EDO UNIVERSITY IYAMHO

Department of Physiology

PHS 301 Neurophysiology

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Lectures: Monday (8-10am) and Wednesday 10am ï 12noon), LT2, phone: (+2348063762090)
Office hours: Monday-Friday, 10am - 3.00pm,
Office: Room 37, 1st Floor, College of Medicine Building, New Jerusalem.

General overview of lecture: Neurophysiology is the scientific study of the brain and nervous system, whose ultimate goal is to understand higher brain function at a variety of levels. This course will provide students with current knowledge about brain structure and function from both a basic research and a clinical perspective, and to allow them to use this knowledge in completing independent or small-group term papers.

Prerequisite: The students are expected to have a strong background in general principles of physiology, cell physiology and excitable tissues.

Learning outcomes: At the completion of this course, students are expected to:

1. To better understand the theoretical foundations of neuroscience
2. Define the molecular, cellular, and tissue-level organization of the central and peripheral nervous system
3. Understand the properties of cells that make up the nervous system including the propagation of electrical signals used for cellular communication
4. Relate the properties of individual cells to their function in organized neural circuits and systems
5. Understand how the interaction of cells and neural circuits leads to higher level activities such as cognition and behavior
6. Communicate effectively orally and in writing
7. Develop an understanding and appreciation of the interdisciplinary nature of neuroscience
8. Apply and integrate their knowledge of neuroscience to other areas of their studies and to their everyday life

Assignments: We expect to have four (4) homework assignments throughout the course in addition to a Mid-Term Test and a Final Exam. Term papers are given at the beginning of the class and submission will be on the due date, including oral presentation of the term paper. Home works in the form of individual assignments, and group assignments are organized and structured as preparation for the midterm and final exam, and are meant to be a studying material for both exams.

Grading: We will assign 20% of this class grade to home works, 10% for the mid-term test and 70% for the final exam. The Final exam is comprehensive.

Textbook: The recommended textbook for this course are as stated:

Title: *Ganong's Review of Medical Physiology*
Editors: K.E. Barrett, S.M. Barman, S. Biotano, and H.L. Brooks
Publisher: McGraw Hill
24th Edition
ISBN: 978-0-07-178004-9
Year: 2012

Title: *Essentials of Medical Physiology*
Authors: K. Sembulingam and PremaSembulingam
Publisher: Jaypee
6th edition
ISBN-978-93-5025-936-8
Year: 2012

Title: *Medical Biochemistry*
Editors: John W Baynes and Marek H Dominiczak
Publisher: Mosby Elsevier
3rd Edition
ISBN: 978-0-323-05371-6
Year: 2009

Introduction to Nervous System

Nervous system controls all the activities of the body. It is quicker than other control system in the body, namely endocrine system. Primarily, nervous system is divided into two parts:

1. Central nervous system
    i. Brain
        a. Prosencephalon
        b. Mesencephalon
        c. Rhombencephalon
    ii. Spinal cord
2. Peripheral nervous system
    i. Somatic nervous system
    ii. Autonomic nervous system.

