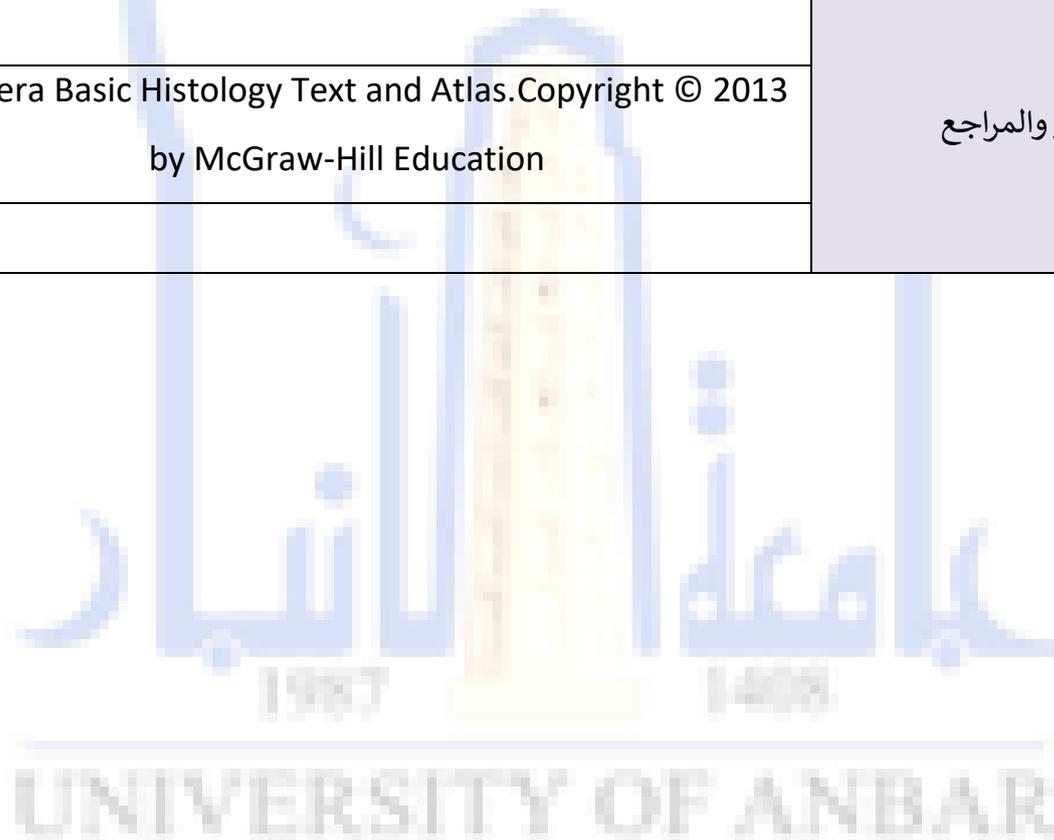


العلوم	الكلية
علوم حياة	القسم
Histology	المادة باللغة الانجليزية
علم الانسجة	المادة باللغة العربية
الثالثة	المرحلة الدراسية
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Muscle Tissue	عنوان المحاضرة باللغة الانجليزية
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Nervous Tissue

The human nervous system, by far the most complex system in the body, is formed by a network of many billion nerve cells (**neurons**), all assisted by many more supporting cells called glial cells. Each neuron has hundreds of interconnections with other neurons, forming a very complex system for processing information and generating responses. Nerve tissue is distributed throughout the body as an integrated communications network. Anatomically, the general organization of the nervous system

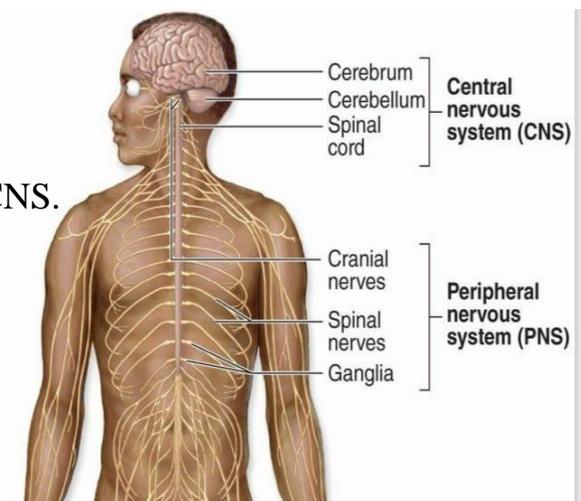
Central nervous system (CNS), consisting of the brain and spinal

cord, **Peripheral nervous system (PNS)**, composed of the cranial, spinal,

and peripheral nerves conducting impulses to and from

the CNS (sensory and motor nerves, respectively) and

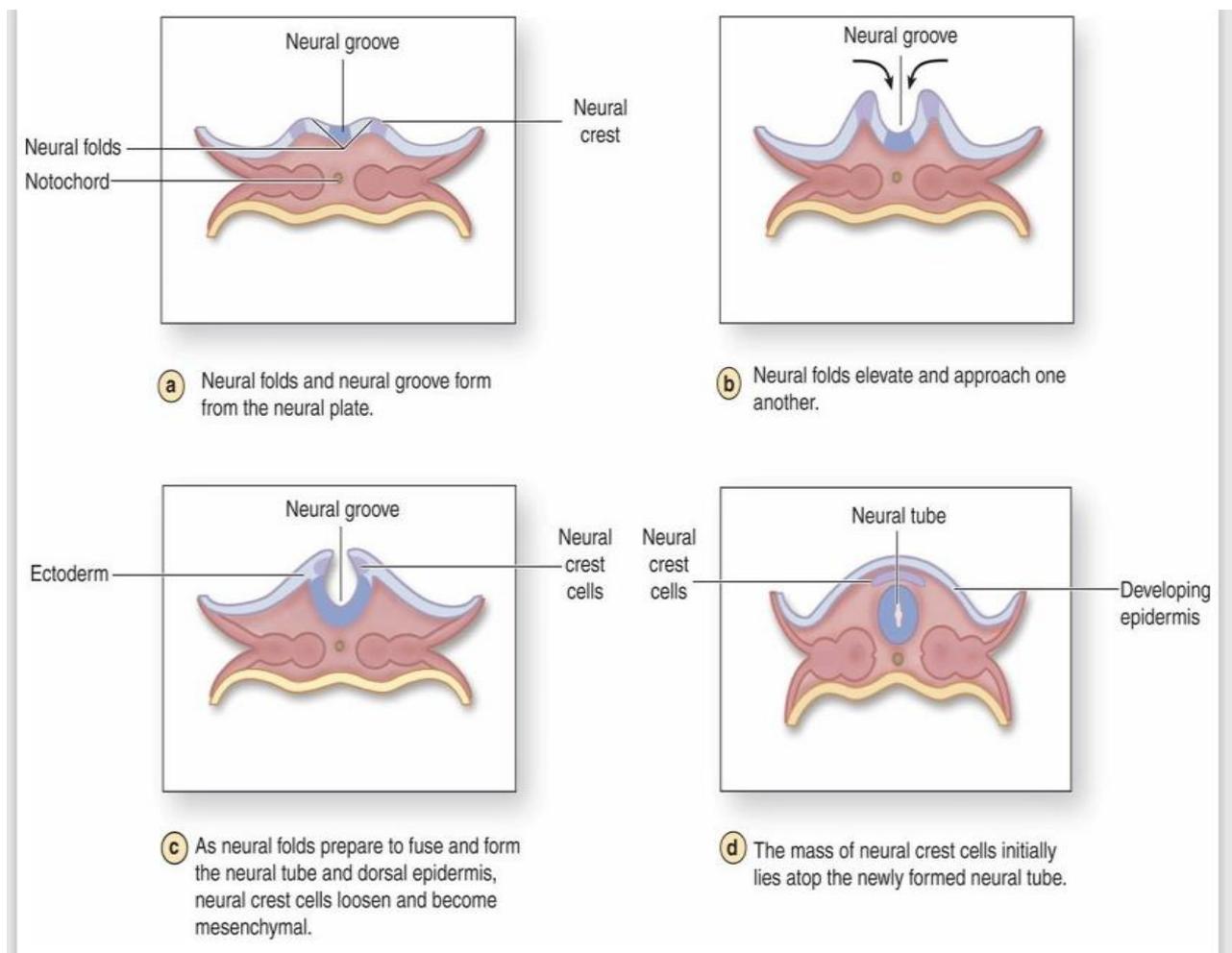
ganglia that are small groups of nerve cells outside the CNS.



Neurons respond to environmental changes (stimuli) by altering the ionic gradient that exists across their plasma membranes. called an electrical potential, but cells that can rapidly change this potential in response to stimuli (eg, neurons, muscle cells, some gland cells) are said to be excitable or irritable. Neurons react promptly to stimuli with a reversal of the ionic gradient (membrane depolarization) that generally spreads from the place that received the stimulus and is propagated across the neuron's entire plasma membrane. This propagation, called the action potential, the depolarization wave, or the nerve impulse, is capable of traveling long distances along neuronal processes, transmitting such signals to other neurons, muscles, and glands. By collecting, analyzing, and integrating information in such signals, the nervous system continuously stabilizes the intrinsic conditions of the body (eg, blood pressure, O₂ and CO₂ content, pH, blood glucose levels, and hormone levels) within normal ranges and maintains behavioral patterns (eg, feeding, reproduction, defense, interaction with other living creatures).

DEVELOPMENT OF NERVE TISSUE

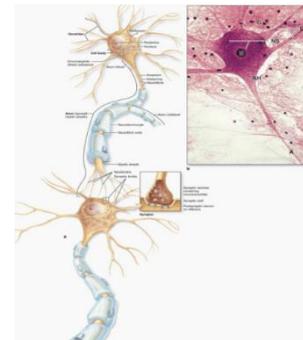
The nervous system develops from the outermost of the three early embryonic layers, the ectoderm, beginning in the third week of development . With signals from the underlying axial structure, the notochord, ectoderm on the mid-dorsal side of the embryo thickens to form the epithelial neural plate. The lateral sides of this plate fold upward, bend and grow toward each other medially, and within a few days fuse to form the neural tube. Cells of this tube give rise to the entire CNS, including neurons and most glial cells



Part (a) shows a cross section of a 21-day human embryo, when it is approximately 1 mm in length, the overlying layer of ectodermal cells thickens to become the neural plate. All other ectoderm will become epidermis. The neural plate forms two lateral

folds, separated by the **neural groove** (b). These folds rise and fuse at the midline (c), converting the neural groove into the **neural tube** (d). The neural tube, which is large at the cranial end of the embryo and much narrower caudally, will give rise to the CNS. As the neural folds fuse and the resulting tube detaches from the now overlying ectoderm (d), a population of neural cells separates and becomes a mass of mesenchymal cells called the **neural crest**.

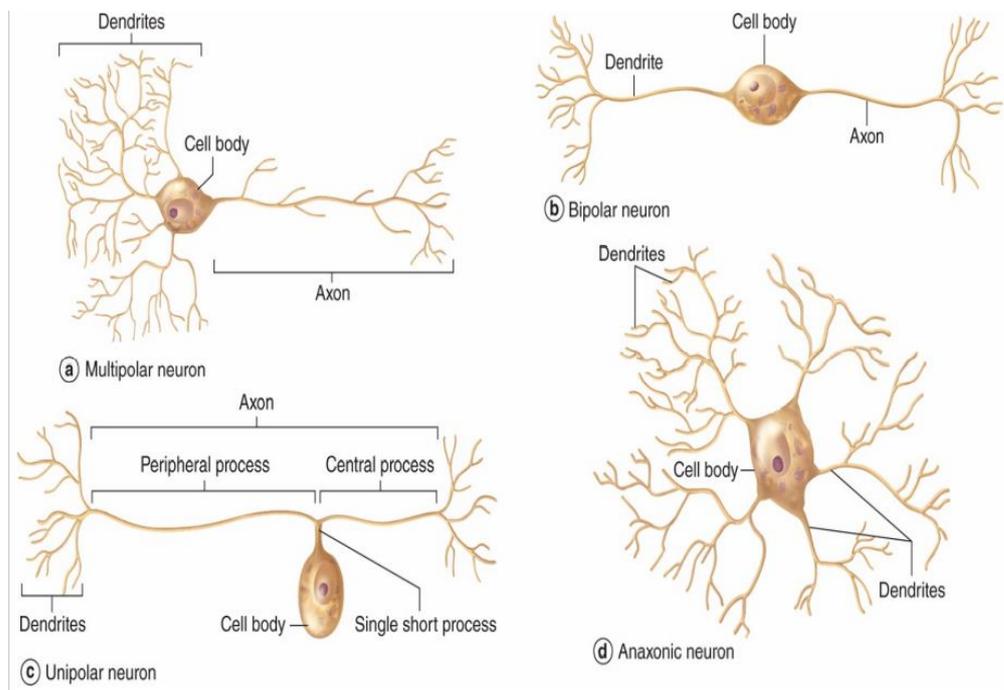
NEURONS The functional unit in both the CNS and PNS is the neuron or nerve cell. Some neuronal components have special names, such as “neurolemma” for the cell membrane. Most neurons consist of three main parts



The cell body, or **perikaryon**, which contains the nucleus and most of the cell’s organelles and serves as the synthetic or trophic center for the entire neuron.

