Overview of the Nervous System

Nervous and endocrine systems – main regulators of body (homeostasis)

- Both transmit info to body, but in different ways.
- Both use chemicals.
  - Nervous system uses neurotransmitters.
  - Endocrine system uses hormones.
- Form feedback loops – nervous system regulates endocrine system and vice versa.

The nervous system transmits information rapidly with a short duration of action by nerve impulses conducted from one body area to another. The endocrine system is a network of ductless glands and other structures that secrete hormones directly into the bloodstream, affecting the function of specific target organs. The action of hormones is slower and longer lasting than that of nerve impulses.

Nervous System Functions

Sensing: Collecting data from the environment

Interpreting: Processing data and formulating a response

Acting: Telling the body to perform the response

Nervous System Divisions

- Central nervous system (CNS)
  - Brain, spinal cord, and coverings
- Peripheral nervous system (PNS)
  - Cranial nerves, spinal nerves, and ganglia
  - Somatic subdivision
  - Autonomic subdivision
    - Sympathetic – activates arousal responses
    - Parasympathetic – reverses sympathetic response (return to nonalarm state)

The somatic subdivision of the PNS monitors and controls bones, muscles, soft tissues, and skin.

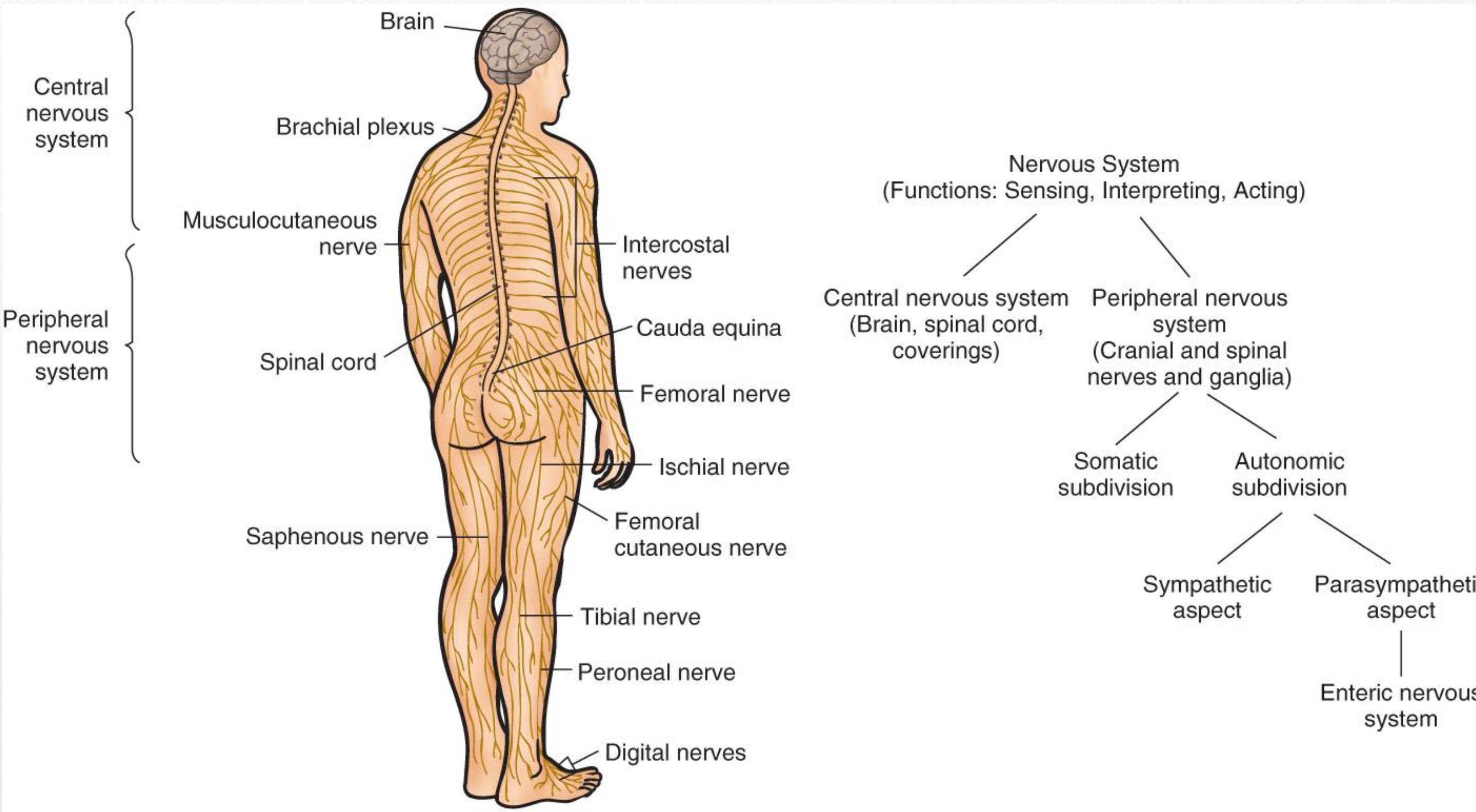
The visceral or autonomic subdivision is associated with the internal glands, organs, blood vessels, and mucous membranes and is further subdivided into sympathetic and parasympathetic aspects.

Enteric nervous system

Division of parasympathetic ANS

Directly controls digestive system

The ENS has been called the "little brain in the gut." It is a network of nerves that is mainly located in the wall of the intestines.


Brain
Central nervous system
Brachial plexus
Musculocutaneous nerve
Intercostal nerves
Peripheral nervous system
Cauda equina
Spinal cord
Femoral nerve
Ischial nerve
Femoral cutaneous nerve
Saphenous nerve
Tibial nerve
Peroneal nerve
Digital nerves
Nervous System (Functions: Sensing, Interpreting, Acting)
Central nervous system (Brain, spinal cord, coverings)
Peripheral nervous system (Cranial and spinal nerves and ganglia)
Somatic subdivision
Autonomic subdivision
Sympathetic aspect
Parasympathetic aspect
Enteric nervous system

Nervous System Structure

Neuron (nerve cell)

Three types:

Afferent or sensory neurons carry impulses to the CNS.

Connecting or associative interneurons transmit nerve impulses between neurons.

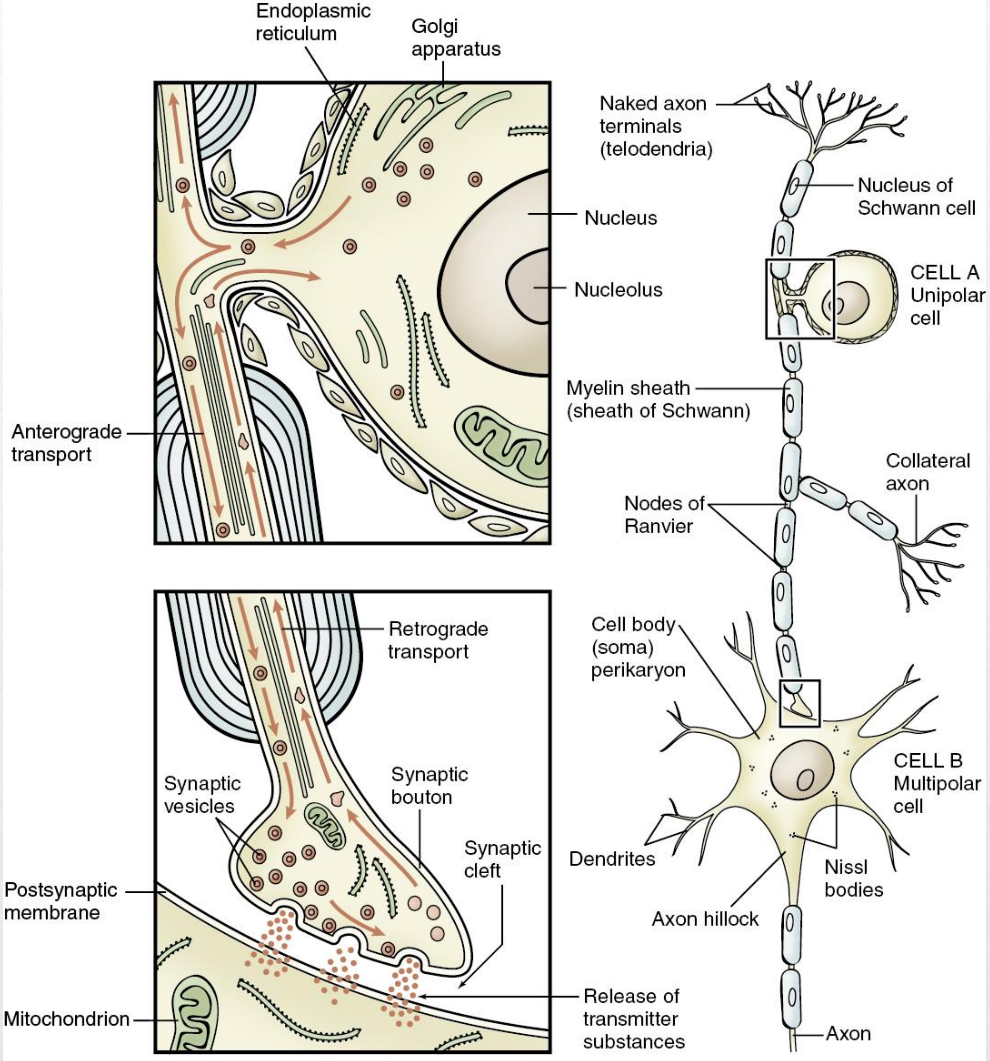
Efferent or motor neurons transmit impulses away from the CNS to muscles, organs, and glands.

When we give a massage, we are communicating with the sensory neurons. They are receptors.

What the body does with the sensory information produced by massage ends up being either a benefit of massage or some sort of adverse outcome.

Nerve Cell Structure

Neurons conduct impulses.



Neurons are identified by their functions:

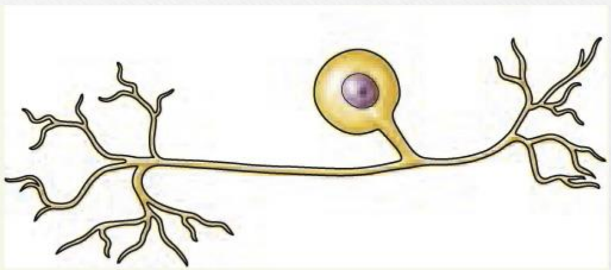
Sensory neurons conduct sensory signals to the central nervous system (CNS).

Motor neurons carry motor signals away from the CNS.

