Cell to Cell Communication

Hormones and Neurotransmitters

Cell Communication

- The signals received by cells can originate from another cell or from a change in the environment.

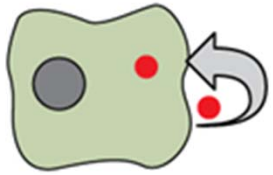
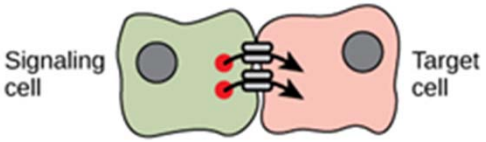
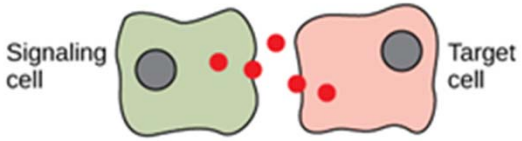
- Cells can sense and respond such external STIMULI such as:
  -- electromagnetic signals (ex: light)
  -- mechanical signals (ex: touch)

- Most often cells communicate with each other using chemical signals.

Types of Cell Signaling

- Autocrine Signaling: the chemical works on the same cell that produces the chemical
- Paracrine Signaling: the signaling cell is nearby the target cell.
- Hormone Signaling: the hormone is secreted by cells of a gland in one part of the body into the bloodstream and travel to the target cells in another part of the body.

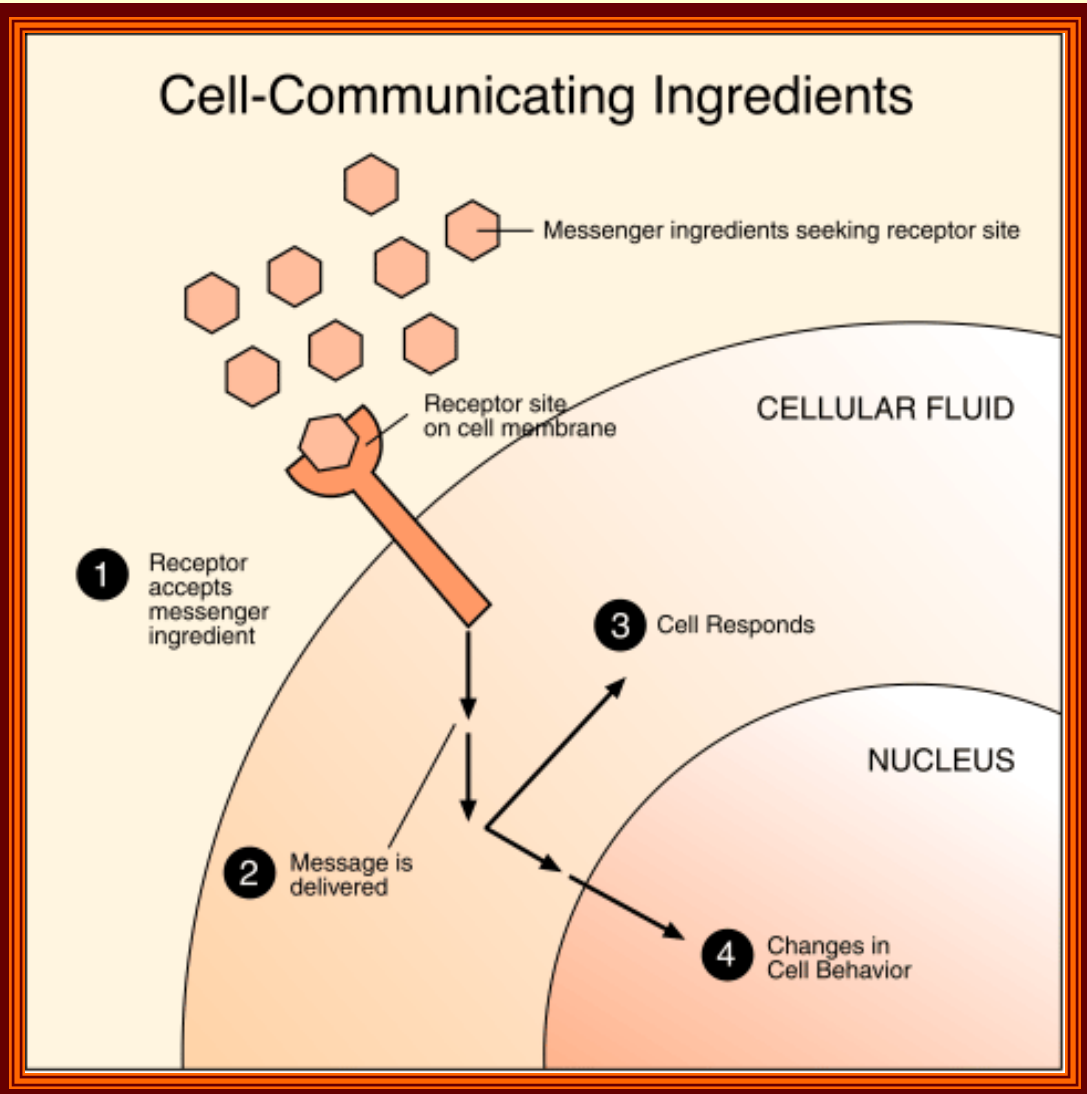
Forms of Cell Signaling

Forms of Chemical Signaling	
Autocrine	A cell targets itself.
	
Signaling across gap junctions	A cell targets a cell connected by gap junctions.
	
Paracrine	A cell targets a nearby cell.
	
Endocrine	A cell targets a distant cell through the bloodstream.
	

Cell Receptor Proteins

- In all types of cell signaling, target cells must have receptors on the cell membrane that will fit with the chemical signal.
- If the chemical signal does not fit with receptors on the cell membrane, the cell will not be affected.
- The binding of a chemical to a receptor cell triggers a series of reactions within the cell that affects the function of that cell.

