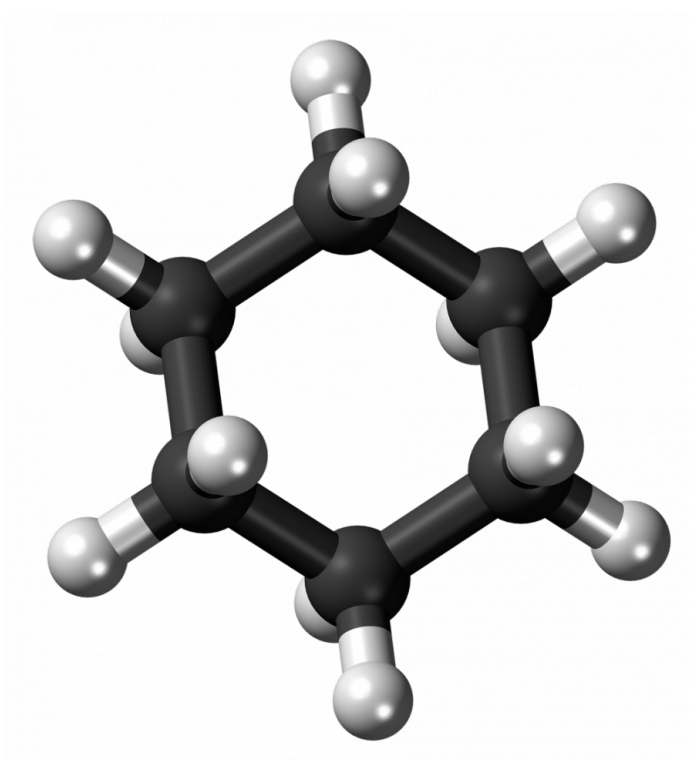




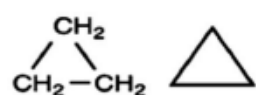
Cycloalkanes

By
Dr.Tabarek Alnqib

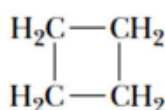


Cycloalkanes

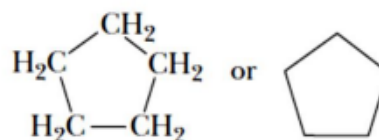
Hydrocarbon (**C-H**) that contains carbon atoms joined to form a ring is called a cyclic hydrocarbon. When all carbons of the ring are saturated, we call the hydrocarbon a cycloalkane. Cycloalkanes of ring sizes ranging from 3 to over 30 abound in nature, and, in principle, there is no limit to ring size. Five-membered (cyclopentane) and six-membered (cyclohexane) rings are especially abundant in nature.



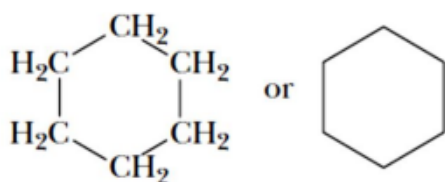
Cyclopropane



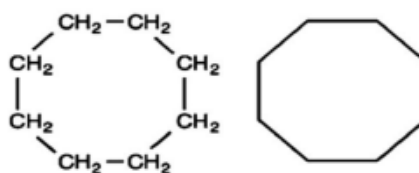
Cyclobutane



Cyclopentane



Cyclohexane

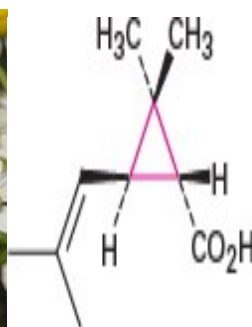


Cyclooctane

Cycloalkanes contain two fewer hydrogen atoms than an alkane with the same number of carbon atoms. For instance, compare the molecular formulas of cyclohexane(C_6H_{12}) and hexane(C_6H_{14}).

The general formula of acycloalkane is **C_nH_{2n}**

Cyclic molecules found in most **Drugs** and types of (**Biomolecules, proteins** and **nucleic acids**) .they are important for understanding the behaviors of cyclicity. most organic compounds contain **rings of carbon atoms**. Chrysanthemic acid, for instance, whose esters occur naturally as the active insecticidal constituents of chrysanthemum flowers, contains a three-membered (cyclopropane) ring.



Chrysanthemic acid

Natural Sources Of Cycloalknes

Human body contains important compounds their structures include cyclic forms.For example:

1.Cholic acid,acomponent of human bile whose function is to aid in the absorption and digestion of dietary fats.

