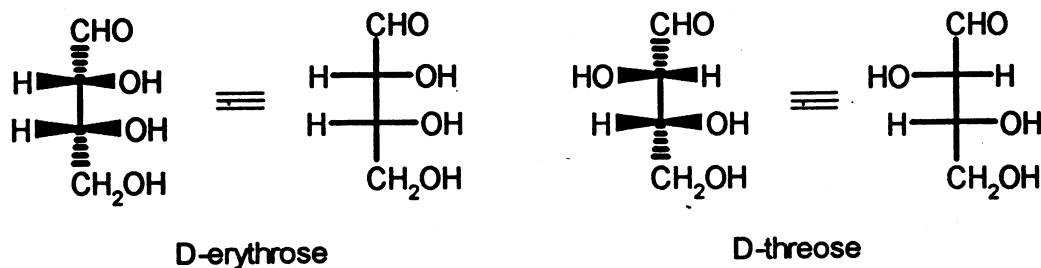


A PRIMER ON DIASTEREOMER NOMENCLATURE

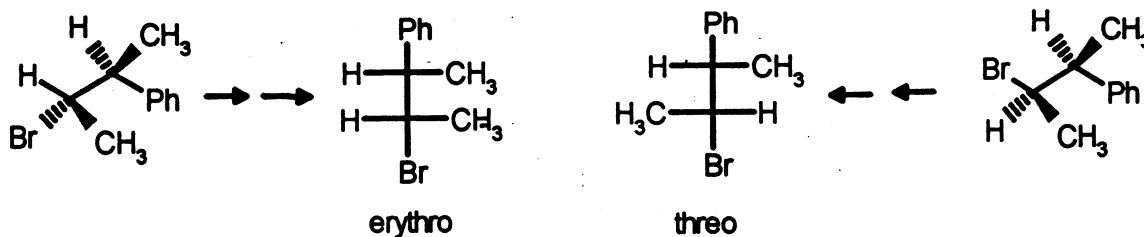
When there are two chiral centres in a molecule, there are two different relationships possible between them. These two compounds are **diastereomers**, with different (but often similar) physical properties. It is quite correct to use the Cahn-Ingold-Prelog system to define each centre as R or S. It is not used all that often, however, when defining the relationship of the two (or more) centres.



Historically, the way to define this stereochemical relationship was based on carbohydrate chemistry, and in particular, erythrose and threose. The following are the Fischer projections of these two molecules.

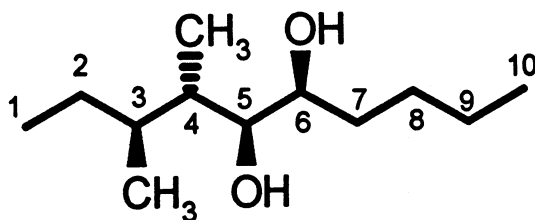
If one puts the two different substituents at the ends of the projection, you'll notice that the OH's are on the same side in erythrose, and the H's are on the same side too. In threose, however, the OH's are on opposite sides, as are the H's. From these two sugars, then, have come the terms *erythro* and *threo*.

Consider now applying this to a non-carbohydrate, 2-bromo-3-phenylbutane. These are converted into the Fischer projections with the unlike substituents (i.e., Br and Ph) at the ends.

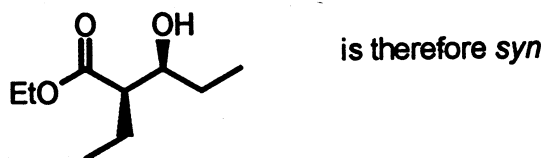


Unfortunately, *erythro* and *threo* as terms tend to fall apart when more than one substituent at each chiral centre is different. The problem is then defining the most different substituents to put at the ends of the Fischer projection, and the most similar ones to put on the sides, so that you can decide whether they're on the same or opposite sides. This decision can be quite subjective.

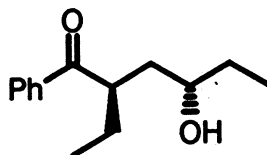
Masamune¹ has introduced a way to get around this. He has decided to abandon *erythro* and *threo* altogether, and to use *syn* and *anti*. To do this, one draws the molecule in question in an extended, zig-zag conformation with the main chain horizontal and in the plane of the page. The substituents are then either out toward the viewer or back into the page.



If the substituents are both out toward the viewer (or both back into the page), the stereochemical relationship is called *syn*. If one is in and the other is out, however, it is called *anti*. So for above, the relationships are 3,4-*anti*; 4,5-*anti*; 5,6-*syn*. This is particularly good for aldol stereochemistry, where the carbonyl is normally considered part of the main chain.



As an aside, it is not necessary to have the chiral centres adjacent to assign a name. For example...



would be *anti*. One just keeps the chain going in a zig-zag fashion.

The *syn/anti* terminology is not without its problems too, and there are alternative ways proposed for describing diastereomeric relationships (including at least one better one, in my opinion)². Nevertheless, the *syn/anti* formalism is the one that has gained international acceptance and wide usage.

References

1. Masamune, S.; Ali, Sk. I.; Garvey, D. S. *Angew. Chem. Int. Ed. Engl.* 1980, 19, 557.
2. (a) Carey, F. A.; Kuehne, M. E. *J. Org. Chem.* 1982, 47, 3811. (b) Seebach, D.; Prelog, V. *Angew. Chem. Int. Ed. Engl.* 1982, 21, 654.