

CHAPTER FOUR

NERVOUS TISSUE

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The human nervous system is the most complex system in the human body. It is comprised of billions of nerve cells (**neurons**), with support from more numerous **glial cells**. Functionally, neurons are grouped as **circuits**, which is a set of coordinated processes intended to produce a definite result. A number of elementary circuits may be combined to form higher-order systems. The nerve tissue is distributed throughout the body as an integrated communications network. The nervous system can be broadly divided into the **central nervous system (CNS)**, comprising of the brain and the spinal cord, and the **peripheral nervous system (PNS)**, comprising of cranial nerves emanating from the brain, spinal nerves emanating from the spinal cord, and their associated small aggregates of nerve cells called **nerve ganglia**. In addition to neurons, the nervous system contains numerous other cells, collectively called **neuroglial cells**, which do not receive or transmit impulses, but support neurons in various ways.

Some neurons have **receptors**, elaborated on their terminals, which are specialized for receiving different types of stimuli (such as, mechanical, chemical, thermal) and transducing them into nerve impulses which may eventually be conducted to nerve centers. These impulses are then transferred to other neurons for processing and transmission to higher centers for perceiving sensations or for initiating motor responses.

The PNS can functionally be divided into a **sensory (afferent) component**, which receives and transmits impulses to the CNS for processing, and a **motor (efferent) component**, which originates in the CNS and transmits impulses to effector organs of the body systems. The motor component is further subdivided as follows:

- **Somatic system:** Impulses originating in the CNS are transmitted directly, via a single neuron, to skeletal muscles.
- **Autonomic system:** Impulses from the CNS are transmitted to an autonomic **ganglion** via one neuron, afterwards a second neuron originating in the autonomic ganglion transmits the impulses to smooth muscles, cardiac muscles, or glands.

The purpose of this practical session is to demonstrate nervous tissue and nerve endings. Nervous tissue is studied according to the following scheme, hence at the end of this section students should be able to:

- (a) identify, differentiate and draw Neurons and Neuroglia;
- (b) identify, differentiate and draw different types of neuronal cell bodies and neuroglia;
- (c) identify, differentiate and draw axons, dendrites, myelinated and non-myelinated axons;
- (d) identify, differentiate and draw nerve endings, motor muscle end plate, Pacinian corpuscle and Meissner's corpuscle;
- (e) understand the structural classification of neurons; and
- (f) understand the functional classification of neurons; and

Neurons

Cell bodies

Multipolar

Pseudo-unipolar

Processes

Dendrites

Myelinated and Non-myelinated axons.

Nerve endings

Central nervous system

Synapse

Peripheral nervous system

Motor units

Motor muscle end plate

Sensory endings

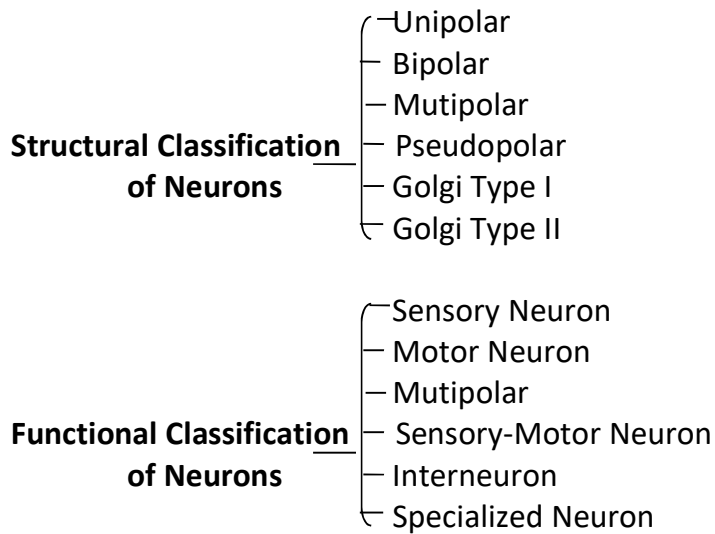
Pacinian corpuscle

Meissner's corpuscle

Neuroglia

Astrocytes

Ependyma



1.1. *Multipolar Neurons*

Slide 44: This is a cross section through the spinal cord and spinal ganglion. The spinal cord serves as an example of multipolar neuron cell bodies.

Identify:

Macroscopic

The orientation of the spinal cord, identifying the H-shaped grey matter, the white matter and the spinal ganglion.

Microscopic

The multipolar neuron cell bodies found in the grey matter.

- (i) Cell body.
- (ii) Nucleus
- (iii) Nissl substance
- (iv) Neurofibrils
- (v) Meshwork
- (vi) Axon hillock
- (vii) Nuclei of the neuroglia

Draw and annotate:

A multipolar neuron cell body. Indicate the components of the neuron in detail.

Questions:

1. What characteristic of the cell bodies is used in the identification of multipolar neurons?
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2. Are the neuron nuclei visible?
.....
3. What is characteristic of the nuclei of the neurons?
.....
4. How does the Nissi-substance appear and what is it in reality?
.....
.....
5. How do the neurofibrils appear and what are they in reality?
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.....
6. What is the meshwork surrounding the cell bodies in reality?

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.....
7. What are the characteristics of the axon hillock?
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.....

4.2. *Pseudo-Unipolar Neurons*

Slide 45: This is a cross section through the spinal cord ganglion. The spinal ganglion is used as an example to demonstrate pseudo-unipolar neuron cell bodies.

Identify:

Macroscopic

The orientation of the spinal ganglion identifying the spinal ganglion next to the spinal cord. The pseudo-unipolar neurons are found in the spinal ganglion.

