Chemistry of Natural Products
(CHEM-6139)

Online Lectures (Steroids)

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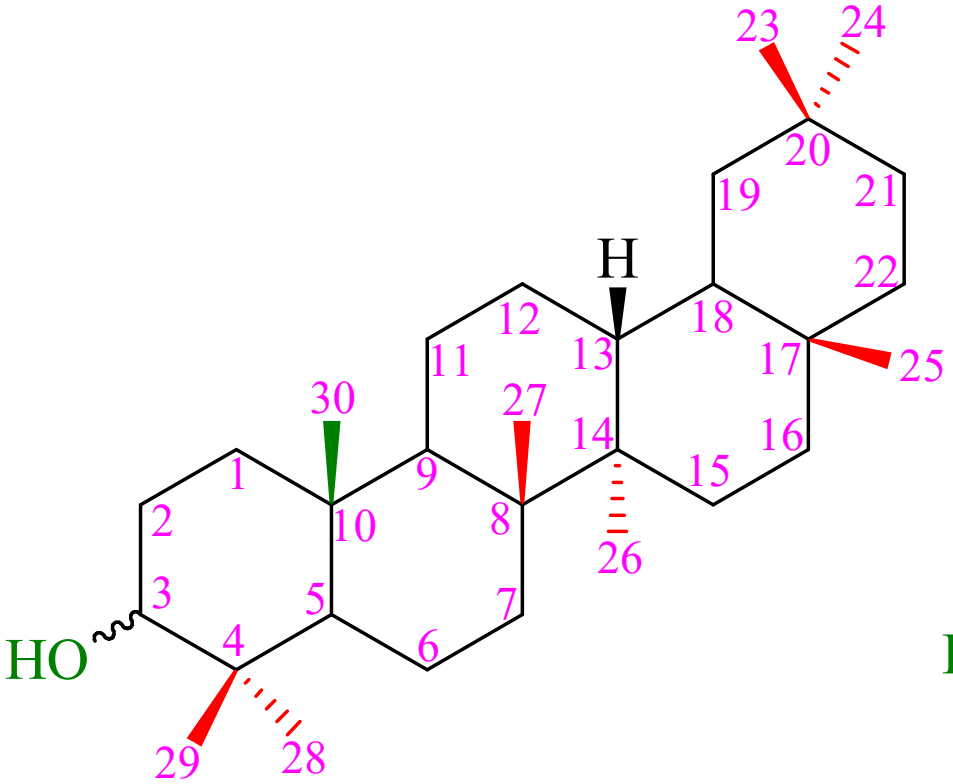
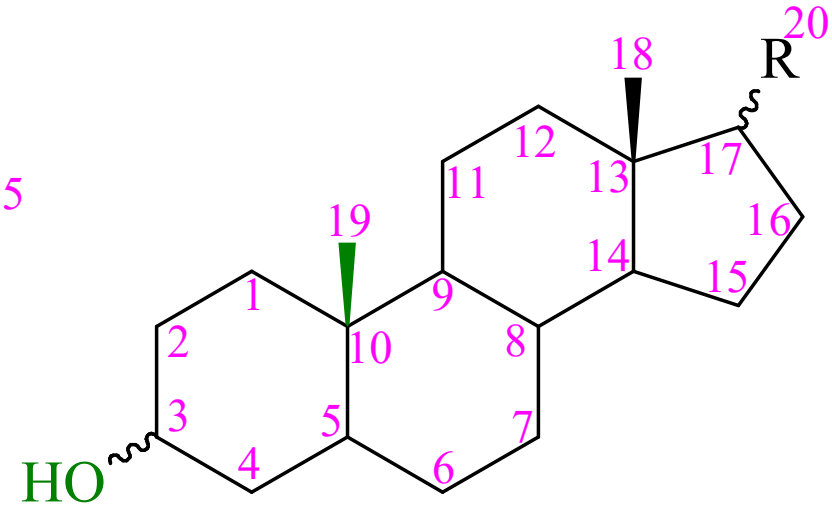
Structure of Steroids

