

REGULATION IN HUMANS

The life function of **REGULATION** in humans is controlled by the **NERVOUS and ENDOCRINE** systems.

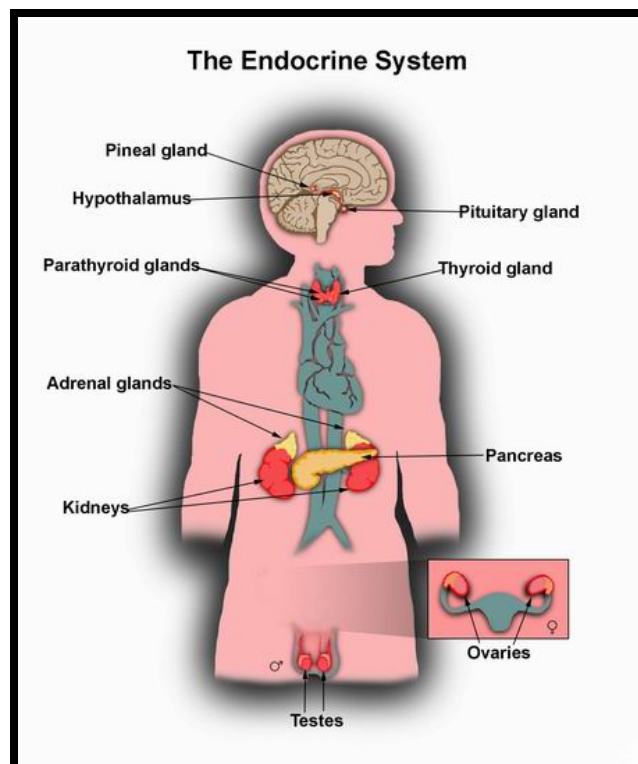
COMPARISON of HUMAN NERVOUS & ENDOCRINE SYSTEMS

I. *Similarities*

- ◆ Both systems play a major role in maintaining homeostasis
- ◆ Both systems secrete chemicals in regulating the human body
 - endocrine system secretes hormones**, chemical messengers that regulate the function of certain cells or tissues.
 - nervous system secretes neurotransmitters**, which carry the impulses across the synapses (space between two neurons)

II. *Differences*

- ◆ **IMPULSES** are transmitted by neurons; **HORMONES** are transmitted by the blood.
- ◆ **Nervous system responses are faster** than responses of the endocrine system
- ◆ **Endocrine system responses last longer** than nervous system responses, continuing for a time after the stimulus ends.



- ◆ The human endocrine system is made up of the endocrine glands, which secrete hormones directly into the blood. These glands are ductless, so hormones are secreted directly into the bloodstream and are transported to the organs and tissues that they regulate.
- ◆ For a hormone to affect a cell, the cell must have a cell receptor on the surface of the cell membrane that fits the hormone.
- ◆ Since hormones are generally produced in one part of the body but affect another part of the body, it takes time for the hormone levels to be high enough to affect the target organ or tissue.
- ◆ Similarly, once hormone production is shut down, it takes some time for the hormone blood levels to decrease to a low level and stop their influence on the target organ or tissue.

DISORDERS OF THE ENDOCRINE SYSTEM

I. *Goiter:*

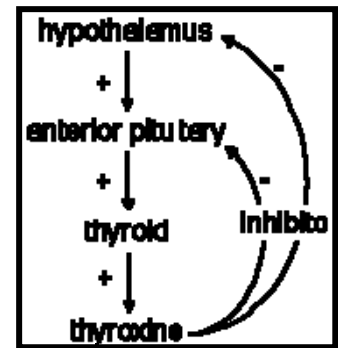
- ◆ enlargement of the thyroid gland usually from the gland's inability to make thyroxin
- ◆ often associates with an iodine deficiency in the diet

2. *Diabetes:*

- ◆ A disorder characterized by a deficiency of insulin which results in an elevated blood sugar level.
- ◆ Patients may have to take insulin to regulate blood sugar levels.

FEEDBACK MECHANISMS

- ◆ **Negative Feedback:** a self-regulatory mechanism that helps the body maintain homeostasis
- ◆ This mechanism operates on the principle that the level of one hormone in the blood either stimulates or inhibits the production of another hormone.
- ◆ **Example:**
 - if the thyroxine level decreases, then the hypothalamus stimulates the pituitary to secrete more TSH, which influences the pituitary to produce thyroxine.
 - the increase in blood levels of thyroxine **negatively feedback** to the thyroid to shut down further production of thyroxine.