Microscopic

- (i) Cell bodies
- (ii) Nuclei
- (iii) Nissl-substance

Draw and annotate:

A Pseudo-unipolar neuron.

Questions:

1. What is characteristic of the shape of a pseudo-unipolar neuron in comparison to that of multipolar neurons?

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2. How do the granules of the Nissl substance of pseudo-unipolar neurons differ from those of the multipolar neurons?

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4.3. *Myelinated Fibres*

Slide 46: This is a cross section through a peripheral nerve.

Identify:

Microscopic

- (i) Epineurium, perineurium and endoneurium
- (ii) Axon
- (iii) Neurilemma
- (iv) Schwann cell nuclei

Draw and annotate:

A line diagram of the nerve in which the connective tissue components and nerve bundles are indicated. Draw a few cross sectional axons with their sheaths.

Questions:

1. How do the axons appear?

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2. How do the myelin sheaths appear?

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3. How does one distinguish between Schwann cell and fibroblast nuclei?

.....

.....

4. How do unmyelinated fibres appear? (See Wheater)

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4.4. Myelinated Fibres

Slide 47: This is a cross-section through a peripheral nerve that has been stained for myelin.

Identify:

Microscopic

(i) Myelin sheath

(ii) Axon

Draw and annotate:

An axon with a myelin sheaths in detail.

Questions:

1. Are all the axons and myelin sheaths sectioned the same?

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2. Why can't the structure of the axons be seen?

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4.5. **Motor End Plates**

Slide 48: This is a slide of separated skeletal muscle fibres illustrating the motor end plates of the peripheral nervous system.

Identify:

Microscopic

- (i) Separated skeletal muscle fibres
- (ii) Nerve fibres
- (iii) Motor end plates

Draw and annotate:

A motor end plate.

Questions:

1. What is the difference between an end plate and a motor end plate?

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2. What is a motor unit?

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4.6. ***Astrocytes***

Slide 49: This is a section through the cerebrum illustrating neuroglia of the central nervous system.

Microscopic

- (i) Astrocytes
- (ii) Blood vessels

Draw and annotate:

An astrocyte in detail.

Questions:

1. What type of astrocyte is visible on this slide, and with which structure are they in contact with?

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.....

2. Where are these astrocytes found?

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.....
3. What is the distinctive feature of astrocytes?
.....
.....

4. Described the perivascular feet?
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.....

4.7. Ependyma

Slide 50: This is a section through the choroid plexus illustrating neuroglia of the central nervous system.

Identify:

Microscopic

- (i) Ependyma
- (ii) Connective tissue and blood vessels

Draw and annotate:

A few ependymal cells, including the underlying blood vessels and connective tissue.

Questions:

1. Where is the choroid plexus located?

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2. What is the difference between ependyma and simple cuboidal epithelium?

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4.8. Cerebrum

Slide 51: This slide is a section through the cerebrum.

Identify:

Macroscopic

The white and grey matter

Microscopic

(i) The different layers of the cerebral cortex.

(ii) White matter

Draw and annotate:

The different types of neurons found in the different layers of the cerebrum.

Questions:

1. What types of neuron are seen here?

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2. What other structures are also visible on this slide?

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4.9. *Cerebellum*

Slide 52: This slide is a sagittal section through the cerebellum.

Identify:

Macroscopic

The grey and white matter

Microscopic

- (I) The different layers of the cerebellar cortex
- (II) White matter

Draw and annotate:

The neurons of the different layers of the cerebellar cortex.

Questions :

- 1. What type of neurons are seen in the grey matter?

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4.10. *Synapse*

Slide 53: This is a cross-section through the spinal cord showing the nerve ends (synapses) of the central nervous system, which are situated on the neuron cell bodies of the large anterior horn of the spinal cord.

Identify:

Microscopic

- (i) Neuron bodies
- (ii) End plates

Draw and annotate:

A neuron cell body with end plates included.

Questions:

1. How are the end plates presented under the light microscope?

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4.11. Pacinian Corpuscle

Slide 54: This is a section through skin from the palm, illustrating sensory nerve ending of the peripheral nervous system.

Identify:

Macroscopic

Orientate yourself with regard to the three visible primary layers of the skin of the palm. Look for the Pacinian corpuscles which are found in the subcutaneous fat tissue.

Microscopic

- (i) Adipose tissue
- (ii) Pacinian corpuscles

Draw and annotate:

A Pacinian corpuscle.

Questions:

1. Describe the Pacinian corpuscle.

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.....

2. What is the capsule made from?

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4.12. Meissner's Corpuscle

Slide 55: This is a section through skin from the palm, illustrating sensory nerve endings of the peripheral nervous system.

Identify:

Macroscopic

Orientate yourself with regard to the three layers of the skin. Look for Meissner's corpuscles in the papillary layer of the dermis

Microscopic

- (i) Stratified squamous keratinized epithelium
- (ii) Loose connective tissue
- (iii) Meissner's corpuscles

Draw and annotate:

A Meissner's corpuscle

Questions:

1. Describe a Meissner's corpuscle.

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2. What is the difference between a Meissner's and Pacinian corpuscle?

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Revision Notes on Nervous Tissue:

1. How are the functions of nervous tissues adapted to their features?

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2. Name 3 types of Neurons.

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3. What is a Synapse?

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4. Name the types of cells which form myelin in the CNS and PNS.

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5. Name the 4 specialized support cells of the central nervous system.

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6. Name and define the 3 meningeal layers.

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7. What is the function of the choroid plexus?

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8. Name the 4 components of a peripheral nerve.

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9. Where are the endoneurium, perineurium and epineurium located?

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10. Which autoimmune disease attacks the myelin of the CNS?
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11. What are neurotransmitters? Give specific examples.
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