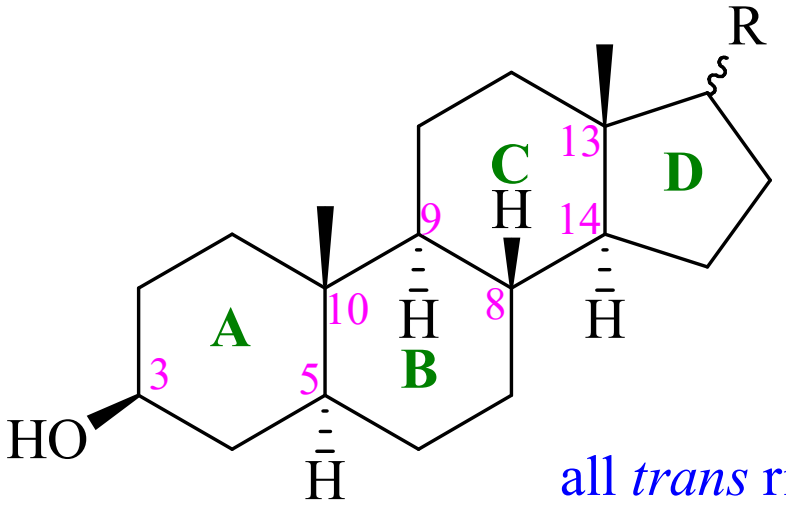


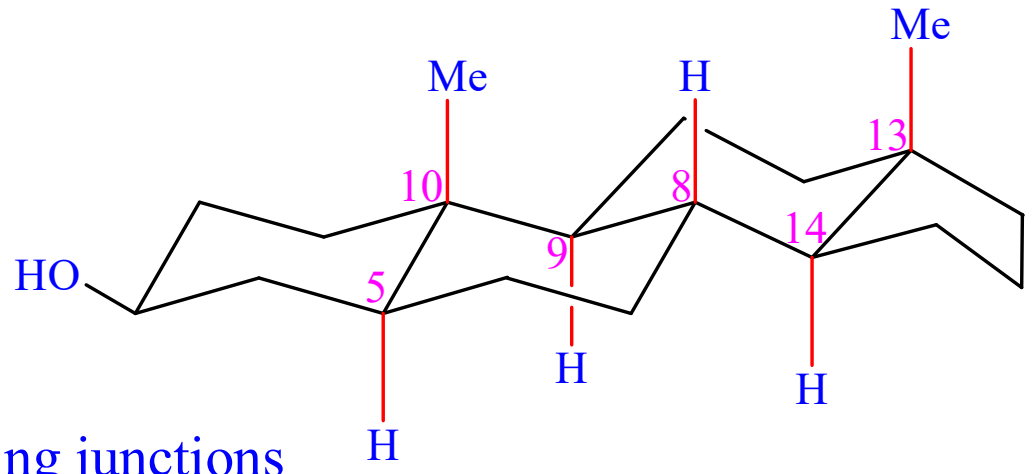
A Pentacyclic Triterpenoid



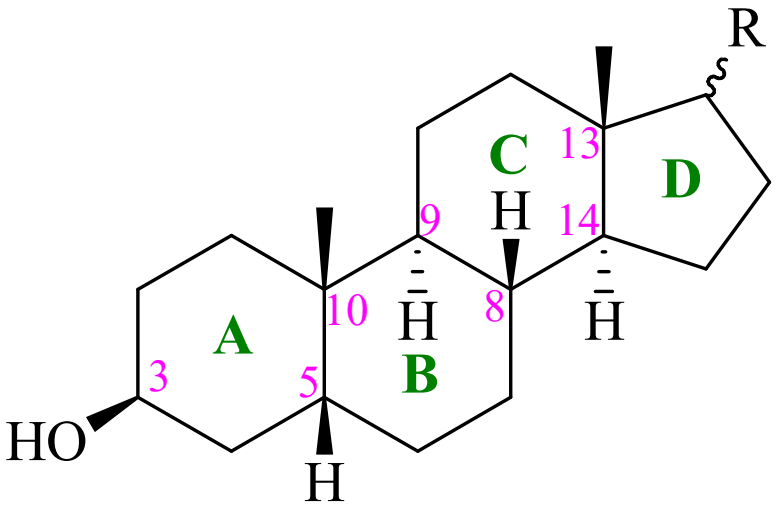
A Steroid

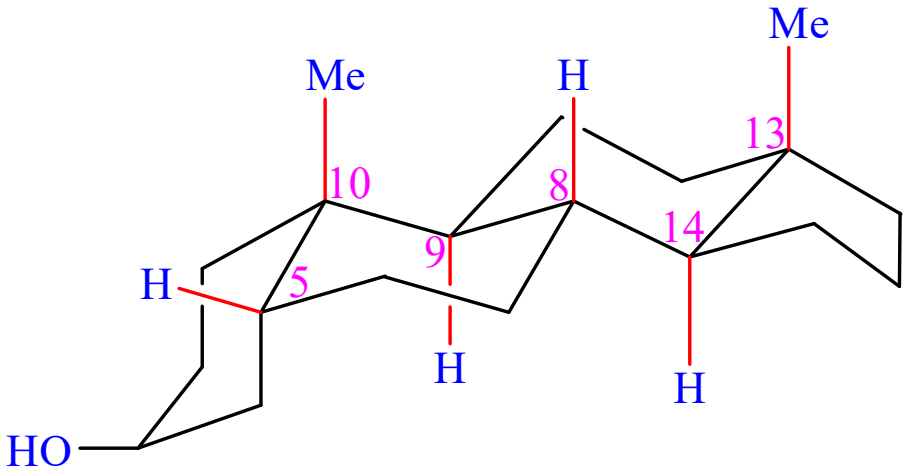
Conformation of Steroids





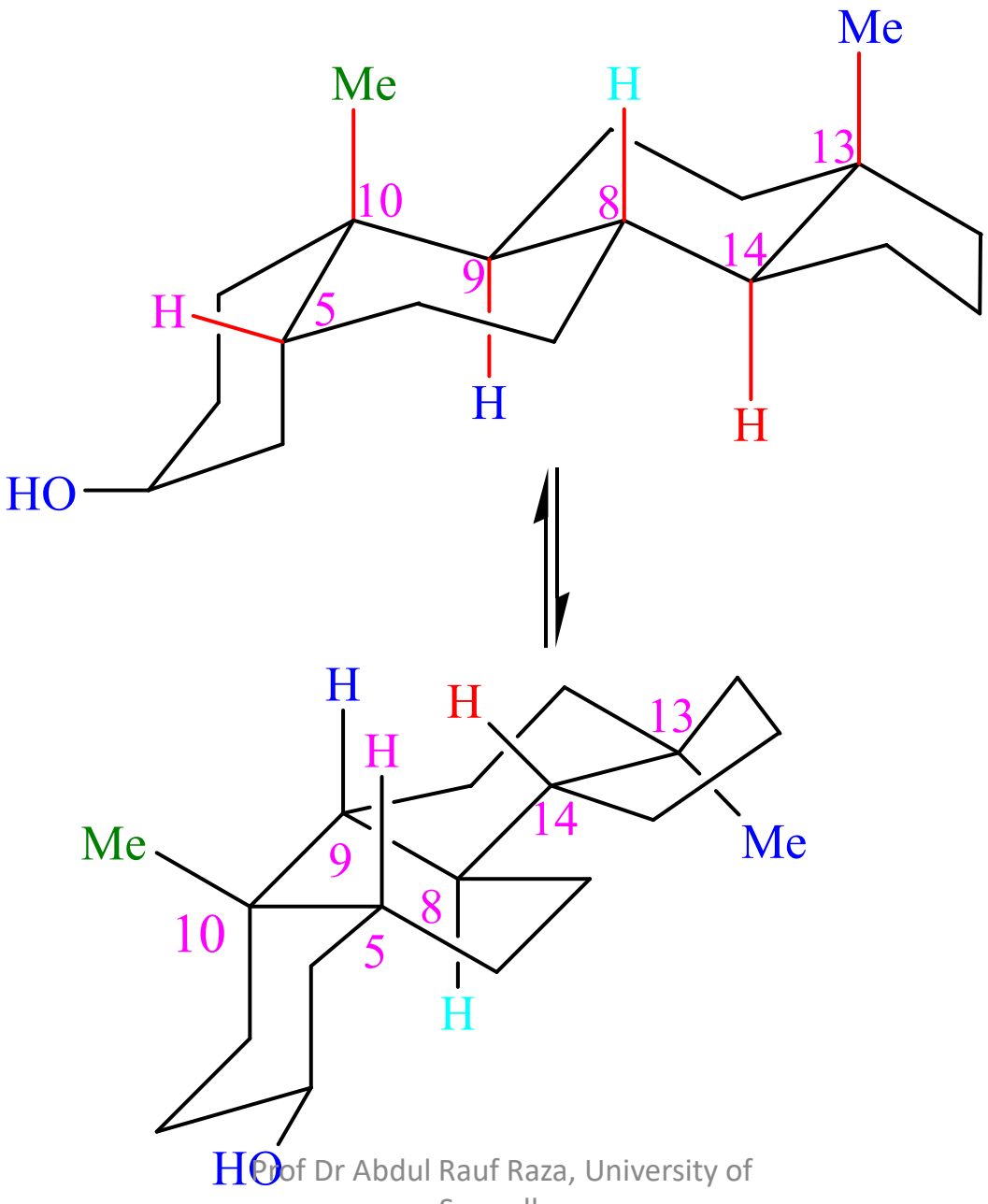
all *trans* ring junctions



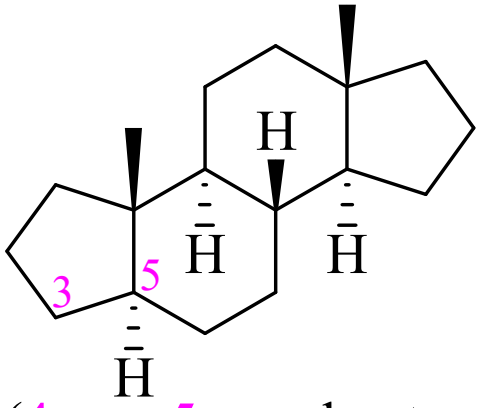


AB *cis* ring junction

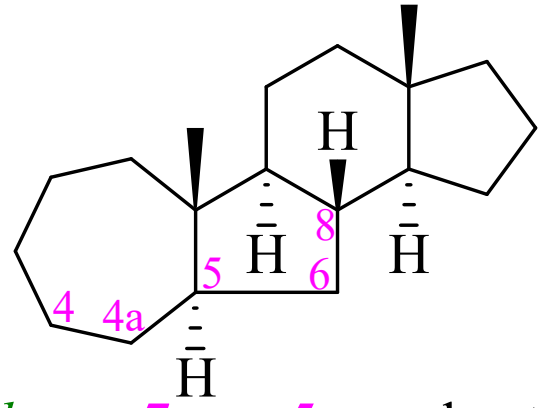
Conformations of *cis*-ring junctions



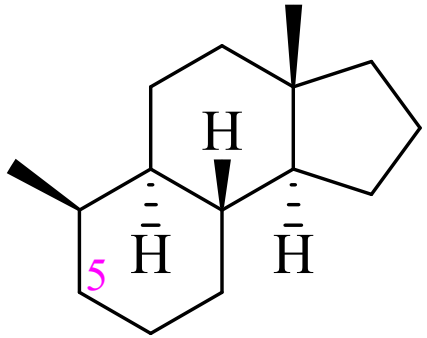
Nomenclature



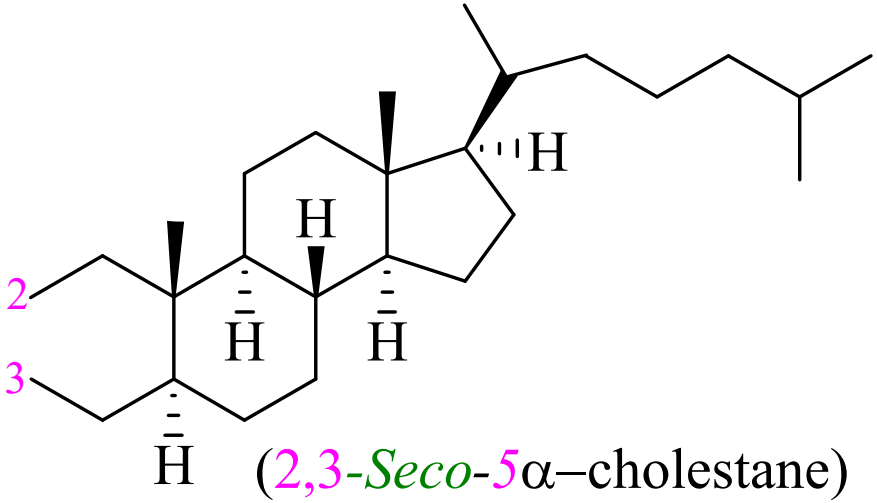
(4-*nor*-5α-androstane)



