Unit 3 Maintaining Homeostasis

Part 2: Nervous System and Endocrine System

Mr. Gillam

Holy Heart

Name: _____

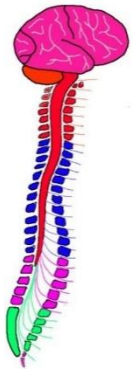
_____ system that detects changes and responds to them; made up of the brain and spinal cord, as well as the nerves that emerge from them and connect them to the rest of the body

Homeostasis

The nervous system regulates body structures and processes to maintain _____ despite fluctuations in the internal and external environment.

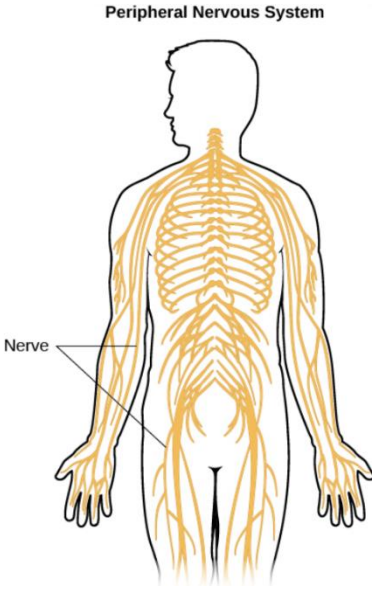
- maintaining a constant internal temperature
- Researchers have discovered that the nervous systems of people living in cooler climates act to constrict blood flow to an extremity (and thus conserve body heat) when the extremity is cooled.
- The nervous system monitors and controls most body processes, from automatic functions (such as breathing) to activities that involve fine motor co-ordination, learning, and thought (such as playing a musical instrument).

Organization of the Nervous System



The nervous system has two major divisions:

_____ which consists of the brain and spinal cord, integrates and processes information sent by nerves.



_____ includes nerves that carry sensory messages to the central nervous system and nerves that send information from the CNS to the muscles and glands.

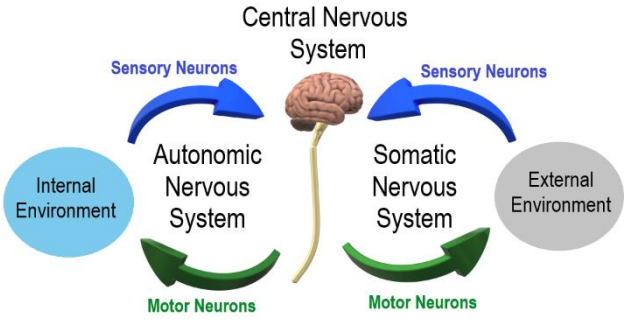
Peripheral nervous system

The peripheral nervous system is further divided into the somatic system and the autonomic system.

The _____ consists of sensory receptors in the head and extremities, nerves that carry sensory information to the central nervous system, and nerves that carry instructions from the central nervous system to the skeletal muscles. You somewhat control it.

The _____ controls glandular secretions and the functioning of the smooth and cardiac muscles.

The autonomic nervous system is divide into two more systems, the _____ and _____ nervous systems.



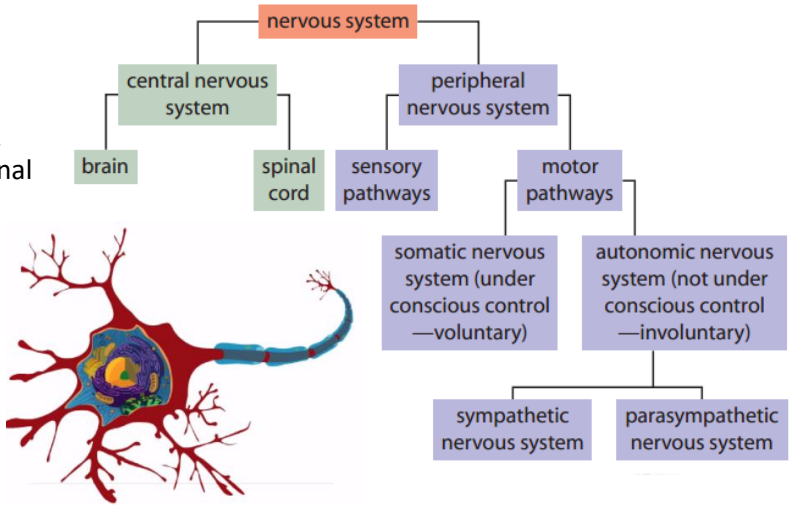
Divisions of the Autonomic

The _____and _____divisions of the autonomic system often work in opposition to each other to _____ _____ of the body. Involuntary processes, such as _____ _____, are those that **do not require or involve conscious control.**

Fight-or-Flight Response

- The sympathetic nervous system is typically activated in stressful situations and is often referred to as the fight-or-light response.
- The sympathetic neurons release a neurotransmitter called **norepinephrine**, which has an excitatory effect on its target muscles.
- As well, the sympathetic nerves trigger the **adrenal glands** to release **epinephrine** and **norepinephrine**, both of which also function as hormones that activate the stress response.
- At the same time, the sympathetic nervous system inhibits some areas of the body.
- For example, in order to run from danger, the skeletal muscles need a boost of energy.
- Therefore, blood pressure increases and the heart beats faster
- **Digestion slows down and the sphincter controlling the bladder constricts.**
- The parasympathetic nervous system is activated when the body is calm and at rest. It acts to restore and conserve energy.
- Sometimes referred to as the _____ response
- The parasympathetic nervous system _____ _____ _____ _____
- The parasympathetic system uses a neurotransmitter called _____ to control organ responses.

Cells of the Nervous System



_____

nerve cell; the structural and functional unit of the nervous system, consisting of a nucleus, cell body, dendrites, axons, and a myelin sheath

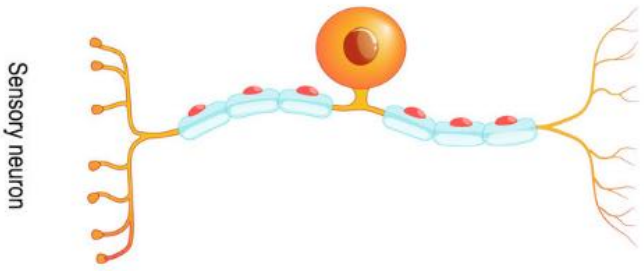
_____

message pathway of the nervous system; made up of many neurons grouped into bundles and

surrounded by protective connective tissue

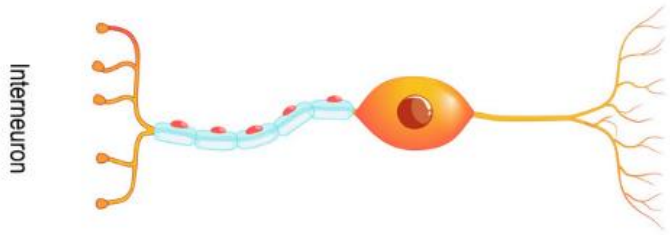
<u>Three main types of neurons</u>

1. _____: _____
   gather information from the _____
   (_____) and transmit these impulses to the central nervous system (brain and spinal

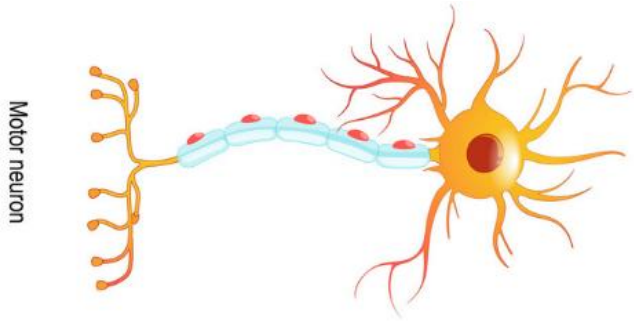


   cord).

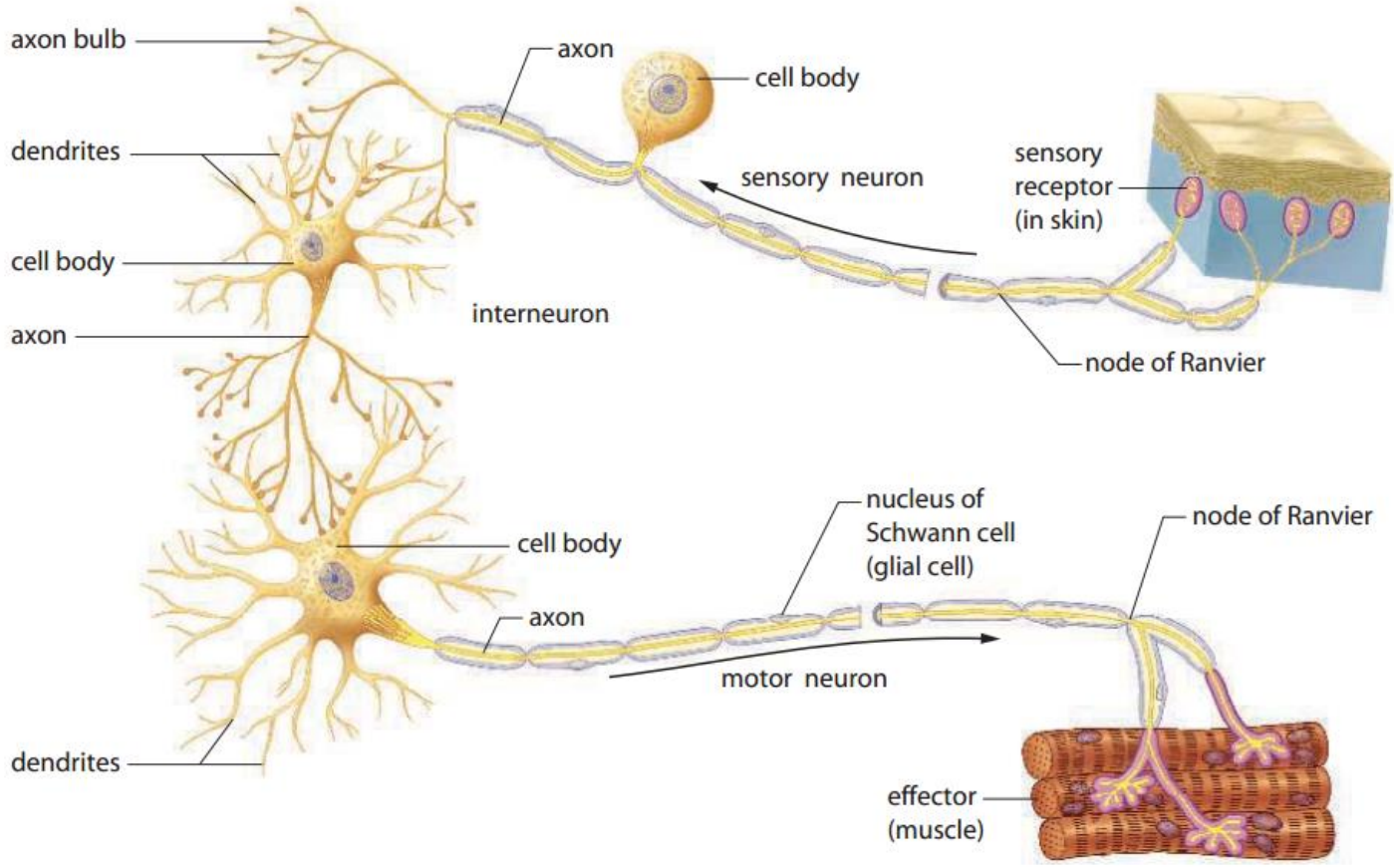
2. _____ : _____ are found entirely within the _____ _____. They act as a link between the sensory and motor neurons. They process and integrate incoming sensory information, and relay outgoing motor information.



