Steroid Hormones are Derivatives of Cholesterol

Harper’s Illustrated Biochem Ch 41
Stryer Biochemistry Ch 15

Classes of steroid hormones

<table>
<thead>
<tr>
<th>Class</th>
<th>Functions</th>
<th></th>
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</thead>
<tbody>
<tr>
<td>Progestagens</td>
<td>21 prepares the lining of the uterus for implantation of an ovum,</td>
<td>corpus luteum</td>
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<td></td>
<td>maintenance of pregnancy.</td>
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<tr>
<td>Glucocorticoids</td>
<td>21 ↑ gluconeogenesis, formation of glycogen,</td>
<td>adrenal cortex</td>
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<td></td>
<td>↑ degradation of fat, protein,</td>
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<tr>
<td>Mineralocorticoids</td>
<td>21 ↑ reabsorption of Na+ the excretion of K+ and H+,</td>
<td>adrenal cortex</td>
<td></td>
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<tr>
<td>Androgens</td>
<td>19 male secondary sex characteristics</td>
<td>testes</td>
<td></td>
</tr>
<tr>
<td>Estrogens</td>
<td>18 development of female secondary sex characteristics</td>
<td>ovaries</td>
<td></td>
</tr>
</tbody>
</table>
Nomenclature of Steroid Hormones

Steroid Nucleus

Nomenclature of Steroid Hormones
Pregnanate Group (C21)

Estrane Group (C18)
Androstane Group (C19)

Cholesterol (C27)
Pregnenolone (C21)
Progestagens (C21)

Glucocorticoids (C21)
Mineralocorticoids (C21)
Androgens (C19)
Estrogens (C18)
Steroids are Hydroxylated by Cytochrome P450 Monooxygenases

\[ \text{RH} + \text{O}_2 \rightarrow \text{ROH} \]

- Important role in the synthesis of cholesterol
- Conversion of cholesterol into steroid hormones and bile salts
- *monooxygenases (mixed-function oxygenases).*
- Require NADPH and O₂.
- Activation of oxygen atom.

\[ \text{RH} + \text{O}_2 + \text{NADPH} \rightarrow \text{ROH} + \text{NADP}^+ + \text{H}_2\text{O} \]
Pregnenolone: a Precursor for many other steroids, is formed from Cholesterol by cleavage of its side chain.

![Chemical Diagram]

Three molecules of NADPH and three molecules of O2 are consumed in this remarkable six-electron oxidation.
Cortisol, is synthesized from progesterone by hydroxylations at C-17, C-21, and C-11; C-17 must be hydroxylated before C-21 is, C-11 can be hydroxylated at any stage.
Aldosterone Synthesis

hydroxylation of progesterone at C-21
then C-11

Oxidation of C-18 methyl group to an aldehyde
Synthesis of Androgens from Pregnenolone and progesterone

- Hydroxylation at C-17
- Cleavage of C20 – C21
- Reduction of the 17-keto group
Testosterone

Androstenediol

Testosterone

Estrogens Synthesis from Androgens by:
- Loss of the C-19 angular methyl group
- Formation of an aromatic A ring