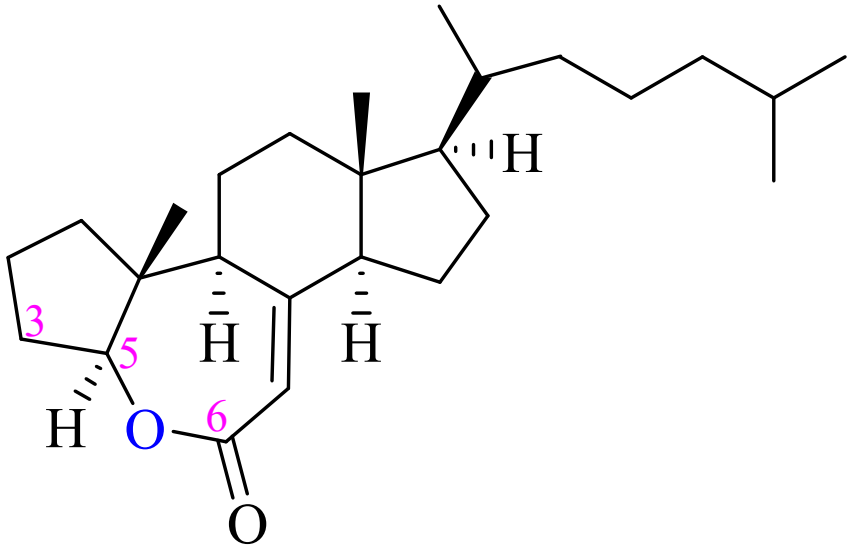
(4a-*homo*-7-*nor*-5α-androstane)



(*Des-A*-androstane)

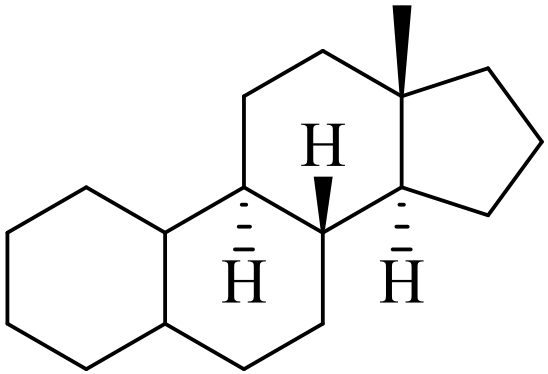


(2,3-*Seco*-5α–cholestane)

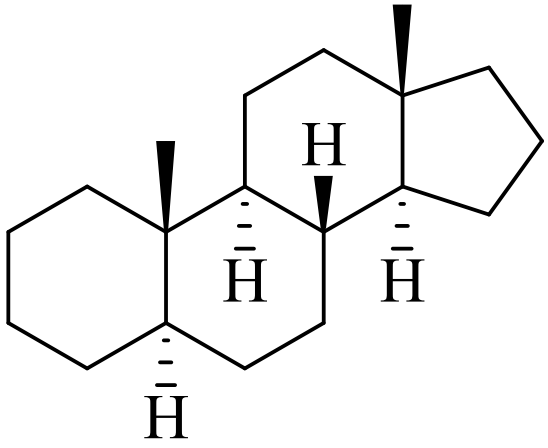


(5a-*Homo*-4-*nor*-5a-oxa-5α–cholest-7-en-6-one)

