



NEET Biology

Short Notes

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In this article we are providing you all short notes on Neural Control and Coordination for NEET 2019. This is one of the important and theoretical chapter from Unit Human Physiology as many concepts required revision at frequent intervals. Significant questions are asked from this chapter in NEET, AIIMS, JIPMER and various other medical examination. So Let's begin with the brief introduction about Neural system.

NEURAL CONTROL AND COORDINATION

INTRODUCTION

The process of interaction of two or more organs in order to adjunct the functions is called the coordination. Similarly, when these organs are coordinated to perform the body functions as a unit, it is called the integration. The neural system of the human body is responsible to catalyse the coordination and integration.

NEURAL SYSTEM

It is made up of specialised cells called the neurons that are arranged in the form of the central and peripheral nervous system. The neurons are capable of the following:

1. Sensation of the stimuli via specific receptors from the environment.
2. Processing of the stimuli to gather the information.
3. Response to the stimuli via effector organs.

HUMAN NEURAL SYSTEM

It can be studied under following heads:

1. CENTRAL NEURAL SYSTEM (CNS): It is comprised of the major organs called the brain and spinal cord that lie along the mid-dorsal axis of the body.
2. PERIPHERAL NEURAL SYSTEM (PNS): It is made up of the neurons that arise from the central neural system and run along the body to innervate various organs. It is further divided as somatic neural system and autonomic neural system.

TYPES OF NERVE FIBRES OF THE PNS

The bundle or group of neuron fibres is called the nerves while the bundle of cell-bodies is called the ganglion in the Peripheral Nervous System. The nerves are of following types:

1. AFFERENT NERVE FIBRES: These nerves are responsible for the transmission of stimuli from the receptors to the central nervous system. Hence, these are made up of sensory neurons.
2. EFFERENT NERVE FIBRES: These nerves are responsible for the transmission of response impulses from the central nervous system to the effector organs. Hence, these are made up of motor neurons.

DIVISION OF THE PERIPHERAL NERVOUS SYSTEM

1. SOMATIC NEURAL SYSTEM: The neurons that innervate the skeletal muscles are kept under this system. So, this system is concerned with the coordination of the voluntary activities of the body.
2. AUTONOMIC NEURAL SYSTEM (ANS): The neurons that innervate the involuntary performing organs are kept under this system. It does not involve the conscious control over the responses



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AUTONOMIC NEURAL SYSTEM

The motor component of the ANS is further divided into the following types:

1. **SYMPATHETIC NEURAL SYSTEM:** It is concerned with the mediation of 'fight-or-flight' responses. It is designated by paired 21 ganglia extending from cervical part to the sacral part of the spinal cord. The following types of nerves fibres are functional in this system:
 - a) Preganglionic Fibres: These comprise of short nerve fibres. These occur only in the thoracic and lumbar region of the spinal cord. Due to this, the sympathetic nervous system is said to giving thoracolumbar outflow. These are cholinergic, that is, they release acetylcholine as the neurotransmitter.
 - b) Collateral ganglia: This system consists of three prevertebral ganglia as coeliac ganglion, superior mesenteric ganglion and inferior mesenteric ganglion.
 - c) Postganglionic Fibres: Their cell bodies synapse with either the preganglionic fibres or collateral ganglia. They transmit the motor impulse to the effector organs. These are adrenergic, that is, they release noradrenaline as the neurotransmitter.
2. **PARASYMPATHETIC NEURAL SYSTEM:** It is concerned with the mediation of 'rest-and-digest' responses. The following types of nerve fibres are functional in this system:
 - a) Preganglionic Fibres: These comprise of the neurons that lie in the midbrain, brainstem and the sacral part of the spinal cord. So, both the cranial nerves and spinal nerves make up the preganglionic fibres. Due to this, the parasympathetic nervous system is said to be giving craniosacral outflow. These are longer and are cholinergic.
 - b) Parasympathetic ganglia: These are the cell bodies that are situated in the visceral organs. The preganglionic fibres synapse with them.
 - c) Postganglionic Fibres: These synapse with the parasympathetic ganglia and they innervate the effector organs to transmit the response impulse. These are also cholinergic.

STRUCTURE OF NEURON

A neuron is the structural and the functional unit of the neural system. It is made up of a cell body from which the cytoplasmic processes arise. The details of the structure are as follows (Fig.1):

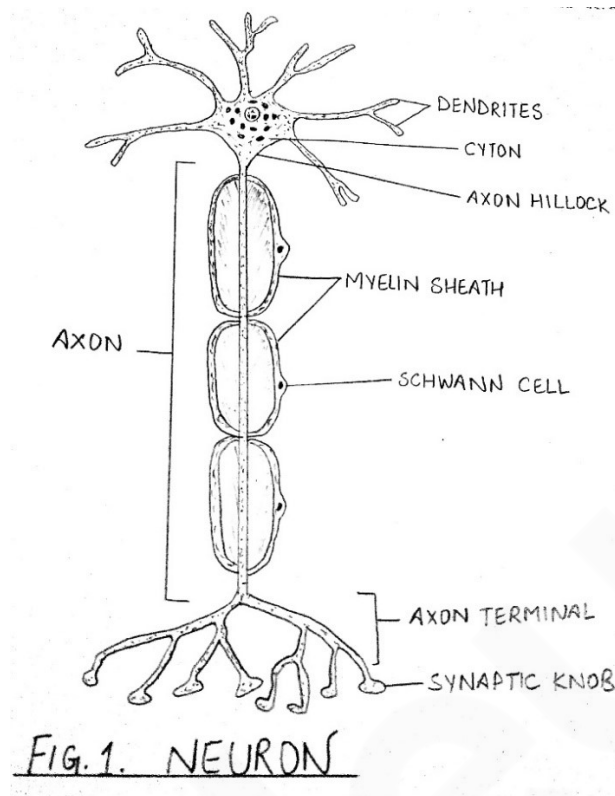
1. Cell body: It is also referred to as cyton or soma. It has the cellular organelles of nucleus, mitochondria, Golgi Apparatus, and Nissl's granules. The Nissl's granules are rough endoplasmic reticulum attached with ribosomes that are involved in the protein formation.
2. Neurites: The cytoplasmic processes are called the neurites. These are of following types:
 - a. Dendrites or dendrons: These are branched and short processes that are involved in the conduction of the nerve impulse towards the cell body.
 - b. Axon: It is a single and long process that conducts the impulse away from the cell body towards the synapse. It arises from a point on the cell body called axon hillock. The ends of the axon are branched and are called axon terminals. These ends are provided with the synaptic knobs that release the neurotransmitters in the synapse.



