Dept. of Biochemistry

Introductory Biochemistry

Biomolecules_Carbohydrate _Lecture_4

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Isomerism

Isomerism, the existence of molecules that have the same numbers of the same kinds of atoms (and hence the same formula) but differ in chemical and physical properties.

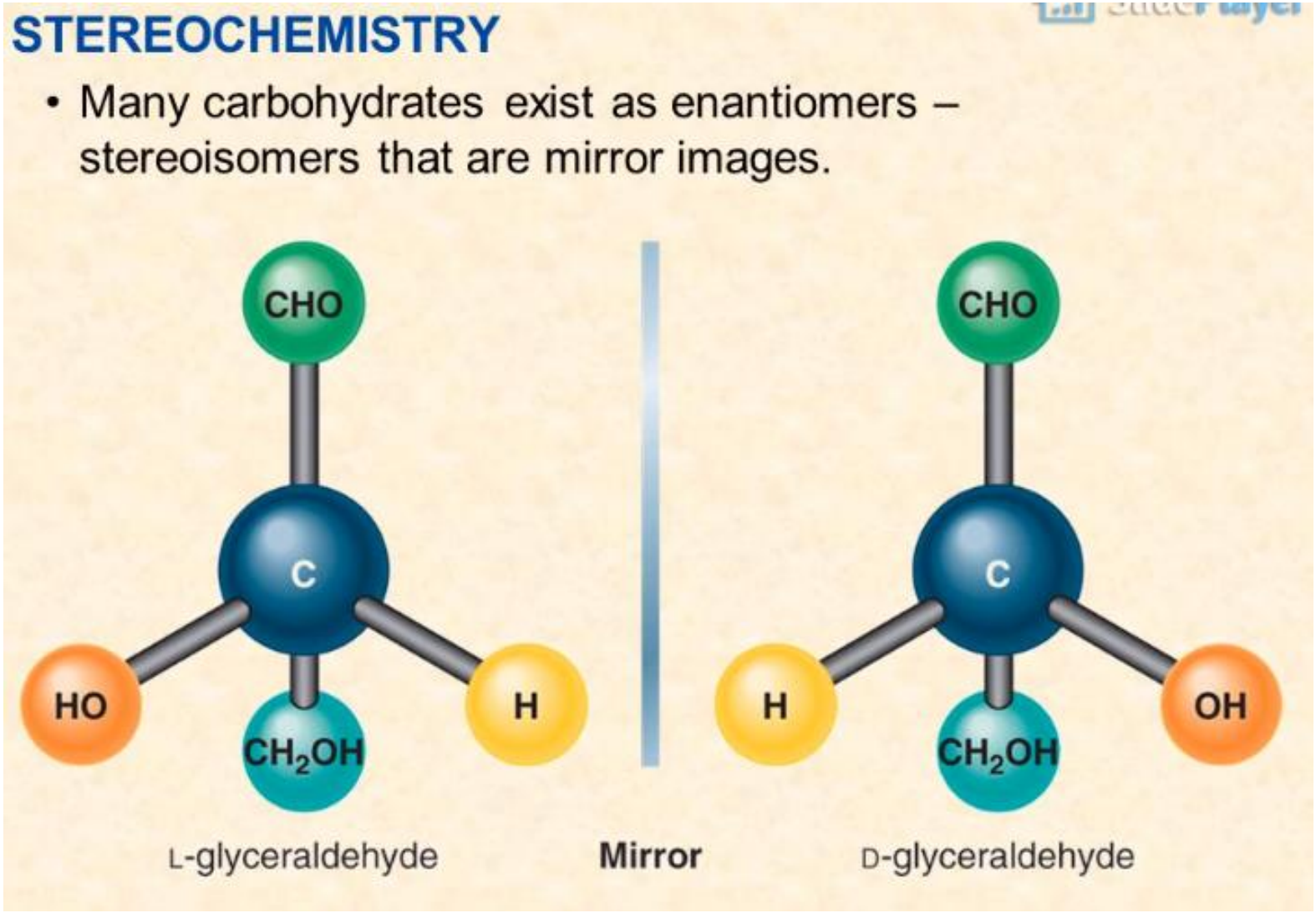
Isomers are chemical compounds that have the same parts but are nonetheless not the same.

There are two general types of isomers. Constitutional isomers are molecules of different connectivity—analogous to simple bracelets in which the order of red and green beads is different. The second type is stereoisomers. In stereoisomers the connectivity is the same, but the parts are oriented differently in space.

