

BP 201T. HUMAN ANATOMY AND PHYSIOLOGY-II (Theory)

UNIT-ONE(PART-1)



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UNIT-1 (PART-1)
5 Hours

Organization of nervous system, neuron, neuroglia, classification and properties of nerve fibre, electrophysiology, action potential, nerve impulse, receptors, synapse, neurotransmitters.

NERVOUS SYSTEM

ORGANIZATION OF THE NERVOUS SYSTEM

The nervous system is one of the smallest and yet the most complex of the 11 body systems.

It's subdivisions include : the central nervous system and the peripheral nervous system.

Neurology deals with normal functioning and disorders of the nervous system.

A neurologist is a physician who diagnoses and treats disorders of the nervous system.

FUNCTIONS OF THE NERVOUS SYSTEM

Gathers information from both inside and outside the body - Sensory Function

Transmits information to the processing areas of the brain and spine

Processes the information in the brain and spine – Integration Function

Sends information to the muscles, glands, and organs so they can respond appropriately
– Motor Function

DIVISIONS OF NERVOUS SYSTEM

1.CENTRAL NERVOUS SYSTEM

2.PERIPHERAL NERVOUS SYSTEM

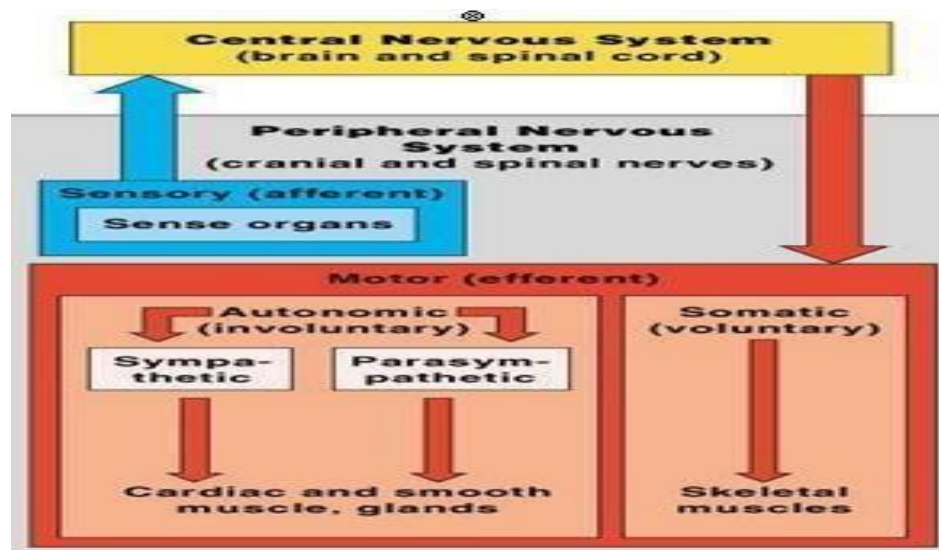
CENTRAL NERVOUS SYSTEM

The central nervous system (CNS) consists :

BRAIN : The brain is the part of the CNS that is located in the skull and contains about 85 billion neurons.

SPINAL CORD: The spinal cord is connected to the brain through the foramen magnum of the occipital bone and is encircled by the bones of the vertebral column. The spinal cord contains about 100 million neurons.

The CNS processes many different kinds of incoming sensory information. It is also the source of thoughts, emotions, and memories. Most signals that stimulate muscles to contract and glands to secrete originate in the CNS.



THE PERIPHERAL NERVOUS SYSTEM

Sensory (afferent) division - Nerve fibers that carry information *to* the central nervous system

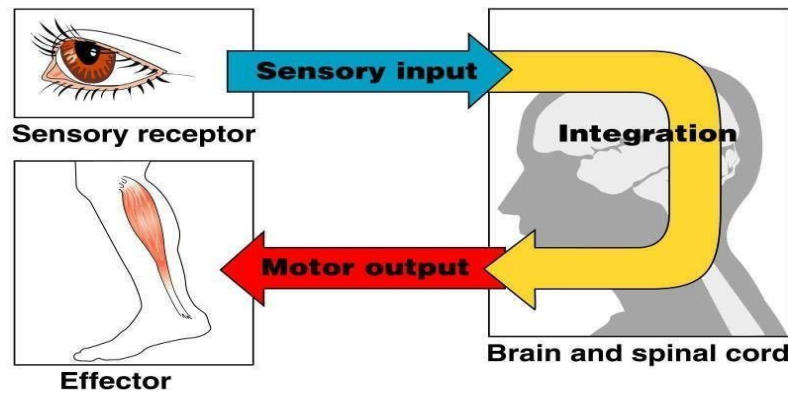
Motor (efferent) division - Nerve fibers that carry impulses *away from* the central nervous system.

