

CO-groups

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<http://web.me.com/whitby/Octahedron/Welcome.html>

Reference

1. Robert Whitby, Octahedron1stEd.pdf
2. Lubert Stryer, *Biochemistry* 2d ed., W. H. Freeman, San Francisco, 1981, "Nomenclature and conformation of monosaccharides", page 257.

Introduction

The chapter SUGAR of Reference 1 built six C-atom assemblies whose basis was two main chain units joined by an O-atom which acted as a shared sidechain. This paper has been prepared as a reference which can be used to build sugars as assemblies of CO-groups.

A C-atom and an O-atom can join cleftly in just four distinct ways. Each of the four CO-groups has twenty-four orientations. There are, then, ninety-six distinct CO-units with which to build an assembly. Assemblies of CO-units of three or more occur as monosaccharides. They have the empirical formula $(\text{CH}_2\text{O})_n$ which suggests that the join between CO-units is C-atom to C-atom and that the H_2 -group is joined to the O-atom. They are also represented in this way in textbooks [See Reference 2]

The C-atom has eight distinct orientations for a given octahedral view; the O-atom has twelve distinct orientations. The orientations of the two atoms are shown in Figure 1. The ninety-six CO-groups are arranged according to the orientation of the C-atom in Figures 2 through 5.

The four ways that a C-atom and an O-atom can join are shown in Figure 6. The twenty-four orientations for each of those ways are shown in Figures 7 through 10.

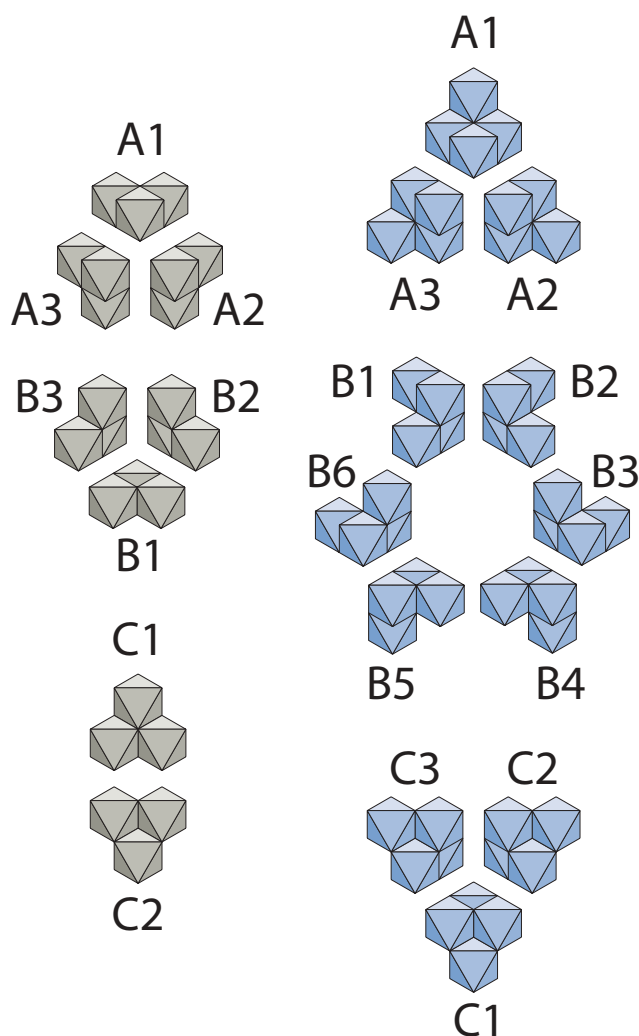


Fig. 1 C-atom and O-atom orientations

A C-atom viewed facially is one of three types—Type A has one He-octa over two He-octas, Type B has two He-octas over one He-octa, Type C has three He-octas over none. The three Type A C-atoms differ by a rotation of one-third turn, those of Type B also differ by a rotation of one-third turn, C2 is the obverse of C1.

An O-atom viewed facially is one of three types—Type A has one He-octa over three He-octas, Type B has two He-octas over two He-octas, Type C has three He-octas over one He-octa. The three Type A O-atoms differ by one-third turn, the Type B O-atoms can be seen as three mirror pairs which differ by one-third turn, the Type C O-atoms differ by one-third turn.