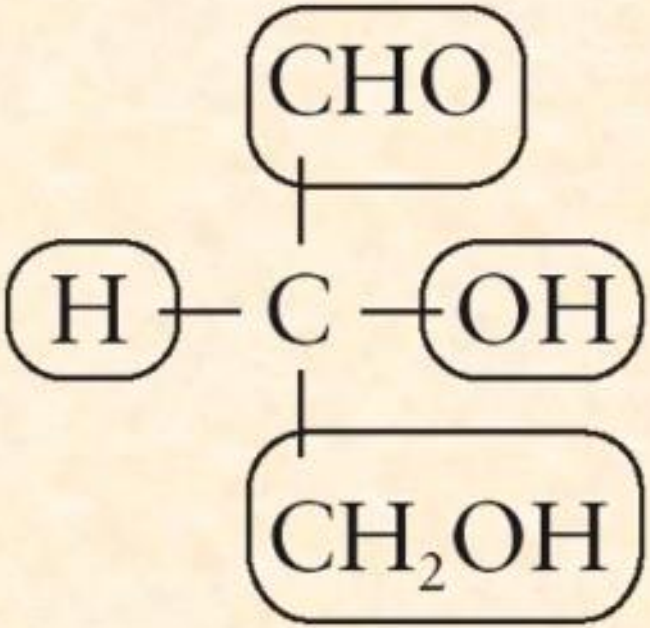
Stereoisomers

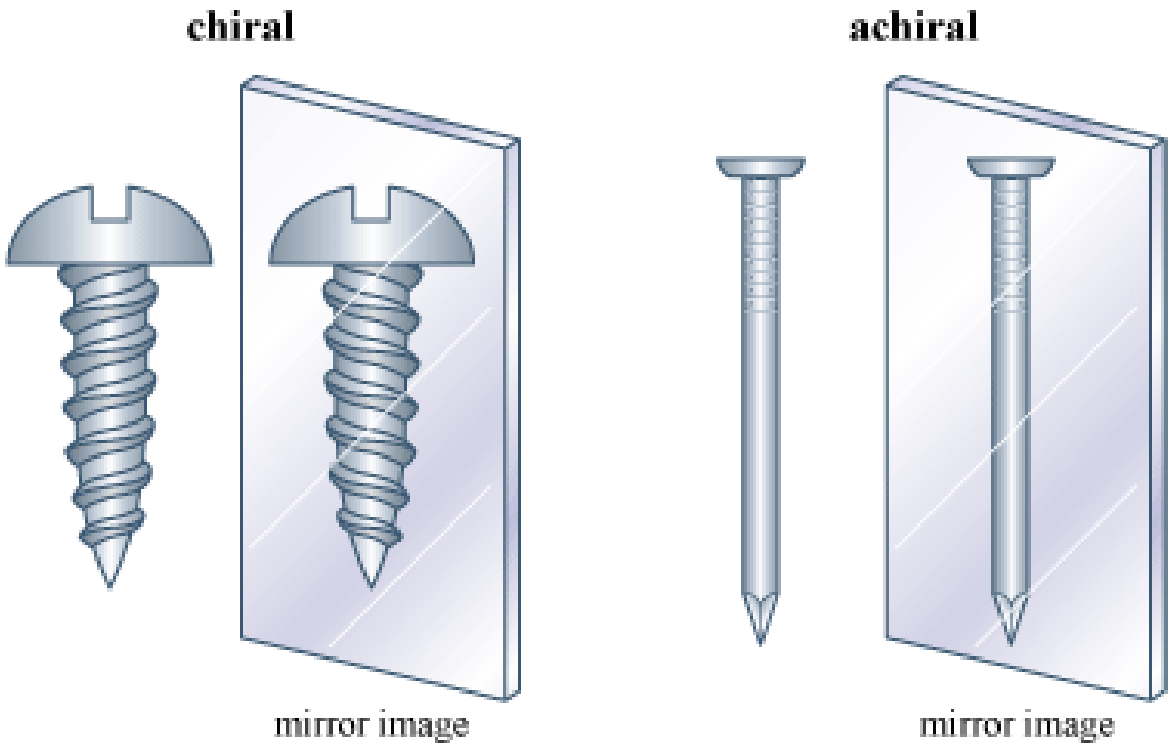
Stereoisomers are isomers that have the same composition (that is, the same parts) but that differ in the orientation of those parts in space. There are two kinds of stereoisomers: enantiomers and diastereomers. Enantiomers are mirror images, like one's hands, and diastereomers are everything else. However, as is stated above, timescale and energy are important. In order to understand these considerations, it is helpful first to consider a special kind of stereoisomer, the conformational isomer.

STEREOISOMERISM



- A **chiral** object cannot be superimposed on its mirror image.
- A **chiral carbon** is one that has four different groups attached to it.

