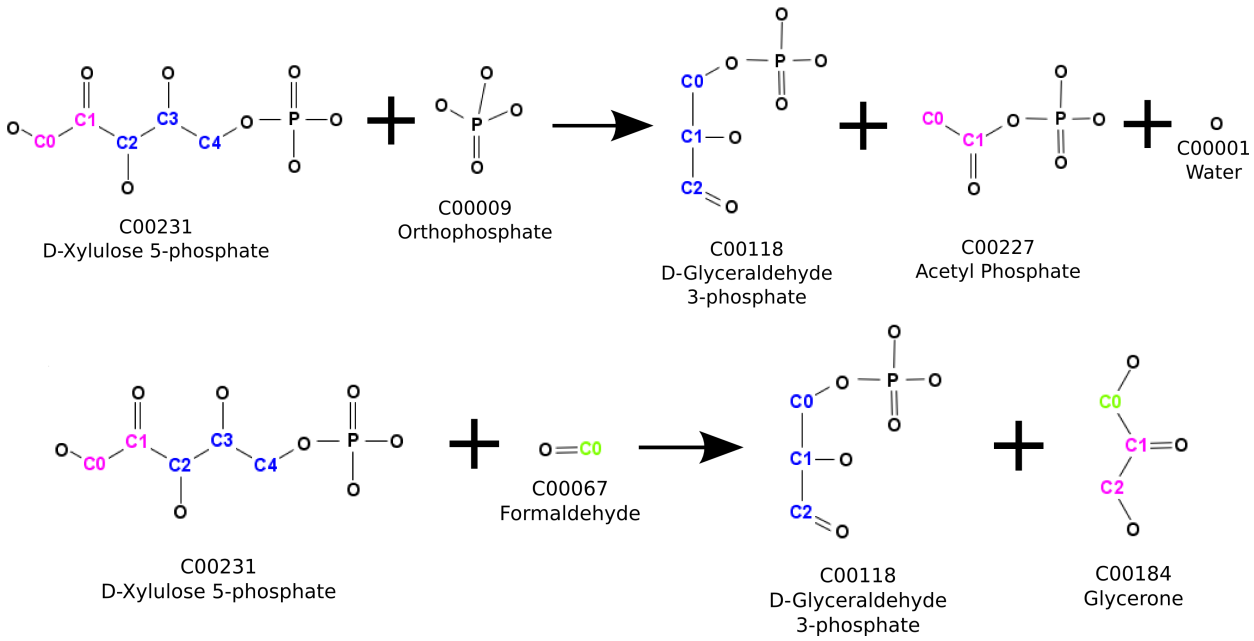
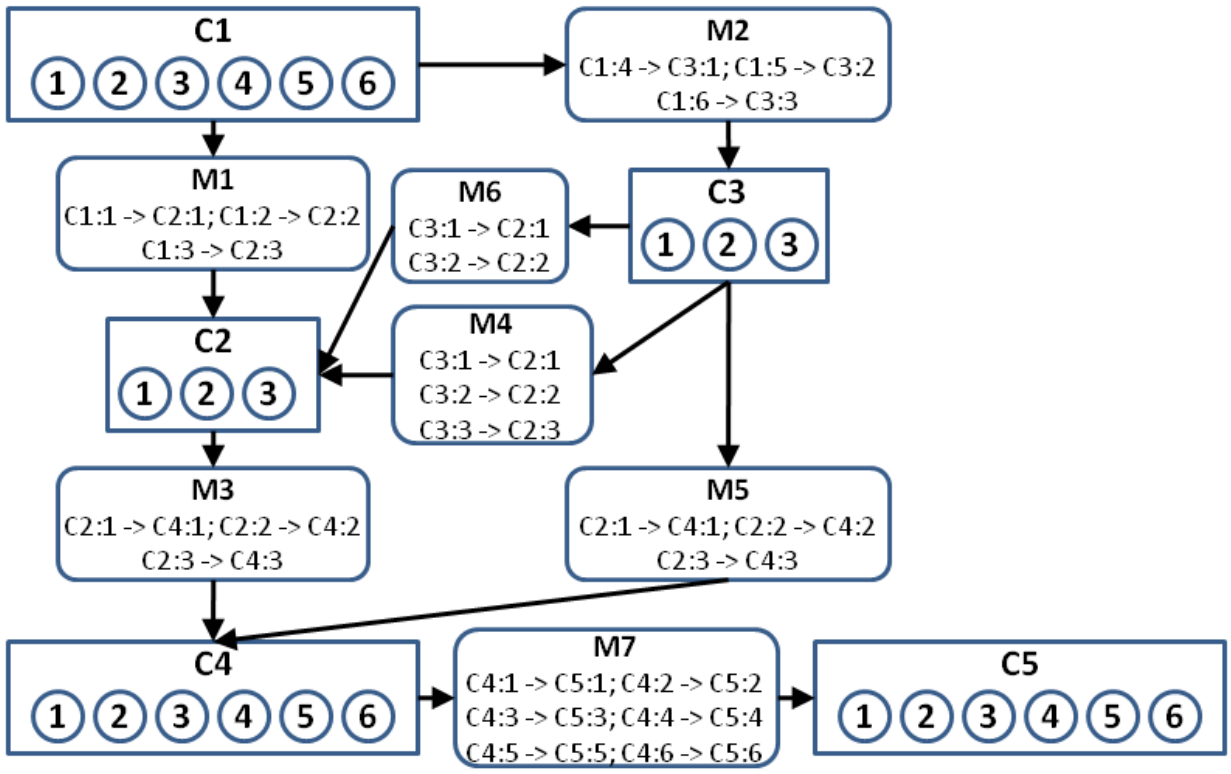


