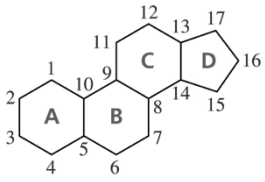
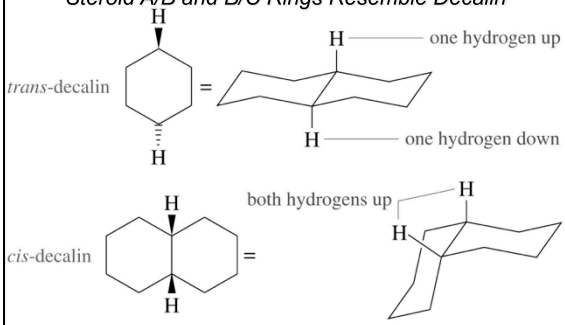
Steroids

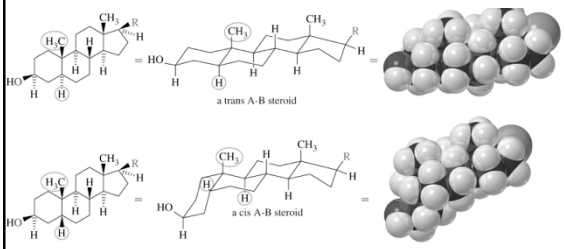
Steroids



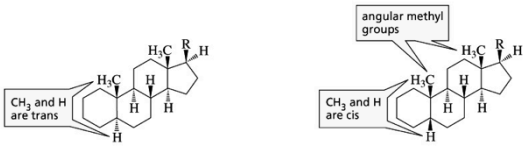
the steroid ring system

Steroid A/B and B/C Rings Resemble Decalin





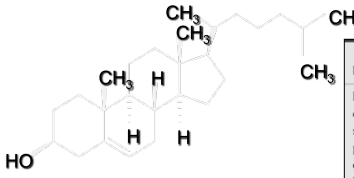
Steroid B/ C, and C/D rings are trans fused



Methyl groups at C-10 and C-13 are “angular” methyl groups

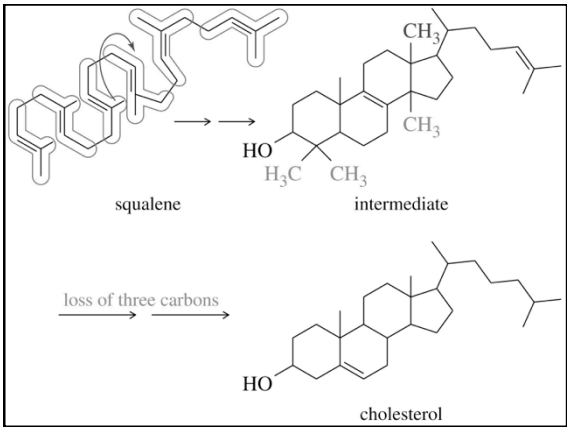
Cholesterol

Structure of Cholesterol

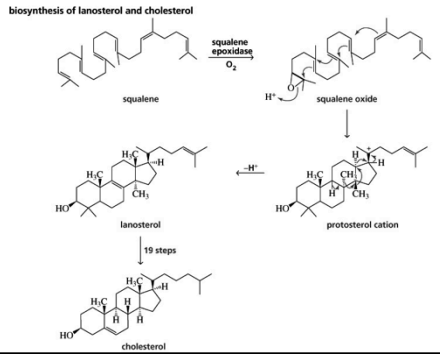


Cholesterol has the fundamental steroid skeleton modified as shown.

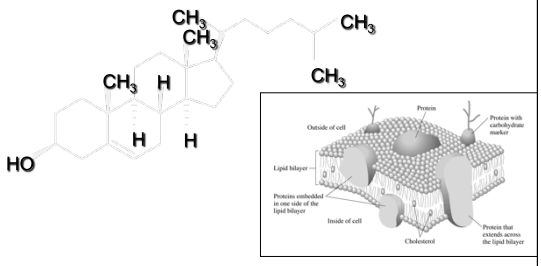
Food	Cholesterol (mg)
liver (3 oz)	410
egg (1 large)	213
shrimp (3 oz)	166
pork chop (3 oz)	83
chicken (3 oz)	75
beef steak (3 oz)	70
fish fillet (3 oz)	54
whole milk (1 cup)	33
cheddar cheese (1 oz)	30
Swiss cheese (1 oz)	26
low-fat milk (1 cup)	22



Biosynthesis of Cholesterol

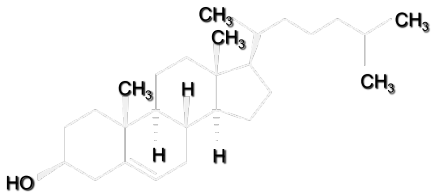


Cholesterol



Vitamin D

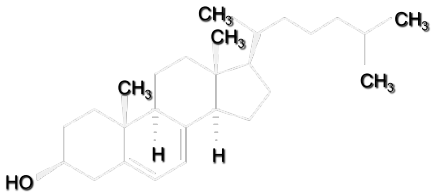
Cholesterol



Cholesterol is the precursor to vitamin D.

