



ADVANCED ASSESSMENT

Nervous System

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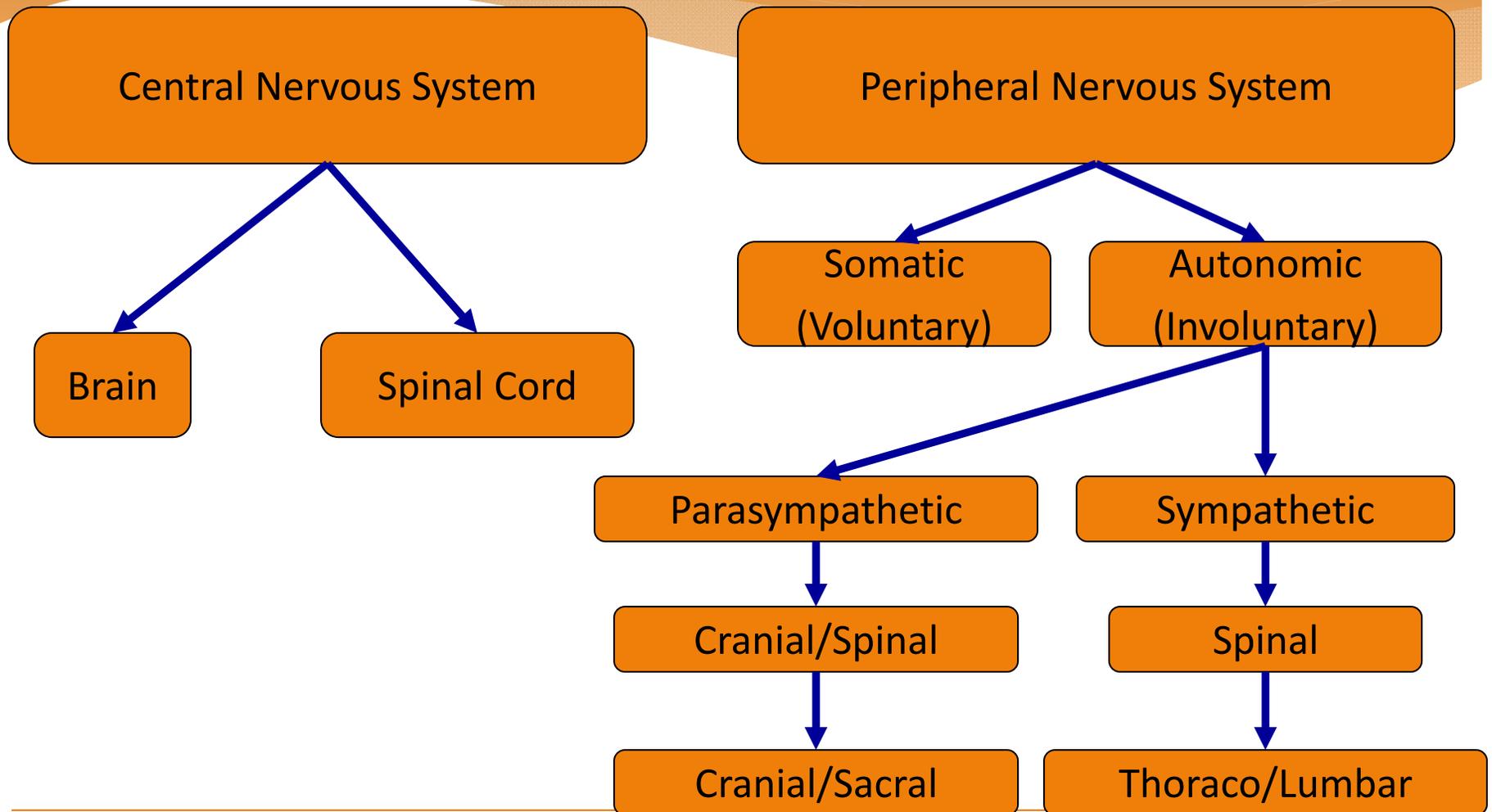
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Nervous System Divisions



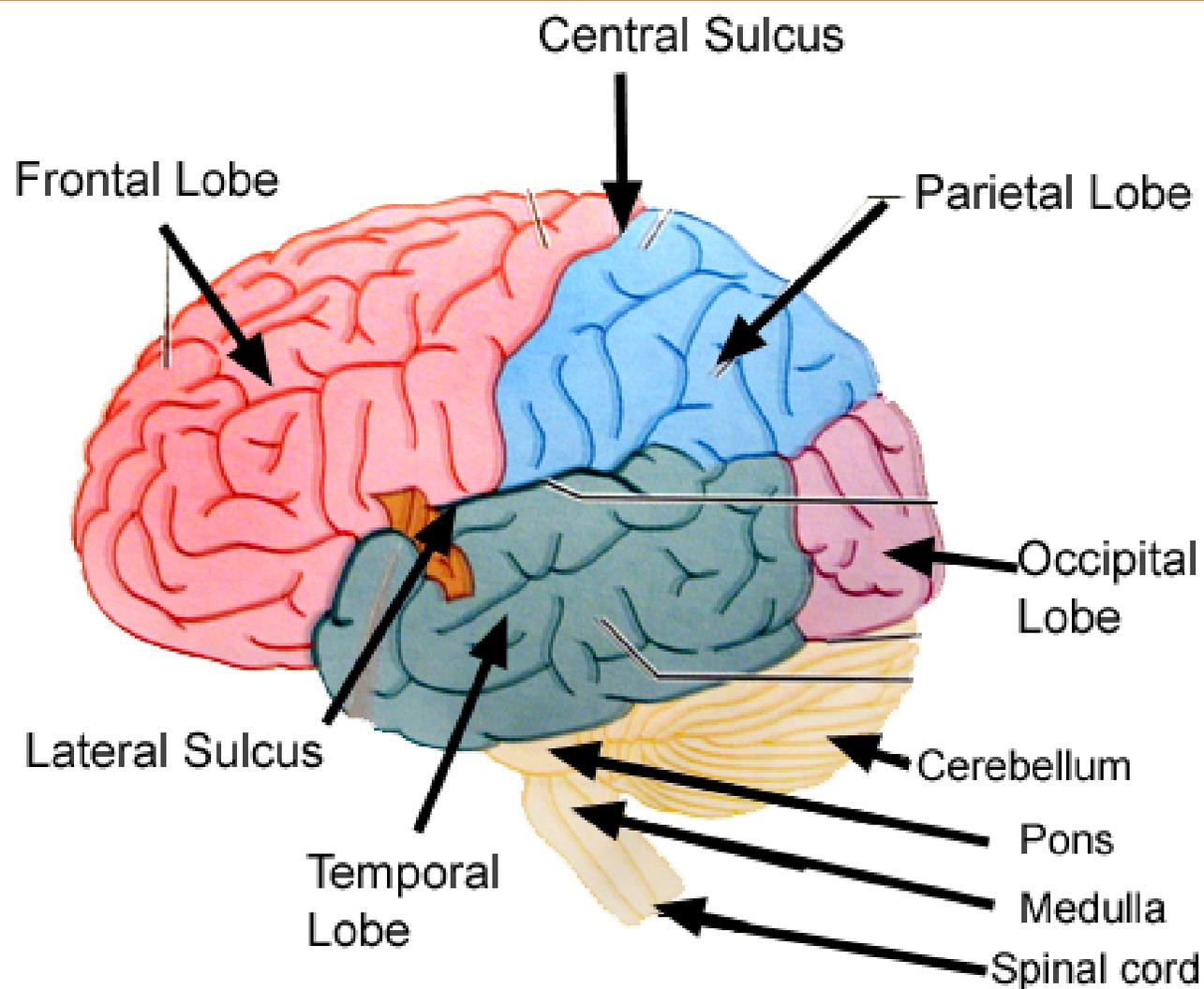
Central Nervous System



Brain

- ◆ Largest most complex mass of nervous tissue
- ◆ Divisions of the Brain: Cerebrum, Cerebellum, Brain Stem
- ◆ Other structures: thalamus, hypothalamus, pituitary gland, meninges

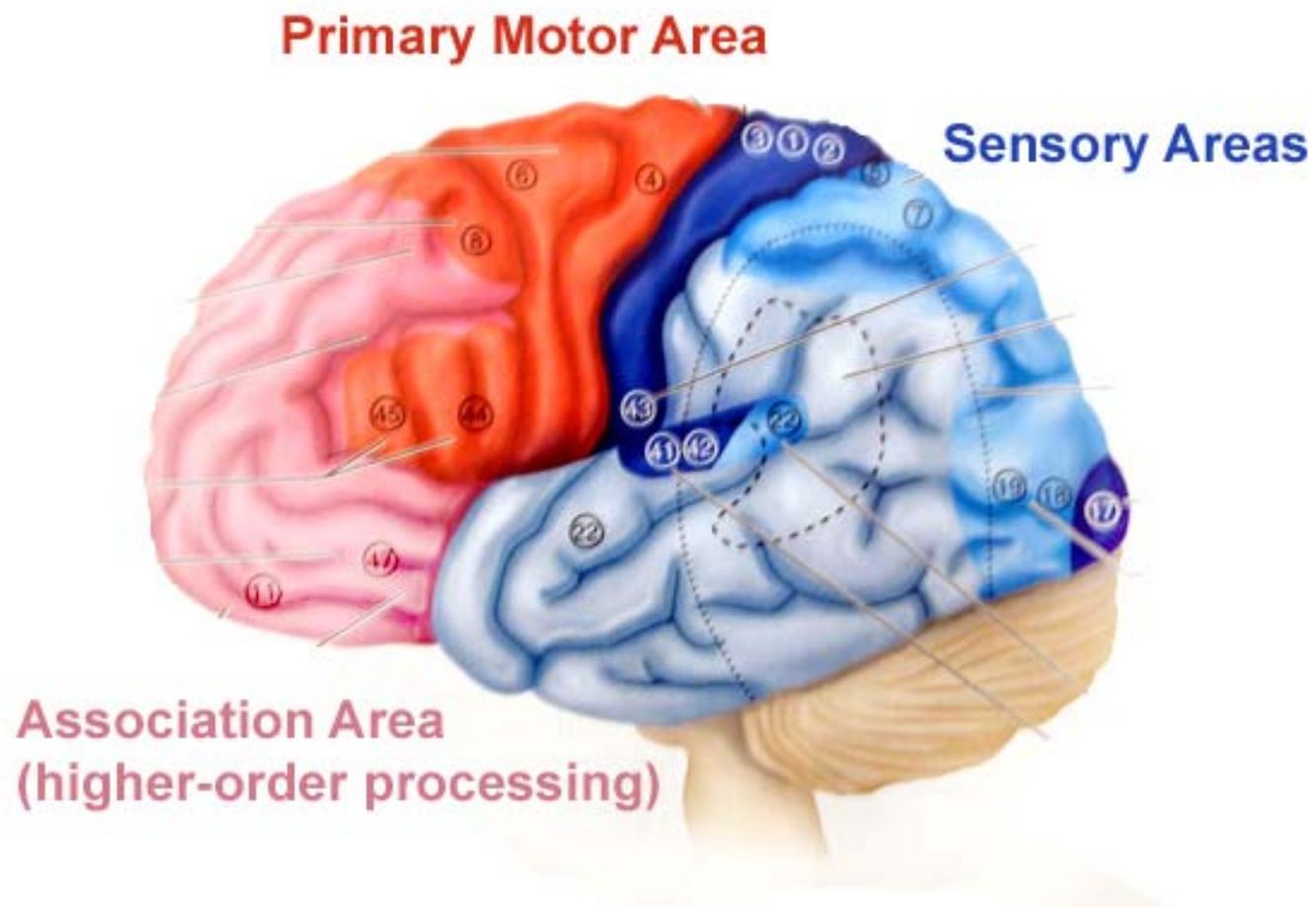
Brain



Cerebrum

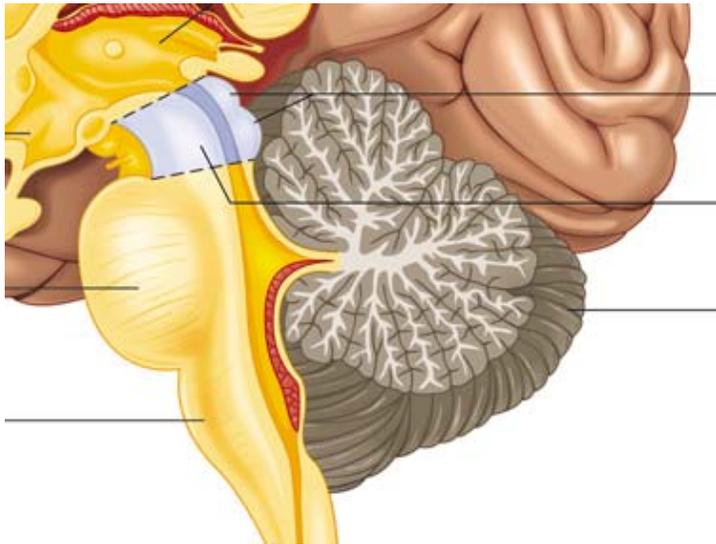
- ◆ Largest part of the brain divided into left and right hemispheres
- ◆ One more dominant than the other, connected by Corpus Callosum
- ◆ Cerebral Cortex- outer layer of grey matter (unmyelinated)
- ◆ Cerebral Medulla-white matter (myelinated)
- ◆ 4 Distinct Lobes of Cerebrum
- ◆ Frontal, Parietal, Temporal, Occipital
- ◆ Interprets Sensory Impulses, Controls Voluntary Muscles, Memory, Thought, Reasoning