This division is further subdivided into a somatic nervous system and an autonomic nervous system.

THE SOMATIC NERVOUS SYSTEM (SNS)[VOLUNTARY] :conveys output from the CNS to skeletal muscles only. Because its motor responses can be consciously controlled, the action of this part of the PNS is voluntary.

THE AUTONOMIC NERVOUS SYSTEM [INVOLUNTARY]:conveys output from the CNS to smooth muscle, cardiac muscle, and glands. Because its motor responses are not normally under conscious control, the action of the ANS is involuntary.

The ANS is comprised of two main branches, the sympathetic nervous system and the parasympathetic nervous system.



STRUCTURE OF A NERVE

A nerve is a bundle of neuron fibers found outside the CNS.

Endoneurium. Each fiber is surrounded by a delicate connective tissue sheath, an endoneurium.

Perineurium. Groups of fibers are bound by a coarser connective tissue wrapping, the perineurium, to form fiber bundles, or **fascicles**.

Epineurium. Finally, all the fascicles are bound together by a tough fibrous sheath, the epineurium, to form the cordlike nerve.

Mixed nerves. Nerves carrying both sensory and motor fibers are called mixed nerves.

Sensory nerves. Nerves that carry impulses toward the CNS only are called sensory, or afferent, nerves.

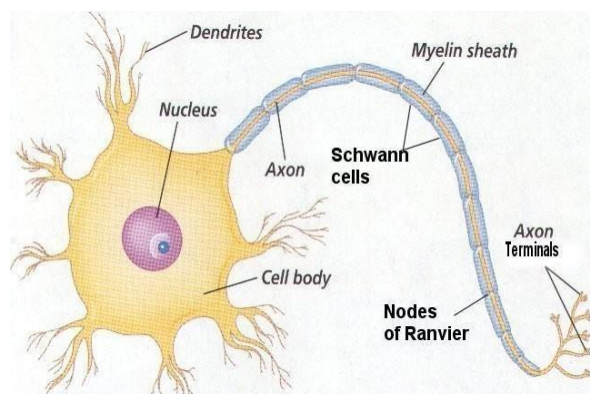
Motor nerves. Those that carry only motor fibers are motor, or efferent, nerves.

BASIC CELLS OF THE NERVOUS SYSTEM

NEURON

Basic functional cell of nervous system

Transmits impulses (up to 250 mph)



PARTS OF A NEURON

Dendrite – receive stimulus and carries it impulses toward the cell body

Cell Body with nucleus – nucleus & most of cytoplasm

Axon – fiber which carries impulses away from cell body

Schwann Cells- cells which produce myelin or fat layer in the Peripheral Nervous System

Myelin sheath – dense lipid layer which insulates the axon – makes the axon look gray

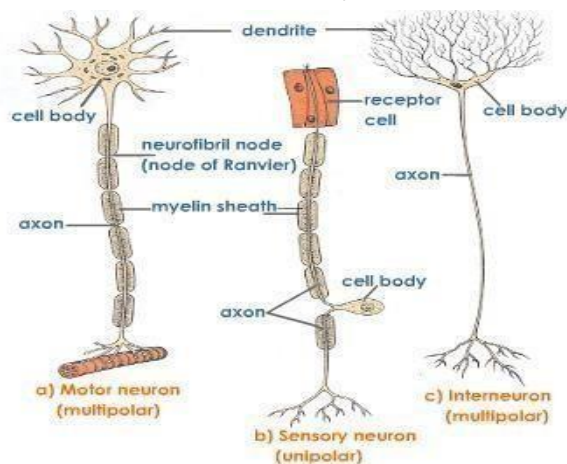
Node of Ranvier – gaps or nodes in the myelin sheath. Impulses travel from dendrite to cell body to axon

THREE TYPES OF NEURONS

Sensory neurons – bring messages to CNS

Motor neurons - carry messages from CNS

Interneurons – between sensory & motor neurons in the CNS



IMPULSES

A stimulus is a change in the environment with sufficient strength to initiate a response.