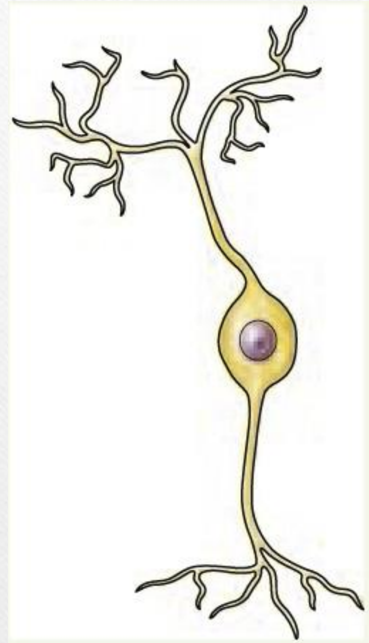
Association neurons, or interneurons, act as bridges in the CNS to conduct signals from one neuron to another.

Classification of Neurons

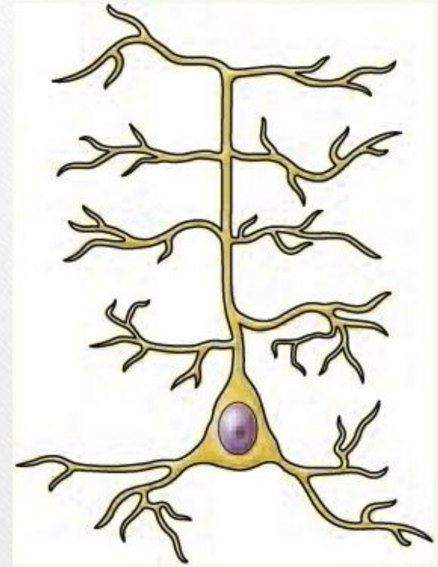
Unipolar neurons, shown on the left here, only have one projection from the cell body, which includes the dendrite and axon.



Unipolar



Bipolar



Multipolar

Bipolar neurons, shown in the middle, have only one dendrite and axon.

Multipolar neurons, shown on the right, have multiple dendrites and one axon exiting from the cell body. Multipolar neurons are the most common.

Neuroglia

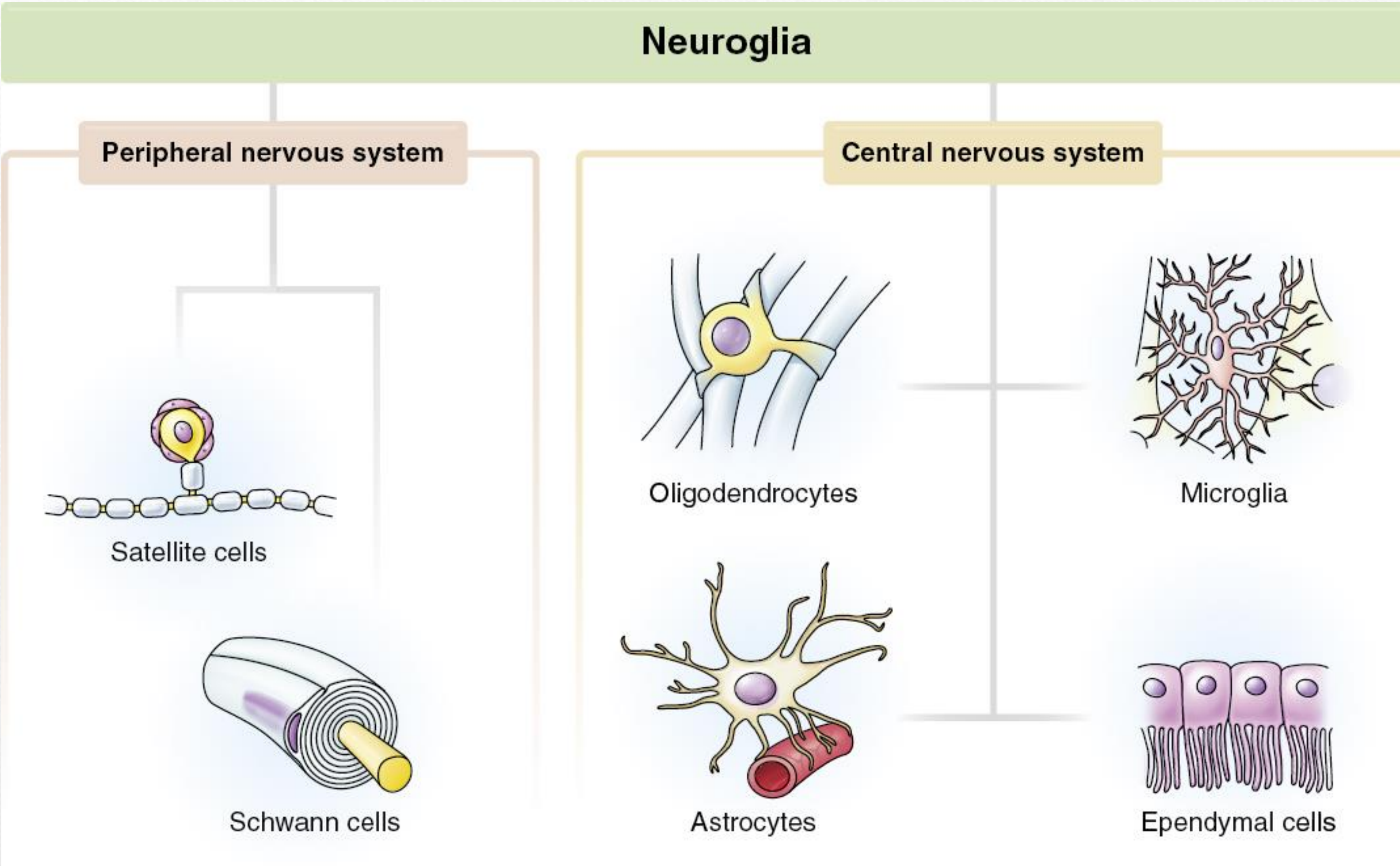
Specialized connective-tissue cells

Four types:

- Ependymal cells
- Astrocytes
- Oligodendrocytes
- Micorglia

Neuroglia provide physical support, protection, insulation, and nutrient exchange pathways between blood and the neurons of the brain and spinal cord.

In the PNS Schwann cells form myelin, a fatty, insulating protective sheath around the axons of certain neurons. The outer layer of the Schwann cell encloses the myelin sheath and is called the neurolemma.


Neuroglia
Peripheral nervous system
Central nervous system
Satellite cells
Schwann cells
Oligodendrocytes
Microglia
Astrocytes
Ependymal cells

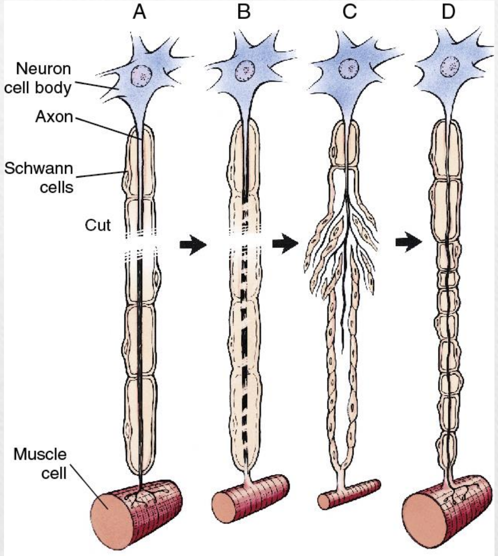
Nerve Repair or Regeneration

Injury – cut nerve

Myelin sheath and distal portion of axon degenerate

Neurolemma forms tunnel

Connection with effector reestablished



Nerve regeneration can take a long time.

Factors that influence how long a neuron takes to repair itself:

The length of the axon, location of the injury, scarring, and inflammatory response.

Nerve Cell Functions

Membrane potential

- Nerve impulse could be generated.
- Created by different concentrations of ions inside and around neuron
  - Outside is positively charged; inside is negatively charged.

Neurons send messages electrochemically. This means that chemicals cause an electrical signal.

Chemicals in the body that are electrically charged are called ions. Ions can have a positive (+) or negative (–) charge.

Resting potential

Polarized, non-stimulated, resting neuron could generate an impulse if receives strong stimulus.

Depolarization

Stimulus results in brief change in charge of one segment of neuron.

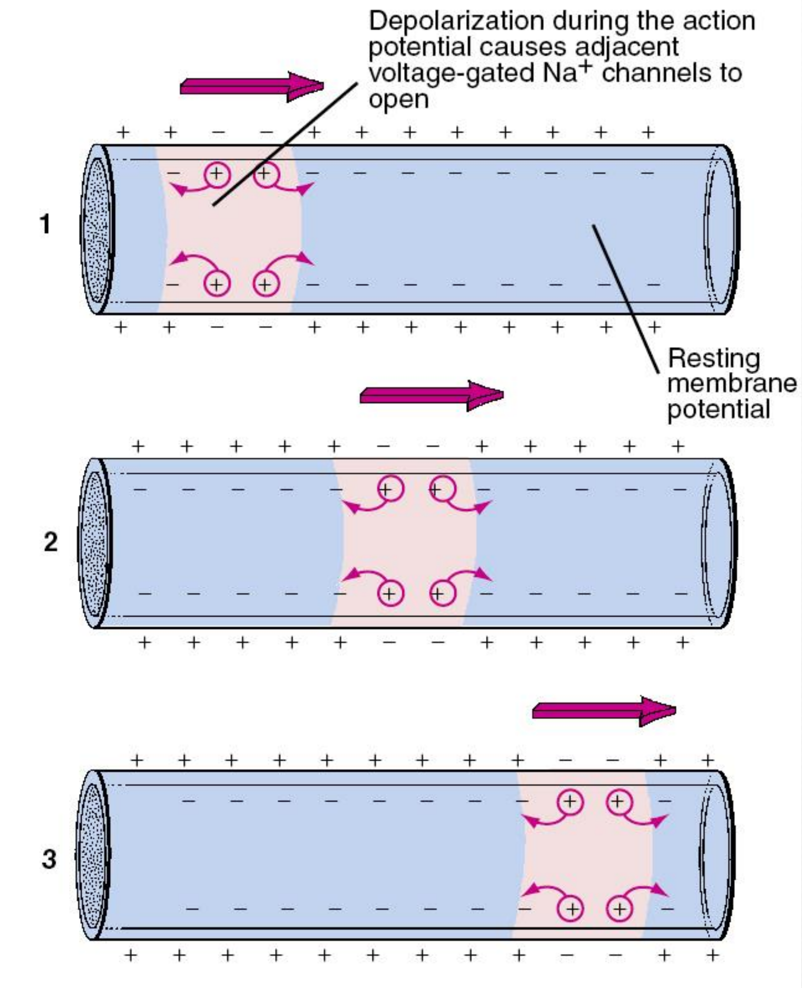
Action potential is the change that occurs when the outside of a segment of membrane becomes negatively charged, while the inside becomes positively charged. Action potential is how nerve signals move through the body.)