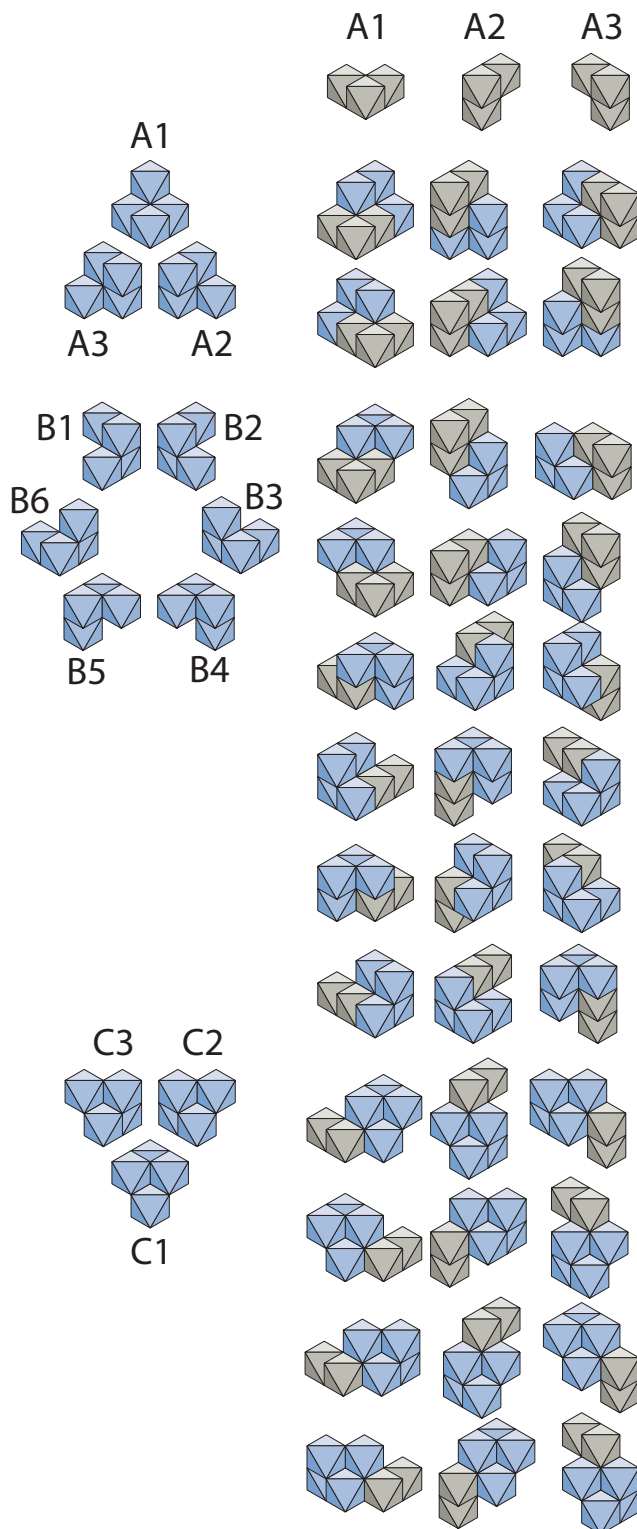
Each distinct orientation of the C-atom and the O-atom has a label which will be used to label the CO-groups which they form. The label of the C-atom will precede the label of the O-atom adjoining it. Where two joins occur wherein the labels are the same, they will be designated by L- or D- according to the relationship of the O-atom to the C-atom. An example of a CO-group label is C2B5. An example of two joins with the same label is A2C1 which will be called L-A2C1 and D-A2C1.

Fig. 2 CO-groups wherein the C-atom has a one-on-two orientation

The figure shows each of the CO-groups wherein the C-atom is in a one-on-two orientation. The CO-groups are placed in columns according to the orientation of the C-atom which heads the column. Within each column, the CO-groups are arranged according to the orientation of the O-atom. The first such grouping uses only O-atoms having a one-on-three orientation. The O-atoms of this type are shown to the left of the CO-groups whose O-atoms are in this orientation. Each CO-group in a row differs only by a rotation of one-third turn from each of the other two CO-groups of the same row.

There are two rows of three CO-groups each in which the O-atom is in a one-on-three orientation. There are six rows of three CO-groups each in which the O-atom is in a two-on-two orientation.

There are four rows of three CO-groups each in which the O-atom has a three-on-one orientation. The total number of CO-groups in which the C-atom is in a one-on-two orientation is thirty-six.



