CYI101
Common CHEMISTRY(Organic)

Stereochemistry: Nomenclature
R/S, D/L and E/Z

3rd January 2022/Sec G & H

Labeling Stereogenic Centers with *R* or *S*

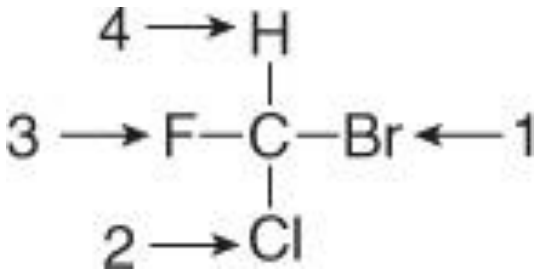
- Since enantiomers are two different compounds, they need to be distinguished by name. This is done by adding the prefix

  R ("rectus" → Latin= "right")

  or ***S*** ("Sinister" → Latin= "left")

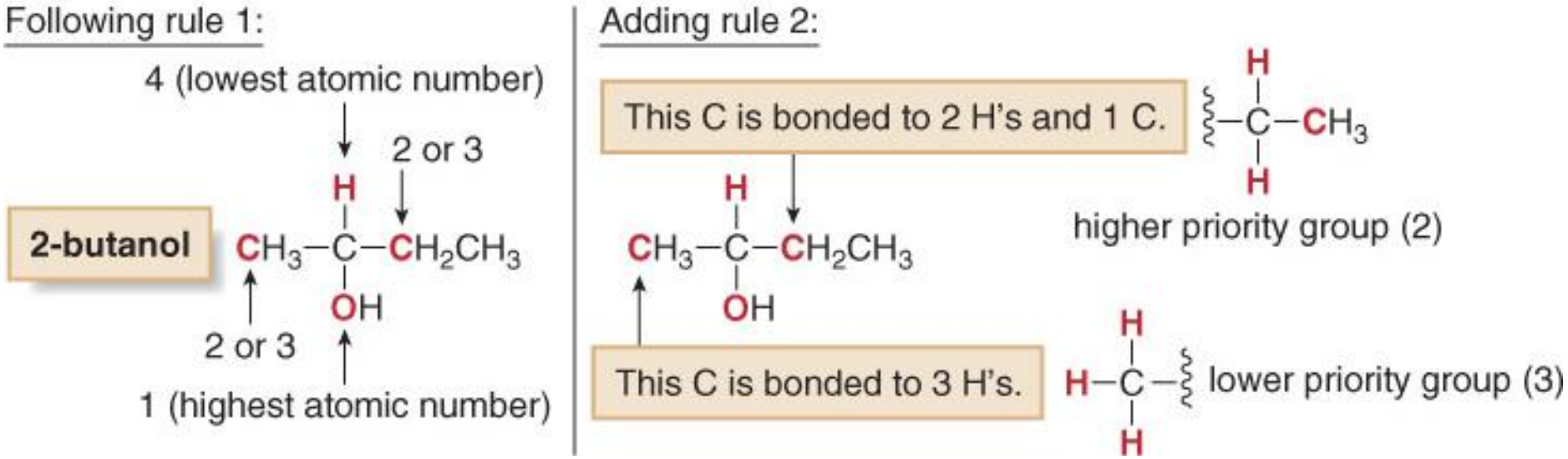
to the IUPAC name of the enantiomer.

- Naming enantiomers with the prefixes *R* or *S* is called the **Cahn-Ingold-Prelog** system.
- To designate enantiomers as *R* or *S*, priorities must be assigned to each group bonded to the stereogenic center, *in order of decreasing atomic number.* The atom of highest atomic number gets the highest priority (1).



Labeling Stereogenic Centers with *R* or *S*

- If two atoms on a stereogenic center are the same, assign priority based on the atomic number of the atoms bonded to these atoms. *One atom of higher atomic number determines the higher priority*.



