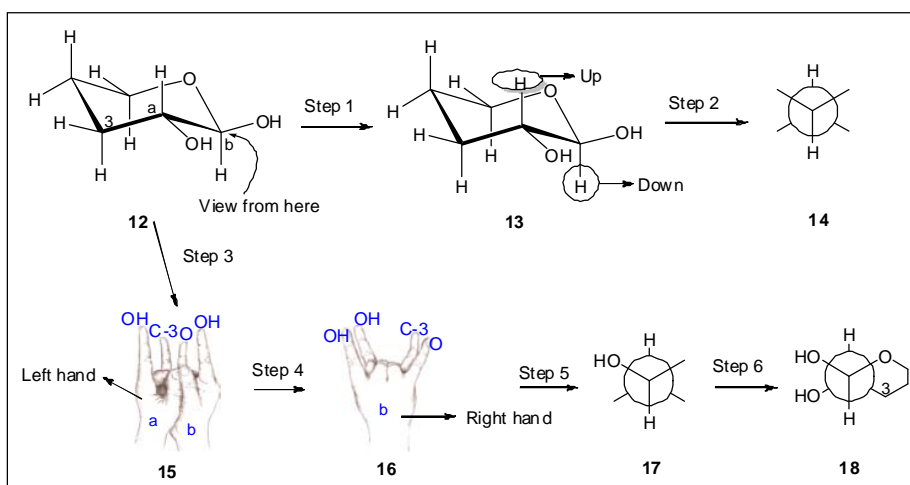
viewed from carbon 'a' (**1**) (*Scheme 2*) can also be drawn easily. Remember, hands represent carbons 'a' and 'b', and now 'a' should be at the front in step 2 (**2**→**8**) and as such, the left hand should go in front of the right in step 4 (**4**→**9**).

Scheme 2. The interconversion when viewed from the carbon 'a'.

The procedure can also be used to draw Newman projections of other types of structural drawings. As an example, the Newman projection of the chair conformer **12** is drawn by following the steps mentioned above (*Scheme 3*).

The above method is short. It takes less than a minute to perform all of the necessary steps. In addition, the procedure allows the students to visualize the molecules in three dimensions. The author has found that, in his class, the students who use this

Scheme 3. The Newman projection of a chair conformation.



technique score better on questions concerning the interconversion of Newman projections and perspective formulae. As such, the method can be a useful tool in the teaching of Newman projections.

Acknowledgements

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Suggested Reading

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- [4] P Vollhardt and N Schore, *Organic Chemistry: Structure and Function*. 6th ed; W H Freeman and Company: New York, p.39, 2011. Solid-block and hashed-block lines also represent bonds in 3-D. For an excellent and entertaining discussion on block and wedged lines and the confusion about their use in literature, see P Wyatt, P and S Warren, *Organic Synthesis: Strategy and Control*. John Wiley & Sons Ltd., West Sussex, pp.376–378, 2007.