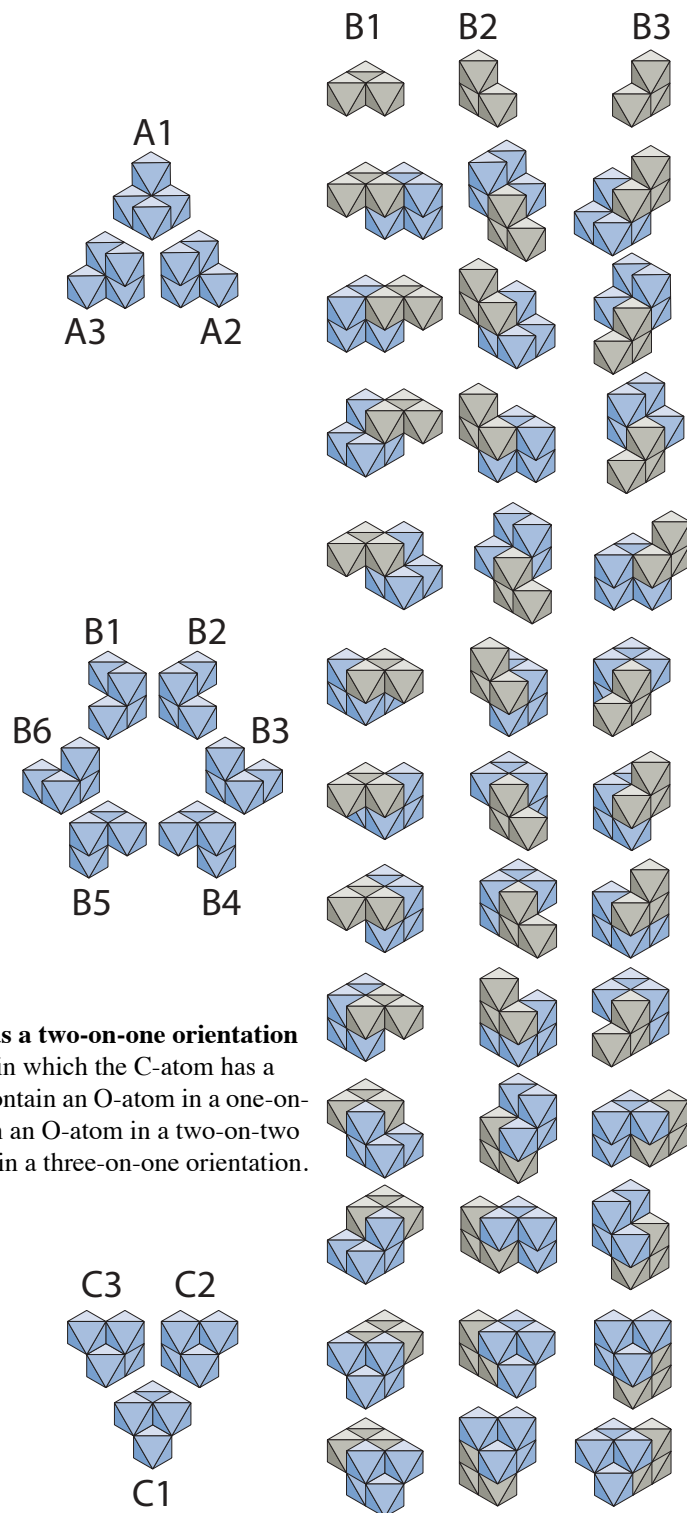


Fig. 3 CO-groups wherein the C-atom has a two-on-one orientation

The figure shows the thirty-six CO-groups in which the C-atom has a two-on-one orientation. Twelve CO-groups contain an O-atom in a one-on-three orientation; eighteen CO-groups contain an O-atom in a two-on-two orientation; six CO-groups contain a O-atom in a three-on-one orientation.