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TYPES OF NEURONS

Non-polar Neurons	<ul style="list-style-type: none"> • There are several branches coming out from the cyton. • Commonly seen in invertebrates.
Unipolar Neurons	<ul style="list-style-type: none"> • There is a single axon coming out from the cyton. • Commonly seen in embryonic stages.
Pseudounipolar Neurons	<ul style="list-style-type: none"> • There is a single process that comes out from the cyton. • It then divides into dendrites and axon. • The dorsal root ganglia of the spinal cord are pseudounipolar neurons.
Bipolar Neurons	<ul style="list-style-type: none"> • There are two processes coming out from the cyton. • One acts as dendrite and the other as axon. • These are seen in the retina.
Multipolar Neurons	<ul style="list-style-type: none"> • There are many dendrites coming out from one end and a single axon.



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TYPES OF AXON BASED ON MYELIN SHEATH

For the neurons of the central neural system, the Schwann cells form the myelin while for the neurons of the peripheral neural system, the oligodendrocytes produced the myelin.

1. **MYELINATED NEURONS:** The axons are covered with the myelin sheath. There are gaps between the two myelin that are called the nodes of Ranvier. These axons form the white matter of the central nervous system.
2. **NON-MYELINATED NEURONS:** The myelin sheath is absent from around the axons. Along with the cell bodies of the myelinated axons, they form the grey matter of the neural system.

NERVE IMPULSE: GENERATION AND CONDUCTION

A nerve impulse can be defined as change in electric potential across the membrane of the axon. It can be described as follows:

- a) **Polarisation:** When the neuron is at rest, the membrane is said to be polarised because the axoplasm has a negative potential and extracellular fluid has a positive potential. This is called the resting potential and it is maintained due to the activity of the Na-K pumps that cause efflux of three sodium and influx of 2 potassium. Also, the negatively charged proteins contribute to the negative potential. It is -70mV.
- b) **Depolarisation:** The arrival of the threshold stimulus causes the influx of the sodium ions that inverses the potential of the axoplasm from negative to positive. This is the generation of the impulse.
- c) **Repolarisation:** The efflux of potassium ions to bring the state of axoplasm back to negative.
- d) **Hyperpolarisation:** At times, the repolarization may cause the potential to fall beyond -70mV. The Na-K pumps activate now to bring the polarisation back.

The nerve impulse is then transferred to the next point along the membrane of axon.

SALTATORY CONDUCTION


In the myelinated neurons, the depolarization is followed only at the nodes of Ranvier and not along the entire axon as in the case of non-myelinated neurons. The nerve impulse appears to be jumping from one node to the next over the successive myelin sheaths and it is called the saltatory conduction. It is much faster as compared to transmission in non-myelinated axons.

TRANSMISSION OF IMPULSE

1. **ELECTRICAL SYNAPSE:** The gap junctions provide a continuous channel between the presynaptic and post-synaptic neurons. The impulse is transferred through the electric current via the ions.
2. **CHEMICAL SYNAPSE:** There is a gap between the presynaptic and postsynaptic neurons called the synaptic cleft. The neurotransmitters are delivered into the space that are perceived by the receptors.

TYPES OF NEUROTRANSMITTERS

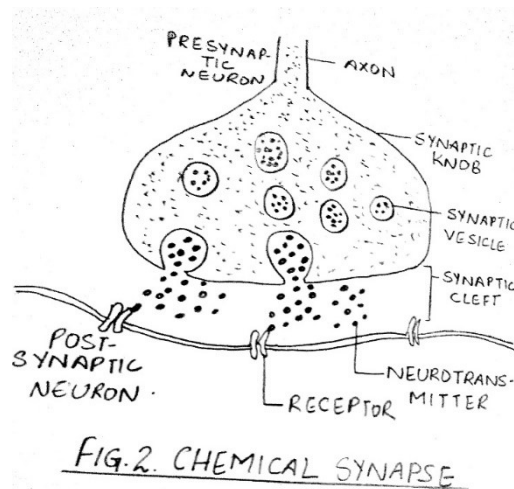
1. **EXCITATORY NEUROTRANSMITTERS:** They cause the generation of the action potential, e.g., acetylcholine, norepinephrine.



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2. **INHIBITORY NEUROTRANSMITTERS:** They cause the inhibition of the action potential, e.g., gamma-amino-butyric acid (GABA).



SYNAPTIC DELAY

It is the time taken for the release of the neurotransmitters, their binding to the receptors and then generation of action potential in the post-synaptic neuron. It occurs in the chemical synapse.

SYNAPTIC FATIGUE

It is caused due to depletion of the neurotransmitter as a result of continuous conduction.

ONE-WAY CONDUCTION

It is also called the Bell-Megendie law, according to which, the nerve impulse travels in one way always from the axon terminal of the presynaptic neuron to the dendrites of the post-synaptic neuron.

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