Labeling Stereogenic Centers with R or S

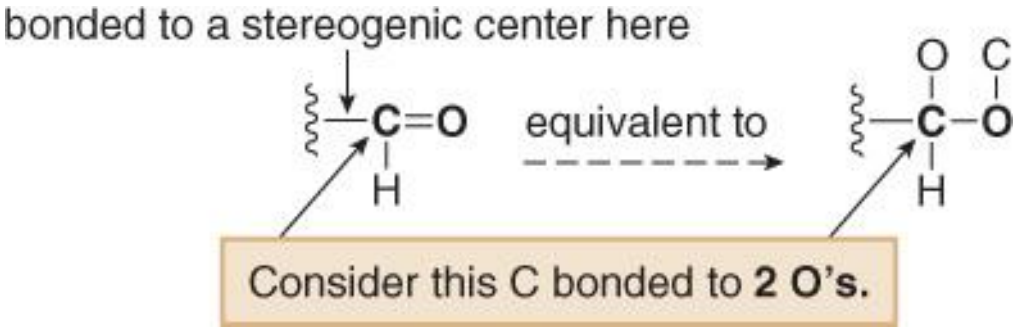
- If two isotopes are bonded to the stereogenic center, *assign priorities in order of decreasing mass number*. Thus, in comparing the three isotopes of hydrogen, the order of priorities is:

Tritium (T) > Deuterium (D)> Hydrogen (H)

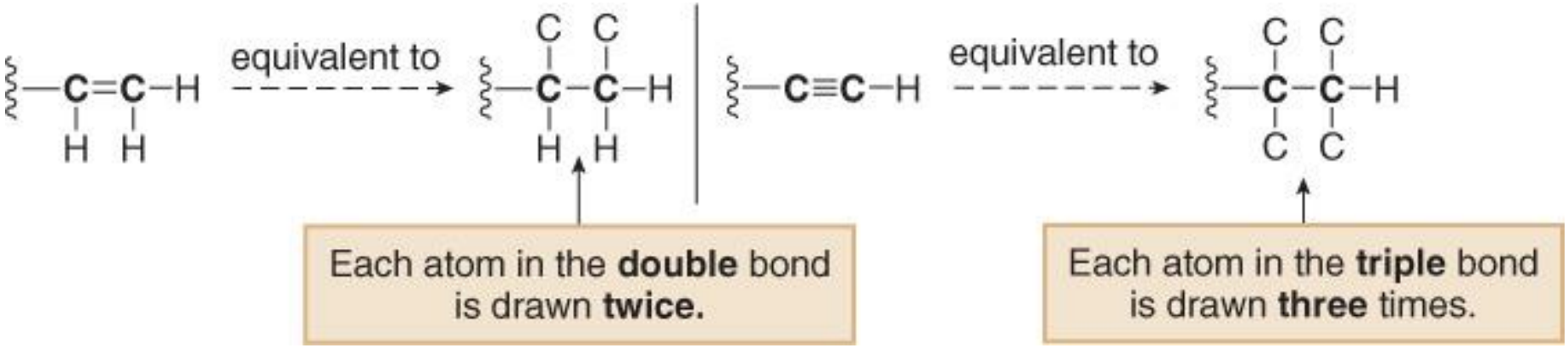
	Mass number	Priority
T (tritium)	3 (1 proton + 2 neutrons)	1
D (deuterium)	2 (1 proton + 1 neutron)	2
H (hydrogen)	1 (1 proton)	3

Labeling Stereogenic Centers with *R* or *S*

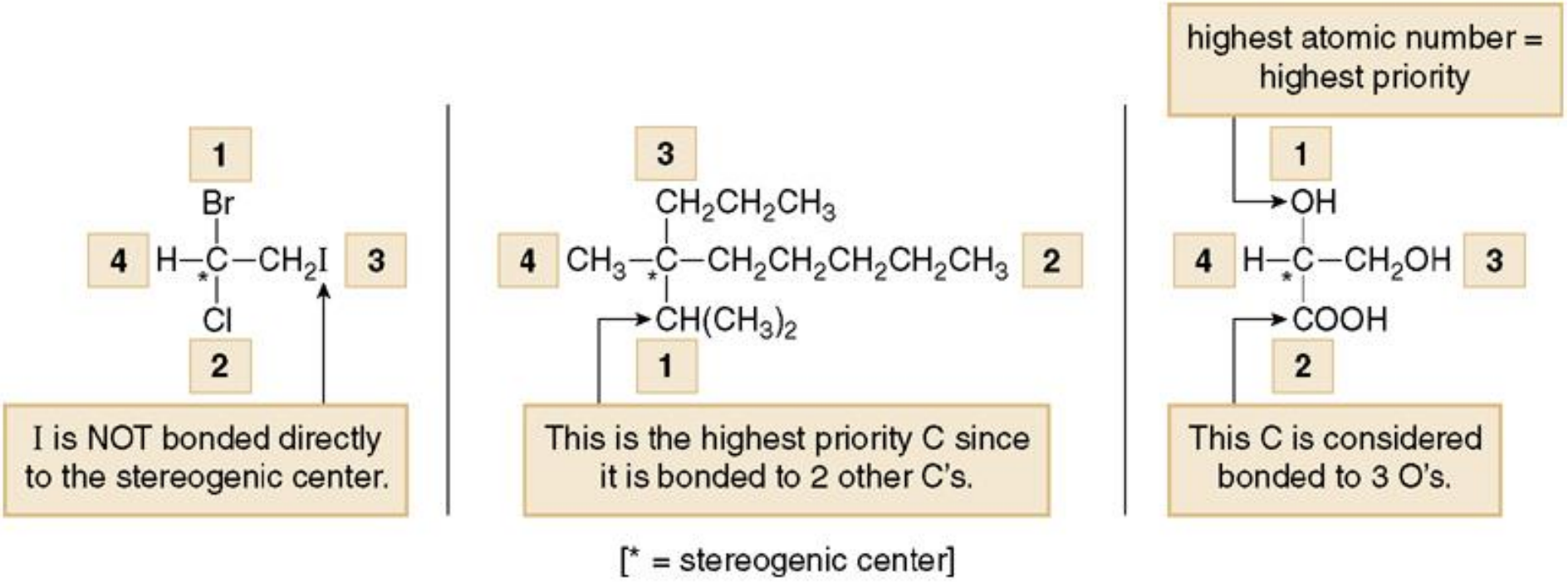
- To assign a priority to an atom that is part of a multiple bond, *treat a multiply bonded atom as an equivalent number of singly bonded atoms.* For example, the C of a C=O is considered to be bonded to two O atoms.