Conduction of the action potential

Depolarization

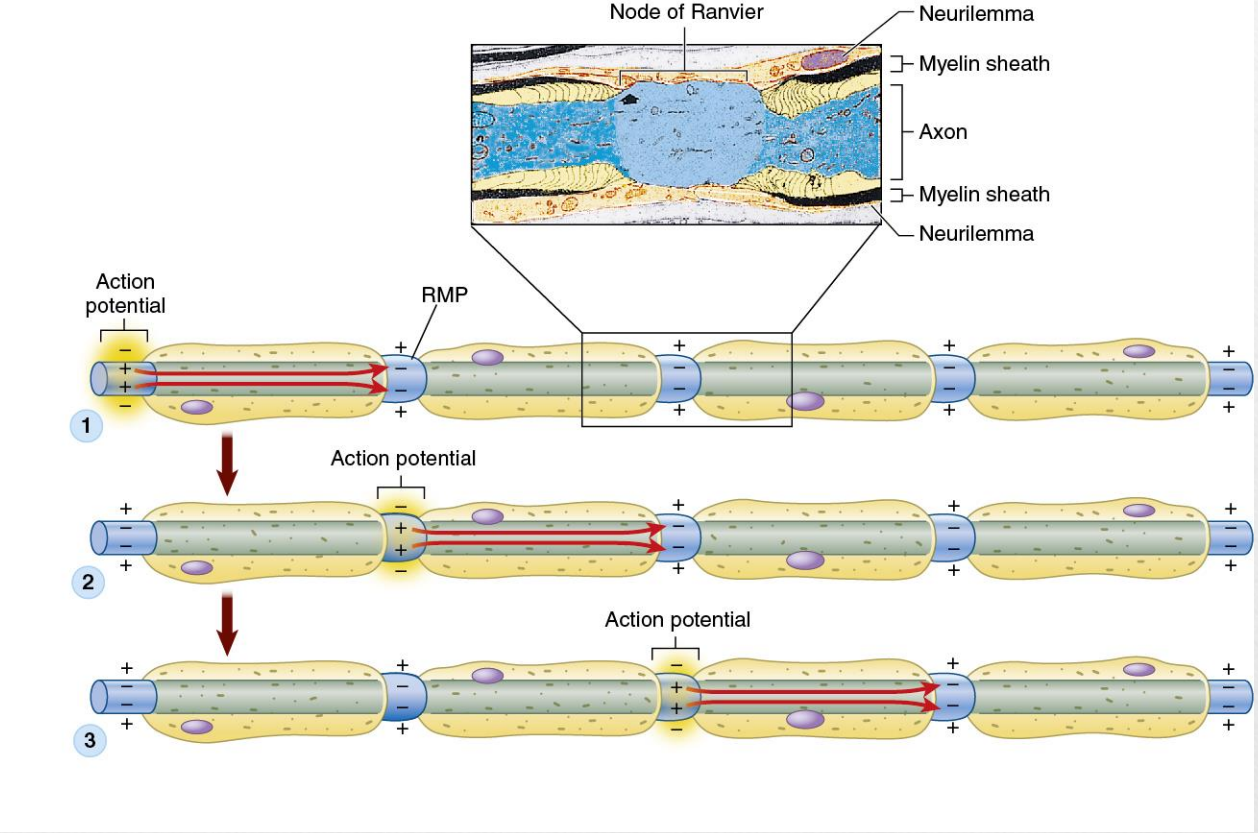
Refractory period

The refractory period is the brief period when the neuron recovers.



Nerve Impulse Conduction

Saltatory conduction – signal jumps from one gap to next



In the PNS myelin has gaps in the insulation where the actual nerve is exposed. These gaps, called nodes of Ranvier, occur at regular intervals along the length of the nerve fiber.

The electrical impulse jumps from gap to gap, greatly decreasing the length of time it takes to travel down the axon. This is called saltatory conduction.

Synapses and Neurotransmitters

Synapse: space or junction between neurons

- Electrical signals become chemical to cross
- Chemical signals known as neurotransmitters

More than 30 neurotransmitters

- Regulate body activities and senses
- Related to endocrine systems, hormones

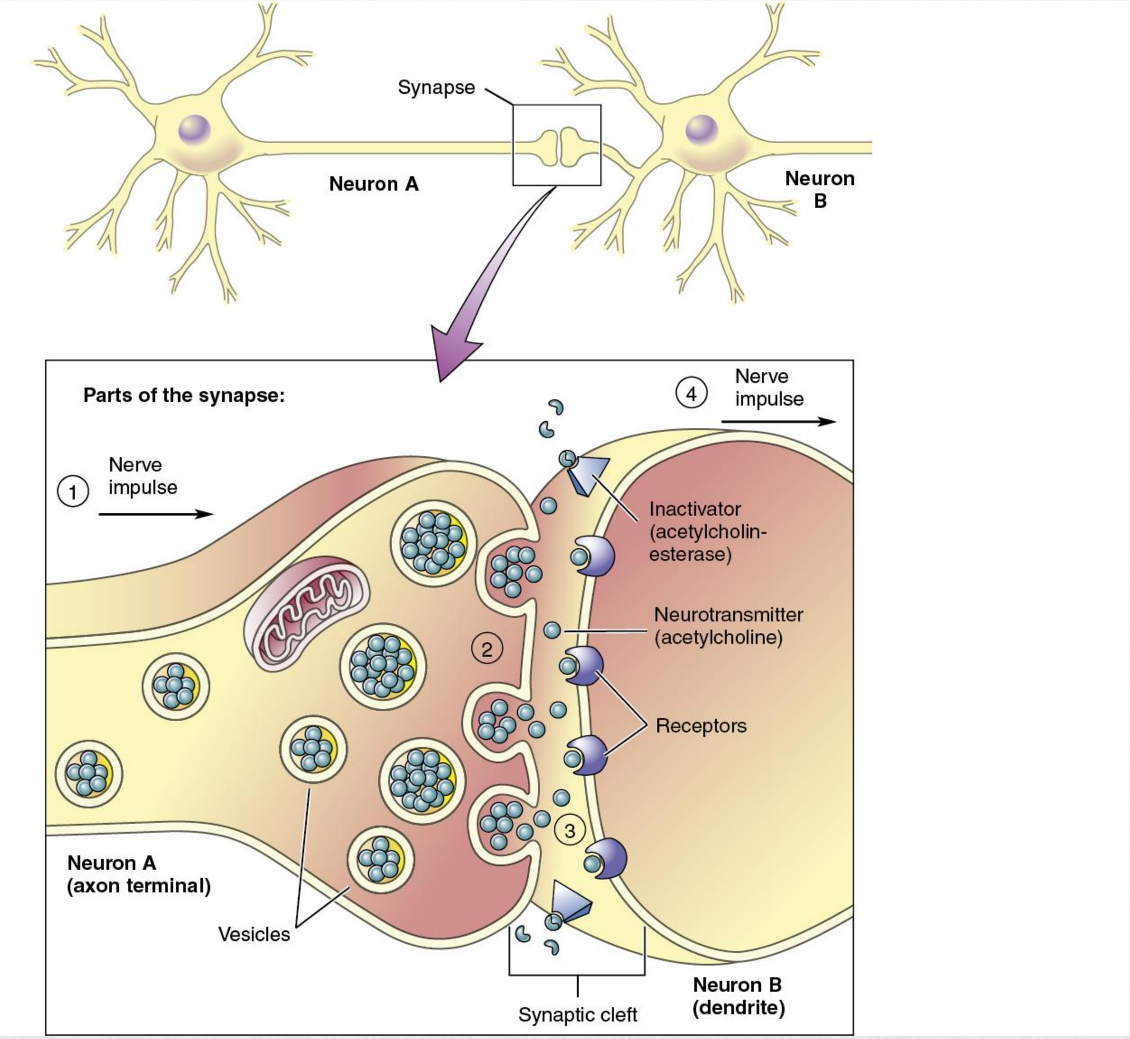
The neuron sending a signal is called presynaptic, while the neuron or muscle fiber receiving it is postsynaptic.

Neurotransmitters that cause the action potential to be transmitted across the synaptic cleft are considered stimulatory, or excitatory, neurotransmitters. Those that slow or prevent the transmission of the action potential are inhibitory neurotransmitters. The two actions, stimulation and inhibition, support balance in nerves like the gas pedal and brakes in a car.

Synapse

A synapse is the junction between two nerve cells or a nerve and an effector organ such as an endocrine gland or a muscle.

The space in the synapse is called the synaptic cleft.



Role of Neurotransmitters

Regulate body's activities and senses

Some hormones act as neurotransmitters.

Three categories

- Amino acids
- Amines
- Peptides

Massage increases the availability of neurotransmitters, such as norepinephrine, dopamine, and serotonin, and it increases endorphin secretion.

Dopamine is sometimes called a "feel-good neurotransmitter." Because dopamine is tied to the reward/pleasure, craving/seeking system, many addictive drugs stimulate dopamine activity—narcotics, alcohol, and cocaine are among them.

Box 4-3 Important Neurochemicals, Their Primary Actions, and Their Locations

Acetylcholine: Acetylcholine stimulates the skeletal muscles and acts primarily on the parasympathetic nervous system. Acetylcholine can stimulate or inhibit various organs, depending on the receptors to which it is bound. Plentiful in the brain, the chemical is involved in memory. A lack of acetylcholine has been found in many patients diagnosed with Alzheimer's disease, although a cause-and-effect relationship has not yet been established. Myasthenia gravis, which is a disease that causes weakening of skeletal muscles, results from a low level of acetylcholine receptors.

Catecholamine: Several compounds occurring naturally in the body that act as or as neurotransmitters or hormones in the sympathetic nervous system. The catecholamines include epinephrine, norepinephrine, and dopamine. These neurochemicals play an important role in the body's physiologic response to stress and increase the rate and force of muscular contraction of the heart, increasing cardiac output; constrict peripheral blood vessels, increasing blood pressure; elevate blood glucose; and promote an increase in blood lipids by increasing the catabolism of fats.

Epinephrine: Epinephrine can be a stimulant or an inhibitor, depending on the type of receptor bound. Epinephrine is found in several areas of the central nervous system and in the sympathetic divisions of the autonomic nervous system. Epinephrine is also involved in fight-or-flight responses, such as dilation of blood vessels to the skeletal muscles, and is classified as a hormone when secreted by the adrenal gland.

Serotonin: Serotonin usually works as an inhibitor in the central nervous system. It is synthesized into melatonin and affects biologic cycles, sleep, and moods. Insufficient levels can result in anxiety or depression. Serotonin is described as one of the feel-good neurotransmitters.

