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 is 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 cylase causes the cell to convert ATP into cyclic adenosine monophosphate (cAMP), which acts as a messenger, activating enxymes 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