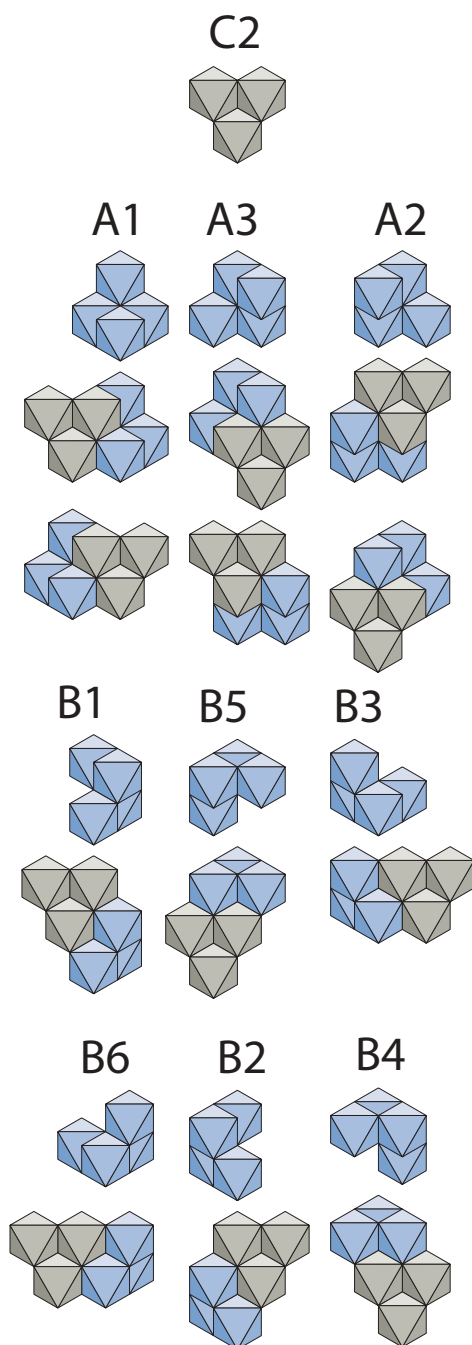


Fig. 4 CO-groups wherein the C-atom is oriented so that its tetrahedral concavity is visible.

The C-atom has the same orientation in each of the CO-groups shown here. The groups are organized in columns headed by the orientation of the O-atom they have in common. There are six CO-groups in which the O-atom is in a one-on-three orientation. There are six CO-groups which are in a two-on-two orientation. There are altogether twelve CO-groups in which the three He-octas of the C-atom are parallel to the projection plane and the tetrahedral concavity formed by them is visible.

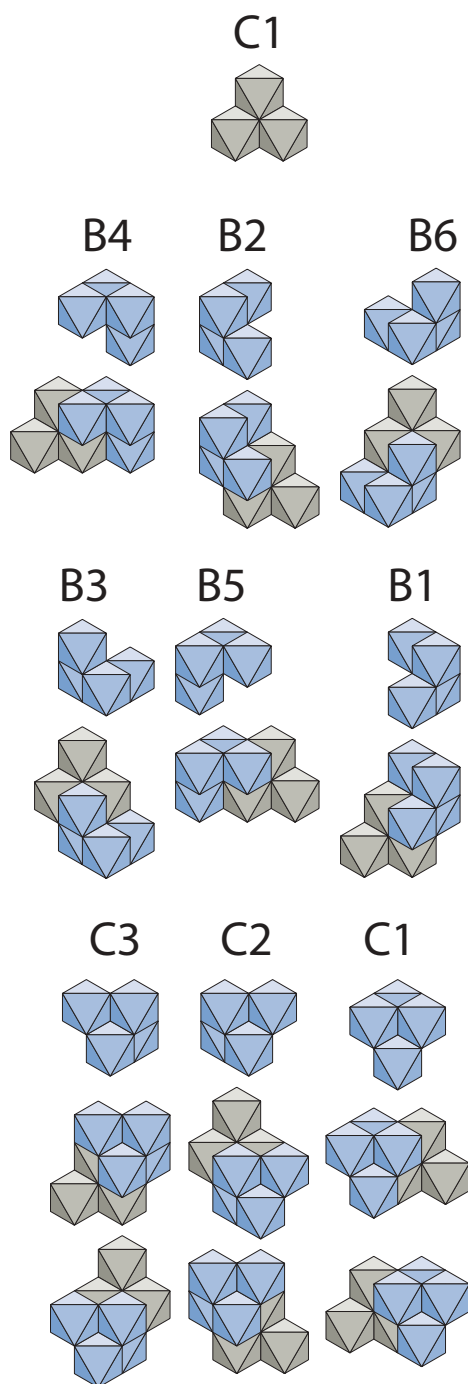


Fig. 5 CO-groups wherein the C-atom is oriented so that its tetrahedral concavity is not visible.

Like the previous figure, the C-atom of the groups shown here have a common orientation. Each CO-group lies in a column headed by an O-atom in the orientation used in the group. There are twelve CO-groups in which the three He-octas are parallel to the projection plane and the tetrahedral concavity formed by them is not visible.

