The Importance of the Endocrine System

- No cell operates in isolation, chemical controls are needed in order to have them working together.
- **Hormones** are chemical regulators produced in cells in one part of the body that affect cells in another part of the body.
- Only a small amount of hormone is required to alter cell metabolism.
- Chemicals produced in glands and secreted directly into the blood are called **endocrine hormones**.
- Hormones are classified according to their activation site and may affect many cells throughout the body.
- **Growth hormone (GH)** or **somatotrophin (STH)** regulates the development of the long bones.
- **Insulin** regulates blood sugar by increasing the permeability of the cells to glucose.
- **Epinephrine** (adrenaline) is produced in times of stress.
- These hormones are called non-target hormones, other hormones may affect only specific cells or tissues.

Chemical Control Systems

- The endocrine system works together with the nervous system (backup).
- The nervous system allows the body to change quickly, the endocrine system maintains control over a longer duration (ex/ puberty).
- The hypothalamus functions though a combination of the two systems.
- It regulates the pituitary gland through nerve stimulation, however the endocrine glands (stimulated by the pituitary) secrete chemicals that affect the nerve activity of the hypothalamus (see Fig. 2, p. 373).
- To discover hormones and their origins, many organs were removed and effects were observed.
- Ex/ von Mering and Minkowski’s experiment with the pancreas in dogs.
- These techniques helped uncover the effect of many hormones, but they were limited because most hormones do not work independently.

- Some glands also produce several hormones, so their removal cannot be linked to one hormone.
- Ex/ attempts to discover the purpose for the thyroid resulted in removing the parathyroid unintentionally.
- Many of the affects attributed to the thyroid were actually caused by secretions from the parathyroid.
- Most hormones are also found in very small amounts (and varies) so isolating them and determining their chemical make up was difficult.
- Technological improvements (microscopy and chemical analysis) have increased our knowledge.
- Radioactive tracers allow scientists to follow messenger chemicals from the organ in which they are produced to the target cells.
- These tracers also enable researchers to determine the chemical breakdown and how it is removed as waste.

Chemical Signals: Steroid and Protein Hormones

- Hormones do not affect all cells, the cells have to have receptors.
The number of receptors vary by cell and tissue
- Ex/ liver and muscle cells have many insulin receptors, bone does not
- Like all biological macromolecules, their shape is essential in their action

Steroid hormones are made from cholesterol (a lipid) and include sex hormones and cortisol (causes conversion of a.a. to glucose by the liver)
- Steroid molecules are composed of complex rings of C, H and O molecules and are lipid soluble (not water soluble)
- Protein hormones include insulin and GH
- Contain chains of a.a.s and are water soluble

Steroid hormones diffuse from the capillaries into the interstitial fluid and then into the target cells, where they combine with receptor molecules located in the cytoplasm
- The hormone-receptor complex then moves into the nucleus and attaches to a segment of chromatin that has a complimentary shape
- The hormone activates a gene that sends a message to the ribosomes in the cytoplasm to begin producing a specific protein (see Fig. 4, p.374)

Protein hormones do not diffuse into the cell, instead they combine with receptors on the cell membrane (specific to that hormone)
- Some of the protein hormones form a hormone-receptor complex that activates the production of an enzyme called adenylyl cyclase
- The adenylyl cyclase causes the cell to convert ATP into cyclic adenosine monophosphate (cAMP), which acts as a messenger, activating enzymes in the cytoplasm to carry out their normal functions (see Fig. 5, p.375)
- Ex/Thyroid-stimulating hormone (TSH) attaches to the receptors in the thyroid gland, cyclic AMP is produced in the thyroid cells. Other cells would not be affected

The Pituitary Gland: The Master Gland
- The pituitary gland exercises control over other endocrine glands
- It is a small sac-like structure, connected by a stalk to the hypothalamus
- The pituitary gland produces and stores hormones, the hypothalamus stimulates the release of hormones from the pituitary gland by nerves
- The pituitary gland is made of two separate lobes: the posterior and anterior lobes (see Fig.6, p.376)
- The posterior lobe of the pituitary stores and releases hormones which have been produced by the hypothalamus, such as antidiuretic hormone (ADH) and oxytocin
- The hormones travel via specialized nerve cells from the hypothalamus to the pituitary
- The anterior lobe produces its own hormones, and the hypothalamus regulates their release
- Hormones are secreted from the nerves ends of the cells of the hypothalamus and transported in the blood to the pituitary gland
- Most of these hormones activate specific cells in the pituitary, causing the release of pituitary hormones, which are then carried by the blood to target tissue
The hypothalamus releases two types of regulator hormones: stimulating hormones and inhibiting hormones.

Homework
p.377 #1-4