Endocrine Systems

The Human Endocrine System

A. Endocrine Glands
   1. Secrete hormones directly into the bloodstream
      a. pineal gland     hypothalamus     pituitary gland
      thyroid gland      parathyroid gland  thymus gland
      adrenal glands     pancreas         ovaries
      testes

B. Target Organs
   1. Organs at which hormones have their effects
      a. Hormones bind at receptors on or inside target cells

Second Messengers

A. Function
   1. Carries message from the plasma membrane to the interior of the cell

B. Examples of Second Messengers
   1. cAMP - cyclic adenosine monophosphate
   2. cGMP - cyclic guanosine monophosphate
   3. Ca^{2+} - calcium ions

Control of Hormonal Secretions

A. Feedback System
   1. The last step in a cycle affects the first step

B. Negative Feedback Systems
   1. Endocrine gland decreases its activity in response to an increased concentration of the substance it regulates
      a. Most common type of feedback

C. Positive Feedback Systems
   1. Endocrine gland increases its activity in response to an increase in concentration of the substance it regulates
      a. Rare type of feedback

Control of Blood Glucose

A. Islets of Langerhans
   1. Endocrine glands cells of the pancreas

B. Response to High Blood Glucose Level
   1. Pancreas secretes insulin
      a. Glucose is taken up by muscles and the liver
      b. Glucose is stored as glycogen

C. Response to Low Blood Glucose Level
   1. Pancreas secretes glucagon
      a. Glycogen is broken down to glucose
      b. Glucose is released into the bloodstream
Control of Blood Calcium
A. Parathyroid Glands
   1. Tiny glands located behind the thyroid glands
      a. Secretes parathyroid hormone (PTH)
B. Parathyroid Hormone
   1. Regulates the level of calcium in the blood
      a. Stimulates the release of calcium from bone
      b. Activates Vitamin D
         (1) Vitamin D increases absorption of calcium from the intestine
C. Calcitonin (a thyroid hormone)
   1. Regulates the level of calcium in the blood
      a. Stimulates the uptake of calcium by bones
      b. Inhibits absorption of calcium in the intestine

Other Glands and Hormones
A. Pineal Gland
   1. Secretes hormone melatonin
      a. Function is not known
      b. At lowest level after onset of puberty
         (1) Possible inhibitor of sexual development
   2. Regulates annual reproductive cycles in other animals
B. Thymus Gland
   1. Functions in the maturation of immune T cells
   2. Gland is larger in young children than in adults
C. Prostaglandins
   1. Hormones produced by most body tissues
      a. Blood vessel diameter
      b. Blood clotting
      c. Inflammation reactions
      d. Ovulation
      e. Uterine contractions during labor
D. Bradykinins
   1. Polypeptides secreted by various body organs
      a. Heat loss in skin
      b. Dissolving blood clots
      c. Countering effects of prostaglandins
The Hypothalamus and Pituitary

A. Hypothalamus
   1. Regulates many of the functions of the Pituitary gland
   2. Secretes several hormones, some of which are stored in the pituitary gland

B. Pituitary Gland
   1. Shape of a pea, 1.5 cm in diameter
   2. Attached to the underside of the hypothalamus

C. Hormones and their functions
   1. See table 23.1

Growth

A. Growth Hormone (GH)
   1. Regulates the rate of growth
      a. Increases protein synthesis
      b. Increases burning of fats and storage of carbohydrate

B. Regulation of GH
   1. Growth Hormone Releasing Hormone (GHRH)
      a. Hypothalamic hormone
      b. Stimulates release of GH
   2. Somatostatin
      a. Hypothalamic hormone
      b. Inhibits the release of GH

Metabolism

A. Thyroxin
   1. Major hormone secretion of the thyroid gland
      a. Controls rate at which food is metabolized
      b. Iodine is required in the manufacture of thyroxin

B. Regulation of Thyroxin
   1. Thyroid Stimulating Hormone (TSH)
      a. Produced in anterior pituitary
      b. Stimulates the release of Thyroxin
   2. Thyroid Releasing Hormone (TRH)
      a. Produced in the hypothalamus
      b. Controls the release of TSH
Milk Production
A. Prolactin
1. Produced in the anterior pituitary
   a. Initiates milk production in the mammary glands
2. Regulation by prolactin-inhibiting hormone (PIH) from hypothalamus
   a. High levels of estrogen during pregnancy stimulate release of PIH
      (1) PIH inhibits prolactin release
   b. Low levels of estrogen after pregnancy inhibit release of PIH
      (2) Absence of PIH stimulates prolactin release
B. Oxytocin
1. Produced in the hypothalamus
2. Released by the posterior pituitary
   a. Causes milk producing glands to contract and move milk into the nipple area
   b. Stimulates the contraction of the uterus during labor

Adrenal Cortex Hormones
A. Corticosteroids
   1. Gonadocorticoids
      a. Male and female hormones that supplement those produced by the reproductive organs
   2. Mineralocorticoids
      a. Regulate ion balance
   3. Glucocorticoids
      a. Fight inflammation
      b. Regulate metabolism of proteins, fats and carbohydrates
B. Regulation of Glucocorticoids
   1. Corticotropin releasing hormone (CRH)
      a. Hypothalamic hormone that stimulates the release of ACTH
   2. Adrenocorticotropic hormone (ACTH)
      a. Anterior Pituitary Hormone
      b. Stimulates the release of glucocorticoids by the adrenal cortex

The Fight or Flight Response
A. Epinephrine (adrenaline) and Norepinephrine
   1. Increase mental alertness
   2. Increase heart rate
   3. Increase breathing rate
   4. Dilate coronary blood vessels
   5. Speed up metabolism
B. Fight or Flight
   1. Hormones stimulate and sustain Sympathetic response
Stress

A. Causes of Stress

- Extreme heat or cold
- Injuries
- Prolonged heavy exercise
- Loud sounds
- Infections
- Danger
- Emotional upset

B. Stages of Stress

1. First stage
   a. Body activates the fight or flight response

2. Second stage
   a. High levels of corticosteroids inhibit the immune system

3. Third stage
   a. Body attempts to recover to a normal state
      (1) Failure to recover = exhaustion