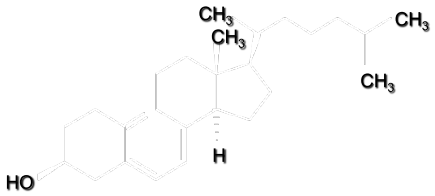
Enzymes dehydrogenate cholesterol to introduce a second double bond in conjugation with the existing one. The product of this reaction is called 7-dehydrocholesterol.

7-Dehydrocholesterol



Sunlight converts 7-dehydrocholesterol on the skin's surface to vitamin D_3.

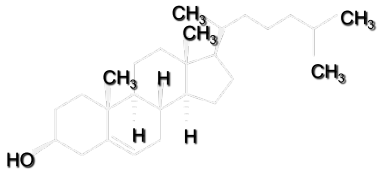
Vitamin D_3



Insufficient sunlight can lead to a deficiency of vitamin D_3, interfering with Ca^{2+} transport and bone development. Rickets can result.

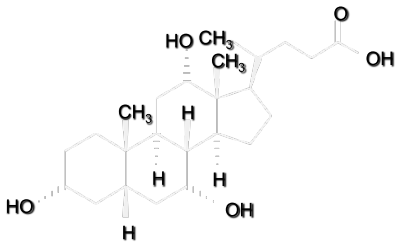
Bile Acids

Cholesterol



Oxidation in the liver degrades the cholesterol side chain. Cholic acid is the most abundant of the bile acids.

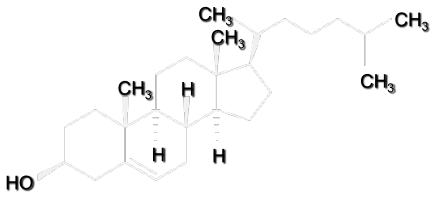
Cholic Acid



Salts of cholic acid amides (*bile salts*) act as emulsifying agents to aid digestion.

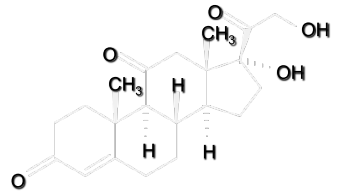
Corticosteroids

Cholesterol



Enzymatic degradation of the side chain and oxidation of various positions on the steroid skeleton convert cholesterol to *corticosteroids*.

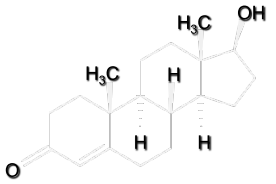
Cortisone



Corticosteroids are involved in maintaining electrolyte levels, in the metabolism of carbohydrates, and in mediating the allergic response.

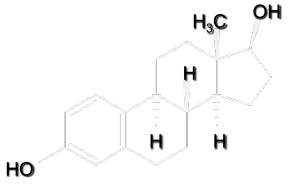
Sex Hormones

Testosterone



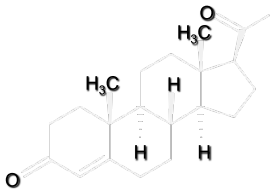
Testosterone is the main male sex hormone.

Estradiol



Estradiol is a female sex hormone involved in regulating the menstrual cycle and in reproduction.

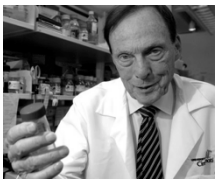
Progesterone

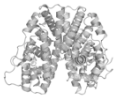


Supresses ovulation during pregnancy.

FDA registers Enovid May 11, 1960
an estrogen and a progestin

Elwood V. Jensen (1920-2012)
Estrogen & Breast Cancer





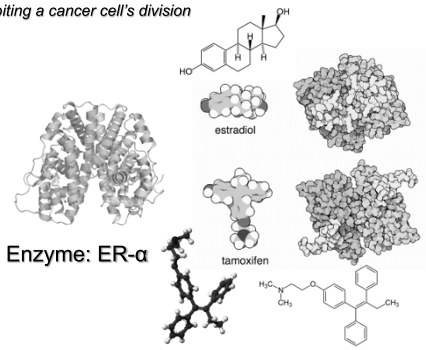
Enzyme: ER-α

Using radiolabeled markers, Dr. Jensen discovered that estrogen (steroid based hormones) bind to a specific receptor protein, ER, in about 30% of breast cancer cells. In those cancers that are ER positive, inhibition of estrogen stops cell growth.

