



# PHYSIOLOGY



Sheet number and date: 9 – 19/2/2020

Author of the sheet: Boudoor sami

correction

Name of the doctor :Dr. Saleem Alkhreesha

## -BODY SYSTEMS:

-Our body is made up of many systems that work in harmony meaning that they do not function separately. For example, the cardiovascular system does not function in the separation of the nervous system and other

<b>System</b>	<b>Components</b>	<b>Functions</b>
Nervous	Brain, spinal cord, peripheral nerves, ganglia	Controls activities of other systems; receives information from the environment; stores memories; initiates and controls behavior
Skeletal	Bone, connective tissue	Support; mineral storage; production of blood cells
Cardiovascular	Heart, blood vessels, red blood cells	Transports nutrients, gases, metabolic end products, and hormones between organ systems
Respiratory	Nose and throat, trachea, bronchi, bronchioles, lungs	Takes up oxygen and releases carbon dioxide to atmosphere; produces sounds; partly responsible for regulating blood acidity
Digestive	Mouth, esophagus, stomach, small and large intestines, salivary glands, liver gall bladder; pancreas	Digestion, food storage, absorption of nutrients; protects against infection

systems

Urinary	Kidneys, ureters, bladder, urethra	Homeostasis of extracellular fluid volume and composition; excretion of waste products
Endocrine	Pituitary, adrenals, thyroid, parathyroids, gonads, pancreas; many other organs secrete hormones in addition to their other functions	Regulation of reproduction, growth, metabolism, energy balance, extracellular fluid composition
Reproductive	Male: testes, associated glands and ducts, penis Female: ovaries, fallopian tubes, uterus, vagina, clitoris, breasts	Reproduction, sexual gratification
Lymphatic	Lymph vessels, lymph nodes	Fluid balance; transport of digested fat; cells of the immune system are also located within it
Immune	Lymphoid tissues, bone marrow, white blood cells, thymus	Resists infection, parasitization, and cancer

In fact, all these systems are controlled by two systems:

1.Nervous system.

2.Endocrine system.

-That's why these two systems are called **control systems** cuz they control your body.

The table below shows all the differences between both systems:

Characteristic	Nervous system	Endocrine system
Mechanism of control	<u>Neurotransmitters</u> released in response to nerve impulses	<u>Hormones</u> delivered to tissues throughout the body by the <u>blood</u> .
Cells affected	Muscle cells, gland cells, other neurons	Virtually <u>all body cells</u>
Type of action that results	<u>Muscular contraction</u> , or <u>glandular secretion</u>	<u>Changes in metabolic activities</u> whether it was <i>anabolism</i> or <i>catabolism</i>
Time to onset of action	Typically within Milliseconds It is usually <b>fast</b>	Seconds to hours or days. -It is <b>usually delayed</b> and takes days "throughout life" -but <b>sometimes "when in need"</b> it is immediate and takes seconds to hours
Duration of action	Generally briefer	Generally longer

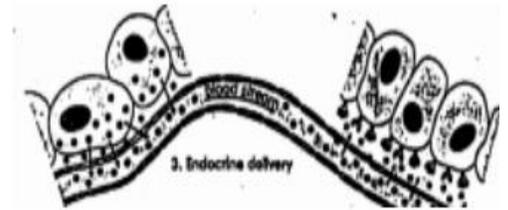
## Glands:

-As we know glands are of two types

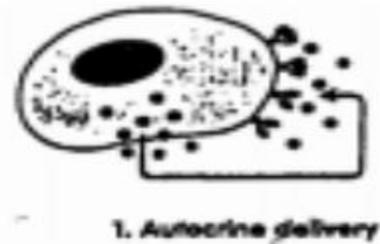
- Endocrine: secretes hormones into the blood and they lack ducts.
- Exocrine: secretes its secretion into ducts.

-And talking about the endocrine glands we found that they are divided into.

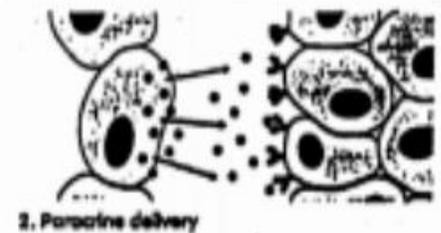
- Classic glands: hormones that are secreted into the blood are called classic hormones.



- Autocrine delivery: This gland produces hormone/s that affect the same cell. Hormones released by this gland are called Autocrine hormones.