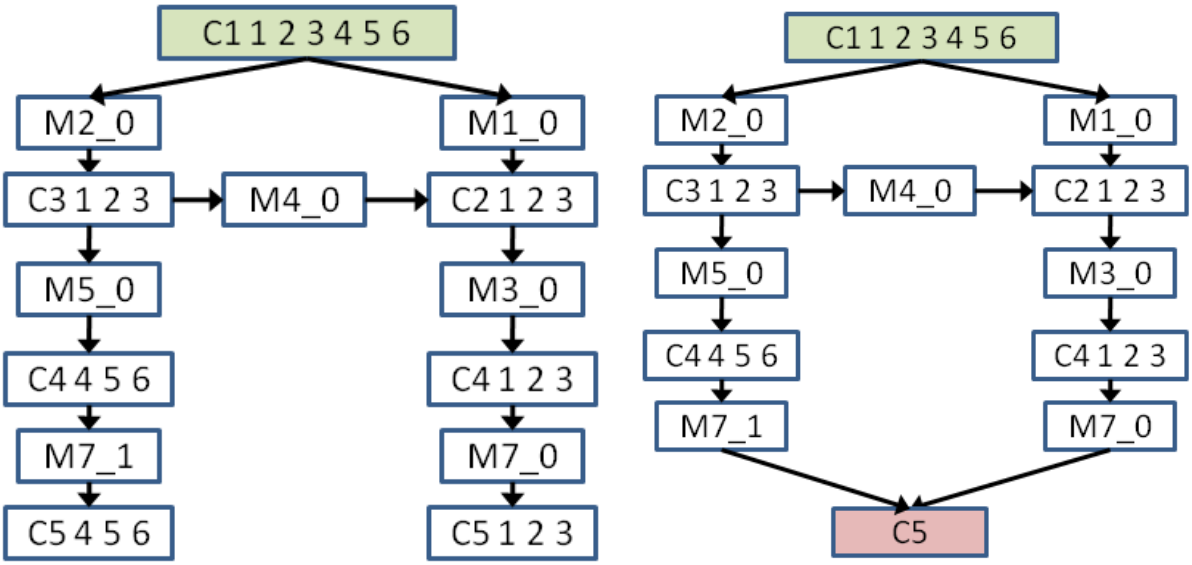
Supplementary Figure 1: The reactions R01621 and R01440 contain the atom mapping found in RP00080.



Supplementary Figure 2: An abstract representation of an atom mapping graph. The square rectangles represent compound nodes, with the compound identifiers being C1, C2, etc and the atoms represented as the internal circles. The rounded rectangles represent mapping nodes that contain the atom mappings between compounds.

C1 1 2 3 4 5 6, M1, C2 1 2 3
C2 1 2 3, M3, C4 1 2 3
C4 1 2 3, M7, C5 1 2 3
C1 1 2 3 4 5 6, M2, C3 1 2 3
C3 1 2 3, M6, C2 1 2
C3 1 2 3, M4, C2 1 2 3
C3 1 2 3, M5, C4 4 5 6
C4 4 5 6, M7, C5 4 5 6

Supplementary Figure 3: The output of the depth-first exploration of the atom mapping graph found in Supplementary Figure 2 starting from C1 and conserving at least three atoms. Each line represents a transition taken in the exploration and contains, in order: the input compound identifier and atom indicies, the mapping node taken and the output compound identifier and corresponding atom indicies. Note that the same compound and same mapping node can be traversed with different sets of atoms.



Supplementary Figure 4: On the left is the auxiliary graph created using the output of the depth-first exploration found in Supplementary Figure 3. Note that because mapping node M7 was traversed two separate times with two different sets of atom, the graph contains "M7_0" and "M7_1" to differentiate between the two traversals. In the right hand graph, the two different nodes corresponding to C5 have been merged into one node. This graph would be used as the input to Eppstein's k shortest path finding algorithm with "C1 1 2 3 4 5 6" as the start node and "C5" as the target node to find pathways that conserve at least three atoms between the compounds.