3. _____ : _____
transmit information from the central nervous system to the
_____
_____

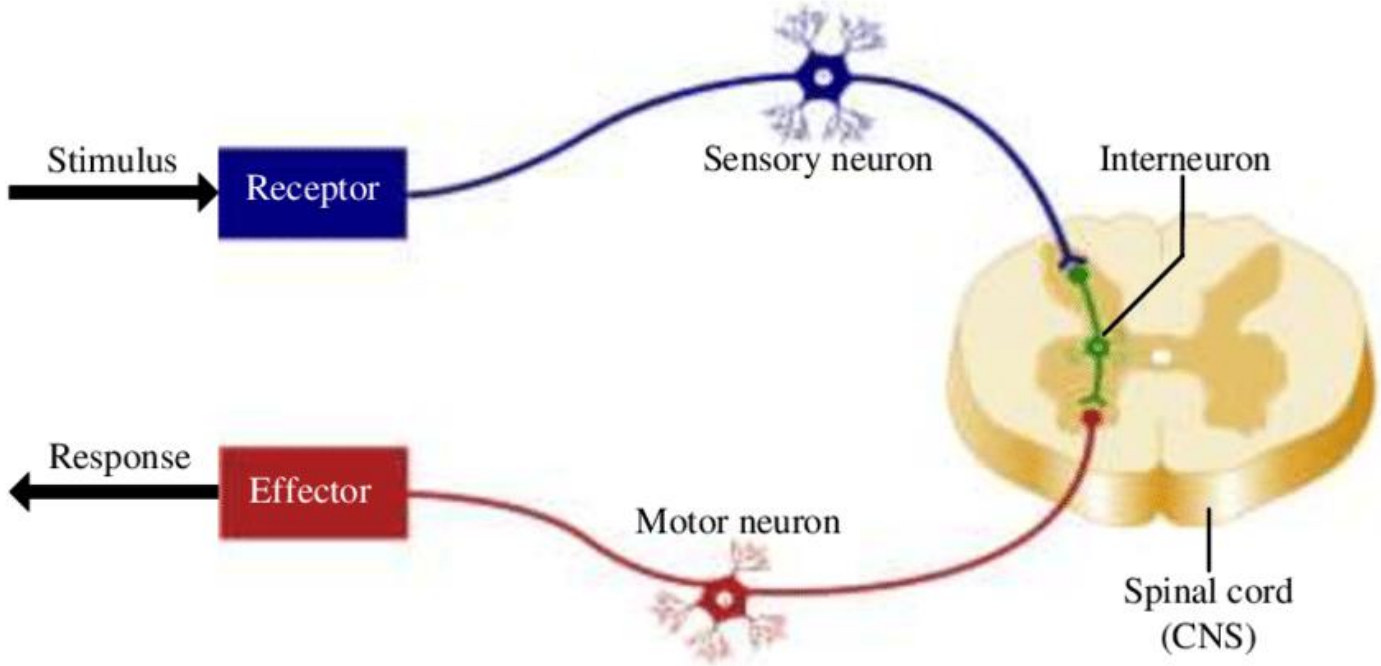


This diagram shows how a sensory neuron, an interneuron, and a motor neuron are arranged in the nervous system. (The breaks indicate that the axons are longer than shown.)



The Reflex Arc

_____ simple connection of neurons that results in a reflex action in response to a stimulus



Some neurons are organized

_____

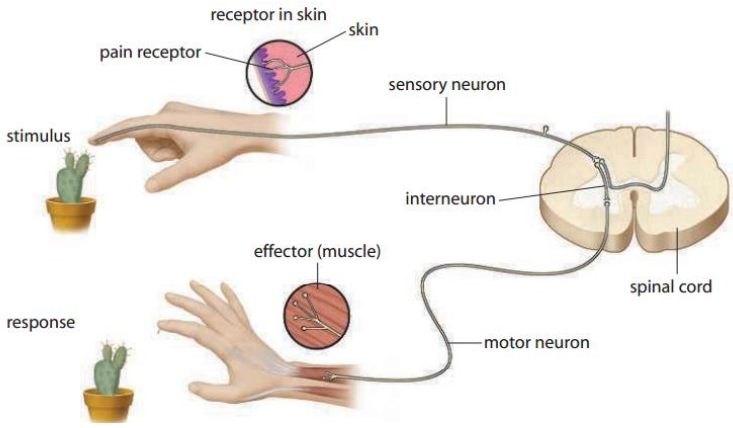
_____

_____

_____

_____ These sudden, unlearned, involuntary responses to certain stimuli are called reflexes.

- jerking your hand away from a hot or sharp object
- blinking when an object moves toward your eye
- vomiting in response to food that irritates your stomach.

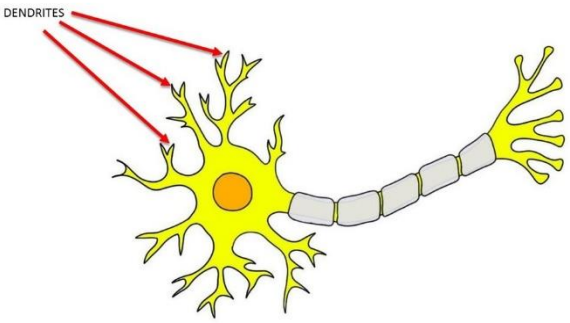


Receptors in the skin sense the pressure of the cactus needle and initiate an impulse in a sensory neuron. The impulse carried by the sensory neuron then activates the interneuron in the spinal cord. The interneuron signals the motor neuron to instruct the muscle to contract and withdraw the hand.

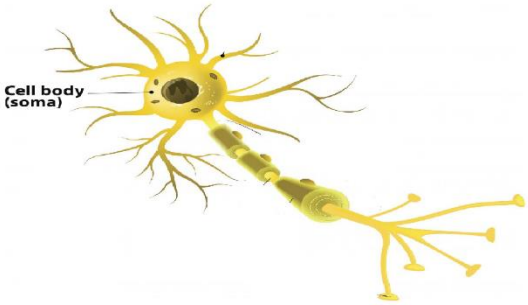
Investigation 9.A

Reflex Arc Lab

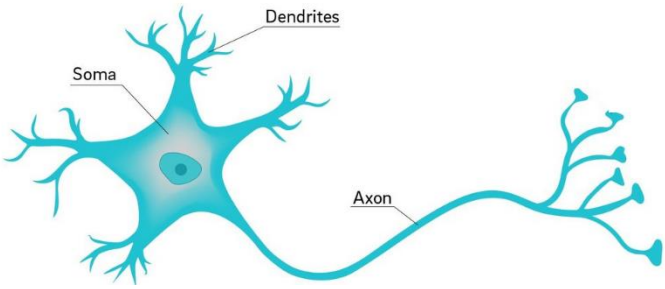
<u>The Structure of a Neuron</u>



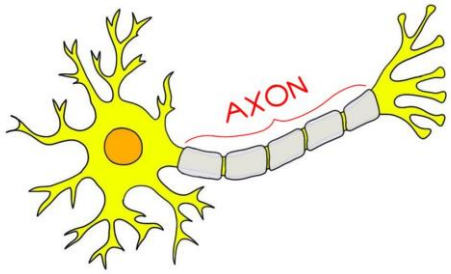
_____ short, branching terminal on a neuron that receives signals from other neurons or sensory receptors and relays the impulse to the cell body

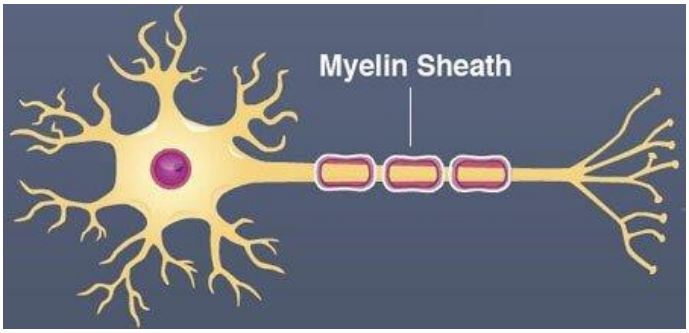


_____the main part of a neuron, containing the nucleus and other organelles and serving as the site of the cell's metabolic reactions; processes input from the dendrites



_____ long, cylindrical extension of a neuron's cell body; transmits impulses away from the cell body along its length to the next neuron



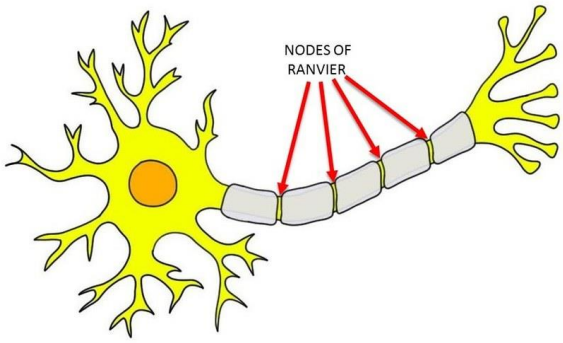


_____ the fatty, insulating layer around the axon of a nerve cell; protects myelinated neurons and speeds the rate of nerve impulse transmission

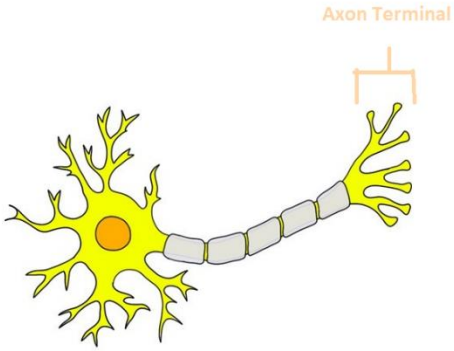
_____ a type of insulating glial cell that wraps around the axon of a neuron, creating a myelin sheath

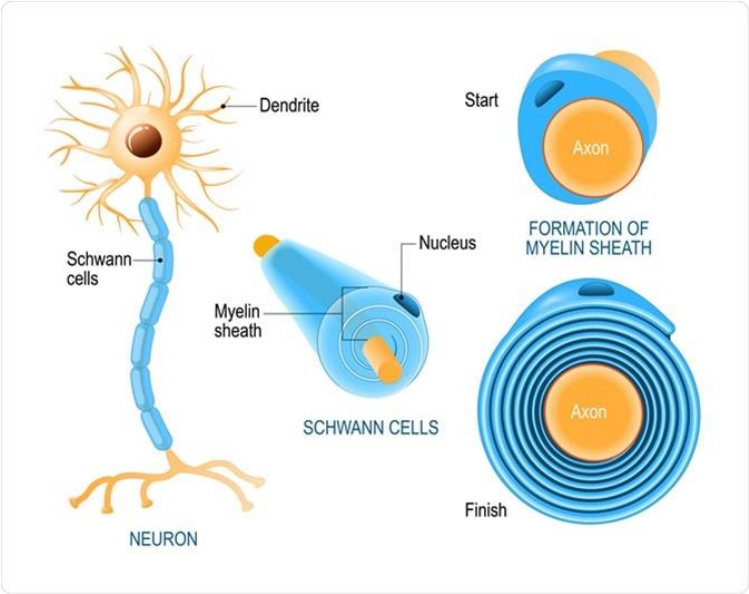
_____

_____ gap in the myelin sheath insulating the axon of a myelinated nerve cell



_____ at the end of the axon release chemical signals into the space between them and the receptors or dendrites of neighbouring cells.