Excitability is the ability of a neuron to respond to the stimulus and convert it into a nerve impulse

All of Nothing Rule – The stimulus is either strong enough to start and impulse or nothing happens

Impulses are always the same strength along a given neuron and they are self-propagating – once it starts it continues to the end of the neuron in only one direction- from dendrite to cell body to axon

The nerve impulse causes a movement of ions across the cell membrane of the nerve cell.

SYNAPSE

Synapse - small gap or space between the axon of one neuron and the dendrite of another - the neurons do not actually touch at the synapse

It is junction between neurons which uses neurotransmitters to start the impulse in the second neuron or an effector (muscle or gland)

The synapse insures oneway transmission of impulses

NEUROTRANSMITTERS

These are the chemicals in the junction which allow impulses to be started in the second neuron

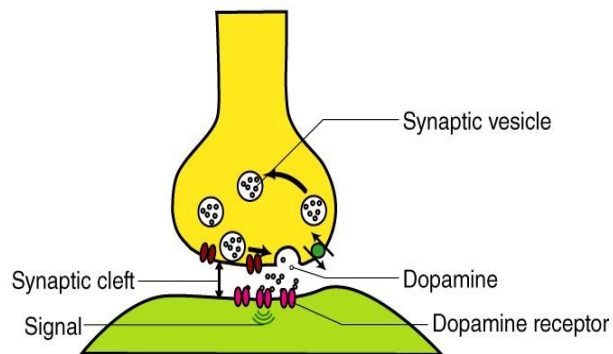
“Neurotransmitter is a type of chemical messenger that transmits signals across a chemical synapse, from one neuron to another.”

A neurotransmitter is the body’s chemical messenger. They are molecules that transmit signals from neurons to

muscles, or between different neurons. The transmission of signals between two neurons occurs in the synaptic cleft.

The electrical signals that travel along the axon are briefly converted into chemical signals through neurotransmitters.

NEUROTRANSMITTER



TYPES OF NEUROTRANSMITTER

There are the following different types of neurotransmitter:

EXCITATORY NEUROTRANSMITTERS

These type of neurons increase the chances of the neuron firing an action potential. Epinephrine and norepinephrine are the two excitatory neurotransmitters.

INHIBITORY NEUROTRANSMITTERS

These have inhibitory effects on the neurons and have fewer chances of the neuron firing an action potential. For eg., serotonin and gamma-aminobutyric acid (GABA).

MODULATORY NEUROTRANSMITTER

These can affect a large number of neurotransmitters at the same time. These can also influence the effect of other chemical messengers.

REFLEX ACTIVITY

Reflex is an involuntary and sudden response to stimuli. It happens to be an integral component of the famed survival instinct.

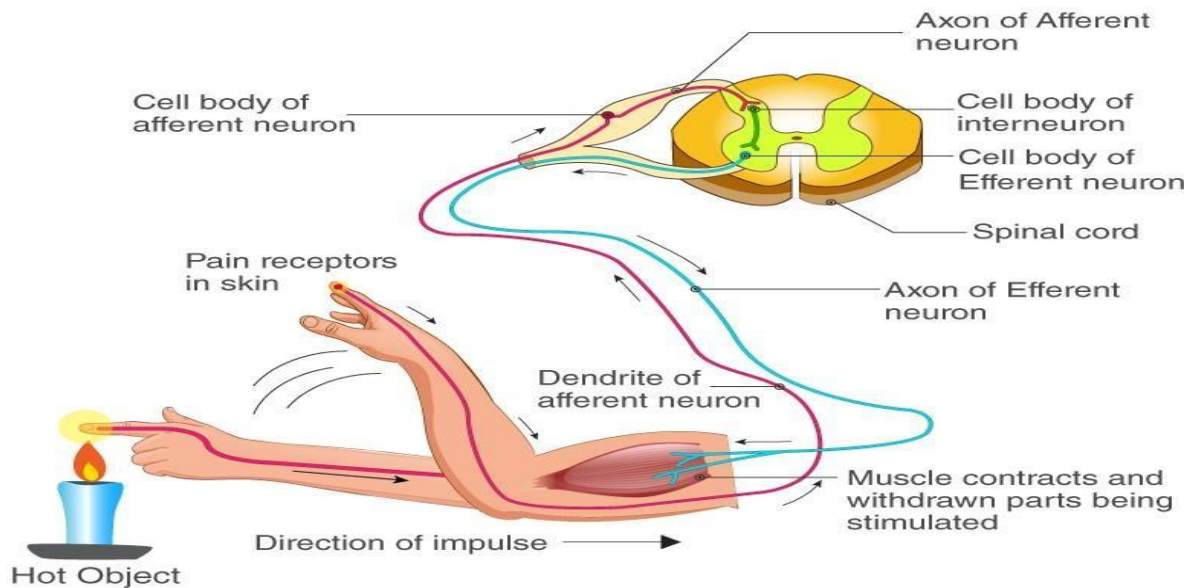
Most of the common reflexes are a response to all the well-trained, accumulated knowledge of caution that we have internalized. It could be anything and ranges from the reflex action of abruptly withdrawing the hand as it comes in contact with an extremely cold or hot object. This action is termed as the reflex action. It has a subtle relation to instinct.