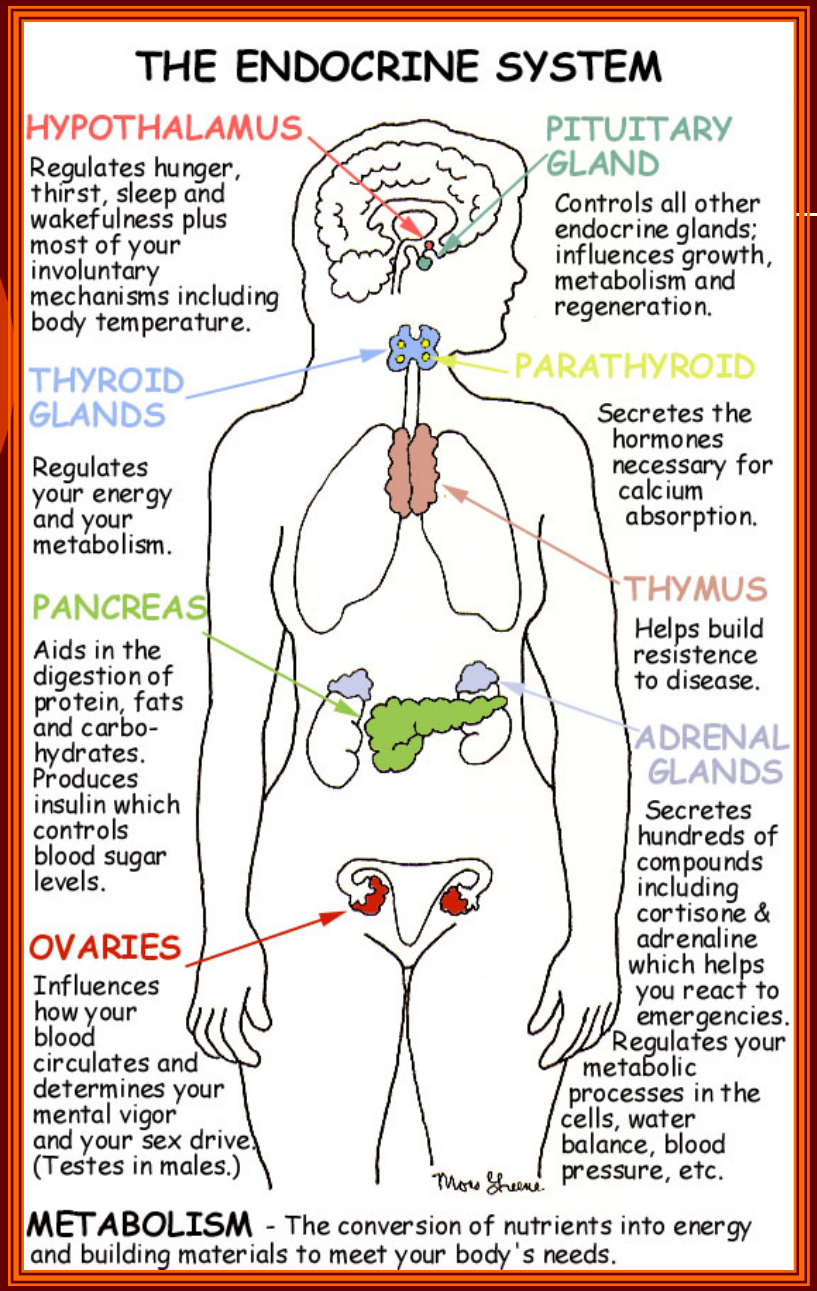
How Cells Communicate

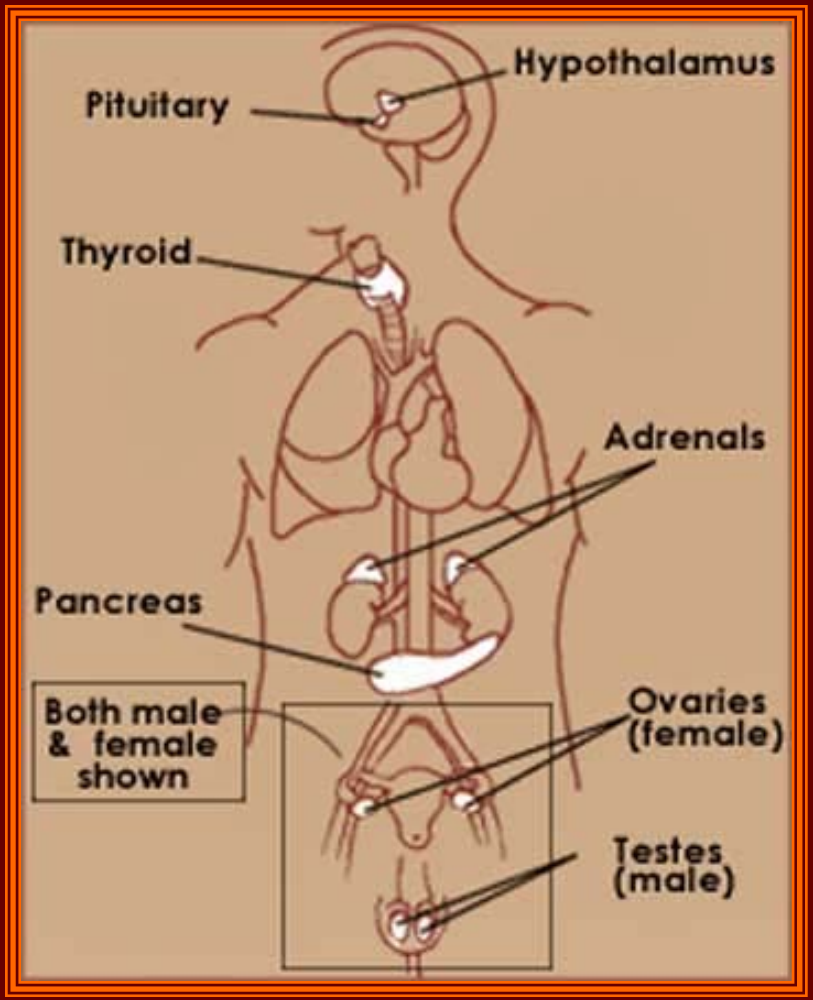


Hormones

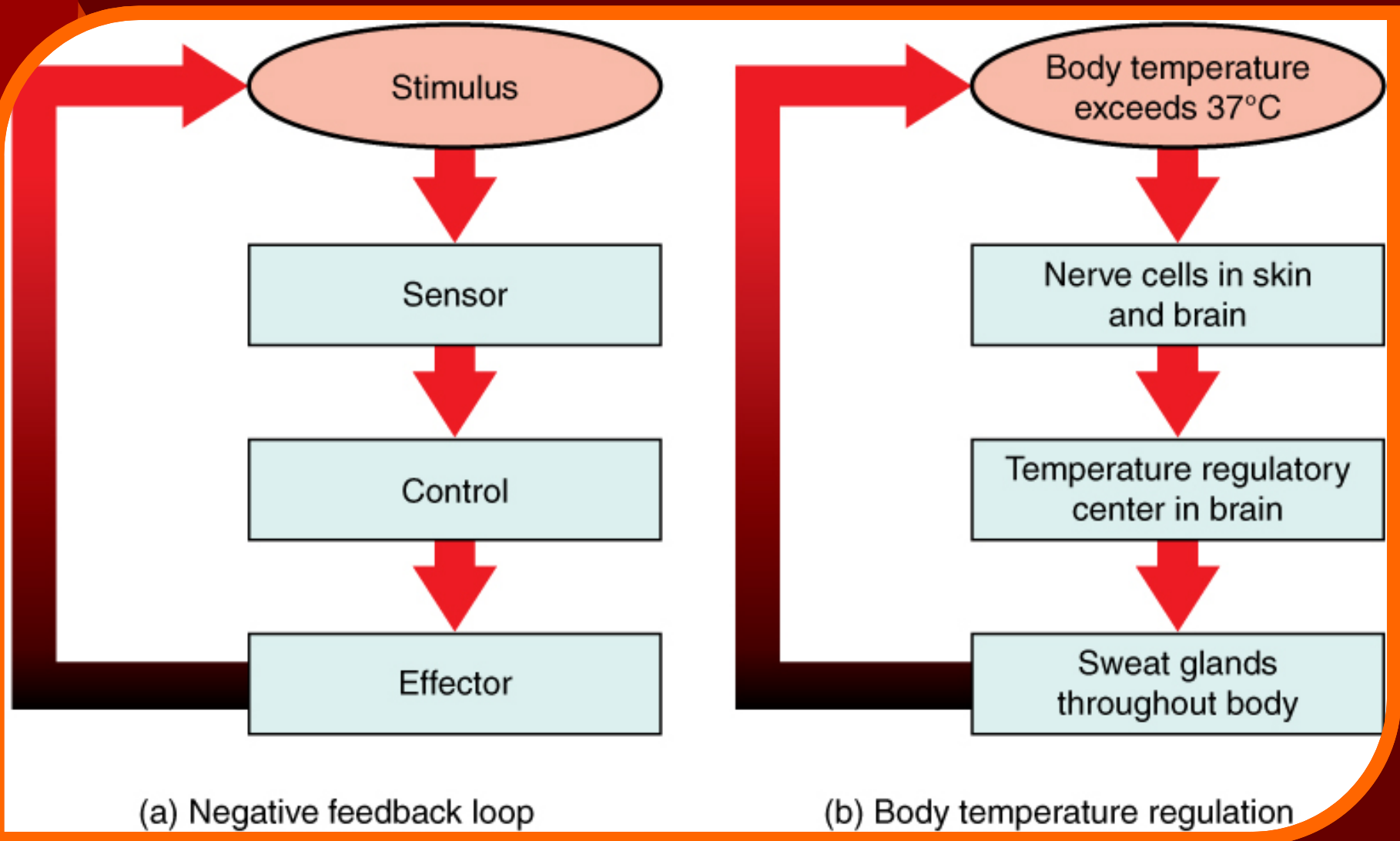
- HORMONES are protein chemical messengers.
- In humans, hormones are secreted by the GLANDS of the ENDOCRINE SYSTEM.
- Generally, glands in one part of the body target cells in another part of the body.
- However, in some cases, hormones may be paracrine signalers, acting on cells within their local area.
- In vertebrates, hormones travel in the circulatory system to get to their target cells.
- Hormone receptors are found either exposed on the surface of the cell or within the cell, depending on the cell and they type of hormone.