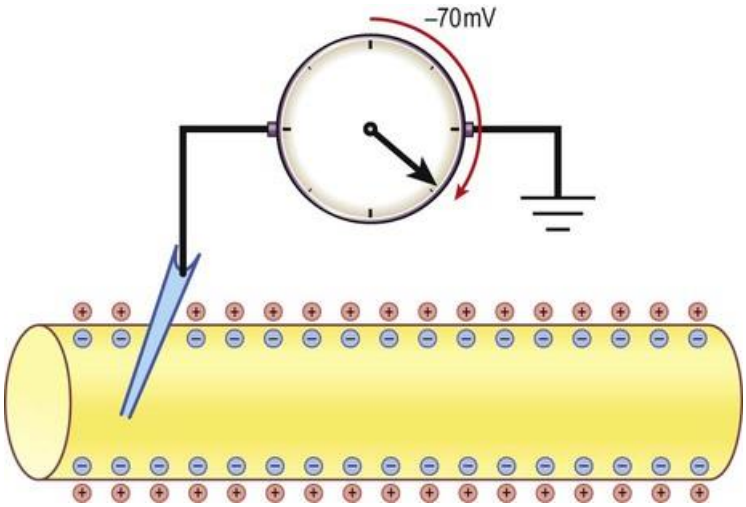


<u>Generation of a Nerve Impulse</u>

Neurons are able to establish a voltage difference between the inside and outside of the cell membrane.

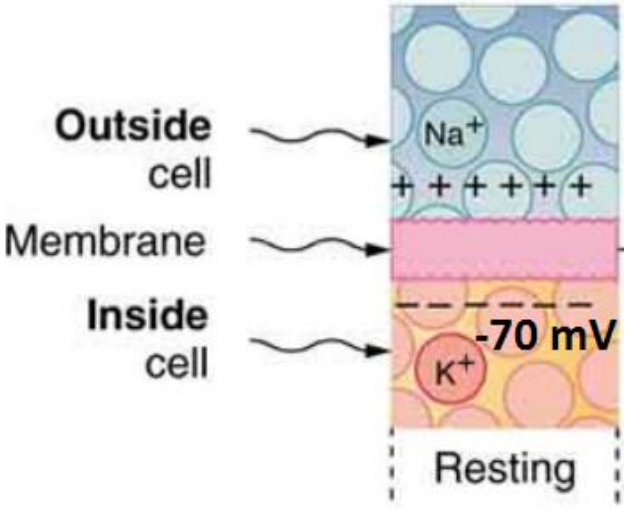
Node of

Ranvier →



_____

potential difference across the membrane in a resting neuron (-70 mV) it is negative on the inside, relative to the outside. When the axon is resting at -70 mV it is said to be _____.



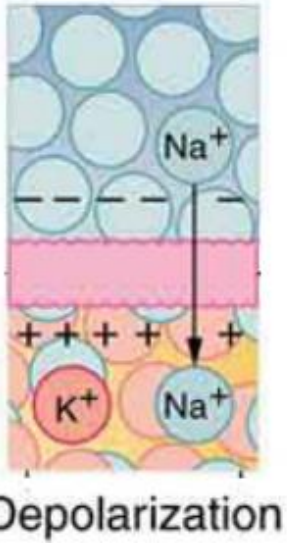
- Na+ outside the axon
- K+ inside the axon

The process of generating a resting Membrane potential

of −70 mV is called _____.

_____

Changing the membrane potential from −70 mV up to +40 mV.

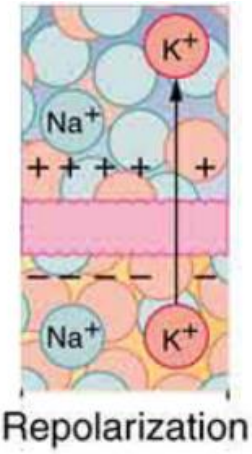


- Na+ moves into the axon to make this change.
- + ions moving into the axon causes it to become less negative and eventually positive

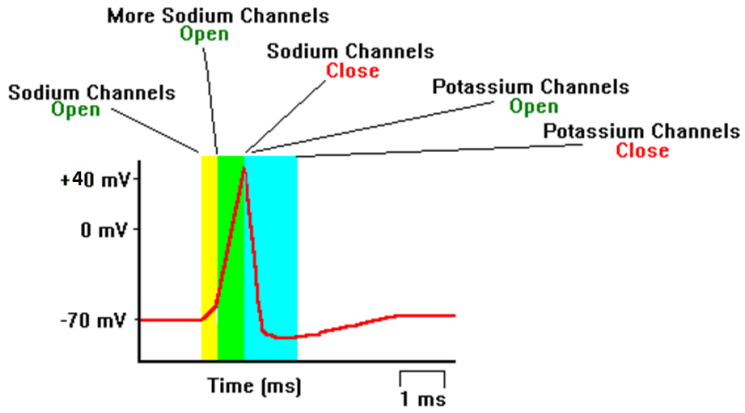
Depolarization only happens if the charge inside the axon passes the _____ _____. The minimum change in the membrane potential required to generate an action potential; usually _____

_____

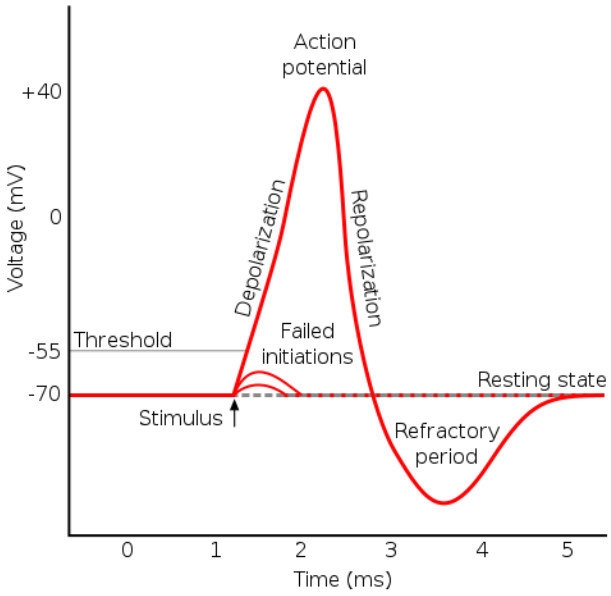
return of a nerve to its resting potential following depolarization



- K+ moves out of the axon
- + ions leaving causes the axon to decrease in charge once again.



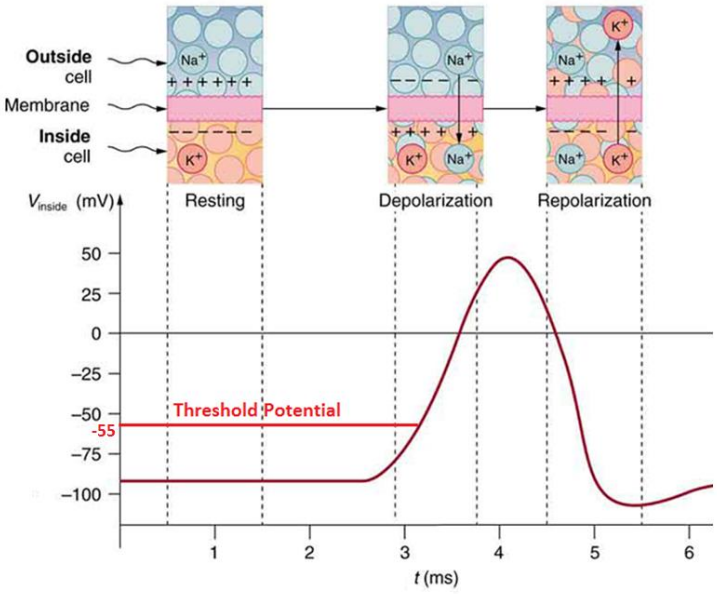
_____ in an axon, the change in charge that occurs when the gates of the K+ channels close and the gates of the Na+ channels open after a wave of depolarization is triggered



An action potential is called an “all-or-none” event because a depolarization to between −70 mV and −55 mV has no effect. Any depolarization to −55 mV, or any other mount up to 0, will produce identical action potentials.

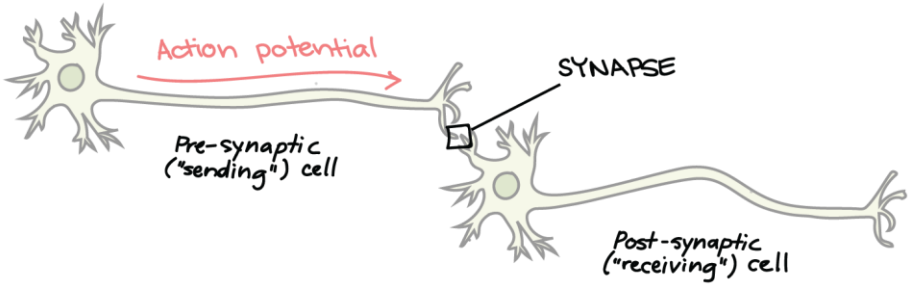
refractory period period following an action potential in which the membrane cannot be stimulated to undergo another action potential

<u>At the Nodes of Ranvier</u>



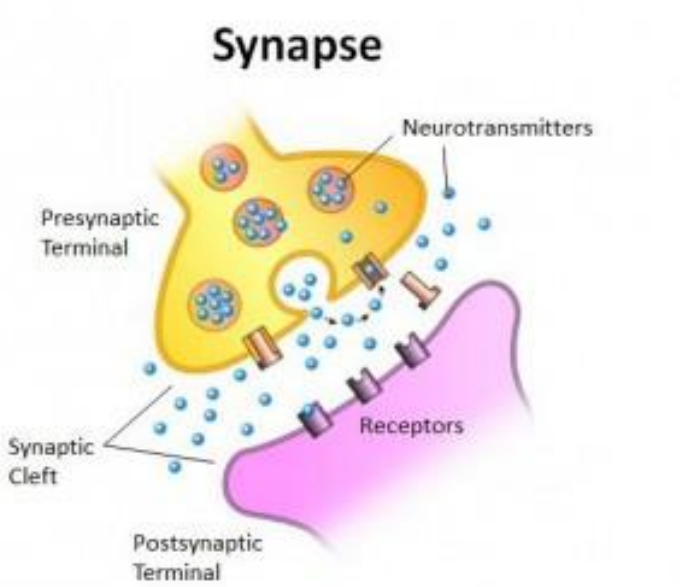
<u>Signal Transmission across a Synapse</u>

_____ junction between two neurons or between a neuron and an effector (muscle or gland)



The Synapse

_____ chemical messenger secreted by neurons to carry a neural signal from one neuron to another, or from a neuron to an effector, such as a gland or muscle fibre

