

# Chemistry of Natural Products (CHEM-479)

## Online Lectures (Steroids)

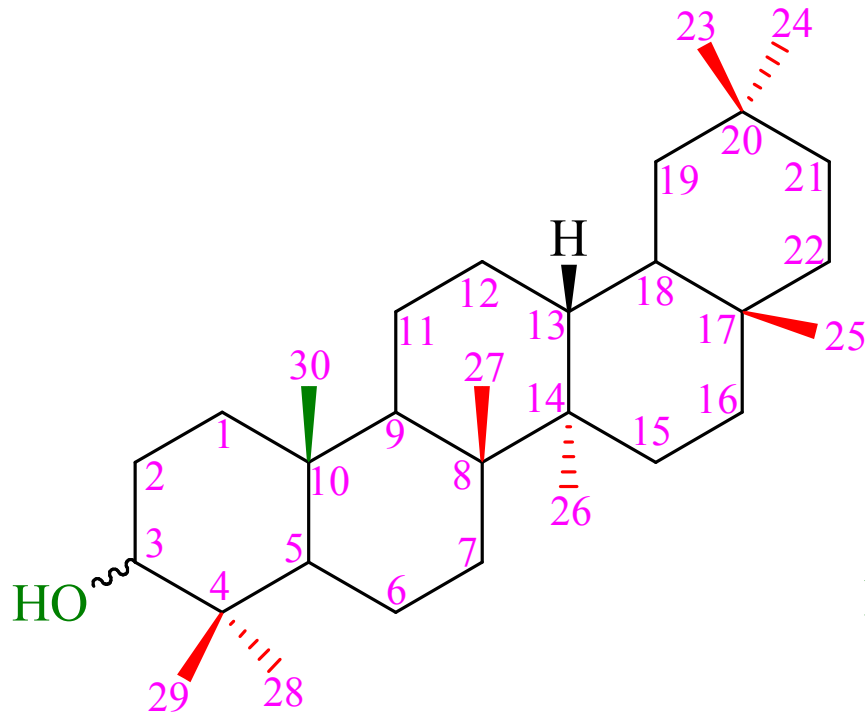
Dr Abdul Rauf Raza

*(Associate Professor)*

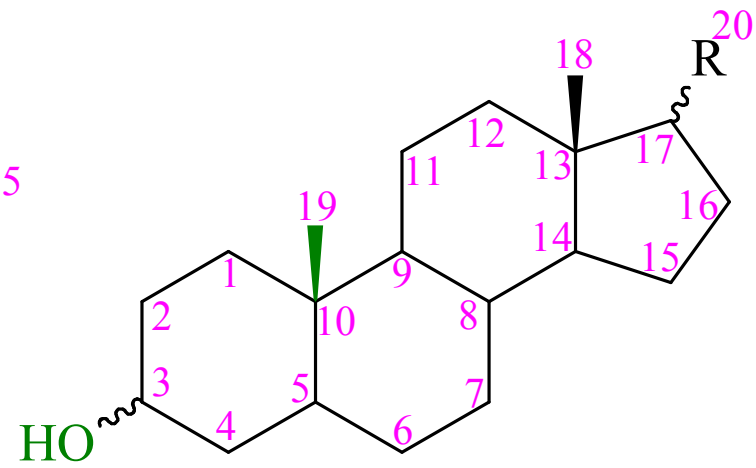
Department of Chemistry

University of Sargodha, Sargodha

# Structure of Steroids

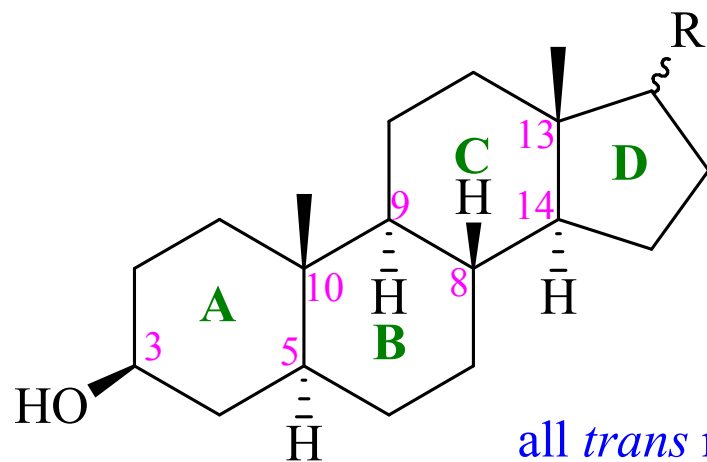


A Pentacyclic Triterpenoid

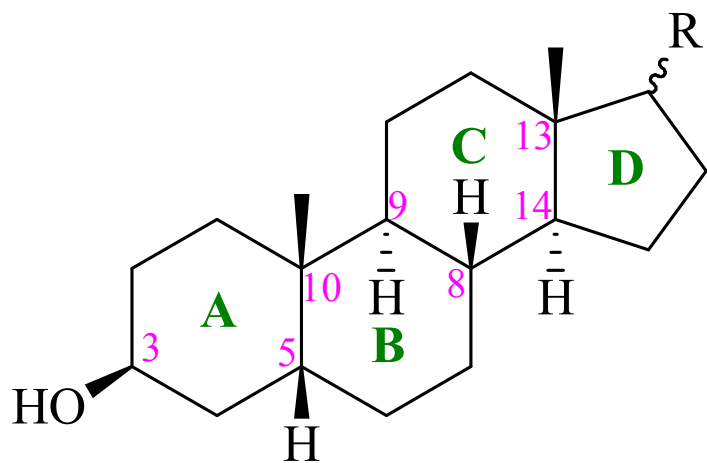
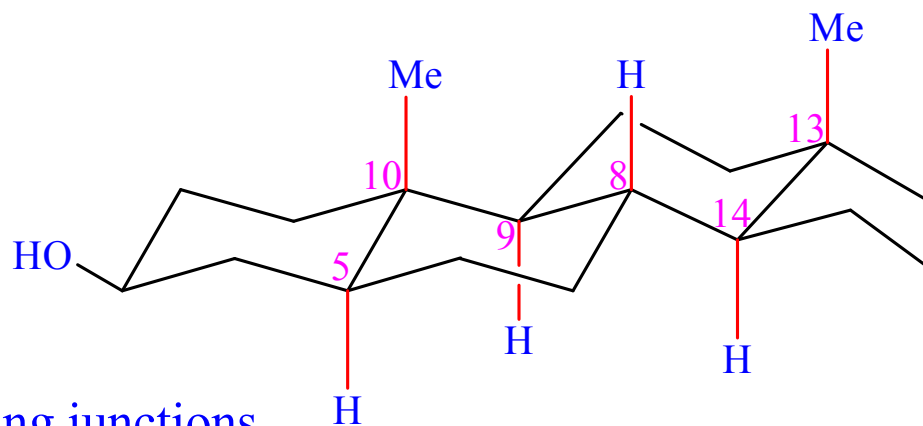