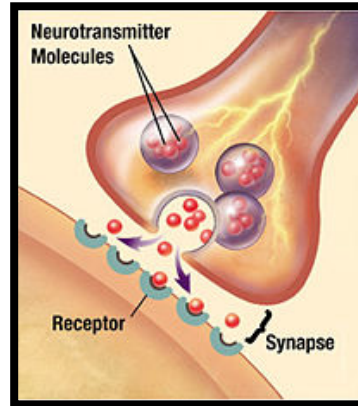
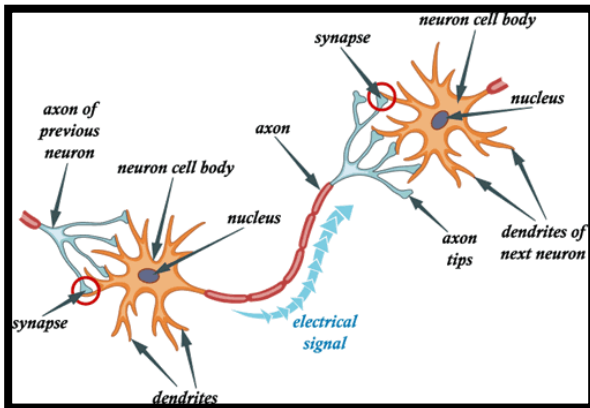
- ◆ Another example of negative feedback with hormones is between **insulin and glucagon**

GLAND	LOCATION	HORMONES	FUNCTION
Hypothalamus	Small region of brain that has endocrine function		Produces hormones that influence the pituitary gland
Pituitary Gland (often referred to as the Master Gland)	Found at the base of the brain, secretes a number of hormones	<ol style="list-style-type: none"> 1. GH – growth stimulation hormone 2. TSH – thyroid stimulating hormone 3. FSH- follicle stimulating hormone 4. LSH – Leutinizing Hormone 	<ol style="list-style-type: none"> 1. Stimulates the elongation of the long bones 2. stimulates the thyroid gland to produce thyroid 3. stimulates the development of the follicles in the ovaries in females; in males,, stimulates sperm production 4. stimulates ovulation and formation of the corpus leutum from the ruptured follicle
Thyroid Gland	Two connected lobes of tissue lying alongside the trachea in the front neck	Thyroxine	<ul style="list-style-type: none"> --Regulates the rate of metabolism in the body cells and is essential for normal physical and mental development --iodine in the diet is essential for the production of iodine
Parathyroid Glands	Patches of tissue embedded in the thyroid gland	Parathormone	<ul style="list-style-type: none"> --Controls metabolism of calcium --Calcium is necessary for nerve function,, blood clotting, and proper growth of teeth and bones
Adrenal Glands	Pair of glands on top of the kidneys	<ol style="list-style-type: none"> 1. Adrenalin (inner part of glands) 2. Cortisol (outer part of glands - steroid) 	<ol style="list-style-type: none"> 1. Flight or fight response – increase blood sugar level & accelerates the heart & breathing rates. 2. promotes the conversion of body fat & protein in glucose to increase blood glucose levels.
Pancreas (cells known as the Islets of Langerhans)	Specific hormone producing cells in the pancreas	<ol style="list-style-type: none"> 1. Insulin 2. Glucagon 	<ol style="list-style-type: none"> 1. When blood sugar is high, stimulates body cells to absorb glucose from the blood & convert extra glucose to glycogen for storage in liver 2. stimulates the release of glucose (breakdown of glycogen) from liver when blood sugar is low
Male Gonads - testes	Pair of glands outside the body in the scrotum	Testosterone	Influences the development of secondary characteristics & stimulates sperm production
Female Gonads - ovaries	Pair of glands in the lower abdominal cavity	<ol style="list-style-type: none"> 1. Estrogen 2. Progesterone 	<ol style="list-style-type: none"> 1. Influences development of secondary sex characteristics; also begins the thickening of uterine lining. 2. Maintains the thickening of the uterine lining in preparation for implantation of the embryo.

HUMAN NERVOUS SYSTEM

I. NEURONS

- a. **NEURONS** are the basic unit of structure and function of the nervous system.
- b. Structure:
- c. **Three types of neurons:**
 - ◆ **Sensory Neurons:** transmit impulses from receptors to spinal cord and brain
--sense organs (ears, eyes, tongue, nose, and skin) are where sensory neurons are most concentrated
 - ◆ **Interneurons:** found in spinal cord and brain, relay nerve impulses between sensory and motor neurons
 - ◆ **Motor Neurons:** transmit nerve impulses from spinal cord to muscles or glands (**effectors**)
- d. **STIMULUS:** the sensory organs pick up a stimulus from the environment by **SENSORY RECEPTORS**. The stimulus is converted into an electrochemical **IMPULSE**.
- e. **IMPULSE** moves along a neuron in **ONE DIRECTION** from dendrites to cell body to axon to terminal branches to terminal button.
- f. **SYNAPSE:** space between two neurons. The Impulse is carried across the synapse by chemicals called **NEUROTRANSMITTERS**
- g. The impulse travels from sensory neurons to interneurons in the spinal cord to the brain interneurons, where the stimulus is interpreted and the **RESPONSE** is sent from interneurons of brain to spinal cord interneurons to motor neurons to **EFFECTORS** (muscles or glands)



