Endocrine System

Chapter 24
Introduction (p. 638)

- Endocrine system works with nervous system to coordinate body functions
  - Nervous system uses neural impulses
  - Endocrine system uses hormones
Comparing Endocrine & Nervous System Functions (p. 638)
Exocrine glands
- Secrete products into ducts
- Examples are:
  - Sudoriferous
  - Sebaceous
  - Salivary

Endocrine glands
- Ductless glands
- Produce hormones
Anatomy (p. 638)

- Hormones
- Hypothalamus
- Pituitary
- Pineal
- Thyroid
- Parathyroids
- Thymus
- Adrenals
- Pancreatic islets
- Ovaries
- Testes
Location of Major Endocrine Glands (p. 638)
Physiology (p. 639)

- Produces and secretes hormones
- Regulates metabolic activities (growth, development)
- Regulates activity of other organs/glands, as well as smooth and cardiac muscle
- Helps body adapt during stress
- Regulates composition/volume of body fluids
- Contributes to reproductive processes
Hormones (p. 639)

- Chemical messengers
- Seeks out a target cell
  - Then regulates its activity by increases or decreases in cell metabolism
Prostaglandins (p. 639)

- Local hormones
- Act near site of secretion
- Helps regulate:
  - Smooth muscle
  - Inflammatory responses
- Thought to increase pain sensitivity
Hormonal Control Mechanisms (p. 639)

- Types are:
  - Negative feedback
  - Hormonal control
  - Neural control
Negative Feedback (p. 639)

- Most common method
- Hormone trigger negative (opposite) response
  - Ex: parathyroid hormone released to raise blood calcium levels when they are low. This hormone stimulates osteoclast activity, causing a rise of calcium level in the blood. As the level rises, this inhibits the production of the hormone, slowing the activity of the osteoclasts

- Thermostat analogy
Hormonal Control (p. 639)

- Hormones themselves stimulate or inhibit the release of other hormones
  - Ex: hypothalamic hormones stimulate or inhibit anterior pituitary hormones
Neural Control (p. 639)

- Hormones are secreted due to neural stimulation
  - Ex: epinephrine/norepinephrine released during stress
Hypothalamus (p. 640)

- Part of the diencephalon that regulates the ANS and the endocrine system by governing the pituitary gland
Hypophyseal Portal System (p. 640)

- Network of blood vessels that carry hypothalamic hormones to anterior pituitary
- Provides direct access
  - Hormones do not have to travel to heart then back to pituitary in brain
Pituitary (p. 641)

- Extends from hypothalamus by stalk-like structure called infundibulum
- Consists of:
  - Anterior lobe
    - 75% of entire gland and produces six of nine hormones
  - Posterior lobe
    - Stores and releases hypothalamic hormones
  - Intermediate lobe
    - Produces melanocyte-stimulating hormone
Pituitary Hormones (p. 641)
Anterior Pituitary Hormones (p. 641)

- Adrenocorticotropic hormone (ACTH)
  - Stimulates hormones of adrenal cortex, especially cortisol

- Growth hormone (GH)
  - Stimulates protein synthesis for muscle and bone development and repair
Anterior Pituitary Hormones, cont’d (pp. 641-642)

- **Thyroid-stimulating hormone (TSH)**
  - Stimulates thyroid hormones

- **Follicle-stimulating hormone (FSH)**
  - Women: stimulates estrogens and ovarian follicle development
  - Men: stimulates sperm production
Anterior Pituitary Hormones, cont’d (p. 642)

- Luteinizing hormone (LH)
  - Women: stimulates estrogens and progesterone, ovulation, and corpus luteum development
  - Men: stimulates testosterone production

- Prolactin (PRL)
  - Promotes lactation (milk production)
Intermediate Pituitary Lobe

Intermediate lobe

- Produces melanocyte-stimulating hormone
Intermediate Pituitary Hormones (p. 642)

- Melanocyte-stimulating hormone (MSH)
  - Increases skin pigmentation by stimulating synthesis and release of melanin
Posterior Pituitary Lobe

Posterior lobe

- Stores and releases hypothalamic hormones
Posterior Pituitary Hormones (pp. 642-643)

- Antidiuretic hormone (ADH)
  - Decreases urine production
  - Raises blood pressure by vasoconstriction
- Oxytocin (OT)
  - Stimulates uterine contraction
  - Stimulates milk expression
Pineal (p. 643)

- Located posterior to diencephalon in brain
- Pinecone-shaped
- Also known as pineal body
Pineal Hormones (p. 643)

- Melatonin
  - Controls biorhythms
  - Develops sexual organs
Thyroid (p. 644)

- Located at base of throat
- Butterfly-shaped
- Contains two lobes connected at center by the isthmus
Thyroid Hormones (p. 644)

- T3 (Triiodothyronine) and T4 (Tetraiodothyronine or Thyroxine)
  - Collectively called “thyroid hormones”
  - Control metabolic rate
  - Regulate growth and development
  - Cannot be made without iodine
Thyroid Hormones, cont’d
(p. 644)