A Steroid

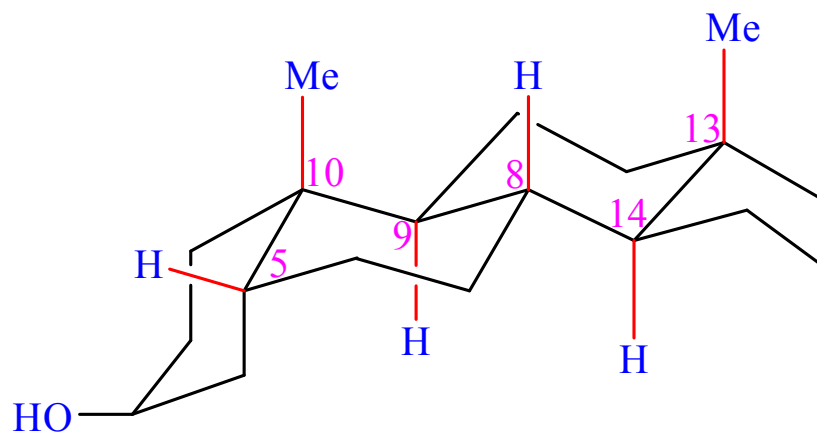
# Conformation of Steroids



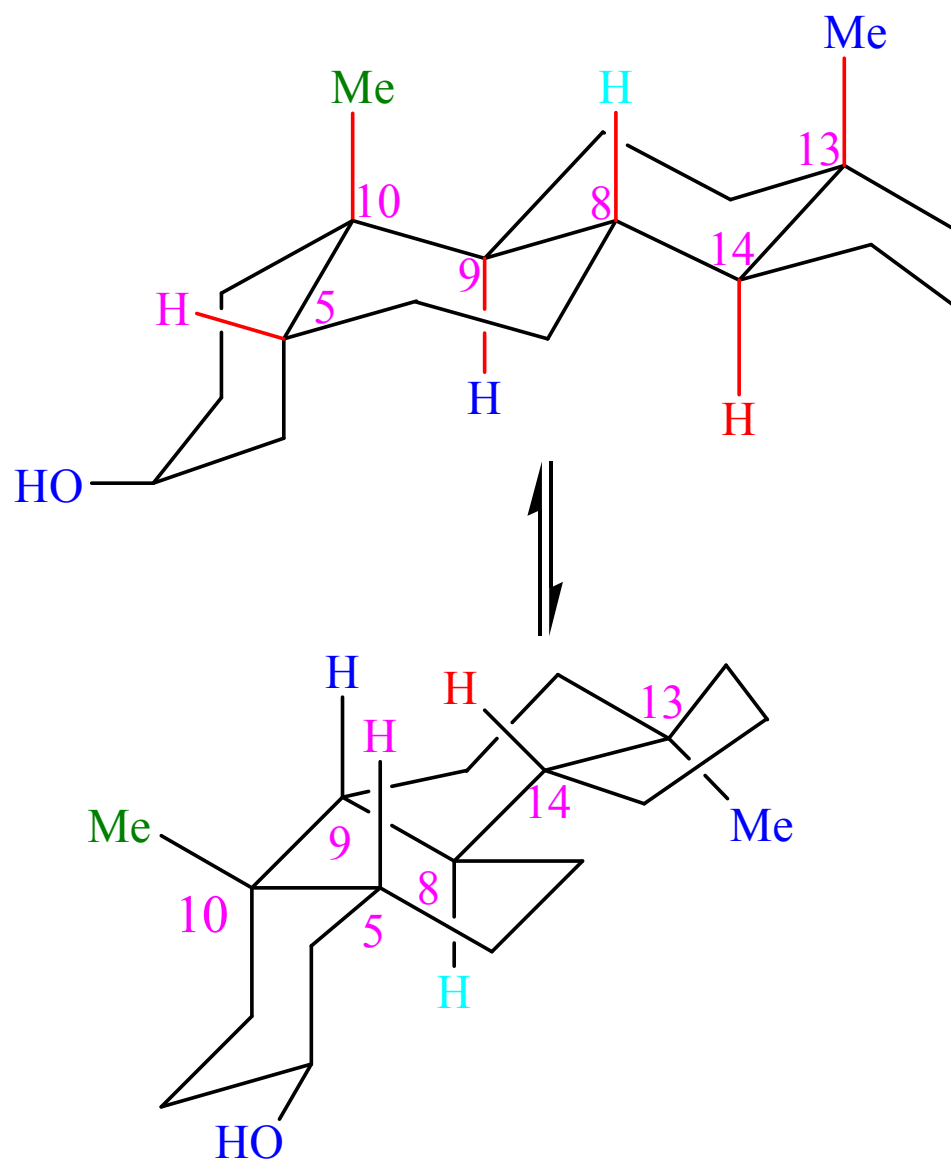
all *trans* ring junctions



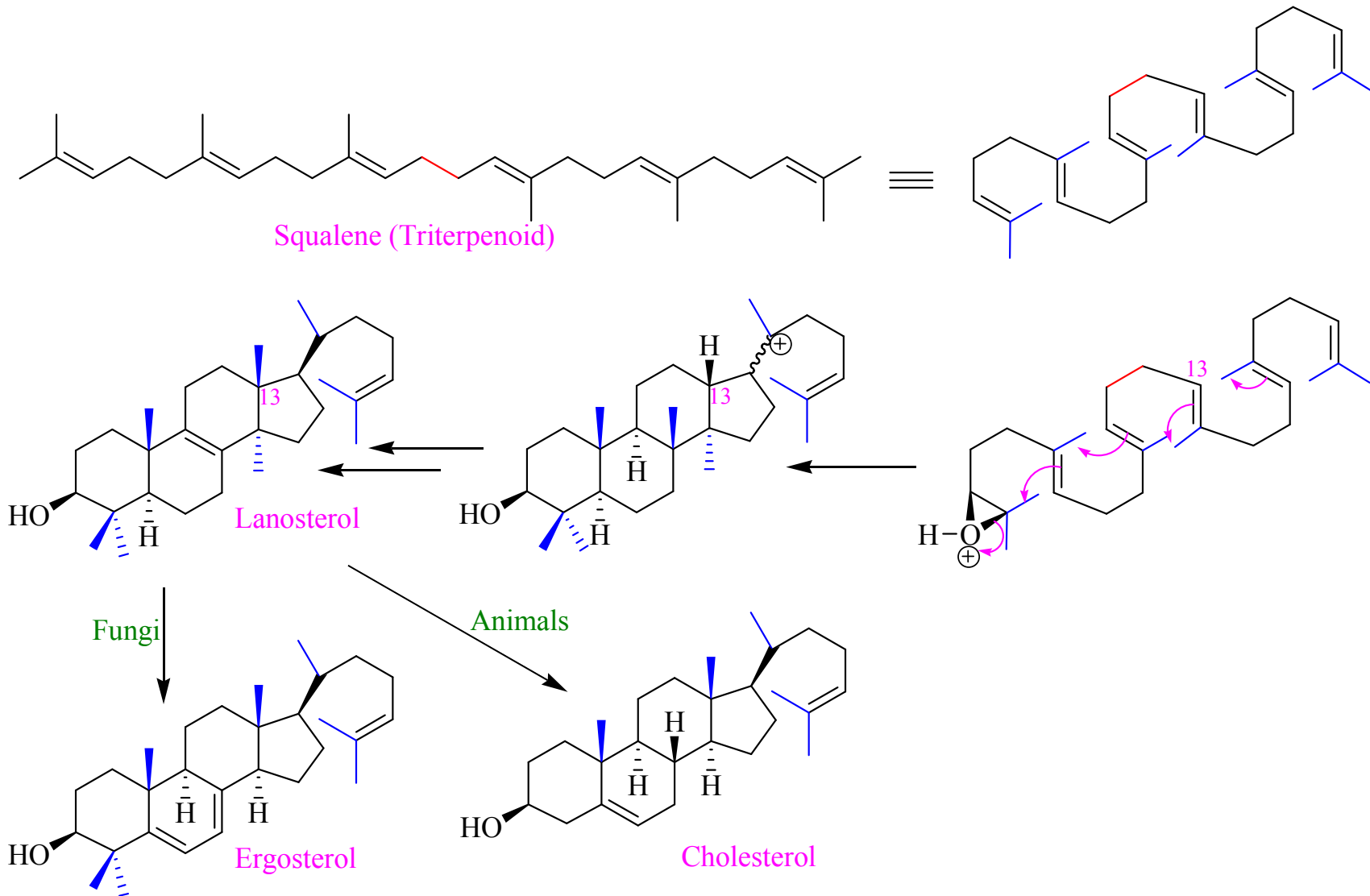
AB *cis* ring junction



# Conformations of *cis*-ring junctions

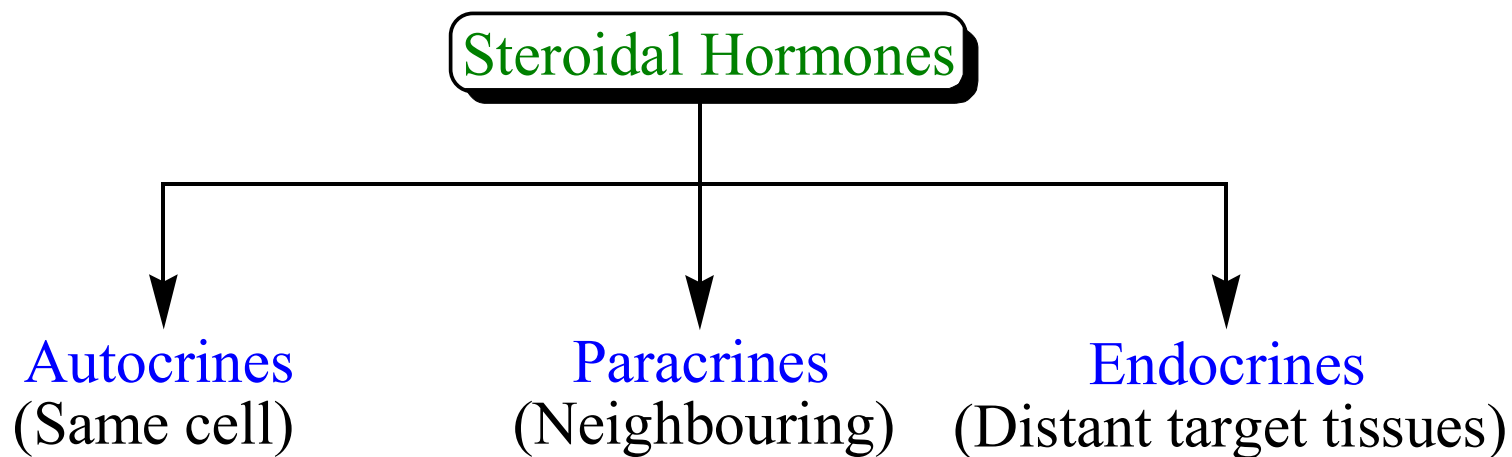


# Biosynthesis of Steroids

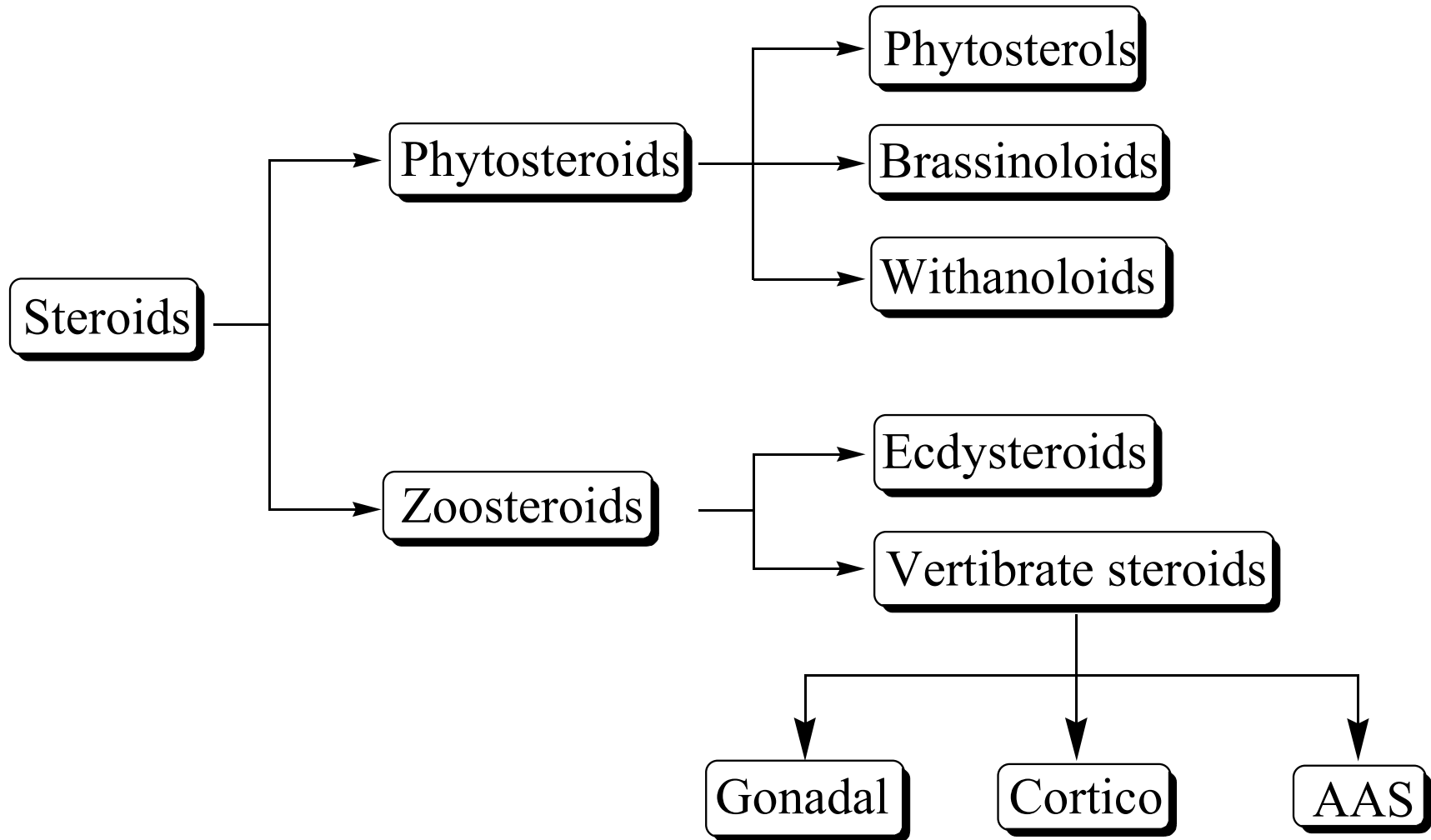


# Basis of Classification of Steroids

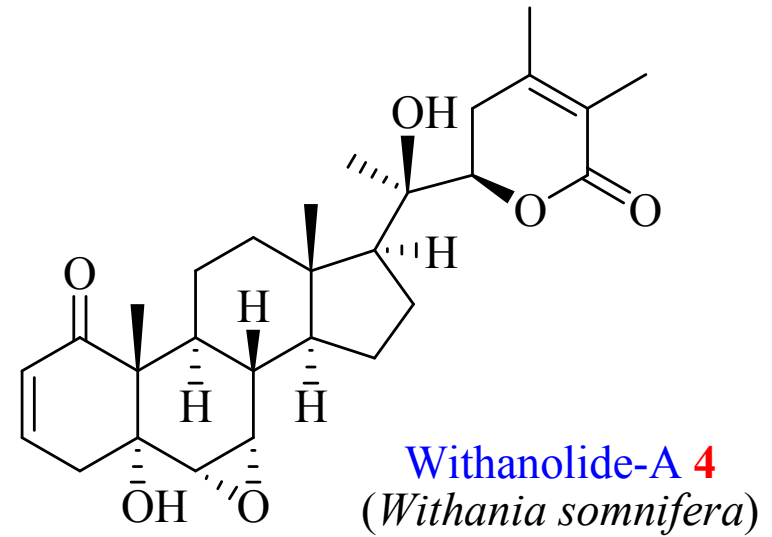