Gamma-Aminobutyric Acid (GABA): Generally inhibitory and found in the brain, this acid is the most common inhibitory neurotransmitter in the brain.

Glutamate (Glutamic Acid): Generally excitatory and found in the central nervous system, glutamate is thought to be responsible for as much as 75% of the excitatory signals in the brain.

Cholecystokinin: Found in the brain, retina, and gastrointestinal tract, the function of cholecystokinin in the nervous system is unclear and may be related to feeding behavior. Cholecystokinin is a gut-brain peptide.

Endorphins, Enkephalins, Endomorphins, Dynorphins: These endogenous morphines block the brain from feeling pain. Generally inhibitory, they are found in several regions of the central nervous system, retina, and intestinal tract. They inhibit pain by inhibiting substance P. Morphine and heroin mimic their effects. Endorphins and enkephalins seem to play a part in mood regulation, pain/pleasure cycles, and the internal reward system of the body.

Somatostatin: Generally inhibitory, somatostatin inhibits the release of growth hormone and is a gut-brain peptide.

Norepinephrine: Like epinephrine, norepinephrine can excite or inhibit and is found in the central nervous system (especially the hypothalamus and limbic system) and in the sympathetic division of the autonomic nervous system. Norepinephrine causes constriction of skeletal blood vessels, is considered a feel-good neurotransmitter, and is involved in emotional responses. The release of norepinephrine is enhanced by amphetamines. Cocaine stops the removal of norepinephrine from the synapses, such that stimulation of the synapses continues.

Dopamine: Generally excitatory, dopamine is found in the brain and the autonomic nervous system. A feel-good neurotransmitter, dopamine is involved in emotions and moods and in the regulation of motor control and the executive functioning of the brain. Release is enhanced by L-dopa and amphetamines. Deficiencies occur in people with Parkinson's disease and possibly also in those with schizophrenia. Dopamine is part of the endogenous reward/pleasure, craving/seeking behavior system in the brain. Many addictive drugs stimulate dopamine activity, including cocaine, narcotics, and alcohol.

Histamine: Considered a stimulant, histamine is released by the mast cells as part of the inflammatory process. Histamine causes itching at a cellular level and also works as a vasodilator. Also found in the hypothalamus, the chemical regulates body temperature and water balance and plays a role in emotions. Histamine also stimulates pain receptors to sensitize against further stimulation, as in the case of sunburn.

Somatostatin: Generally inhibitory, somatostatin inhibits the release of growth hormone and is a gut-brain peptide.

Substance P: Substance P is excitatory and is found in the brain, spinal cord, sensory pain pathways, and gastrointestinal tract. Substance P transmits pain information.

Vasoactive Intestinal Peptide: Found in the brain, some autonomic nervous system and sensory fibers, retina, and the gastrointestinal tract; the function of this peptide in the nervous system is unclear. It plays an important role in the regulation of coronary blood flow, cardiac contraction and relaxation, and heart rate.

Oxytocin: Involved in complex emotional and social behaviors, including attachment, social recognition, aggression, and approach and avoidance behavior toward others. It reduces anxiety, increases feelings of trust, helps establish maternal behavior, and is associated with well-being in relationships. Touch causes the body to produce oxytocin, which produces the desire to touch and be touched. It is also involved with uterine contractions and lactation but as a hormone.

Phenylethylamine (PEA): Helps regulate mood, focus, and stress. Exercise seems to increase PEA levels, causes feelings of happiness, and relieves depression. It aids in the transmission of dopamine and norepinephrine and can enhance aggression.

Nitric oxide: A gas that supports transport of oxygen to the tissues and transmission of nerve impulses. It can function as a neurotransmitter involved in functions of blood flow to heart and erectile tissue (e.g., the penis), the sphincters in the gut, and formation of memory.

Body Chemistry of Behavior and Pain Behavior

Behaviors that bring pleasure, pain, and survival are determined by chemistry.

Pain: a protective device for the body

- Important for survival
- Pain behavior – way we act when under influence of pain
- Complicated neurochemical event

Behavior is affected by the type and amount of neurotransmitters released at the synaptic junction.

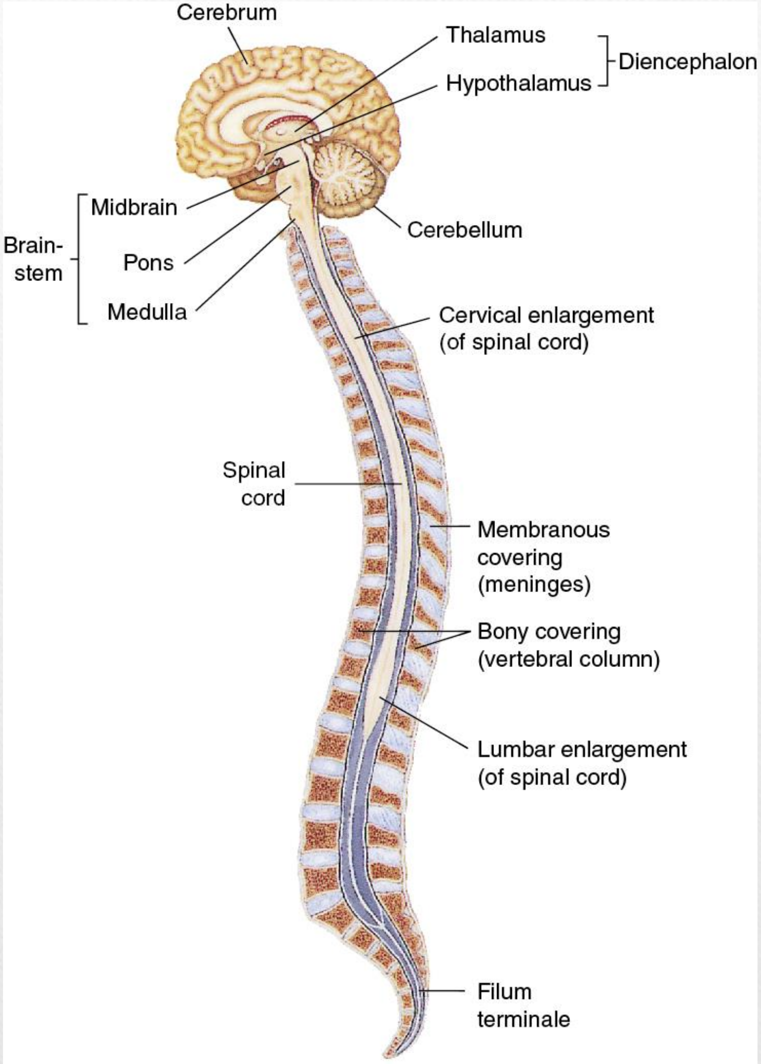
Too much or too little of any single neurotransmitter results in a behavior that takes extra to change.

Anatomy and Physiology of the Brain and Spinal Cord

Central Nervous System

Two main parts

- Brain
- Spinal cord



The average brain weighs about 3 pounds.)

Massage therapy interacts with the cerebral cortex and reticular activating system. These same mechanisms are involved in consciousness. Because of this interaction, massage methods often generate the sensations of altered consciousness.

Brain

Largest, most complex part of nervous system

- 100 billion neurons
- Responsible for intellect, emotions, actions

Divided into:

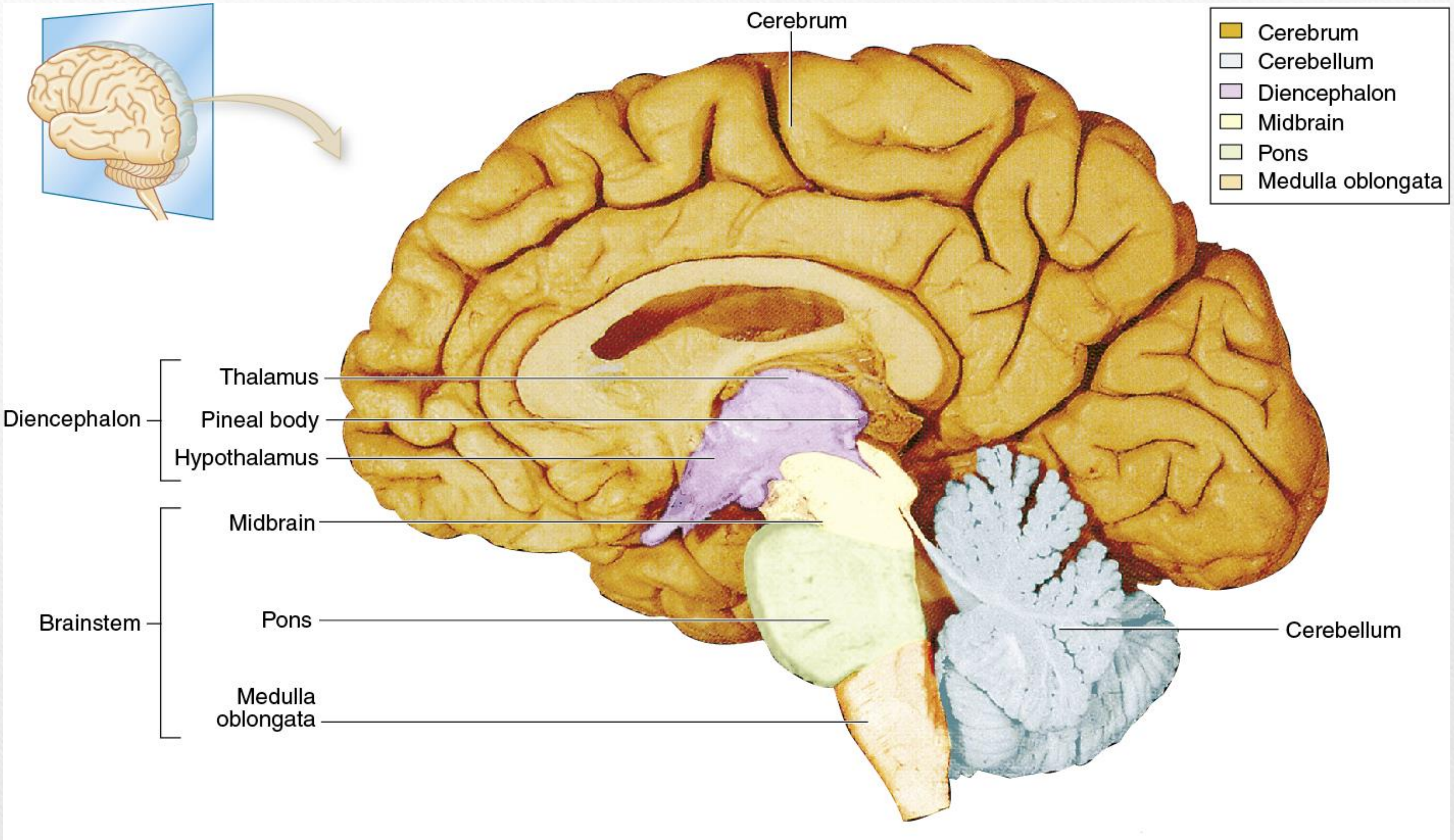
- Cerebrum
- Dienchephalon
- Cerebellum
- Brainstem

The brain makes up more than 97% of the nervous system. More than half of its weight comes from the neuroglia.