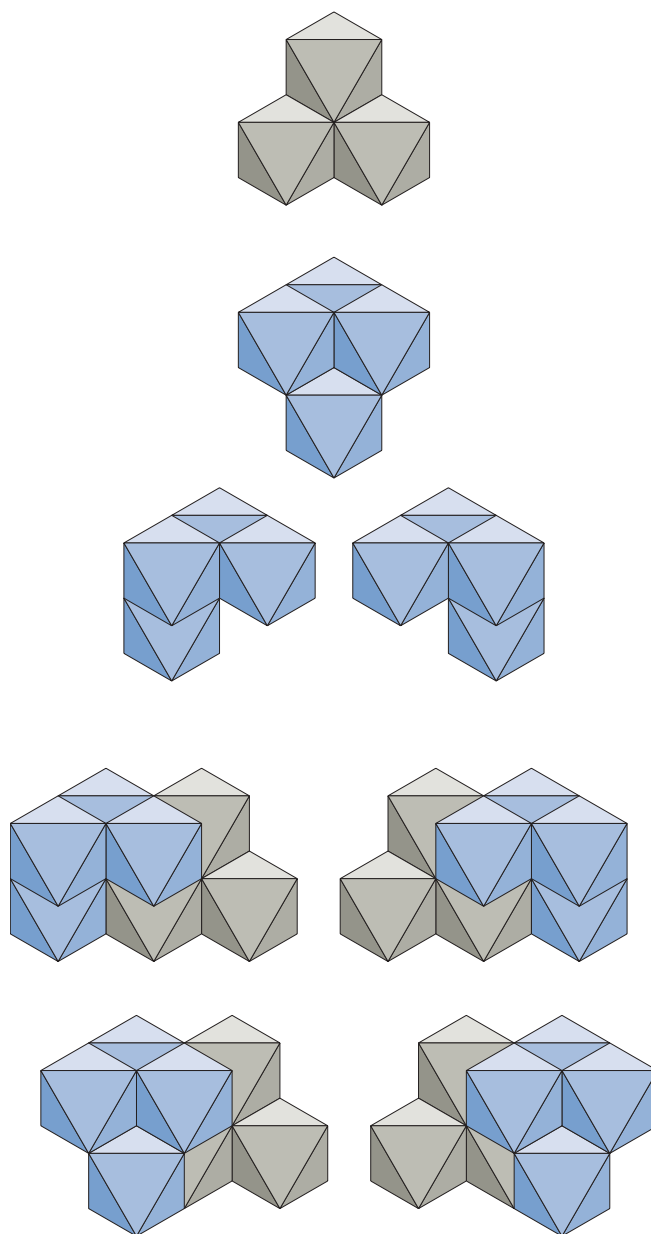


Fig. 6 CO-groups, four only

An O-atom can cleftly join with a C-atom in only four distinct ways. In each of the four CO-groups which are shown at the bottom of the figure, the C-atom is identically oriented to the C-atom of each of the other groups. The atoms which make up the groups are shown separately at the top of the figure. The orientations of the O-atoms are described by the number of He-octas in each of its two facial layers and their relationship. The first O-atom has a *three-on-one* orientation, there being three He-octas in the nearer facial layer and one He-octa in the second facial layer. Each of the other two O-atoms has a *two-on-two* orientation which is a mirror image of the other. The name of each CO-group corresponds to the name of the orientation of its O-atom and its relationship to the C-atom. The names are *two-on-two left*, *two-on-two right*, *three-on-one left*, and *three-on-one right*.

Fig. 7 Orientations of the two-on-two left CO-group

The twenty-four orientations of the two-on-two left CO-group are arranged in threes. Each orientation in a threesome differs from the other two orientations by one-third turn. Each orientation is labeled with a code which signifies the orientations of the C-atom and the O-atom of the CO-group. The code B3A1 says that the C-atom has the orientation B3 and the O-atom has the orientation A1.

