Interaction of Hormones at Target Cells

1) **Permissiveness** – one hormone cannot exert its effects without another hormone being present

2) **Synergism** – more than one hormone produces same effects on a target cell

3) **Antagonism** – one or more hormones opposes action of another hormone

Hormone Interactions

Synergism & Antagonism:
- multiple synergistic stimuli more than additive
- insulin opposes glucagon

*Is insulin a competitive inhibitor of glucagon?*

Permissiveness:
- need 2nd hormone to get full expression
- *e.g.* reproductive development
Adrenal Androgens

Source: zona recticularis
physiological role??
very low titers compared to gonadal production
females: contribute to pubertal changes:
adrenarche
   presence of pubic hair < 8 years old
development of axillary (armpit) hair & adult axillary odor
premature production ↑dehydroepiandosterone (DHEA)
   ↑growth: advancing bone age & clitoral enlargement
   ↑incidence in African American females
benign condition that requires no treatment
   abnormal growth acceleration
development secondary traits

pregnancy: abnormal production due to tumor or steroidogenesis
morphogenetic consequences:
mammary carcinomas
cigarette smoking
dehydroepiandosterone (DHEA)
antiestrogenic effect
breast cancer/endometrial cancer risks
cardiovascular disease & osteoporosis

postmenopausal:
subrate for extragonadal estrogen production

males: contribute prepurberatal changes
1) adrenarche
   pubic hair < 9 years old
   penal enlargement
2) prostate carcinomas
Common Inherited Disorders of Steroid Hormone Metabolism

↓ 21-hydroxylase enzyme: synthesis of glucocorticoids/mineralocorticoids

↓ glucocorticoids → ↑ ACTH anterior pituitary gland
normal feedback mechanism

↑ adrenal glands enlarge:
  ↑ pregnenolone synthesis
  ↑ progesterone
  ↑ 17α-Hydroxyprogesterone
  ↑ androgens

Figure 15.3 Pathways of adrenal steroid hormone biosynthesis.
A) Effects of high levels of androgens

1) Development of female fetus →
   masculinization of external genitalia

2) Development of male fetus
   a) sexual organs normal at birth
   b) sexual precocity apparent several months later
   c) growth & early bone maturations →
      short stature

3) 50% with 21-Hydroxylase deficiency lose Na⁺ in urine

4) ↓ titers aldosterone (mineralocorticoid)
   loss of salts → dehydration & hypotension

5) Therapy
   a) administration of glucocorticoid hormone: ↓ ACTH secretion
   b) mineralocorticoid for those who lose salts
   c) symptoms reversed: therapy started within first 2 years after birth
B) Congenital adrenal hyperplasia (inherited disease)
1) affect enzymes required for steroidogenesis
   11β-Hydroxylase virilization*
   17α-Hydroxylase
   3β-OH-Dehydrogenase
   Desmolase
2) all above enzymes deficiency → enlargement of adrenal gland

*development of exaggerated masculine characteristics, usually in women, often as a result of adrenal glands overproducing androgens