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 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 (e.g. cAMP)
   - 2nd messenger activates biochemical reactions

2) **Internal Receptor System:**
   - Steroid / Prostaglandin Hormones (hydrophobic)

   - **Hormone binds with receptor**
   - 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:
  - Releasing hormones:
    - Stimulate pituitary activity
  - Inhibiting hormones:
    - Inhibit pituitary activity

Pituitary Hormones:
1) Anterior Pituitary:
   - Follicle-stimulating Hormone (FSH)
     - Regulates egg / sperm production
   - Lutenizing 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

Growth Hormone Extremes:
- Dwarfism
- Gigantism

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

Parathyroid Glands:
- **Parathormone** (Peptide Hormone):
  - Regulates concentration of calcium in blood
    - Increases Ca^{++} level in blood (bones release Ca^{++})

Pancreas:
- **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)

Sex Organs:
1) **Ovaries** (Female):
   - **Estrogen / Progesterone** (steroid hormone)
2) **Testes** (Male):
   - **Testosterone** (steroid hormone)

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**

Diabetes Mellitus:
- Defect in insulin production/detection
  - High & fluctuating levels of sugar in blood
  - Can cause fat deposits throughout body
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Other Sources of Hormones:

1) Most Cells in Body
   - Prostaglandins (Fatty Acid Hormones):
     - 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