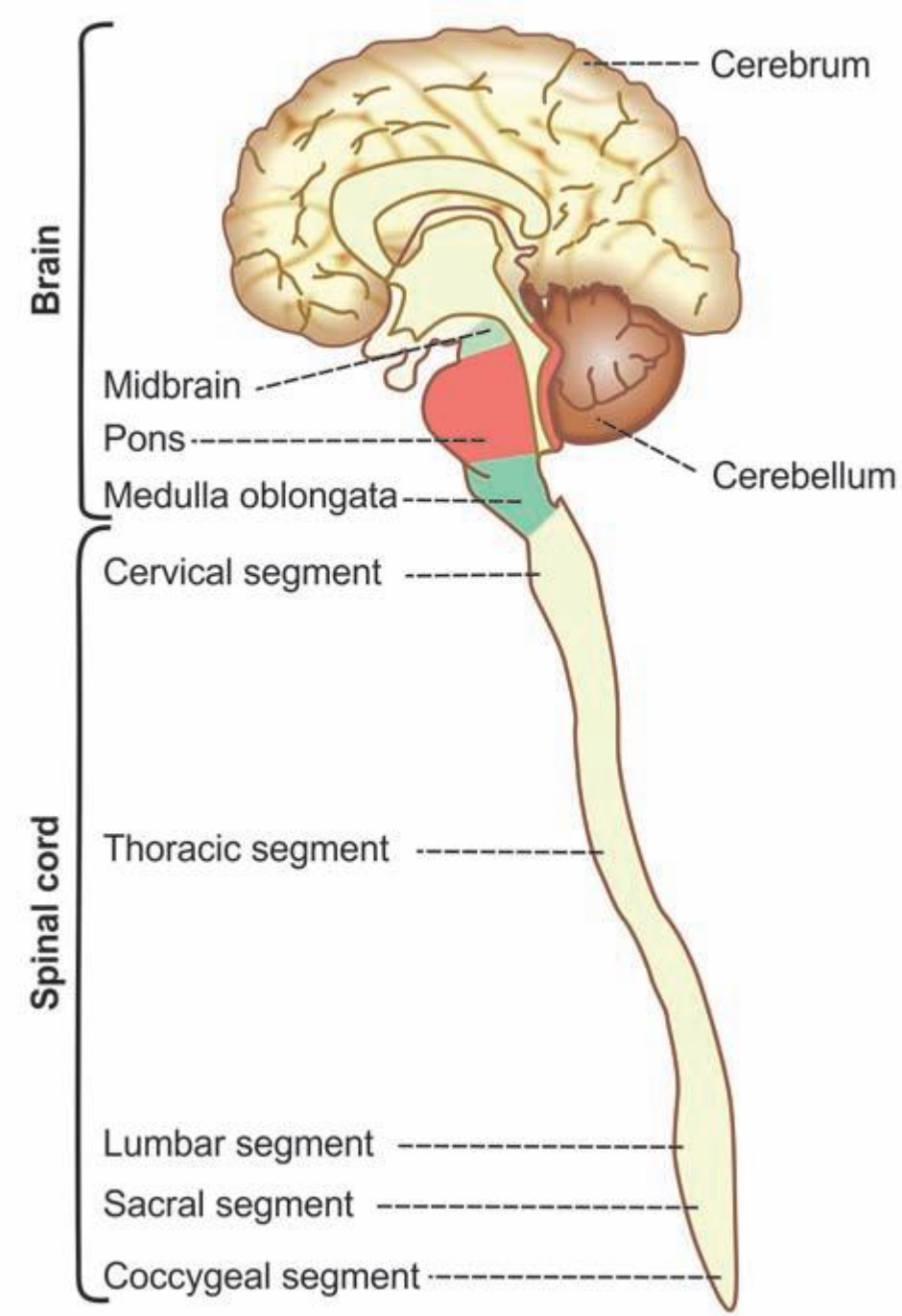

Fig. 1: Parts of central nervous system. Source: *Essentials of Medical Physiology, 2012.*