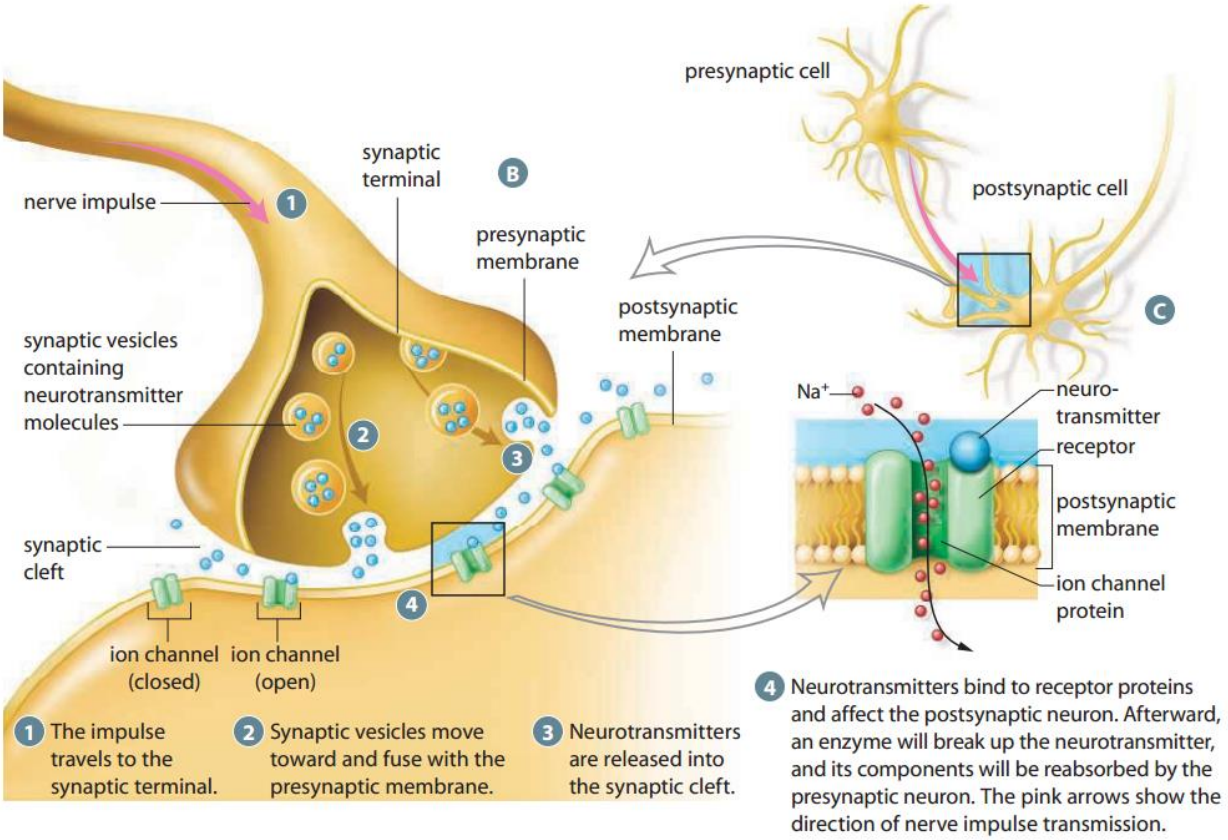


1. an action potential travels down the axon to the axon terminal

2. synaptic vesicles move to and fuse with the presynaptic membrane

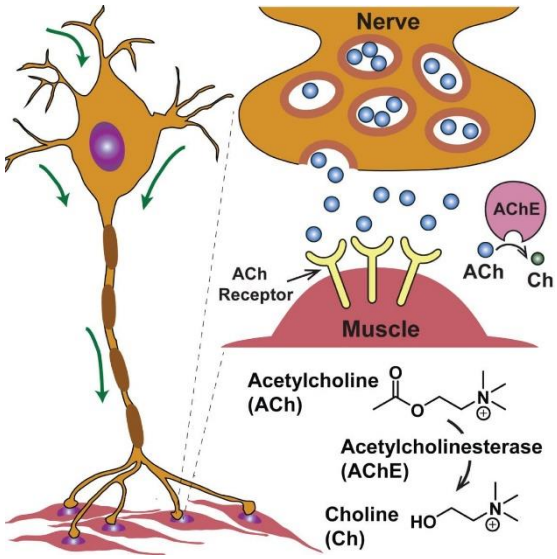
3. neurotransmitters are released into the synaptic cleft

4. Neurotransmitters bind to receptor proteins and affect the postsynaptic neuron. Afterward, an enzyme will break up the neurotransmitter, and its components will be reabsorbed by the presynaptic neuron.



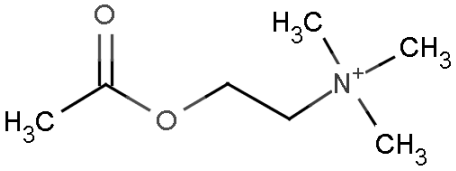
Types of Neurotransmitters

_____ (Ach)excites the muscle cell membrane, causing depolarization and contraction of the muscle fibre.



_____ breaks down acetylcholine so that it can be removed from the protein receptors, thus allowing the ion channels to close and the membrane to repolarize in a fraction of a second.

Acetylcholine (ACh)



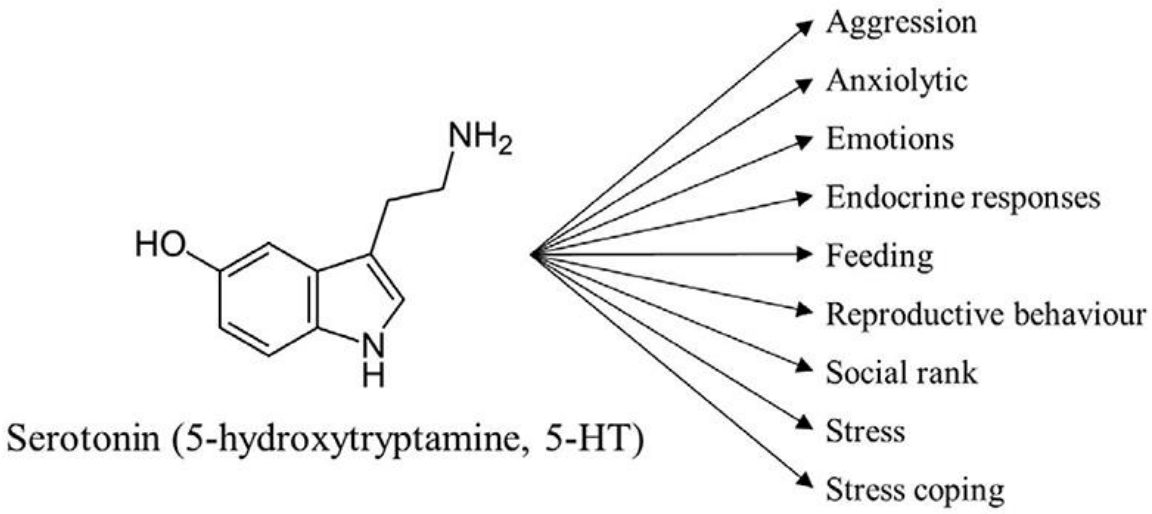
_____ Affects the brain synapses in the control of body movements; is linked to _____, such as eating

Excessive production linked to _____, a disorder in which the individual's _____ _____.

inadequate production linked to _____, a progressive disorder that destroys neurons, causing _____ _____

_____ regulates temperature and sensory perception; is involved in mood control

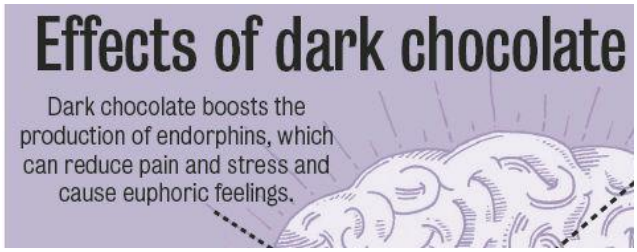
Inadequate amounts in the brain synapses is linked to _____



Serotonin (5-hydroxytryptamine, 5-HT)

_____ act as natural painkillers in synapses in the brain and also affect emotional areas of the brain

Deficiency linked to an increased risk of alcoholism



_____ is used by the brain and some autonomic neurons; complements the actions of the hormone epinephrine,

_____

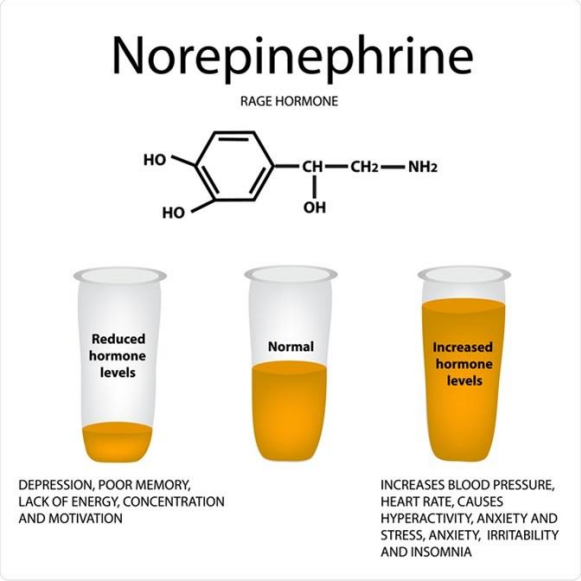
_____

_____

_____

_____

Overproduction linked to high blood pressure, anxiety, and insomnia; deficiency linked to hunger cravings and exhaustion



Activity 9.1/9.2 : How do Certain Medications Help Neurotransmitters in the Brain/The Effects of Drugs on Neurons and Synapses POSTER

The Central Nervous System Structures

The _____ is a column of nerve tissue that extends out of the skull from the brain and downward through a canal within the backbone

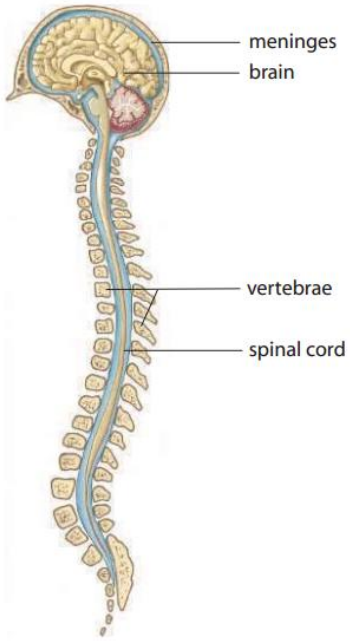


Figure 9.20 The central nervous system

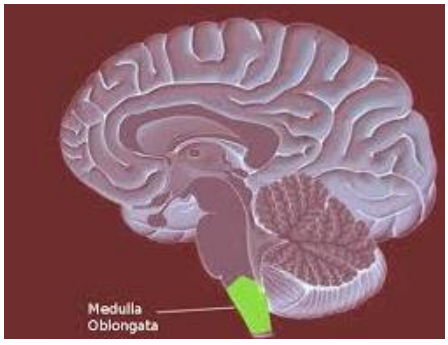
The Brain

The _____ is a walnut-shaped structure located below (inferior to) and largely behind (posterior to) the cerebrum, described below.

