

Chapter 10 Endocrine System

The two major systems responsible for the regulation of homeostasis (performed by *all* the organ systems) are the ***nervous system*** and the ***endocrine system***. While the nervous system acts more quickly it has ***short-term*** effects. The ***endocrine system***, which is composed of a group of glands placed throughout the body, releases chemicals (hormones) that must travel through the circulatory system to reach a target tissue or organ causing that tissue or organ to effect a regulatory change. This is a much slower process but the effect is more ***long-term***.

I. **Main Functions**

- A. **Growth, metabolism, and maturation** of many tissues and organs
- B. **Ionic Regulation** – regulates ion concentrations in the blood (blood chemistry)

- III. **Hormones** – chemical messengers in the **endocrine system** – *intercellular* chemical signals produced within and secreted by the endocrine glands – transported by blood some distance to target tissues/organs – attach to receptor sites (molecules) on the target to effect a change in activity – broken down in the liver and excreted in the urine
- A. **Hormone Chemistry** – 2 basic chemical base types
1. **Proteins** – which can range from; a simple **amino acid**, to a **polypeptide** (20 to less than 100 *amino acids*), to a full protein (greater than 100 *amino acids*) – most bind to membrane bound receptors (exception- peptide hormones secreted by the thyroid that diffuse) – when bound to its receptor on a cell membrane one of two things happens: ¹ it alters the permeability of the cell membrane; ² it can activate a “*first messenger-second messenger*” system where the **protein hormone** is the **first messenger** bound to the cell membrane activating a **regulatory substance** as the **second messenger** which activates *enzymes* that effect a change by **catalyzing** (changing the rate at which reactions occur) chemical reactions
 2. **Lipid** (steroids) – derived from **cholesterol** – have structures that vary only slightly among the different types –

hypothalamus which travel to the *anterior pituitary* by the **hypothalamic-hypophyseal portal system** (a group of capillaries and veins within the anterior portion of the *pituitary gland* and the *infundibulum*) - 7 main hormones secreted

a. **Growth Hormone (GH)** – *target tissue* is most tissues of the body – *effects*; increasing protein synthesis, breaking down of fats, and releasing of fatty acids from cells – influences the liver to produce and secrete **somatomedins** (protein chemical signals, which bind to cells of other tissue (like bone and cartilage) stimulating growth), neurons synapse with capillaries by releasing vesicles filled with *releasing factors* that disperse into the capillaries by *exocytosis* and are carried to the *anterior pituitary gland* – stimulates uptake of amino acids into cells giving them more raw materials to manufacture tissues with **(3 main tissues effected; muscle, bone, and adipose)**

€ **hyposecretion** – causes **pituitary dwarfism** (normal proportionally, just remaining small)

€ **hypersecretion** – causes **giantism** (increased bone length) during growth

b. Oxytocin (OT)

€ **The Renin-Angiotensin Mechanism:** *Kidneys* detect a drop in *blood pressure* *kidneys* release renin (which acts as an enzyme) converts angiotensinogen (a blood protein produced by the liver) into *angiotensin I* *angiotensin I* is acted on by angiotensin-converting enzyme (produced in the lungs) converting it to angiotensin II (active version) which causes blood vessel constriction and increased aldosterone (mineralocorticoid produced by the *adrenal cortex*) causes the *kidneys* to excrete K^2 and retain Na^2

€ **3 targets of Angiotensin II**

- The *hypothalamus* – to increase parasympathetic stimulation of the *salivary glands*
- The *circulatory system* – systemic vasoconstriction
- The *adrenal cortex* – **release of aldosterone**

c. **Androgens** – derivatives of *estrogen* and *testosterone* – produced in minute quantities – responsible for some male characteristics – increases female sex drive and influences some female characteristics (mainly hair growth in pubic and Axillary regions)

2. **Adrenal Medulla** – inner portion of the *adrenal glands* – derived from embryonic neuronal tissue – produces catcolamines (which prepare the body for vigorous physical activity) – called ‘fight-or-flight’ hormones – released in response to sympathetic stimulation by the autonomic nervous system – *drivers* are stress and low blood glucose levels – *effects*: ¹ increased heart rate, ² vasodilation of the vessels that supply blood to the muscles, ³ vasoconstriction (shunting) of blood vessels that supply the skin and internal organs, ⁴ increased break down of glycogen to glucose and release of fatty acids to increase metabolism, ⁵ increase of respirations

a. **epinephrine** – principal hormone released by the *adrenal medulla* (80%) – also called adrenalin

b. **norepinephrine**

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1. **Testes** – 2 of them – located in the scrotum (a flesh sac extending from the base of the penis) – produce and secrete the sex hormone *testosterone*
 - a. **Testosterone** – steroid based hormone produced by the *interstitial cells of Leydig* (located between the *seminiferous tubules* which produce sperm) – driver release of *ICSH (LH)* by the *anterior pituitary* which is stimulated by release of *GnRH* by the *hypothalamus* in a negative-feedback loop triggered by a drop in serum *testosterone* – **prebirth** is responsible for masculinizing the reproductive organs – **no production from birth to puberty** – **puberty** is responsible for enlarging the male reproductive system, beginning spermatogenesis (production of sperm by the *seminiferous tubules*, of the testes, stimulated by the release of *FSH* by the *anterior pituitary*), development of secondary male sex characteristics (distribution of muscle mass, growth of facial and groin hair, deepening of male voice tone), and the male sex drive
2. **Ovaries** – 2 of them – located lateral posterior to the *uterus* – produce and secrete 2 hormones which contribute to the development and function of the female reproductive structures, female sex characteristics (enlargement of breasts, distribution of fat that influences the hips and breasts), and the menstrual cycle (caused by the cyclical release of ovarian sex hormones)
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