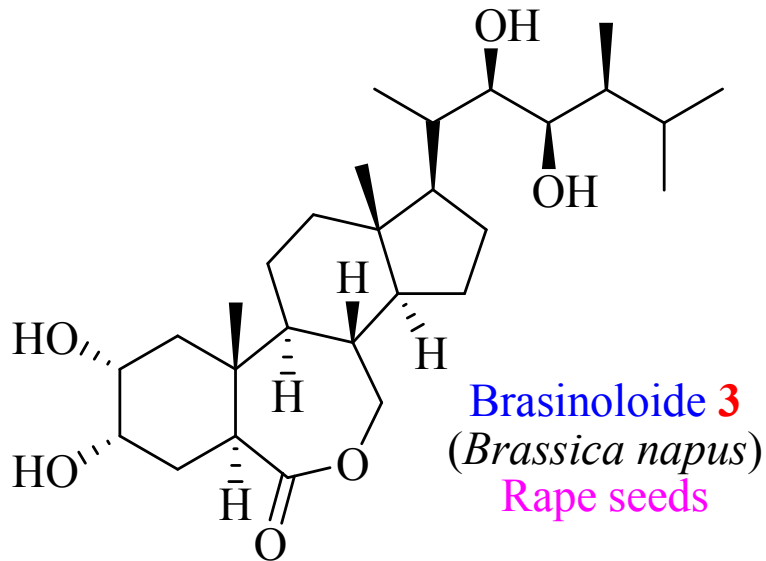
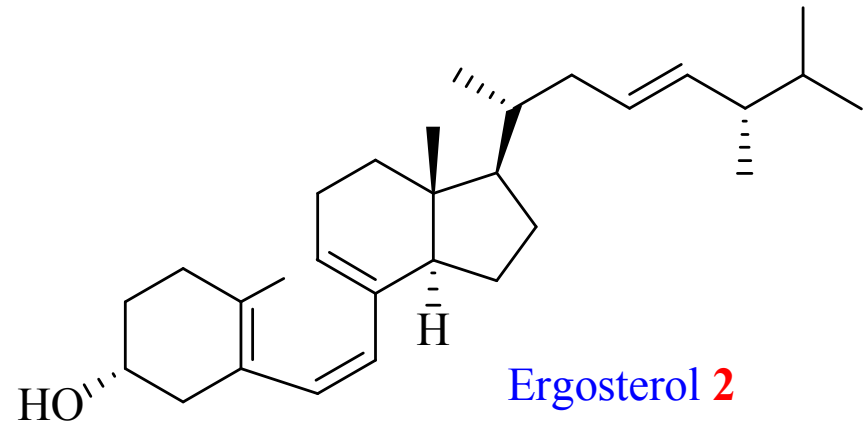
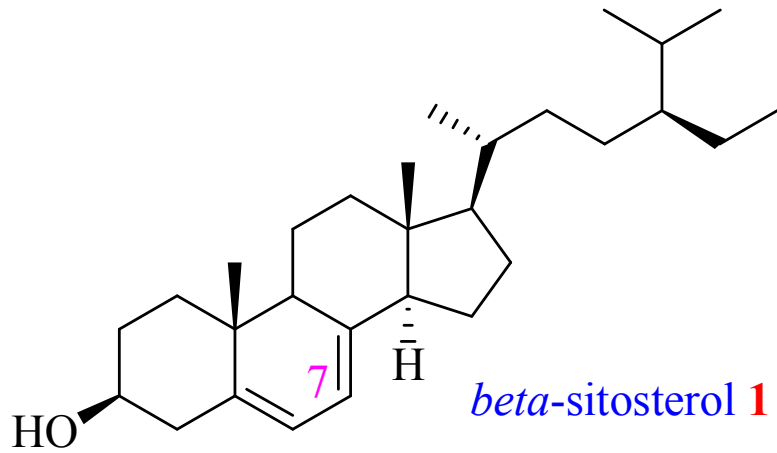
- Chemical Structure (Side chain at C-17, C=C etc.)
- Biological Function (Glucocorticoids, genital steroids etc.)
- Molecular Action (Estrogen-receptor agonist)
- Source of Organism (Fungal, microorganism, plants)
- Site of Production (Adrenal cortex, CNS, gonads)