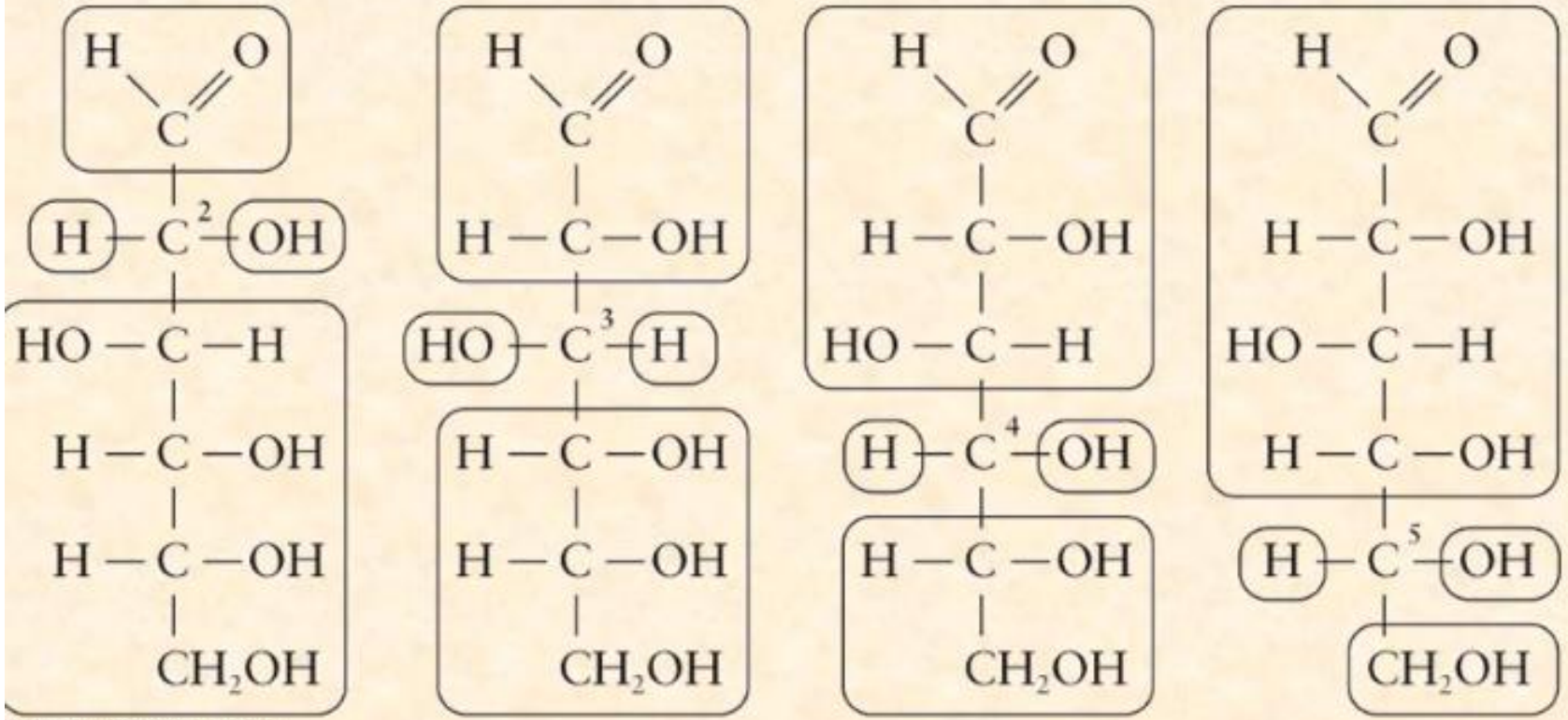



chiral
achiral
mirror image
mirror image

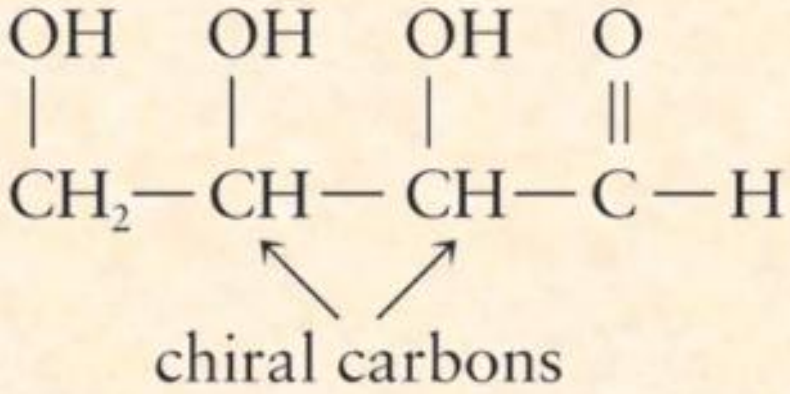
- The presence of a single chiral carbon gives rise to stereoisomerism.

