

Ribulose 1,5-diphosphate + CO₂ yields two 3-phosphoglycerates

Robert William Whitby

28 March 2004

<http://homepage.mac.com/whitby/>

Copyright 2004 by Robert William Whitby

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

Reference

1. Octahedron1stEd.pdf
2. COassys.pdf
3. SugarBackbones.pdf
4. Lubert Stryer, *Biochemistry* 2d ed., Chapter 19: Photosynthesis, "CO₂ reacts with ribulose diphosphate to form two phosphoglycerates", page 445

Introduction

In the Calvin cycle, ribulose 1,5-diphosphate combines with a CO₂-group [Reference 4]. The resulting assembly is then cloven to yield two 3-phosphoglycerates. This paper provides a view of this process which considers only the C-atom backbones of the monosaccharides and the H₂PO₄-groups which attach to them.

Figure 1 shows how a symmetrical triplet grows C-atom by C-atom to form the C-atom quintuplet of D-ribulose. An additional C-atom converts the quintuplet to a di-L-triplet. The L-triplets which result from the cleavage of the di-triplet are shown in the same orientations that they have in the assembly. The L-triplet is the C-atom backbone of D-glyceraldehyde [References 2 and 3].

Figure 2 shows a way in which the H₂PO₄-groups might attach to the di-L-triplet and how the assembly is subsequently cloven.

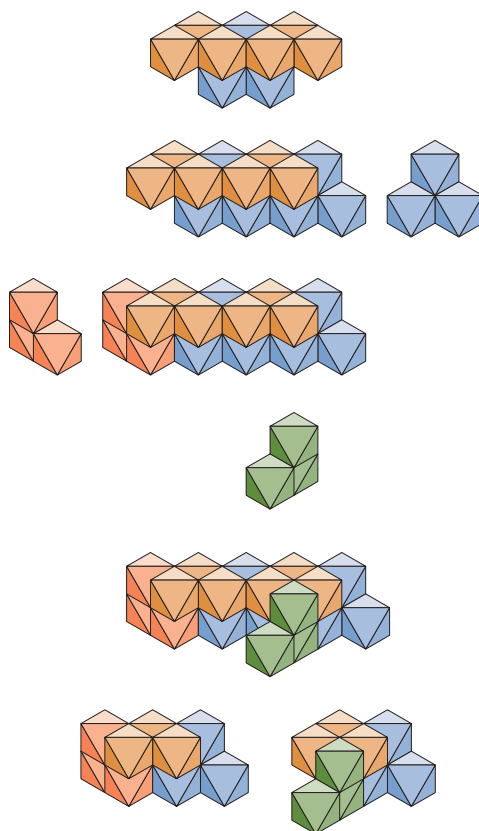


Fig. 1 Symmetrical triplet to cleavable sextuplet

The figure shows how a cleavable sextuplet is formed by the addition of C-atoms to a symmetrical triplet. The symmetrical triplet is shown at the top of the figure. The blue C-atom is added to the right end of the triplet to form a quadruplet. A red C-atom is added to the left end of the quadruplet to form a quintuplet. The green C-atom attaches to the orange atom on the right to form a di-L-triplet. The L-triplets are shown at the bottom of the figure. This progression from symmetrical triplet to quadruplet to quintuplet to cleavable di-L-triplet to two L-triplets is the backbone analogy of the progression from dihydroxyacetone to D-erythulose to D-ribulose to “transient intermediate” to two molecules of 3-phosphoglycerate [See Reference 4].

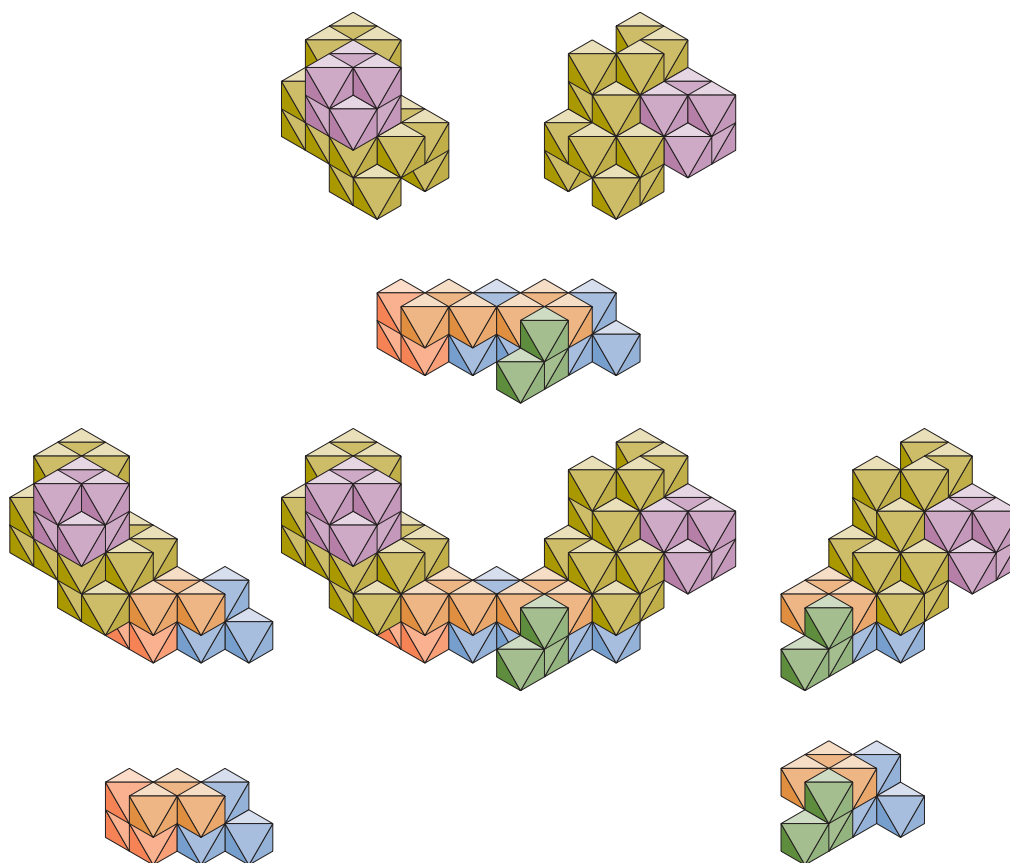


Fig. 2 Cleavage of ribulose 1,5-diphosphate + CO₂ to yield two 3-phosphoglycerates

Two H₂PO₄ groups are shown at the top of the figure. Below them is the C-atom backbone of the transient intermediate formed by ribulose and a CO₂-group. In the middle of the next row, the H₂PO₄-groups have been attached to the C-atom backbone. Flanking it are cleavage products each of which consists of an L-triplet joined to an H₂PO₄-group. The L-triplets are shown at the bottom.

4 Ribulose 1,5-diphosphate + CO₂ yields two 3-phosphoglycerates

Ribulose 1,5-diphosphate + CO₂ yields two 3-phosphoglycerates 5

Ribulose 1,5-diphosphate + CO₂ yields two 3-phosphoglycerates 6