# Classification of Steroids

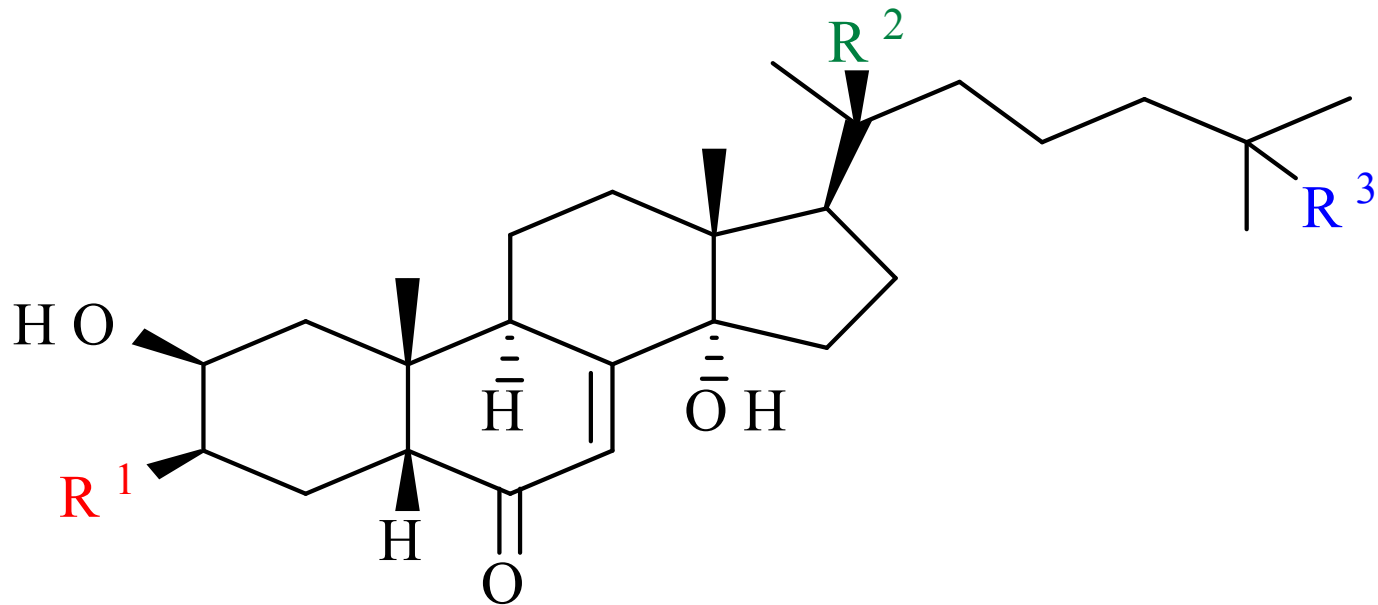


# Phytosteroids





# Ecdysteroids

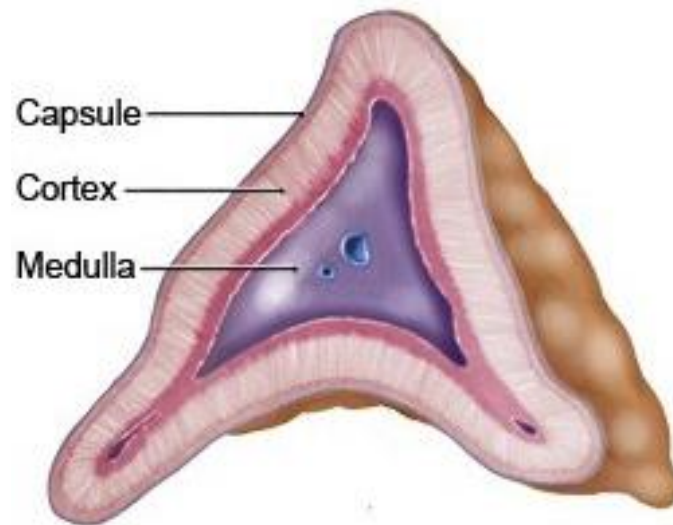


<i>R</i> <sup>1</sup>	<i>R</i> <sup>2</sup>	<i>R</i> <sup>3</sup>	<i>Ecdysteroid</i>
OH	H	H	25-Deoxyecdysteroid
OH	H	OH	Ecdysone
OH	OH	H	Ponasterone-A
OH	OH	OH	20-Hydroxyecdysone
=O	H	OH	3-dehydroecdysone

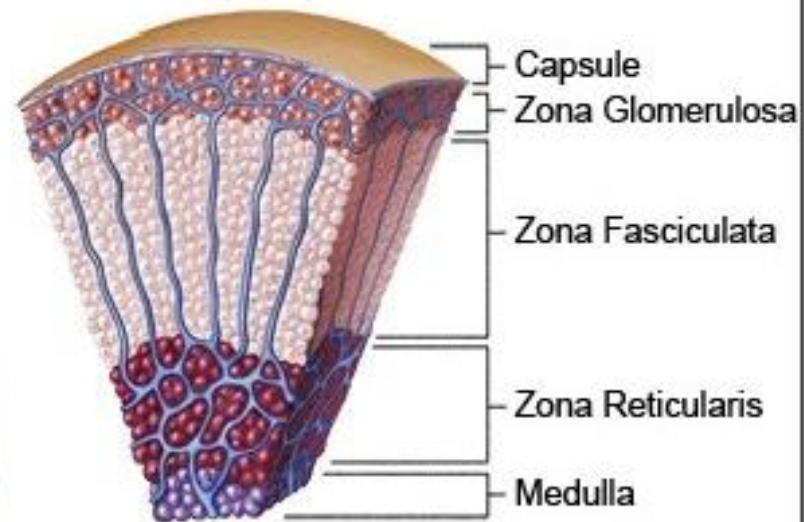
# Vertebrate Steroids (Corticocoids)