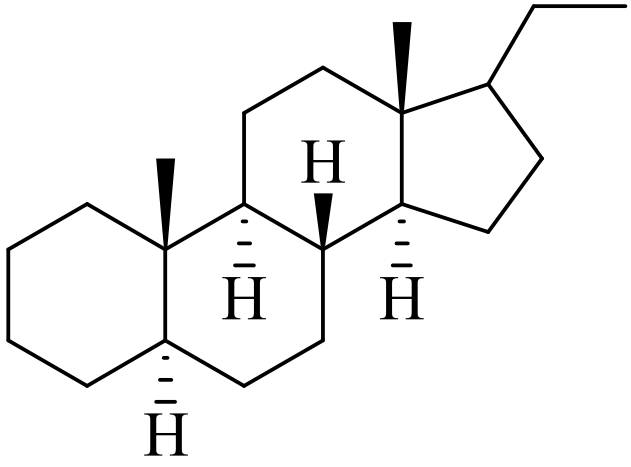
Nomenclature



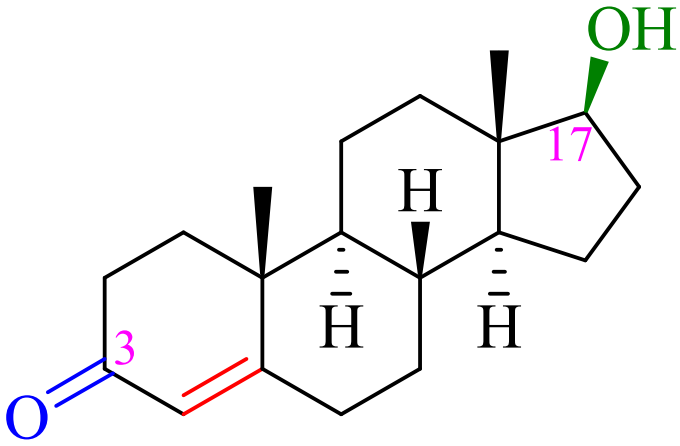
1 Estrane



2 Androstane



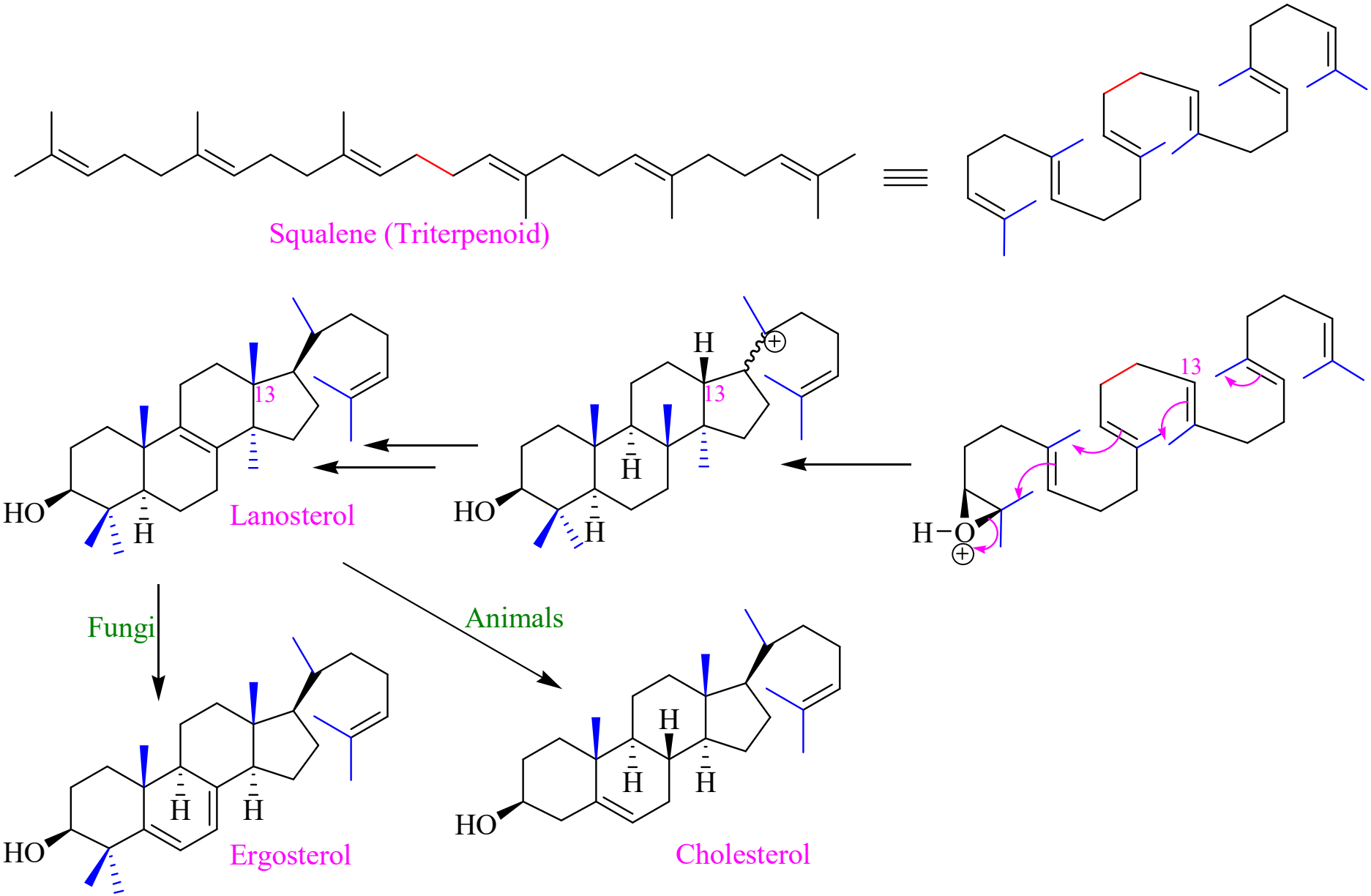
3 Pregnane



4 Testosterone (17β-Hydroxyandrost-4-en-3-one)

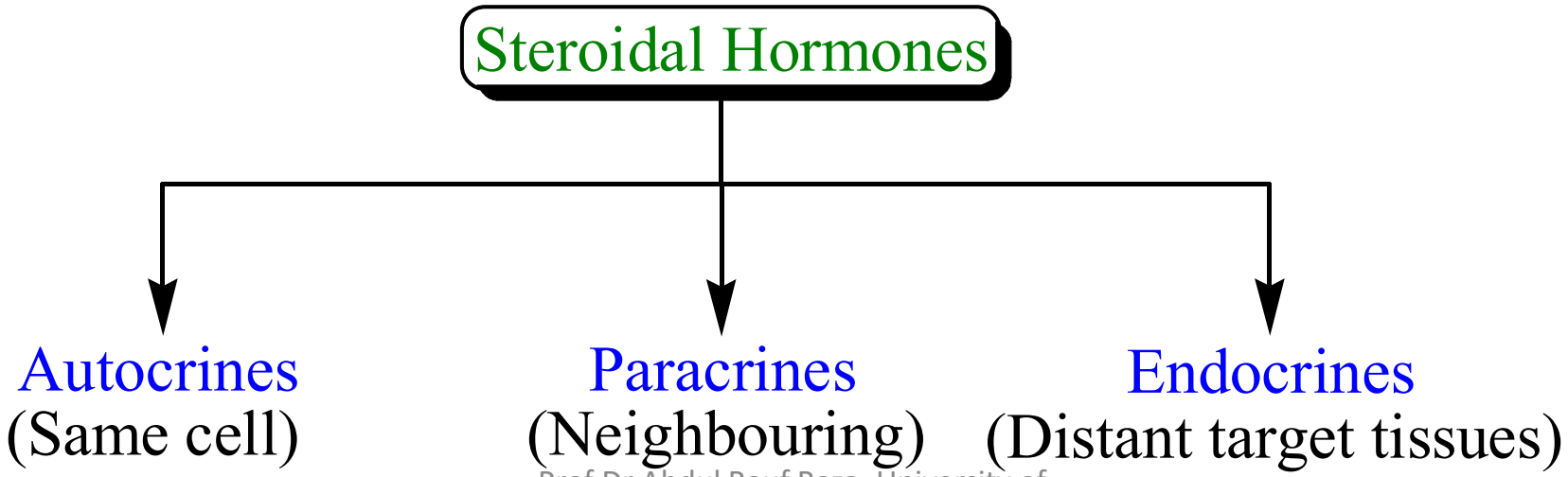
Ring contraction	= *nor*
Ring expansion	= *homo*
Ring fission	= *seco*
Whole ring removal	= *des*

Biosynthesis of Steroids

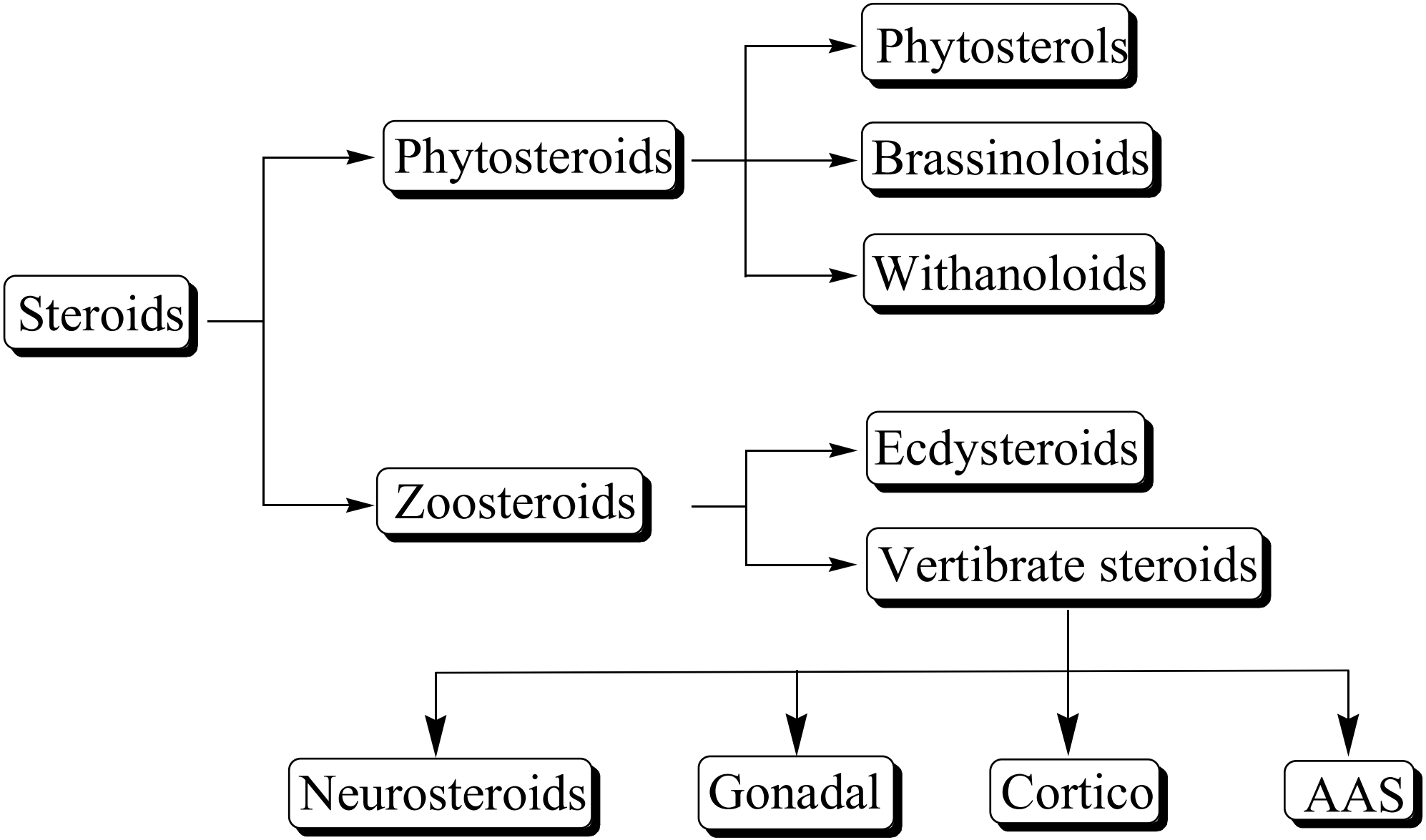


Basis of Classification of Steroids

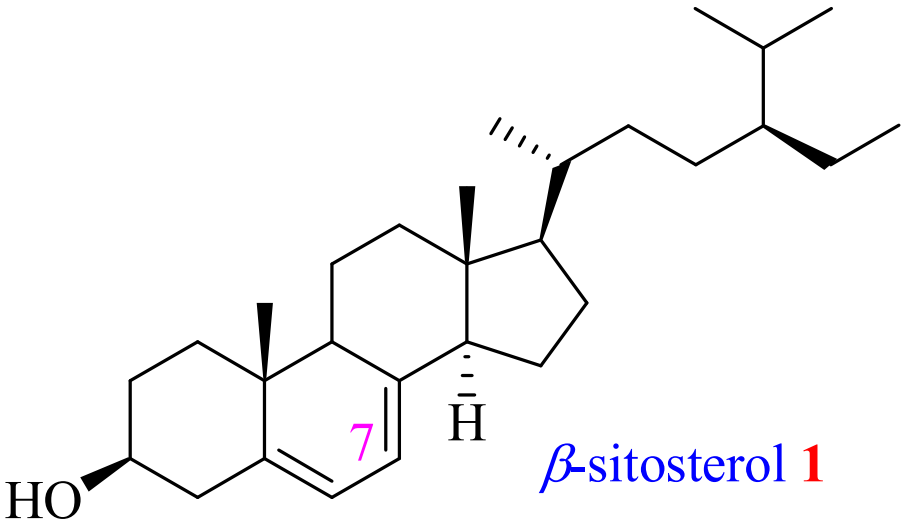
- Chemical Structure (Side chain at C-17, C=C etc.)
- Biological Function (Glucocorticoids, genital steroids etc.)
- Molecular Action (Estrogen-receptor agonist)
- Source of Organism (Fungal, microorganism, plants)
- Site of Production (Adrenal cortex, CNS, gonads)



