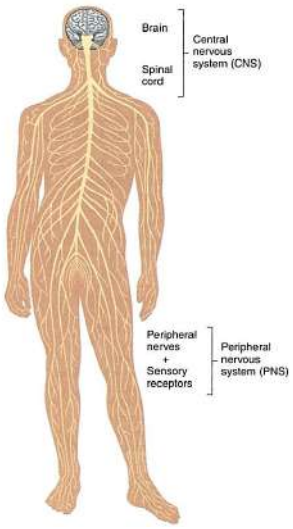
The Nervous System

Functions of the Nervous System:

-

Structures of the Nervous System:

Brain, Spinal Cord, Nerves, and Sensory Organs

• **Central Nervous System (CNS) -** • **Peripheral Nervous System (PNS)** - • **Autonomic Nervous System (ANS)** -	

The Nerves -

1. One or more bundles of neuron cells
2. Connect the brain and the spinal cord with other parts of the body

a. Tract - **i. Ascending tracts** - carry impulses toward the brain **ii. Descending tracts** - carry impulses away from the brain
b. Ganglion -
c. Plexus -
d. Innervation -
e. Receptors -
f. Stimulus -
g. Impulse -

The Neurons - basic cell of the nervous system

1. **Types of Neurons:** - **ACE:**

Table 10.1

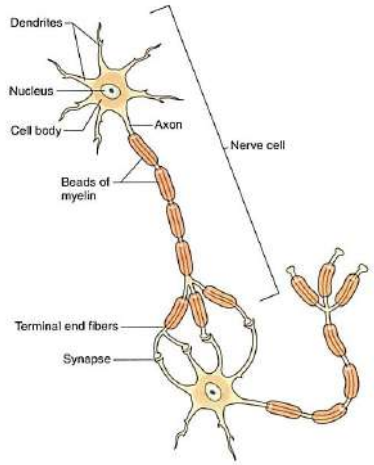
TYPES OF NEURONS

Afferent neurons (**AF**-er-ent)
Also known as **sensory neurons,** they emerge from the skin or sense organs and carry impulses toward the brain and spinal cord.

Connecting neurons Also known as **associative neurons,** they carry impulses from one neuron to another.

Efferent neurons (**EF**-er-ent)
Also known as **motor neurons,** they carry impulses away from the brain and spinal cord and toward the muscles and glands.

2. **Neuron Parts:** consists of cell body, several dendrites, single axon, and terminal fibers

a. **Dendrites** -	
b. **Axon** - i. Protected by a fatty tissue covering: **myelin**	
c. **Terminal end fibers** -	

Synapse -

Neurotransmitters -

- At least 30 neurotransmitter have been identified

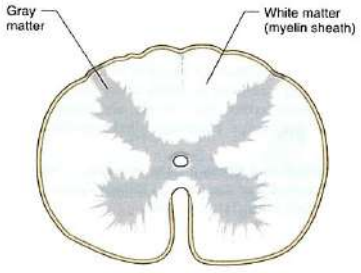
Table 10.2

EXAMPLES OF NEUROTRANSMITTERS AND THEIR FUNCTIONS

Acetylcholine (**ass**-eh-til-**KOH**-leen)	Released at some synapses in the spinal cord and at neuromuscular junctions; influences muscle action.
Dopamine (**DOH**-pah-meen)	Released within the brain; is thought to cause some forms of psychosis and abnormal movement disorders such as Parkinson's disease.
Endorphins (en-**DOR**-fins)	Released within the spinal cord in the pain condition pathway; inhibit the conduction of pain impulses and act as natural pain relievers.
Serotonin (**sehr**-oh-**TOH**-nin or **seer**-oh-**TOH**-nin)	Released in the brain; has roles in sleep and pleasure recognition.

Neuroglia -

Myelin Sheath - white protective covering over some nerve cells including parts of the spinal cord, white matter of the brain, and most peripheral nerves.