## Adrenal Gland Cross Sections

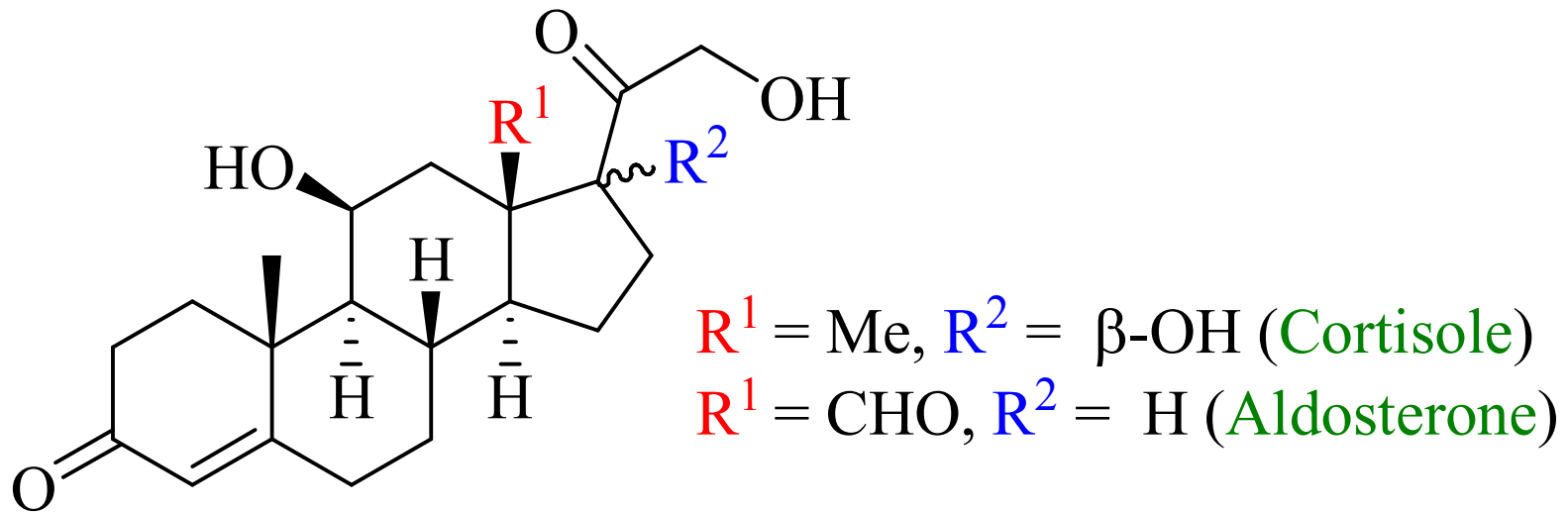
Transverse Section



Microscopic Section



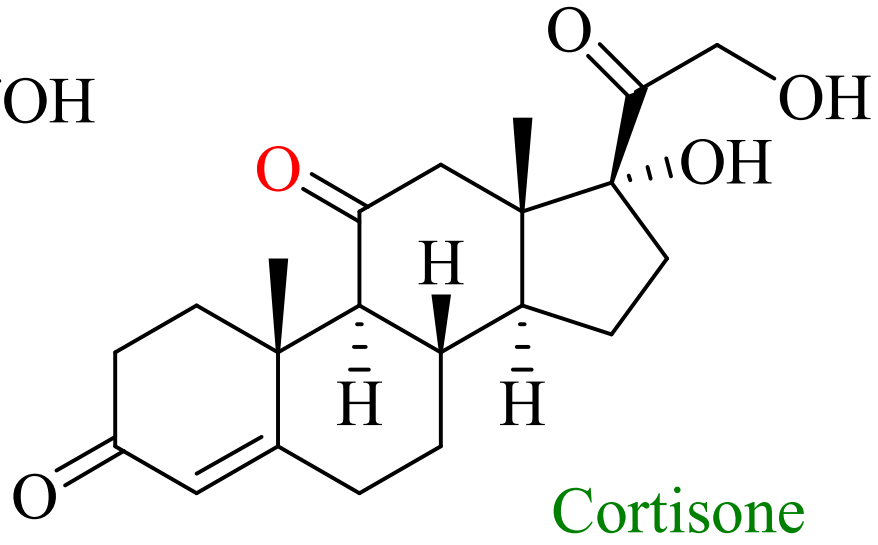
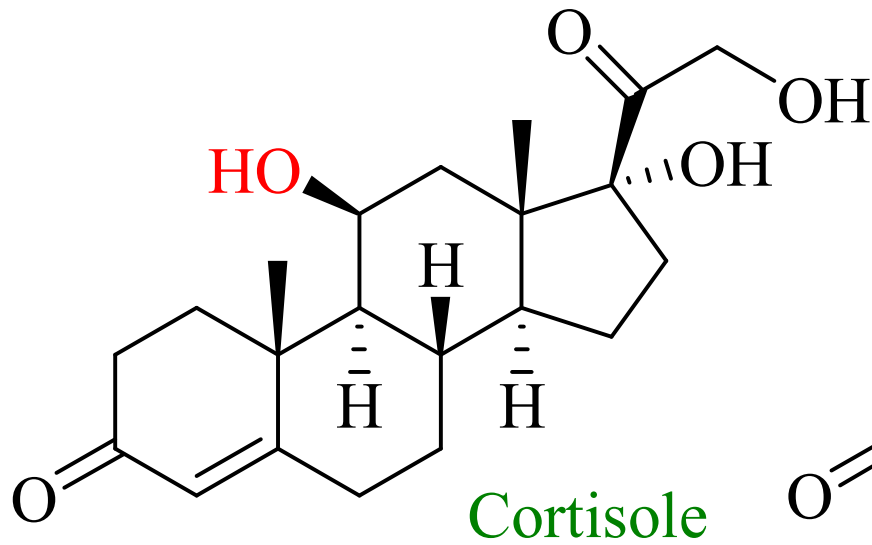
# Mineralocorticoids



## (Mineral + cortex + steroid)

Aldosterone, the main **mineralocorticoid**, is a steroidal hormone produced by the **zona glomerulosa** of the adrenal cortex in the adrenal gland. It is essential for  $\text{Na}^+$  conservation in the kidney, salivary glands, sweat glands and colon. It plays a central role in the homeostatic regulation of blood pressure, plasma  $\text{Na}^+$  and  $\text{K}^+$  levels.