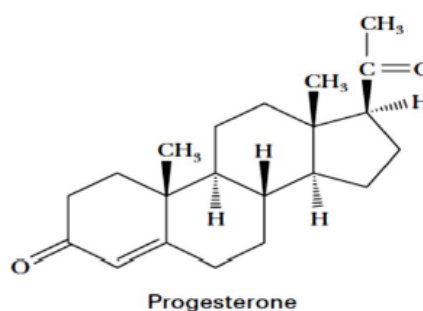
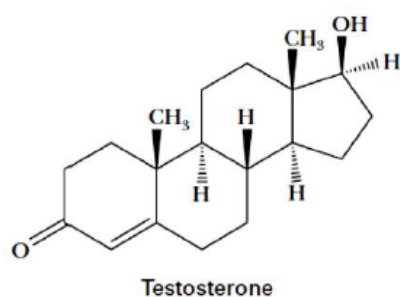
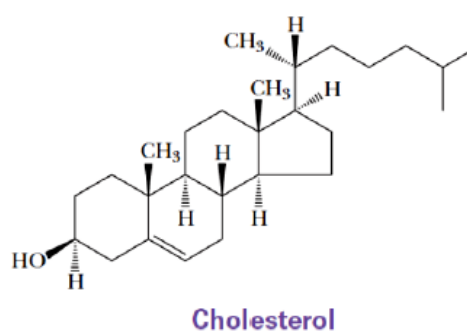
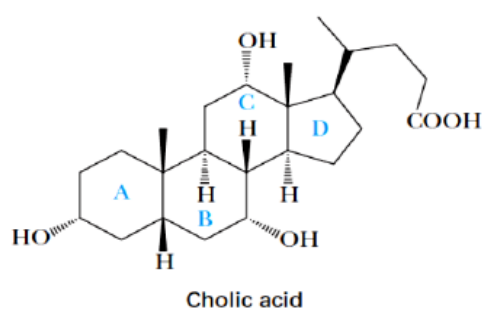
2.Cholesterol,awhite,water insoluble,waxy solid found in blood plasma and in all animal tissues,is an integral part of human metabolism.

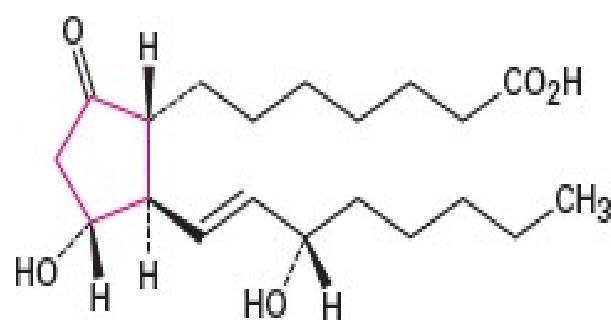
3. Testosterone, an androgen (male sex hormones): synthesized in the testes; responsible for development of male secondary sex characteristics.

4. Progesterone, an estrogen (female sex hormones): synthesized in the ovaries; responsible for development of female secondary sex characteristics and control of the menstrual cycle.

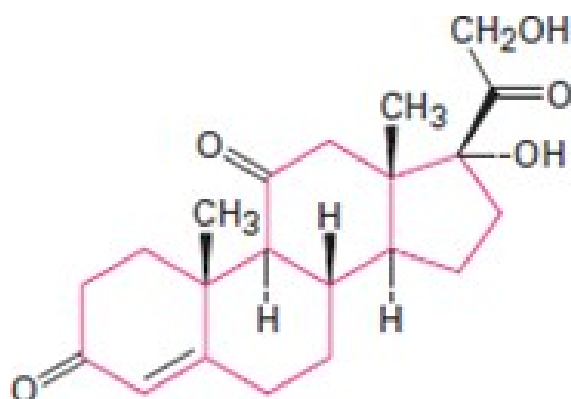
5. Prostaglandins potent hormones that control an extraordinary variety of physiological functions in humans, contain a five-membered (cyclopentane) ring.

6. Steroid such as cortisone, contain four rings joined together 3 six membered (cyclohexane) and 1 five-membered..





Prostaglandin E₁



Cortisone

The IUPAC Naming Cycloalkanes

Saturated cyclic hydrocarbons are called **cycloalkanes**, or **alicyclic** compounds (**aliphatic cyclic**). Because cycloalkanes consist of rings of CH₂- units, they have the general formula (CH₂)_n, or C_nH_{2n}, and can be represented by polygons in skeletal drawings.