This part of the brain is involved in the _____ _____

_____

_____, such as those used to hit a tennis ball, ride a bicycle, or write.



The _____ sits at the base of the brain stem, where it connects the brain with the spinal cord. The medulla oblongata contains centres that

_____

_____

_____

_____

_____

_____

The _____is found above (superior to) and in front of (anterior to) the medulla oblongata in the brain stem. _____
_____
_____
_____
_____
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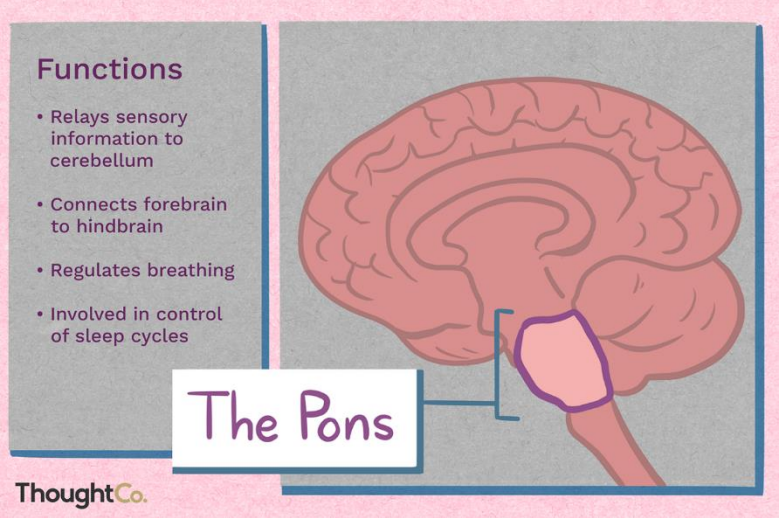
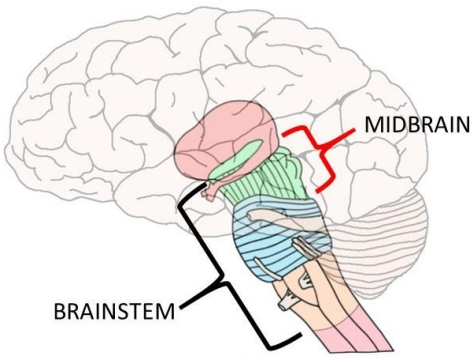
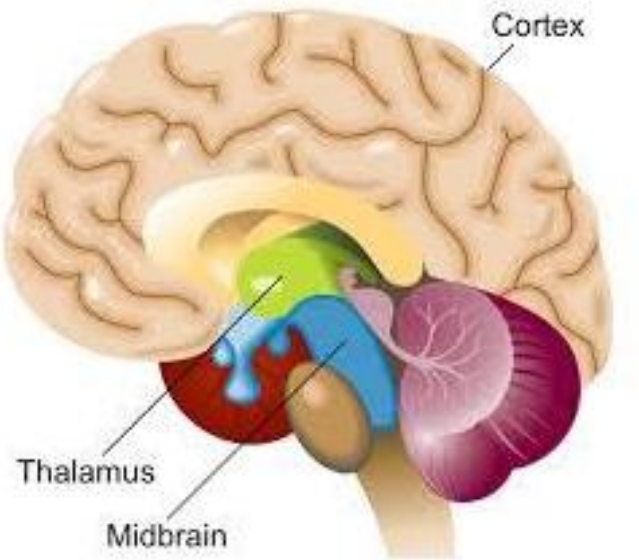


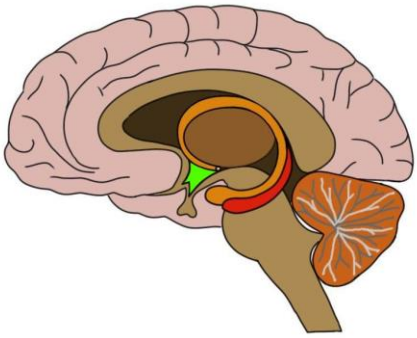


The _____ is found above the pons in the brain stem. _____
_____
_____
_____
_____.
As well, it plays an important role in _____
_____
_____
_____

The _____ sits at the base of the forebrain. It consists of neurons that provide connections between various parts of the brain. These connections are mainly between the forebrain and hindbrain, and between areas of the sensory system (except for the sense of smell) and cerebellum. ____
_____
_____
_____
_____
_____

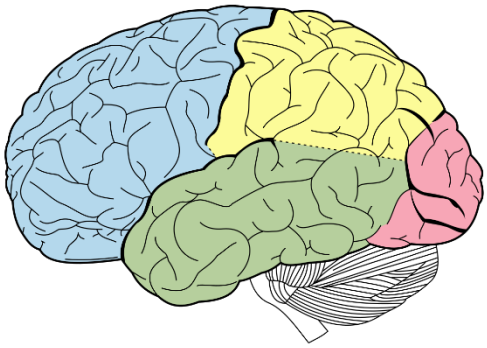


The _____, which lies just below the thalamus, helps to regulate the body's internal environment, as well as certain aspects of behaviour.

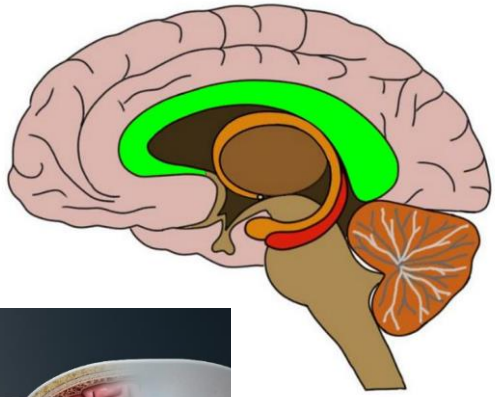


The hypothalamus contains neurons that control _____
_____
_____
_____
_____
_____

Brain damage or a tumour that affects the hypothalamus can cause a person to display unusual, even violent behaviour.

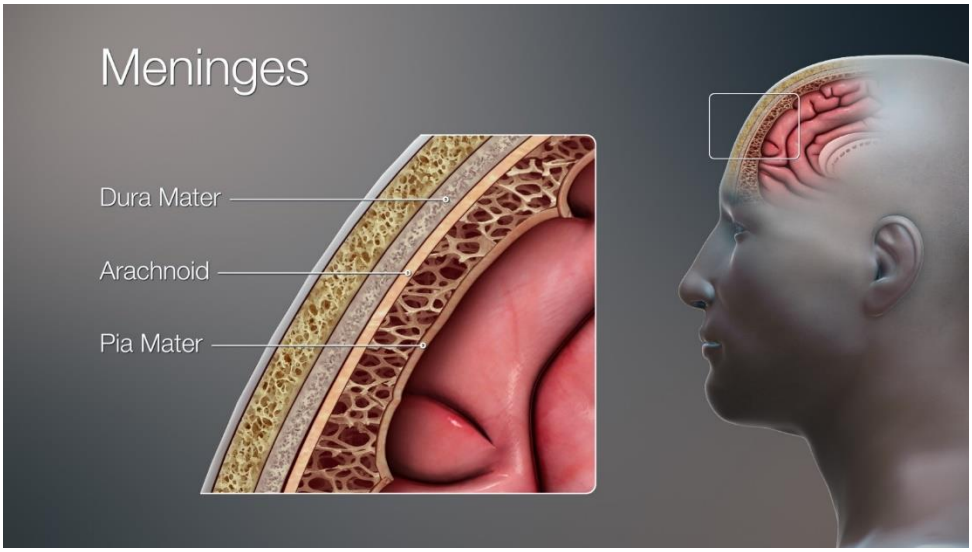


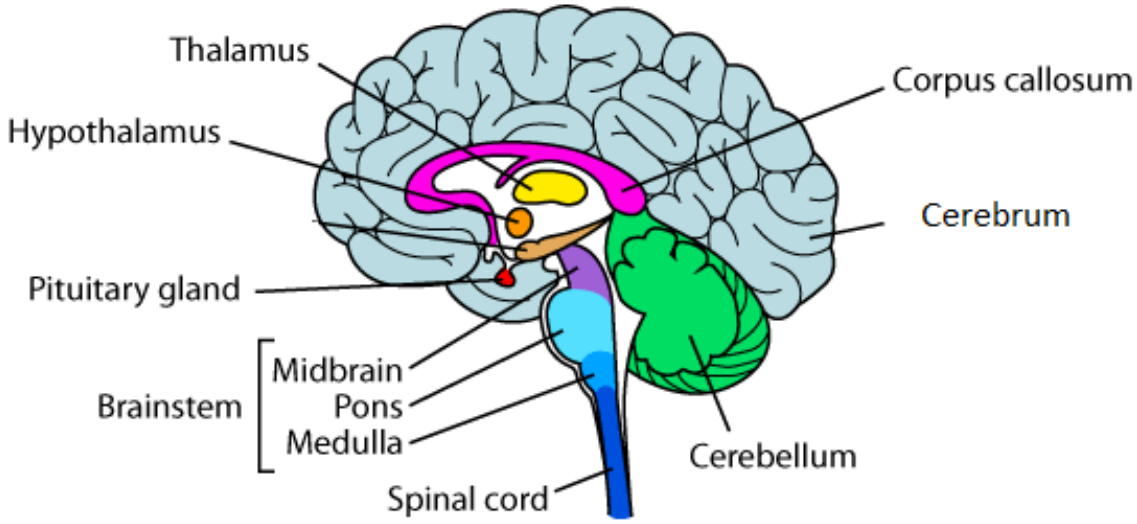
The _____ the largest part of the brain and accounts for more than four fifths of the total weight of the brain. The cerebrum is divided into right and left cerebral hemispheres, which _____
_____
_____
_____
_____
_____



_____
bundle of white matter that joins the two cerebral hemispheres of the cerebrum of the brain

_____three layers of tough, elastic tissue within the skull and spinal column that directly enclose the brain and spinal cord





Investigation 9.D The Brain

Activity 9.3 Thin as an Egg Shell

Nervous System Disorder Poster

Connections + Environmental Contexts: Maintaining and Terminating Human Life Worksheet

Quiz

Regulating Homeostasis: The Endocrine System

Nervous System and Endocrine System

The body systems that facilitate cellular communication and control are the nervous and endocrine systems

Homeostasis depends on the close relationship between the nervous system and the endocrine system.

Some nervous system tissues secrete hormones, such as cells in the hypothalamus, pituitary gland, and adrenal glands.

Several chemicals function as both _____ and _____ depending on their location in the body. An example is _____, which acts as a neurotransmitter between certain neurons in the nervous system, and as a hormone released by the adrenal glands in the _____ response.

The endocrine and nervous systems both include responses that are regulated by negative feedback loops.

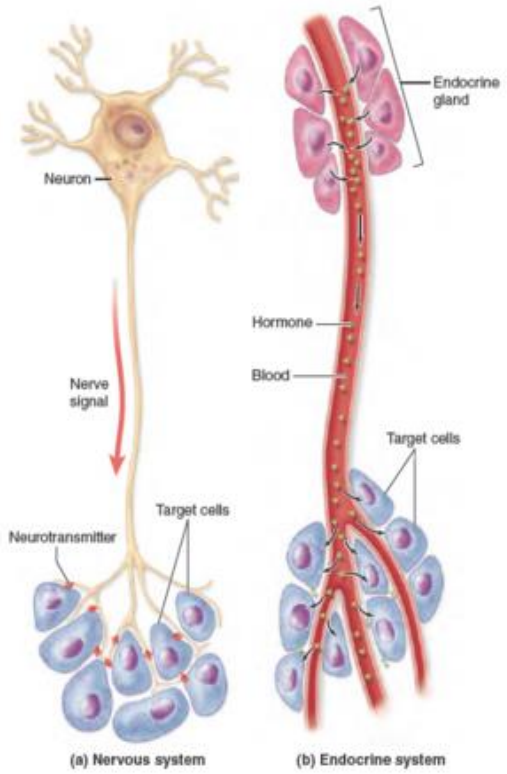
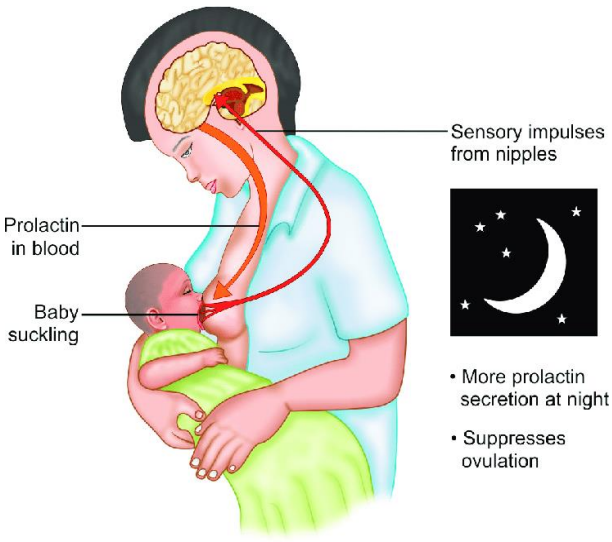


Figure 17.1 Nervous and Endocrine System Communication Methods. (*a*) In the nervous system, neurons release neurotransmitters into a synaptic cleft to stimulate their target cells. (*b*) In the endocrine system, hormones are secreted by endocrine cells. The hormones enter the blood and travel throughout the body to reach their target cells.

