

## 4.11: JOINED RINGS

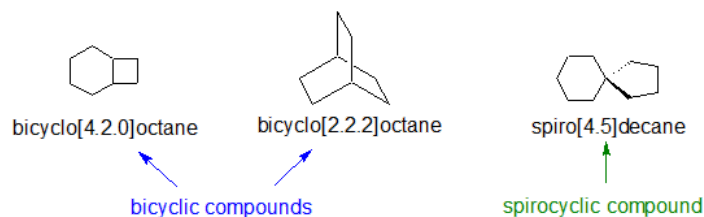


### Learning Objective

- recognize, classify, and draw the three ways to join two rings

### BICYCLIC RING SYSTEMS

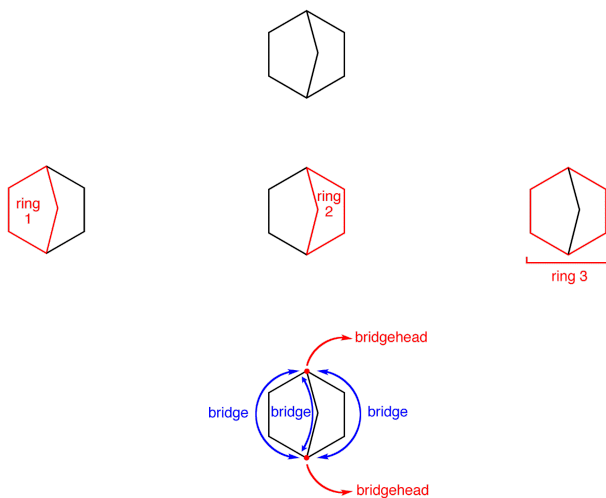
There are three ways to join two rings. If two rings share two or more atoms, then the structure is called a bicyclic compound. If the two rings share a single atom, then the structure is called a spirocyclic compound. Examples of each way to join rings is shown below.



### BICYCLIC COMPOUNDS

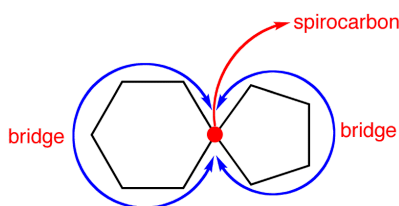
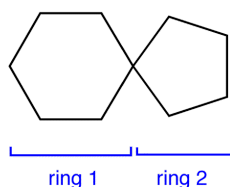
Fused rings share two adjacent carbon atoms. Decalin is a fused bicyclic compound. Its IUPAC name is bicyclo[4.4.0]decane to communicate the bonding arrangement.

Bridged rings share two non-adjacent carbon atoms and one or more carbon atoms between them. Bicyclo[2.2.1]heptane shows the difference between the bridgehead carbons and the bridge carbons.



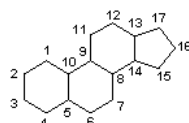
### SPIROCYCLIC COMPOUNDS

A spirobicycloalkane is a molecule in which only one carbon atom is shared by the two rings in the molecule. The carbon atom shared by the two rings is called the spirocarbon. A chain of bonds originating and ending at the spirocarbon is called a bridge. The compound below is named spiro[4.5]decane to communicate the number of carbons in each bridge with the spirocarbon.



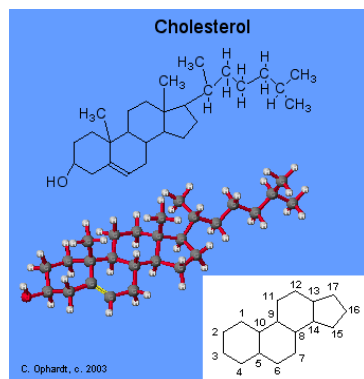
## STEROIDS

Steroids include such well known compounds as cholesterol, sex hormones, birth control pills, cortisone, and anabolic steroids.



The best known and most abundant steroid in the body is cholesterol. Cholesterol is formed in brain tissue, nerve tissue, and the blood stream. It is the major compound found in gallstones and bile salts. Cholesterol also contributes to the formation of deposits on the inner walls of blood vessels. These deposits harden and obstruct the flow of blood. This condition, known as atherosclerosis, results in various heart diseases, strokes, and high blood pressure.

Much research is currently underway to determine if a correlation exists between cholesterol levels in the blood and diet. Not only does cholesterol come from the diet, but cholesterol is synthesized in the body from carbohydrates and proteins as well as fat. Therefore, the elimination of cholesterol rich foods from the diet does not necessarily lower blood cholesterol levels. Some studies have found that if certain unsaturated fats and oils are substituted for saturated fats, the blood cholesterol level decreases. The research is incomplete on this problem.

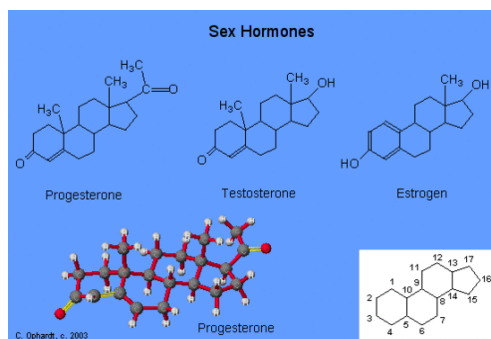


## STRUCTURES OF SEX HORMONES

Sex hormones are also steroids. The primary male hormone, testosterone, is responsible for the development of secondary sex characteristics. Two female sex hormones, progesterone and estrogen or estradiol control the ovulation cycle. Notice that the male and female hormones have only slight differences in structures, but yet have very different physiological effects.

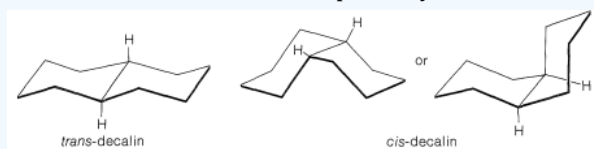
Testosterone promotes the normal development of male genital organs and is synthesized from cholesterol in the testes. It also promotes secondary male sexual characteristics such as deep voice, facial and body hair.

Estrogen, along with progesterone regulates changes occurring in the uterus and ovaries known as the menstrual cycle. For more details see Birth Control. Estrogen is synthesized from testosterone by making the first ring aromatic which results in more double bonds, the loss of a methyl group and formation of an alcohol group.



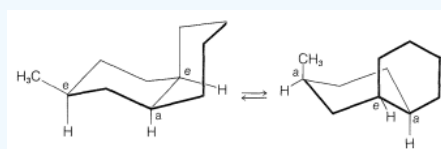
### Exercise

- Someone stated that *trans*-decalin is more stable than *cis*-decalin. Explain why this is incorrect.



### Answer

- Cis*-decalin has fewer steric interactions than *trans*-decalin because each ring can assume the chair form in both conformations. Working with models can be helpful.



### CONTRIBUTORS AND ATTRIBUTIONS

- Gamini Gunawardena from the [OChemPal](#) site ([Utah Valley University](#))

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