# Steroid Hormones

A) 21 or fewer carbon atoms

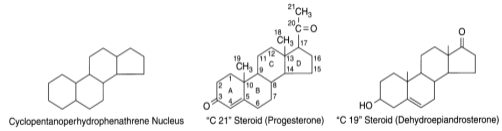
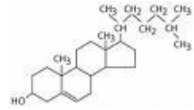



**Figure 15.4** Steroid hormone structure and nomenclature.

B) Precursor is 27 carbon cholesterol



C) major classes of steroid hormones

1) Progestagens
   a) progesterone- prepares lining of the uterus for implantation of an ovum
   b) site of synthesis: corpus luteum
      - maintenance of pregnancy

2) Glucocorticoids
   a) cortisol-promote gluconenogenesis /formation of glycogen
      -degradation of fat & protein
   b) site of synthesis: adrenal cortex

3) mineralocorticoids
   a) aldosterone-increase kidney reabsorption of $Na^+$, $Cl^-$ & $HCO_3$
      - increase blood volume & blood pressure
   b) site of synthesis: adrenal cortex

4) androgens
   a) testosterone: development of male secondary sex characteristics
   b) site of synthesis: testes

5) estrogens
   a) estradiol-development of female secondary sex characteristics
   b) site of synthesis: ovary

## STEROIDOGENESIS

Hydroxylation (OH) reactions
require: NADPH and $O_2$
O for the OH group
comes from $O_2$ and not from $H_2O$

*RH +* ***$O_2$ + NADPH + H+ ------> ROH + $H_2O$ + NADP+***

Cytochrome $P_{450}$ terminal; component of an electron-transport chain
NADPH transfers its high-potential e- to a flavoprotein

adrenodoxin (nonheme iron protein) → e- oxidized form of cytochrome $P_{450}$
reduced form of $P_{450}$ activates $O_2$

1) Adrenocorticotrophic hormone (ACTH)
polypeptide from anterior pituitary gland stimulates
conversion of cholesterol → pregnenolone (precursor to all steroid hormones)
2) cholesterol 6-carbon side chain broken off at $C_{20}$
3) inner membrane of mitochrondrial cristae →
mixed-function oxygenases enzymes (cytochrome $P_{450s}$)
4) Side-chain cleavage (scc) of cholesterol by $P_{450scc}$
requires reducing factor (NADPH) →pregnenolone ($C_{21}$)
5) Pregnenolone transported out of mitochrondria →
endoplasmic reticulum

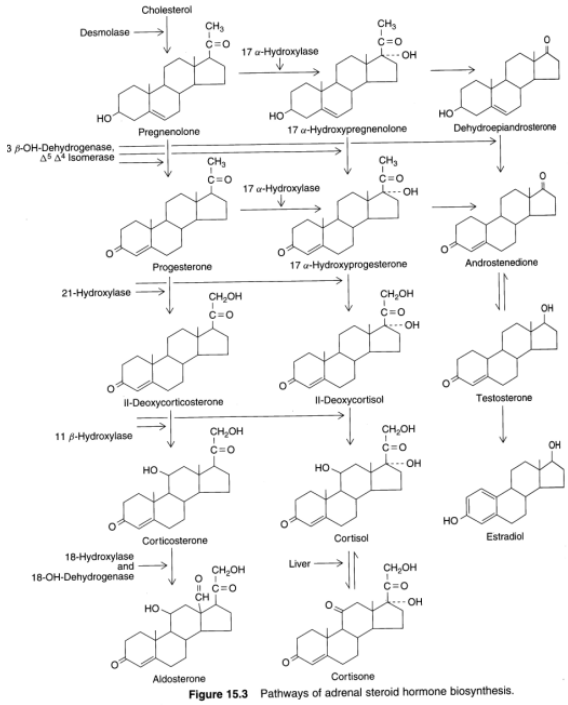
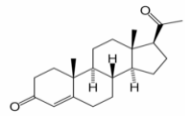


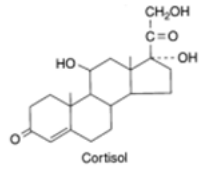

**Figure 15.3** Pathways of adrenal steroid hormone biosynthesis.

**Progesterone ($C_{21}H_{30}O_2$) from pregnenolone synthesized two ste**



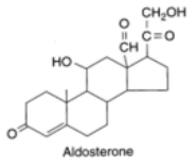
1) 3-hydroxyl group oxidized to 3-keto group
2) 5-double bond is isomerized to 4 double bond

**Cortisol ($C_{21}H_{28}O_5$) from progesterone**



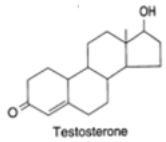

1) hydroxylations at $C_{17}$ before $C_{21}$, whereas $C_{11}$at any step
2) hydroxylating enzymes: high specific →
   inherited disorders of steroid metabolism

**Aldosterone ($C_{21}H_{28}O_5$ )from progesterone**



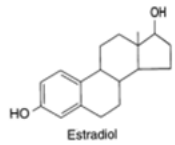

1) hydroxylation at $C_{21}$
2) hydroxylation at $C_{11}$
3) $C_{18}$ angular methyl group oxidized to aldehyde

**Testosterone ($C_{19}H_{28}O_2$ androgen) from progesterone**




1) hydroxylation at $C_{17}$
2) $C_{20}$ & $C_{21}$ cleaved to yield androstenedione
3) 19 carbons

**Estradiol ($C_{18}H_{24}O_2$ estrogen) from androgens**




1) loss of $C_{19}$ angular methyl group
2) formation of an aromatic A ring require NADPH & $O_2$
3) 18 carbons

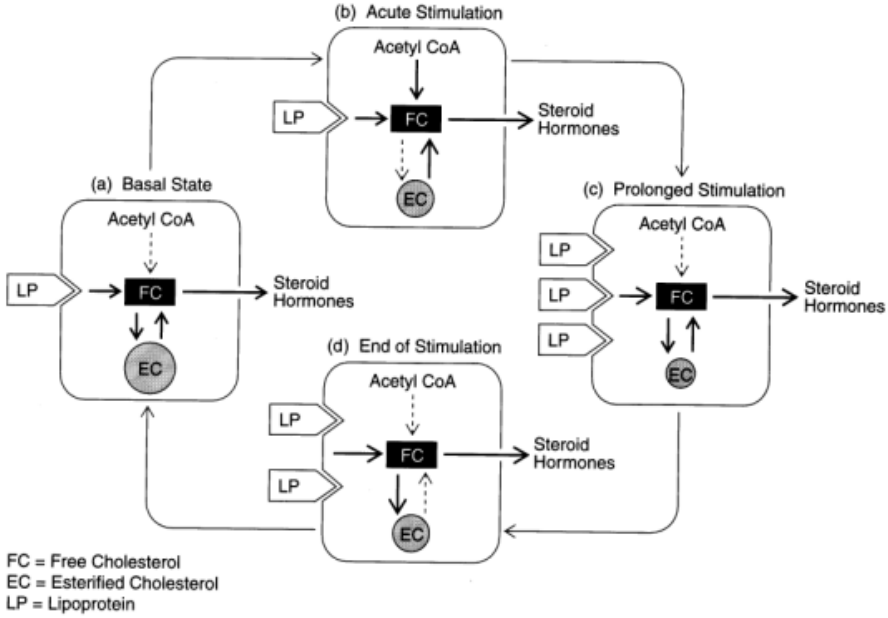



**Figure 15.5** Model for cholesterol homeostasis in the adrenal. (From Brown, Kovanen, and Goldstein [4], with permission.)