II. CENTRAL NERVOUS SYSTEM

A. BRAIN:

- ◆ large mass of neurons located in the cranial cavity
- ◆ Brain has three major divisions

a. Cerebrum:

- largest part of the brain; center for **VOLUNTARY** activity
- specific areas for interpretation of sensory impulse, interpretation, initiation of motor activities, memory, thinking and reasoning

b. Cerebellum:

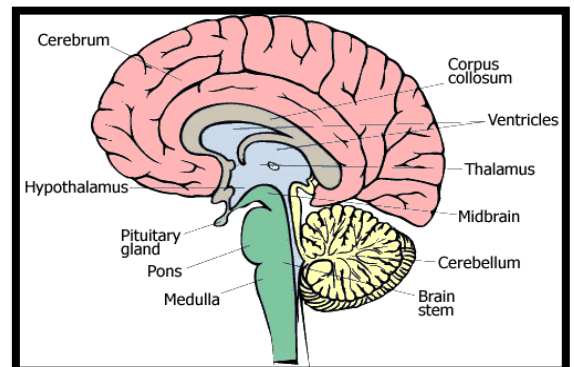
- located below and behind the cerebrum; coordinates motor activities and aids in maintaining balance

c. Medulla:

- located at the base of the brain; connects the brain and spinal cord
- controls **INVOLUNTARY** activities in the body such as **BREATHING, HEARTBEAT, BLOOD PRESSURE, & PERISTALSIS**

B. SPINAL CORD

- ◆ the medulla of the brain is continuous with the spinal cord
- ◆ the spinal cord is contained inside and protected by the **VERTEBRAE** of the spinal column (the backbone)
- ◆ spinal cord coordinates activities between the brain and the other body structures



III. Peripheral Nervous System

- ◆ includes all neurons outside the central nervous system
- ◆ these neurons (sensory and motor) neurons carry impulses between the central nervous system and the rest of the body.
- ◆ **Peripheral Nervous System is subdivided into:**
 - a. **Somatic Nervous System** (controls **VOLUNTARY MUSCLES** of the skeletal system)
 - b. **Autonomic Nervous System** (controls **INVOLUNTARY MUSCLES** or **SMOOTH muscle, CARDIAC muscle and GLANDS**)
 - controls heart rate, pulse rates, circulation, respiration, and peristalsis

IV. HUMAN BEHAVIOR

A. *Voluntary behavior:*

- conscious, intentional behavior that involves the cerebrum of the brain
- such behaviors include, memory, association of ideas, imagination of possible outcomes, planning and the ability to choose a particular outcome or behavior.

B. *Involuntary Behavior*

- behavior that occurs automatically

1. reflex arc:

- a set pathway from sensory receptors to sensory neurons to the interneurons in the spinal cord.
- the spinal cord responds automatically, sending an impulse to the motor neurons to react AND sends the sensory impulse to the brain for further interpretation.
- such reflexes are generally inborn and protective in nature, allowing the individual to have a rapid response to a potentially dangerous situation
- ex: when you touch a hot stove, your hand pulls away before your brain gets the impulse and causes you to react to the pain.

2. Conditioned (learned) behavior

- automatic behavior that is learned
- *habits*: learned behavior, that through repetition, has become automatic.
- Example – writing your name on a paper when it is given to you even though the teacher is telling you **NOT** to write your name anywhere on the paper

V. DISORDERS OF THE NERVOUS SYSTEM

1. **Cerebral Palsy:** congenital disease (happens in fetal development, not hereditary)
 - characterized by a disturbance in motor function
 - damage to the motor centers of the brain, usually the cerebellum
 - symptoms include poor coordination of muscles and difficulty in speech
2. **Stroke:** results from a cerebral hemorrhage or clot in a brain cerebral vessel
 - can result in some brain damage such as paralysis and loss of mental functions such as speech, & memory.
3. **Meningitis:** inflammation of the membranes surrounding the brain and spinal cord
 - symptoms include severe headache, fever, & chills.
 - stiffness and back pain usually follow
4. **Polio:** viral disease of the central nervous system which can result in paralysis.
 - preventable with immunization by the Salk injection vaccine or Sabin oral vaccine