What type of enzyme inhibition could best stop the multiplication of breast cancer cells?

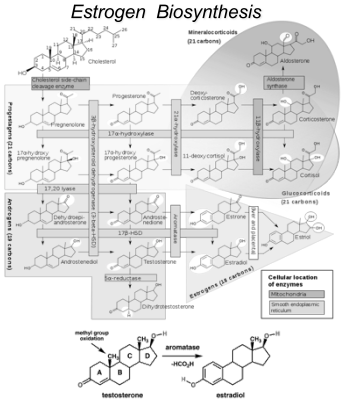
Enzyme Inhibition: Estrogen & Breast Cancer

Inhibiting a cancer cell's division

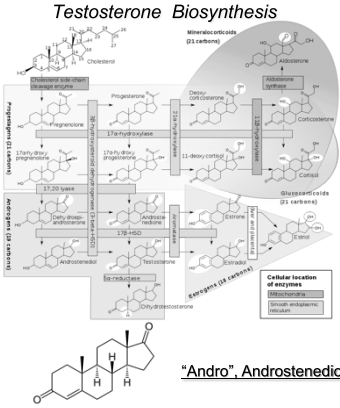


Enzyme: ER-α

Estrogen Biosynthesis



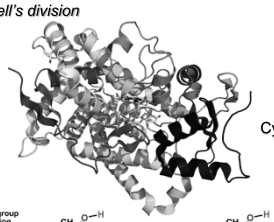
Testosterone Biosynthesis



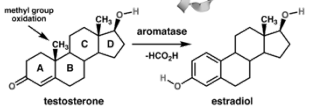
"Andro", Androstenedione*

Enzyme Inhibition: Estrogen & Breast Cancer

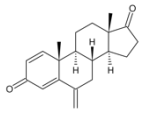
Inhibiting a cancer cell's division



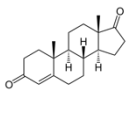
Cytochrome p450



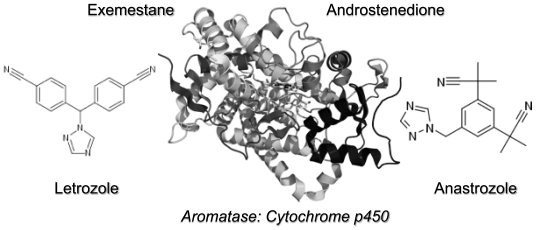
Enzyme Inhibition



Exemestane



Androstenedione

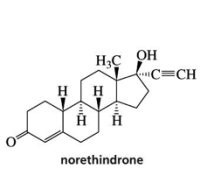


Letrozole

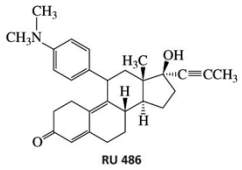
Anastrozole

Aromatase: Cytochrome p450

Synthetic Steroids



norethindrone

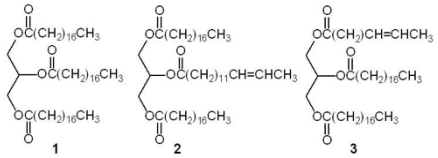


RU 486

Recognizing Lipids: Structural Differences

Question

Which of the triglycerides below is optically active?



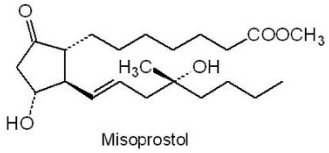
1 2 3

A) 1 and 3 B) 2 and 3 E) none

C) 3 only D) 1, 2, and 3

Question

Misoprostol is classified as a



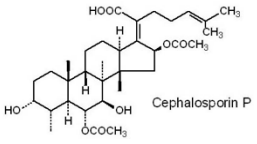
Misoprostol

A) terpene. B) wax.

C) steroid. D) prostaglandin.

Question

The backbone of cephalosporin P is classified as a



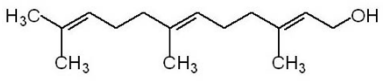
Cephalosporin P

A) prostaglandin. B) steroid.

C) cholesterol. D) sesterpene.

Question

Farnesol is classified as a



Farnesol

A) monoterpene.

B) sesquiterpene.

C) diterpene.

D) triterpene.