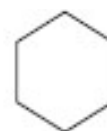
Cyclopropane



Cyclobutane



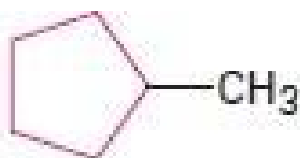
Cyclopentane



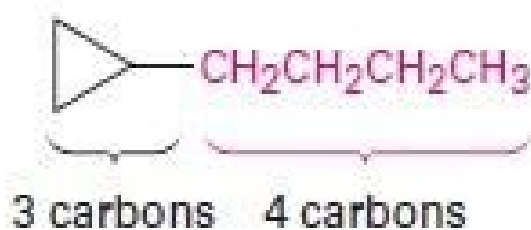
Cyclohexane

Substituted cycloalkanes are named by rules similar to those we saw in the previous chapter for open chain alkanes. For most compounds, there are only two steps.

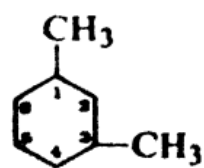
1. Count the number of carbon atoms in the ring and the number in the largest substituent. If the number of carbon atoms in the ring is **equal to or greater** than the number in the substituent, the compound is named as an alkyl-substituted cycloalkane. If the number of carbon atoms in the largest substituent is greater than the number in the ring, the compound is named as a cycloalkyl-substituted alkane. For example:



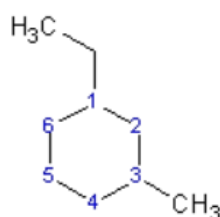
Methylcyclopentane



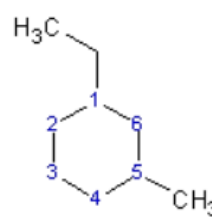
1-Cyclopropylbutane



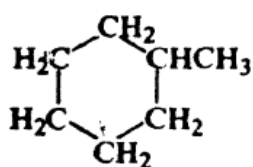
1,3-Dimethylcyclohexane



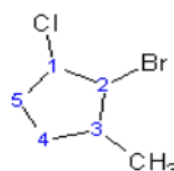
1-ethyl-3-methylcyclohexane



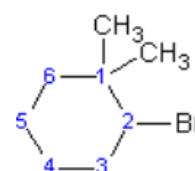
1-ethyl-5-methylcyclohexane



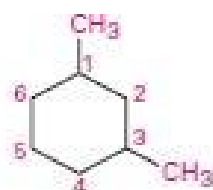
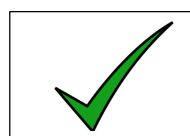
Methylcyclohexane



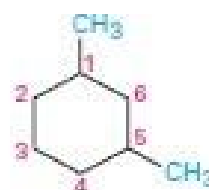
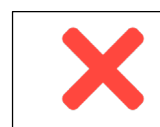
2-Bromo-1-chloro-3-methylcyclopentane



2-Bromo-1,1-dimethylcyclohexane

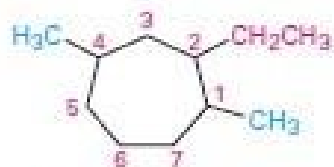


1,3-Dimethylcyclohexane
Lower

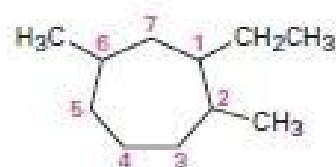


1,5-Dimethylcyclohexane
Higher

NOT

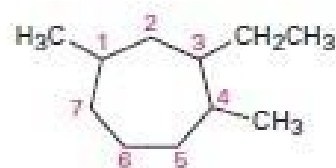


2-Ethyl-1,4-dimethylcycloheptane
Lower Lower



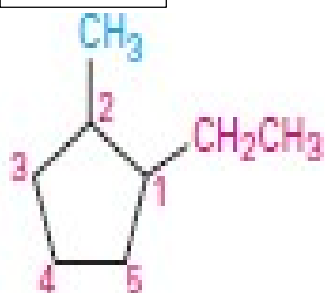
1-Ethyl-2,6-dimethylcycloheptane
Higher

NOT



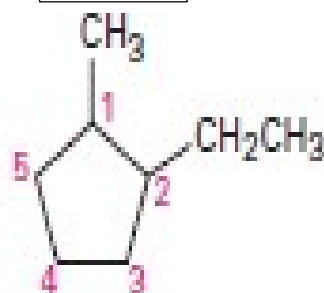
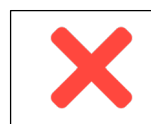
3-Ethyl-1,4-dimethylcycloheptane
Higher

a. When **two or more different alkyl groups** are present that could potentially take the same numbers, number them by alphabetical priority, ignoring numerical prefixes such as di- and tri-.