● **White matter** - ○ **Myelinate -** having a myelin sheath	
● **Gray matter** -	

The Central Nervous System: (CNS)

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-

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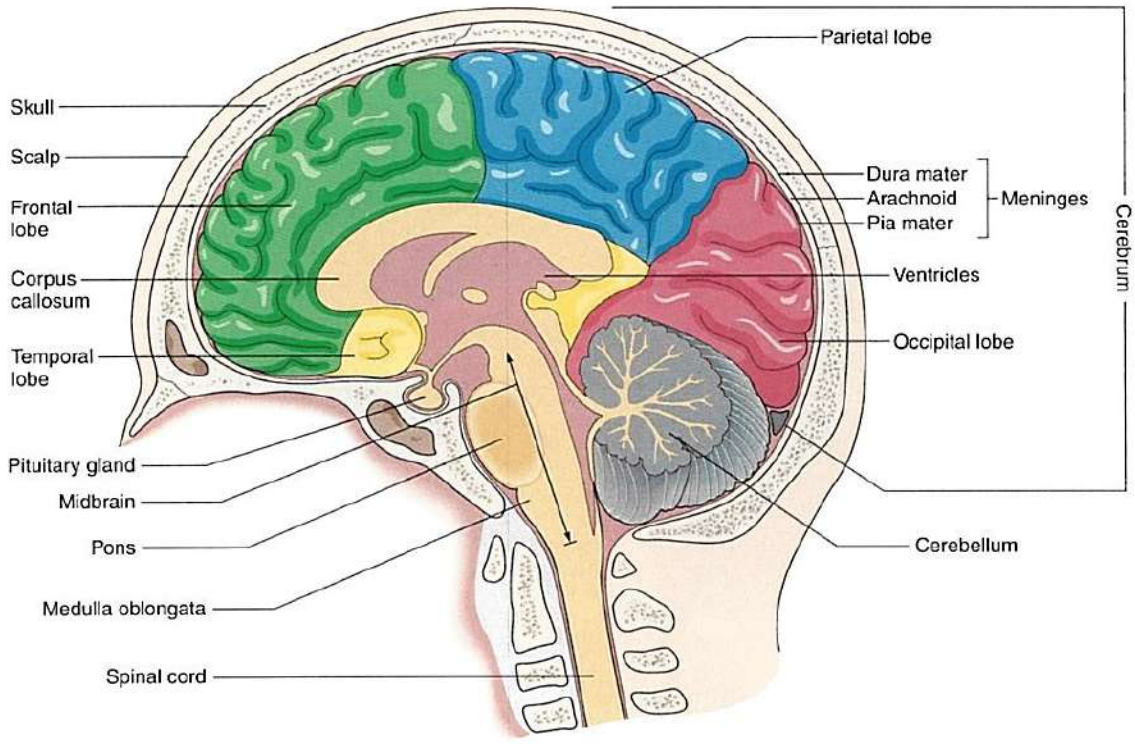
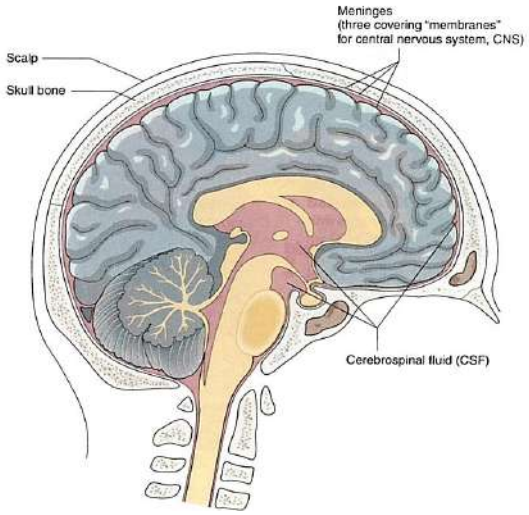


The Meninges - 3 layers of connective tissue membrane that enclose the brain and spinal cord