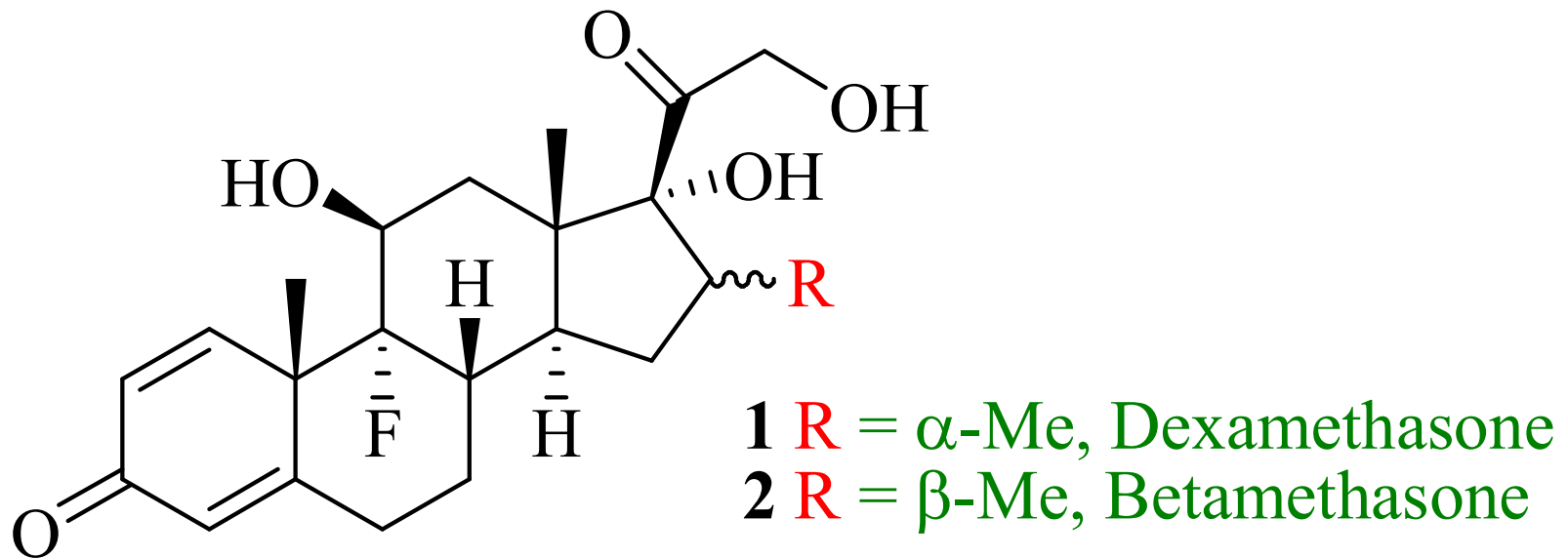
# Glucocorticoids



## (Glucose + cortex + steroid)

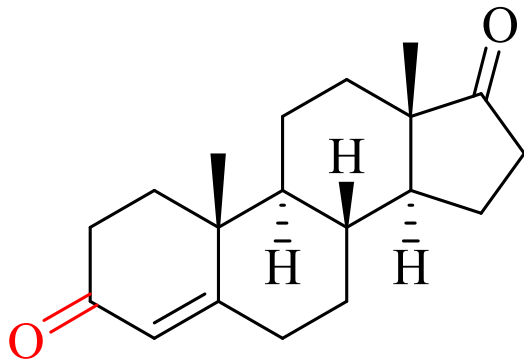
Aldosterone, the main glucocorticoid, is a steroidal hormone produced by the zona fasciculata of the adrenal cortex in the adrenal gland. They are therefore used to treat diseases caused by an overactive immune system, such as allergies, asthma, autoimmune diseases and sepsis.

# Synthetic Glucocorticoids

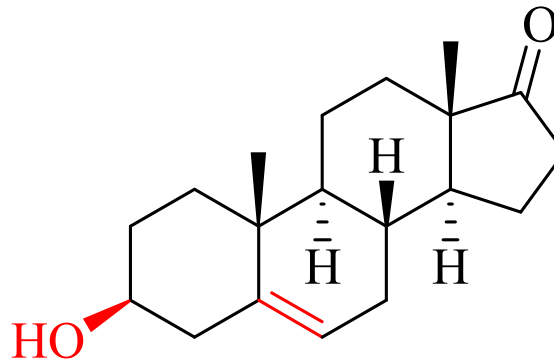


Dexamethasone **1** is anti-inflammatory (arthritis) and immunosuppressant. Betamethasone **2** is also anti-inflammatory against allergy caused due to itching.

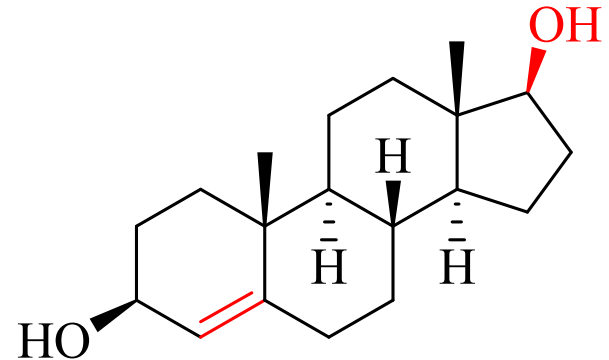
# Anabolic Androgenic Steroids (AAS)