- Other common multiple bonds are drawn below:



Labeling Stereogenic Centers with *R* or *S*

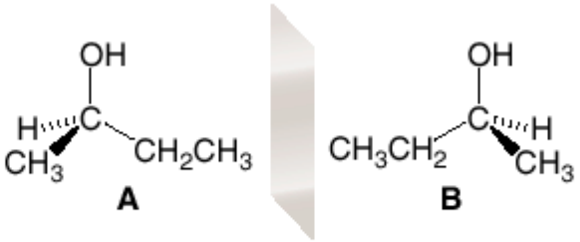


[* = stereogenic center]

Labeling Stereogenic Centers with *R* or *S*

- ❑ Assign ***R*** or ***S*** to a Stereogenic Center
  - ➢ Example: Label each enantiomer as R or S

Step [1]:



two enantiomers of 2-butanol

Assign priorities from 1 to 4 to each group bonded to the stereogenic center.

- The priorities for the four groups around the stereogenic center in 2-butanol were given in Rule 2, on page 172.

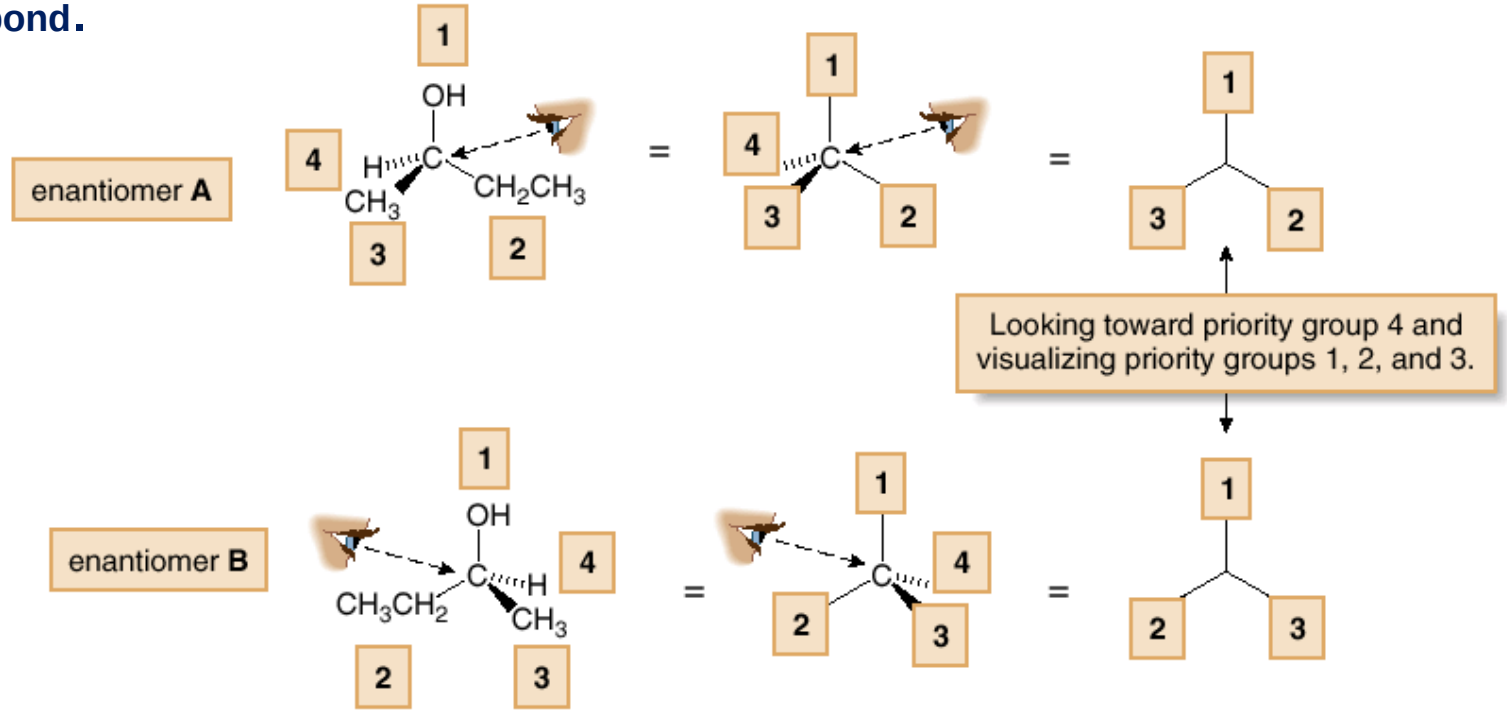
−OH	$-CH_2CH_3$	$-CH_3$	−H
1	2	3	4
highest			lowest