Hormones

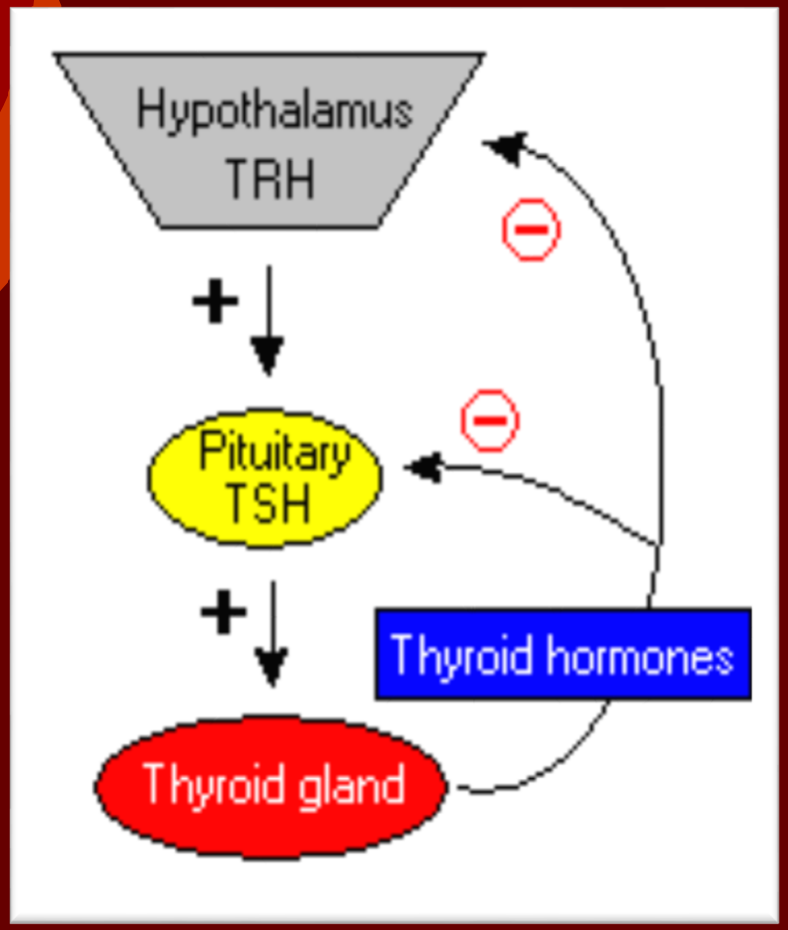

THE ENDOCRINE SYSTEM
HYPOTHALAMUS
Regulates hunger, thirst, sleep and wakefulness plus most of your involuntary mechanisms including body temperature.
PITUITARY GLAND
Controls all other endocrine glands; influences growth, metabolism and regeneration.
THYROID GLANDS
Regulates your energy and your metabolism.
PARATHYROID
Secretes the hormones necessary for calcium absorption.
PANCREAS
Aids in the digestion of protein, fats and carbo-hydrates. Produces insulin which controls blood sugar levels.
THYMUS
Helps build resistence to disease.
ADRENAL GLANDS
Secretes hundreds of compounds including cortisone & adrenaline which helps you react to emergencies. Regulates your metabolic processes in the cells, water balance, blood pressure, etc.
OVARIES
Influences how your blood circulates and determines your mental vigor and your sex drive. (Testes in males.)
METABOLISM - The conversion of nutrients into energy and building materials to meet your body's needs.


Hypothalamus
Pituitary
Thyroid
Adrenals
Pancreas
Both male & female shown
Ovaries (female)
Testes (male)

Negative Feedback

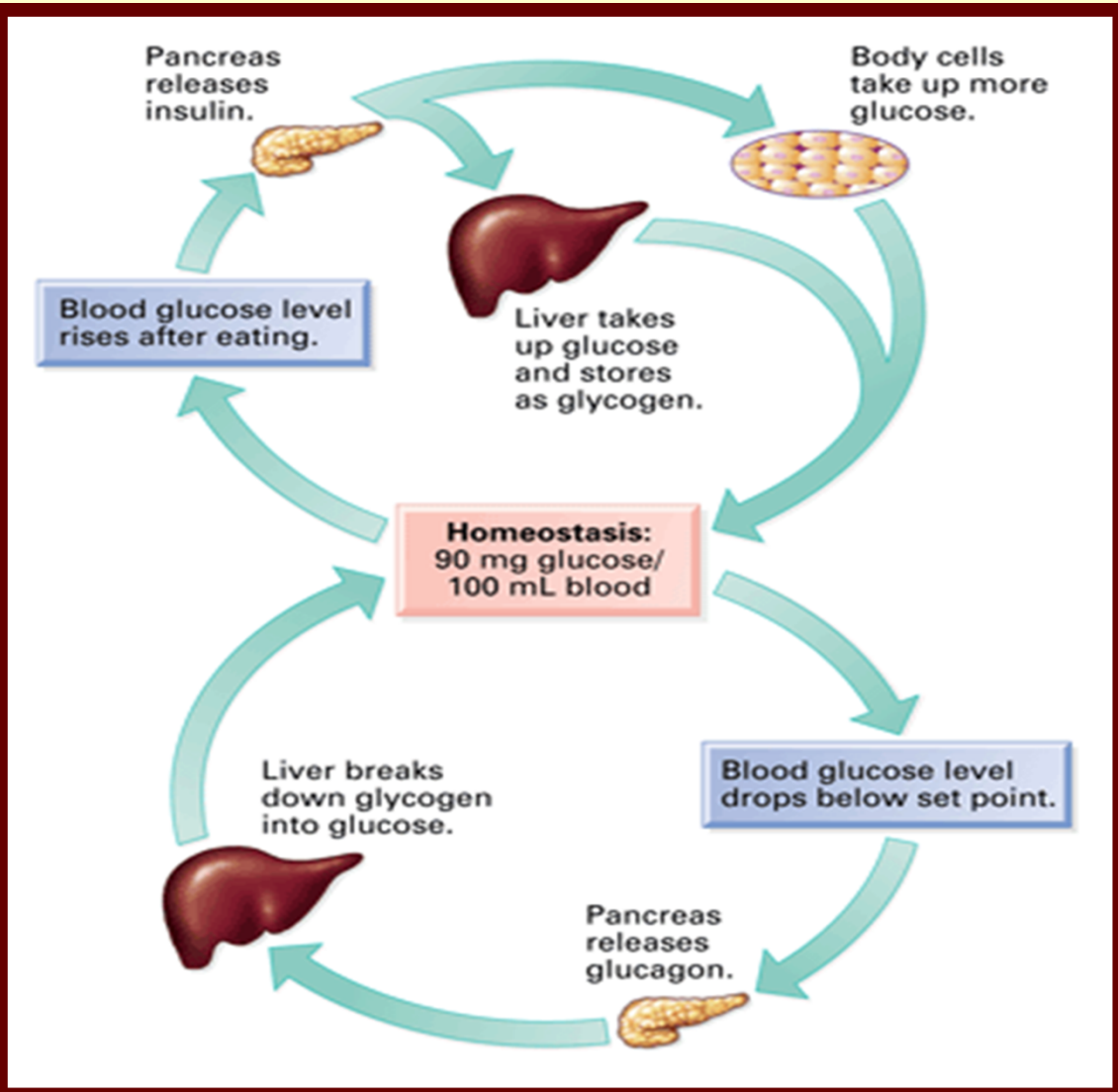


Thyroid & Negative Feedback



- The pituitary secretes TSH which influences the thyroid gland to produce thyroxin .
- When thyroxin blood levels become to high, it negatively feeds back to the pituitary to shut off TSH to decrease blood levels of thyroxin.
- The hypothalamus (only part of the brain that has an endocrine function) monitors the blood levels of hormones & secretions of the pituitary gland.