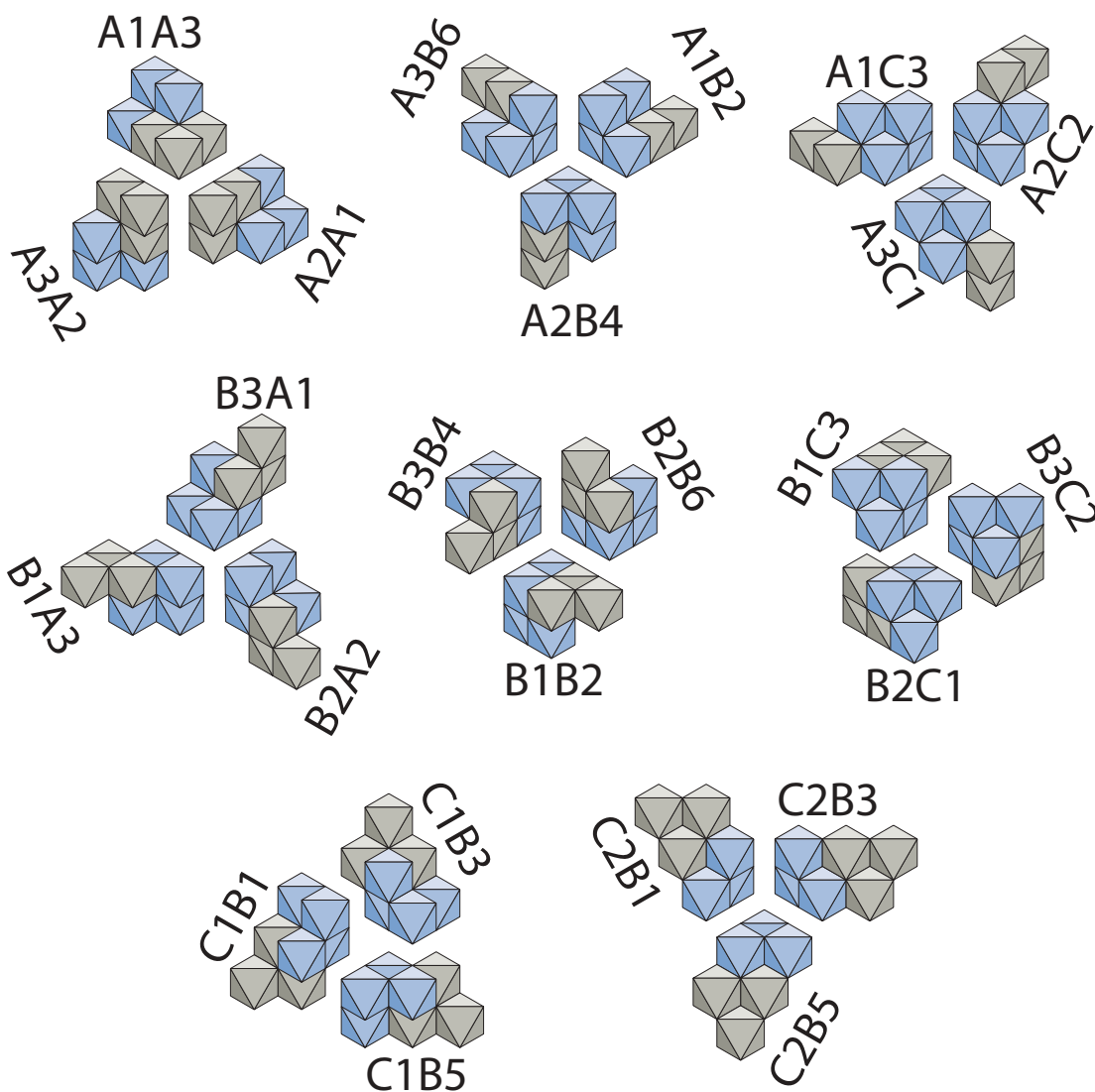
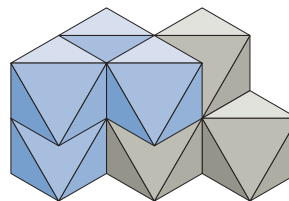


Fig. 8 Orientations of the two-on-two right CO-group

The two-on-two right CO-groups are arranged in threes. Each CO-group in a threesome differs from the other two CO-groups by one-third of a revolution. Each CO-group has been given an identity code which is related to the orientations of the C-atom and the O-atom which form it. CO-group C2B6 says that its C-atom is in the C2 orientation and that its O-atom is in the B6 orientation.