- **Dura Mater** -
  - **Epidural Space -**
    - Contains fat and supportive connective tissues to cushion the dura mater
  - **Subdural Space** -
- **Arachnoid Membrane** - 2nd layer surrounding the brain and spinal cord
  -
  - Loosely attached to the other meninges to allow space for fluid between the layers
  - **Subarachnoid Space** -
    - Contains **cerebrospinal fluid**
- **Pia Mater** - 3rd layer of the meninges
  -
  - Delicate connective tissue with a rich supply of blood vessels



Cerebrospinal Fluid - (CFS)

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-
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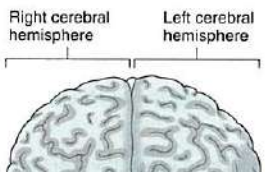
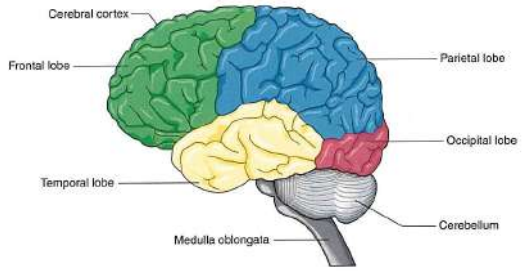
The Cerebrum - largest and uppermost portion of the brain

-
  - **Cerebral -**



○ **Cerebral Cortex** - ■ Outer layer of the cerebrum and is arranged in folds	
Cerebral Hemispheres - ○ Connected at the lower midpoint by the **corpus callosum**	

- **The Lobes of the Brain** - divided into 4 lobes

○ **Frontal lobe -**	
○ **Parietal lobe -**	
○ **Occipital lobe -**	
○ **Temporal lobe -**	

- **The Ventricles** -
  - 4 of them
  - Within the middle region of the cerebrum
  - Contains CFS

The Thalamus - Located below the cerebrum

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- **The Hypothalamus** - below the thalamus
  -

Table 10.4

REGULATORY FUNCTIONS OF THE HYPOTHALAMUS

1. Regulates and integrates the autonomic nervous system, thereby controlling heart rate, blood pressure, respiratory rate, and digestive tract activity.
2. Regulates emotional responses and behavior.
3. Regulates body temperature.
4. Regulates food intake by controlling hunger sensations.
5. Regulates water balance and thirst.
6. Regulates sleep-wakefulness cycles.
7. Regulates endocrine system activity.

The Cerebellum - 2nd largest part of the brain

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•	

The Brainstem - stalklike portion of the brain that connects the cerebral hemisphere with the spinal cord

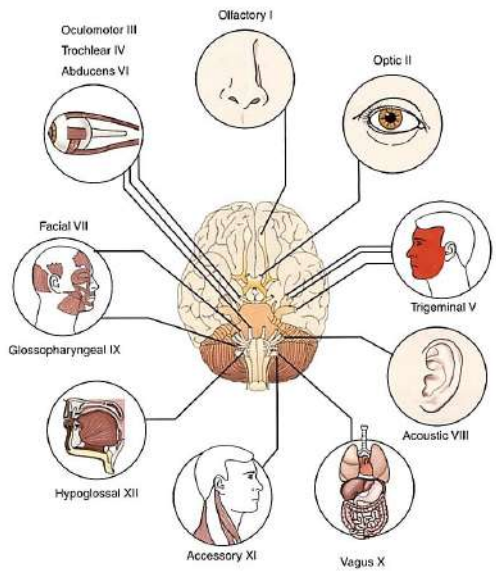
- Made up of the midbrain, pons, and medulla oblongata
- **The Midbrain** -
  - Conduction pathways to and from higher and lower centers
- **The Pons** - means bridge
  - Base of the brain
  -
- **The Medulla Oblongata** - located at the lowest part of the brainstem
  -

The Spinal Cord - pathway for impulses going to and from the brain

-
- Protected by **CFS** and surrounded by the **3 meninges**
-
-

The Peripheral Nervous System:

Consists of the cranial nerves and the spinal nerves

The Cranial Nerves - 12 pairs that originate from the undersurface of the brain • •	

The Spinal Nerves - 31 pairs

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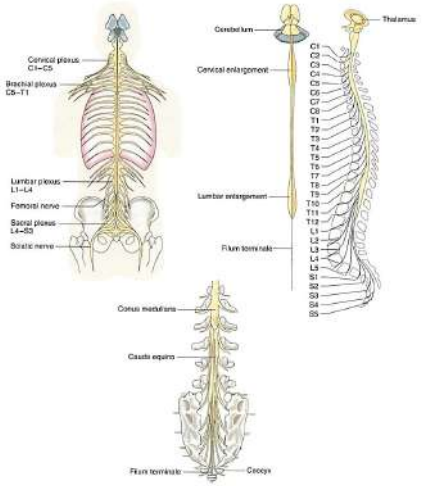


<u>The Autonomic Nervous System: (ANS)</u>

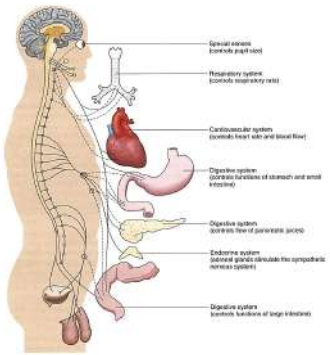
Controls the involuntary actions of the body

-
- Both help to maintain **Homeostasis**

Table 10.5

DIVISIONS OF THE AUTONOMIC NERVOUS SYSTEM AND THEIR CONTRASTING ACTIONS

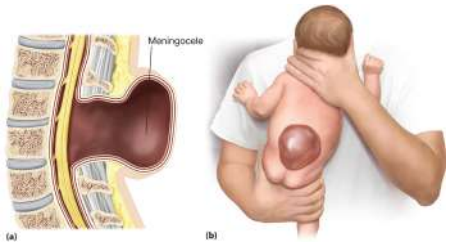
Sympathetic Nervous System	Parasympathetic Nervous System
Prepares the body for emergency and stressful situations by increasing the breathing rate, heart rate, and blood flow to muscles.	Returns the body to normal after a stressful response. It also maintains normal body functions during ordinary circumstances that are not emotionally or physically stressful.



<u>Pathology of the Nervous System:</u>

Head and Meninges -

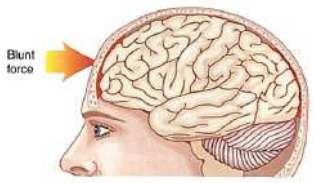
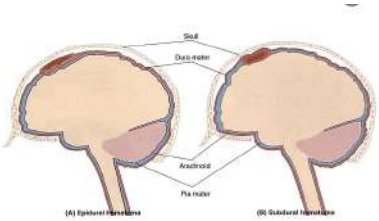
• **<u>Cephalalgia</u>** - aka **cephalodynia** 	• **<u>Encephalocele</u>** - (**craniocele)** 
• **<u>Migraine Headache</u>** -	• **<u>Meningitis</u>** -
• **<u>Hydrocephalus</u>** -	• **<u>Meningocele</u>** -

Disorders of the Brain -

- **Alzheimer's disease** - group of disorders associated with degenerative changes in the brain structure that lead to characteristic symptoms including progressive memory loss, impaired cognition, and personality changes
- **Cognition** -
- **Encephalitis** -
- **Parkinson's disease (PD)** - chronic, slowly progressive, degenerative **CNS** disorder
    -
- **Tetanus** - (**lockjaw)**

Brain Injuries -

• **Amnesia** -	• **Cerebral contusion** -
• **Concussion** - **(cerebral concussion)**	
• **Cerebral hematoma** - ○ **Epidural hematoma, subdural hematoma, intracerebral hematoma**	

Levels of Consciousness -

- **Conscious** - **(alert)**
- **Syncope** - **(fainting)**
- **Lethargy** - lowered level of consciousness marked by listlessness, drowsiness, and apathy
- **Stupor** - state of impaired consciousness marked by a lack of responsiveness to environmental stimuli
- **Coma** -