Feedback Mechanisms: Insulin & Glucagon



Neurons

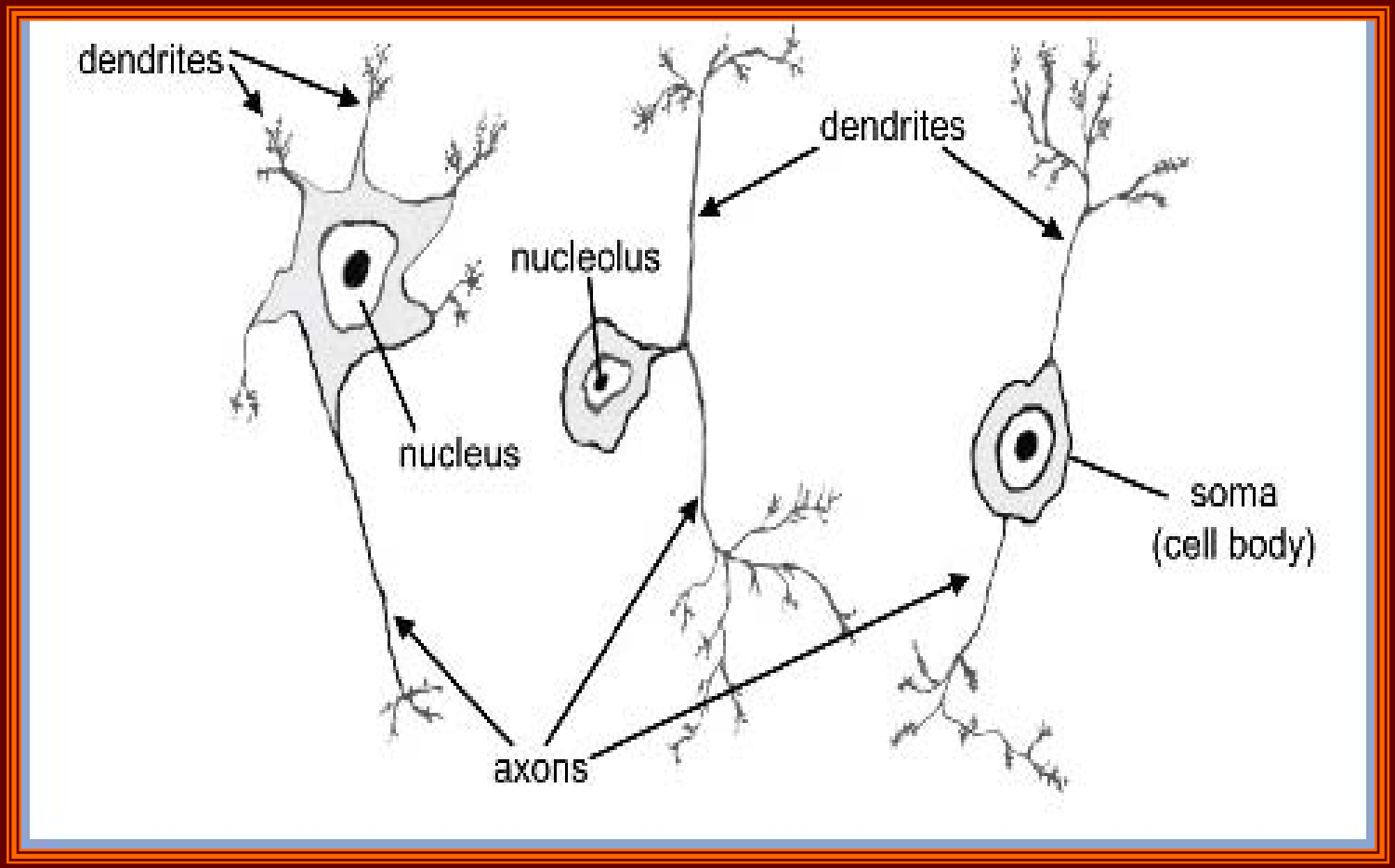
- NEURONS are specialized cells that make up the nerves of the nervous system.
- Sensory information is picked up receptors embedded in our receptor cells of our sense organs.
- Sensory information is converted to an electrochemical signal or IMPULSE which travels in ONE direction from sensory neurons to interneurons of the spine and brain (where it is interpreted) and then sent back down the interneurons of the spine to the motor neurons to glands or muscles, collectively called EFFECTORS, which carry out the response to the stimulus.
- Nerves are made up of individual neurons that are separated by one another by spaces called SYNAPSES.