  If a carbon atom is attached to four different groups, it is chiral.

  If any two groups are identical, it is not chiral.



- Compounds can have more than one chiral carbon:

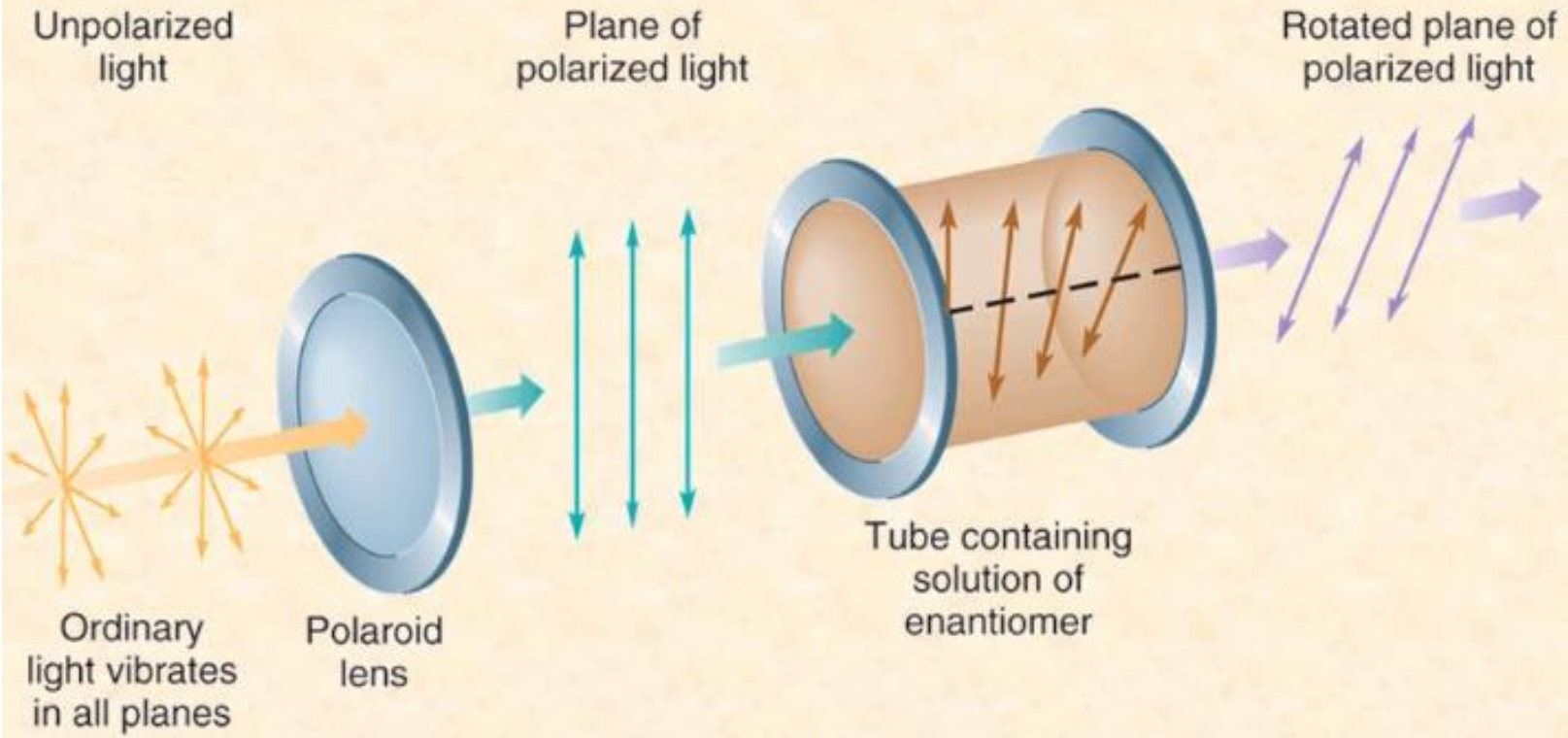


  - The maximum number of stereoisomers is 2^n where n= number of chiral carbon atoms.

- Therefore, this compound with two chiral carbon atoms has 2^2 or 4 stereoisomers.

- The compound on the previous slide with four chiral carbon atoms has 2^4 or 16 stereoisomers.

- D and L enantiomers rotate polarized light in opposite directions.



- The enantiomer that rotates polarized light to the left is the levorotatory or (-) enantiomer.
- The enantiomer that rotates it to the right is the dextrorotatory or (+) enantiomer.

- The D and L designations do not represent dextrorotatory and levorotatory.

- In some instances only the D or L enantiomers are found in nature. They are rarely found together in the same biological system.
- For example, humans can only metabolize the D-isomers of monosaccharides.