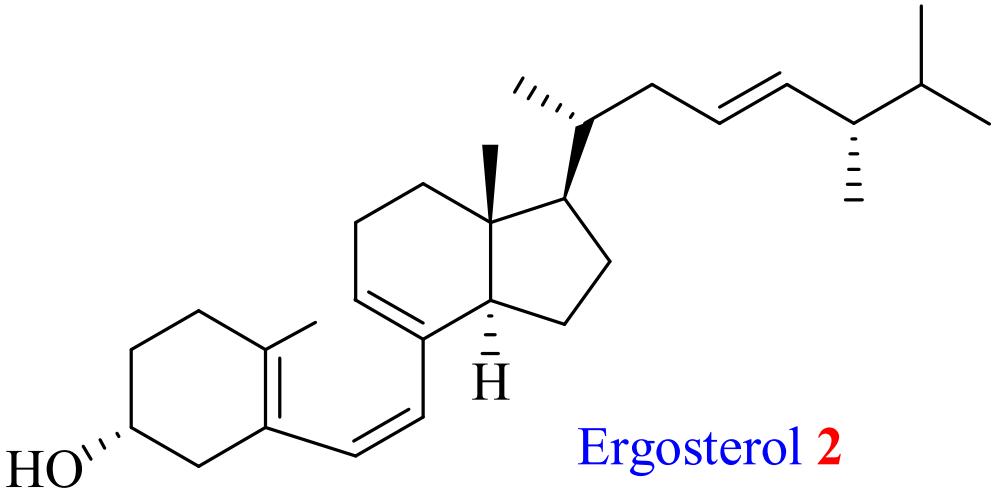
Classification of Steroids



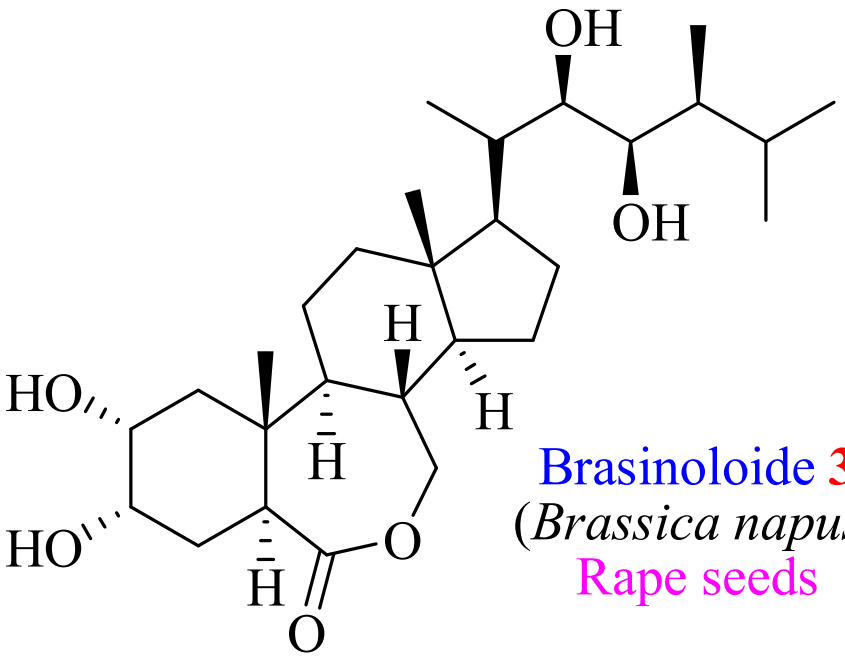
Phytosteroids



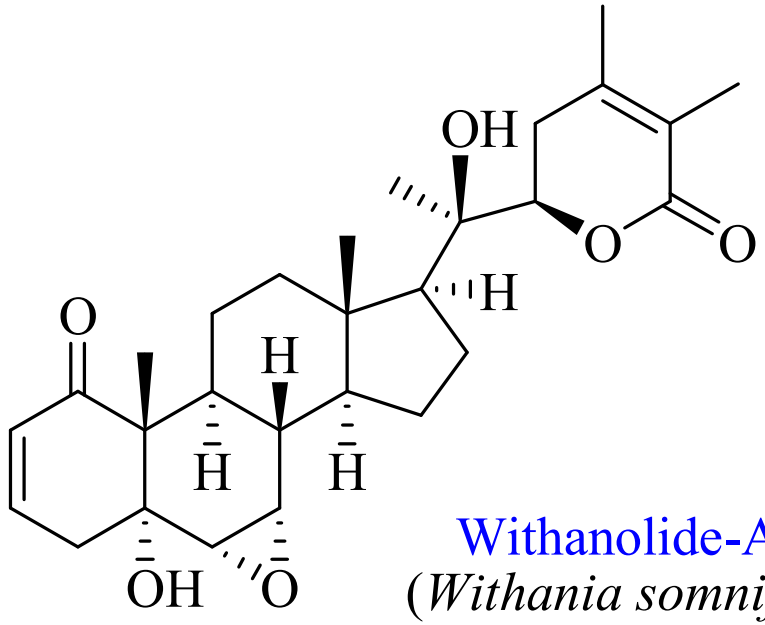
β-sitosterol **1**



Ergosterol **2**

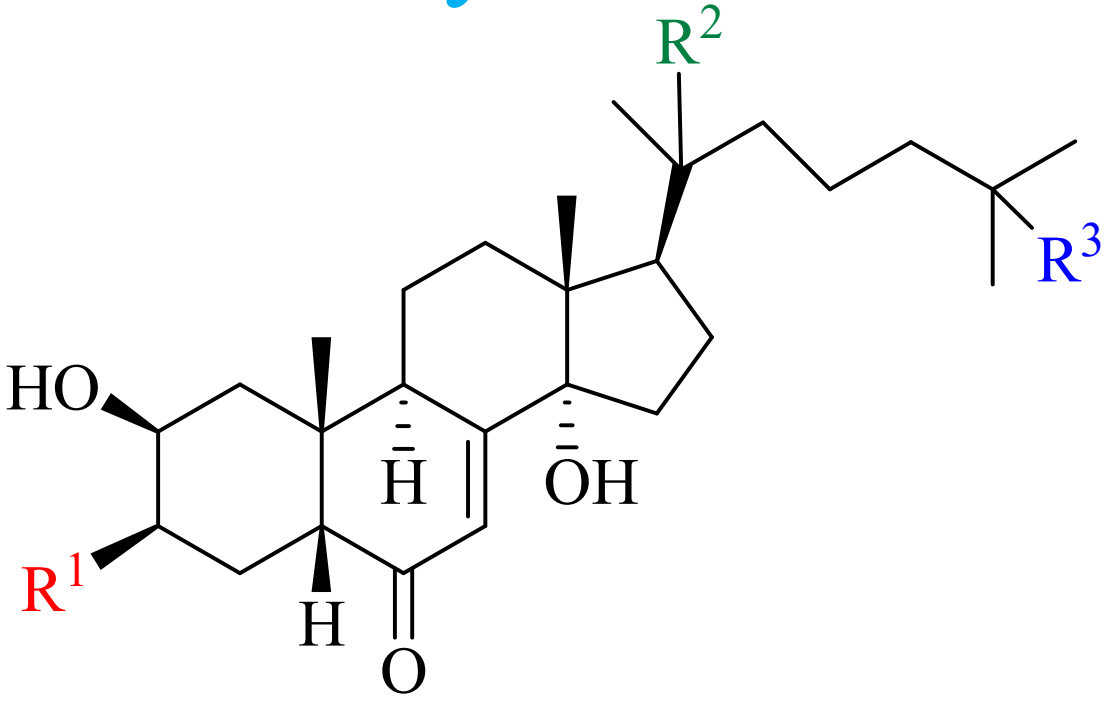


Brasinoloide **3**
(*Brassica napus*)
Rape seeds



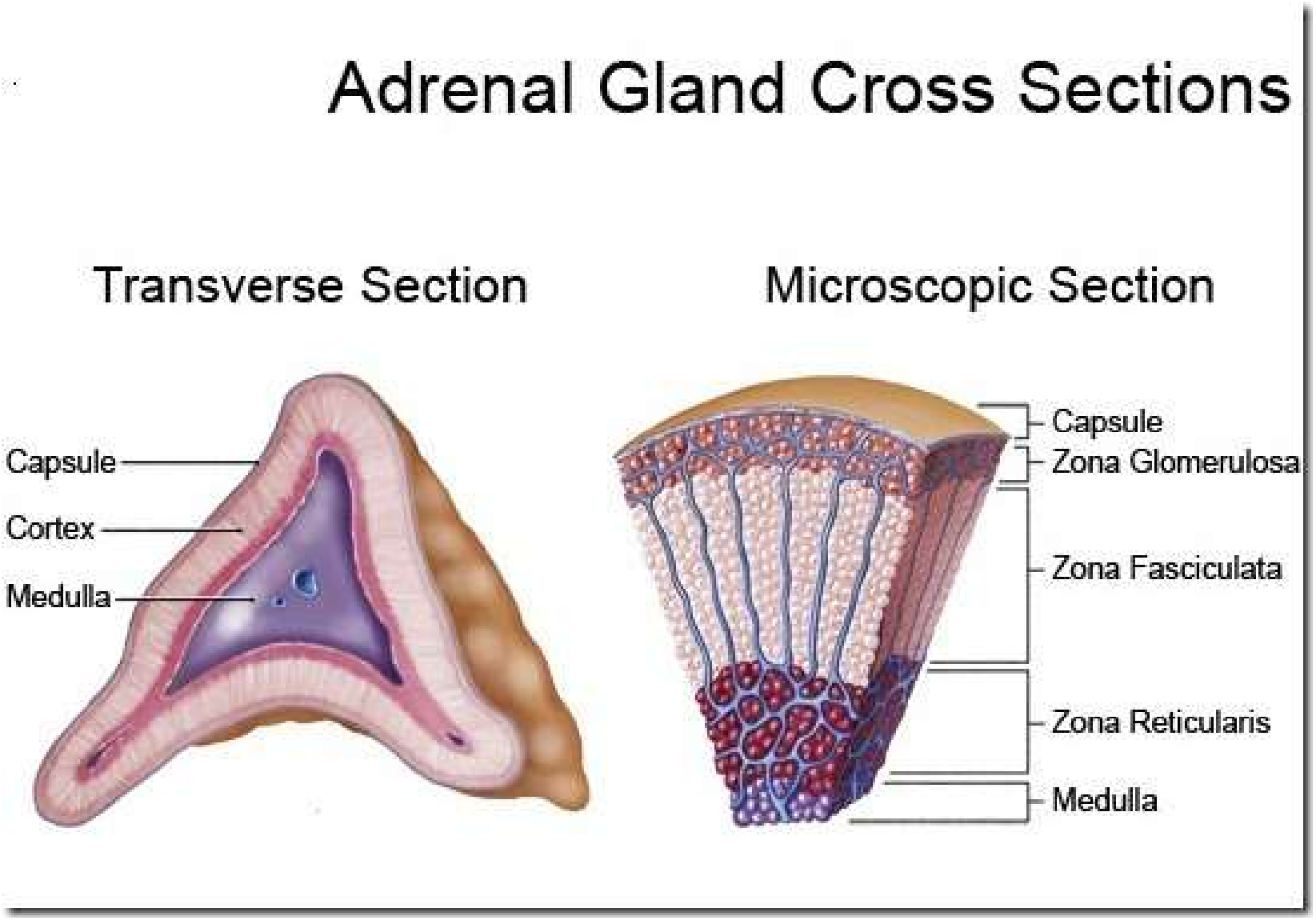
Withanolide-A **4**
(*Withania somnifera*)