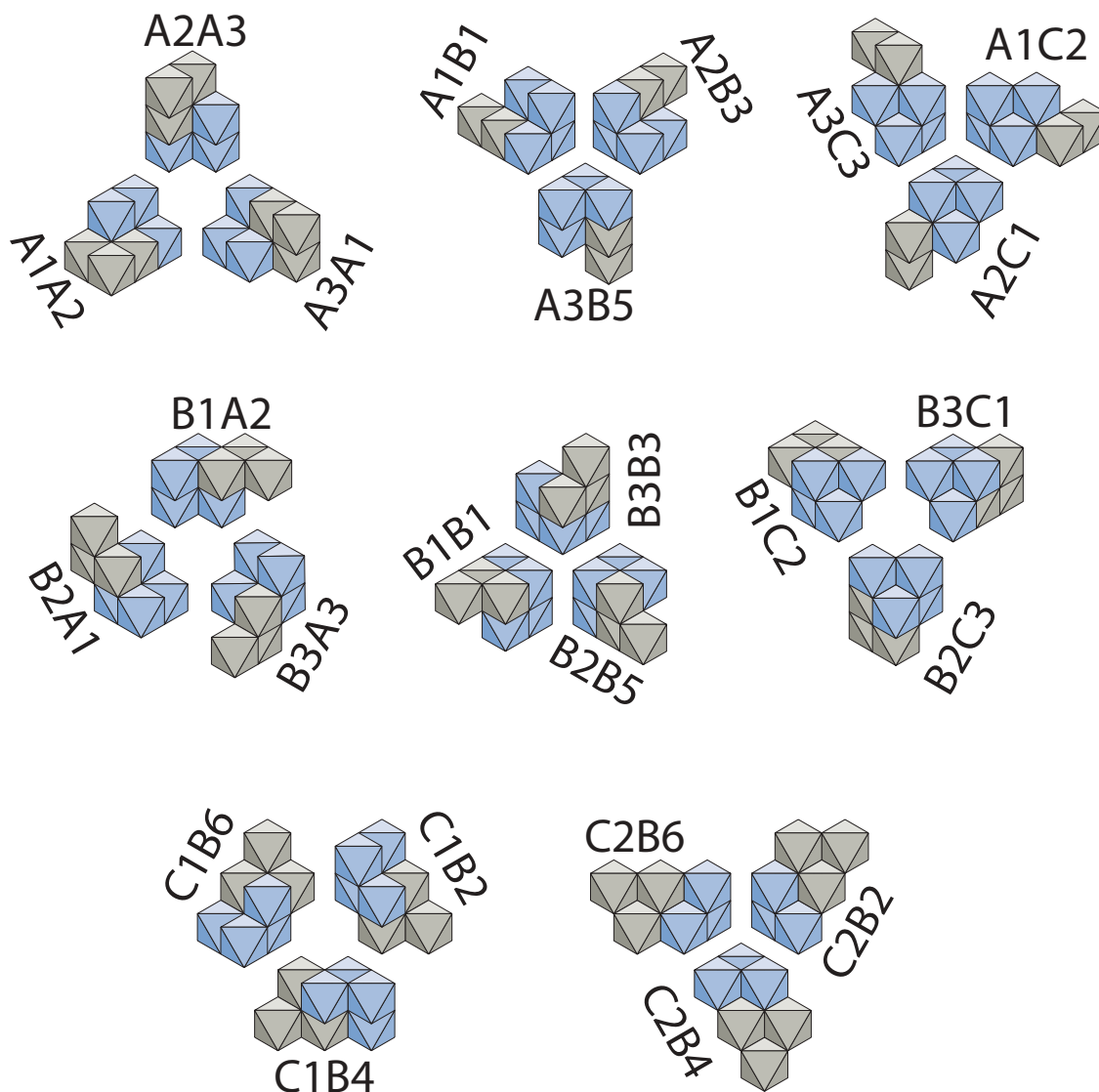
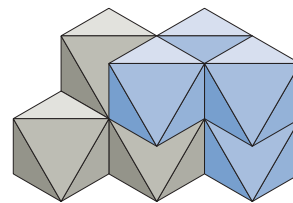


Fig. 9 Orientations of the *three-on-one left* CO-group

Each of the three-on-one left CO-groups has a three-on-one right CO-group counterpart that is composed a C-atom and an O-atom which are identically oriented to its own C-atom and O-atom. The codes of the two counterparts are distinguished by the prefixes L- and D-. The codes of the three-on-one left CO-groups are prefixed with an L-; the codes of the three-on-one right CO-groups are prefixed with a D-.