Androstendione



Dehydroepiandrostenane

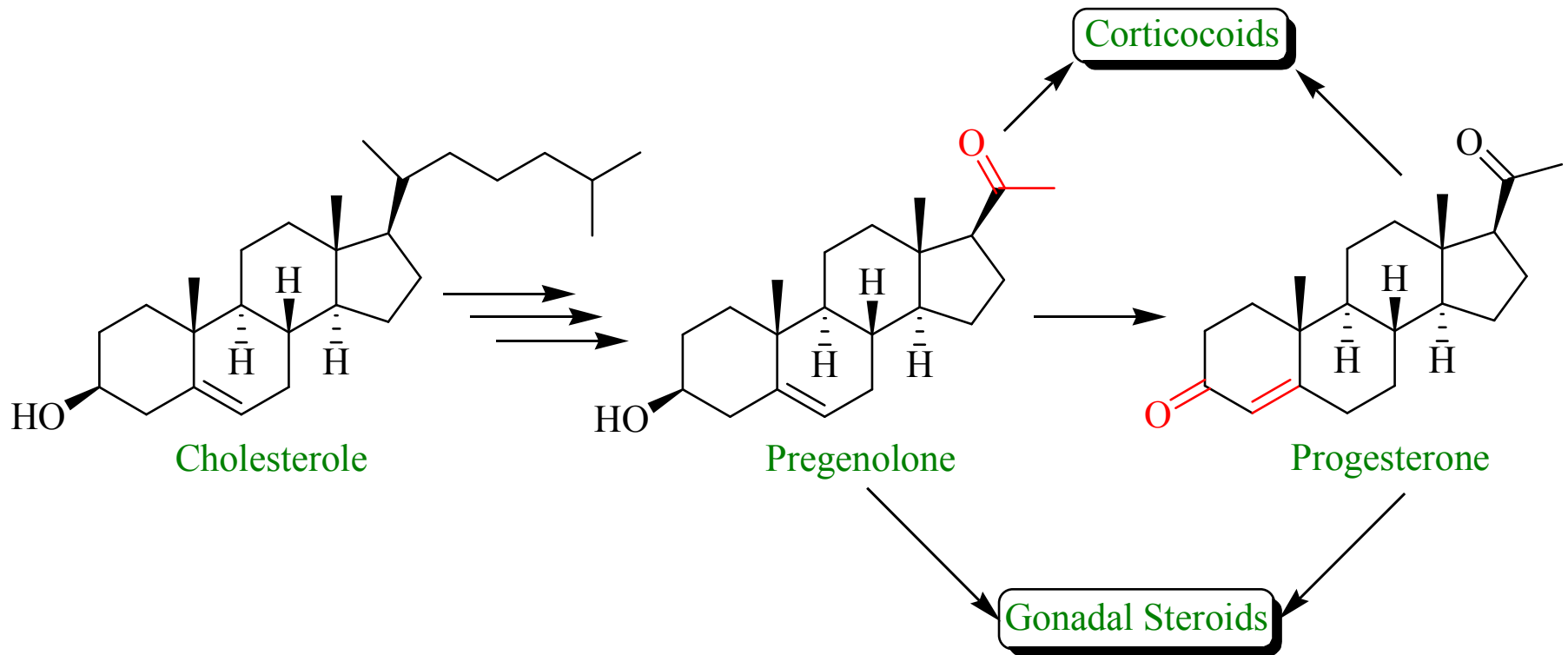


4-Androstenediol

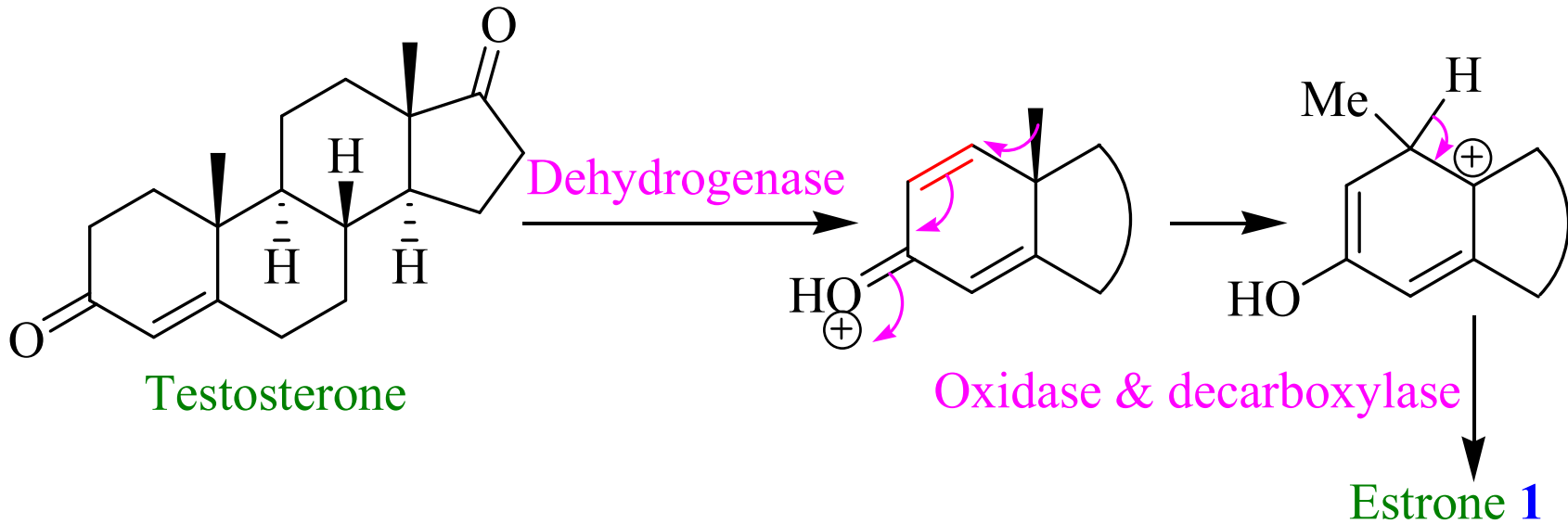
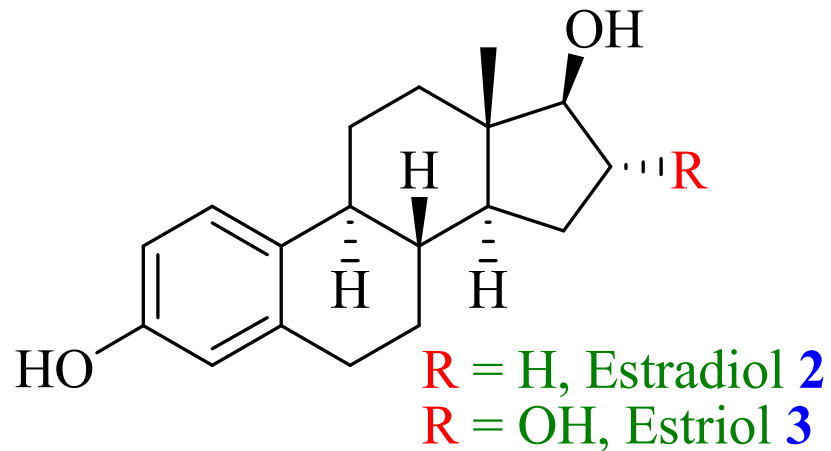
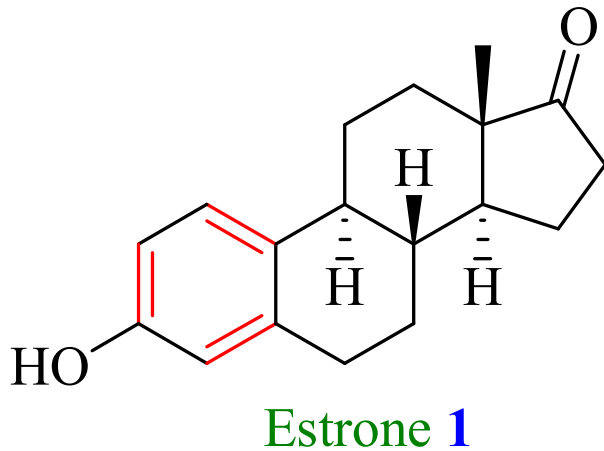
(Anabole = to build up; Andros = man; Genein = to produce)

An androgen is any natural or synthetic steroid hormone that regulates the development and maintenance of male characteristics in vertebrates by binding to androgen receptors. They stimulate the protein synthesis within cells that results in the building up of cellular tissues, especially skeletal muscles.

# Gonadal (Sex) Steroids



# Estrogens

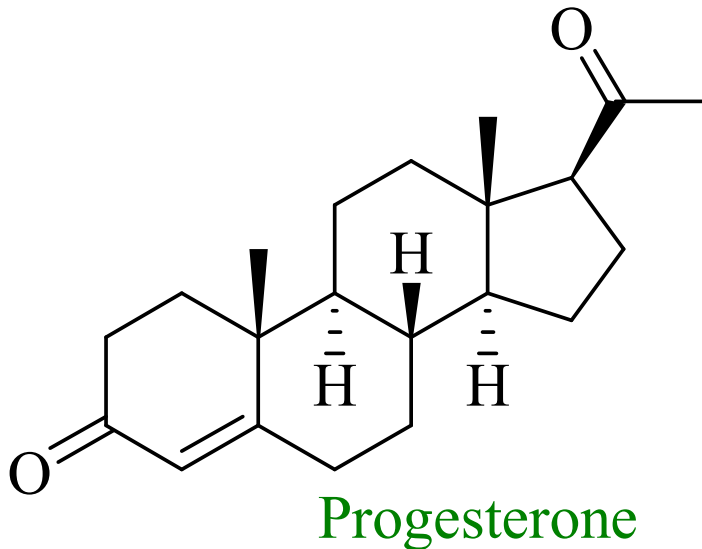




# Estrogens

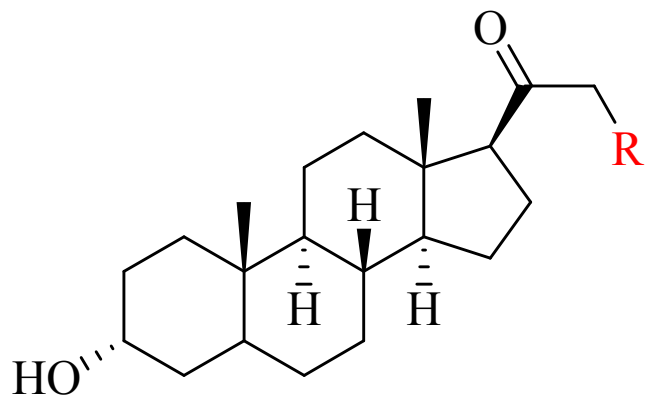
- Produced by ovaries, corpus luteum or placenta
- Some are produced by liver or adrenal cortex
- Promotes the 2<sup>o</sup>-sex characters in ♀
- Decelerate height growth
- 80% Breast cancer are due to abnormal production of it
- Used as oral contraceptive and suppresses lactation after child birth
- Accelerate the catabolism of fats (burns fat)

# Progesterones

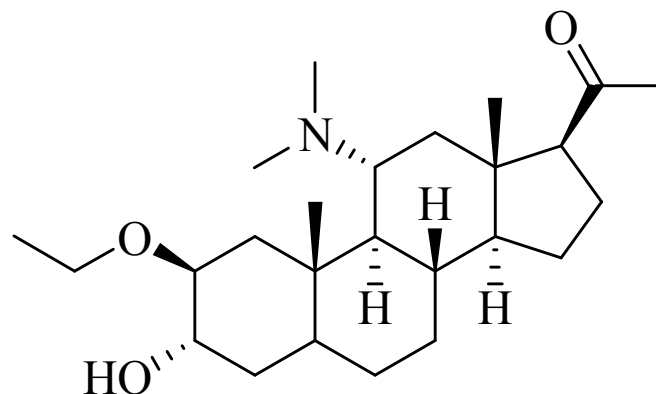


1. Produced in adrenal cortex, gonads (after ovulation), brain and placenta
2. Involves in female menstrual cycle, pregnancy and embryogenesis
3. Inhibits lactation during pregnancy and level abruptly decreases after labor.

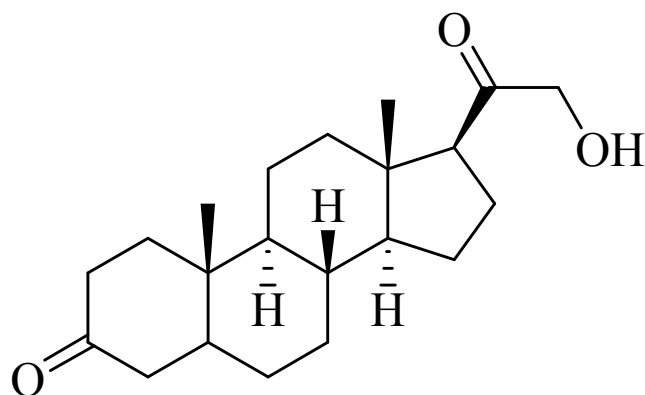
# Neurosteroids



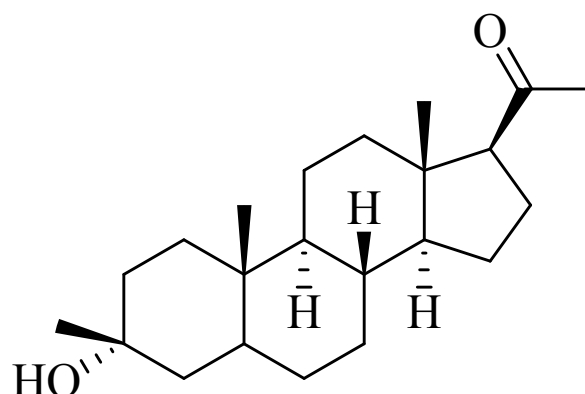
- 1 R = H, Alphaxolone  
2 R = OH, Alphadolone