Ecdysteroids

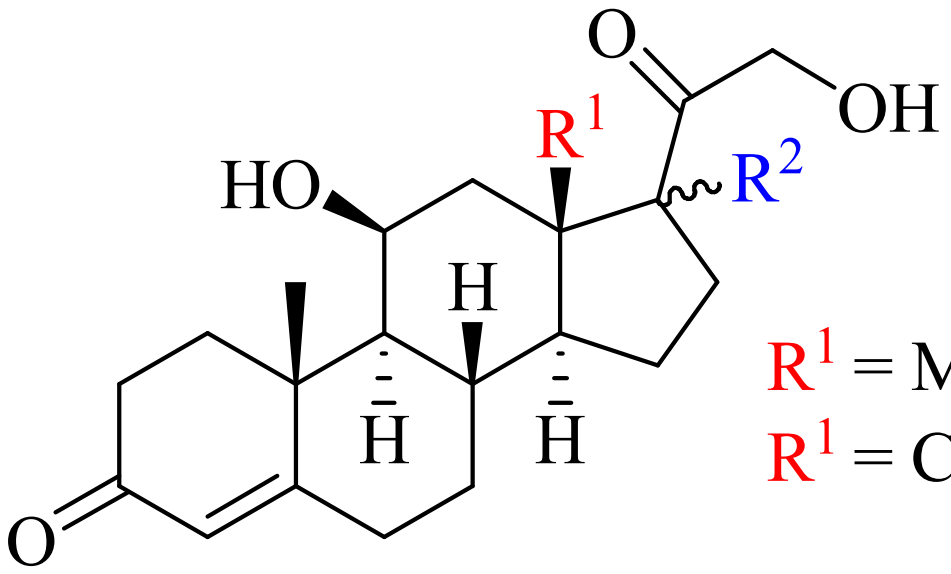


R^1	R^2	R^3	*Ecdysteroid*
OH	H	H	25-Deoxyecdysteroid
OH	H	OH	Ecdysone
OH	OH	H	Ponasterone-A
OH	OH	OH	20-Hydroxyecdysone
=O	H	OH	3-dehydroecdysone

Vertebrate Steroids (Cortecocoids)



Mineralocortecoids



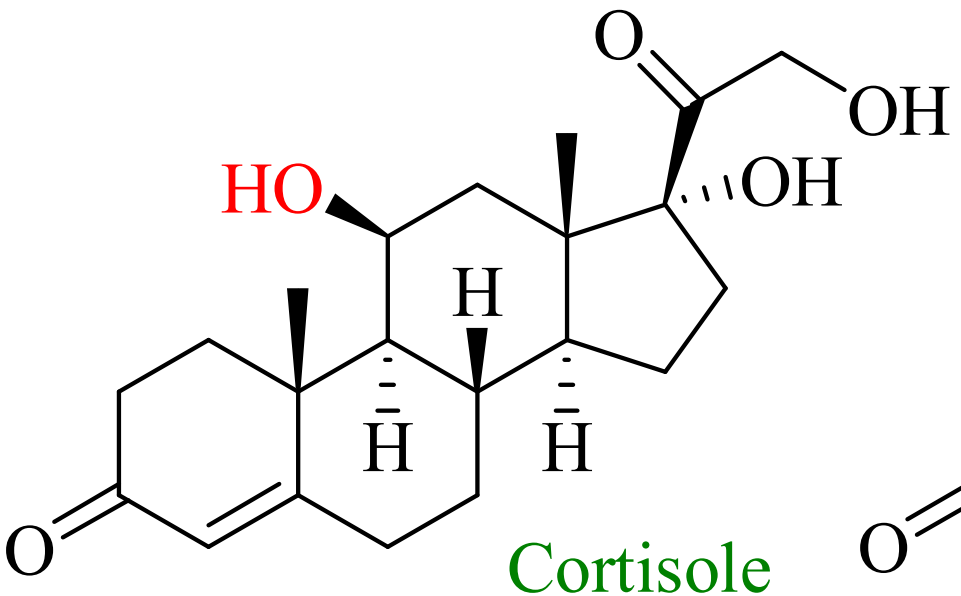
R^1 = Me, R^2 = β-OH (Cortisole)

R^1 = CHO, R^2 = H (Aldosterone)

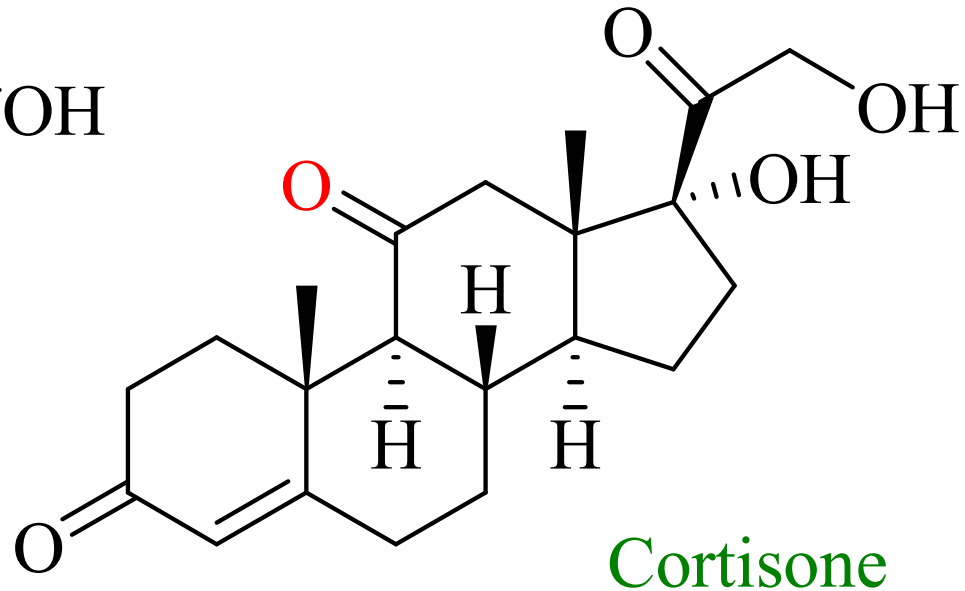
(Mineral + cortex + steroid)

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 Na^+ conservation in the kidney, salivary glands, sweat glands and colon. It plays a central role in the homeostatic regulation of blood pressure, plasma Na^+ and K^+ levels.

