Chapter 32: Endocrine System

Endocrine System: Hormones and the various cells that secrete and receive them

Types of Glands:
1) **Endocrine Glands:**
   - Release substances within the body via bloodstream
2) **Exocrine Glands:**
   - Release substances outside the body via ducts
     - Sweat glands
     - Salivary glands
     - Mammary glands

Target Cells: Cells specialized to respond to hormones
- Changes may be: 1) prolonged and irreversible (puberty)
  2) transient and reversible (adrenaline)
- Hormone release regulated via feedback mechanisms

General Classes of Hormones:
1) **Peptide Hormones:** Amino acid chains
2) **Amino Acid-based Hormones:** Single amino acids
3) **Steroid Hormones:** Resemble cholesterol
4) **Prostaglandins:** Synthesized from fatty acids

Hormones (1st messenger) Bind to Receptors at Target Cells:
1) **Second Messenger System:** Peptide / Amino acid Hormones (hydrophilic)
   - Hormone binds with receptor (plasma membrane)
   - Receptor activates 2nd Messenger in cell (e.g. cAMP)
   - 2nd messenger activates biochemical reactions

2) **Internal Receptor System:** Steroid / Prostaglandin Hormones (hydrophobic)
   - Hormone binds with receptor INSIDE cell
   - Receptor-hormone complex binds to DNA
   - Complex increases rate of gene transcription

Major Endocrine Glands in Humans:
Pituitary Gland:
- Pea-sized gland; hanging from hypothalamus
- Receives instructions from hypothalamus (also a gland):
  - Releasing hormones:
    - Stimulate pituitary activity
  - Inhibiting hormones:
    - Inhibit pituitary activity

Hypothalamus

Pituitary Hormones:
1) Anterior Pituitary:
- Follicle-stimulating Hormone (FSH)
- Regulates egg / sperm production
- Luteinizing Hormone (LH)
- Regulates sex hormone secretion
- Thyroid-stimulating Hormone (TSH)
- Regulates hormones from thyroid
- Adrenocorticotropic Hormone (ACTH)
- Regulates hormones from adrenal cortex
- Prolactin
- Stimulates mammary gland development
- Growth Hormone
  - Regulates growth of body cells

2) Posterior Pituitary:
- Contains neurosecretory cells with bodies in hypothalamus
- Antidiuretic Hormone (ADH)
  - Stimulates water conservation (kidneys)
- Oxytocin
  - Contraction of uterus muscles
  - "Milk letdown" reflex
  - Maternal behaviors

Hypothalamus

Thyroid Gland:
- Thyroxine (T4 - Amino Acid Hormone):
  - Increases metabolic rate of cells (↑ glucose breakdown)
  - Important for: 1) Regulating growth
    2) Regulating body temperature
  - Release stimulated by Thyroid-stimulating hormone
  - Levels in blood controlled via negative feedback loop
    - ↑T4 in blood = ↓TSH (pituitary)
    - ↓T4 in blood = ↑TSH (pituitary)
  - Iodine required for T4 production

Goiter: Enlarged thyroid gland due to iodine deficiency

Treatment = Iodized Salt

Thyroid Gland:
- Calcitonin (Peptide Hormone):
  - Regulates concentration of calcium in blood
  - Decreases Ca^{2+} level in blood (bones absorb Ca^{2+})

Parathyroid Glands:
- Parathormone (Peptide Hormone):
  - Regulates concentration of calcium in blood
  - Increases Ca^{2+} level in blood (bones release Ca^{2+})
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Pancreas:
- Produces both exocrine and endocrine secretions:
  - Exocrine = Digestive enzymes (enter small intestine)
  - Endocrine = Hormones regulating glucose levels in blood
- Insulin
  - Reduced blood sugar levels (cells uptake glucose)
- Glucagon
  - Increased blood sugar levels (cells release glucose)

Control of Blood Glucose Levels:
(Figure 32.9)

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Sex Organs:
1) Ovaries (Female):
   - Estrogen / Progesterone (steroid hormone)
2) Testes (Male):
   - Testosterone (steroid hormone)
- Sex hormone functions:
  - Early development
  - Puberty
  - Secondary sexual characteristics
  - Menstrual cycle; pregnancy
- Release regulated by FSH and LH

Adrenal Gland:
1) Adrenal Medulla (center of gland)
   - Epinephrine/Norepinephrine (Amino acid hormones):
     - Released in stressful situations (sympathetic NS)
     - Release regulated by NS
2) Adrenal Cortex (outside of gland)
   - Glucocorticoids (Steroid hormones)
     - Released in long term-stressful situations
     - trauma, infection
     - Released regulated by ACTH
   - Aldosterone (Steroid hormone)
     - Regulates sodium conc. in blood
     - Target = Kidneys
   - Testosterone

Other Sources of Hormones:
1) Most Cells in Body
   - Prostaglandins (Fatty Acid Hormones): Ibuprofen
     - Target = Nearby cells
     - Function is varied (e.g. Inflammatory agents; Uterine contractors)
2) Pineal Gland
   - Melatonin (Amino Acid Hormone):
     - Regulate sleep/wake cycle
3) Thymus
   - Thymosin: Stimulates development of immune cells
4) Adipose Cells:
   - Leptin: Regulates body fat