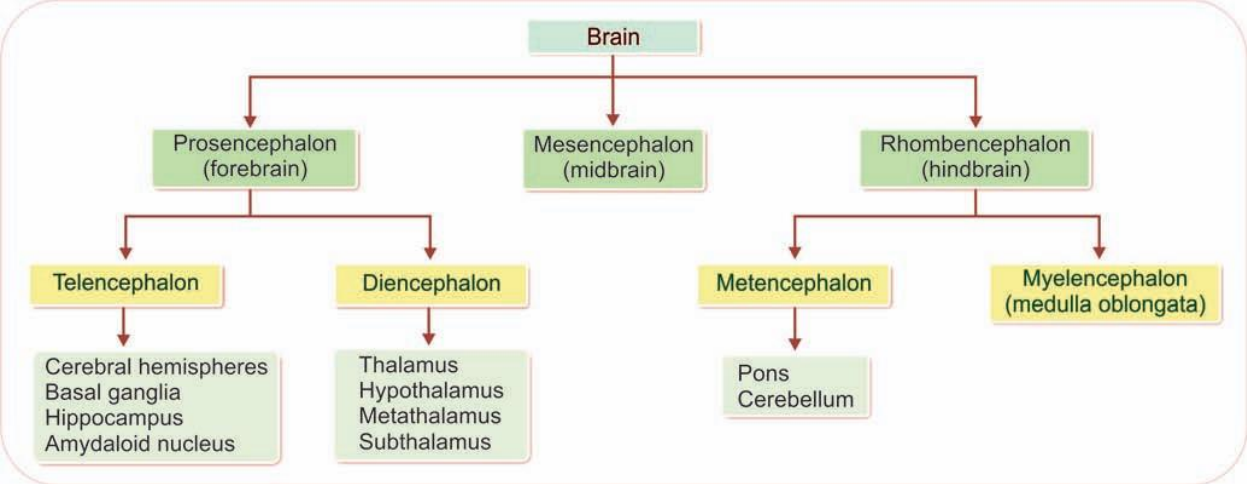

Fig. 2: Parts of brain. Source: *Essentials of Medical Physiology, 2012.*

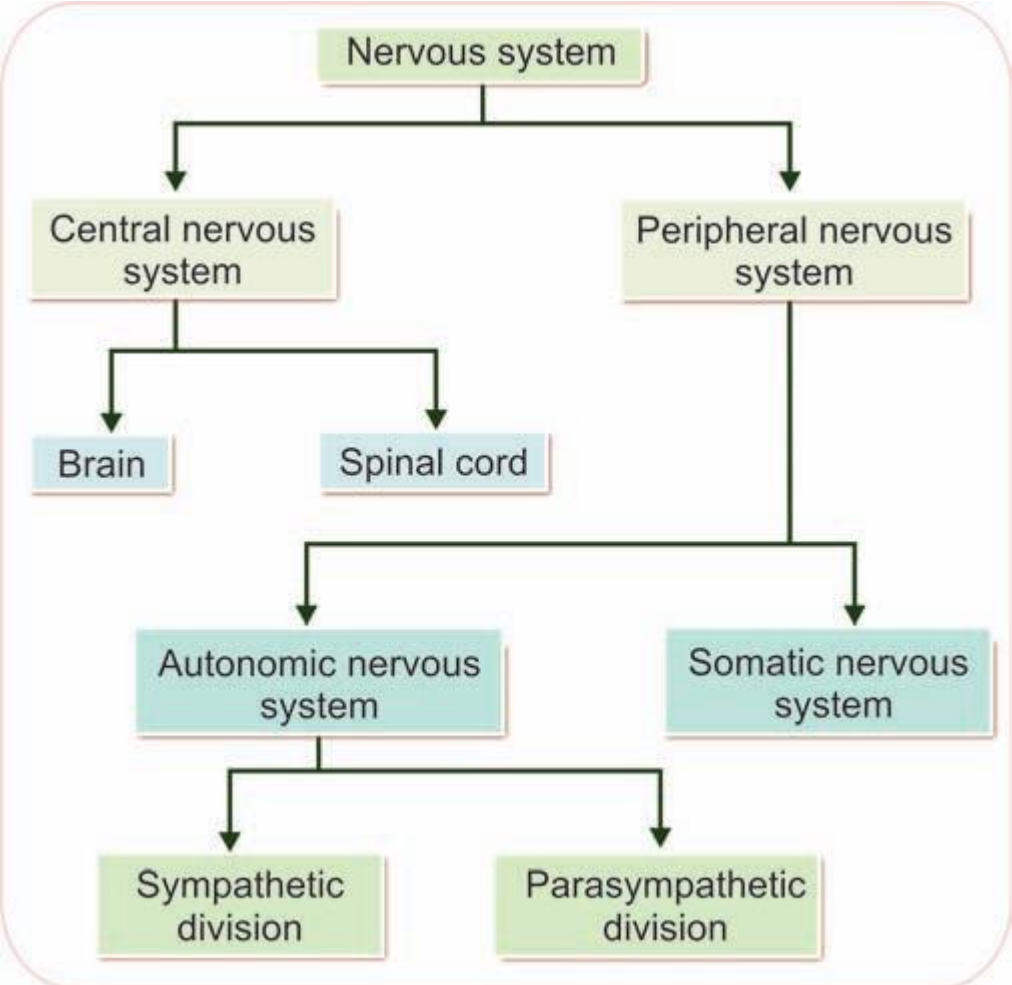

Fig. 3: Organization of nervous system. Source: *Essentials of Medical Physiology, 2012.*

Neuron

The two principal cell types of the nervous system are:

- ï Neurons ï excitable cells that transmit electrical signals
- ï Neuroglia - supporting cells

Neuron or **nerve cell** is defined as the structural and functional unit of nervous system. Neuron is similar to any other cell in the body, having nucleus and all the organelles in cytoplasm. However, it is different from other cells by two ways:

1. Neuron has branches or processes called axon and dendrites
2. Neuron does not have centrosome, therefore, it cannot undergo division.