Glucocortecoids



Cortisole

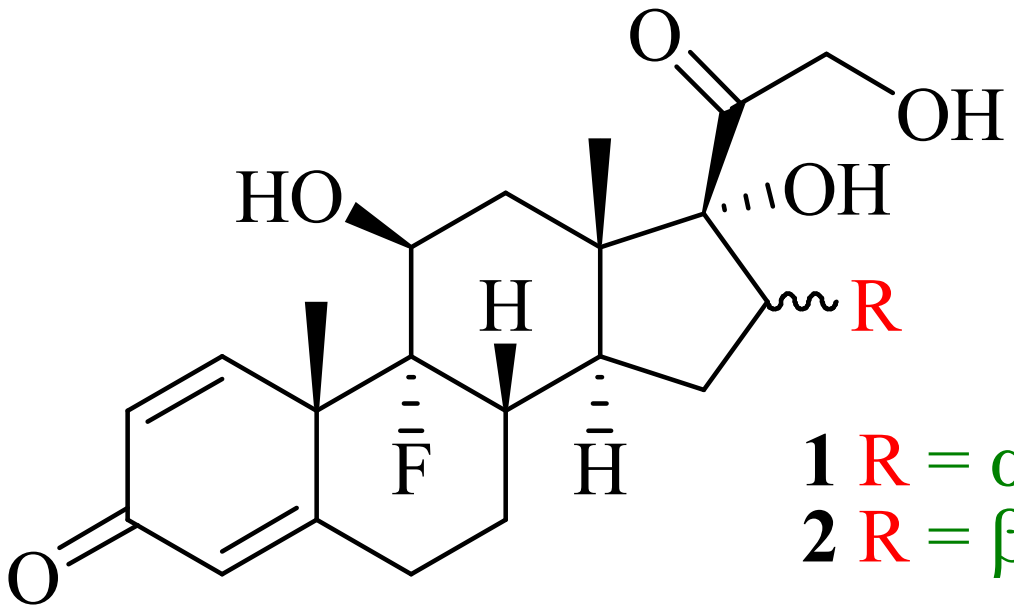


Cortisone

(**Gluco**se + **cort**ex + ster**oid**)

Cortisone, 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.

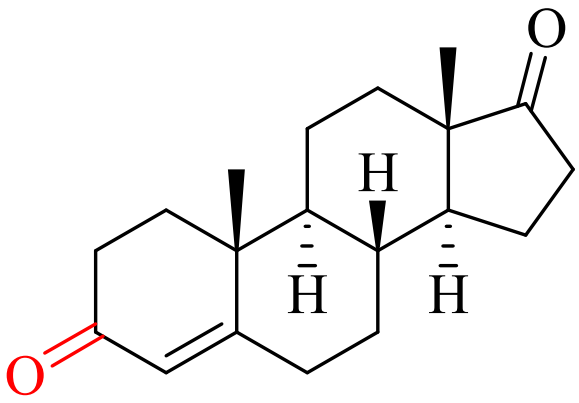
Synthetic Glucocortecoids



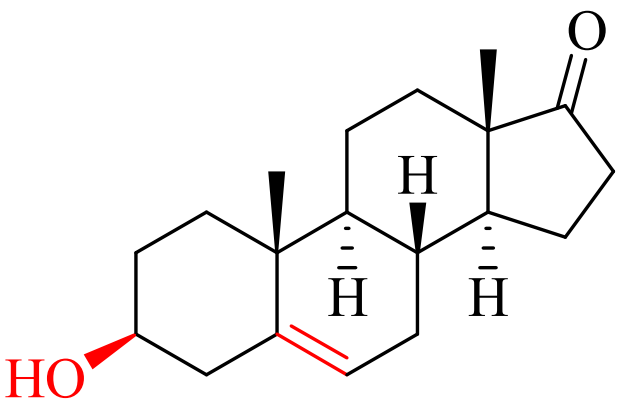
1 R = α-Me, Dexamethasone
2 R = β-Me, Betamethasone

Dexamethasone **1** is anti-inflammatorial (arthritis) and immunodepressant. Betamethasone **2** an anti-inflammatorial agaist allergy caused due to itching.

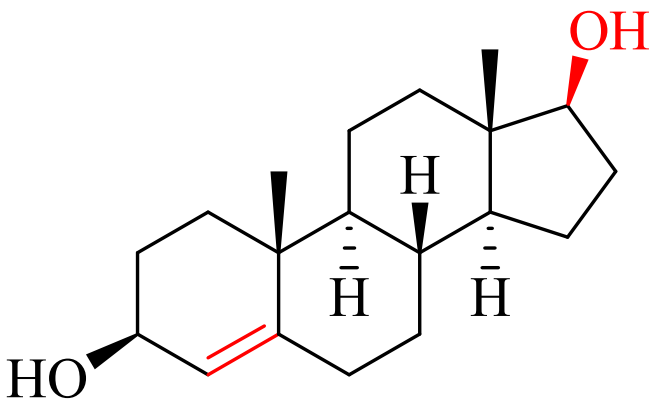
Anabolic Androgenic Steroids (AAS)



Androstendione



Dehydroepiandrostenane

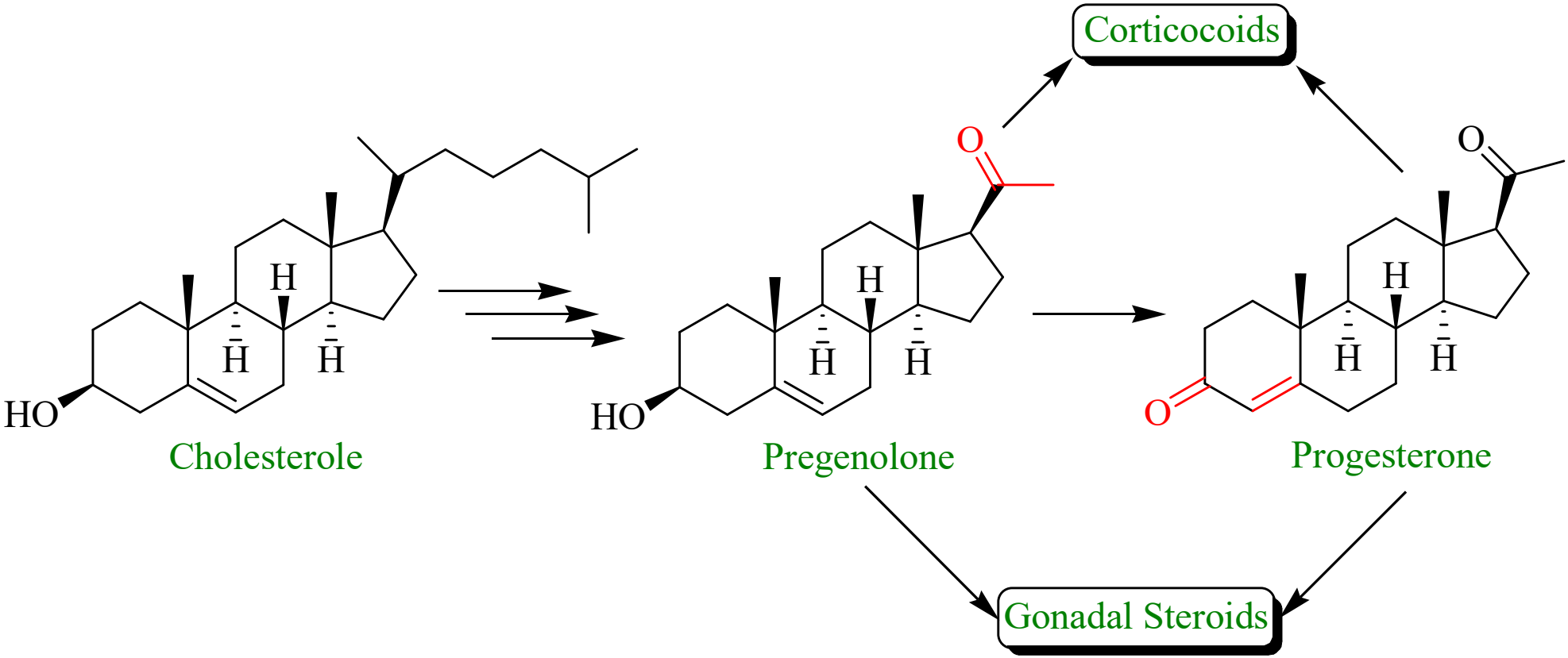


4-Adrostenediol

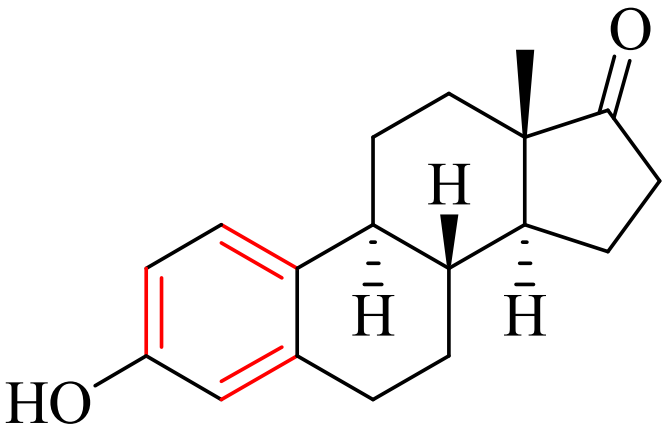
(Anabole = to build up; Andros = man; Genein = to produce)

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 stimulates the protein synthesis within cells that results in the building up of cellular tissues, especially skeletal muscles.

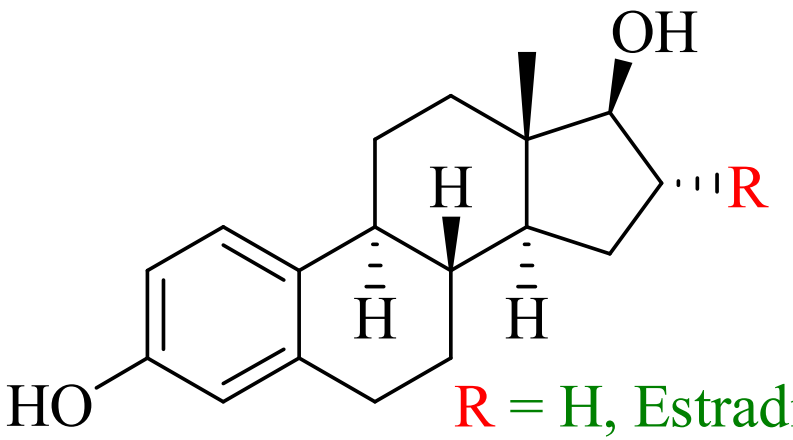
Gonadal (Sex) Steroids



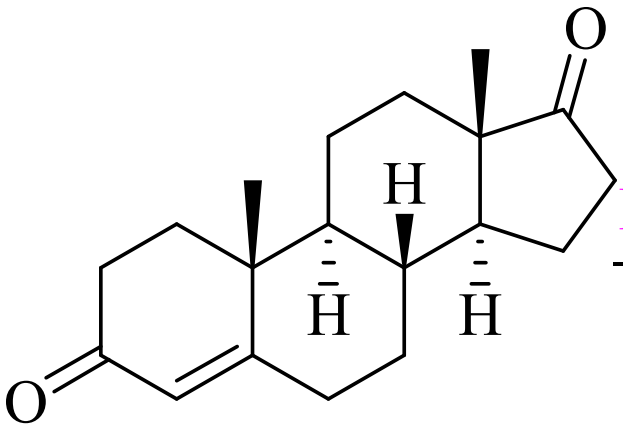
Estrogens



Estrone **1**

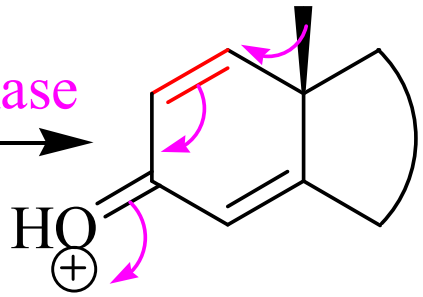


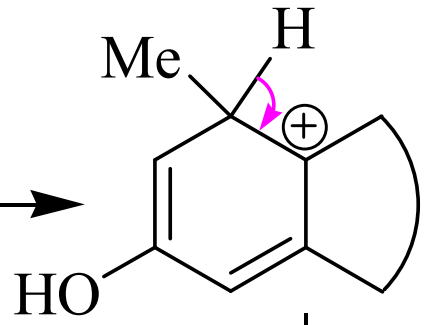
R = H, Estradiol **2**
R = OH, Estriol **3**



Testosterone

Dehydrogenase





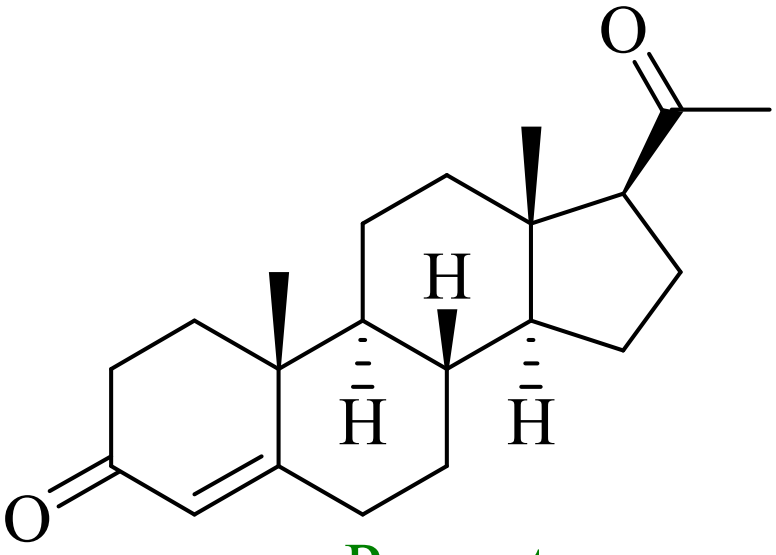
Oxidase & decarboxylase

Estrone **1**

Estrogens

- Produced by ovaries, corpus luteum or placenta
- Some are produced by liver or adrenal cortex
- Promotes the 2^{o}-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)

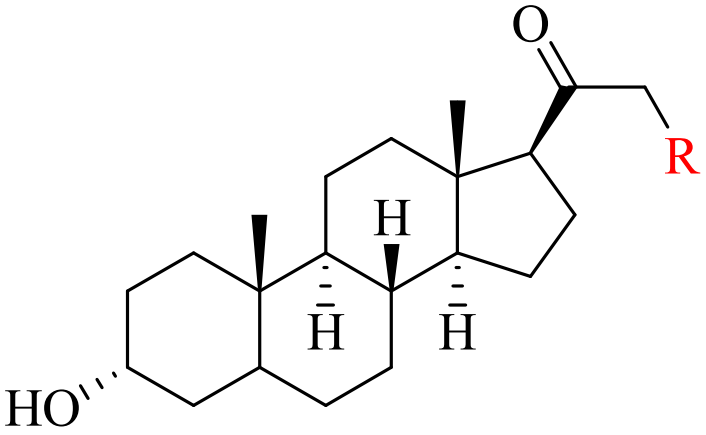
Progesterones



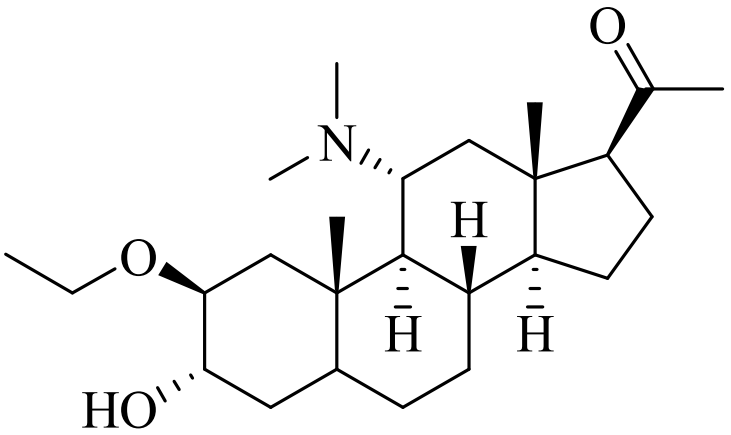
Progesterone

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

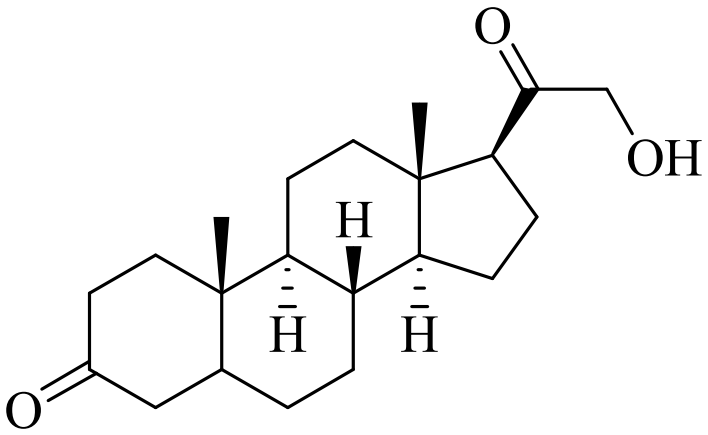
Neurosteroids



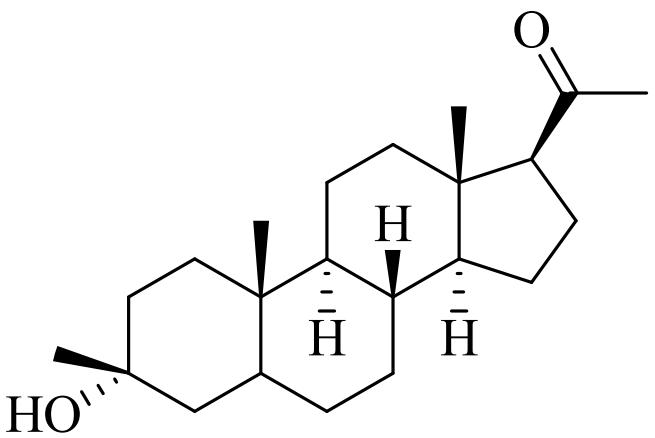
1 R = H, Alphaxolone
2 R = OH, Alphadolone



3 Minaxolone



4 3-Dehydrodione



5 Genaxolone

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