Types of Neurons

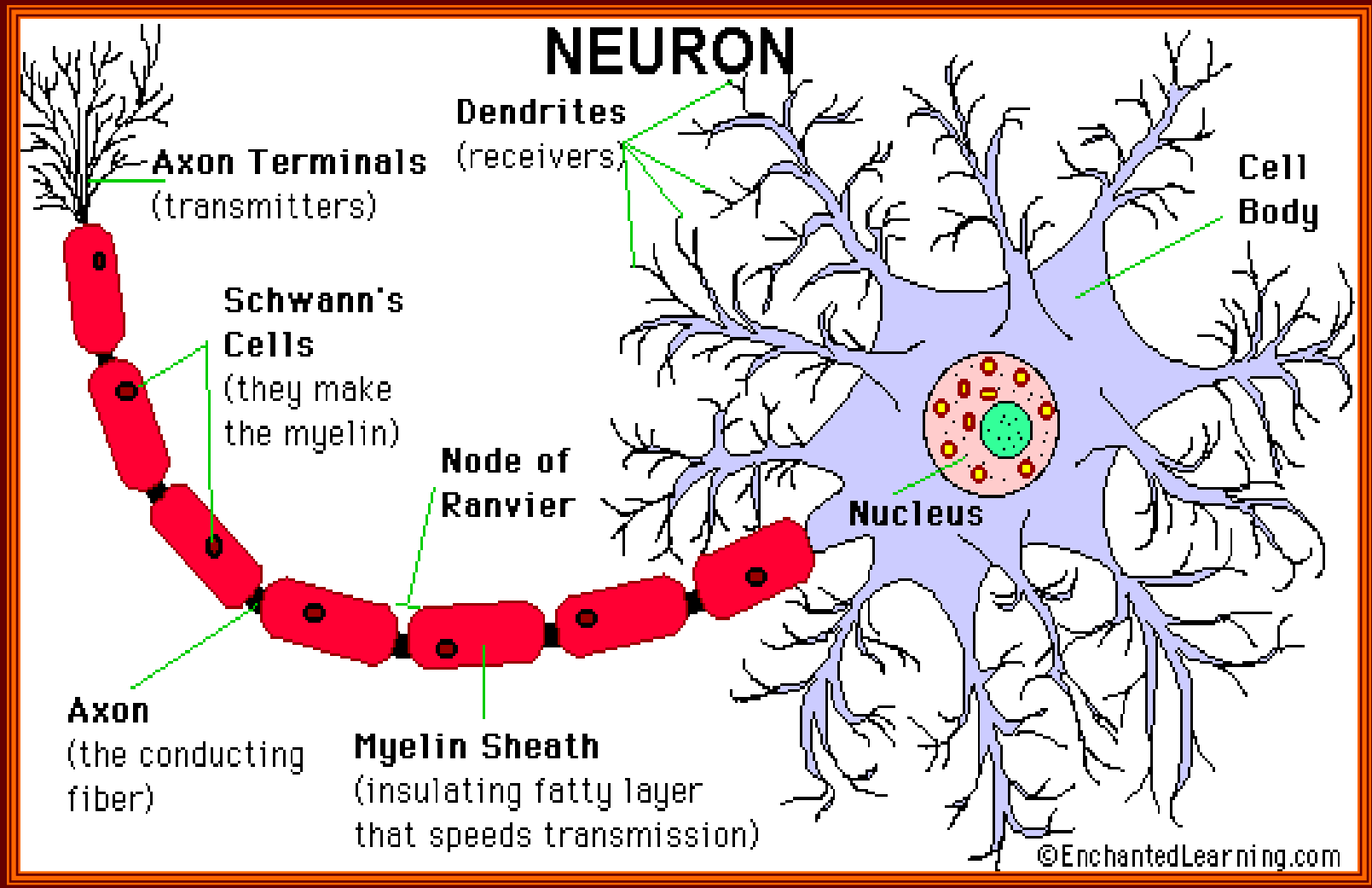
- There are 3 types of neurons:
- --*sensory neurons:* carry the stimuli from the sensory organs to the spinal cord and brain for interpretation.
- --*interneurons* (associative neurons): found in the spinal cord, and brain, between the sensory and motor neurons.
- *motor neurons:* carry the interpretation of sensory input to the muscles and/or endocrine glands, which respond to the stimulus.

Diagram of Neuron Cells

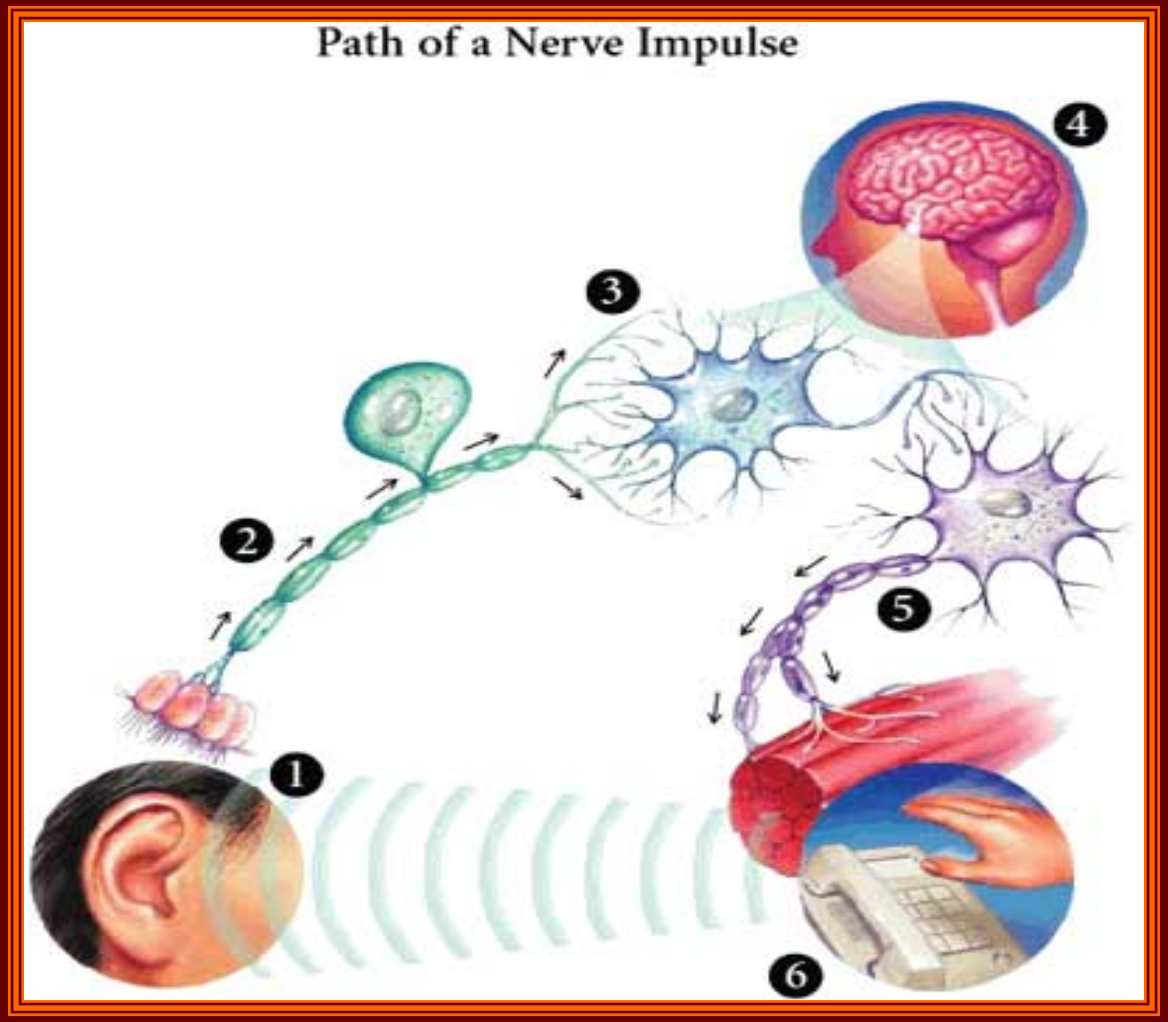
Motor Sensory Interneuron



Parts of the Neuron



The Nerve Pathway



Identify structures 1-5 in the Nerve Impulse Path…

1.