A point to be thought upon is that we all have our instincts differently depending on our past experiences and understanding. A reflex is a reaction triggered by this instinct. At

times, we have no prior knowledge if the pan is hot or not. In other words, instinct has little to do with reflex.

REFLEX ACTION

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Reflex Arc Diagram

From an evolutionary perspective, reflex action has played an important part in ensuring the survival of organisms as it has enabled quick reactions to certain situations where an organism's life could be at stake

The Action of Neuron

Two neurons dominate the pathway, afferent nerves (receptor) and the efferent **nerves** (effector or excitor).

The events that take place:

- ❖ Firstly, it begins with receptor detecting the stimulus or a sudden change in the environment, where the instinct again has a role to play. The stimulus is received from a sensory organ.
- ❖ Then, the sensory neuron sends a signal to the relay neuron.
- ❖ This is followed with the relay neuron sending the signal to the motor neuron.
- ❖ Further, the motor neuron sends a signal to the effector.
- ❖ The effector produces an instantaneous response, for example, pulling away of

the hand or a knee-jerk reaction.

The moment the afferent neuron receives a signal from the sensory organ; it transmits the impulse via a dorsal nerve root into the **Central Nervous System**. The efferent neuron then carries the signal from the CNS to the effector. The stimulus thus forms a reflex arc.

In a reflex action, the signals do not route to the brain – instead, it is directed into the synapse in the spinal cord, hence the reaction is almost instantaneous.

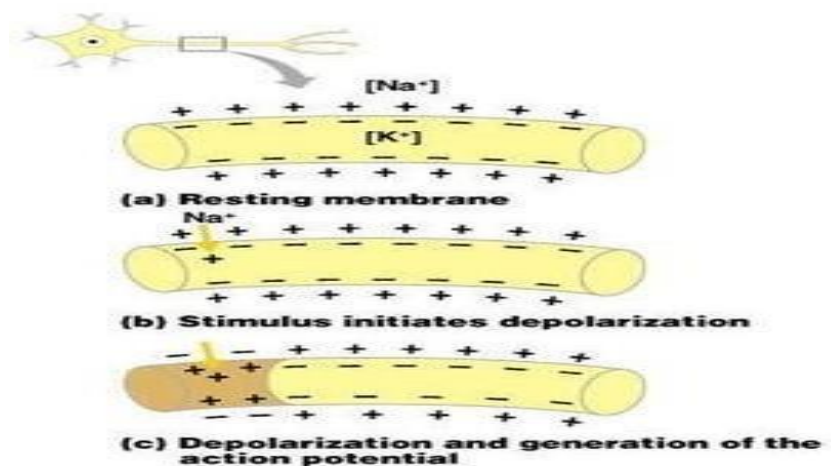
ELECTROCHEMICAL NERVE IMPULSE

Steps involved include:

Dendrite depolarization where the stimulus depolarizes the dendrite's membrane

Sodium (Na^+) flows inside the membrane with the help of Na^+ pumps

This exchange of ions initiates an (+) action potential in the neuron



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