The regulation of several physiological processes involves both the nervous and endocrine systems acting in conjunction with each other.

For example, when a _____ her baby, the baby's suckling initiates a sensory message in the mother's neurons that travels to the _____, _____ _____ _____.

Oxytocin travels in the bloodstream to the _____ _____ _____ _____.



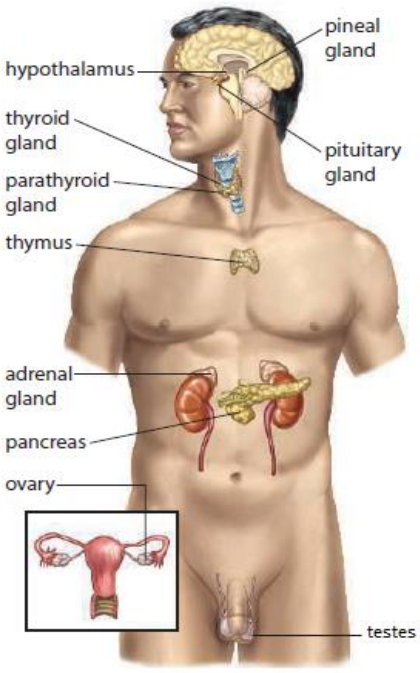
Endocrine System

_____ system that works in parallel with the nervous system to maintain homeostasis by releasing chemical hormones from various glands

_____ secrete chemical messengers called hormones directly into the bloodstream, which transports the hormones throughout the body.

Hormones

_____ chemical messenger sent to many parts of the body to produce a specific effect on a target cell or organ



Many of the hormones released from the anterior pituitary and the hypothalamus are called **tropic hormones**, which means that their targets are other endocrine glands. Tropic hormones stimulate endocrine glands to release other hormones

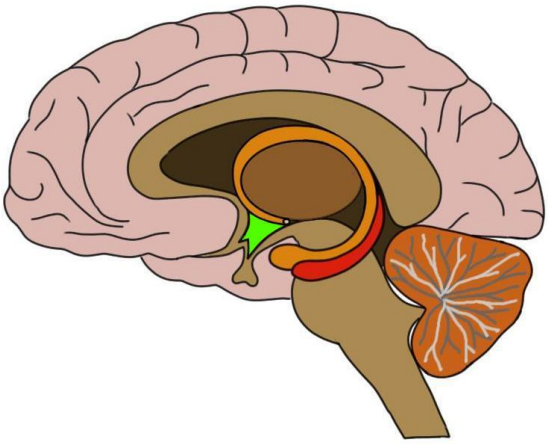
Endocrine Gland List:

Hypothalamus, Pineal, Pituitary, Thyroid, Parathyroid, Thymus, Adrenal, Pancreas, Ovaries, Testes

Target Tissues/Organs

a specific organ on which a hormone, drug, or other substance acts.

Hypothalamus



Hormones: hypothalamic releasing- and inhibiting-hormones

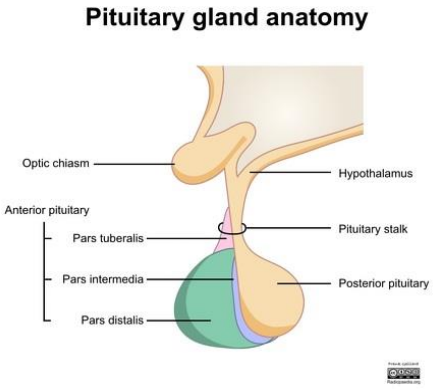
Releasing: CRH, TRH, GnRH, GHRH

Inhibiting: Somatostatin, Prolcatostatin, RFRP-3, GnLH, Follistatin, Myostatin

_____
_____
_____
_____
_____
_____
_____

Function: Regulates anterior pituitary hormones

Anterior Pituitary



The anterior pituitary is a true hormone-synthesizing gland. Its cells produce and release six major hormones:

_____

_____

_____

prolactin (PRL)

follicle-stimulating hormone (FSH)

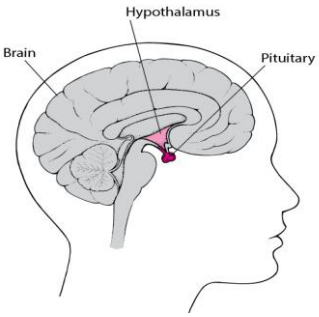
Luteinizing hormone (LH).

Hormone: _____(_____)

Function: Stimulates cell division, bone and muscle growth, and metabolic functions

Hormone: _____ (_____)

Function: Stimulates the thyroid gland



Hypothalamus, Pituitary, Thyroid

_____

_____

(1) The hypothalamus secretes a _____ that stimulates the anterior pituitary gland.

(2) The anterior pituitary releases _____ into the bloodstream.

(3) _____ targets the thyroid gland,

(4) causing it to secrete thyroxine into the bloodstream. _____

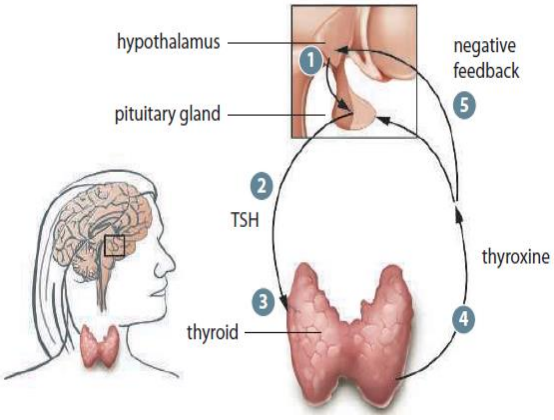
_____

_____

_____

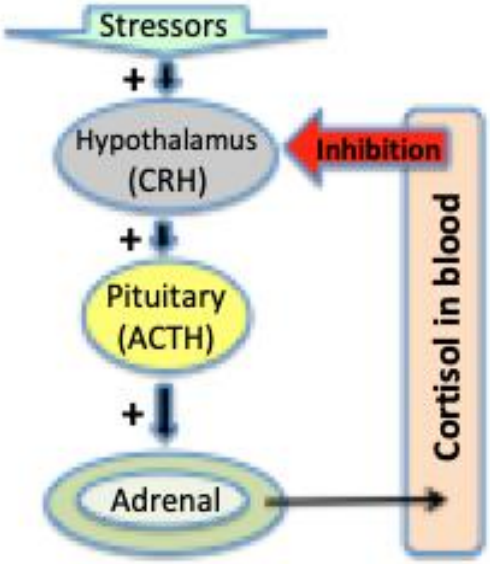
(5) High levels of thyroxine cause _____

_____ on the pituitary and hypothalamus, shutting down production of TSH.



Hormone: _____ (_____)

Function: Stimulates the adrenal cortex to secrete glucocorticoids



Posterior Pituitary

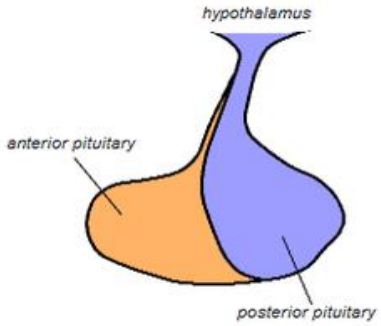
Hormone: _____ (_____)

_____

_____

Function: Promotes the retention of water by the kidneys

ADH targets the nephrons of the kidneys, causing the tubules to become more permeable to water. As a result, more water is reabsorbed, the body excretes less (but more concentrated) urine, and blood pressure increases. The hypothalamus detects this and sends a signal to the posterior pituitary to stop secreting ADH.



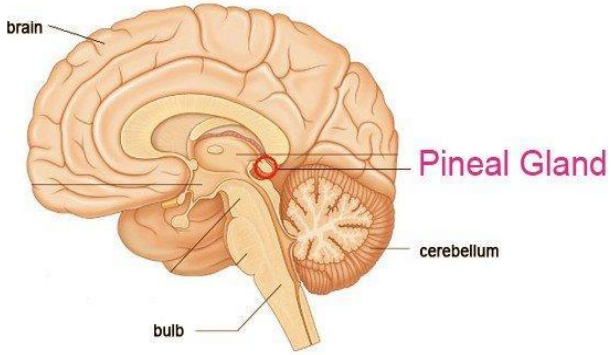
Pineal Gland

Hormone:

_____

Function: Influences the body's daily sleep/wake cycle; thought to promote sleepiness

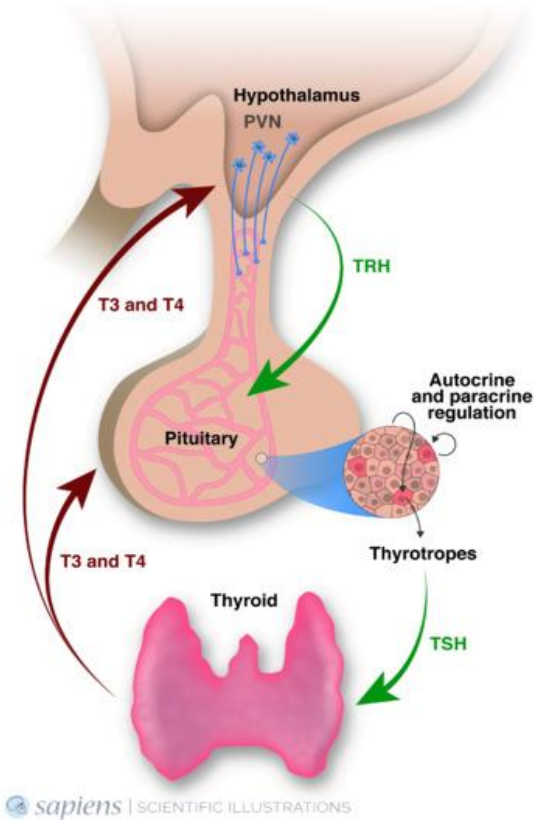
Target: Various Tissues



Thyroid

Hormone: _____
(_____)

Function: Affects all tissues Increases metabolic rate and regulates growth and development



Thyroid Metabolism

_____

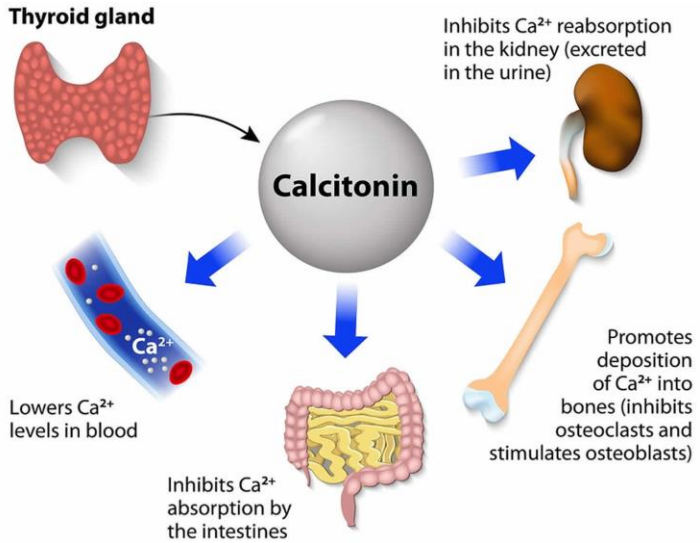
The primary effect of thyroxine is to _____
_____
_____
_____
_____

Thyroxine does not have one specific target organ, but especially stimulates the cells of the _____
_____
_____
_____

Thyroxine also plays an important role in the growth and development of children by influencing the organization of various cells into tissues and organs.