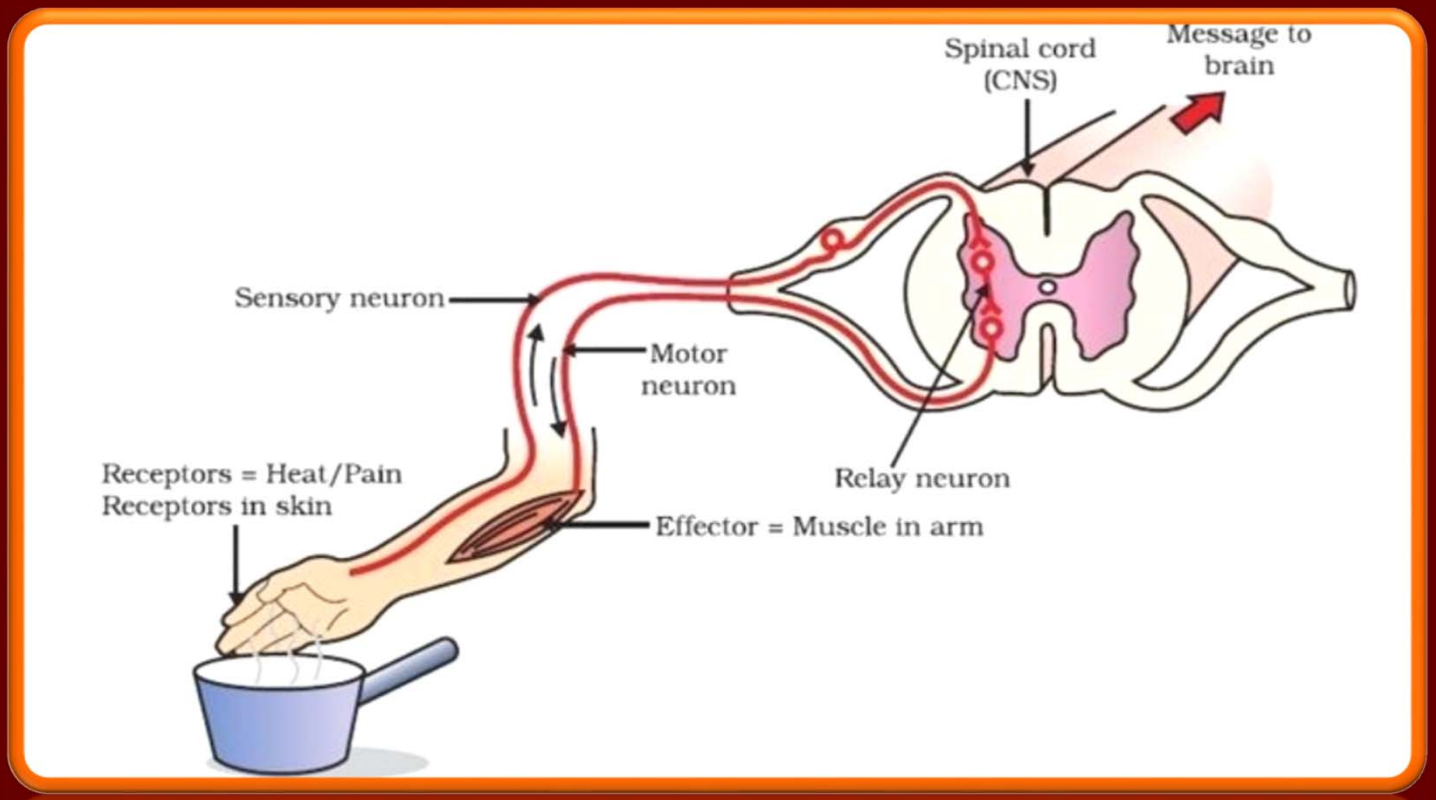
2.

3.

4.

5.