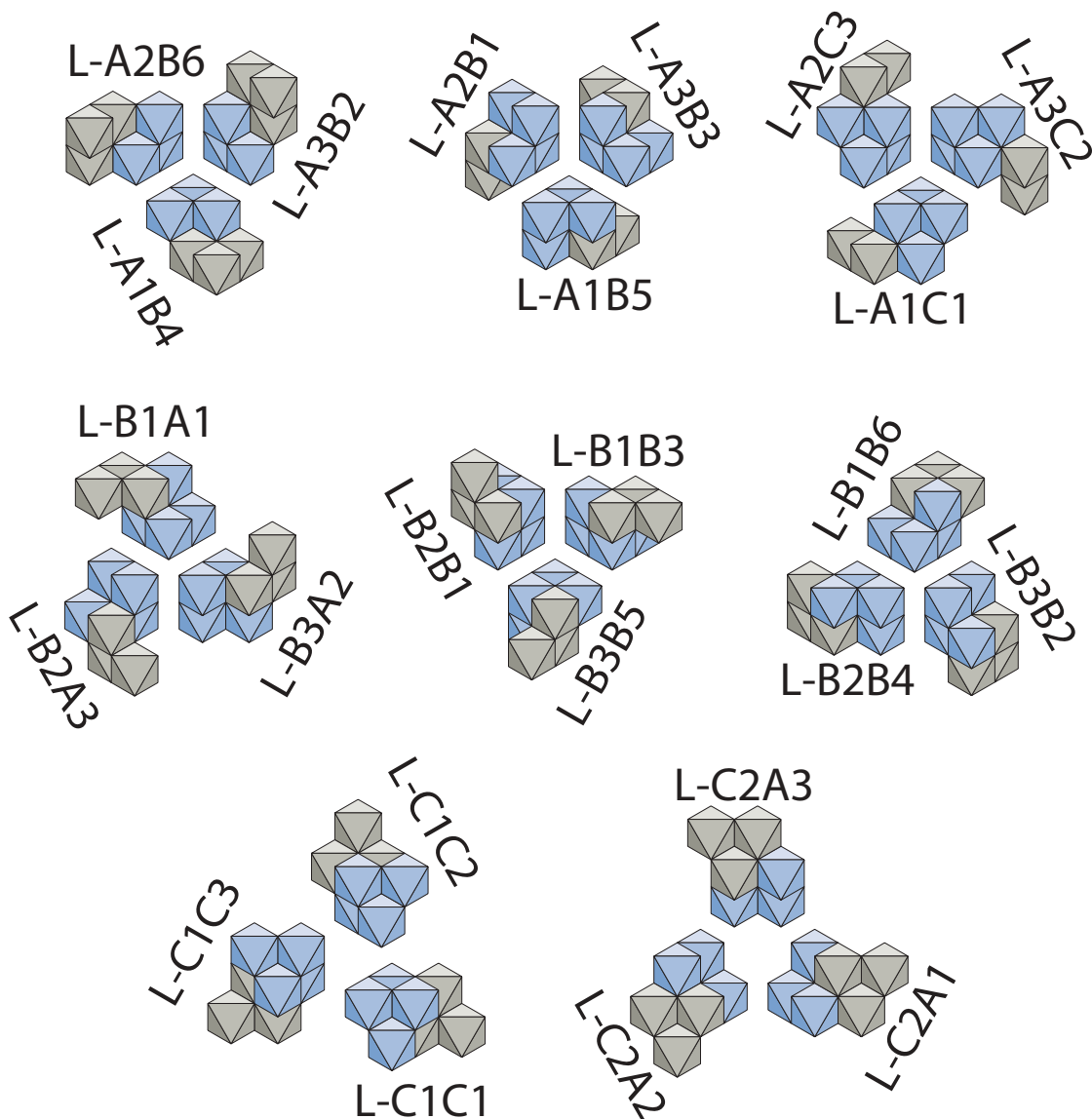
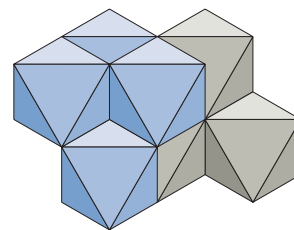


Fig. 10 Orientations of the *three-on-one right* CO-group

The twenty-four orientations of the three-on-one right group are arranged in threes. Each CO-group in a threesome differs from the other two CO-groups by a rotation of one-third turn. The coding applied to each of the CO-groups relates to the orientations of the C-atom and the O-atom which constitute the group. The code D-A2B6 states that the orientation of the C-atom is A2 and the orientation of the O-atom is B6. The D- signifies that the join between the two atoms is right-handed. It is used to distinguish between two CO-groups whose C-atoms are identically oriented and whose O-atoms have identical orientations. Each of the twenty-four orientations of the three-on-one right CO-groups has an identically coded counterpart among the orientations of the three-on-one left CO-group. The latter are preceded by an L-.