Decreasing priority

Labeling Stereogenic Centers with *R* or *S*

Step [2]: Orient the molecule with the lowest priority group (4) back (on a dash), and visualize the relative positions of the remaining three groups (priorities 1, 2 and 3).

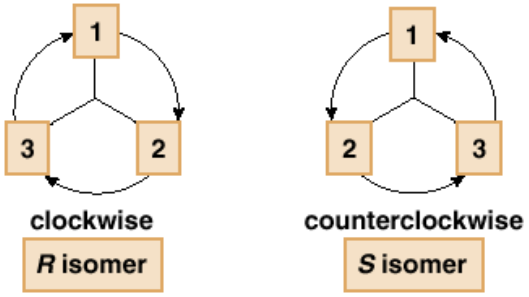
- **For each enantiomer of 2-butanol, look toward the lowest priority group, drawn behind the plane, down the C-H bond.**



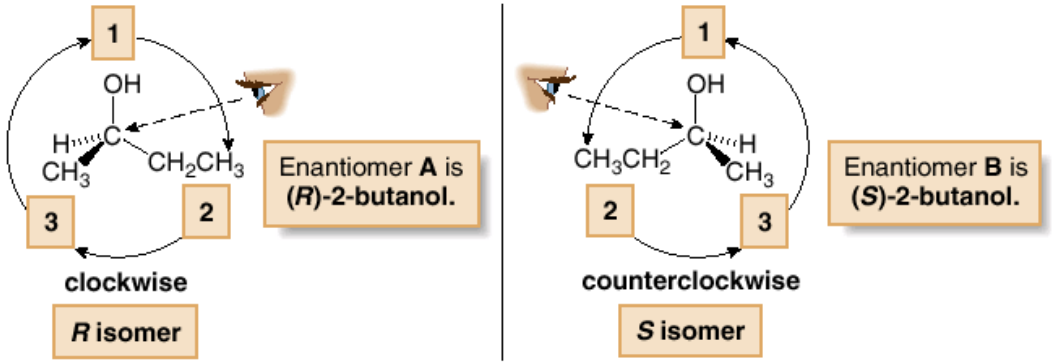
Labeling Stereogenic Centers with *R* or *S*

