

**OBJECTIVES: TO MAKE PROGRESS IN I1** - Read the documents and answer the following questions.

### Doc 1: The origin of the word "chiral"

Chiral is derived from the Greek word *kheir*, which means "hand".

The mirror image of the right hand is the left hand, and it cannot be superimposed on the right hand. If molecules (enantiomers) cannot be superimposed on their mirror images, they are behaving rather like left and right hands - hence the word « chiral ».

*Chemistry - IB Diploma programme  
Oxford edition - 2012*

### Doc 2: CRAM representation

Your sheet of paper has only two dimensions, but molecules are in 3D. The Cram's representation gives an indication of the spatial arrangement of the bonds inside a molecule.

A bond, in the plane of the paper, is represented by a normal line.

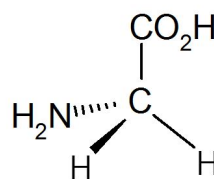
A bond going backward is represented by a dotted line.

A bond going forward is represented by a wedged line.

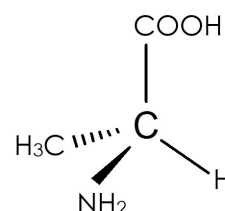
### Doc 3: a butterfly



### Doc 4: Glycine



### Alanine



### Doc 5: Thalidomide

This ability of different enantiomers to have different physiological effects became tragically apparent with one particular drug that was used in the middle of last century. In 1958 a German pharmaceutical company launched a massive publicity campaign for a new tranquilizer to combat "morning sickness" in pregnant women. The drug was sold worldwide under brand names such as Thalidomide. In many countries it was sold without prescription and was marketed as completely innocuous. Reports of severe adverse side-effects began to appear in 1959, and it later transpired that as early as 1956 clinical trials by the company itself had revealed problems. Nevertheless, because it was making so much profit the company continue to market the drug heavily, and sales kept increasing until it was withdrawn in 1961. By that time many children had been born with absent or severely malformed limbs.

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### Doc 6: Asparagine


Asparagine is an amino acid that exists under two forms: (S)-Asparagine is tasteless whereas its enantiomer (R)-Asparagine has a sweet taste.

## QUESTIONS

1. What does chiral mean in chemistry?
2. Is the butterfly of document 3 chiral? Why?
3. What is the interest of the CRAM representation?
4. Is it necessary to use this representation to know if a molecule is chiral? Why?
5. An **asymmetric carbon atom** is a carbon atom that is attached to four different types of atoms or four different groups of atoms.  
Among the amino acids proposed in document 4, is there an asymmetric carbon atom?  
If you find one, place an asterisk (\*) next to it.
6. Among the amino acids proposed in document 4, is there one chiral? Why?
7. Compare your two last answers and find a relation between "asymmetric carbon" and "chiral".
8. Are asparagine and thalidomide chiral?
9. (S)-Thalidomide and (R)-Thalidomide are enantiomers. Could you explain what enantiomers are?
10. From Document 5, can you explain why it is so important to make the difference between two enantiomers.

**OBJECTIVES: TO MAKE PROGRESS IN I2** - Read the documents and answer the following questions.

Mirror

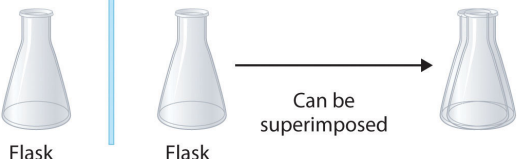


Left hand      Right hand

**(a) Chiral objects**

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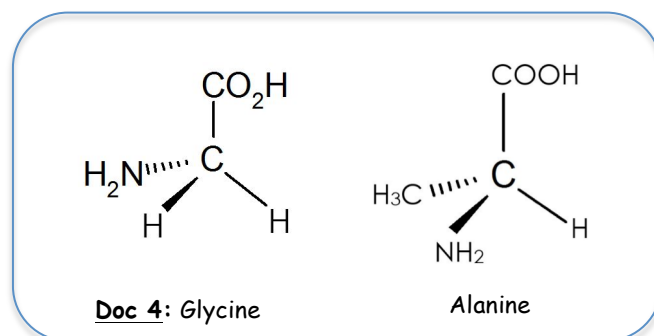
Mirror



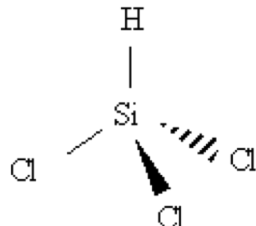
Flask      Flask

**(b) Achiral objects**

**Doc 1:** <https://prezi.com/gm1trd3f2wgf/stereochemistry/>



**Doc 2: CRAM REPRESENTATION**



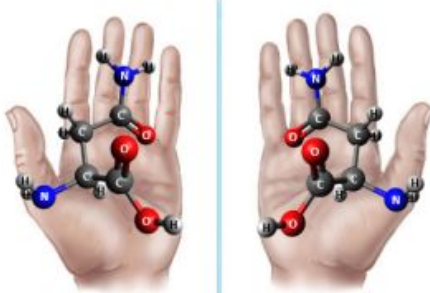
Normal line:  
The bond is in the plane of the paper

Dotted line:  
The bond is going backward

Wedged line:  
The bond is going forward



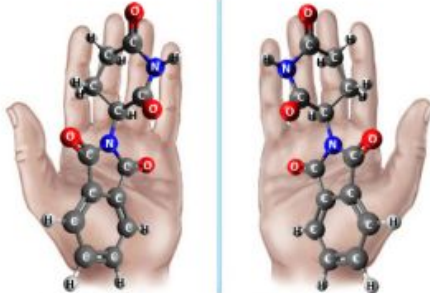
Mirror



(S)-asparagine  
flavourless

(R)-asparagine  
sweet

Mirror



(S)-Thalidomide  
teratogenic

(R)-Thalidomide  
sedative

**Doc 5:** [http://doktori.bme.hu/bme\\_palyazat/2013/honlap/Bagi\\_Peter\\_en.htm](http://doktori.bme.hu/bme_palyazat/2013/honlap/Bagi_Peter_en.htm)

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