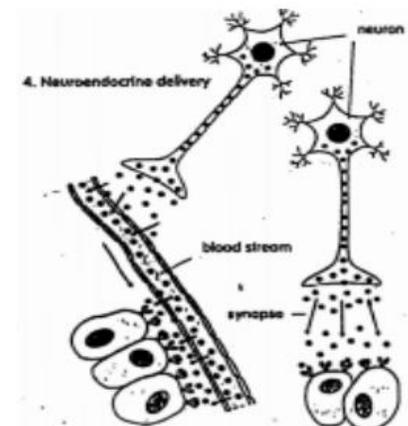


- Paracrine delivery: Hormones are released into interstitial spaces thus affecting neighboring cells. Hormones released by this gland are called Paracrine hormones.



- Neuroendocrine delivery: These glands are represented by neurons. Neurons produce hormones called neuro-hormones. There are two subtypes:

A. Hormones that are released by a neuron into the blood. B. Hormones that are released by a neuron



into an empty space (cleft); affecting post-synaptic cells.

- Pheromonal delivery: Hormones produced by cells in the body are called **Pheromones**. These hormones are volatile, and affect nearby individuals “insects, mammals, human beings”.

Examples:

1. Having chemistry with someone, so you become friends.

-Mainly female pheromones in human beings.

2. Deer musk "المسك"

-mainly male pheromones.

-Endocrine glands in the abdomen contain substances that produce musk.

-Siberian, Ukrainian deer produce the largest amount of musk.

3. Whale ambergris "العنبر"

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## VERY IMPORTANT POINTS TO KNOW ABOUT ENDOCRINE SYSTEM:

1. The single endocrine gland secretes many hormones with different functions.

2. Most hormones have multiple actions in their **target tissues** and are said to have **pleiotropic effects**. This phenomenon occurs when a single hormone regulates several functions in the same target tissue. The same hormone has many functions in the same target tissue.

**Example: In skeletal muscles;** Insulin: stimulates glucose uptake, glycolysis, glycogenesis, inhibits glycogenolysis, stimulates amino acids uptake, stimulates protein synthesis, and inhibits protein degradation.

3. Some hormones are known to have **different effects** on certain different types of tissues. The same hormone affects many tissues with different functions.

**Example: testosterone** “the male sex steroid” promotes normal sperm formation in the testes, stimulates the growth of accessory sex glands such as prostate and seminal vesicles, and promotes the development of several secondary sex characteristics such as beard growth and deepening of the voice.

4. A single hormone may be secreted by more than one endocrine gland.

**Example hypothalamus and pancreas:** both secrete the hormone somatostatin, but it's known as a neurotransmitter when secreted by hypothalamus while it's a hormone when secreted by the pancreas

5. The multiplicity of regulation is also common in the endocrine system. The input of information from several sources allows a highly integrated response to many stimuli; which is of ultimate benefit to the whole animal.

**Example:** Several different hormones including insulin, glucagon, epinephrine, thyroid hormones, and adrenal cortisol may regulate liver glycogen metabolism. Many hormones function in liver cells, and this is just for liver glycogen.

6. In addition, to change receptor number many target cells can regulate receptor function. The chronic exposure of a cell to a hormone may cause the cell to become less responsive to that hormone. This state is called **Desensitization**.

### **Types of desensitization:**

1. If the exposure of a cell to a specific hormone causes a desensitizing effect on the action of the same hormone, the effect is **homologous desensitization**
2. But, If the exposure of a cell to a specific hormone causes a desensitizing effect on the action of a different hormone, the effect is **heterologous desensitization**.
7. Some of the glands produce only hormones while others have other functions ( mixed organs).

**Examples:** Thyroid just secretes hormones, while intestine secretes hormones and digestion enzymes. Moreover, ovaries and testes are mixed organs.

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### **GENERAL FUNCTIONS OF HORMONES:**

- 1. Metabolism:** Regulate metabolic processes (catabolism and anabolism), and the rate of synthesis and degradation of carbohydrates, proteins, and lipids.
- 2.Reproduction:** no reproduction without hormones as they control reproductive processes, including the development of the sex organs, secondary sexual characteristics, gametogenesis, and the menstrual cycle. (ex: testosterone, progesterone estrogen...)
- 3. Digestion:** no digestion without hormones as they control digestive processes, including gut motility and the secretion of digestive enzymes, bile, gastric acid, and bicarbonate.
- 4. Blood circulation:** Regulate blood pressure by altering cardiac output, vascular constriction, and blood volume via the control of water excretion by the kidneys.

**5. Transport of substrates to tissues “blood composition”:** Regulate blood plasma concentrations of glucose, minerals e.g. sodium, potassium, calcium), gases (oxygen, carbon dioxide) blood cells, water. and hydrogen ions.

**6. Defense against pathogens:** Regulate Immune system responses. Including leukocyte activation, inflammation, antibody production, and fever.