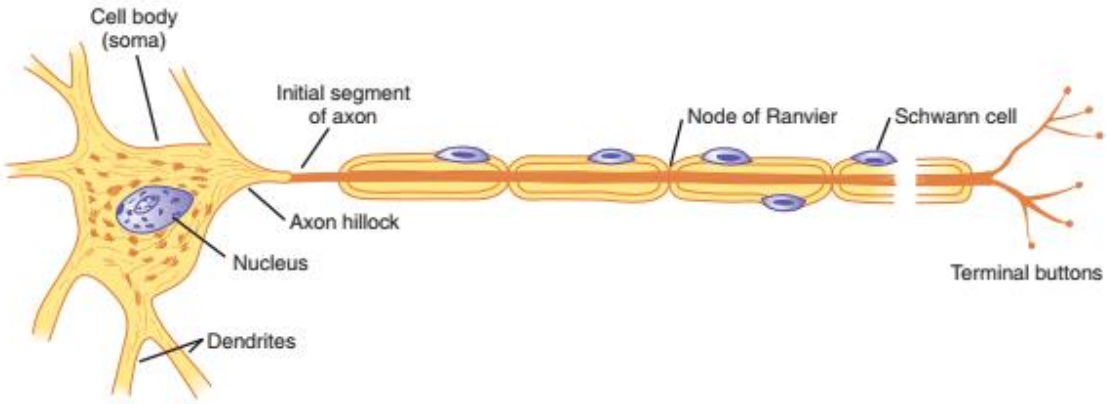

Fig. 4: Motor neuron with a myelinated axon. Source: Review of Medical Physiology, 2012.

Dendrites receive signals.

The cell body integrates signals.

The axon transmits action potential. The myelin sheath makes the signal travel faster.

Synaptic terminals transmit signals.

Neuroglia

Neuroglia or glia (glia = glue) is the supporting cell of the nervous system. Neuroglial cells are non-excitableand do not transmit nerve impulse (action potential). So, these cells are also called non-neural cells or glial cells. When compared to the number of neurons, the number of glial cells is 10 to 15 times greater. Neuroglial cells play an important role in the reaction of nerve during infection. Most commonly, neuroglial cells constitute thesite of tumors in nervous system.

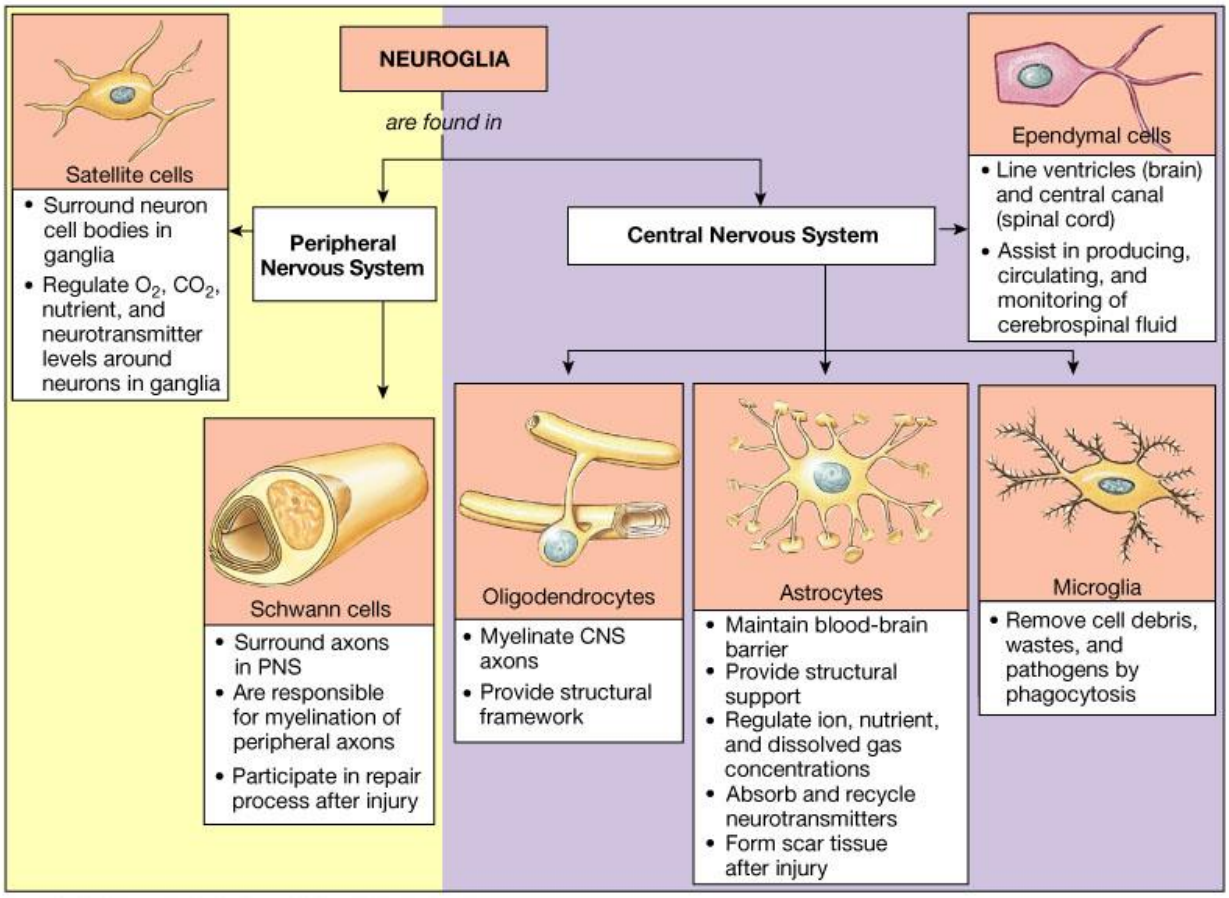

Fig. 5: Types of Neuroglia. Source: https://www.pinterest.com/pin/560768591071953485. Accessed: 1/26/2019.

Review of Resting membrane (RMP) and Action Potential (AP)

Is the potential difference recorded across the cell membrane at rest in millivolts (mV).Is by convention, expressed as the intracellular potential relative to the extracellular potential.Thus, RMP of -70mV means 70mV, cell negative.

Causes:

1. 80% caused by selective permeability of the cell membrane. The K+ permeability is 50-75 folds more than Na+ at rest.
2. 20% is caused by the Na+ K+ pump
   an active process that needs energy taken from ATP. It pumps 3 Na+ out of the cell for every 2 K+ pumped into the cell.

The change in electrical potential associated with the passage of an impulse along the membrane of a muscle cell or nerve cell is termed action potential (AP).