Functional Areas of the Cerebrum



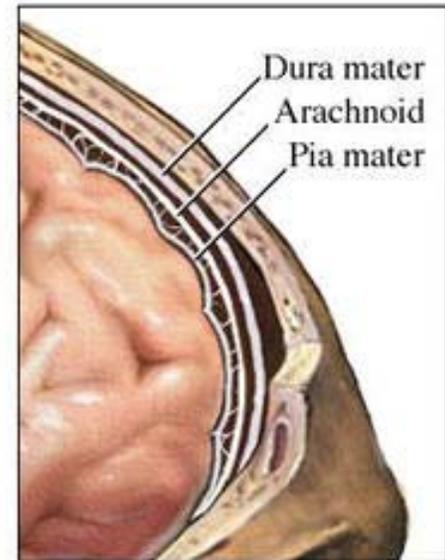
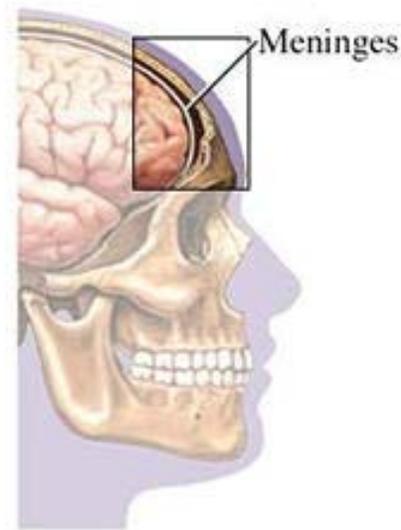
Cerebellum

- ◆ Controls posture and fine muscle control

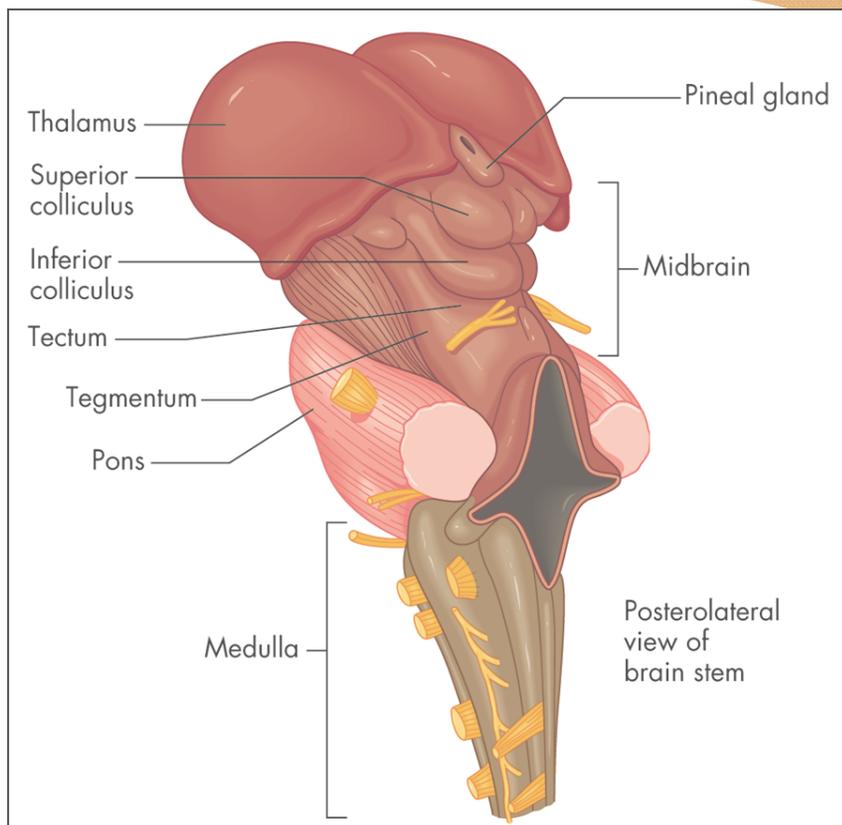


Meninges

- ◆ 3 layers of protection of brain and spinal cord
- ◆ Outermost to inner
- ◆ Dura mater
- ◆ Arachnoid
- ◆ Pia mater



Brain Stem



Brain Stem

Consists of:

1) Midbrain

- ◆ Just below cerebellum
- ◆ Connects cerebrum to lower brain centers

2) Pons

- ◆ Located between Mid brain and Medulla
- ◆ Conduction network between spinal cord and brain
- ◆ Part of respiratory center

Brain Stem

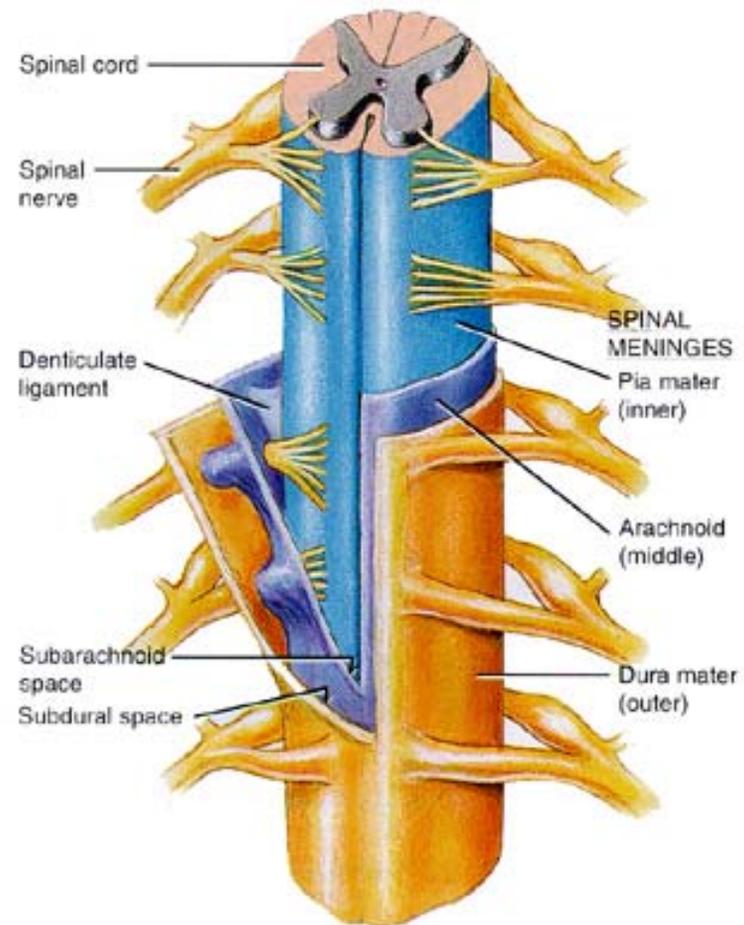
3) Medulla Oblongata

- ◆ Enlargement of the cord as it enters the cranial nerve through the foramen magnum
- ◆ Cardiac Center (controls heart rate)
- ◆ Vasomotor Center (control of blood vessel diameter)
- ◆ Respiratory Center (functions with Pons to regulate rate, depth and rhythmicity of breathing)
- ◆ Vomiting

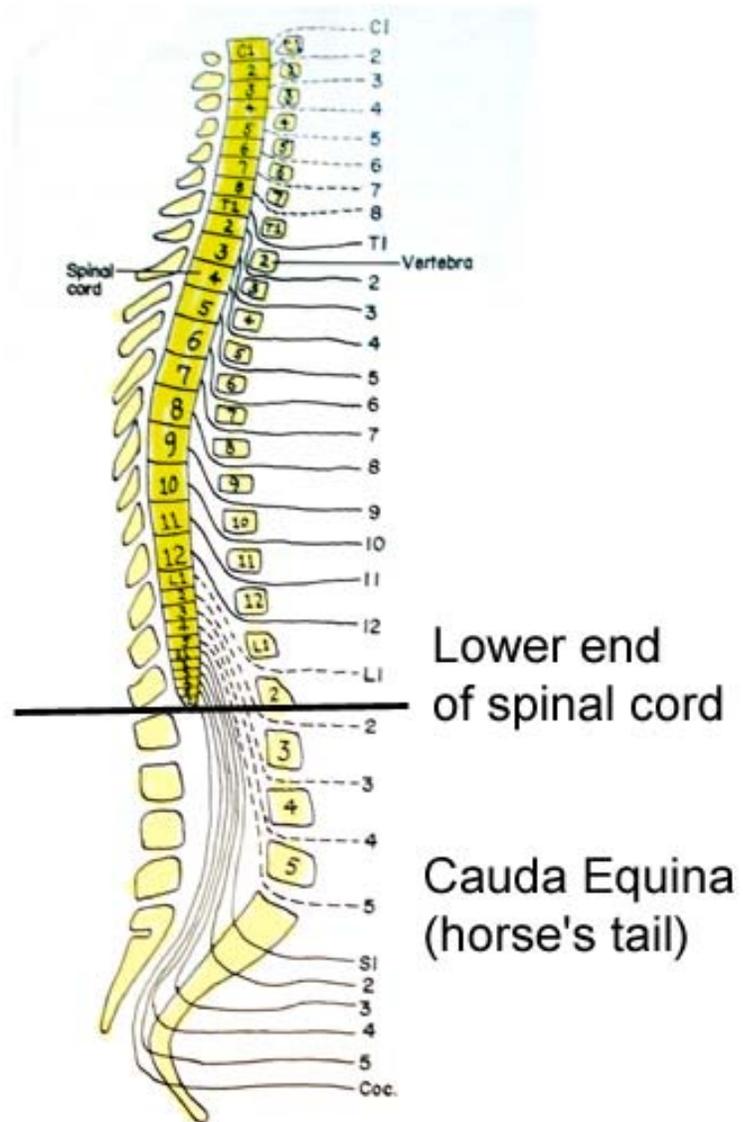
- ◆ Illness or injury affecting Medulla can result in death due to compromise of vital control center

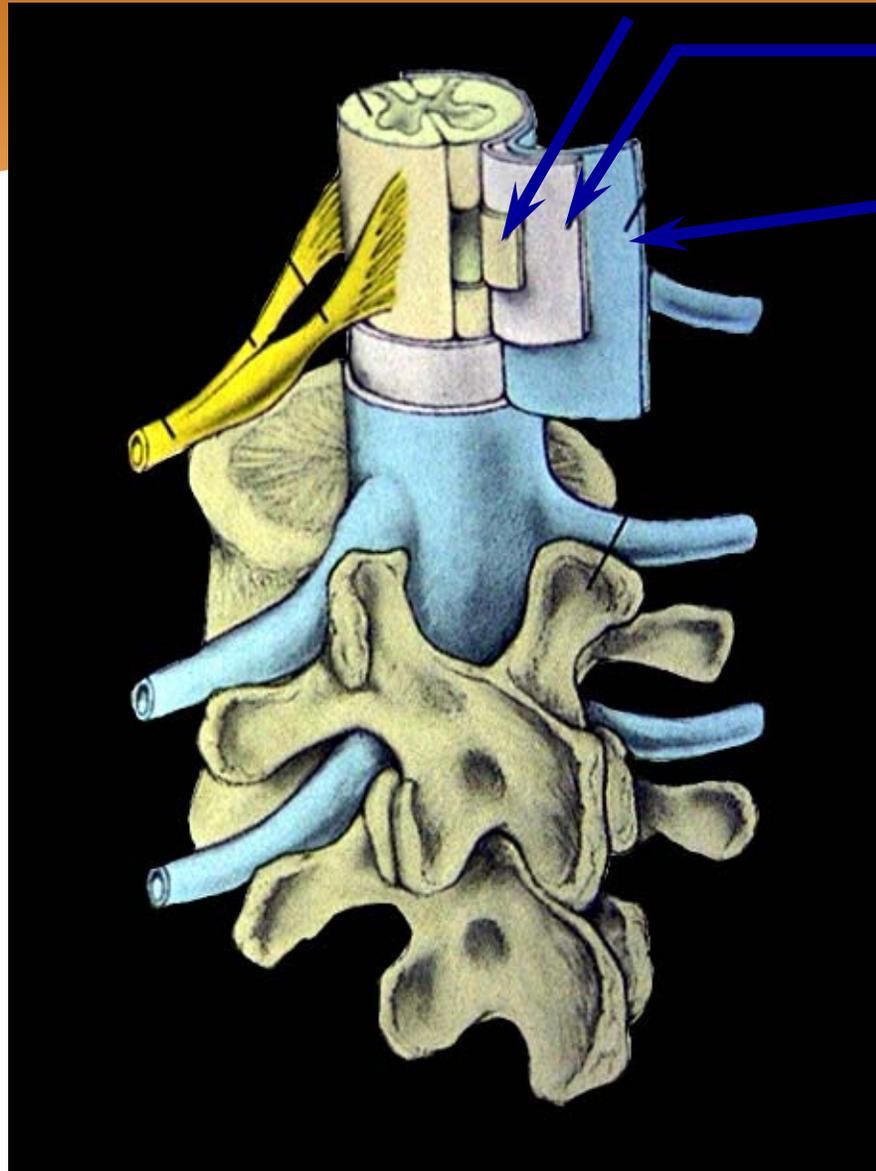
Spinal Cord

- ◆ Continues from Medulla approx 45 cm to level of L1
- ◆ Same protective coverings as brain



Cauda Equina





Pia

Arachnoid

Dura

Around the spinal cord

RAS

- ◆ Reticular Activating System
- ◆ Collection of neurons responsible for wakefulness

Cerebrospinal Fluid

- ◆ Fluid mostly made up of water that circulates in subarachnoid space around brain and spinal cord
- ◆ Acts as a cushion to protect brain and spinal cord

Blood Supply to Brain

- ◆ Receives 16% of total cardiac output and utilizes 20% of total oxygen consumption
- ◆ Supplied through carotid arteries
- ◆ 10 sec reserve of oxygen
- ◆ Brain relies on a constant supply of glucose as well as oxygen
- ◆ Prolonged hypoglycemia can result in brain death
- ◆ Blood supply drained by jugular veins

Peripheral Nervous System

Broken into Somatic and Autonomic

1) Somatic Nervous System

- ◆ Conscious control (willed movements)
- ◆ Somatic nerves are in two groups:
 - ◆ spinal and cranial nerves

Spinal Nerves

- ◆ 31 pairs of spinal nerves

Peripheral Nervous System

Cranial Nerves

- ◆ 12 Cranial Nerves

2) Autonomic

- ◆ Sympathetic
- ◆ Parasympathetic

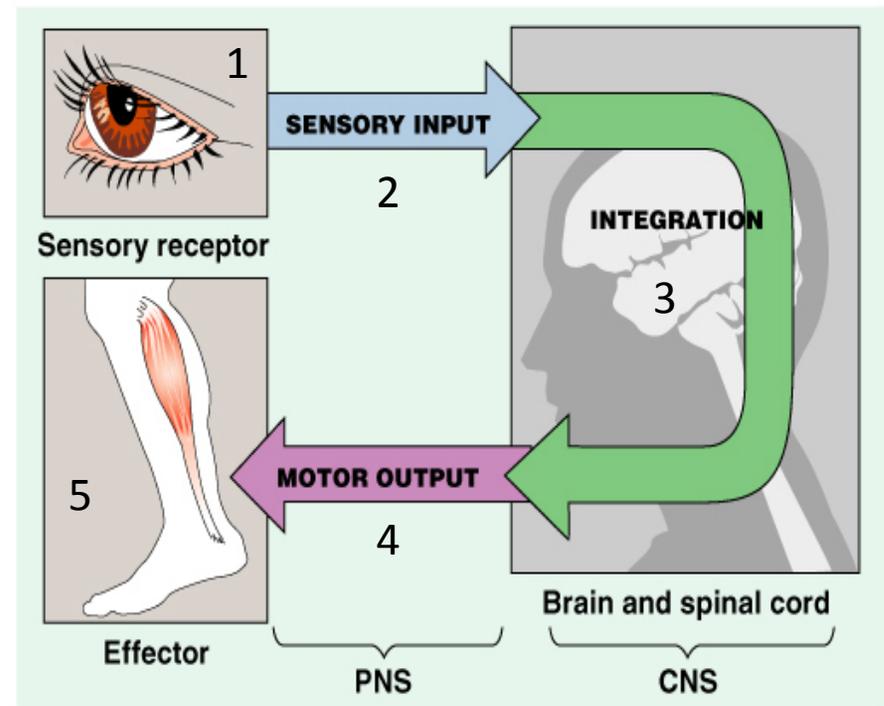
Functions of Nervous Tissue

- 1) Transmission of nerve impulses
- 2) Interpretation
- 3) Storage (memory)

Nervous System Function

Interconnected Functions:

1. Receptors
 - ◆ Nerve endings that respond to environmental stimulus
2. Sensory Input
 - ◆ Transmit information into command center
3. Integration Center
 - ◆ Interprets signal and formulates response
4. Motor Output
 - ◆ Transmits response to periphery
5. Effectors
 - ◆ Performs commands from integration center



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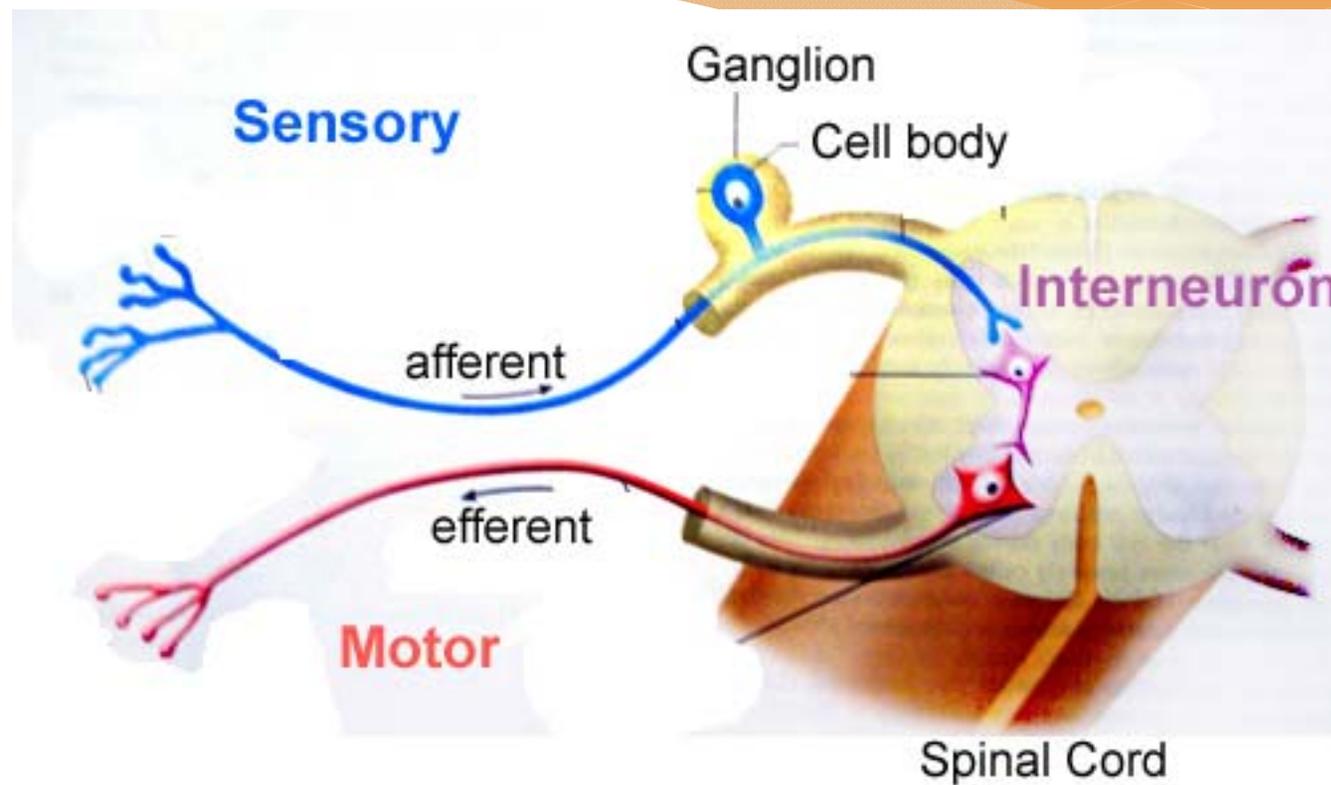
Neurons

- ◆ Relay impulses from various areas of the body to spinal cord and brain
- ◆ Send messages from brain and spinal cord to all compartments of the body

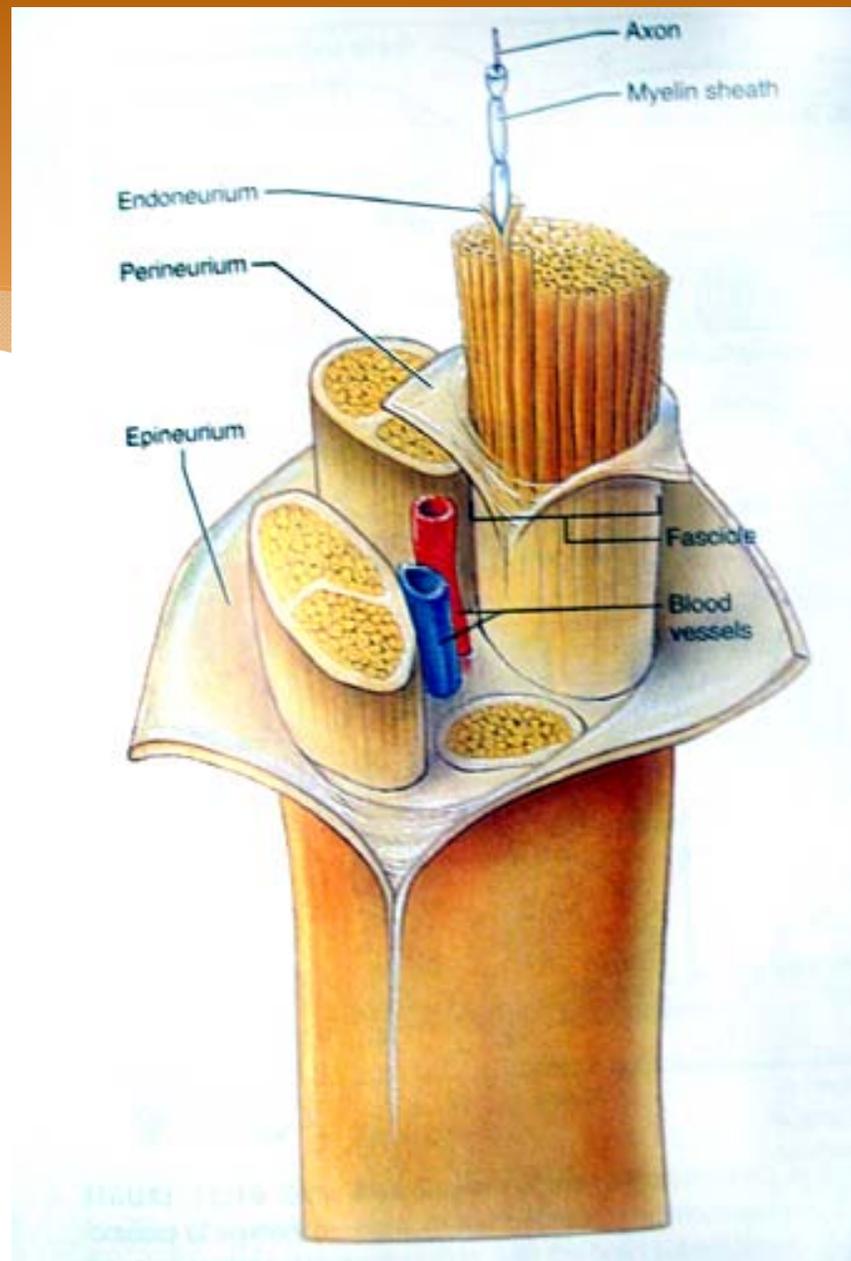
Divided into 2 Types

- ◆ Afferent (sensory): carry impulses toward brain and spinal cord from tissues and organs
- ◆ Efferent (motor): carry impulses away from brain and spinal cord
- ◆ Interneurons: exclusive to brain and spinal cord are inter or association neurons

Spinal Nerve Neuron Types

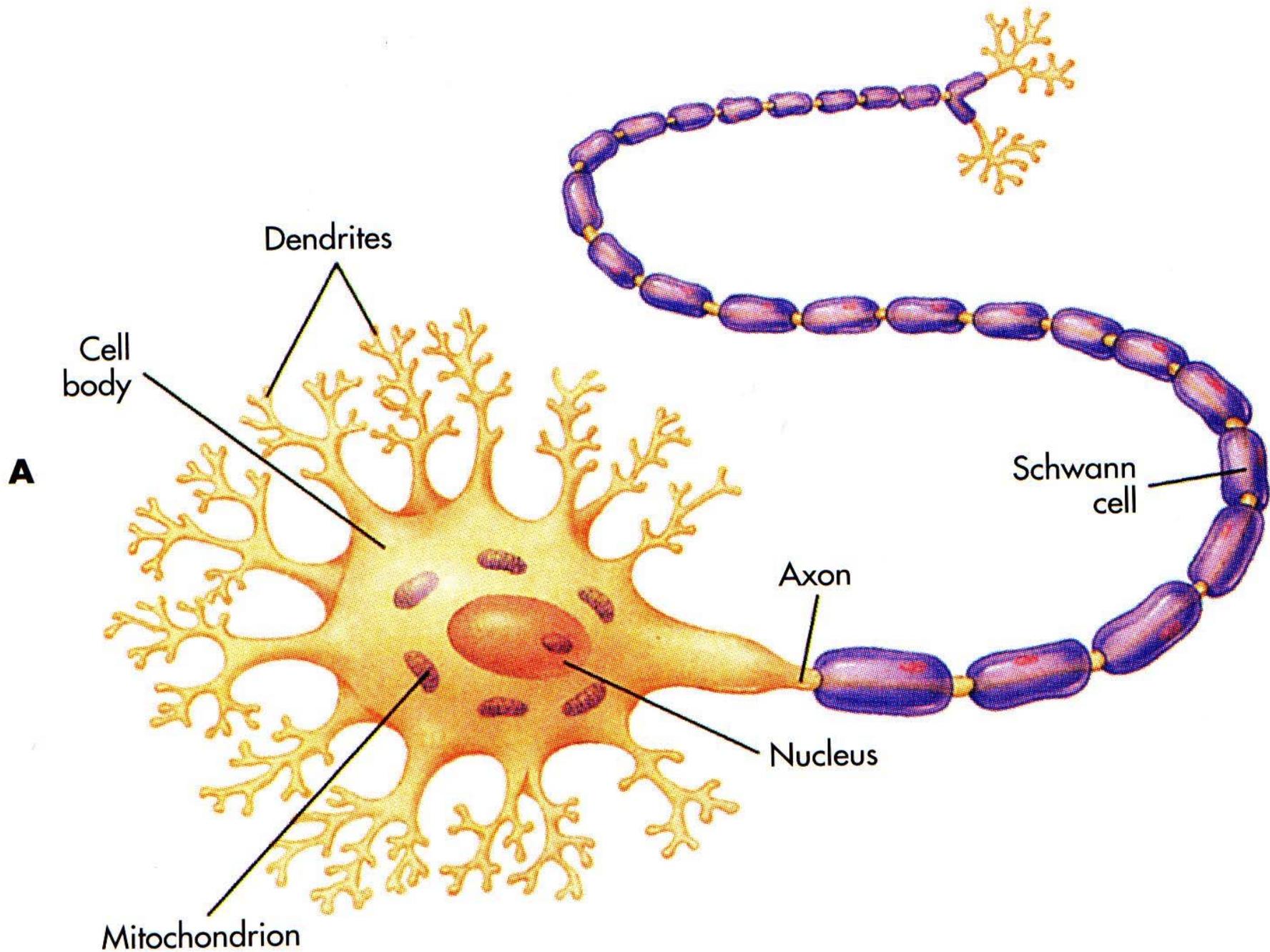


Anatomy of the Nerve



Neurons Made Up of Three Parts

- 1) Dendrite: receives information, conveyed to cell body
- 2) Cell Body: contains nucleus
- 3) Axon: carries information away from cell body



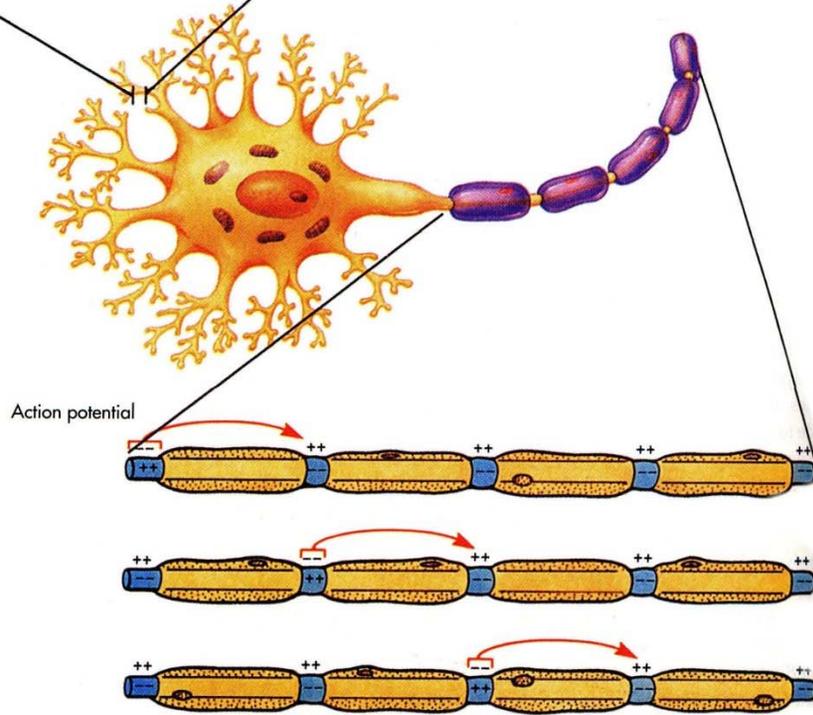
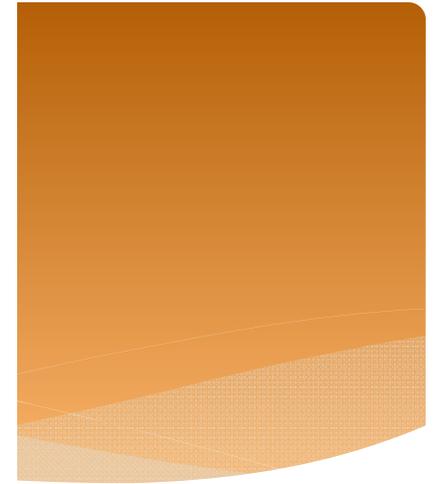
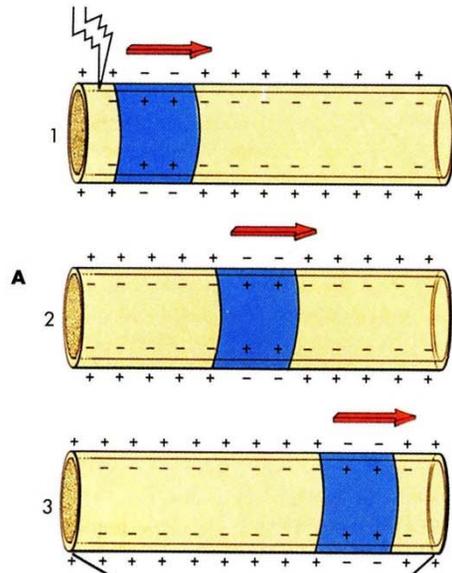


Motor (efferent nerve fibers) differ in peripheral nervous system

- ◆ Somatic: one neuron
- ◆ Autonomic: two neurons

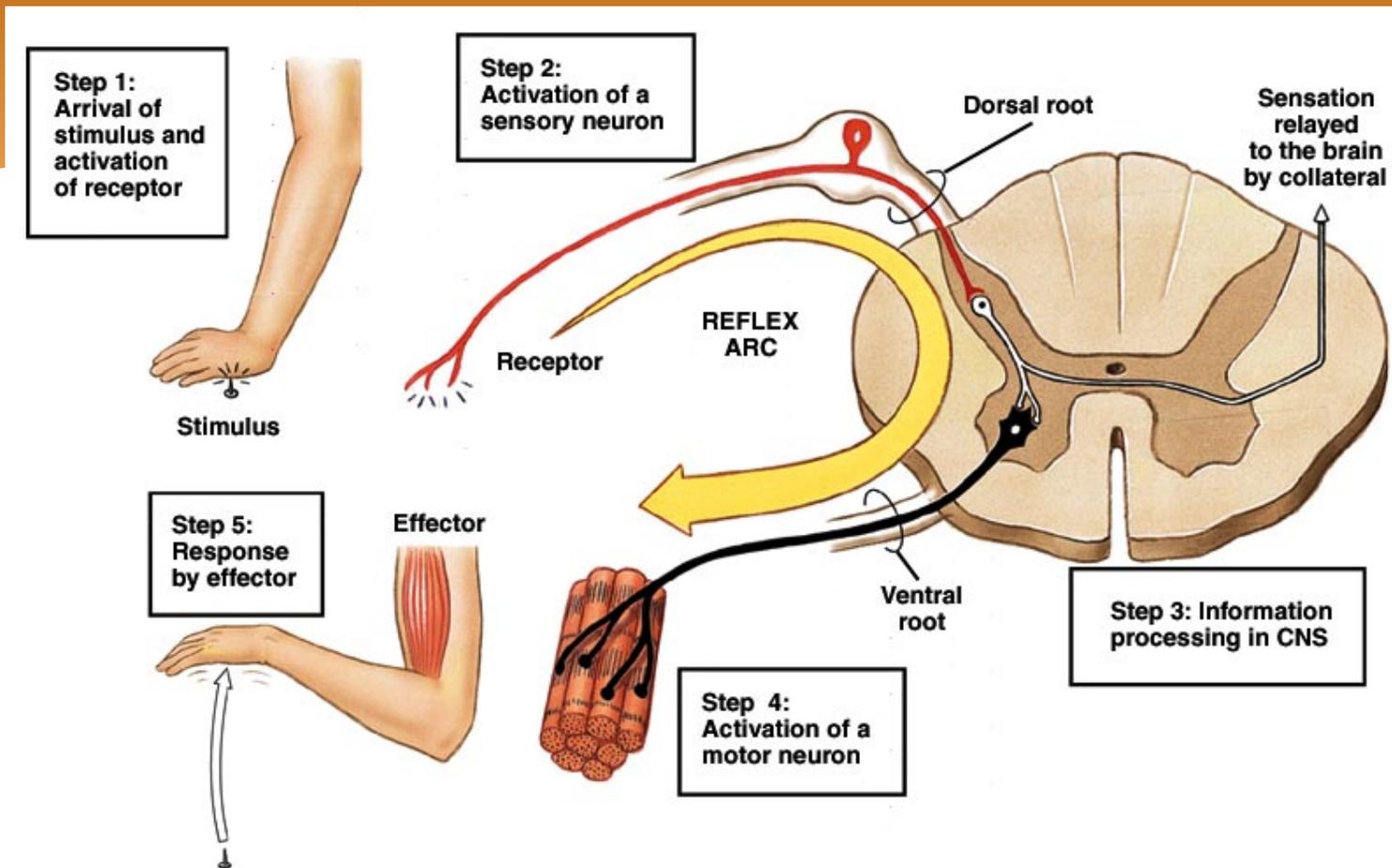
Excitability and Conductivity

- ◆ Nervous tissue has property of
 - ◆ Excitability (responds to change in environment)
 - ◆ Conductivity (transmits nerve impulses)
- ◆ Resting neuron has a potential to depolarize
- ◆ A stimulus changes the neurons permeability to sodium allowing a rush of sodium into nerve cell (depolarizing cell)
- ◆ This action is conveyed along the whole nerve fiber (all or none principal)



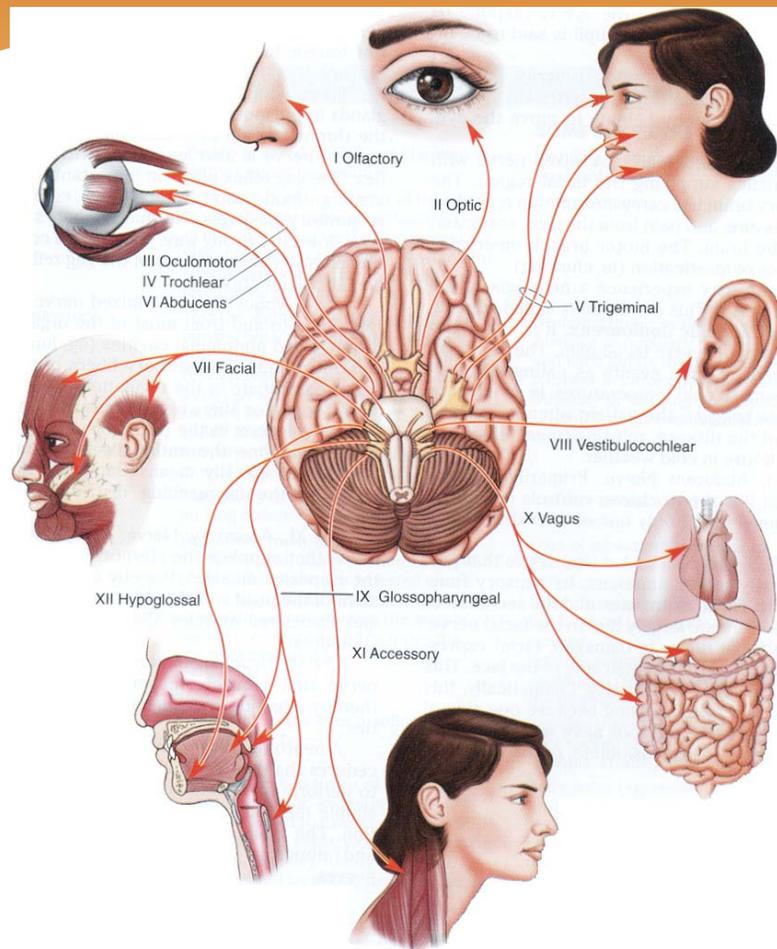
Synaptic Transmission of a Nerve Impulse

- ◆ SYNAPTIC CLEFT: Space between one neuron and (presynaptic neuron) and the dendrite of an adjacent neuron (postsynaptic neuron)
- ◆ At the end of each presynaptic neuron are tiny sacs called vesicles, each containing a chemical neurotransmitter
- ◆ When an action potential (wave of depolarization) reaches the end of the presynaptic neuron the vesicles move to the surface of the axon membrane and release their contents into the synaptic cleft
- ◆ This neurotransmitter will fill the cleft and continue the wave of depolarization of postsynaptic neuron
- ◆ Cleft between neurons and effector organs have same principal



Reflex = Negative Feedback

Cranial Nerves

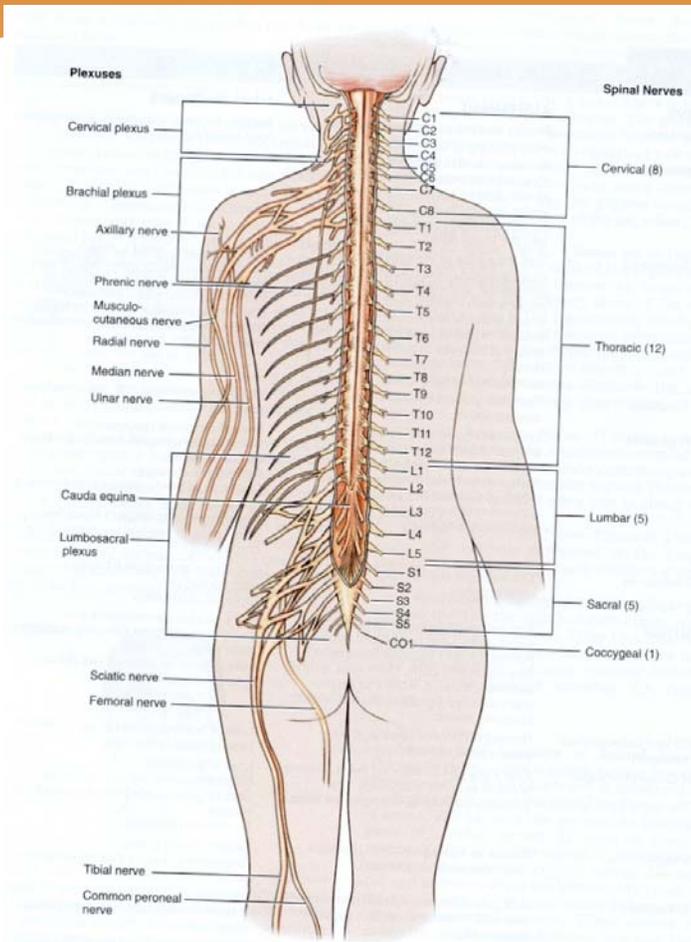


- ◆ Paired
- ◆ Numbered from front to back of brain
- ◆ Usually named for area served
- ◆ Sensory – general and special senses
- ◆ Motor – voluntary and autonomic
- ◆ Mixed

Cranial Nerves

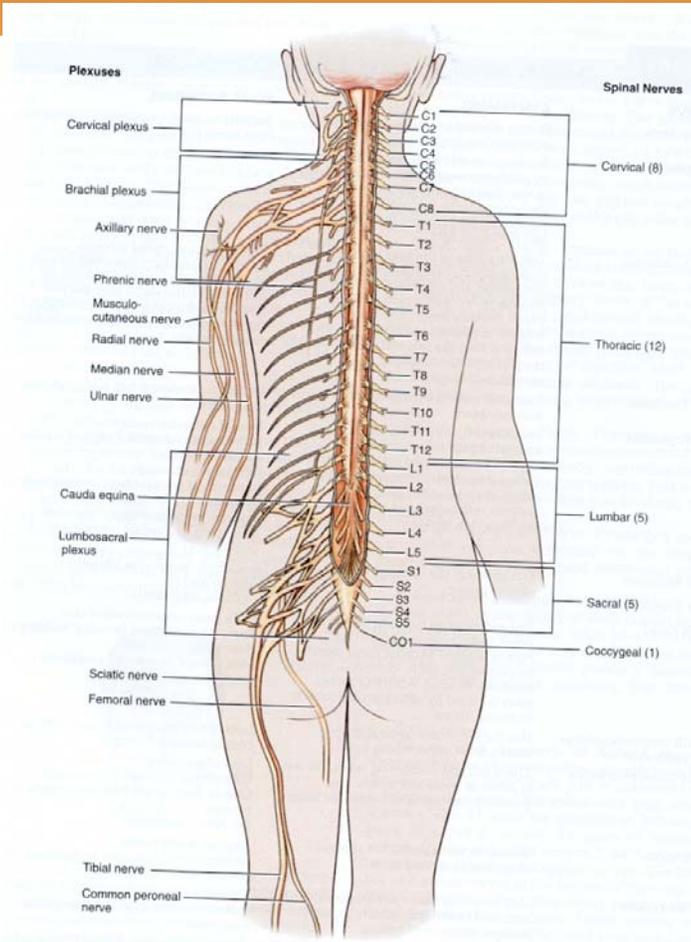
- I. Olfactory
- II. Optic
- III. Oculomotor
- IV. Trochlear
- V. Trigeminal
- VI. Abducens
- VII. facial
- VIII. Vestibulocochlear/auditory
- IX. Glossopharyngeal
- X. Vagus
- XI. spinal accessory
- XII. Hypoglossal

Spinal Nerves



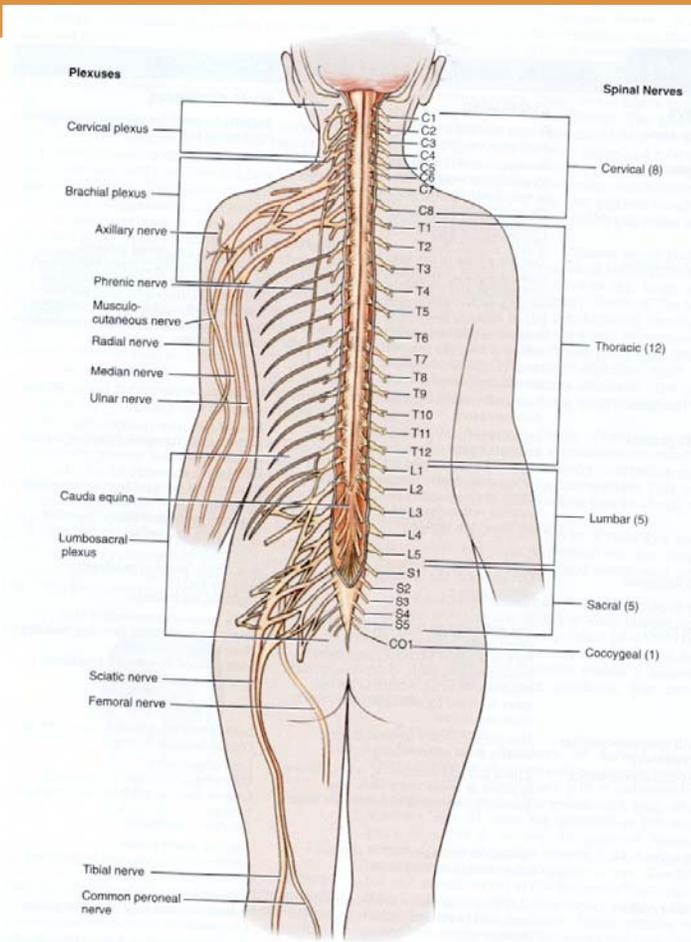
- ◆ 31 pairs
- ◆ 8 cervical
- ◆ 12 thoracic
- ◆ 5 lumbar
- ◆ 5 sacral
- ◆ 1 coccygeal
- ◆ Lumbar and sacral form cauda equina

Spinal Nerves - Cervical Plexus



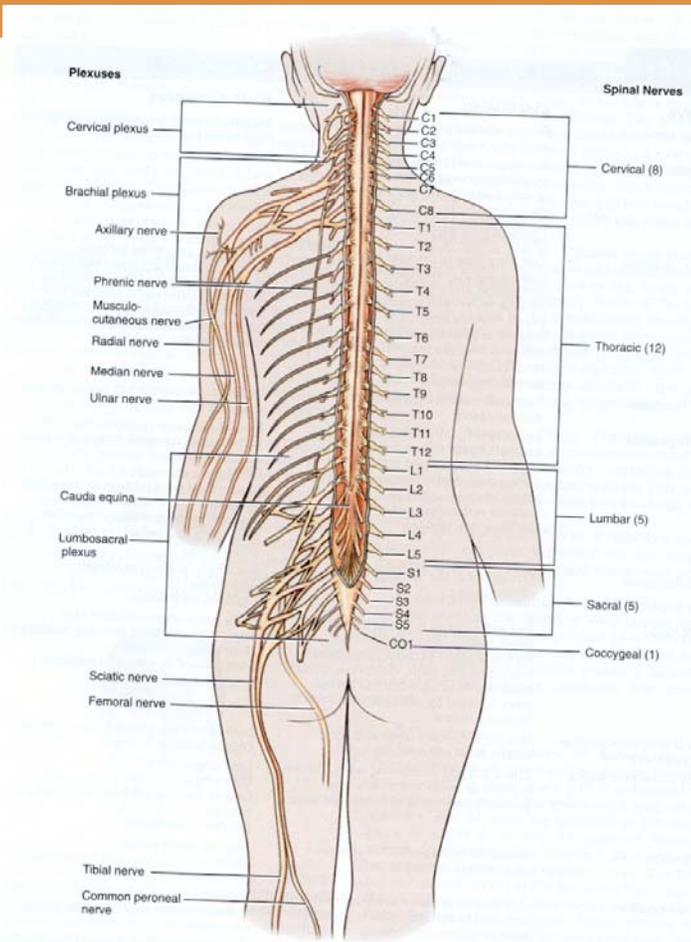
- ◆ C1-C4
- ◆ Skin and muscles of neck and shoulders
- ◆ Diaphragm
- ◆ Phrenic nerve – diaphragm (from C3, C4, and C5)
- ◆ Injury below C5 – breathing continues

Spinal Nerves - Brachial Plexus



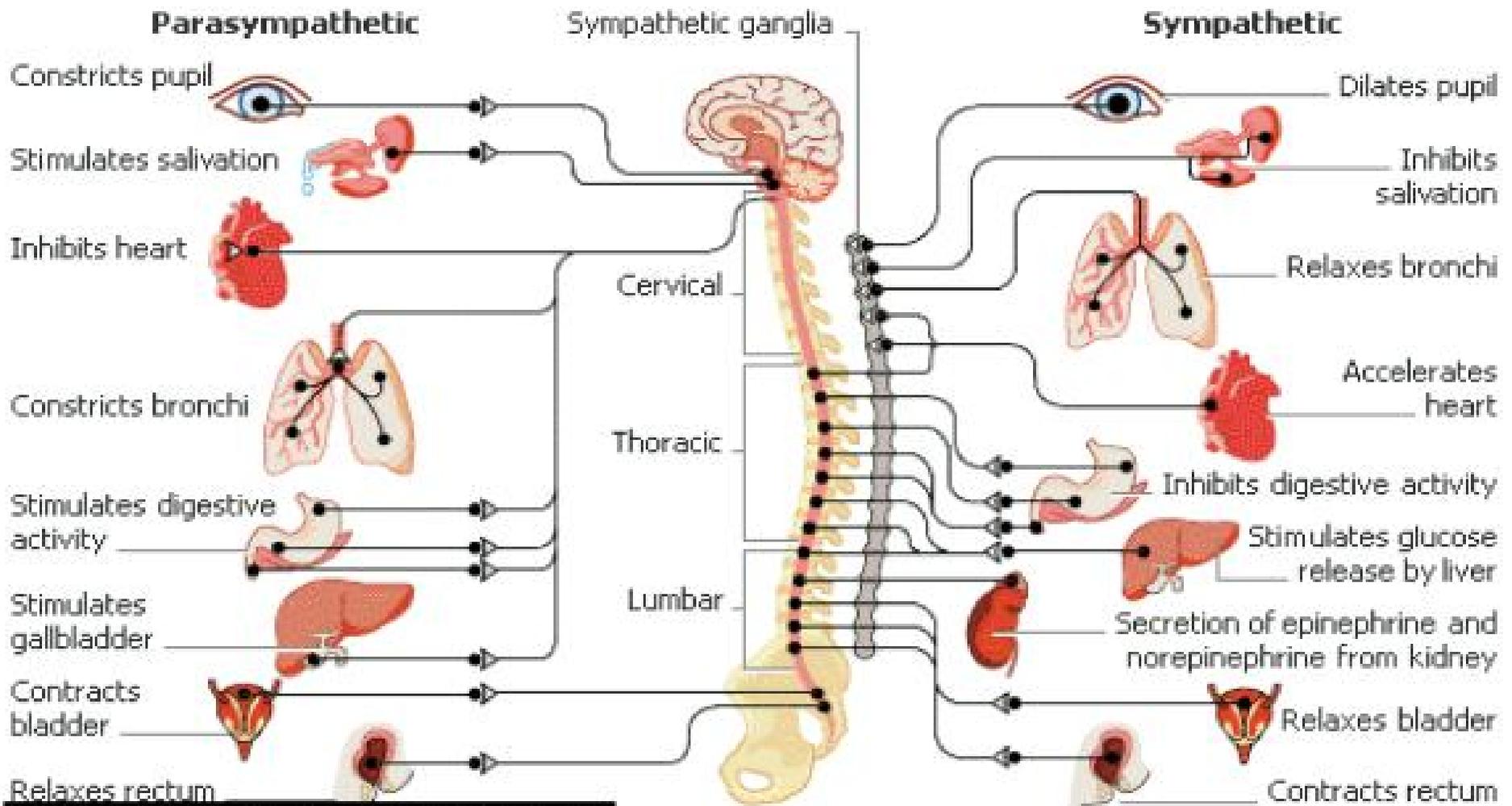
- ◆ C5-C8, T1
- ◆ Skin and muscles of the arm
- ◆ Axillary – muscles of shoulder
- ◆ Radial – back of arm, forearm, hand, thumb, 2 fingers (wrist drop)
- ◆ Medial – forearm, hand (carpal tunnel)
- ◆ Ulnar – wrist and hand muscles (claw hand)

Spinal Nerves - Lumbosacral Plexus



- ◆ T12, L1-5, S1-4
- ◆ Lower torso and legs
- ◆ Sciatic Nerve – back of leg, buttocks
- ◆ Femoral – lower abdomen, front of thigh, medial leg & foot
- ◆ Peroneal – Lateral leg, foot
- ◆ Tibial – back of leg, foot

Autonomic Nervous System



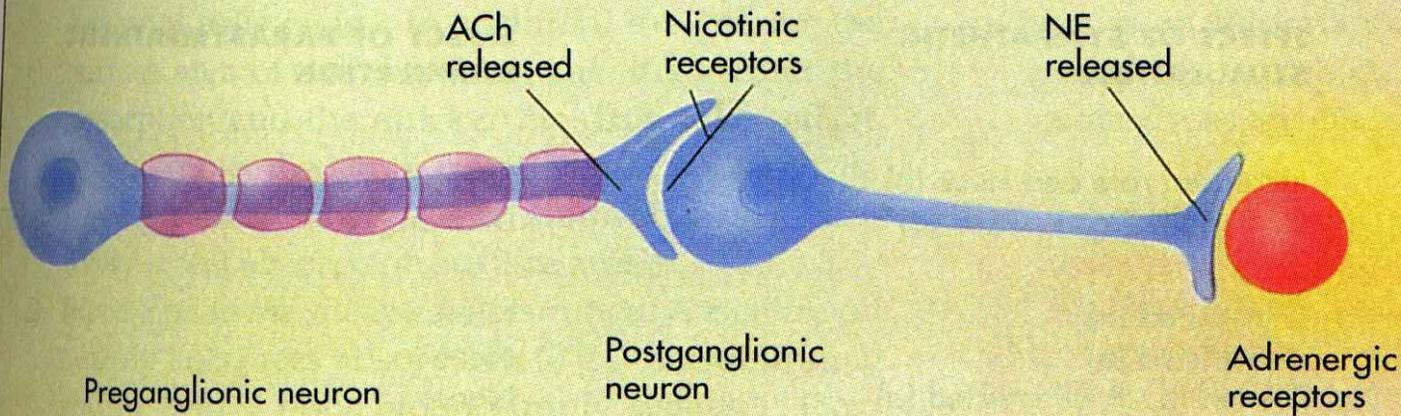
Autonomic Neurotransmitters

- ◆ Acetylcholine & epinephrine
- ◆ Neurons that release Acetylcholine are cholinergic
- ◆ Neurons that release epinephrine are called adrenergic

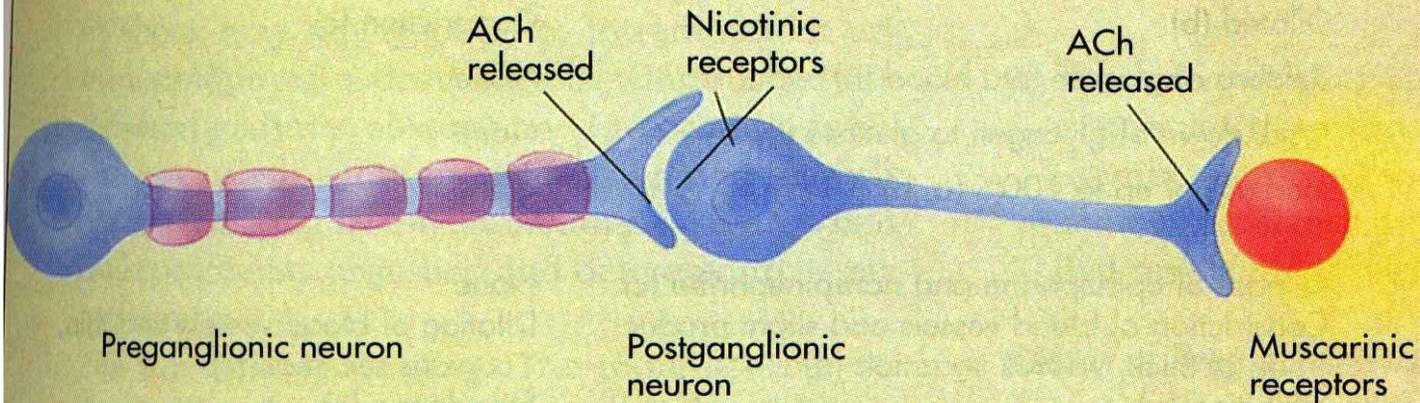
Adrenergic and Cholinergic

- ◆ Parasympathetic pre and post ganglionic neurons are cholinergic
- ◆ Sympathetic preganglionic are also cholinergic
- ◆ Sympathetic post ganglionic neurons are adrenergic

Sympathetic division

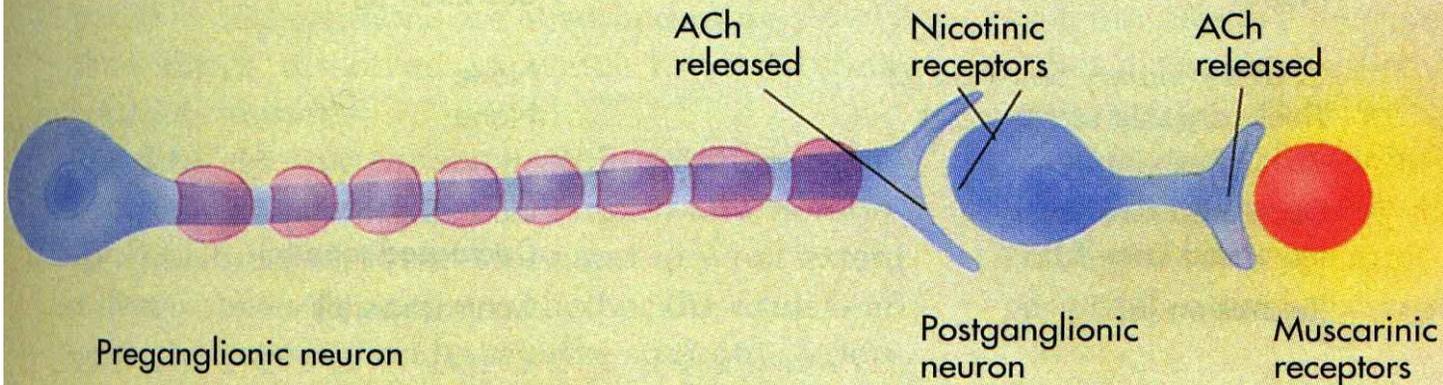


Some target tissues are stimulated, others are inhibited. For example, blood vessels (including those in skeletal muscle) are stimulated to vasoconstrict, and stomach glands are inhibited.



Sweat glands are stimulated, skeletal muscle blood vessels are inhibited (vasodilate) during exercise.

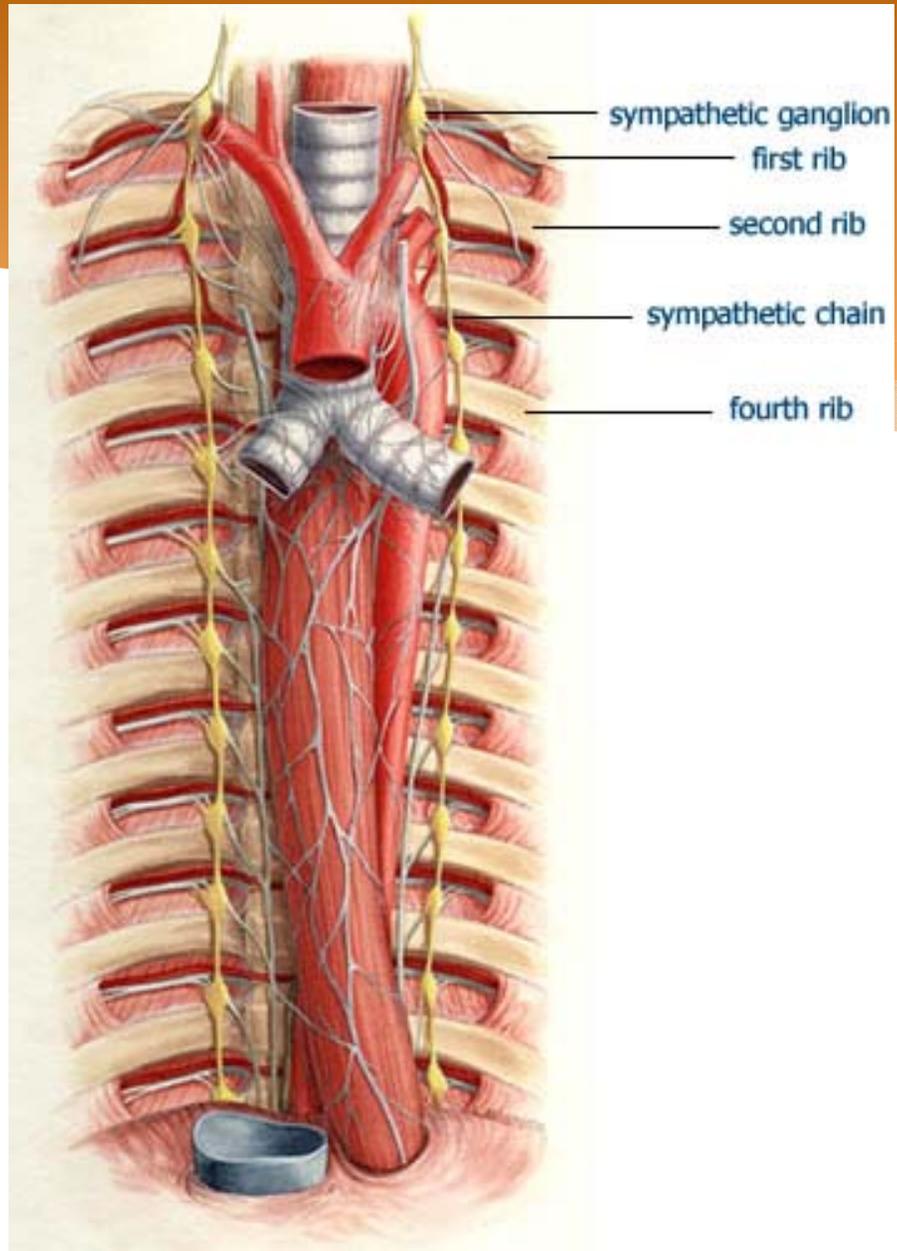
Parasympathetic division



General response is excitatory, but some target tissues are inhibited, e.g., the heart.

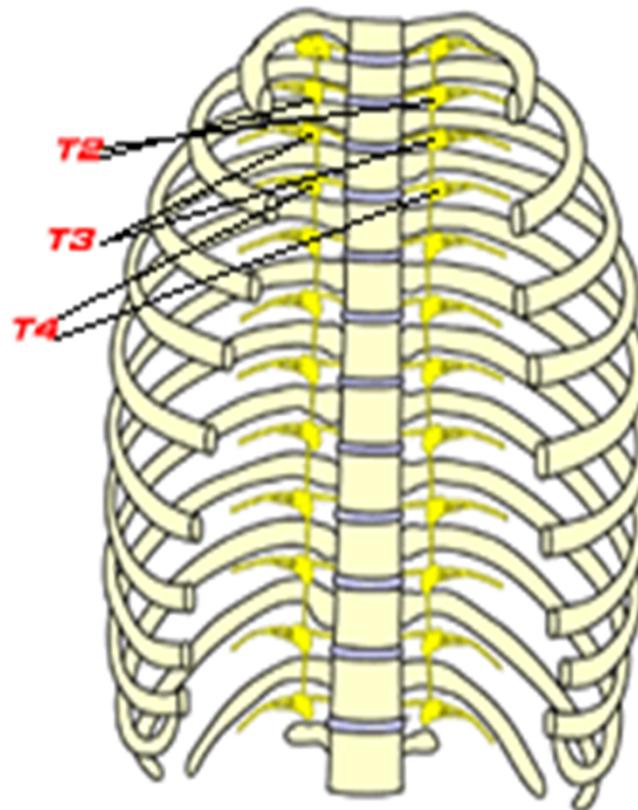
Sympathetic Chain Ganglia

- ◆ Sympathetic axon collaterals bridge between adjacent ganglia
- ◆ This occurs in the same side of vertebral column



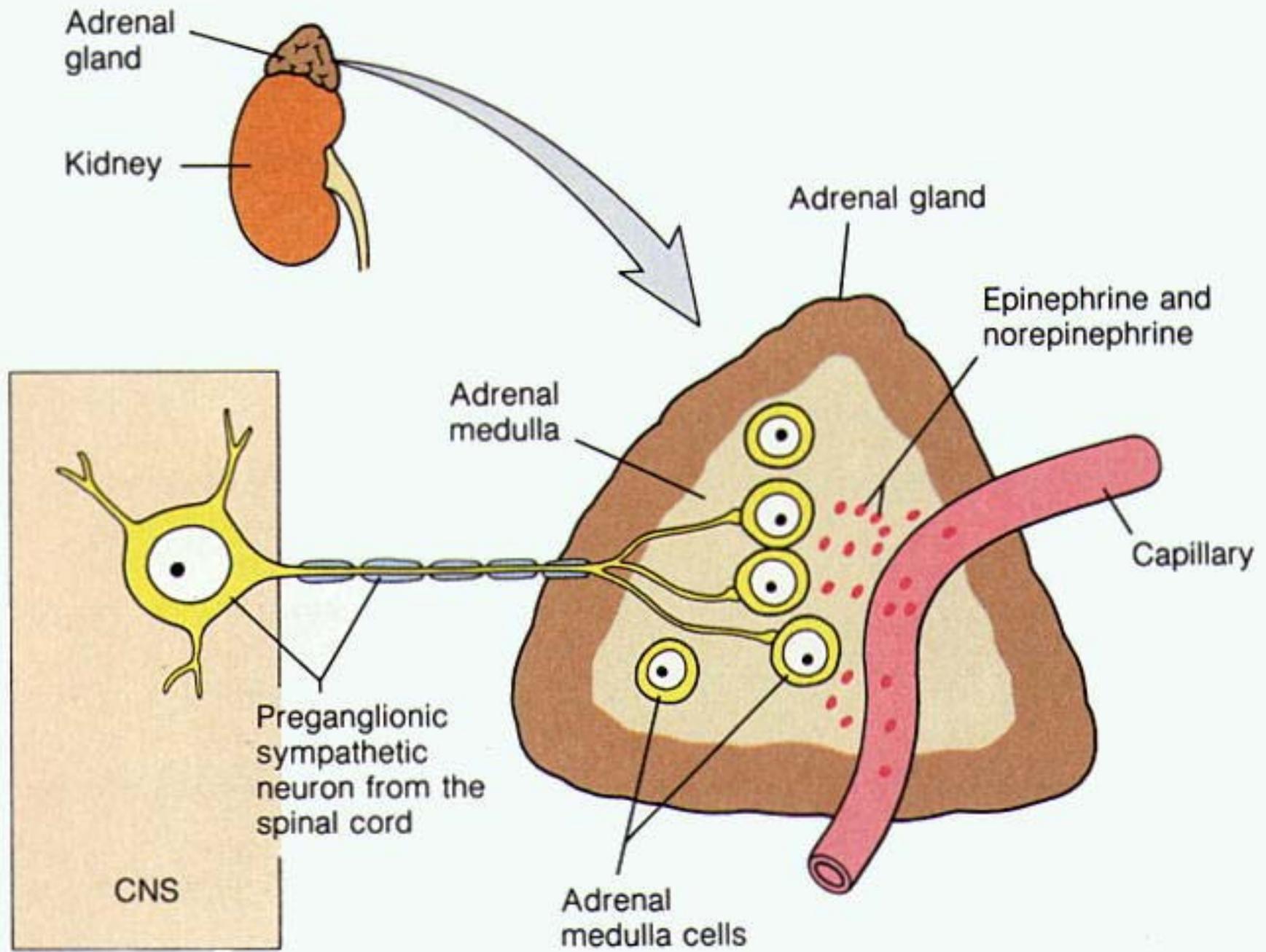
22 Sympathetic Chain Ganglia

- ◆ 3 cervical
- ◆ 11 thoracic
- ◆ 4 lumbar and
- ◆ 4 sacral



Adrenal Medulla

- ◆ Some of the neurons pass the celiac ganglion and goes to adrenal medulla. There they synapse with modified neurons that produce epinephrine and norepinephrine



Adrenergic Receptors

- ◆ Alpha1 – Blood Vessels Vasoconstriction
- ◆ Alpha2 – Presynaptic neuron – eliminates further release of Norepinephrine.
- ◆ Beta1 – Heart - increases contractility and heart rate
- ◆ Beta2 – Lungs, Skeletal Muscle - dilation

Norepinephrine

- ◆ Has two main types of receptors
- ◆ Alpha and beta receptors are the main types
- ◆ They both have some subtypes

Norepinephrine Effect

- ◆ Is different on organs based on type of the receptor
- ◆ Epinephrine that comes from the adrenal medulla prolongs its effect

Norepinephrine Deactivation

- ◆ Occurs by means of two enzymes MAO and COMT
- ◆ It happens slower than deactivation of Acetylcholine

Parasympathetic Neurons

- ◆ Their cell bodies are in the ganglion near the effector organ
- ◆ They usually synapse with one postganglionic neuron

Parasympathetic Effect

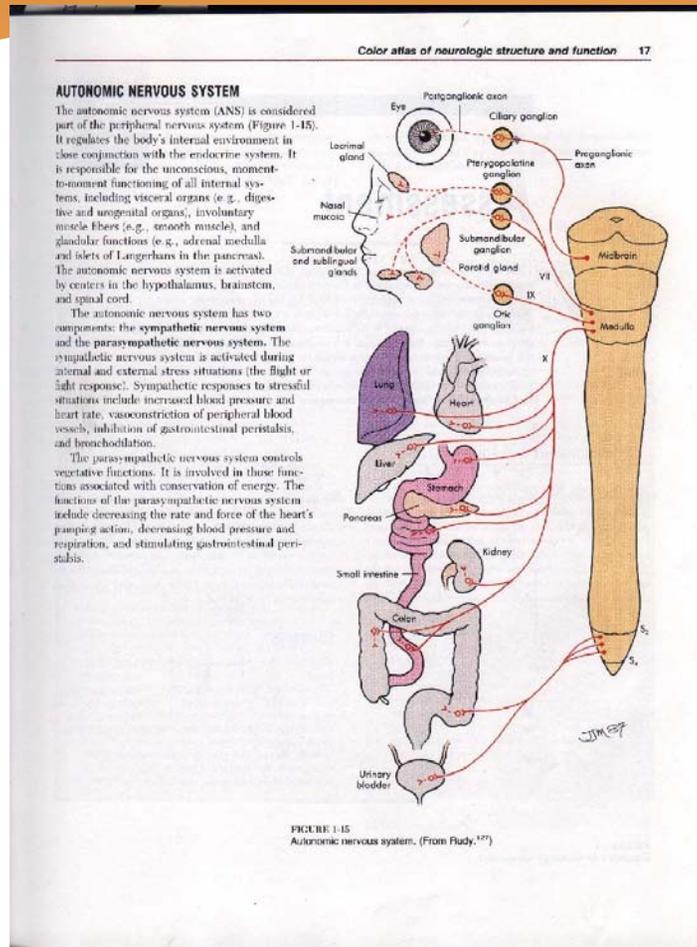
- ◆ Restores vegetative function
- ◆ Slows body functions
 - ◆ Heart rate
- ◆ Speeds up body functions
 - ◆ GI Motility

Acetylcholine Deactivation

- ◆ Acetylcholinesterase
- ◆ Occurs in synaptic cleft

NERVOUS SYSTEM DISEASES

Nervous System Diseases

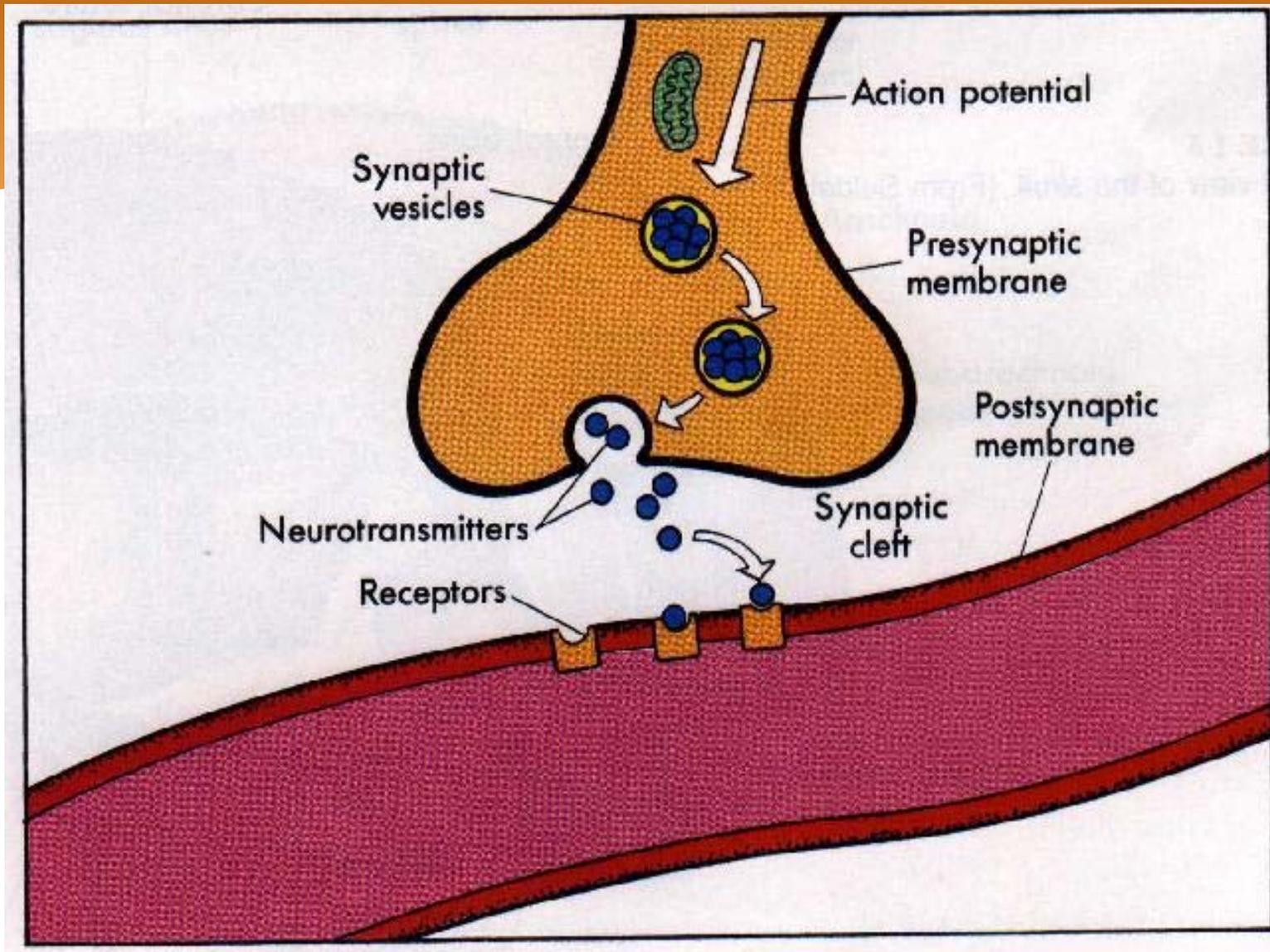


- ◆ Myasthenia Gravis
- ◆ Bell's Palsy
- ◆ Guillian-Barre Syndrome
- ◆ Parkinson's Disease
- ◆ Amyotropic Lateral Sclerosis
- ◆ Meningitis

Why Do We Need to Know About Those Diseases???

- ◆ Knowing a basic knowledge of some of these Diseases will help us understand the problems our patients are having
- ◆ Can anticipate and be ready for complications
- ◆ Prepare equipment
- ◆ Understand the frustrations patients have with the progression of their disease
- ◆ Better understanding of the disease process
- ◆ Ultimately better treatment and understanding

MYASTHENIA GRAVIS PNS



Myasthenia Gravis

- ◆ Auto immune neuromuscular disorder
- ◆ Shows signs of muscle weakness of voluntary muscles: oculomotor, facial, laryngeal, pharyngeal, and RESPIRATORY
- ◆ There is a 70-89% reduction in Acetylcholine receptors per each post synaptic cleft...therefore muscle weakness
- ◆ Improves with rest and drug administration (anti-cholinesterase meds)

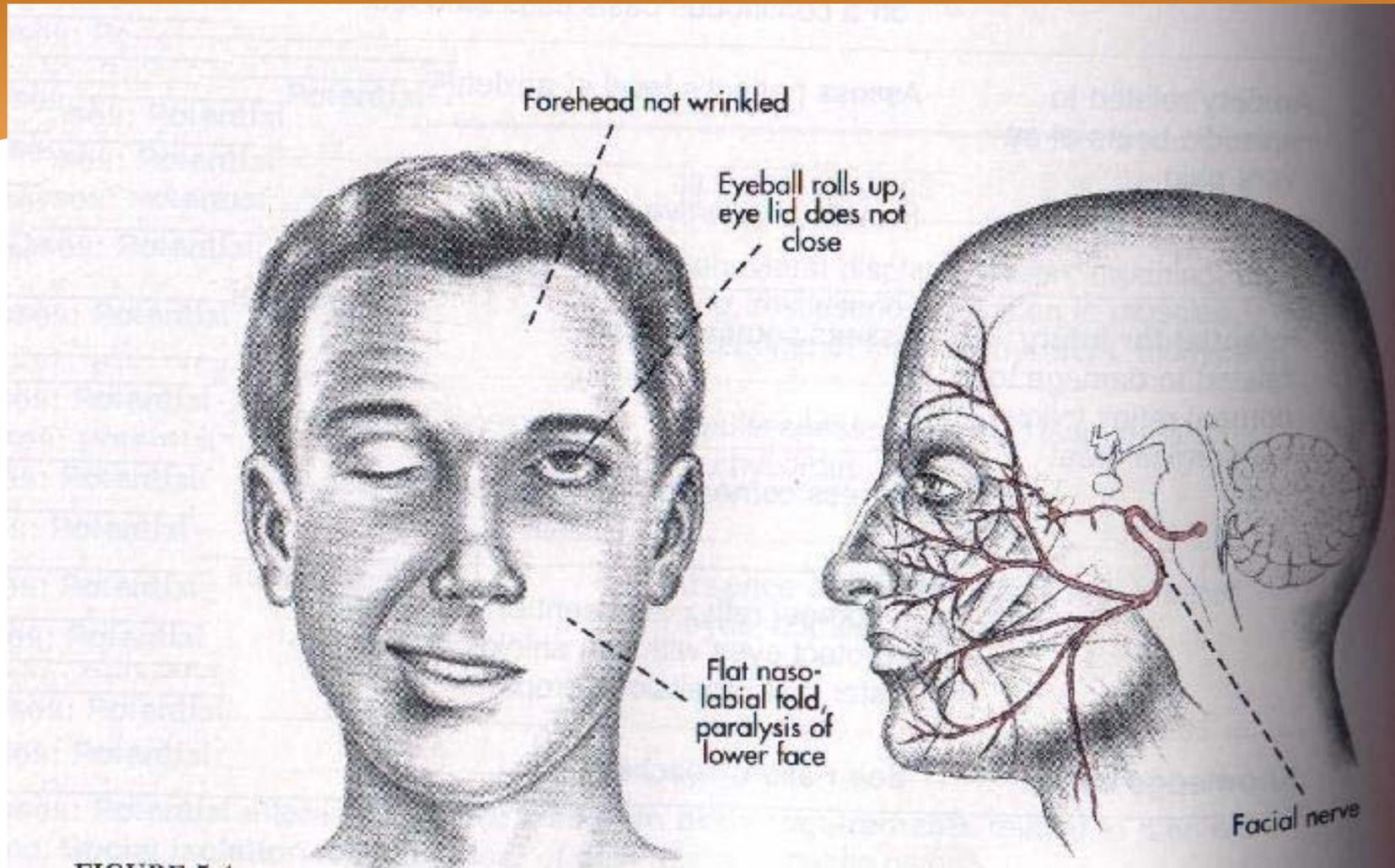
Signs and Symptoms

- ◆ Drooping eyelids
- ◆ Double vision
- ◆ Slurred speech
- ◆ Nasal quality to speech
- ◆ Inability to speak
- ◆ Drooling
- ◆ Nasal regurgitation
- ◆ Weak cough
- ◆ Problems chewing and swallowing (choking)
- ◆ Trouble sitting up/holding head erect
- ◆ Trouble walking
- ◆ Feeling SOB

Complications

- ◆ Myasthenic Crisis (insufficient acetylcholine)
- ◆ Cholinergic Crisis (SLUDGE) due to an overdose of med's
- ◆ Pneumonia
- ◆ Sepsis
- ◆ Complications related to immobility
- ◆ Respiratory Distress
- ◆ Choking

BELL'S PALSY



Bell's Palsy

- ◆ Comes on rapidly
- ◆ 15-60 years old
- ◆ Effects 7th cranial nerve
- ◆ Causes unilateral or bilateral facial weakness
- ◆ Majority of patients have full recovery

Blockage of 7th Cranial Nerve By:

- ◆ Infection
- ◆ Hemorrhage
- ◆ Tumor
- ◆ Meningitis
- ◆ Local trauma

Signs and Symptoms

- ◆ Unilateral facial weakness
- ◆ Aching pain around angle of jaw/behind ear
- ◆ Headache
- ◆ Tearing
- ◆ Unilateral mouth drooling and drooping
- ◆ Inability to control facial expression in smiling, squinting, blinking/closing eyelid
- ◆ Loss of sensation of taste (front 2/3rds)

Complications

- ◆ Corneal ulceration and blindness
- ◆ Impaired nutrition
- ◆ Long-term psycho social problems

GUILLIAN-BARRE SYNDROME

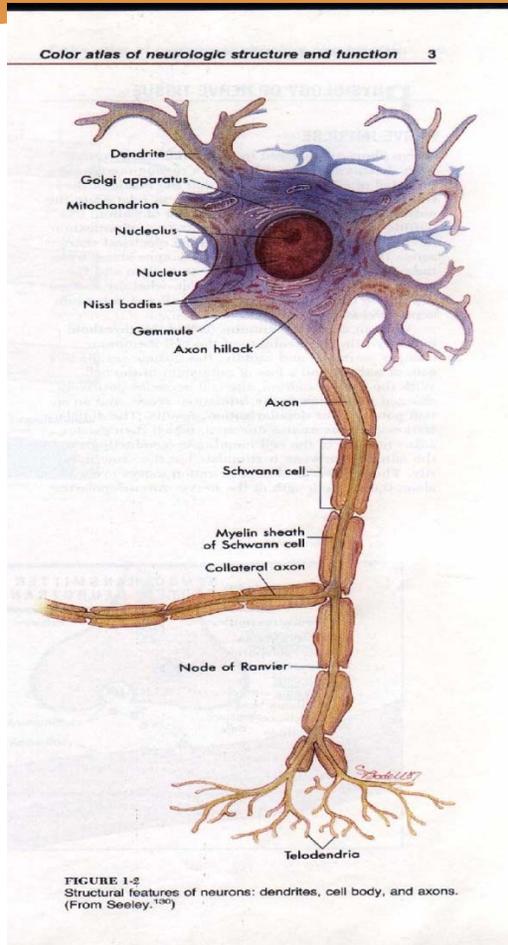
Guillain-Barre Syndrome

- ◆ Acute syndrome characterized by widespread inflammation or demyelination of ascending/descending nerves in the peripheral nervous system (conduction)
- ◆ Causes weakness, paralysis
- ◆ Muscles unable to respond to commands sent from brain due to decreased conduction

Cause

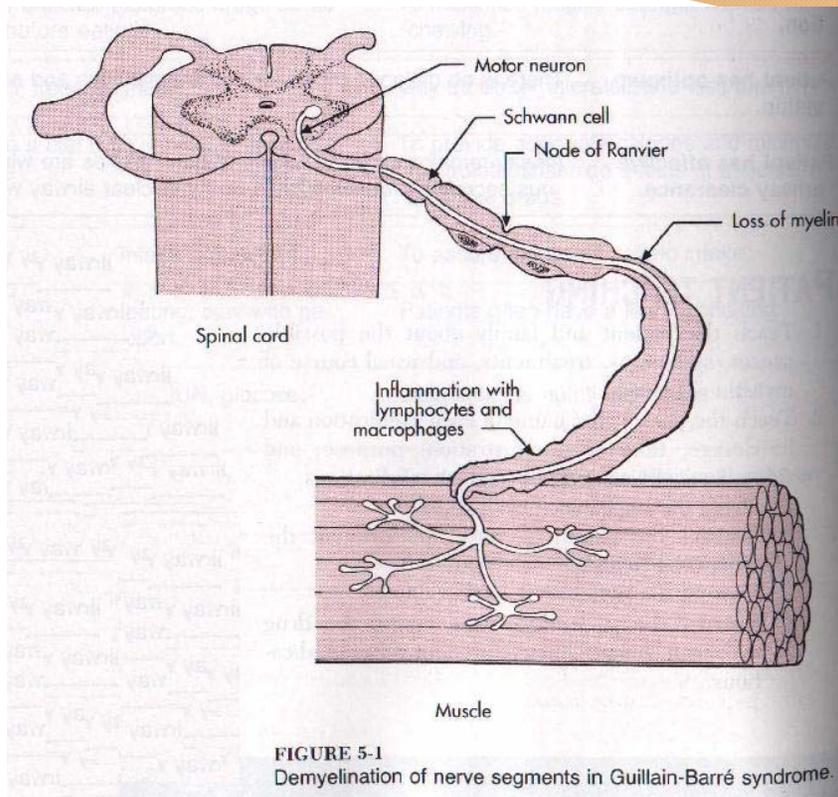
- ◆ Unknown
- ◆ >50% patients had non-specific infection 10-14 days prior to GBS symptoms (possible sensitized lymphocytes may produce demyelination)
- ◆ Which causes decrease conduction

Normal Myelinated Nerve



- ◆ Saltatory Conduction
- ◆ Myelinated fibers
- ◆ The action potential jumps around the insulating myelin rapidly
- ◆ Increases conduction times

Demyelinated Nerve Segments



- ◆ Demyelination delays nerve conduction
- ◆ Therefore decreasing conduction times
- ◆ Muscles are unable to respond to commands sent from the brain
- ◆ Fewer incoming sensory signals to be interpreted as heat, pain, etc.

Signs and Symptoms

- ◆ Lower extremity weakness leads to upper extremity and facial weakness
- ◆ Sensory and motor loss
- ◆ Complete paralysis with respiratory failure within 48 hours (33% of GBS patients need to be intubated)
- ◆ Paralysis can progress in 2-3 weeks (30% quadriplegics, 30% bed bound)

Continued

- ◆ Sympathetic and parasympathetic involvement leads to :
 - ◆ Hypertension
 - ◆ Hypotension
 - ◆ Dysrhythmias
 - ◆ Circulatory collapse

Complications

- ◆ Cardiac failure
- ◆ Respiratory failure
- ◆ Infection and sepsis
- ◆ Venous thrombosis
- ◆ Pulmonary embolus

PARKINSON'S DISEASE

Parkinsonism

Parkinson's Disease

- ◆ Mainly a disease of movement
- ◆ Progressive disease becoming worse over 10 years

Parkinson's Disease

- ◆ Our brain (basal ganglia) directs all of our movements
- ◆ It uses many chemicals to transmit messages
- ◆ Dopamine, acetylcholine, Norepinephrine
- ◆ In the basal ganglia the most important chemical for the transmission of messages is Dopamine

Cause

- ◆ In Parkinson's, cells that produce Dopamine die off
- ◆ The remaining cells can't relay information from cell to cell therefore causing the signs and symptoms of this disease.

Signs and Symptoms

- ◆ Muscle rigidity and akinesia
- ◆ Jerky tremor (begins in fingers)
- ◆ Difficulty walking due to akinesia
- ◆ High pitched monotone voice, drooling
- ◆ Mask like facial expression
- ◆ Loss of posture control
- ◆ Difficulty speaking/swallowing
- ◆ Decreases with purposeful movement and sleep

AMYOTROPIC LATERAL SCLEROSIS aka...Lou Gehrig's Disease

Amyotrophic Lateral Sclerosis

- ◆ Terminal neurological disorder
- ◆ Progressive degeneration of nerve cells in spinal cord and brain
- ◆ Does not effect mental functioning or senses such as hearing or seeing
- ◆ Not contagious
- ◆ No cure
- ◆ Age group 40-70 years old
- ◆ 50% of patients die within 18 months

Amyotrophic Lateral Sclerosis

- ◆ A- without
- ◆ Myo- muscle
- ◆ Tropic- nourishment
- ◆ Lateral- side (of spinal cord)
- ◆ Sclerosis- hardening/scaring

Cause

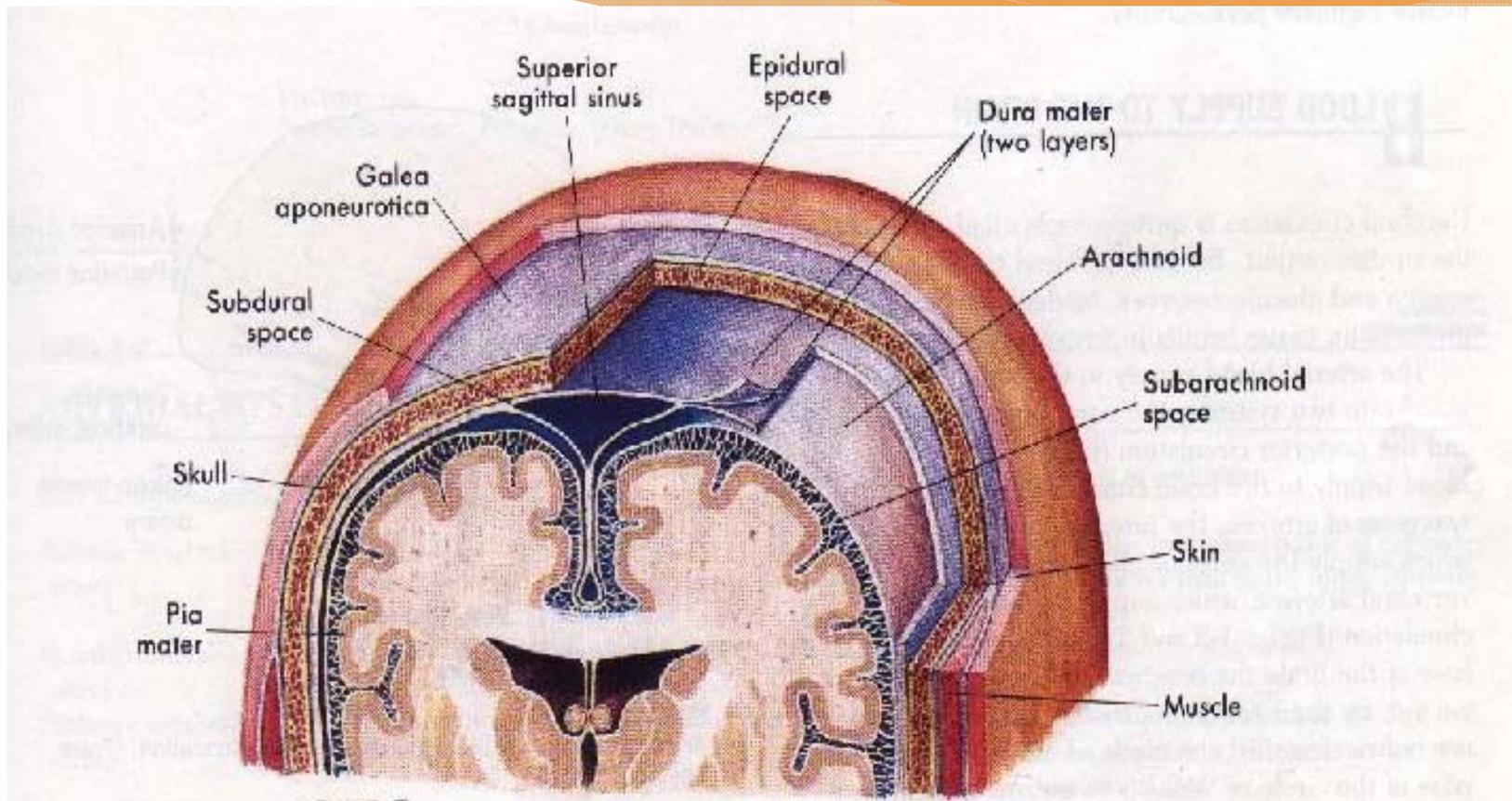
- ◆ Unknown
- ◆ Theory- excess of a neurotransmitter called Glutamate, clogs the synapse of the nerve cell not allowing a neural impulse to be transmitted.

Signs and Symptoms

- ◆ Twitching and cramping of muscles(hands/ feet)
- ◆ Loss of motor control in hands and arms
- ◆ Increased weakness in diaphragm and chest muscles
- ◆ Tripping and falling
- ◆ Persistent fatigue
- ◆ Slurred/thick speech
- ◆ As the disease progresses:
 - ◆ Difficulty breathing & swallowing
 - ◆ Paralysis
 - ◆ Cardiac arrhythmia
 - ◆ Pneumonia
 - ◆ Respirator arrest

MENINGITIS

Meningitis



Meningitis

- ◆ Inflammation of the meninges due to:
 - ◆ Bacteria
 - ◆ Viruses
 - ◆ Trauma
 - ◆ Lumbar puncture
 - ◆ Ventricular shunting procedure
 - ◆ Fungi
 - ◆ Parasites
 - ◆ Other toxins

Meningitis

- ◆ Bacterial

- ◆ Most common
- ◆ Can lead to death

- ◆ Viral

- ◆ Aseptic
- ◆ Develop post variety of viral infection
- ◆ If found early—treatment with antibodies = prognosis good

Meningitis

- ◆ Involves pia-arachnoid layers, subarachnoid space and ventricular system
- ◆ Bacteria enters which causes an inflammatory response, thickening the CSF
- ◆ Decreases flow causing an obstruction of arachnoid villi
- ◆ Causing Hydrocephalus and increased ICP

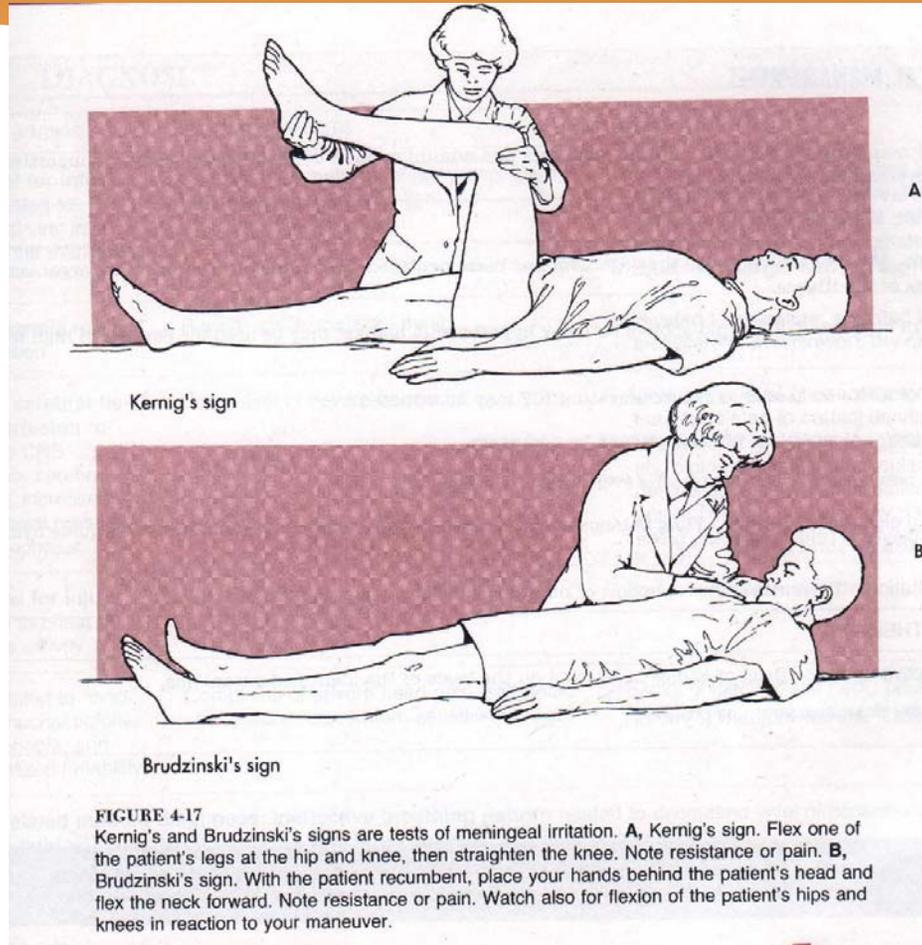
Signs and Symptoms

- ◆ Severe headache
- ◆ Increased temperature (bacterial)
- ◆ Decreased LOA to stupor to coma
- ◆ Malaise
- ◆ Confusion, agitation
- ◆ Photophobia
- ◆ Skin rash with petechial hemorrhage (meningococcal meningitis)
- ◆ Cerebral edema
- ◆ Hydrocephalus
- ◆ Nuchal rigidity (positive Brudzinski's and Kernig's signs)

Complications

- ◆ Increased ICP
- ◆ Hydrocephalus
- ◆ Cerebral infarction
- ◆ Cranial nerve deficits
- ◆ Brain abscess
- ◆ Visual impairment
- ◆ Seizures
- ◆ Endocarditis
- ◆ Deafness
- ◆ Intellectual deficits

Kernig's and Brudzinski's Sign





Well Done!

Ontario Base Hospital Group
Self-directed Education Program