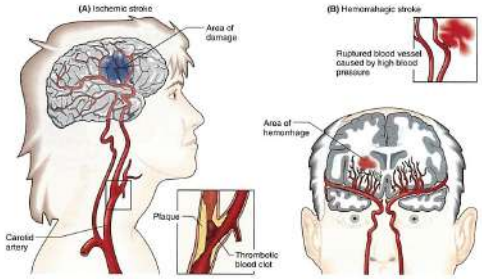
- **Delirium and Dementia** -
    - **Delirium:** potentially reversible condition often associated with high fever that comes on suddenly.
        -

- **Dementia:**

Brain Tumors -

• Abnormal growth within the brain (benign or malignant)
  ○ Can cause damage in two ways:
  ■
  ■
	

Strokes - **(cerebrovascular accident - CVA)** damage to the brain that occurs when the blood flow to the brain is disrupted because a blood vessel supplying it either is blocked or has ruptured

• **<u>Ischemic attacks</u>**:
  ○ **Transient Ischemic Attack (TIA) -** temporary interruption in the blood supply to the brain
  ■
  ○ **Ischemic Strokes** - flow of blood in the brain is blocked
  ■
  ○ **Aphasia** -
	

• **<u>Hemorrhagic stroke:</u>** (bleed)	

Sleep Disorders -

• **<u>Insomnia:</u>** 	**<u>Narcolepsy</u>**: 
• **<u>Somnambulism:</u>** (**noctambulism/sleepwalking)** 	• **<u>Somnolence:</u>** 

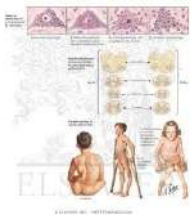
The Spinal Cord -

- **Myelitis** -

- **Myelosis** - tumor of the spinal cord

- **Multiple Sclerosis** -
  - **Demyelination**: disrupts the transmission of nerve impulses

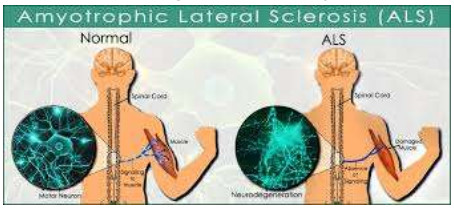
- **Poliomyelitis** - (**Polio)**



- **Postpolio syndrome** - recurrence later in life of some polio symptoms in individuals who have had poliomyelitis and have recovered from it
- **Spinal Cord Injuries** - (SCIs)
- **Radiculitis** -

Nerves -

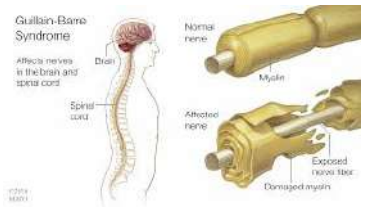
- **Amyotrophic lateral sclerosis** - (ALS/Lou Gehrig's Disease)



- **Bell's palsy** -

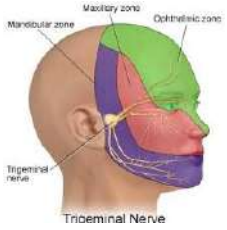
- **Guillain-Barre syndrome** - (GBS/acute ascending polyneuritis)
- **Peripheral Neuropathy** - (peripheral

The Nervous System



neuritis)

- **Tic doulourex** - (trigeminal neuralgia)
  - Sudden, intense, sharp pain on one side of the face



Trigeminal Nerve

- **Sciatica** -

Abnormal Sensation -

- **Causalgia** -
- **Hyperesthesia** -
- **Paresthesia** -

Cerebral Palsy - (CP)

- caused by an injury to the part of the brain that controls muscle movement
- injury occurs during pregnancy, birth or soon after birth

Convulsions and Seizures -

- **generalized seizure (generalized tonic-clonic seizure):** characterized by loss of consciousness with tonic convulsions followed by clonic convulsions
- **Tonic convulsions:** state of continuous muscular contraction that results in rigidity and violent spasms
- **Clonic convulsion:** marked by the alternate contraction and relaxation of muscles, resulting in jerking movements of the face, trunk, or extremities
- **Partial seizure/localized seizure:** specific motor, sensory, or psychomotor phenomena without loss of consciousness

Epilepsy -

- **Grand mal epilepsy:** more severe form; characterized by generalized tonic-clonic seizures
- **Petit mal epilepsy:** (absence epilepsy) sudden, temporary loss of consciousness, lasting only a few seconds.

- ○
- ○

- **Epileptic Aura:** manifestation, such as a particular smell or light, which may be experienced just before a seizure

Mental Health:

Developmental Disorders -

- **Mental Retardation:** significantly below average general intellectual functioning that is accompanied by a significant limitation in adaptive functioning
- **Autistic disorder (autism):** disorder in which a young child cannot develop normal social relationships
  - ○
  - ○
- **Attention deficit disorder (ADD):**
  - ○
  - ○
- **Attention deficit/hyperactivity disorder (ADHD):** pattern of inattention and hyperactivity that is inappropriate for the child's development age
- **Dyslexia (reading disorder):** learning disability characterized by reading achievement that falls substantially below that expected given the individual's chronological age, measured intelligence, and age-appropriate education

Substance-Related Disorders -

- **Addiction:** compulsive and overwhelming involvement with a specific activity despite the fact that it causes significant health hazards plus recurrent legal and social problems
  - **Alcoholism**
  - **Delirium Tremens (DTS) -** form of acute organic brain syndrome due to alcohol withdrawal
    - Characterized by:

Schizophrenia and Other Psychotic Disorders -

- **Psychotic disorders:**

- **Schizophrenia:** delusions, hallucinations, disorganized speech that is often incoherent and disruptive or catatonic behavior\
- **Delusion:** false personal belief that is maintained despite obvious proof or evidence to the contrary
- **Hallucination:**
- **Catatonic behavior:**

Mood Disorders -

- **Manic episode:** distinct period during which there is an abnormally and persistently elevated, expansive and irritable mood
- **Major depressive episode:**

- **Bipolar disorder (manic depressive episode):** clinical course characterized by the occurrence of manic alternating with depressive episodes

Panic Disorders -

- Characterized by the sudden, unanticipated recurrence of a group of symptoms known as a panic attack
- **Panic attack:** intense feelings of apprehension, fearfulness, terror, and impending doom
  - Physical symptoms:

Anxiety Disorders -

- **Anxiety state:** apprehension, tension, or uneasiness that stems from the anticipation of danger
- **Obsessive-compulsive disorder:**
- **Posttraumatic stress disorder (PTSD):** development of characteristic symptoms after a psychologically traumatic event
    - Symptoms:

Phobias - persistent, irrational fear of a specific thing or situation

- **Acrophobia**:
- **Agoraphobia:** overwhelming and irrational fear of leaving the familiar setting of home or venturing into the open
- **Claustrophobia:**

Somatoform Disorders - term used to describe the presence of physical symptoms that suggest general medical conditions not explained by the patient's actual medical condition

- **Conversion Disorder:** physical disorder but has no physical cause
    -
- **Hypochondriasis:** preoccupation with fears of having or the idea that one does have a serious disease based on the misinterpretation of one or more bodily signs or symptoms

Impulse-Control Disorder -

- **Kleptomania:** recurrent failure to resist impulses to steal objects not for immediate use or their monetary value
- **Pyromania:**

Personality Disorders -

- **Antisocial Personality Disorder:** pattern of disregard for and violation of the rights of others;
    -
- **Narcissistic Personality Disorder:** pattern of exaggerated need for admiration and complete lack of empathy
    - **Empathy -**

Other Conditions -

- **Malingering:** characterized by the intentional creation of false or grossly exaggerated physical or psychological symptoms
- **Munchausen Syndrome:** "patient" repeatedly makes clinically convincing simulations of disease for the purpose of gaining medical attention
- **Munchausen Syndrome by Proxy:** form of child abuse;
    -

Diagnostic Procedures of the Nervous System:

- **CT Scan/MRI -**
- **Echoencephalography -** ultrasound imaging to diagnose a shift in the midline structures of the brain
- **Electroencephalography -** recording the electrical activity of hte brain through the use of electrodes attached to the scalp **(electroencephalogram)**
- **Encephalography -** radiographic study demonstrating the intracranial fluid containing space of the brain
- **Myelography** - radiographic study of the spinal cord after the injection of a contrast medium

- **Level of Consciousness (LOC)** -

Treatment Procedures of the Nervous System:

Medications to Treat Mental Disorders -

- **Tranquilizers (antianxiety drugs):**
- **Antidepressant:**
- **Antipsychotic:**
- **Psychotropic drugs:**

Pain Control -

- **Transcutaneous Electronic Nerve Stimulation (TENS):** pain control by the application of electronic impulses to the nerve endings through the skin
- **Analgesic:**
- **Nonnarcotic Analgesic:** used for mild to moderate pain
- **Narcotic Analgesic:**

Sedative and Hypnotic Medications -

- **Sedative:** depresses the **CNS** to produce calm and diminish responsiveness without producing sleep
  - **Sedation** -
- **Hypnotic**: depresses the **CNS** and usually produces sleep
- **Barbiturate:** class of drugs whose major action is calming or depressed effect of the **CNS**
  - **Amobarbital:**
  - **Phenobarbital:**
  - **Anticonvulsant:**

Anesthesia - the absence of normal sensation, especially sensitivity to pain

- **Anesthetic:**
- **Topical Anesthetic:** numbs only the tissue surface and is applied as a liquid, ointment, or spray
- **Local Anesthetic:**

- **Regional Anesthetic:** temporary interruption of nerve conduction;
  -
- **Epidural Anesthesia:** regional anesthesia produced by injecting a local anesthetic into the epidural space of the lumbar or sacral region of the spine
- **Spinal Anesthesia:**

- **General Anesthesia:** total loss of body sensation and consciousness as induced by various anesthetic agents, given primarily by inhalation or IV

Brain and Head -

- **Electroshock Therapy (electroconvulsive therapy ECT):** controlled convulsion produced by the passage of an electric current through the brain
- **Lobectomy:** surgical removal of a portion of the brain to treat brain cancer or seizure disorders that cannot be controlled by medication
- **Thalamotomy:** surgical incision into the thalamus;
  -

Nerves -

• **Neurectomy:**	• **Neuroplasty:**
• **Neurorrhaphy:**	• **Neurotomy:**

Career Opportunities:

Anesthesiologist **Anesthetist** **Neurologist** **Neurosurgeon** **Psychiatrist** **Psychologist** **Electroencephalographic (EEG) Tech**	**Electroneurodiagnostic Tech** **Polysomnographic tech** **Social Worker** **Social Services Assistant** **Psychiatric or Mental Health Tech, Assistant or Aide** **Art, Music,or Dance Therapist** **Recreational Therapist**

Table 10. 3

BRAIN PARTS AND WHAT THEY CONTROL

Brain Part	Controls
Cerebrum—uppermost and least protected layer of the brain	Is responsible for the highest level of thought including judgment, memory, association, and critical thinking.
Thalamus—located below the cerebrum	Monitors sensory stimuli by suppressing some and magnifying others.
Hypothalamus—located below the thalamus.	Controls vital bodily functions (see Table 10.4).
Cerebellum—located in the lower back of the cranium below the cerebrum	Coordinates muscular activity for smooth and steady movements.
Pons—located in the brainstem at the base of the brain	Nerves cross over so that one side of the brain controls the opposite side of the body.
Medulla oblongata—most protected part of the brain	Controls the basic vital functions of life.