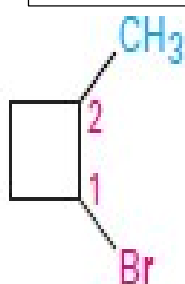
1-Ethyl-2-methylcyclopentane

NOT



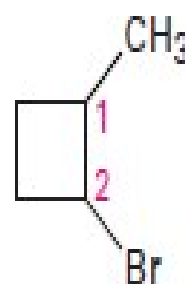
2-Ethyl-1-methylcyclopentane

b. If **halogens** are present, treat them just like alkyl groups.



1-Bromo-2-methylcyclobutane

NOT

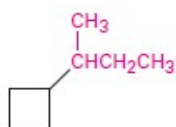


2-Bromo-1-methylcyclobutan

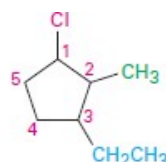
Some additional examples follow:



1-Bromo-3-ethyl-5-methyl-cyclohexane



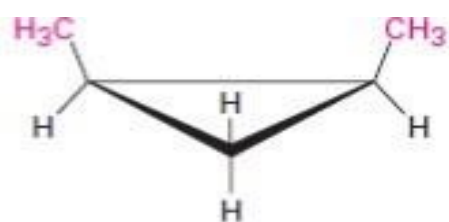
(1-Methylpropyl)cyclobutane
or *sec*-butylcyclobutane



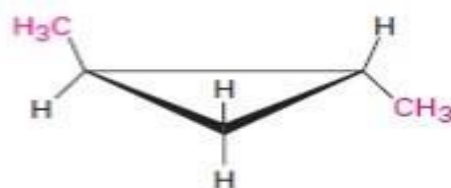
1-Chloro-3-ethyl-2-methyl-cyclopentane

Cis–Trans Isomerism in Cycloalkanes

Because of their cyclic structures, cycloalkanes have two faces when viewed edge-on, a "top" face and a "bottom" face. As a result, isomerism is possible in substituted cycloalkanes. For example, there are two different 1,2-dimethylcyclopropane isomers, one with the two methyl groups on the same face of the ring and one with the methyl groups on opposite faces. Both isomers are stable compounds, and neither can be converted into the other without breaking and reforming chemical bonds.



cis-1,2-Dimethylcyclopropane



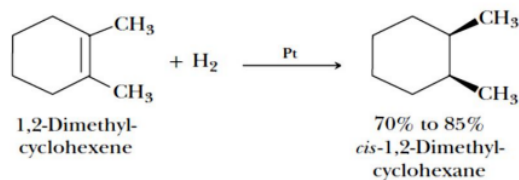
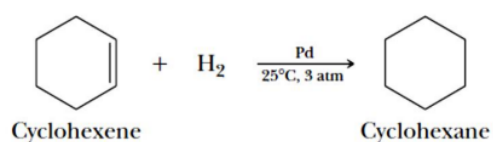
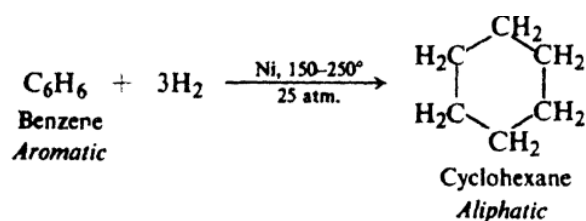
trans-1,2-Dimethylcyclopropane

stereoisomers called **cis–trans isomers**. The prefixes *cis-* (Latin "on the same **side**") and *trans-* (Latin "**across**") are used to distinguish between them. Cis–trans isomerism is a common occurrence in substituted cycloalkanes and in many cyclic biological molecules .



Preparation of Cycloalkanes

1. Hydrogenation of aromatic hydrocarbons or alkenes



2. Addition reactions

Cyclopropane and cyclobutane undergo certain addition reactions. These addition reactions destroy the cyclopropane and cyclobutane ring systems, and yield open-chain products. For example:

