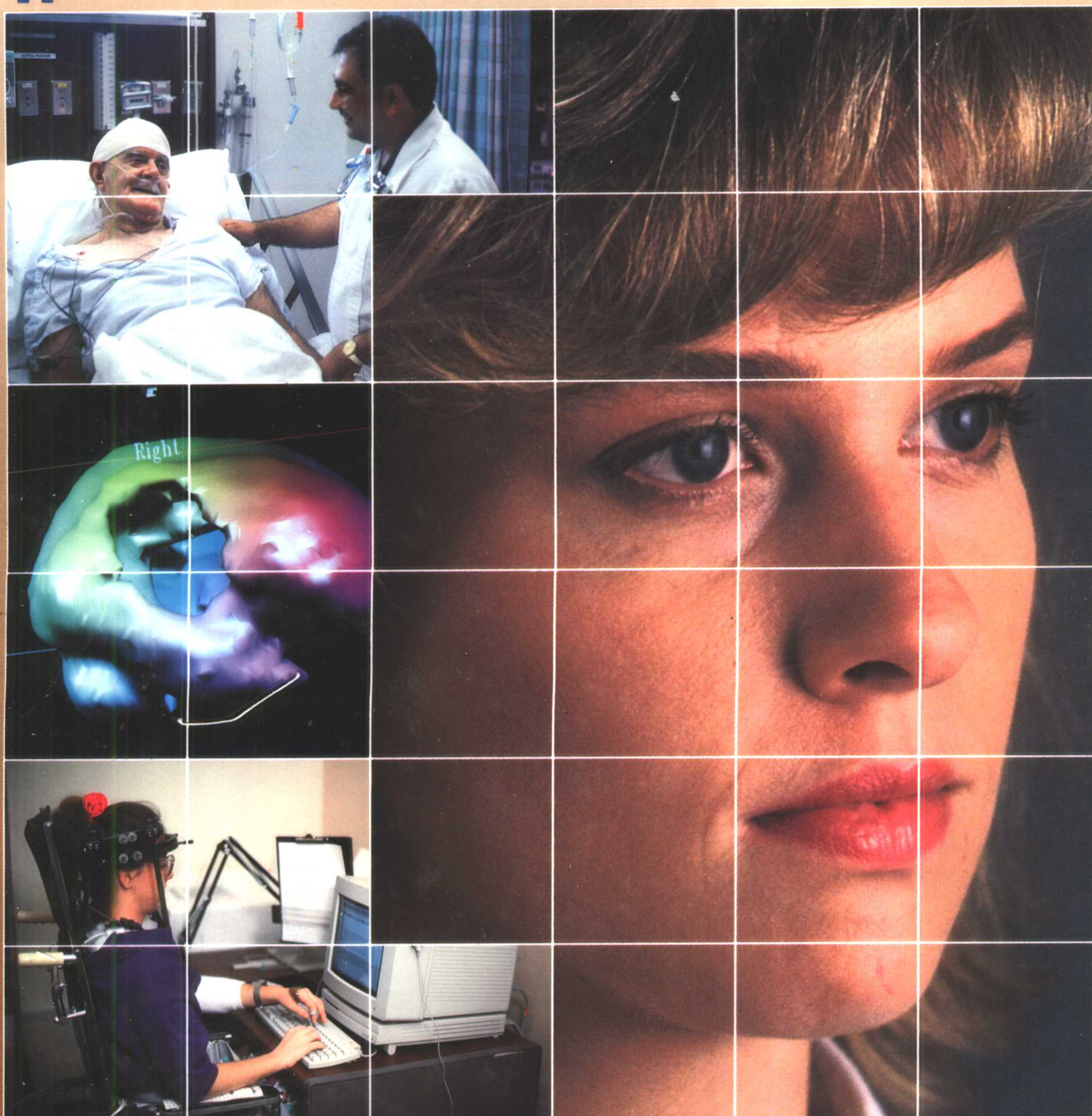
NEUROLOGIC DISORDERS

Mosby's Clinical Nursing Series



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NEUROLOGIC DISORDERS

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Preface

Neurologic Disorders is the sixth volume in Mosby's Clinical Nursing Series, a new kind of resource for practicing nurses.

The Series is the result of the most elaborate market research ever undertaken by Mosby–Year Book. We first surveyed hundreds of working nurses to determine what kind of resources practicing nurses want in order to meet their advanced information needs. We then approached clinical specialists—proven authors and experts in 10 practice areas, from cardiovascular to orthopedics—and asked them to develop a common format that would meet the needs of nurses in practice, as specified by the survey respondents. This plan was then presented to 9 focus groups composed of working nurses over a period of 18 months. The plan was refined between each group, and in the later stages we published a 32-page full-color sample so that detailed changes could be made to improve the physical layout and appearance of the book, section by section and page by page. The result is a new genre of professional books for nursing professionals.

Neurologic Disorders begins with an innovative Color Atlas of Neurologic Structure and Function. This review of the anatomy and physiology contains a collection of detailed full-color drawings to depict normal structure and function.

Chapter 2 is a comprehensive guide to neurologic assessment. Clear, full-color photographs have been included to show proper patient positioning and assessment techniques in sharp detail. All photos are accompanied by concise instructions in the text. Special assessment tools for determining neurologic status and cognitive functioning are included inside the front cover.

Chapter 3 presents detailed information and full-color photographs of diagnostic tests and equipment. A consistent format for each diagnostic procedure gives nurses information about the purpose of the test; indications and contraindications; and nursing care associated with each test, including necessary patient teaching.

Chapters 4 and 5 present neurologic disorders of the central nervous system and the peripheral nervous system. Many detailed charts and illustrations accompany the text. The pathophysiology is comprehensive to aid in understanding the nature of the condition or disease. Potential complications of each disorder are highlighted in a box for quick and easy reference. Commonly prescribed diagnostic tests and medical management techniques are briefly reviewed for the nurse's reference. The nursing process format provides detailed assessments and findings, nursing diagnoses, patient goals, nursing interventions with rationales, and expected outcomes. While concepts of acute care and rehabilitation have been integrated throughout the nursing process presentations, there is a special emphasis on their integration in the discussions of craniocerebral trauma, cerebrovascular accidents, and spinal cord trauma. An up-to-date and comprehensive discussion of the central nervous system complications of AIDS is also included. Patient teaching concerns are identified at the end of each disorder, thus enabling the nurse to anticipate questions often asked by the patient and family, and to maximize teaching efforts and time.

Chapter 6 focuses on frequently performed surgical procedures and therapeutic interventions for neurologic conditions. A discussion of cranial and spinal surgery, emphasizing the most common complications and nursing care is included. Plasmapheresis, a relatively new therapeutic procedure used in the treatment of neuromuscular diseases of immunologic origin, is included.

Chapter 7 provides further in-depth discussion of rehabilitation philosophy and goals, followed by special sections on adjustment, adaptation, and coping; sexuality; and stabilization and mobility. Other major concerns of rehabilitation are identified, and the reader is referred to the integrated content elsewhere in the text.

Chapter 8 presents numerous patient teaching guides. These are designed so that they can be copied, distributed to patients and their families, and used for a reference after discharge.

Chapter 9 reviews many of the pharmaceutical agents used to treat patients with neurologic disorders. Drugs are listed by trade and generic names and common dosages are identified.

This book is intended for use by nurses practicing in acute care as well as rehabilitation settings, including general medical-surgical practitioners as well as those nurses practicing in the neuroscience area. We also hope that this book will be a valuable adjunct to medical-surgical nursing texts for nursing students. It is our hope that this book will contribute to the overall advancement of neuroscience nursing. The nursing care of the patient with a neurologic condition requires an in-depth knowledge base, refined problem-solving skills, clinical technical skills, and a dedication to assisting patients and their families to adapt to challenging and complex changes in function and lifestyle.

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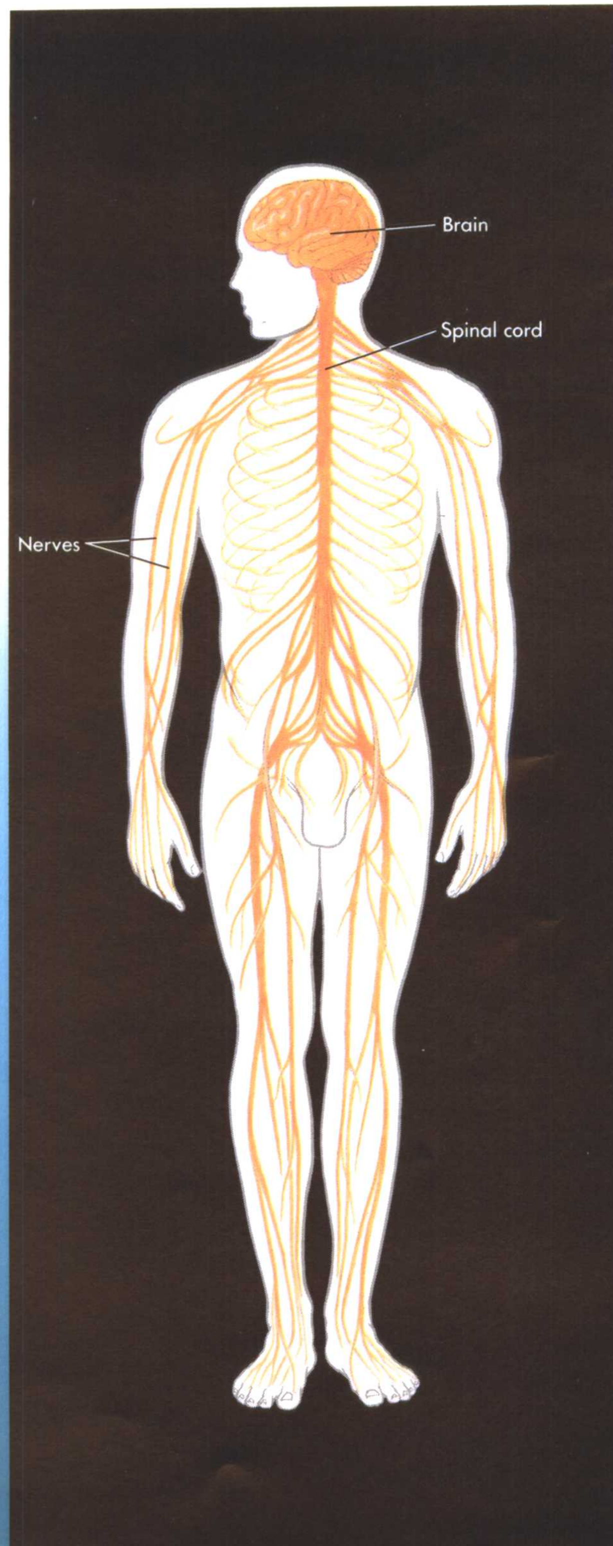
Brain
Spinal cord
Nerves

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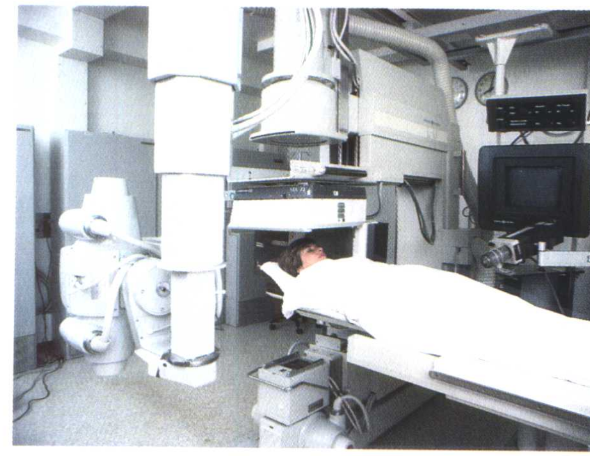

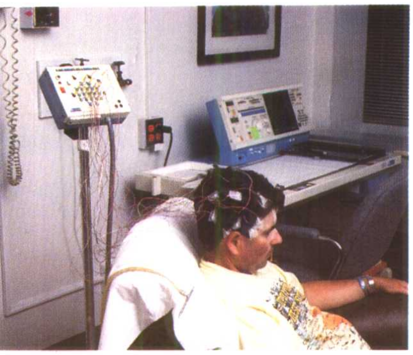

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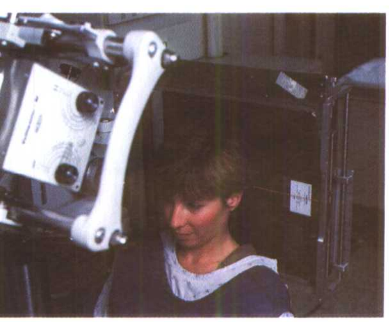

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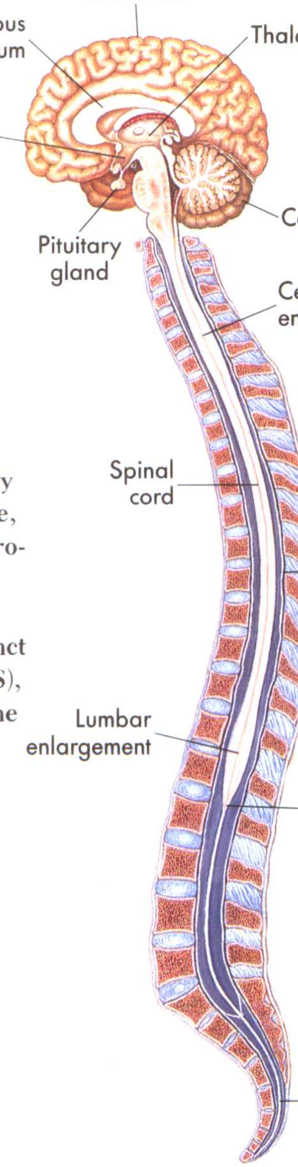
CHAPTER 1

Color Atlas of Neurologic Structure and Function



The human nervous system consists of complex structures and processes similar to an intricate circuit board, through which the various functions of the body are integrated. Because these functions are integrative, the physiologic and psychologic ramifications of a neurologic dysfunction can be devastating for both patients and their families.

The nervous system is divided into two fairly distinct structural categories: the central nervous system (CNS), which consists of the brain and the spinal cord, and the peripheral nervous system (PNS), which comprises 12 pairs of cranial nerves, 31 pairs of spinal nerves, and the sympathetic and parasympathetic subdivisions of the autonomic nervous system. Functionally, the central and peripheral nervous systems are interdependent in that each is made up of millions of shared neurons and neuroglial cells. The neuron is the basic unit of the nervous system; the neuroglial cells support the neuron.

MICROSTRUCTURE OF THE NERVOUS SYSTEM

NEUROGLIAL CELLS

About 40% of the structures of the brain and spinal cord are made up of **neuroglial cells.** These cells protect, support, and nourish the cell bodies and processes of the neurons. There are four distinct types of neuroglial cells: **astroglia** (astrocyte), **ependyma, microglia,** and **oligodendroglia** (Figure 1-1 and Table 1-1). Unlike neurons, neuroglial cells can divide and multiply by mitosis, and they are a main source of nervous system tumors.

NEURONS

Neurons come in many sizes and shapes, and each transmits specific nervous stimuli (Figure 1-2). Neurons have properties of excitation and electrical-chemical conductivity. In the central nervous system, groups of neurons are called **nuclei;** in the peripheral nervous system, they are called **ganglia.**

NERVES

In the peripheral nervous system, the neuron carries impulses to and from the central nervous system via the chainlike grouping of neuron cell fibers called nerves. The term **nerve** applies only to cell fibers in the peripheral nervous system; in the central nervous system, these groups of cell fibers are called **fiber tracts.**

The axon is the part of the nerve that conducts impulses. The myelin sheath around the axon insulates, protects, and nourishes the axon. Periodic interruptions of the myelin sheath are called **nodes of Ranvier.**

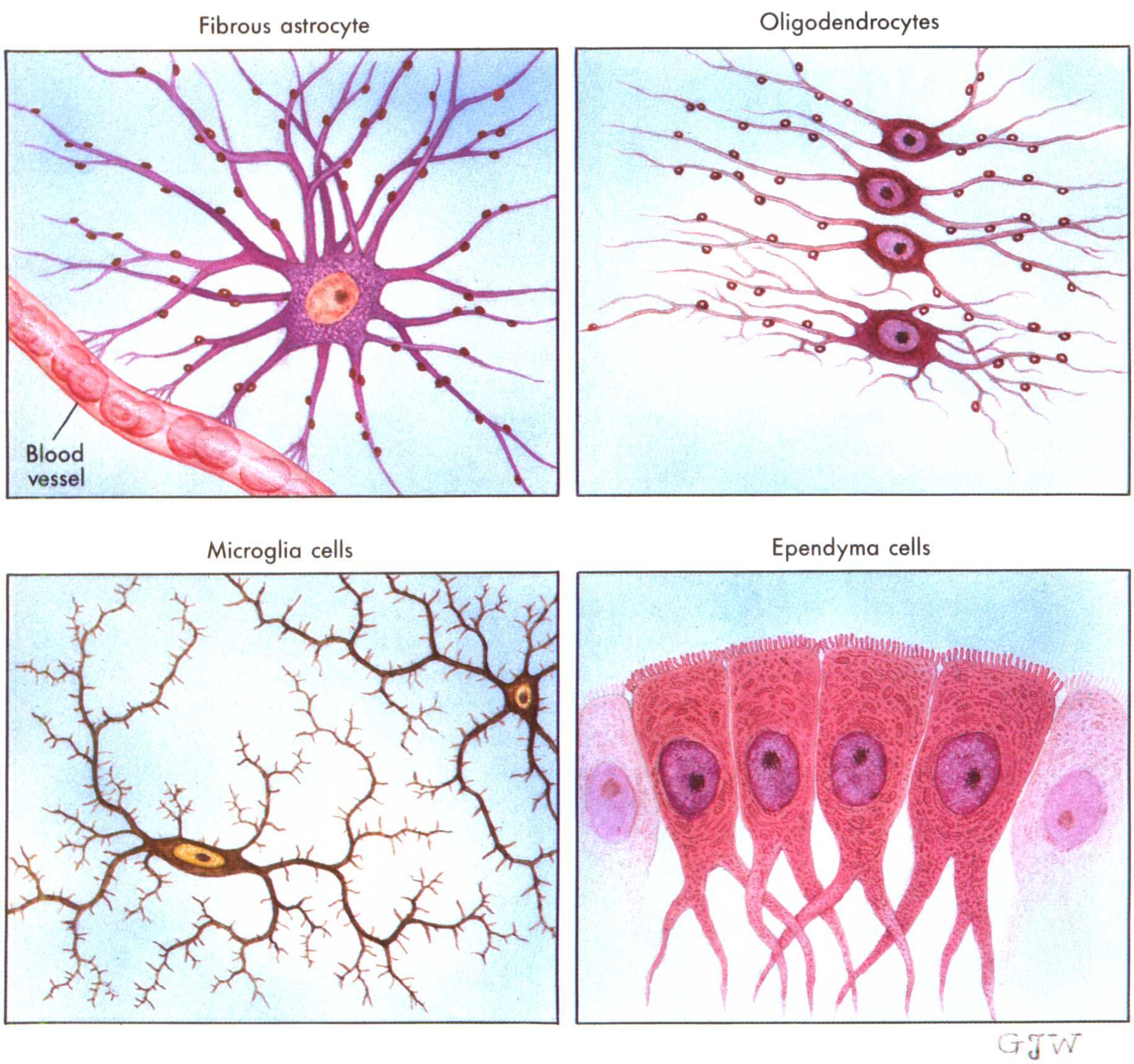


FIGURE 1-1
Types of neuroglial cells.

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Table 1-1

TYPES OF NEUROGLIAL CELLS

Astroglia (astrocyte)

Supplies nutrients to neuron structure and supports framework for neurons and capillaries; forms part of the blood-brain barrier

Oligodendroglia

Forms the myelin sheath in the CNS

Ependyma

Lines the ventricular system; forms the choroid plexus, which produces CSF

Microglia

Occurs mainly in the white matter; phagocytizes waste products from injured neurons

From Thelan.[138]

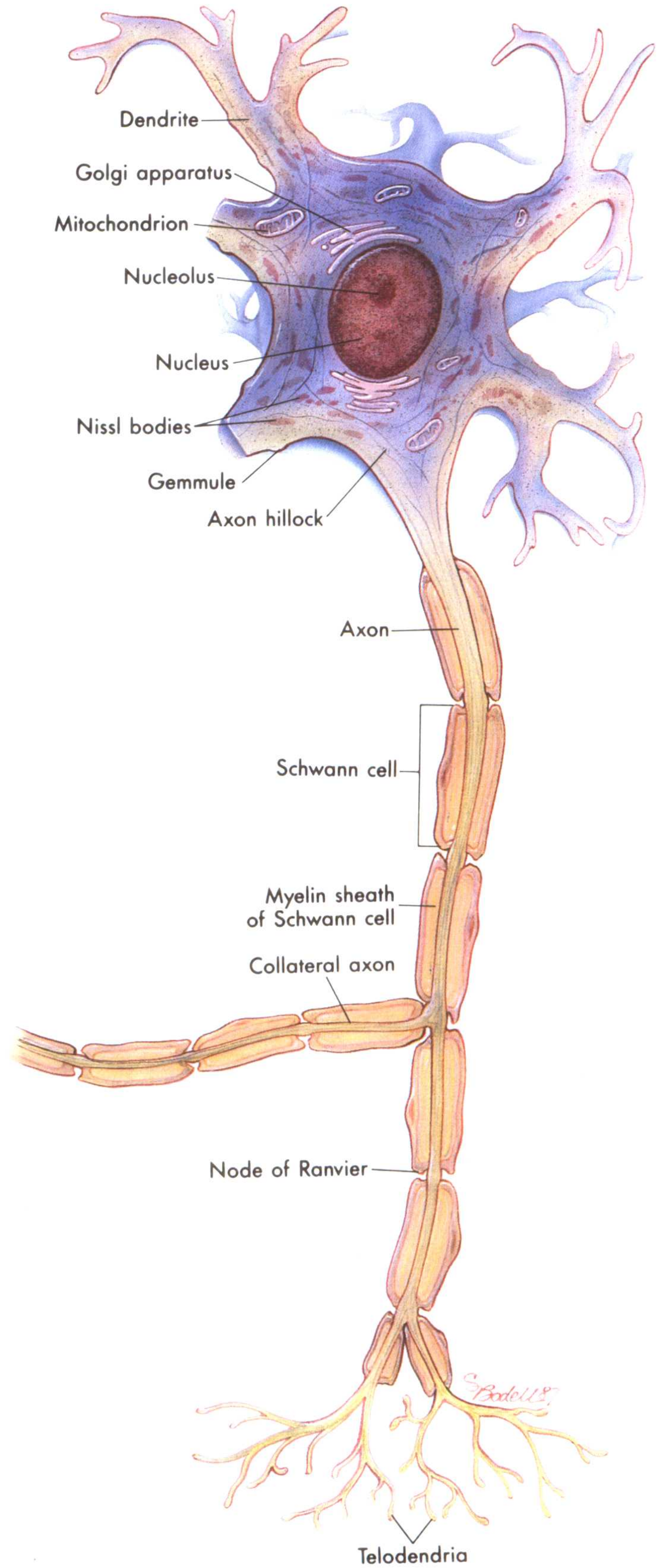


FIGURE 1-2
Structural features of neurons: dendrites, cell body, and axons. (From Seeley.[130])

PHYSIOLOGY OF NERVE TISSUE

NERVE IMPULSE

Nerve fibers are charged (**polarized**) in their resting state. In this state the cells have a resting membrane potential of −70 mV, meaning that the inside of the cell membrane has a negative charge in relation to the outside. There is a high concentration of sodium (Na^+) outside the cell and a high concentration of potassium (K^+) in the cell, resulting in unequal electrical charges across the cell membrane. This difference stems from the cell's relative impermeability to sodium and the sodium-potassium pump mechanism, whereby sodium is pumped continuously out of the cell and potassium is pumped in.

With an adequate stimulus (called the **threshold intensity**). the permeability of the cell membrane changes markedly and rapidly; this change results in a gain of sodium and a loss of potassium in the cell. With the gain of sodium, the cell becomes positively charged in relation to the interstitial space, and an action potential, or **depolarization,** results. The depolarization stimulus excites one area, which then excites adjacent parts of the cell membrane (**conduction**), until the entire membrane is stimulated at the same intensity. Thus the wave of depolarization moves cyclically along the entire length of the nerve. After depolarization, the ionic flow reverses: sodium is pumped out as potassium is pumped back into the cell. This is the **repolarization** process, whereby the membrane is returned to its resting potential. During depolarization and one third of the repolarization process, the neuron cell cannot be restimulated with another action potential. This interval, or **absolute refractory period,** prevents repeated excitation of the neuron (Figure 1-3).

SYNAPSE

Because neurons are arranged in chainlike pathways, impulses must travel from one cell to another via functional junctions called synapses (Figure 1-4). Actual synaptic transmission is a chemical process that occurs because of the release of neurotransmitters (see box). In addition, synapses are polarized so that the impulse flows in one direction only (e.g., from the axon of one neuron to the axon, dendrites, or cell body of another neuron in a pathway).

The anatomic structures of the synapse consist of **presynaptic terminals,** the **synaptic cleft,** and the **postsynaptic membrane.** The presynaptic terminals (also called **presynaptic knobs**) contain hundreds of very small circular vesicles that store excitatory or inhibitory neurotransmitters.

NEUROTRANSMITTER SUBSTANCES AND SUSPECTED NEUROTRANSMITTER SUBSTANCES

Neurotransmitters

Acetylcholine
Norepinephrine
Epinephrine
Glycine
Gamma-aminobutyric acid (GABA)
Glutamic acid
Substance P
Serotonin
Dopamine
Aspartic acid

Neuromodulators

Enkephalins
Endorphins
Substance P

Other compounds (**either neurotransmitters or neuromodulators**)

Prostaglandins
Cyclic AMP
Histamine
Cholic acid

Modified from Seeley.[130]

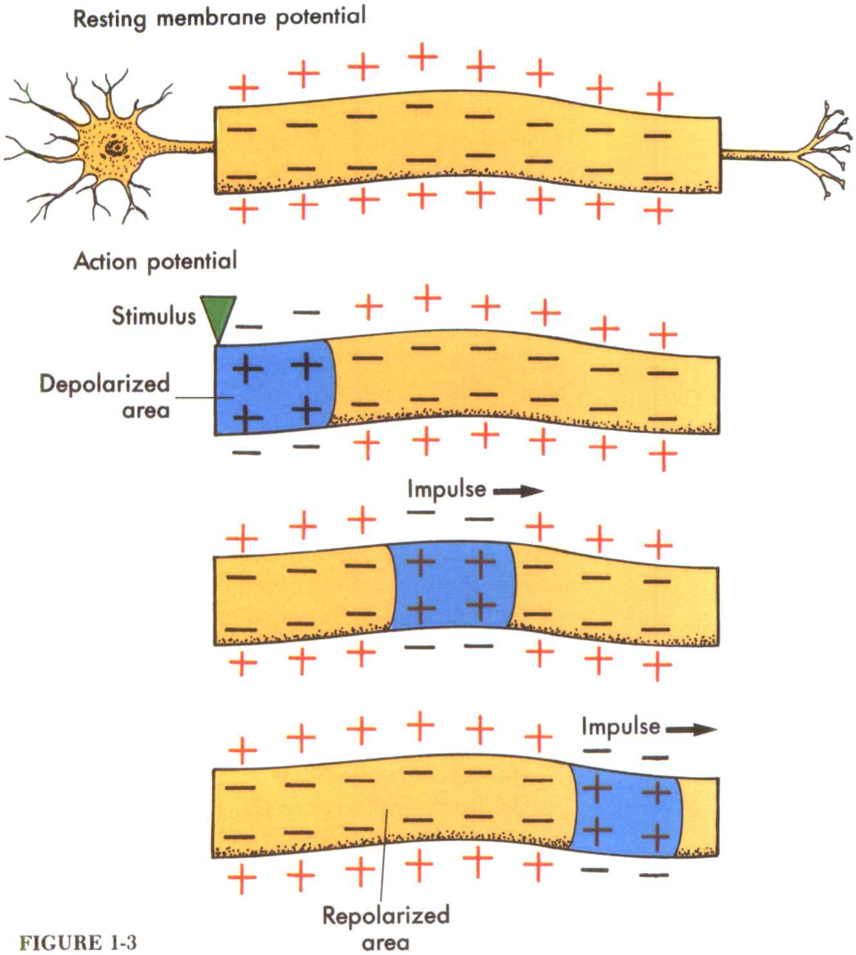


FIGURE 1-3
Nerve impulse.

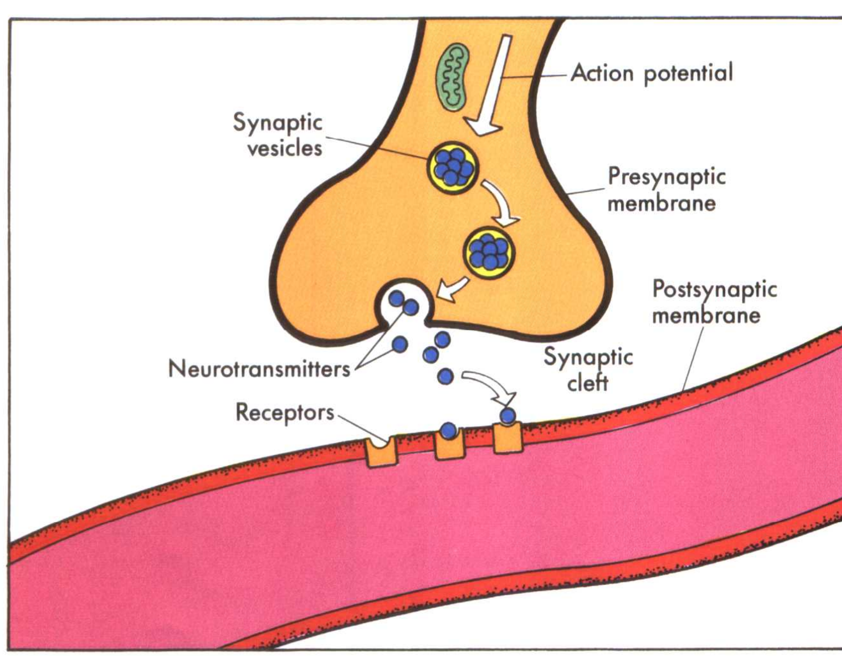


FIGURE 1-4
Synaptic transmission.

CENTRAL NERVOUS SYSTEM

PROTECTIVE STRUCTURES OF THE CENTRAL NERVOUS SYSTEM

Skull

The brain is protected by the bony structure of the skull, which is divided into two primary sections, the cranium and the skeleton of the face (Figure 1-5). The cranial portion of the skull is made up of eight relatively flat, irregular bones joined by a series of fixed joints, called **sutures.**

At the base of the skull in the inferior-anterior portion of the occipital bone is a large, oval opening called the **foramen magnum.** It is here that the brain and spinal cord become continuous. Also at the base of the skull is a series of openings (called **foramina**) for the entrance and exit of paired cranial nerves and cerebral blood vessels.

Cranial Meninges

Between the skull and the brain lie three connective tissue layers called the **meninges** (Figure 1-6). Each meningeal layer is a continuous separate sheet that, like the skull, protects the soft brain tissue.

The outermost meninx is the fibrous, double-layered **dura mater.** The dura mater envelops the brain and separates the brain into compartments by its various folds. The **falx cerebri** is a vertical fold of the dura mater at the midsagittal line that separates the two cerebral hemispheres. The **tentorium cerebelli** is a horizontal double fold of dura that supports the temporal and occipital lobes and separates the cerebral hemispheres from the brainstem and the cerebellum. (The tentorium provides an important line of division.) Structures above the tentorium are called supratentorial, and those below it are called infratentorial. The **falx cerebelli** separates the two hemispheres of the cerebellum.

Between the dura mater and the middle meningeal layer is a narrow serous cavity called the **subdural space.** Vessels within the subdural space have few support structures and therefore are easily injured.

The middle layer of the meninges is called the **arachnoid.** It is composed of a two-layered, fibrous, elastic membrane that crosses over the folds and fissures of the brain. Between the arachnoid and the inner meningeal layer is the **subarachnoid space.** Within the subarachnoid space are cerebral arteries and veins of different sizes. At the base of the brain, dilations in the subarachnoid space form **cisterns.** It is in the subarachnoid space that cerebrospinal fluid circulates over the surfaces of the brain.

The innermost layer of the meninges is called the **pia mater.** The pia mater is rich in small blood vessels, which supply the brain with a large volume of blood. It is in direct contact with the external structure of the brain tissue.

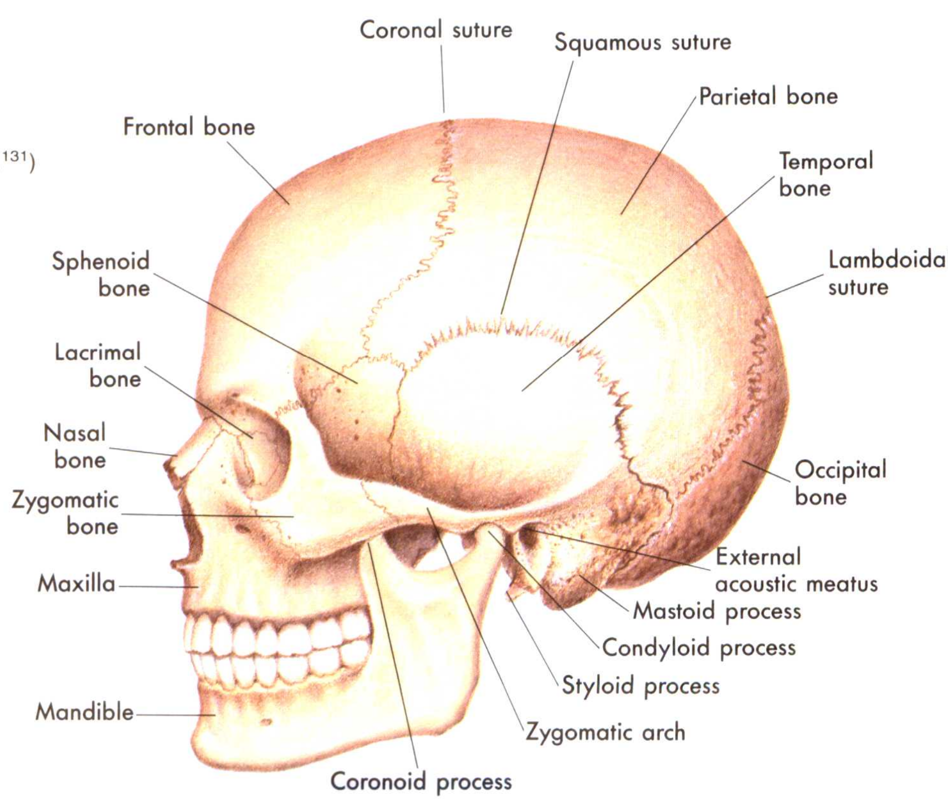
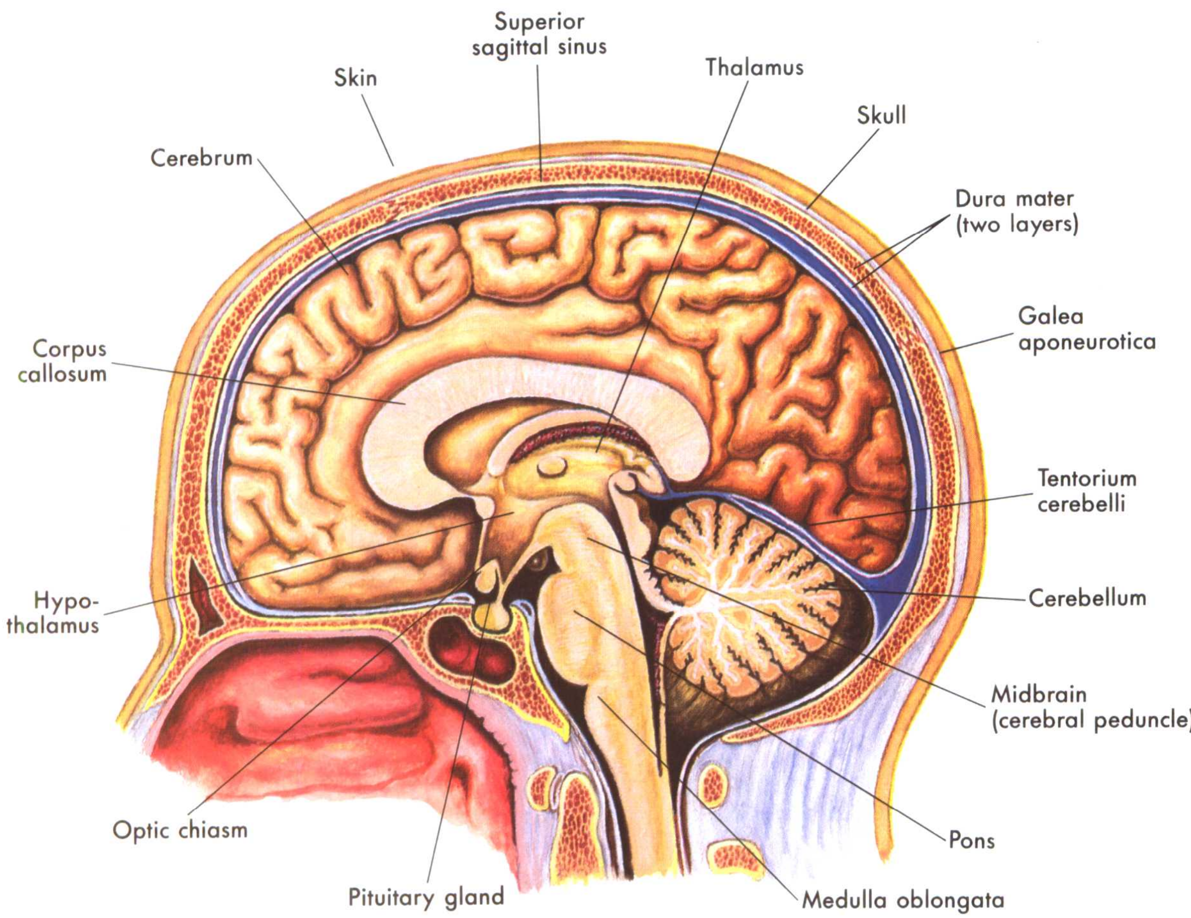


FIGURE 1-5
Lateral view of the skull. (From Seidel.[131])



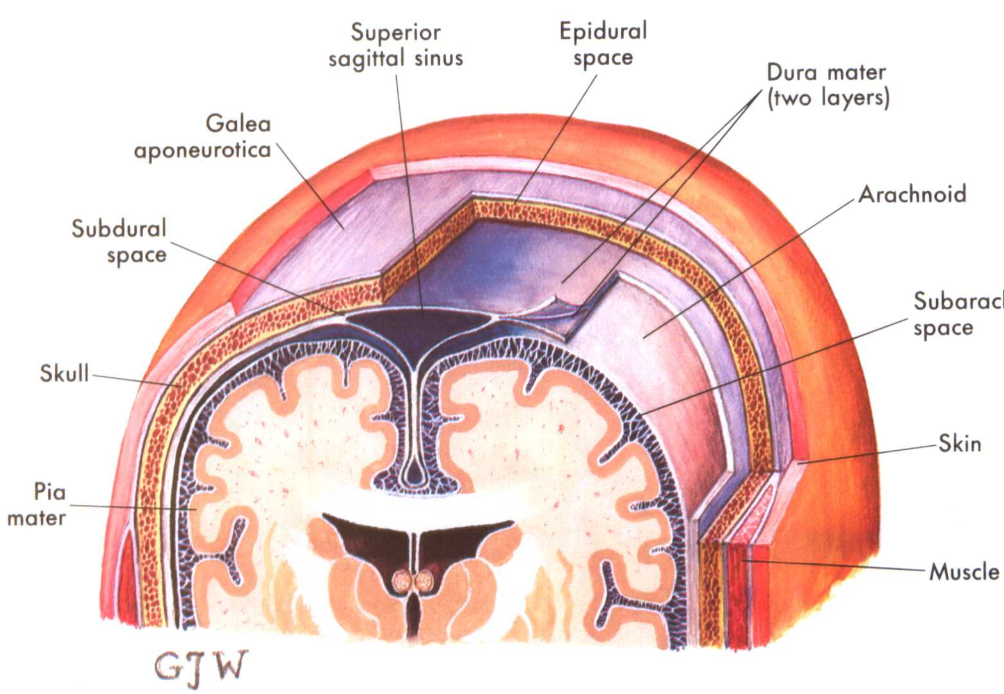


FIGURE 1-6
Meningeal layers of the brain.

CEREBRAL VENTRICULAR SYSTEM AND CEREBROSPINAL FLUID

The cerebral ventricular system consists of four interconnecting chambers that produce and circulate cerebrospinal fluid (Figure 1-7). The system is composed of two **lateral ventricles,** the **third ventricle,** and the **fourth ventricle.**

Cerebrospinal fluid is a colorless, odorless fluid that contains glucose, electrolytes, oxygen, water, carbon dioxide, small amounts of protein, and a few leukocytes. It is produced by the choroid plexus, which is located in the ventricular system. Cerebrospinal fluid cushions the central nervous system, removes metabolic wastes, provides nutrition, and maintains normal intracranial pressure.

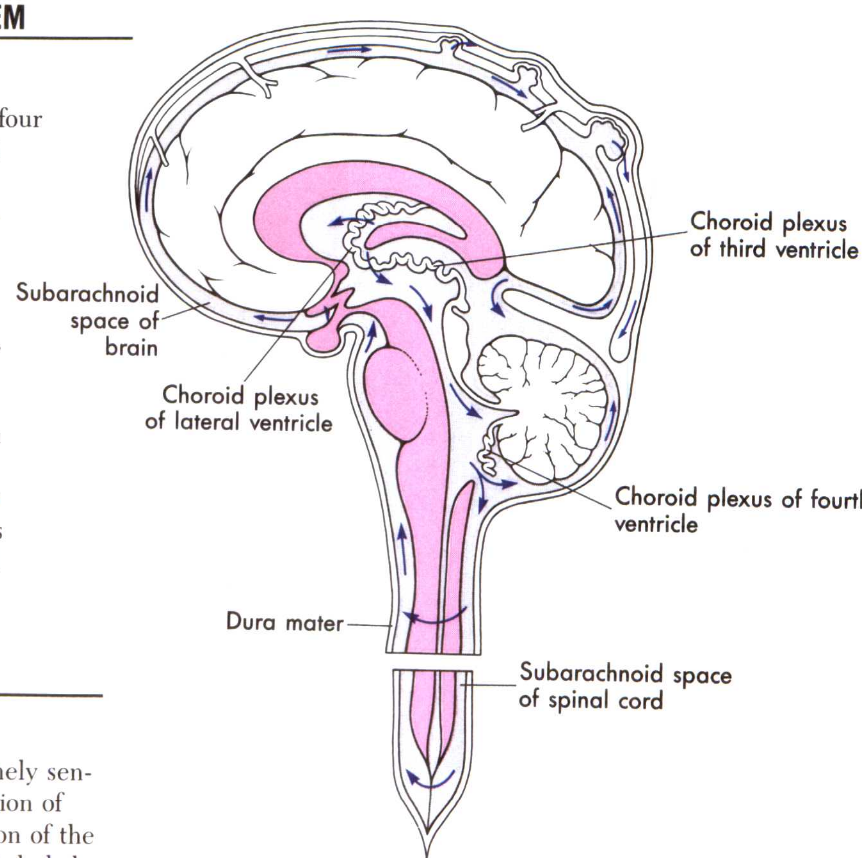


FIGURE 1-7
Cerebrospinal fluid (CSF) circulation. The arrows represent the route of flow. (From Seeley.[130])

BLOOD-BRAIN BARRIER

The neuronal tissues of the brain are extremely sensitive to any changes in the ionic concentration of their environment. Therefore the composition of the brain's internal environment must be delicately balanced to ensure normal functioning. The blood-brain barrier is a physiologic mechanism that helps maintain and protect this homeostatic balance by means of selective capillary permeability.

BLOOD SUPPLY TO THE BRAIN

Cerebral circulation is quite complex and uses 20% of the cardiac output. Because cerebral tissues have no oxygen and glucose reserves, inadequate blood supply to brain tissue results in irreversible damage.

The arterial blood supply to the brain is divided into two systems, the anterior circulation and the posterior circulation (Figure 1-8). The blood supply to the brain comes principally from two pairs of arteries: the internal carotid arteries, which supply the anterior circulation, and the vertebral arteries, which supply the posterior circulation (Figure 1-9 and Table 1-2). At the base of the brain the cerebral arteries are connected, by their communicating branches, into an arterial circle called the **circle of Willis.** The purpose of the circle of Willis is to ensure circulation if one of the four main blood vessels is interrupted. (See Figure 1-10.)

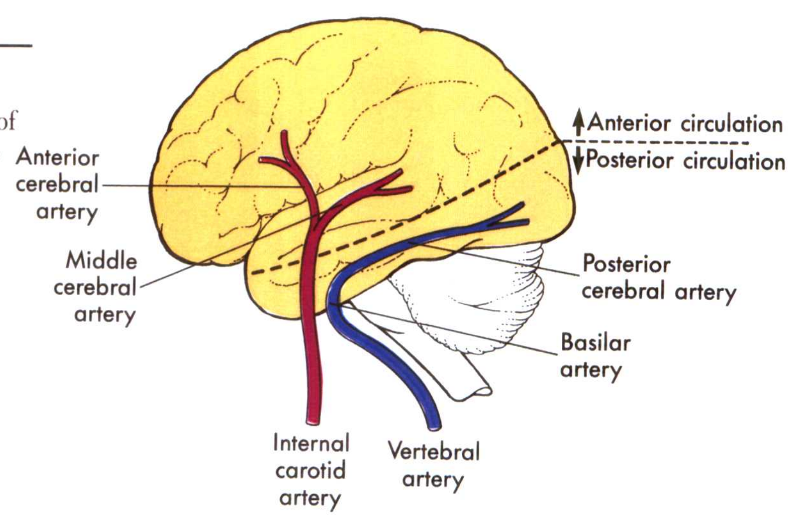


FIGURE 1-8
Arteries of anterior and posterior cerebral circulation. (From Thelan.[138])

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