The dendrites, which are the numerous elongated processes extending from the perikaryon and specialized to receive stimuli from other neurons at unique sites called synapses.

The axon which is a single long process ending at synapses specialized to generate and conduct nerve impulses to other cells (nerve, muscle, and gland cells). Axons may also receive information from other neurons, information that mainly modifies the transmission of action potentials to those neurons. Neurons and their processes are extremely variable in size and shape. Cell bodies can be very large, measuring up to 150 μm in diameter. Other neurons, such as the cerebellar granule cells, are among the body’s smallest cells. Neurons can be classified according to the number of processes extending from the cell body.



a-Multipolar neurons, which have one axon and two or more dendrites

b-Bipolar neurons, with one dendrite and one axon

c- Unipolar or pseudounipolar neurons, which have a single process that bifurcates close to the perikaryon, with the longer branch extending to a peripheral ending and the other toward the CNS.

d-Anaxonic neurons, with many dendrites but no true axon, do not produce action potentials, but regulate electrical changes of adjacent neurons.

Nervous components can also be subdivided functionally

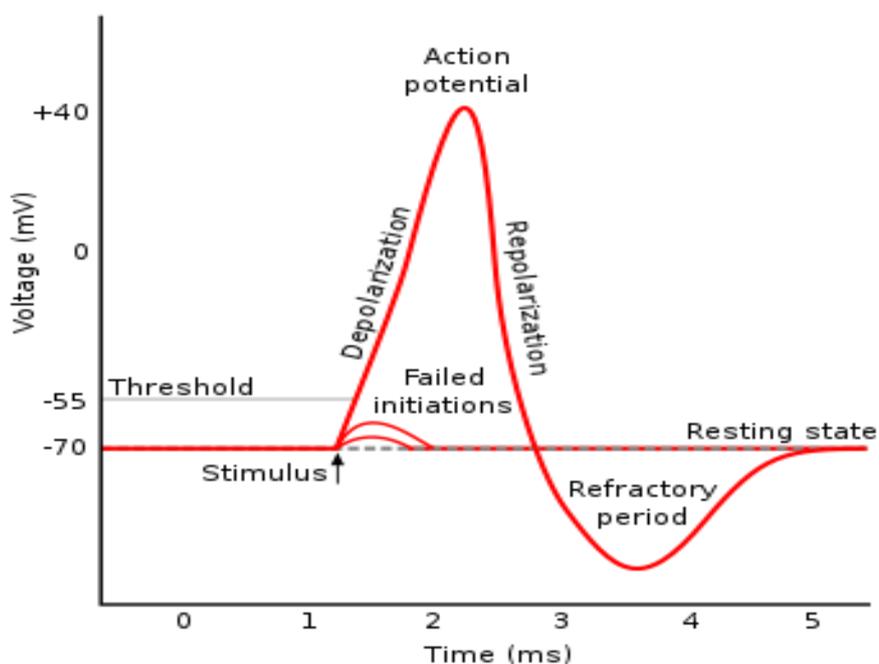
Sensory neurons are afferent and receive stimuli from the receptors throughout the body.

Motor neurons are efferent, sending impulses to effector organs such as muscle fibers and glands. **Somatic motor nerves** are under voluntary control and typically innervate most skeletal muscle; autonomic motor nerves control the “involuntary” activities of glands, cardiac muscle, and most smooth muscle.

Nerve Impulses

A nerve impulse, or action potential, travels along an axon like a spark moves along an explosive’s fuse. It is an electrochemical process initiated at the cell body or dendrites meet a certain threshold. The action potential is propagated along the axon as a wave of membrane **depolarization** produced by **voltage-gated Na⁺ and K⁺ channels** in the axolemma that allow diffusion of these ions into and out of the axoplasm. When the threshold triggering an impulse is met, channels at the axon’s initial segment open and allow a very rapid influx of extracellular Na⁺ that makes the axoplasm positive in

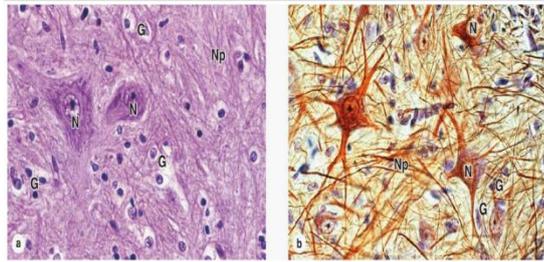
relation to the extracellular environment and shifts (depolarizes) the resting potential from negative to positive, to +30 mV. Immediately after the membrane depolarization, the voltage-gated Na⁺ channels close and those for K⁺ open, **for repolarization** and this rapidly returns the membrane to its resting potential, the opening and closing of the potassium channels is slower. and the potassium ions continue to exit from inside the membrane until the outside of the cell membrane carries the charge positive and the inside carries a negative charge with an electrical potential difference of -70 millivolts, This cycle of events occurs in less than **1 millisecond**.



GLIAL CELLS & NEURONAL ACTIVITY

Glial cells support neuronal survival and activities, and are ten times more abundant in the mammalian brain than the neurons. Like neurons, most glial cells develop from progenitor cells of the embryonic neural plate. In the CNS glial cells surround both the neuronal cell bodies, which are often larger than glial cells, and the processes of axons and dendrites occupying the spaces between neurons. Except around the larger blood vessels, the CNS has only a very small amount of connective tissue and collagen. Glial cells substitute for cells of connective tissue in some respects, supporting. The fibrous intercellular network surrounding cells of the CNS may superficially resemble collagen

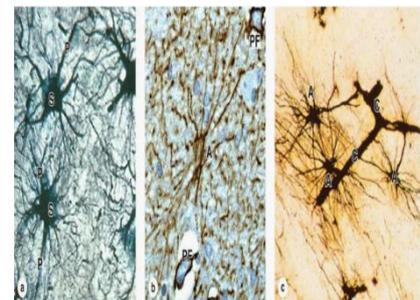
with light microscopy, but it is actually the network of cellular processes emerging from neurons and glial cells. Such processes are collectively called the neuropil



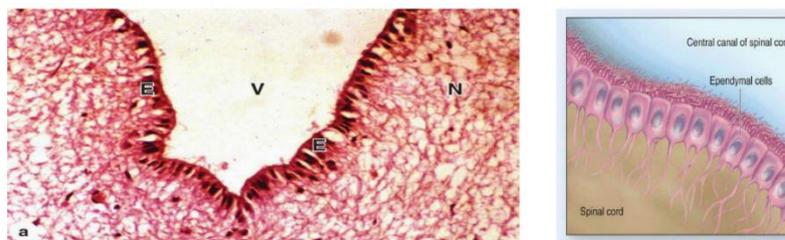
There are six kinds of glial cells; these are shown schematically in Figure 9–9 and basic features are summarized in Table

Oligodendrocytes **Oligodendrocytes** produce the myelin sheaths around axons that provide the electrical insulation for neurons in the CNS. Oligodendrocytes extend sheetlike processes that wrap around parts of several axons, producing myelin sheaths.

Astrocytes **Astrocytes** have a large number of radiating processes, and are also unique to the CNS. Astrocytes are by far the most numerous glial cells of the CNS, as well as the most diverse structurally and functionally. Functions associated with various astrocytes include, Regulating the extracellular ionic concentrations around neurons, Guiding and physically supporting movements and locations of differentiating neurons in the developing CNS.



Ependymal Cells Ependymal cells are columnar or cuboidal cells that line the ventricles of the brain and central canal of the spinal cord. In some CNS locations, the apical ends of ependymal cells have cilia, which facilitate the movement of cerebrospinal fluid (CSF), and long microvilli, which are likely involved in absorption.



Microglia Less numerous than oligodendrocytes or astrocytes but nearly as common as neurons, microglia are small cells with short irregular processes Unlike other glial cells,

microglia migrate through the neuropil, scanning the tissue for damaged cells and invading microorganisms. They secrete a number of immunoregulatory cytokines and constitute the major mechanism of immune defense in the CNS. Microglia do not originate from neural progenitor cells like other glia, but from circulating blood monocytes, belonging to the same family as macrophages and other antigen-presenting cells.



Schwann Cells Schwann cells (named for 19th century German histologist Theodor Schwann), sometimes called neurolemmocytes, are found only in the PNS and differentiate from precursors in the neural crest. Schwann cells have trophic interactions with axons and importantly allow for their myelination, like the oligodendrocytes of the CNS. As discussed with peripheral nerves, one Schwann cell forms myelin around a segment of one axon.

satellite cells form an intimate covering layer over the large neuronal cell bodies in the ganglia of the PNS .Satellite cells exert a trophic or supportive effect on these neurons, insulating, nourishing, and regulating their microenvironments.