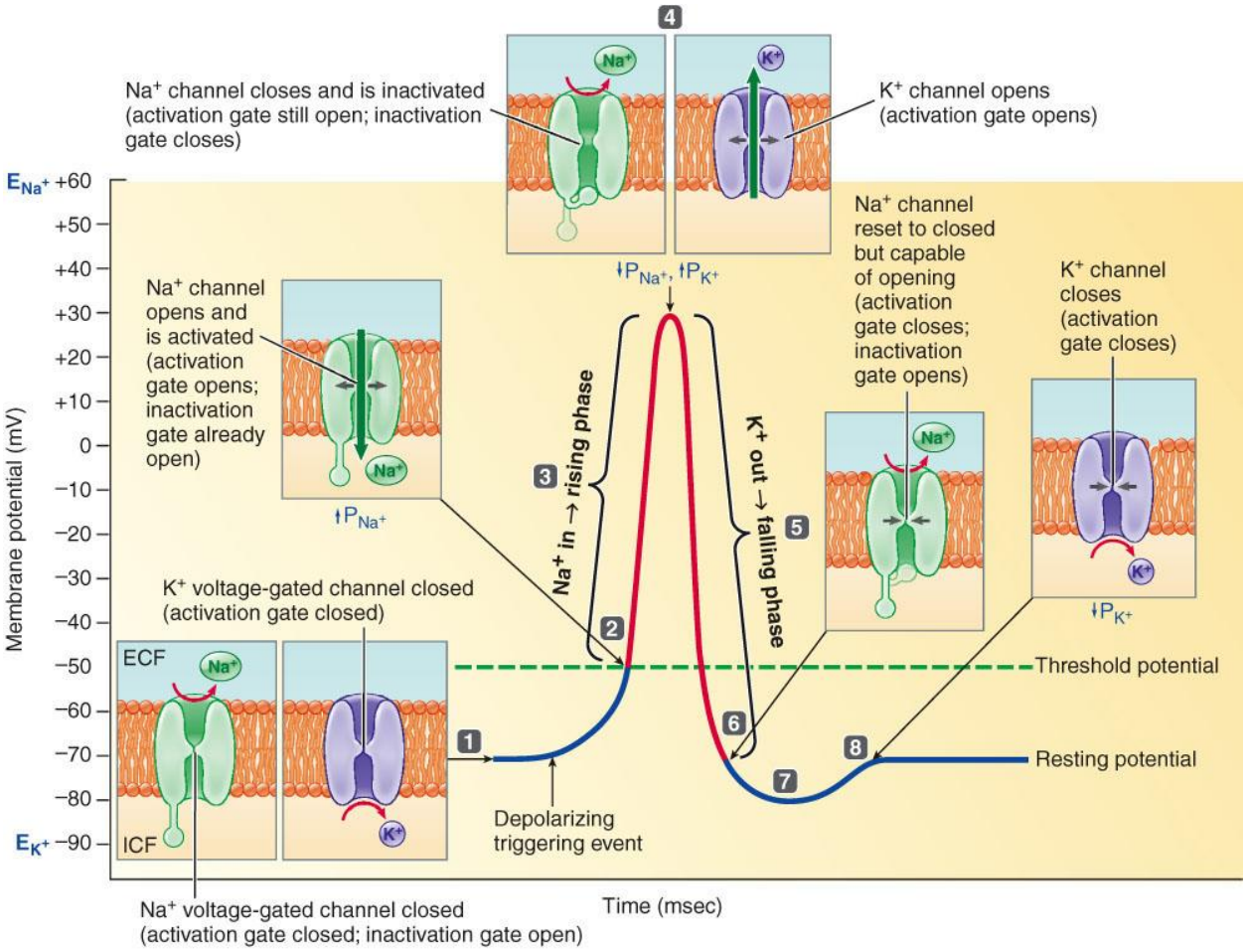

Fig. 6: Permeability changes and ion fluxes during an action potential. Source: https://www.slideserve.com/meira/graded-potential-action-potential. Accessed: 1/26/2019.