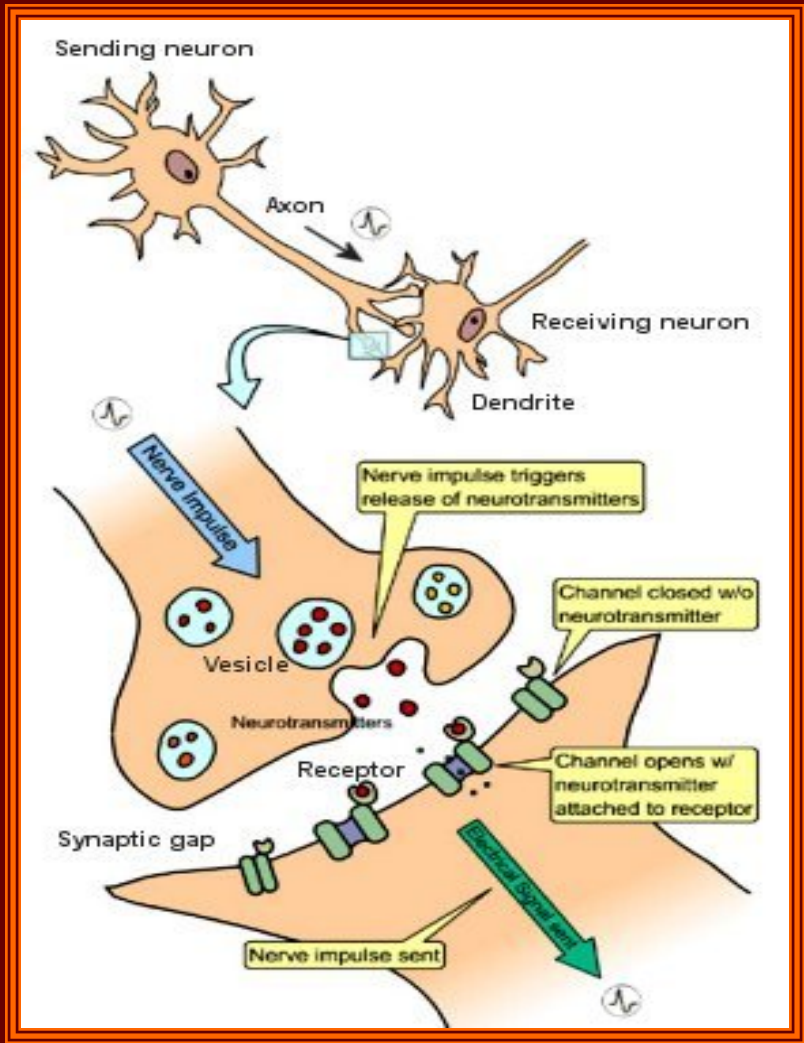
Reflex Arc



- Protective, inborn responses
- Spinal interneurons respond to stimulus first, then information is sent to the brain for further interpretation.

Neurotransmitters

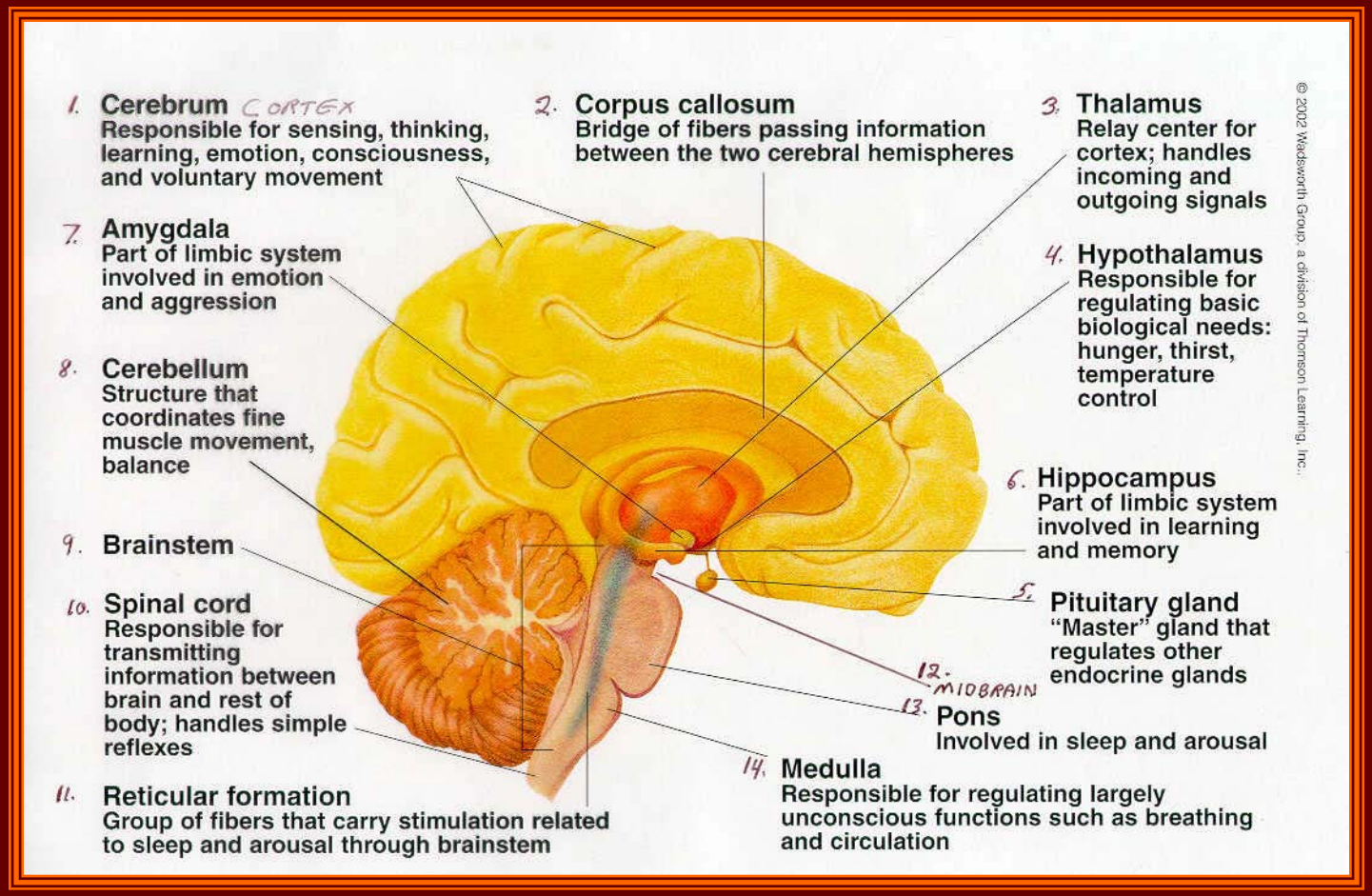
- At the end of the terminal branches are synaptic buttons, which produce NEUROTRANSMITTERS that carry the impulse across the synapse.
- If chemical signaling is blocked in any way, cells communication may be interrupted and organism homeostasis may be negatively affected.



Examples of Neurotransmitters

- Examples of neurotransmitters include:
  --Acetylcholine (ACh): involved in muscle action
  --Dopamine: brain neurotransmitter, involved in regulating movement and emotion, Loss of dopamine has been implicated in the development of Parkinson's disease.
  --Serotonin: involved in sleep, depression, and memory

Structures of the Brain



Divisions of the Nervous System