**7. Growth:** Control cell division, and differentiation. The growth doesn't only depend on growth hormones also it depends on other factors that will be discussed later on.

**8. Stress response:** Regulate the body's response to stress.

**9. Behavior:** Control sexual and social behavior.

### → **The chemistry of hormones :**

Hormones are chemically classified into three types:

1-Hormones are **mainly proteins**, whether they were “polypeptides, glycoproteins, and dipeptides”.

2- Few are **amino acid derivatives**:

- Catecholamines (adrenaline, noradrenaline, dopamine).
- Thyroid hormones (T3, T4)

3- Few are **Steroids**:

- adrenal cortex hormones.
  - Female and male hormones.
  - Vitamin D.
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## REGULATION OF HORMONE SECRETION:

-There are **three mechanisms** that regulate hormone secretion.

### 1. Feedback control

-Mainly all hormone secretions are usually regulated by feedback control.

→ **What is the feedback control?**

-It's a relationship between the stimulus and response.

-- **Types of feedback control:**

a. **Negative feedback control:** The response decreases the stimulus.

b. **Positive feedback control:** The response increases the stimulus.

**Feedback control is either:**

a. Hormone – hormone: the stimulus and the response are hormones.

b. Substrate - hormone :e.g. Glucose (substrate) –insulin( hormone).

c. Mineral – hormone: e.g. Calcium(substrate) - parathyroid (hormone).

-There are so many examples on negative feedback, but usually, there are two famous examples about positive feedback.

Examples ( Positive feedback):

1. When the baby starts sucking milk from his mother, the more and more the baby sucks the milk the more oxytocin is released until the baby is full.

2. During delivery, the more and more uterus contracts the more and more oxytocin is released.

## 2. Neural control

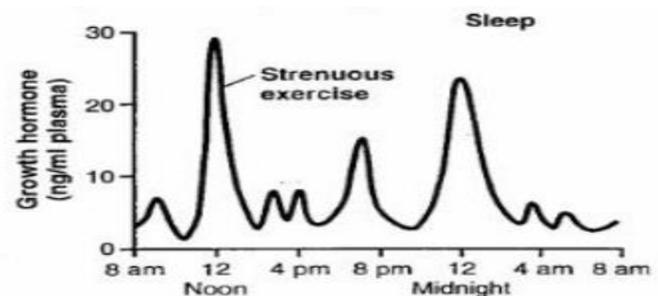
-There are conditions that occur in the body. These conditions are: Pain, emotion, sexual excitement, fright, injury, and stress. All of them can moderate hormone secretion through neural mechanisms.

-These conditions cause the secretion of one or more of these hormones: adrenaline, acetylcholine dopamine, serotonin.

## 3. Chronotropic control

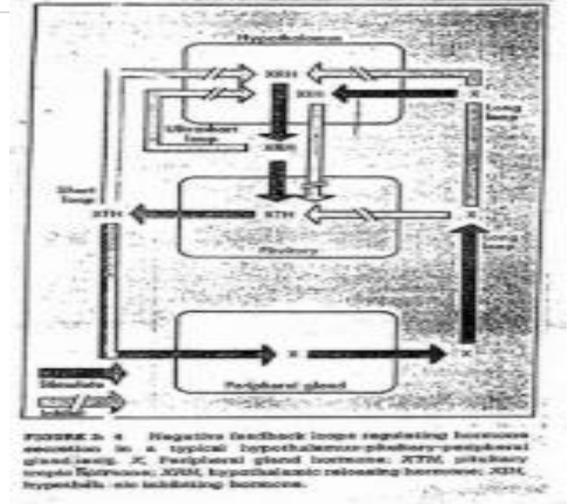
-It deals with the duration of secretion. Many hormones are secreted in distinct pulses “in durations, timing”, either in:

- Oscillating patterns
- Pulsatile patterns
- Diurnal rhythm “Sleep-wake rhythm”



-There are variations in the level of growth hormone during the day. It is high at noon (12pm) and midnight (12am), and it is relatively low in between. -The diagram shows the levels of a hormone during sleep and wake.

- Menstrual rhythm: Levels of certain hormones during menstrual cycle “28 days”.
- seasonal rhythm: It is especially seen in mammals during seasons, and how the levels of hormones change during each season.
- Developmental rhythm during the development of the human being, and variations in growth hormone which is high during childhood, low during adulthood and decreased in old age.



-Negative feedback loops :

1. ultra-short loop → when hypothalamus produces hormone that affects the hypothalamus.

2. short loop → when pituitary affects the hypothalamus

3. long loop → when the hypothalamus, pituitary, and peripheral gland are included.

GOOD LUCK

Don't hesitate to ask ...

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