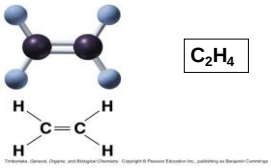
4.6 Isomerism in alkenes

1

- **open-chain (linear and branched) and cyclic**
- **Generic formula: Start with C_nH_{2n+2} and minus two for each C=C**
- **one C=C → C_nH_{2n} e.g., C_2H_4**



C_2H_4

2

3 kinds of isomerism

1. Constitutional (structural) isomerism
   - Structural – C=C or ring
   - Skeletal – C atoms connected in a different order
   - Positional - The location of C=C varies but the C skeleton remains unchanged
2. Stereoisomerism (geometric isomerism)
   Because of the rigidity of C=C there can be cis-trans isomerism in alkenes.

3

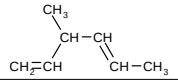
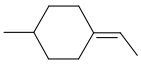
1. Constitutional isomerism (cont.)

Structural isomers → C=C or ring

- **One C=C → C_nH_{2n} e.g., C_3H_6 or**
- **One ring**

4

C_nH_{2n-2}

2 C=C		**C_7H_{12}**
1 C=C and 1 ring		**C_9H_{16}**
2 rings		**C_9H_{16}**

Alkenes & cyclic alkanes are constitutional isomers

5

1. Constitutional isomerism (cont.)

- Positional - The location of C=C varies but the C skeleton remains unchanged

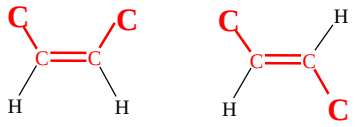
6

1. **Constitutional isomerism (cont.)**
   - Skeletal – C atoms connected in a different order

cis AND *trans* ISOMERS

The atoms attached to the C=C are locked in place

Because there is no rotation about a carbon-carbon bond



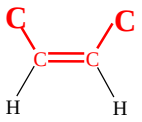
THIS GIVES STEREO or SKELETAL ISOMERS

CIS / TRANS ISOMERS

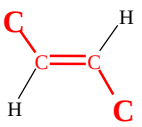
substituents on the same side of main chain

substituents on opposite sides of main chain

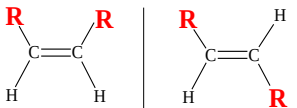
cis



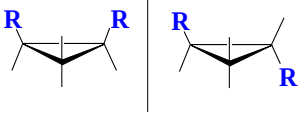
trans



COMPARE *cis / trans* ISOMERS IN RING COMPOUNDS



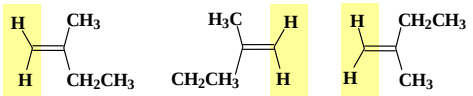
cis ***trans***



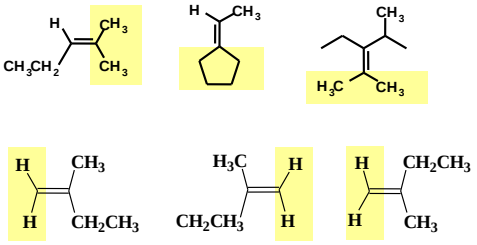
In alkenes and rings *cis* / *trans* isomers are called stereoisomers or geometric isomers.

TWO IDENTICAL SUBSTITUENTS

RULE: A C=C at the end of a chain cannot be cis/trans



RULE: If there are two identical substituents on one of the double-bond-carbons, ***cis / trans*** is not possible.



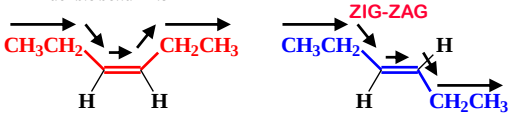
13

NAMING cis / trans ISOMERS OF ALKENES

main chain stays on same side of double bond = *cis*

main chain crosses to other side of double bond = *trans*

ZIG-ZAG



cis-3-hexene

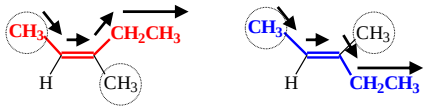
trans-3-hexene

notice that these prefixes are in italics

14

Be Careful !!!

The longest chain determines cis / trans in the IUPAC name



~~cis~~-3-methyl-2-pentene

~~NOT THE LOCATION OF THE METHYL GROUPS~~

~~cis~~-3-methyl-2-pentene

This compound is ***cis*** Although the two methyl groups are ***trans*** to each other they don't determine the name of the compound.

This compound is ***trans*** Although the two methyl groups are ***cis*** to each other they don't determine the name of the compound.

15

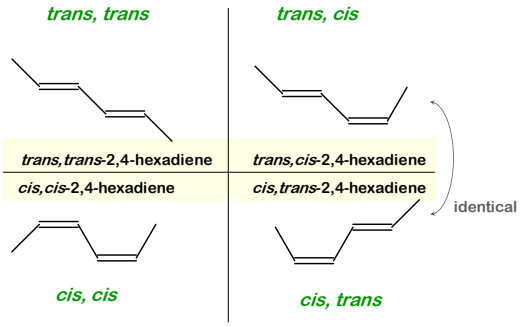
MORE THAN ONE DOUBLE BOND

DIENES , etc.

16

DIENES AND POLYENES

Hexadiene



17