

11.6 Cis–Trans Isomers

The atoms or groups of atoms attached to the carbon atoms on the double bond may form two different structures, which are called geometric or cis–trans isomers.



Cis-hands (cis-thumbs/fingers)



Trans-hands (trans-thumbs/fingers)

Learning Goal Draw the condensed structural formulas and give the names for the cis–trans isomers of alkenes.

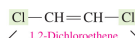
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Cis and Trans Isomers

In an alkene, the double bond

- is rigid and does not rotate
- holds attached groups in fixed positions
- makes cis–trans isomers possible when two different groups are attached to the carbon atoms on each side of the double bond



1,2-Dichloroethene

Chlorine atoms are on the same side of the double bond.



cis-1,2-Dichloroethene



trans-1,2-Dichloroethene

Chlorine atoms are on opposite sides of the double bond.

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Cis–Trans Isomers

Cis–trans isomers have different physical and chemical properties.

You can make a “double bond” with your fingers with both thumbs on the same side or opposite from each other.



Cis-hands (cis-thumbs/fingers)



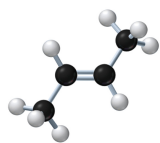
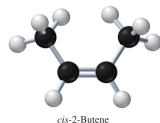
Trans-hands (trans-thumbs/fingers)

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Cis-Trans Isomers of Butene

- In a **cis isomer**, the alkyl groups are attached on the same side of the double bond and H atoms are on the other side.
- In a **trans isomer**, the groups and H atoms are attached on opposite sides of the double bond.



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Chemistry Link to the Environment: Pheromones

Many insects emit minute quantities of chemicals called pheromones to send messages to others of the same species.



Pheromones allow insects to attract mates from a great distance.

Pheromones may

- warn an insect of danger
- mark a trail
- attract the opposite sex

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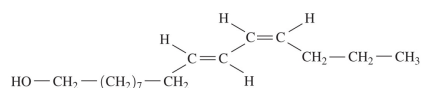
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Chemistry Link to the Environment: Pheromones

The effectiveness of many of these pheromones depends on the cis or trans configuration of the double bonds in the molecules.

One pheromone is bombykol,

- the sex pheromone produced by the female silkworm moth
- which contains one cis double bond and one trans double bond



Bombykol, sex attractant for the silkworm moth

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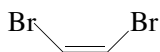
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Naming Cis-Trans Isomers

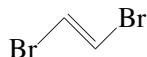
The prefix of *cis* or *trans* is placed in front of the alkene name when the compound is a cis or trans isomer.

cis

trans



cis-1,2-dibromoethene



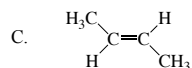
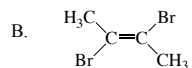
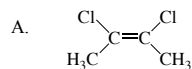
trans-1,2-dibromoethene

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Study Check

Name each, using *cis* or *trans* prefixes when needed.

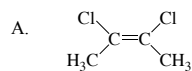


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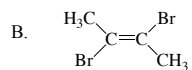
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Solution

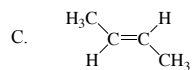
Name each, using *cis* or *trans* prefixes when needed.



cis-2,3-dichlorobutene



trans-2,3-dibromobutene



trans-2-butene

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