3 Minaxolone



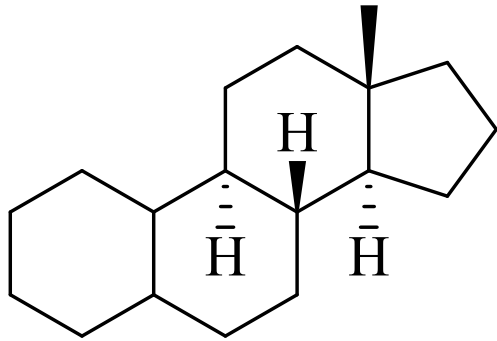
4 3-Dehydrodione



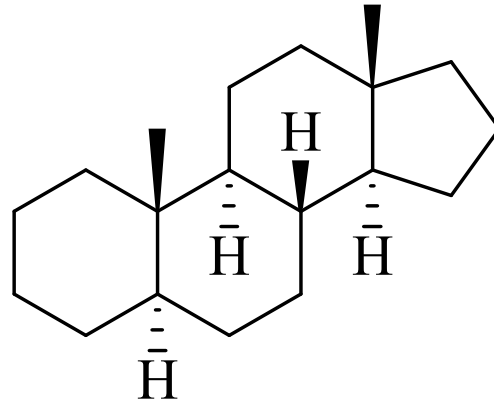
5 Genaxolone

1. Produced by CNS or PNS from cholesterol
2. Used as sedative (anaesthesia for surgery), for example 1-4.
3. Also in use as anticonvulsant (anti-epileptic), for example 5.

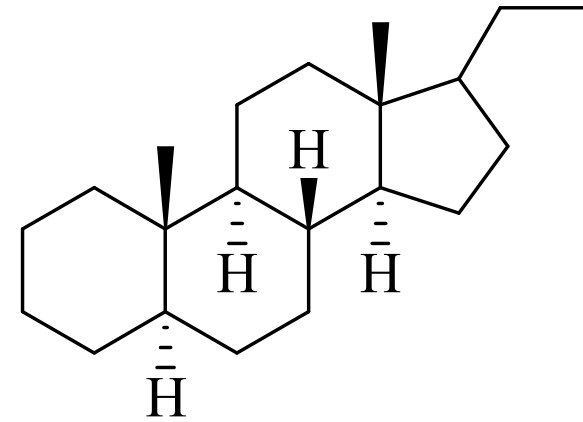
# Nomenclature



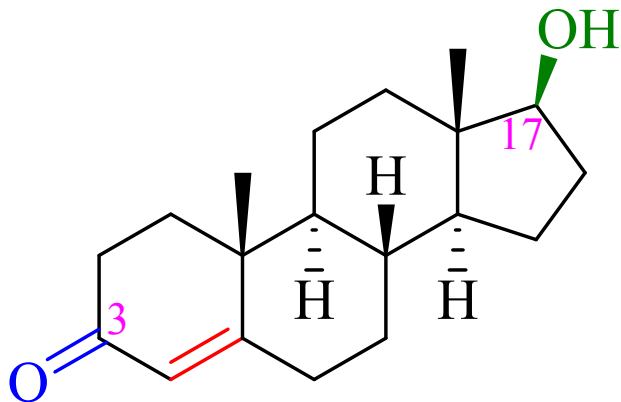
1 Estrane



2 Androstane



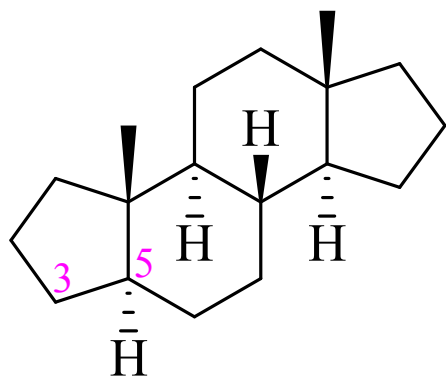
3 Pregnane



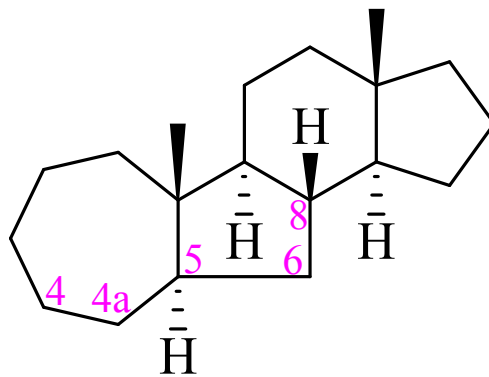
4 Testosterone (17 $\beta$ -Hydroxyandrost-4-en-3-one)

Ring contraction	= <i>nor</i>
Ring expansion	= <i>homo</i>
Ring fission	= <i>seco</i>
Whole ring removal	= <i>des</i>

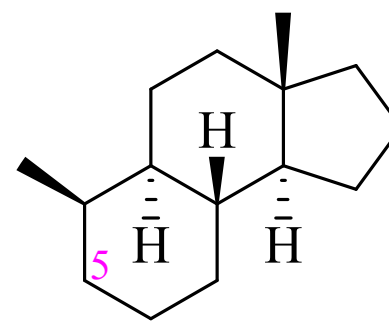
# Nomenclature



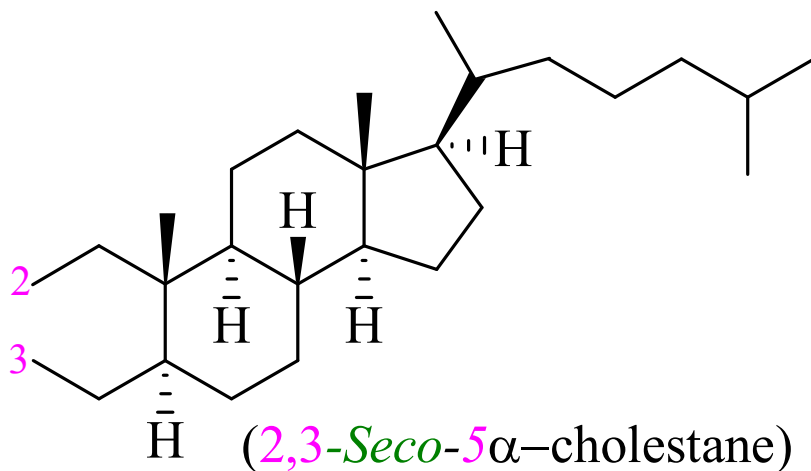
(4-*nor*-5 $\alpha$ -androstane)



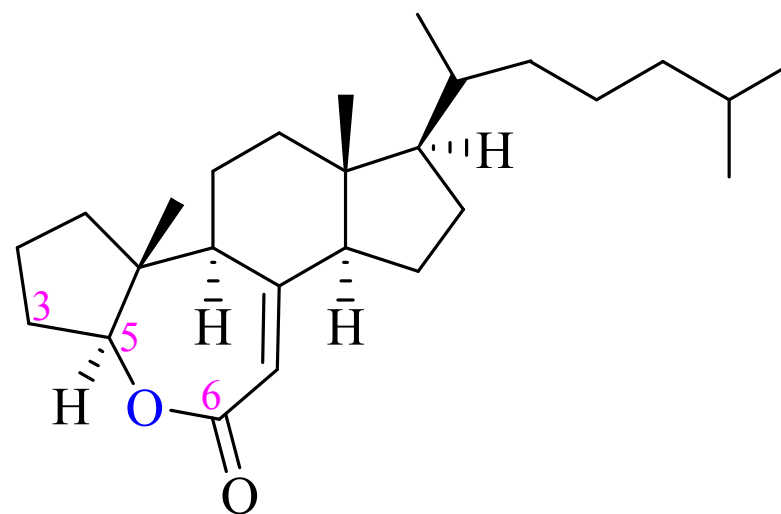
(4a-*homo*-7-*nor*-androstane)



(*Des-A*-androstane)



(2,3-*Seco*-5 $\alpha$ -cholestane)



(5a-*Homo*-4-*nor*-5a-*oxa*-5 $\alpha$ -cholest-7-en-6-one)