Hormone: _____

Function: Targets bones and kidneys to lower blood calcium by inhibiting release of calcium from bone and reabsorption of calcium by kidneys



_____
_____
_____
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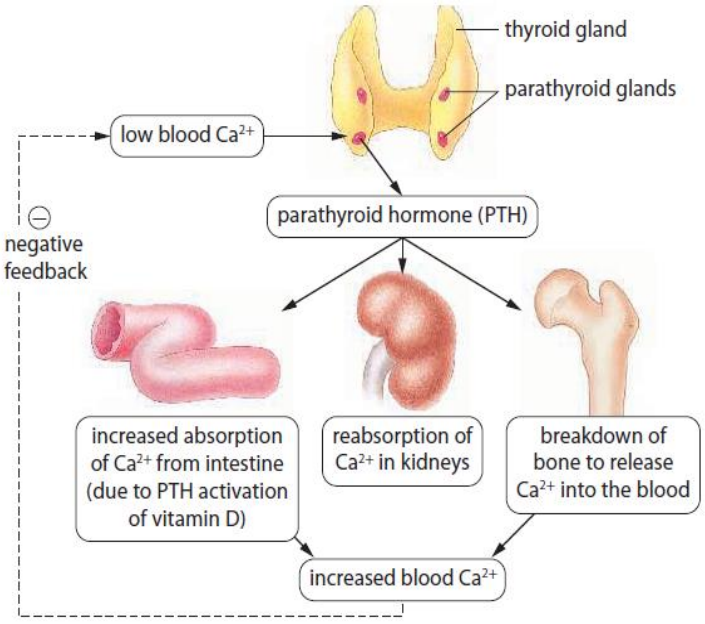
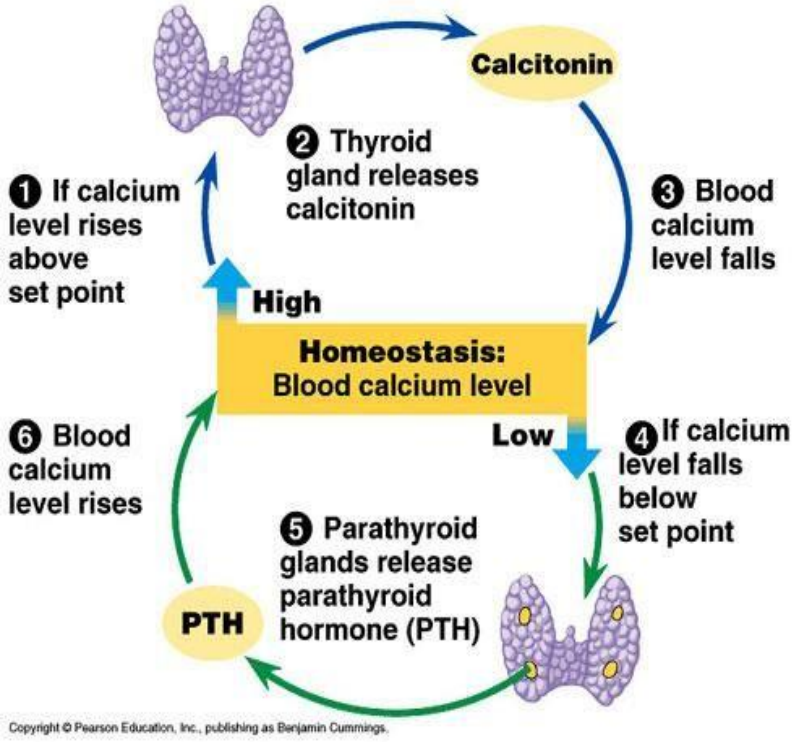
Investigation 10.C

Parathyroid

Hormone: _____ (_____)

Function: Raises blood calcium levels by stimulating the bone cells to release calcium, the intestine to absorb calcium from food, and the kidneys to reabsorb calcium



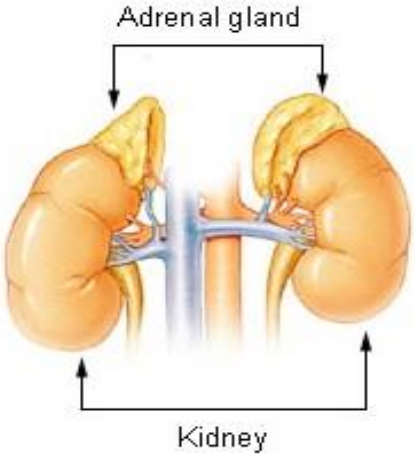


Adrenal Gland

_____

Hormone: **glucocorticoids** (e.g., _____)

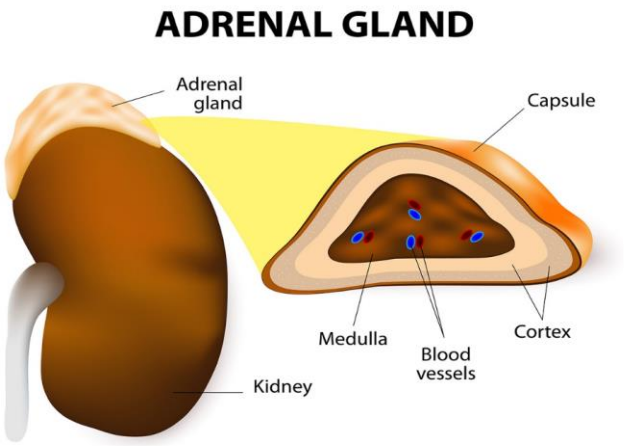
Function: Stimulate tissues to raise blood glucose and break down protein



Hormone: **mineralocorticoids**

(e.g., _____)

Function: Promote reabsorption of sodium and water by the kidneys

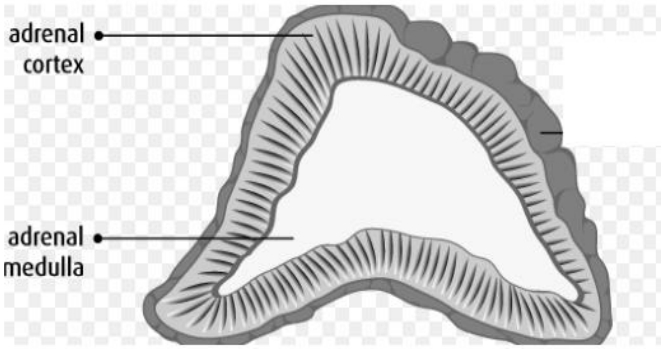


_____

Hormone: _____

These hormones are also called adrenaline and noradrenaline, respectively

Function: Fight-or-flight hormones, Raise blood glucose levels



Stress Response in the Nervous System and Endocrine System

In response to stressors,

1.) the sympathetic nervous system initiates stress responses. The short-term stress response (_____ _____) includes increases in heart rate, blood pressure, and blood glucose.

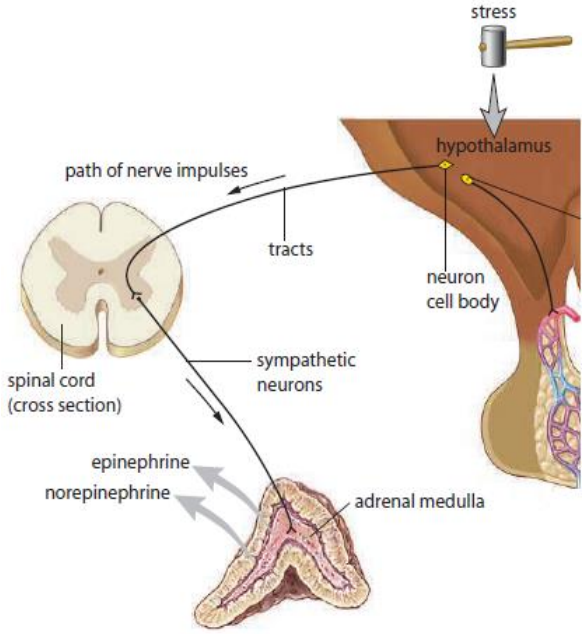
2.) In response to a perceived threat, the hypothalamus sends nerve signals to the adrenal medulla, which releases the short-term stress hormones _____ _____

Adrenal Gland and Stress Response

The _____ produces two closely related hormones: _____

(These hormones are also called adrenaline and noradrenaline, respectively.)

These hormones regulate a short-term stress response that is commonly referred to as the fightor-flight response. The effects of these hormones on the body are similar to those caused by stimulation of the _____ _____.



Adrenal Gland and Short-term Stress Response

Like the sympathetic nervous system, the hormones of the adrenal medulla prepare the body for **fight-or-flight** by increasing metabolism.

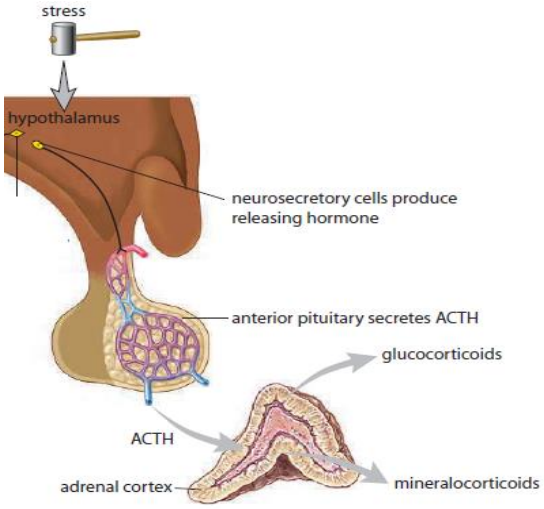
1.) In response to a stressor, neurons of the sympathetic nervous system carry a signal from the hypothalamus directly to the adrenal medulla.

2.) These neurons (rather than hormones) stimulate the adrenal medulla to secrete epinephrine and a small amount of norepinephrine.

3.) These hormones trigger an increase in breathing rate, heart rate, blood pressure, blood flow to the heart and muscles, and the conversion of glycogen to glucose in the liver. At the same time, the pupils of the eyes dilate and blood flow to the extremities decreases. Epinephrine acts quickly.

This is why **epinephrine injections** can be used to treat different life-threatening conditions. For example, it can be used to **stimulate the heart to start beating in someone with cardiac arrest.** In cases of **anaphylactic shock** caused by severe allergies, injected epinephrine will open up the air passages and restore breathing

Adrenal Gland and Long-term Stress Response

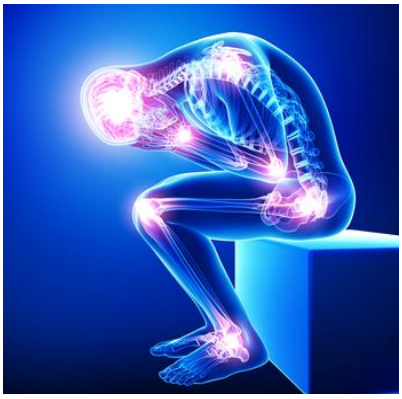


In the long-term stress response, the

1.) The hypothalamus secretes adrenocorticotropic hormone (ACTH),

2.) The adrenal cortex to secretes cortisol.

3.) The adrenal cortex also secretes aldosterone, which increases blood pressure and balances electrolytes in the blood.