- Calcitonin (CT)
  - Decreases blood calcium levels (hypocalcemic) by stimulating osteoblast activity
  - This moves calcium from blood to bones
Thyroid and Parathyroid Glands (p. 644)
Parathyroid (p. 644)

- Located on posterolateral surface of thyroid
- Usually four in number
Parathyroid Hormone (p. 644)

- Parathyroid hormone (PTH)
  - Increases blood calcium levels (hypercalcemic) by stimulating osteoclast activity
  - This breaks down bone and releases calcium into blood
  - Also increases calcium resorption from urine and intestines back into blood
Thymus (p. 644)

- Located posterior to sternum
- Large in infancy to puberty
- Atrophies in adulthood
Thymic Hormones (p. 644)

- Thymosin and Thymopoietin
  - Stimulates T cell maturation
    - T cells: specialized lymphocytes involved in immune response
Adrenal Glands (p. 645)
Adrenals (p. 644)

- Located superior to each kidney
- Two glands in one
- Cortex
  - Outer region
  - Produces three steroid hormones:
    - Glucocorticoids
    - Mineralocorticoids
    - Sex hormones
- Medulla
  - Inner region
  - Produces neurohormones
Corticol Hormones (p. 645)

- **Glucocorticoids (primarily cortisol)**
  - Affects carbohydrate, protein, and fat metabolism; converting them to fuel for energy – also an anti-inflammatory

- **Mineralocorticoids (primarily aldosterone)**
  - Helps to regulate fluid and electrolyte balances

- **Sex hormones (primarily adrenal estrogens and androgens)**
Corticol Hormones, cont’d
(pp. 645-646)

- Cortisol (Hydrocortisone)
  - Stress hormone
  - Has antiinflammatory effects

- Aldosterone
  - Salt-retaining hormone
  - Maintains mineral balance

- Sex Hormones
  - Development of secondary sex characteristics
Medullary Hormones (p. 645)

- AKA Neurohormones
- Epinephrine (adrenaline)
  - Enhances and prolongs sympathetic arousal
- Norepinephrine (noradrenaline)
  - Enhances and prolongs sympathetic arousal
Pancreatic Islets (p. 645)

- Also called islets of Langerhans
- Contains:
  - Alpha cells
    - Secrete glucagon (increases blood glucose)
  - Beta cells
    - Secretes insulin (decreases blood glucose)
- These hormones help regulate carbohydrate metabolism
Pancreatic Hormones (p. 645)

- **Insulin**
  - Decreases blood glucose levels (hypoglycemic)
    - Causes liver, muscle, and adipose tissue to take up glucose
    - Liver and muscle cells store glucose as glycogen
  - Only hormone that decreases glucose levels

- **Glucagon**
  - Increases blood glucose levels (hyperglycemic)
    - Stimulated by low glucose blood levels
    - Causes liver and muscles to convert glycogen into glucose
Regulation of Blood Glucose by Pancreas (p. 646)
Ovaries (p. 646)

- Located in female abdominopelvic area
- Houses developing oocytes within follicles
- Produces estrogens and progesterone
- Regulates menstrual cycle
- Helps maintain pregnancy
Ovarian Hormones (p. 646)

- **Estrogens**
  - Responsible for secondary sex characteristics in females
  - Ovum development and its release during ovulation
  - Thickens uterine lining for fertilized ovum

- **Progesterone**
  - Maintains uterine lining for implantation and pregnancy
  - Slightly elevates temperature for incubating effect
Testes (p. 647)

- Located in male scrotum
- Contains Interstitial cells of Leydig
  - Produce androgens
    - Principal androgen is testosterone
Testicular Hormones (p. 647)

- **Testosterone**
  - Stimulates sperm production
  - Responsible for secondary sex characteristics in males
  - Involved in increasing libido
Organs That Possess Endocrine Cells (p. 647)
Placenta (p. 647)

- Organ formed against uterine lining
- Allows developing embryo and mother to exchange nutrients and wastes
- Secretes hormones required to maintain pregnancy
Placenta: Hormones (p. 647)

- Human Chorionic Gonadotropin (hCG)
  - Pregnancy hormone
  - Stimulates estrogens and progesterone
  - Decreases lymphocyte activation

- Relaxin
  - Facilitates implantation by relaxing uterus
  - Softens connective tissue and dilates cervix for fetal delivery
Gastric and Intestinal Mucosa: Hormones (p. 647)

- **Gastrin**
  - Secreted by the stomach
  - Stimulates bile, gastric juices, and pancreatic enzymes

- **Cholecystokinin**
  - Produced by intestinal mucosa
  - Stimulates release of bile and pancreatic enzymes

- **Secretin**
  - Produced by intestinal mucosa
  - Stimulates pancreas to secrete alkaline liquid to neutralize acidic chyme, thereby facilitating the action of intestinal enzymes
Atrial Natriuretic Hormone (ANH)

- Released when right atrium is overstretched
- Triggers urine production (diuresis)
  - Decreases blood volume and therefore blood pressure
Fat Cells: Hormones (p. 647)

- Leptin
  - Regulates energy through appetite and metabolism

- Resistin
  - Increases blood glucose levels by reducing insulin sensitivity