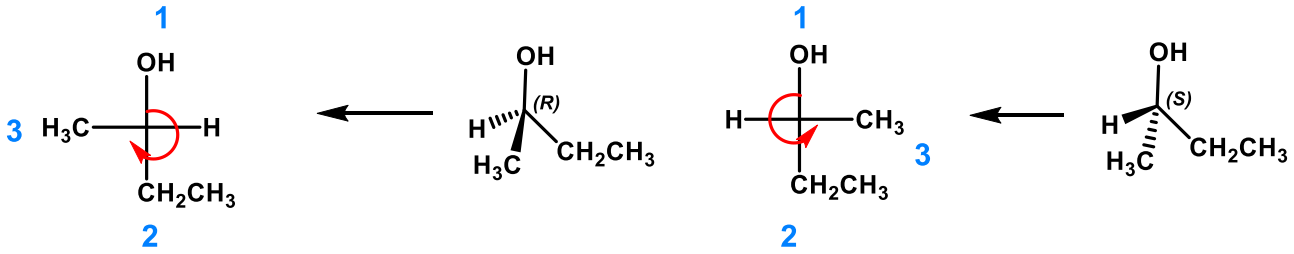
Step [3]: Trace a circle **1 → 2 → 3**

- If tracing the circle goes in the ***clockwise*** direction-to the right form the noon position-the isomer is named ***R***
- If ***counterclockwise*** direction-to the left from the noon position-the isomer is named ***S***



- The letters *R* or *S* precede the IUPAC name of the molecule. For the enantiomers of 2-butanol:

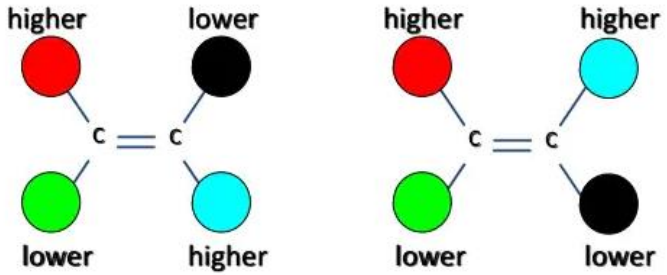




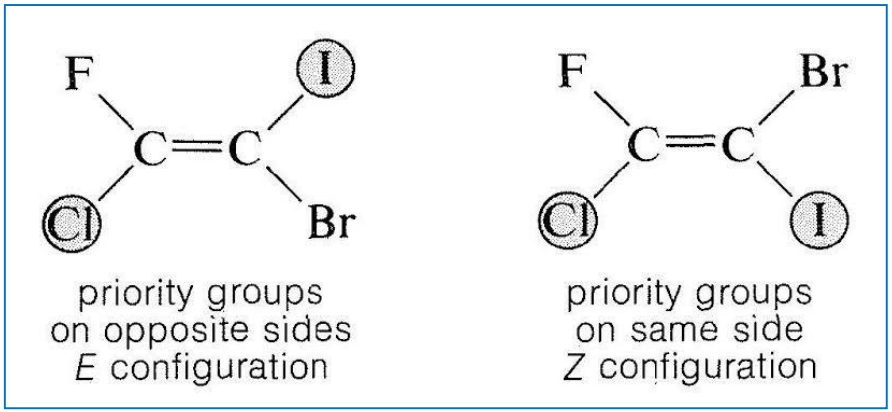
The E (Trans) / Z (Cis) Notational System

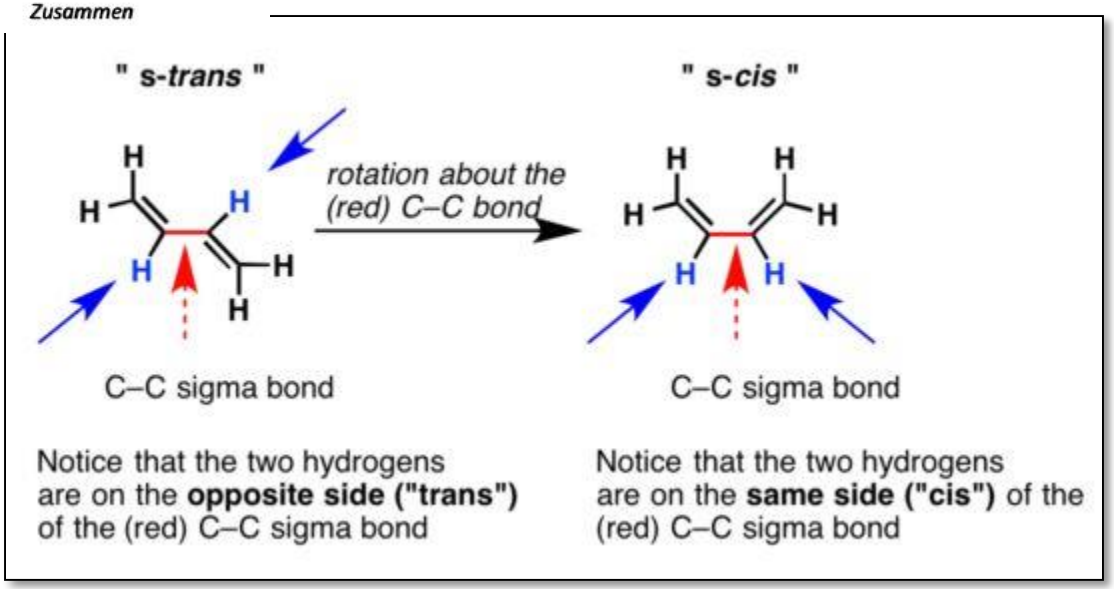
E–Z configuration, or the ***E–Z*** convention, is the **IUPAC** preferred method of describing the absolute stereochemistry of double bonds in organic chemistry.