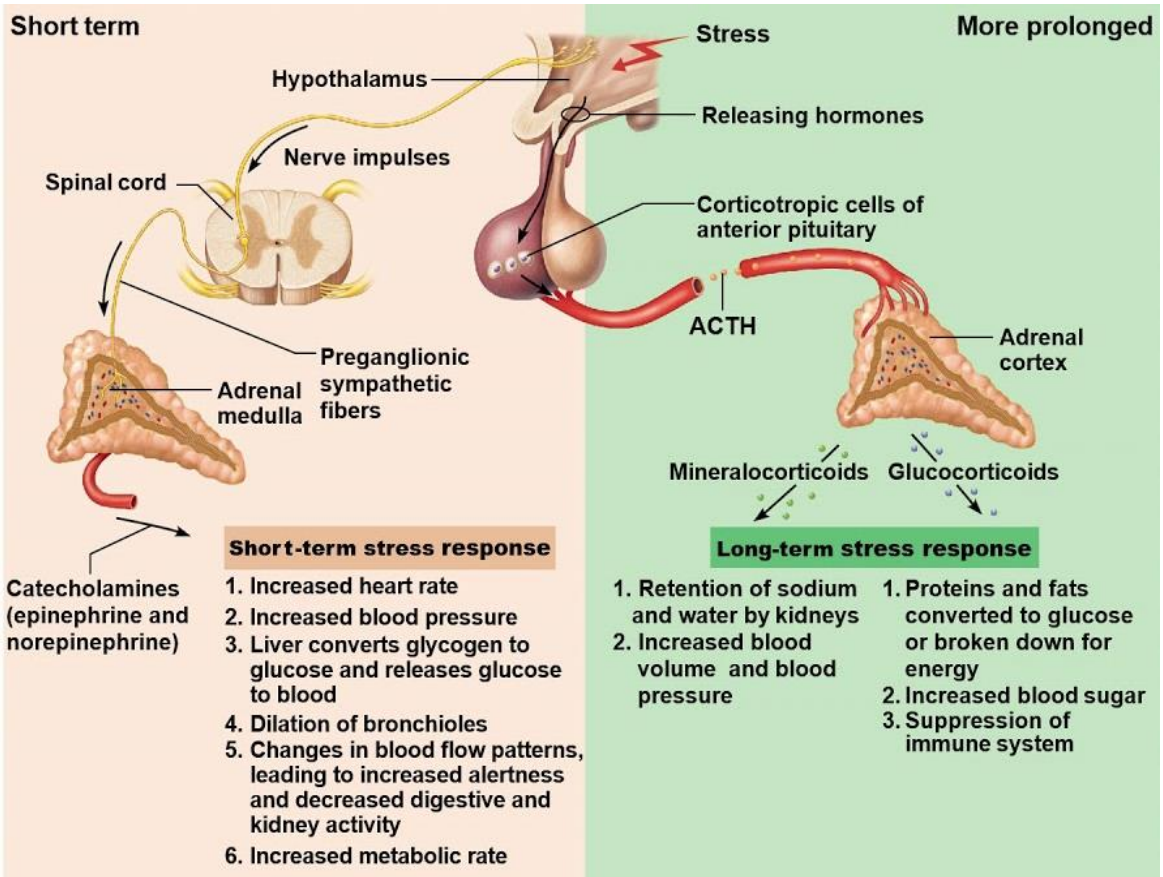


_____

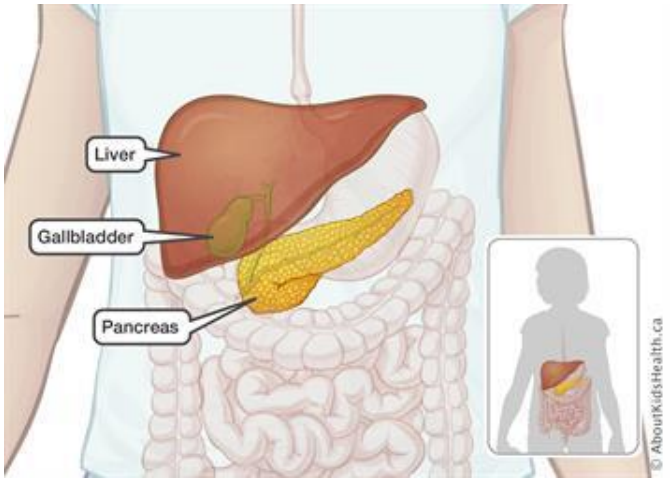
_____

_____

kidney absorbs sodium ions and water, and blood volume and pressure increase protein and fat metabolism stimulated, which releases glucose inflammation is reduced and immune cells suppressed



Pancreas



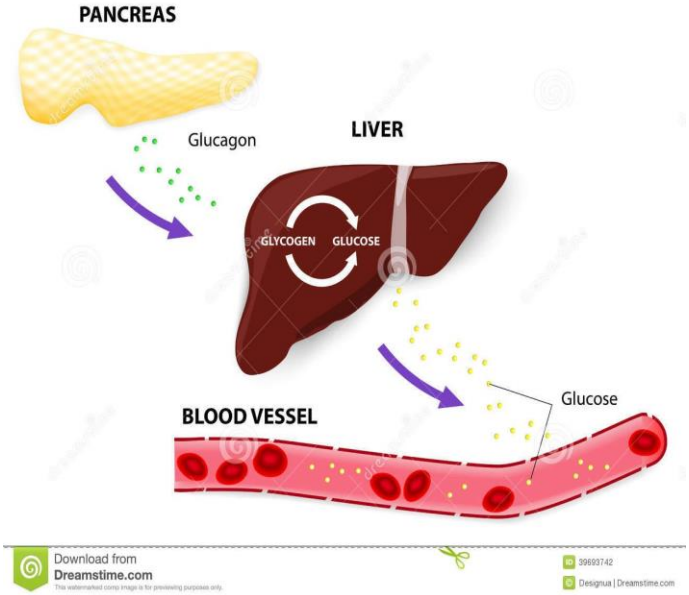
_____
small gland in the abdomen that secretes digestive enzymes; also secretes the hormone insulin

Hormone:
_____

Function: a hormone secreted by the **beta** cells of the islets of Langerhans in the pancreas _____
_____
_____

islet of Langerhans cluster of endocrine cells found throughout the pancreas

Hormone: _____



Function: hormone produced by the alpha cells of the islets of Langerhans in the pancreas to stimulate the liver to convert glycogen back into glucose –
_____
_____
_____
_____

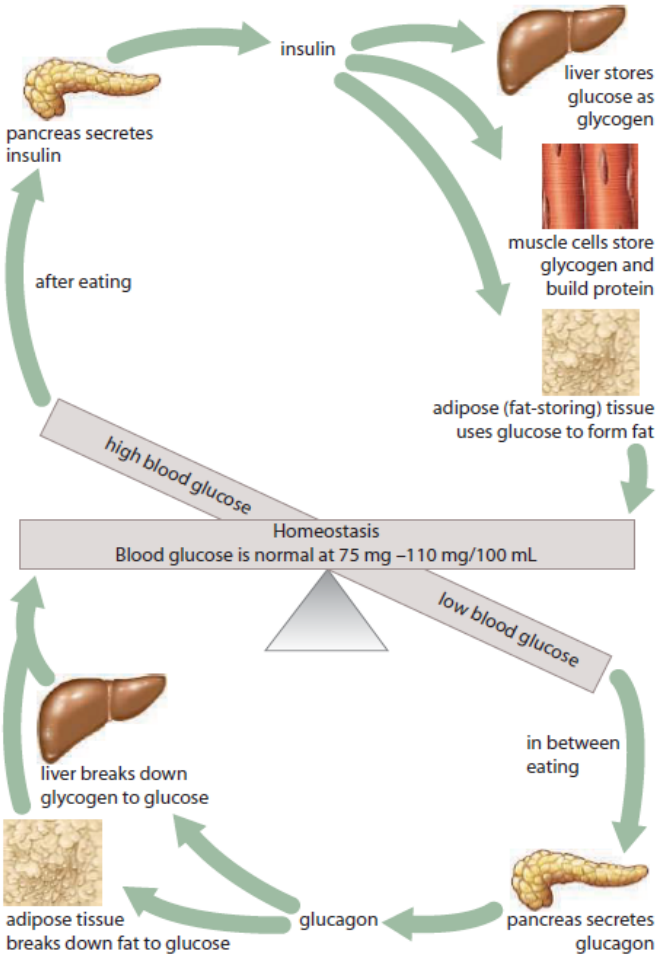
Glycogen The storage polysaccharide found in animal cells.

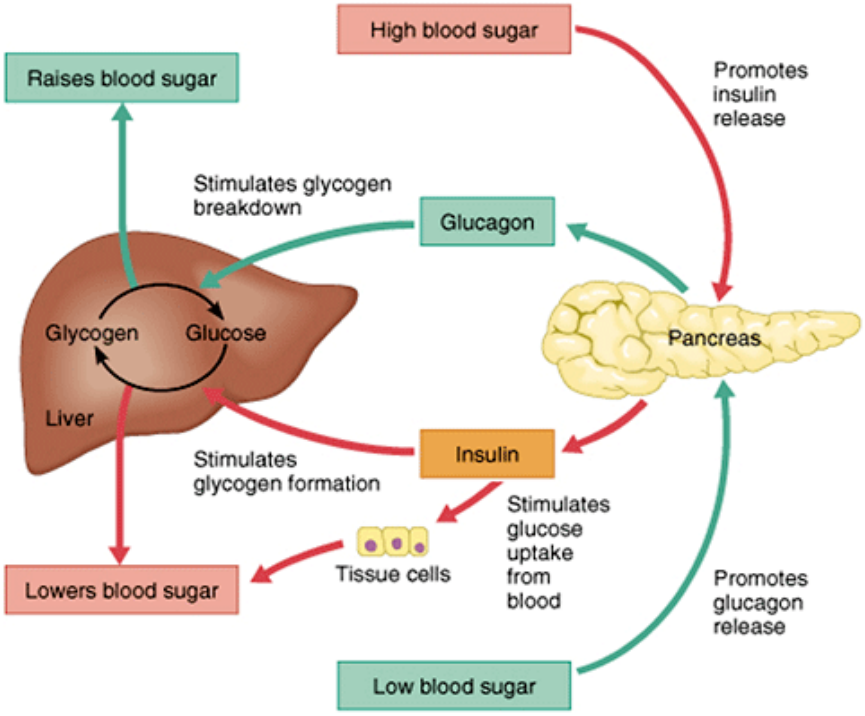
Glucose Regulation

Negative feedback regulates blood glucose levels within a very narrow range. 75-100mg/100ml

The hormones of the pancreas act _____ to regulate blood glucose levels. The beta cells of the islets of Langerhans secrete insulin, which lowers blood glucose. The alpha cells secrete glucagon, which raise blood glucose.

_____
_____
_____
_____
_____



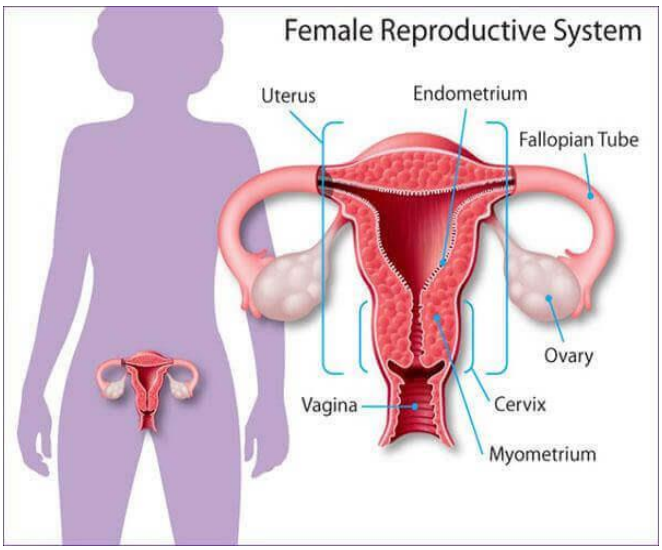


Ovaries

Hormone:

_____

Function: Stimulates uterine lining growth and promotes development of the female secondary sexual characteristics



Testes

Hormone: _____

Function: Promotes sperm formation and development of the male secondary sexual characteristics

Investigation 10B: Evaluating Potential Uses for Human Growth Hormone

Activity 10.1 Blood Glucose Regulation and Homeostasis