Neuroglia support, protect, and hold neurons together.

The brain in influenced by massage (i.e., sensory stimulation of ANS changes neurotransmitters

Divisions of the Brain



The brain is made up of more than 85% water. This is a higher percentage than the rest of the body as a whole.

Dehydration affects brain processes.

Cerebrum

Forebrain, largest portion of brain

Major functions:

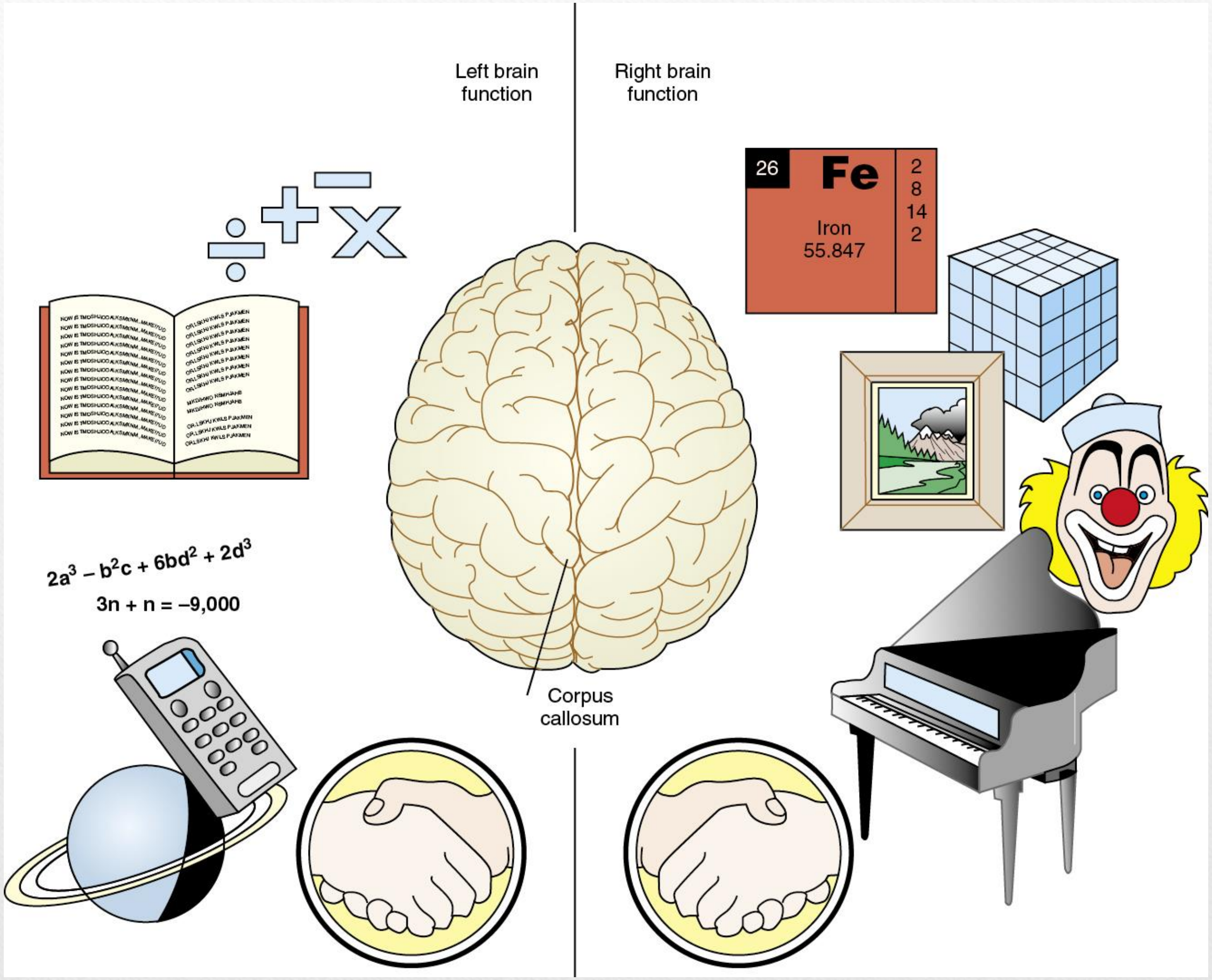
- Receive sensory information
- Interpret it
- Associate it with memories, past experiences
- Transmit most appropriate response
- Involved in emotions, memories

The cerebrum is divided into left and right hemispheres, and each hemisphere is divided into five lobes.

The frontal lobe is primarily responsible for control of the voluntary skeletal muscles. The parietal lobe is the primary sensory area of the brain. The temporal lobe is responsible for the reception and evaluation involved in hearing and smell. The occipital lobe is responsible for the mechanical control of eyesight, and the insula, or island, of Reil gives us a feeling or impression of what is real, true, and important.

Left Brain, Right Brain

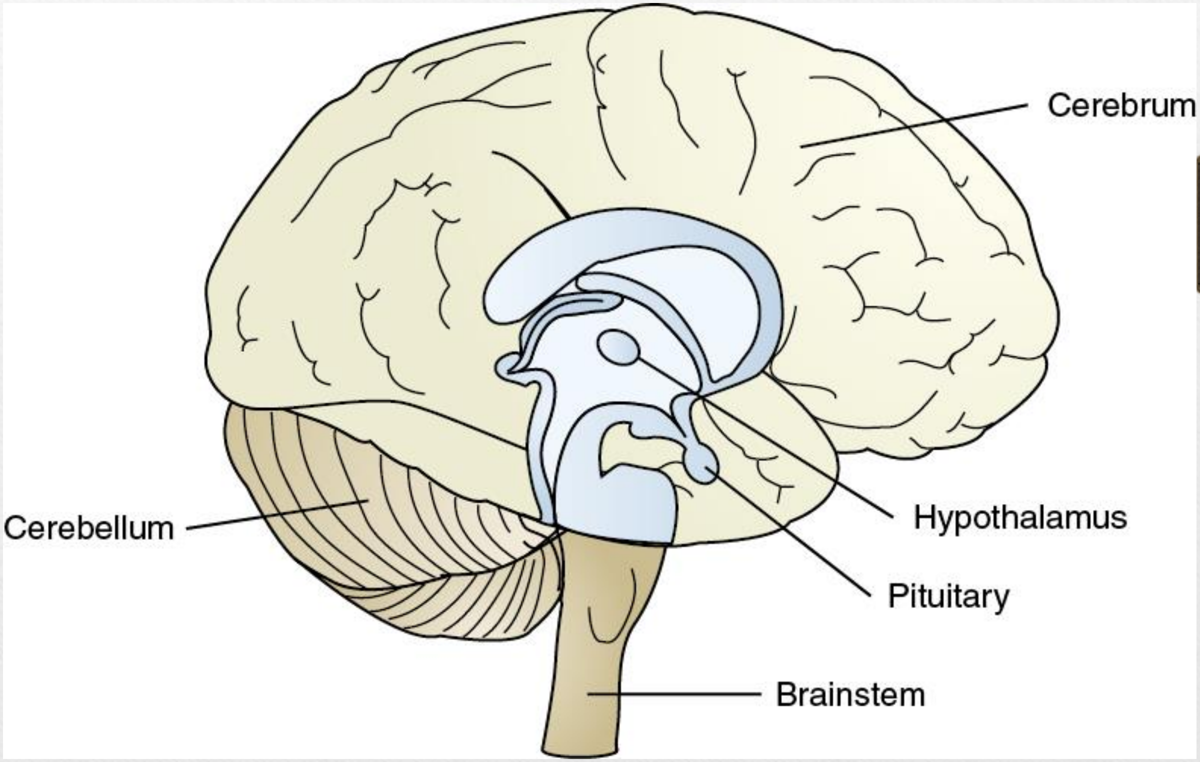
Right hemisphere: creative, intuitive abilities, and imagination. Left hemisphere: language functions, linear thought processing.



Location of Brain Structures

Most of the cerebrum is composed of white matter. Because the corpus callosum is composed of myelinated axons, it is white.

The surface of the cerebrum is covered by the cerebral cortex, a thin layer of matter that is gray because of the presence of dendrites and cell bodies.



Lobes of the Cerebrum

Frontal lobe

Parietal lobe

Temporal lobe

Occipital lobe

Insula (Island of Reil)

The parietal lobe is the sensory area of the brain.

The insula is part of the limbic system and gives us a feeling of what is real.

Functional Organization of the Cerebral Cortex

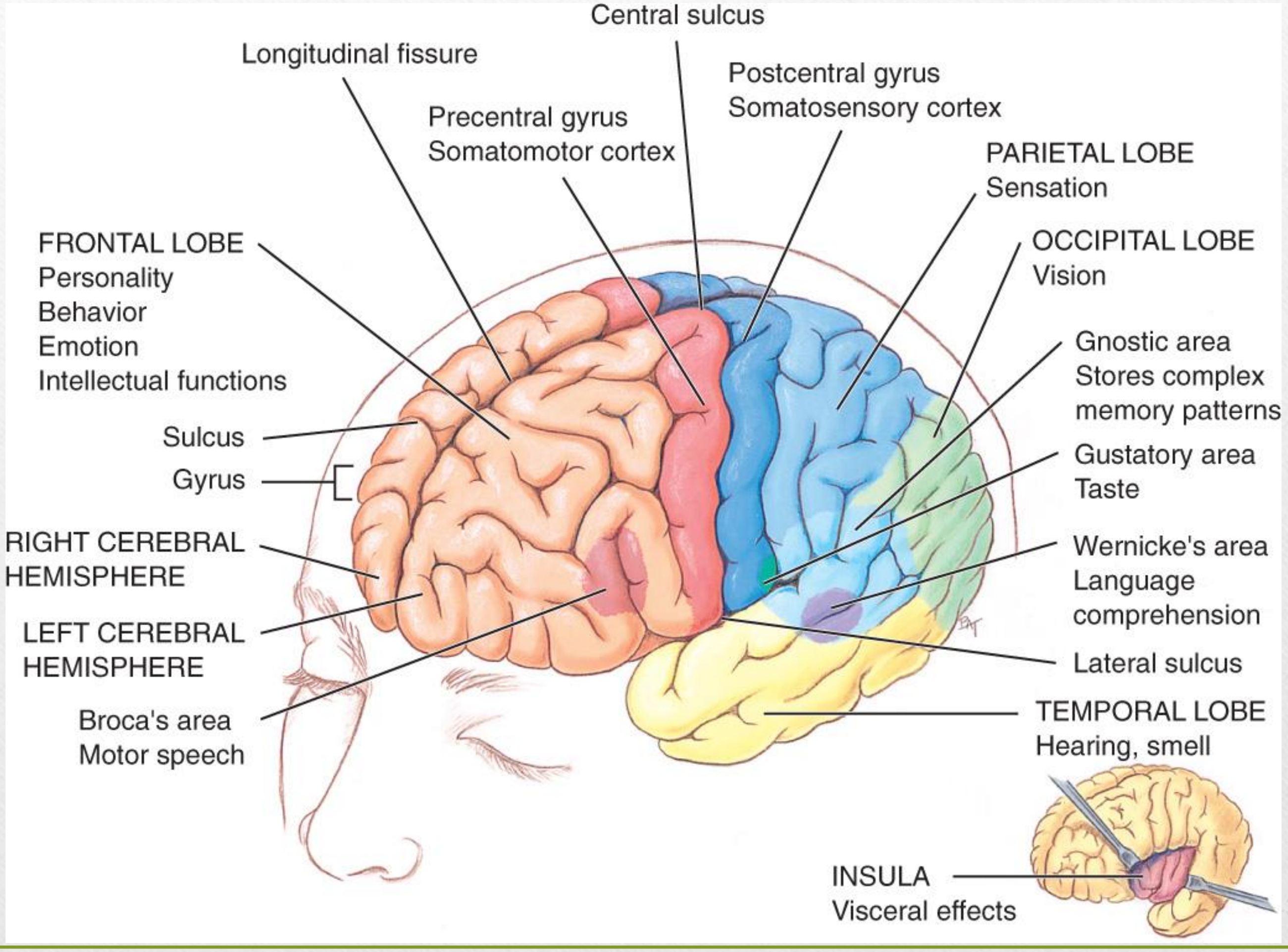


Table 4-1 Functions of the Cerebral Cortex

Functional Area	Anatomic Area	Functional and Performance Components
Frontal Lobes		
Primary motor area	Precentral gyrus	Execution of movement
Secondary association area	Premotor cortex	Planning and programming of movement Sequencing, timing, and organization of movement Frontal eye field Voluntary eye movements Broca's area in the left inferior frontal gyrus Programming of motor speech Supplementary motor area Intention of movement
Tertiary association area	Orbitofrontal and dorsolateral prefrontal cortex	Ideation Concept formation Abstract thought Intellectual functions Sequencing, timing, and organization of action and behavior Initiation and planning of action Judgment Insight Intention Attention Alertness Personality Working memory Emotion
Parietal Lobes		
Primary somesthetic sensory area	Postcentral gyrus	Fine touch sensation Proprioception Kinesthesia

Continued

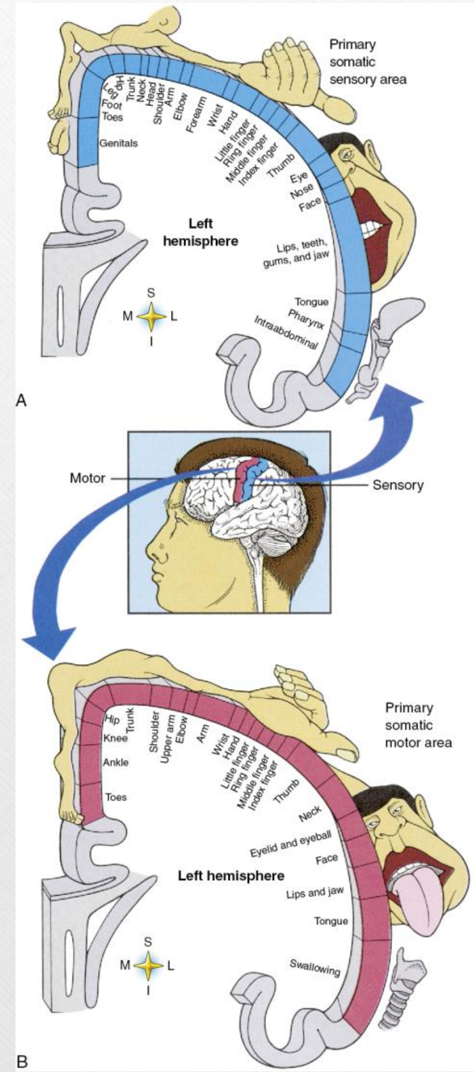
Table 4-1 Functions of the Cerebral Cortex—cont'd

Functional Area	Anatomic Area	Functional and Performance Components
Secondary somesthetic sensory association area	Superior parietal lobule	Coordination, integration, and refinement of sensory input Tactile localization and discrimination Stereognosis
Tertiary association area	Inferior parietal lobule	Gnosis: recognition of received tactile, visual, and auditory input Praxis: storage of programs or visuokinesthetic motor engrams necessary for motor sequences Body scheme: postural model of body, body parts, and their relation to the environment Spatial relations: processing related to depth, distance, spatial concepts, position in space, and differentiation of foreground from background
Occipital Lobes		
Primary visual sensory area	Calcarine fissure	Visual reception (from the opposite visual field)
Visual association area	Brodmann's areas 18 and 19	Synthesis and integration of visual information Perception of visuospatial relationships Formation of visual memory traces Prepositional construction of language comprehension and speech
Temporal Lobes		
Primary auditory sensory area	Superior temporal gyrus	Auditory reception
Secondary association area	Superior and middle temporal gyri (Wernicke's area)	Language comprehension Sound modulation Perception of music Auditory memory
Tertiary association area	Temporal pole, parahippocampus	Long-term memory Learning of higher-order visual tasks and auditory patterns Emotion Motivation Personality
Limbic Lobes		
Tertiary association area	Orbitofrontal cortex in frontal lobe, temporal pole, and parahippocampus in the temporal lobe	Attention
	Cingulate gyrus in frontal and parietal lobes	Motivation Emotions Long-term memory

Modified from Árnadóttir G: *The brain and behavior: assessing cortical dysfunction through activities of daily living*, St Louis, 1990, Mosby.

Integrative or Associative Brain Functions

Sensory and motor areas of the brain



On the sensory side, the face, lips, and fingers are most prominent; on the motor side, the surface area is largest for the hands and face because these areas send the most messages that need interpretation

Consciousness

Awareness of our environment

Relationship to everyone and everything

Can be altered in any number of ways:

- Food
- Medication
- Repetitive activities, sounds
- Trance

Yoga, tai chi, meditation, and even massage therapy can alter consciousness

Language

The perception of written and spoken words

The ability to speak and write

Usually occurs in the left hemisphere of the cerebrum

Within the left hemisphere of the brain, language takes place in the frontal, parietal, and temporal lobes.

Wernicke's area, which is located in the superior portion of the gyrus of the dominant hemisphere in the temporal lobe, is involved in understanding language and transmits information to the Broca's area of the frontal lobe.

Broca's area processes language information comprehended by Wernicke's area and relays it to the precentral gyrus.

Emotions

Tied to the limbic system of the brain

Motivation driven by emotions, especially pleasure

Cause people to move toward feelings of pleasure, move away from feelings of distress

When the limbic system malfunctions emotions can get out of control, as in instances of rage.

Memory

Storing of information in the brain

Major mental activity

Includes long- and short-term

State-dependent memory

- Various forms of bodywork may have effect.

Long-term memory can be retrieved days or years after an event. Short-term memory is fragile and disappears unless it is transferred to long-term memory.

Not the amount of time spent on a subject, but the number of times exposed to the subject, transfers short into long.

Box 4-6 State-Dependent Memory

Sometimes the memory takes the form of state-dependent memory. In state-dependent memory, the engram cannot be accessed unless the state of consciousness is similar to that in effect when the event occurred and was encoded. State-dependent memory can take many forms. Sometimes trauma beyond what the conscious centers can integrate is hidden in state-dependent memory. Any form of therapy that can engage the various states of consciousness, such as hypnosis, biofeedback, and various forms of bodywork, may recreate the state of consciousness that holds the key to the memory structure, allowing it to surface. Depending on the person's coping skills, resources, support systems, and professional services available, this awareness of past experience can be a time of conscious understanding and integration of a part of the person's life. However, without the proper resources this resurfacing of state-dependent memory can be devastating and extremely harmful.

Pleasure states also are encoded in state-dependent memory. Warm feelings such as being held or feelings of exhilaration such as running in the wind on a beautiful spring day can be remembered and in a sense recreated through various forms of bodywork. These are health-enhancing states that support homeostasis.

Learning

Use of synaptic pathways to process information

Cerebral cortex – associated with advanced learning

E.g., ability to read

Brainstem – associated with primitive learning

E.g., identification of hot or cold

Learning can be thought of as the best and simplest way to solve a problem.

Learning is initially conscious, but can eventually become unconscious and develop into a habit. Changing learned behavior and habits takes tremendous energy, so in an attempt to conserve energy, the body will resist.

Diencephalon

Contains

- Thalamus
- Hypothalamus
- Pineal body

The hypothalamus regulates and coordinates functions such as heart rate, blood pressure, peristaltic actions, appetite and satiety, and pleasure.

The pineal body functions as an internal biologic clock. It regulates daily and yearly rhythms and needs exposure to natural sunlight and darkness to do so.

Brainstem

Primitive portion of brain

Divided into:

- Midbrain: vision, hearing, muscle tone
- Pons: breathing, eye movement
- Medulla oblongata: connects pons to spinal cord
- Reticular activating system

The reticular activating system is part of the brainstem; it maintains arousal levels, keeping the body awake and alert.

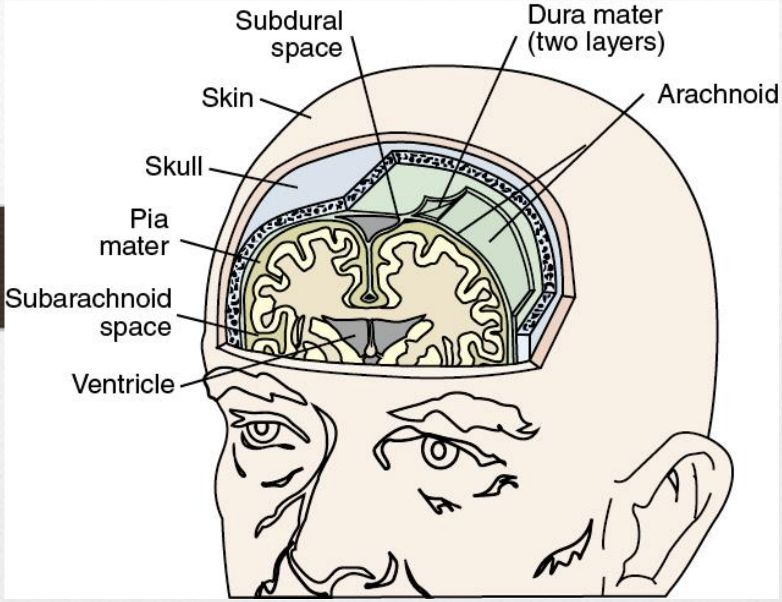
Cerebellum

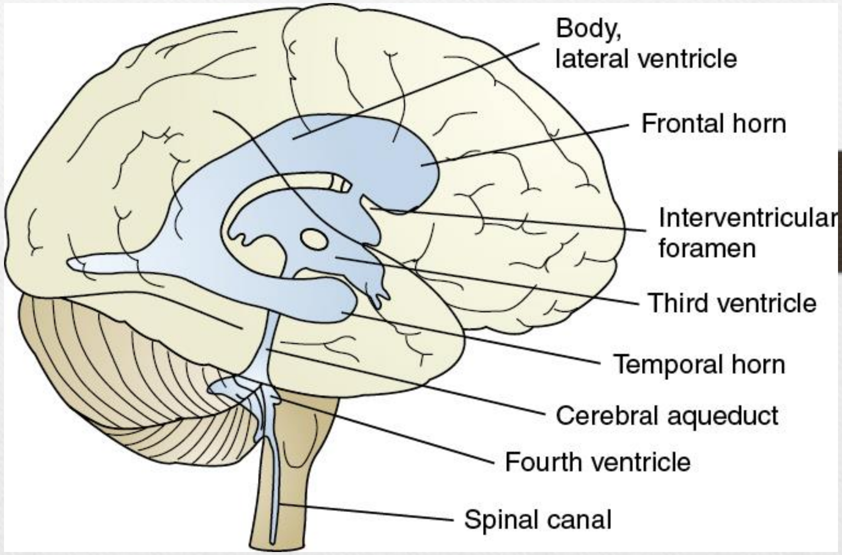
Cerebellum

- Second-largest part of brain
- Composed of gray (outer) and white (inner) matter
- Vestibular apparatus

Stimulation of the cerebellum by altering muscle tone, position, and vestibular balance also stimulates the hypothalamus to adjust ANS functions and thus restore homeostasis.

Meninges


Subdural space
Dura mater (two layers)
Skin
Arachnoid
Skull
Pia mater
Subarachnoid space
Ventricle

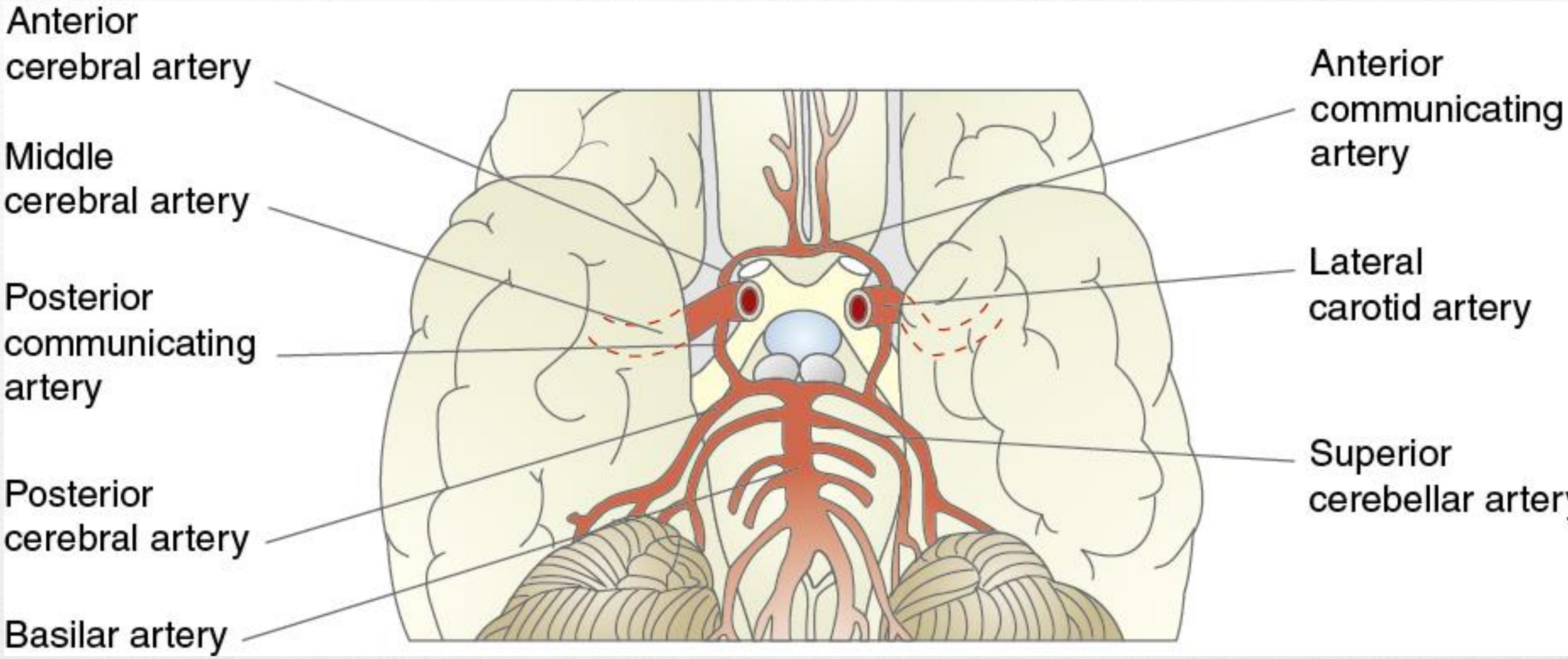

Body, lateral ventricle
Frontal horn
Interventricular foramen
Third ventricle
Temporal horn
Cerebral aqueduct
Fourth ventricle
Spinal canal

The meninges are three layers of connective tissue membranes that cover and protect the brain and spinal cord. The layers are the dura mater, which is the outermost layer; the arachnoid mater middle layer; and the pia mater third layer.

The meninges also form three spaces that add additional cushioning and protection to the CNS. They are the epidural, subdural, and subarachnoid spaces.

The subarachnoid space contains the cerebrospinal fluid.

Ventricles and Vessels of the Brain



The ventricles are four fluid-filled chambers found within the brain.

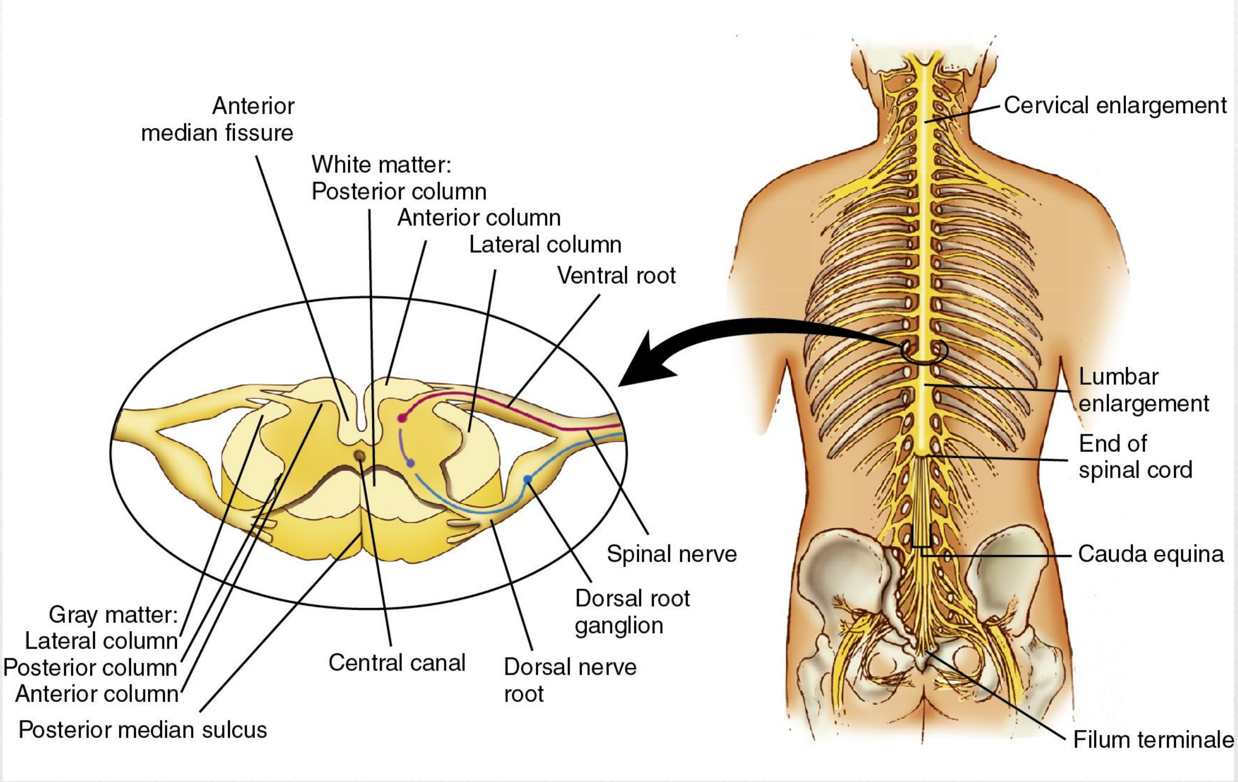
Blood is supplied to the brain through three arteries, which are connected at the midbrain in the circle of Willis.

The circle of Willis is a check-and-balance system that provides blood flow to the brain in case of blockage or damage to any of the three arteries.

Spinal Cord

Begins at base of brainstem

About 17-18 inches long in the average person

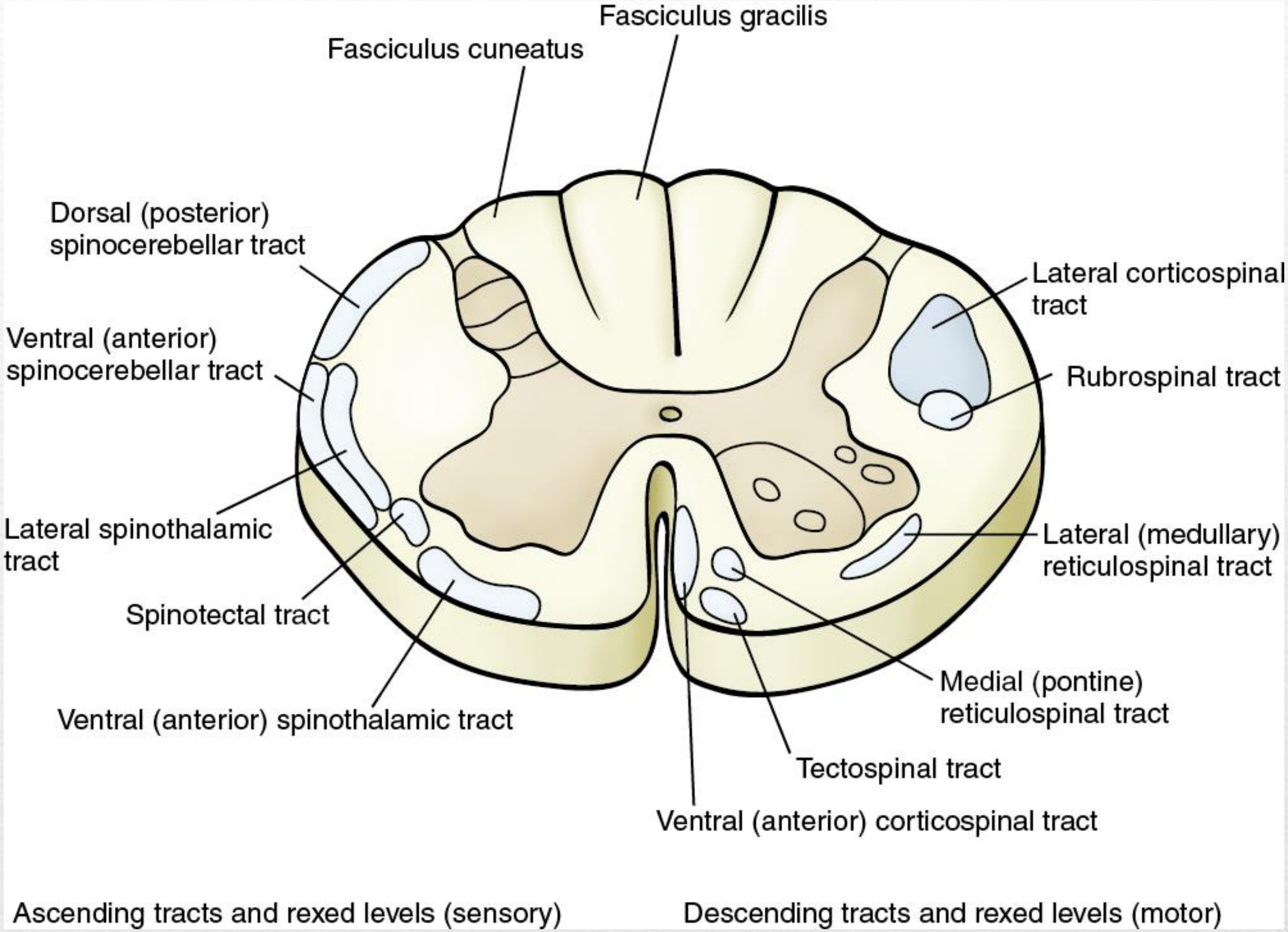


Thirty-one pairs of spinal nerves connect the spinal cord and brain with the rest of the body.

This is the peripheral nervous system.

The spinal cord conducts nerve impulses and acts as a center for spinal reflexes.

Inner Structure of the Spinal Cord



Surrounding the gray matter are pathways of white matter called tracts, created from the myelinated nerve fibers.

The ascending tracts conduct sensory impulses such as pain, touch, and temperature up from the spinal nerves through the spinal cord to the brain.

The descending tracts conduct motor impulses from the brain down the cord to the spinal nerves.

Tracts

Sensory ascending tracts

- Follow nerves to spinal cord
- Spinal cord to brain

Motor descending tracts

- From central nervous system (CNS) to muscles
- Lateral corticospinal, anterior or ventral corticospinal, reticulospinal, rubrospinal

The functions of the axons in each tract are limited to a single action, such as passing along specific touch and pain sensations.

The spinal cord has five main motor tracts

When upper motor neurons are damaged or destroyed by trauma or disease, the result is spastic paralysis, which presents with an increase in rigidity and an exaggerated response to reflexes. When injuries to the lower motor neurons result in a lack of signal to the muscles, flaccid paralysis results, causing absence of movement.

Box 4-9 The Spinal Cord

The spinal cord has five main motor tracts:

1. Lateral corticospinal tracts: These tracts handle voluntary movements, especially the contraction of small groups of muscles such as those in the hands and feet. They affect muscles on the side of the body opposite from the cerebral cortex.
2. Anterior or ventral corticospinal tracts: These tracts handle the same lateral tracts, but the muscles are on the same side of the body as the cortex. The term *pyramidal tracts* refers to the lateral and anterior corticospinal tracts. The neurons from the cerebral cortex cross through the pyramid areas of the medulla.
3. Lateral reticulospinal tracts: These tracts transmit facilitatory impulses from the medulla through the anterior horn motor neurons to skeletal muscles that handle muscle tone and extensor reflexes.
4. Medial reticulospinal tracts: These tracts carry mainly inhibitory impulses from the pons through the anterior horn motor neurons to skeletal muscles that deal with muscle tone and extensor reflexes.
5. Rubrospinal tracts: These tracts transmit impulses that coordinate body movements and maintain posture. The extrapyramidal tracts are composed of the lateral and medial reticulospinal and rubrospinal tracts. They relay motor signals through the cerebrum, thalamus, brainstem, and cerebellum to the gray matter of the spinal cord. At this point most synapse with interneurons, which then synapse with the lower motor neurons. It should be noted that facilitating and inhibiting signals are sent through these motor neurons.

Pathology of the Central Nervous System

Drugs Affecting CNS Function

Stimulants: caffeine, nicotine, amphetamines, cocaine

Depressants: alcohol, narcotics, tranquilizers, barbiturates

Hallucinogens: LSD, PCP, peyote, marijuana

Stimulants affect the CNS in a range of ways, from euphoria to psychosis, depending on which neurotransmitters and receptor sites are affected.

Addiction, or physical dependency, means that when a drug is withdrawn, severe autonomic excitability occurs. The person thus requires the drug to feel normal. Tolerance means that larger doses of the drug are required for the same effect because the body adjusted to the current dose.

Some of these drugs, such as caffeine and alcohol, are appropriate at times. Amphetamines, tranquilizers, and narcotics are appropriate when prescribed and monitored by a physician.

Strokes, Cerebrovascular Disease, and Aneurysms

Strokes occur when an artery in the brain is occluded or closed off.

Can cause severe damage

Cerebrovascular disease is a gradual buildup of arteriosclerotic lesions.

Blood clots and hemorrhage may result in stroke.

Aneurysm is a weakening or bulging of any artery.

Transient ischemic attacks (TIA) are prestroke conditions that mimic strokes. They are usually resolved in less than 24 hours.)

Stroke is a medical emergency requiring immediate medical referral. Massage can be an effective part of a supervised comprehensive program and can help manage secondary muscle tension.

Massage therapy is contraindicated for aneurysm. Client should be referred immediately to a physician.

Central Nervous System Trauma

Can result from a sudden blow to the head or intense shaking of the head

Concussion is brain trauma.

- Can be mild, moderate, or severe

Cerebral palsy: a general term for brain damage sustained before, during, or shortly after birth

Intracranial bleeding can occur on two levels: between the dura and arachnoid (subdural hematoma) or between the skull and dura (epidural hematoma).

Therapeutic massage can be an effective part of a supervised comprehensive care program. Massage and other forms of bodywork can help manage secondary muscle tension.

Spinal Cord Injury

Results in many neurologic problems

Location of injury determines parts of body affected.

Paraplegia – lower lesion affecting lower limbs

Monoplegia – only one limb affected

One of the complications common among persons with spinal cord injuries is decubitus ulcer. Because voluntary shifting of weight does not occur, the weight of the body compresses the circulation to the skin over bony prominences and produces ulcers.

Massage is an effective part of a comprehensive, supervised rehabilitation and long-term care program by helping to manage secondary muscle tension resulting from the alteration of posture and the use of wheelchairs, braces, and crutches. The circulation enhancement produced by massage can assist in the management of a decubitus ulcer.

Tumors

Brain tumors

Most are benign, but they can compress crucial parts of the brain.

Signs and symptoms:

Loss of sensory or motor function, mainly on one side of the body

Personality changes, behavioral changes, or both

Headaches

Awkward movement or gait (ataxia)

Massage therapists should be able to recognize the signs and symptoms of a possible brain compression and refer the client to a medical professional for diagnosis and care.

During rehabilitation from surgery, massage can be used as supportive care and to improve any compensation patterns that have resulted from brain damage caused by surgery.

Degenerative Disorders

Alzheimer's disease is an example of a degenerative disorder.

Amyotrophic lateral sclerosis (ALS) progresses from the central nervous system.

Involves degeneration of motor neurons

ALS is often referred to as Lou Gehrig's disease as he suffered from this disease.

The degeneration of Alzheimer's disease may be slowed with therapeutic intervention and medication. Rhythmic massage and movement may provide calming and orienting influences.

Massage is indicated for ALS, with caution and under a doctor's supervision. Adjustments must be made to pressure and intensity, and the practitioner should avoid stressing the system.

Seizures

Seizure: sudden involuntary series of muscle contractions

Minor: petit mal

Major: grand mal

Status epilepticus is a state of continual seizure. This is a medical emergency.

Symptoms can vary, dependent upon the area of the brain that is affected.

The application of massage techniques may decrease the side effects of medications and can be used as supportive care during rehabilitation from surgery. Massage therapists must remember to refer clients with exaggerated or increased symptoms, or any undiagnosed symptoms, to a physician.

Other Problems

- Tremors
  - Parkinson's disease
  - Chorea
    - St. Vitus's dance
    - Huntington's chorea
- Headache
- Depression
- Anxiety
- Schizophrenia
- Infectious disease

Chorea results from the degeneration of neurons in the basal ganglia. Normal voluntary movements are replaced by involuntary dancelike motions.

As part of a multidisciplinary treatment, massage therapy is indicated for schizophrenia, depression, tremors, headache, and spinal cord injury and can help manage secondary muscle tension.

Massage therapy for patients with infectious processes is contraindicated unless closely supervised by appropriate medical personnel.

To Test

Access Code: WJN6

Please write down code. You will be asked for it

Once you have successfully passed the test (70% correct), please email Kim Jackson at kim_hotschool@yahoo.com. We will email you your CE certificate within 7 business days.