- *E* :higher ranked substituents on opposite sides
- *Z* :higher ranked substituents on same side



Entgegen *Zusammen*

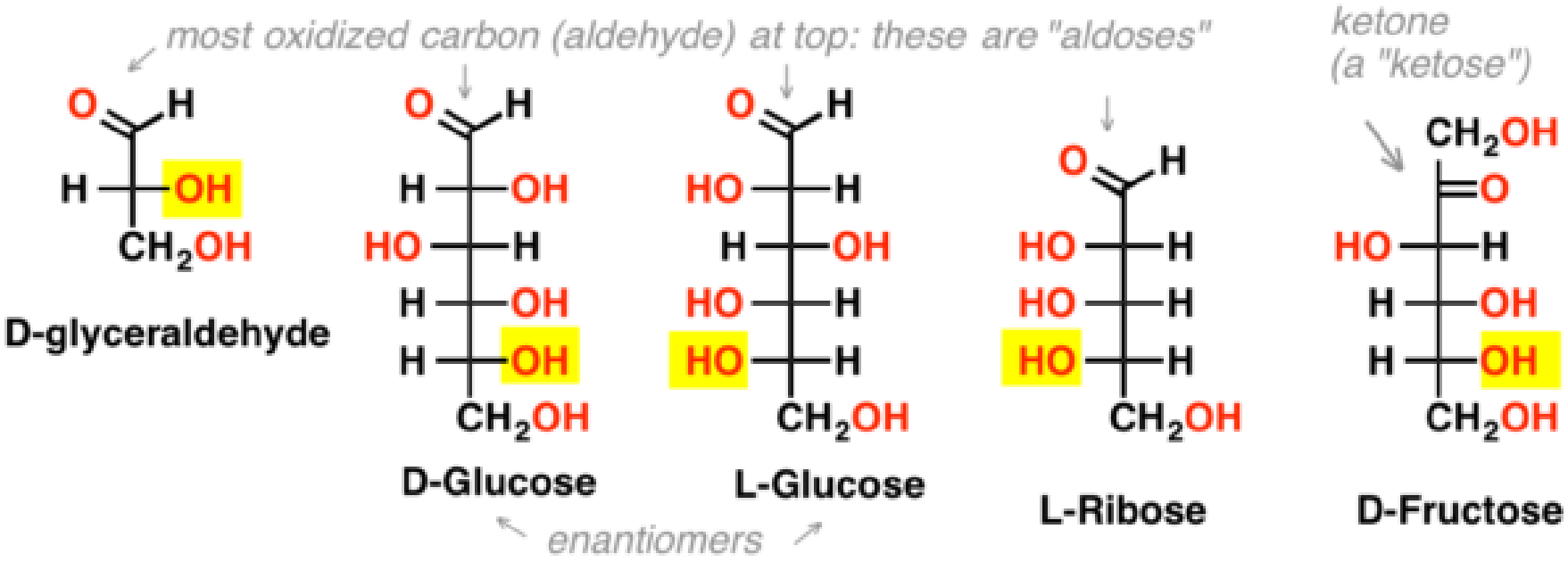




D- and L- Sugars

For a sugar drawn in the Fischer projection with the most oxidized carbon at the top:

- If the OH on the bottom chiral center points to the **right**, the sugar is **D**
- If the OH on the bottom chiral center points to the **left**, the sugar is **L**



L- and D- is a means of describing the **absolute configuration** of a molecule that pre-dates *R* and *S* but is still used for some biological molecules (sugars, amino acids). It's a quick way of denoting enantiomers: e.g. L-glucose and D-glucose are enantiomers.

L- and D- have no relation to the optical rotation of a molecule.

The D- L- system can also be applied to other chiral molecules, e.g. amino acids: