The Body Works?
Part 2

Part of the UVic
Retirees Association (UVRA)
Elder Academy Program

Presenters: David Docherty, Ph.D., with Chris Pengilly, M.D., Mike Bassett, M.D. and Dr. Helen Martendale. Ph.D., O.D.

Overall approach:

Purpose: To provide some insight into how the body works and what can go wrong so you are able to understand what goes on in your body and communicate more effectively with medical professionals.

Presentations: two parts

1. The anatomy and function of four new selected systems
2. Things that can go wrong and the medical interventions commonly available

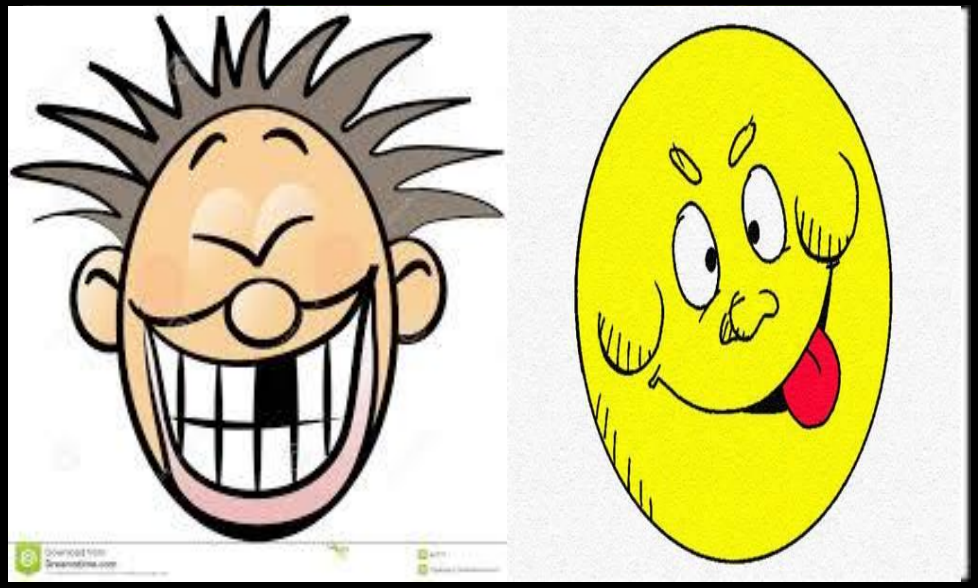
4 New Systems

- The Brain-Dr. Mike Bassett
- The Endocrine System-Dr. Chris Pengilly
- The Respiratory System-Dr. Chris Pengilly
- The Special Senses (Vision)-Dr Helen Martendale

Presentation 1: The Brain (and associated parts!)

However, before we start.....

Differences between men's brains and women's brains with apologies to Mark Gungor (marriage expert)



Compared the two brains!

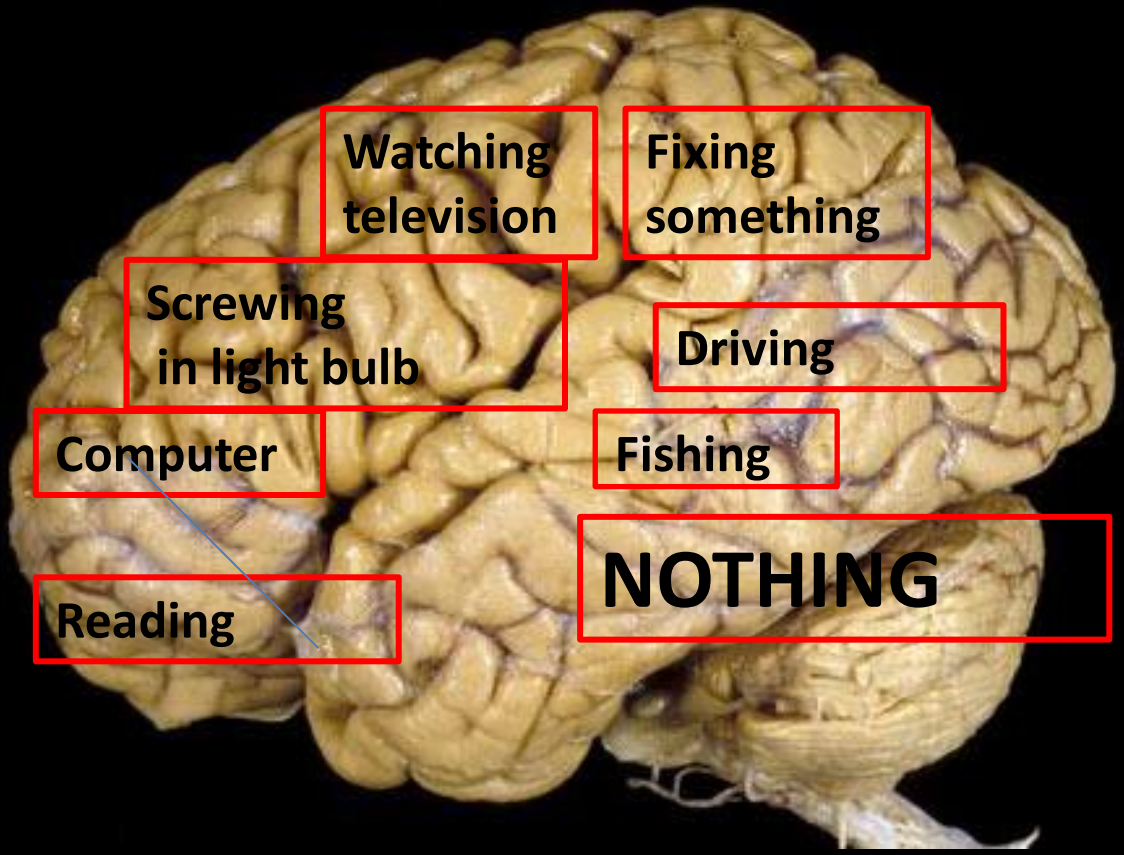
Woman's brain

Complex network

Man's brain

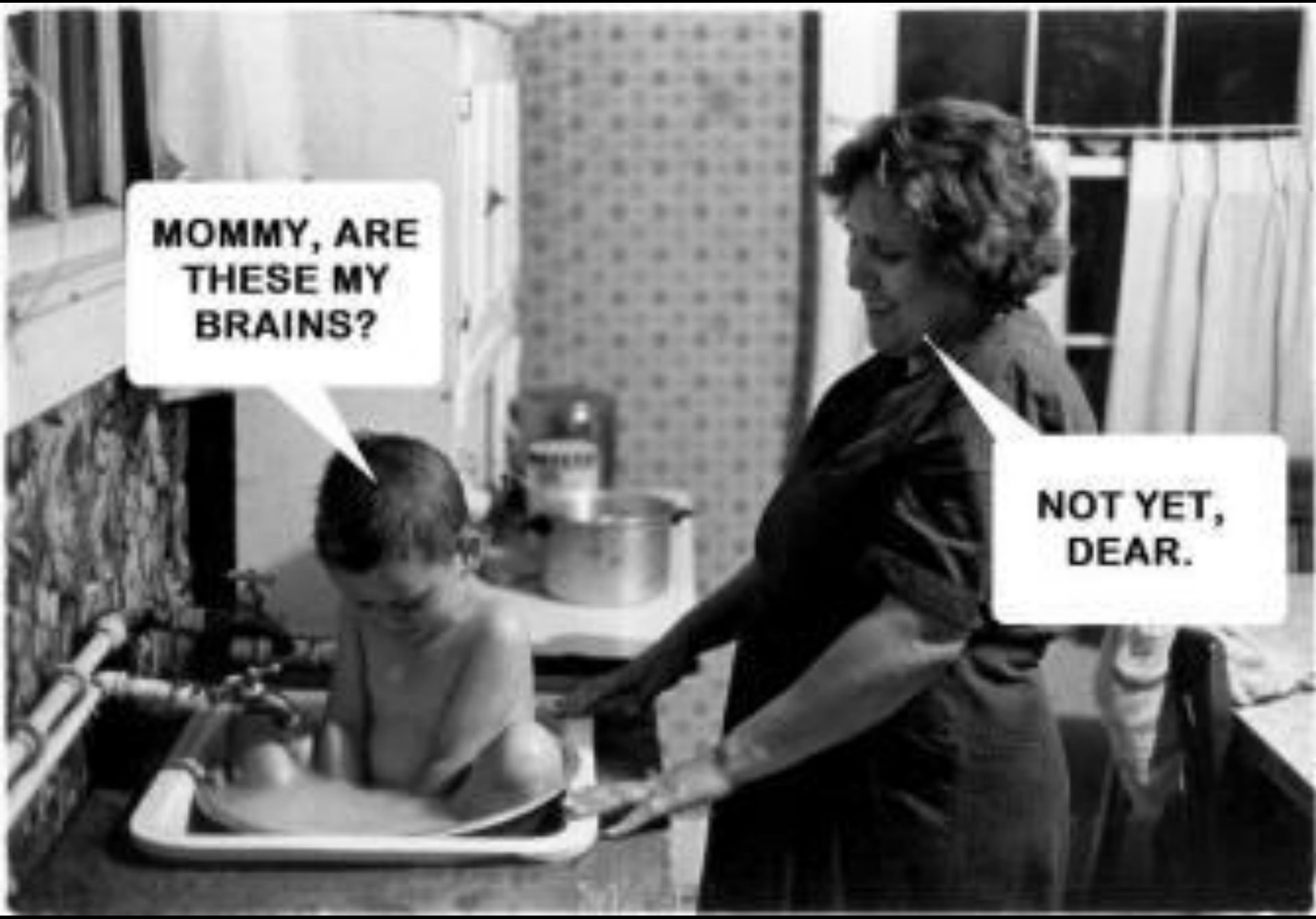
Boxes

Man's brain



Organized into boxes that do not touch or connect.

Note: There is no shopping box


MOMMY, ARE THESE MY BRAINS?
NOT YET, DEAR.

The real thing!

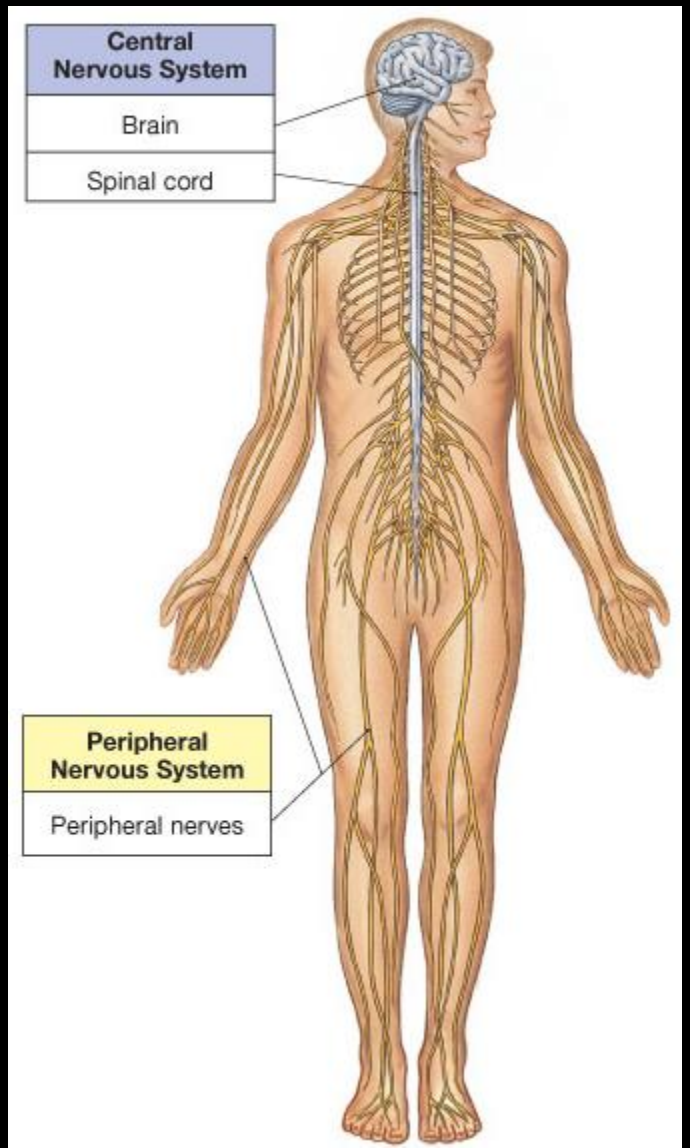
The brain

The nerve cells (neurons)

Would you believe 100 billion!

The Nervous System

- The nervous system includes all of the neural tissue in the body.



Outline of presentation (first part)

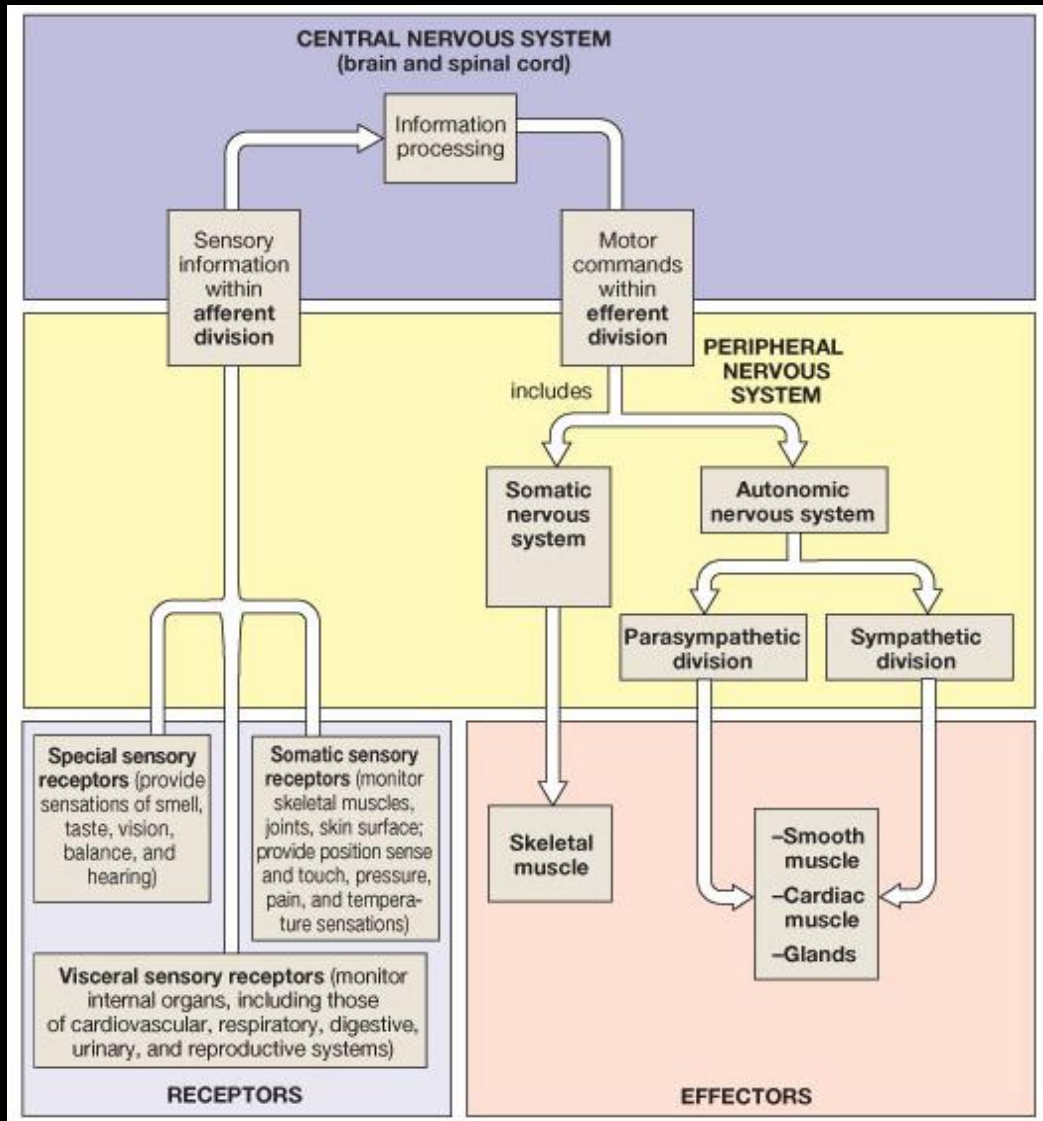
- Neurons and how they communicate
- Organization of the brain and nervous system
- How messages get to their targets and how information is relayed back.
- Brief mention of the Autonomic Nervous System
- How the brain is protected.
- Circulation of blood and CSF in the brain.

Functional divisions of nervous system

- Afferent
  - Sensory information from receptors to CNS
- Efferent
  - Motor commands to muscles and glands
    - Somatic division
      - *Voluntary control over skeletal muscle*
    - Autonomic division
      - *Involuntary regulation of smooth and cardiac muscle, glands*

A Functional Overview of the Nervous System

- This diagram shows the relationship between the CNS and the PNS and the functions and components of the afferent and efferent divisions.



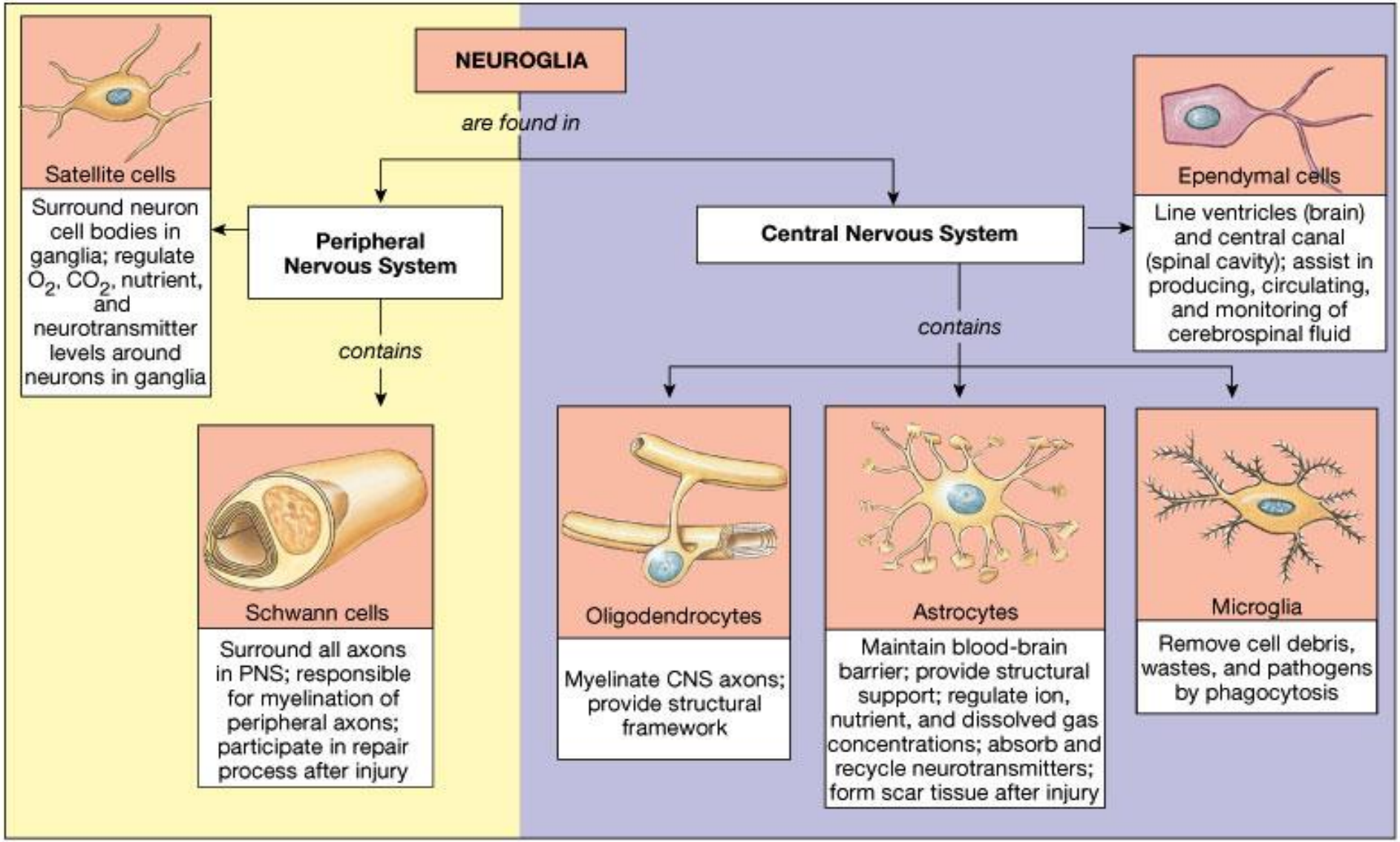
Nerve Cells

- **Neuroglial cells** (supporting structure, phagocytic role, and isolates the neurons from surrounding tissue)
  - *Neuroglial cells come in different shapes and sizes and perform a variety of roles*
- **Neurons** (responsible for transferring and processing information)
  - *Neurons come in many different shapes and perform several different functions*

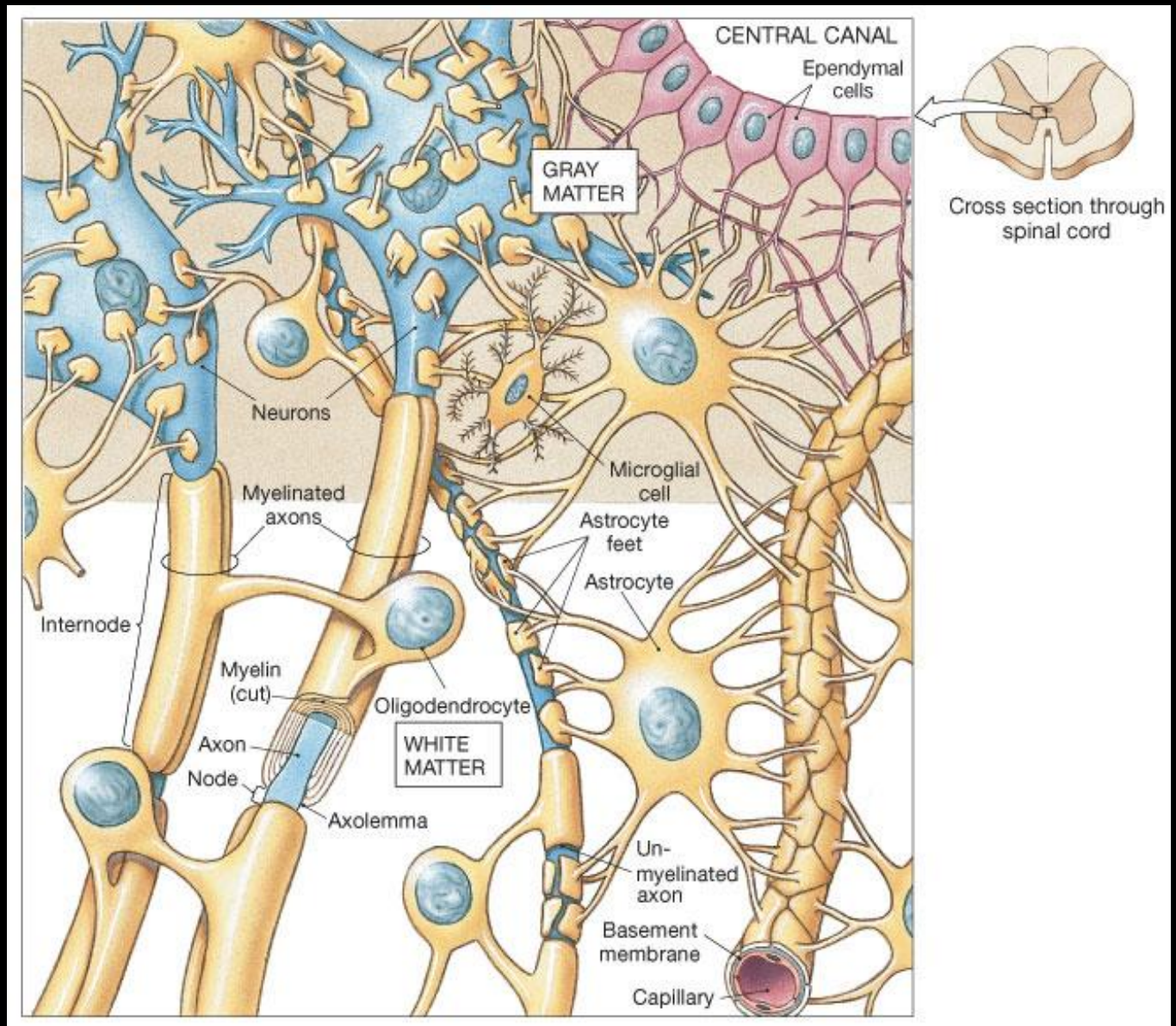
Neuroglia cells

- Four types of neuroglial cells in the **CNS**
  - Astrocytes
  - Oligodendrocytes
  - Microglia
  - Ependymal cells

The categories and functions of the various neuroglial cell types.

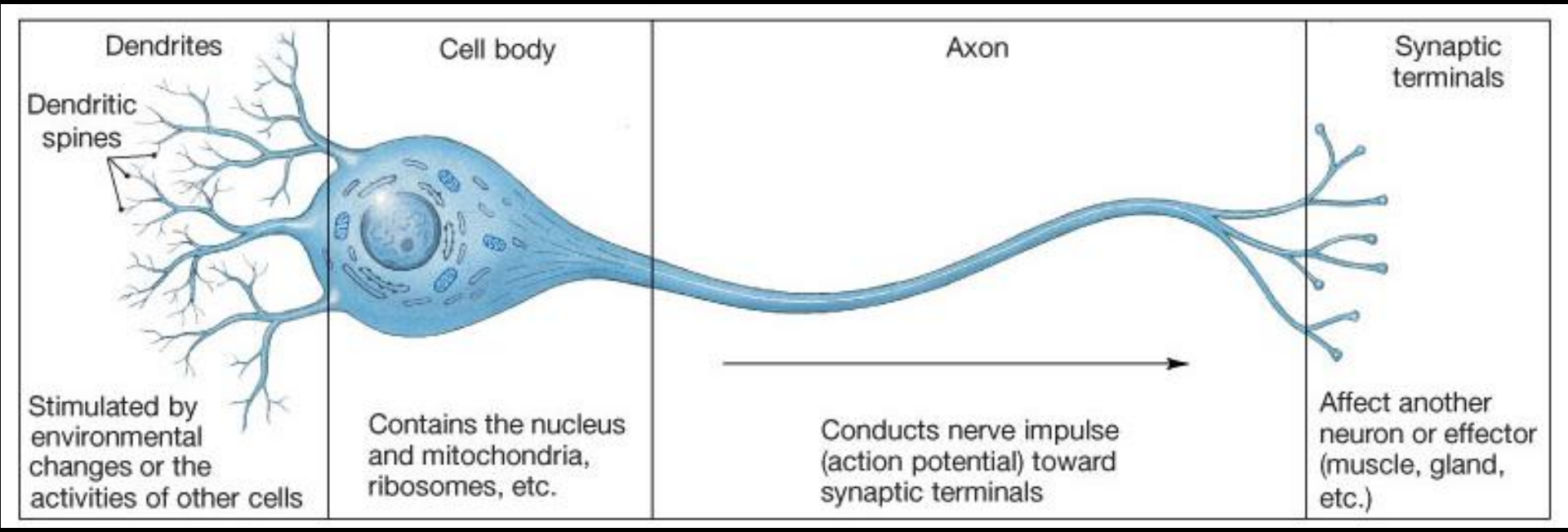


Histology of Neural Tissue in **CNS**



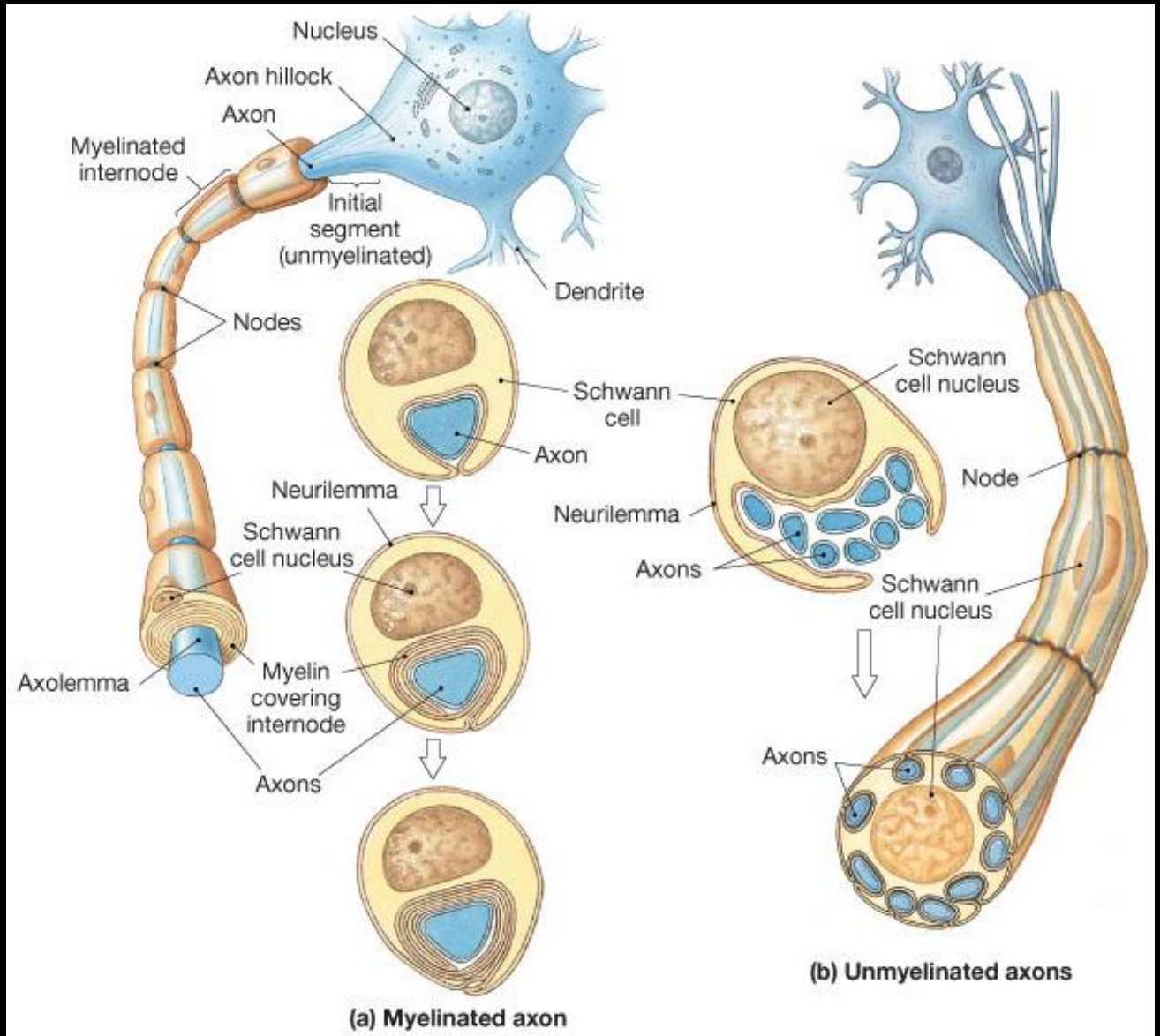
Neuron Structure

- The relationship of the four parts of a neuron (dendrites, cell body, axon, synaptic terminals).



Schwann Cells (neuroglia) and Peripheral Axons

- Schwann cells ensheath every peripheral axon.



Sensory Neurons

- Afferent division of PNS
- Deliver sensory information from sensory receptors

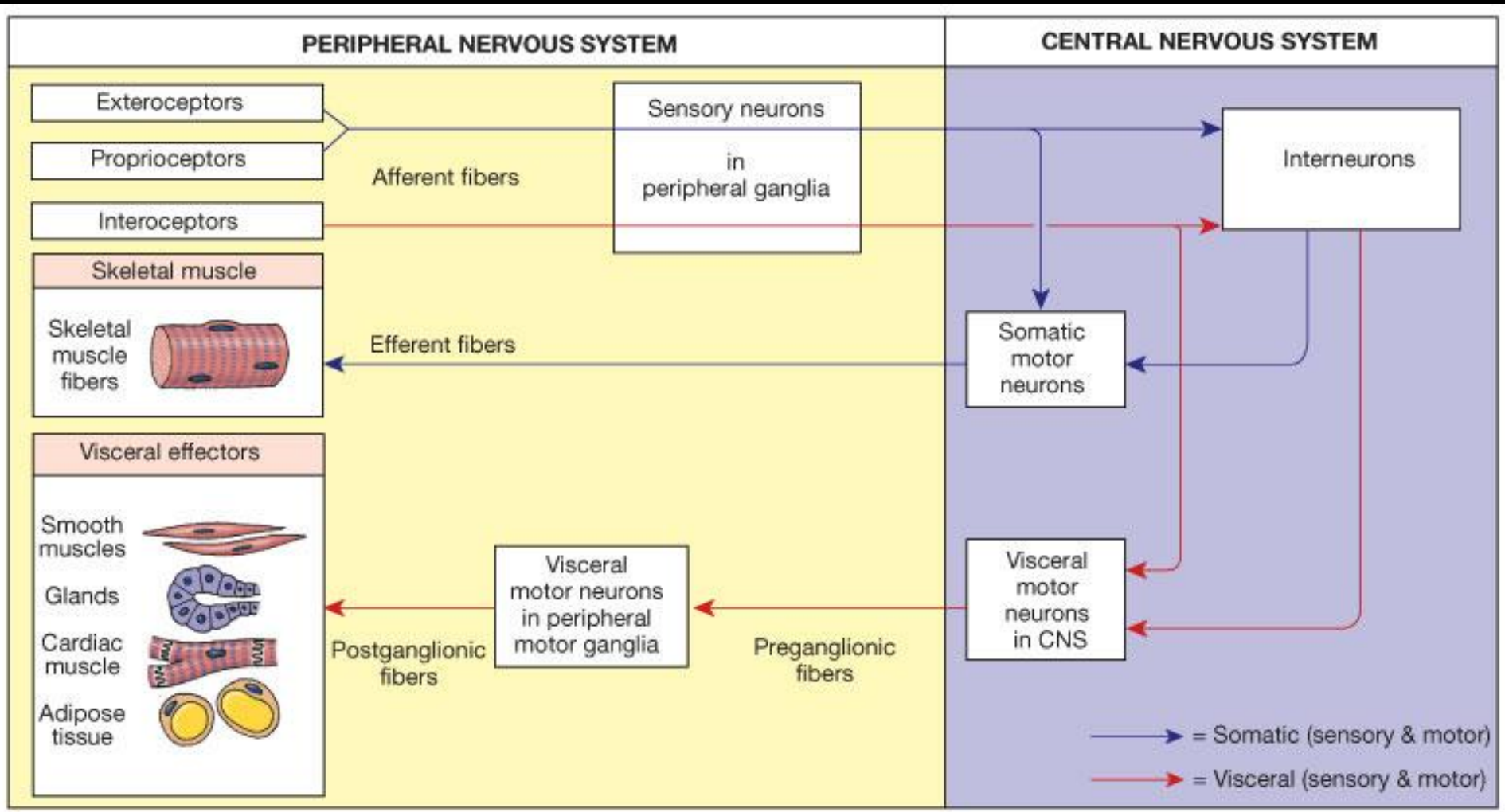
  to CNS
  - *Exteroceptors*
  - *Proprioceptors*
  - *Interoceptors*

Motor Neurons

- Efferent pathways
- Stimulate peripheral structures
  - *Somatic motor neurons*
    - Innervate skeletal muscle
  - *Visceral motor neurons*
    - Innervate all other peripheral effectors
    - Preganglionic and postganglionic neurons

A Functional Classification of Neurons

- Neurons are classified functionally into three categories (sensory, motor and interneurons)

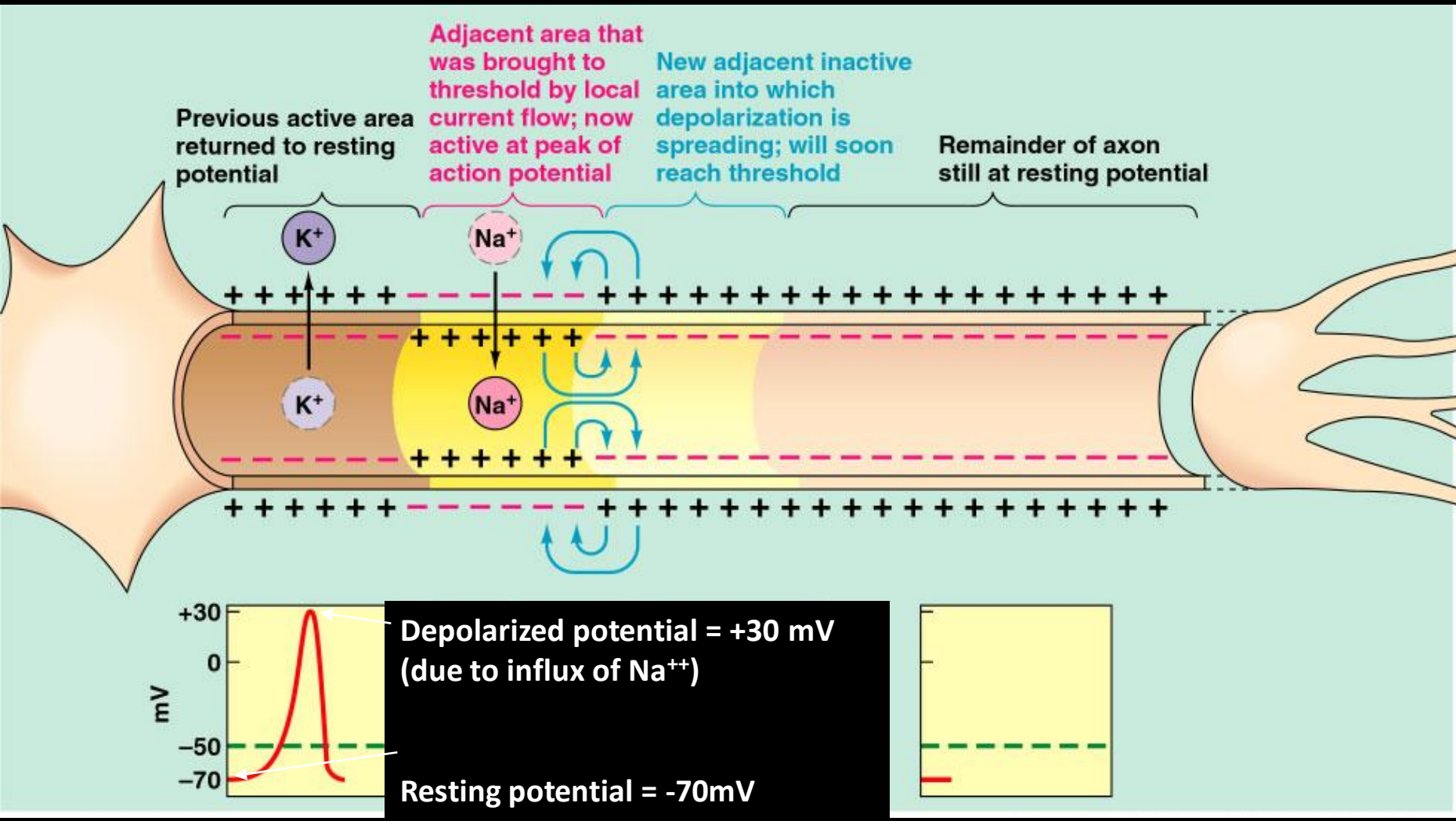


The Nerve Impulse

Excitability

- Ability of cell membrane to conduct electricity
  - Skeletal muscle fibers
  - Most neurons
- Changes in transmembrane potential
  - Due to changes inflow of sodium and potassium ions
  - When threshold reached, action potential results
  - Action potential along axon = nerve impulse

TRIGGERING AND PROPOGATING THE ACTION POTENTIAL

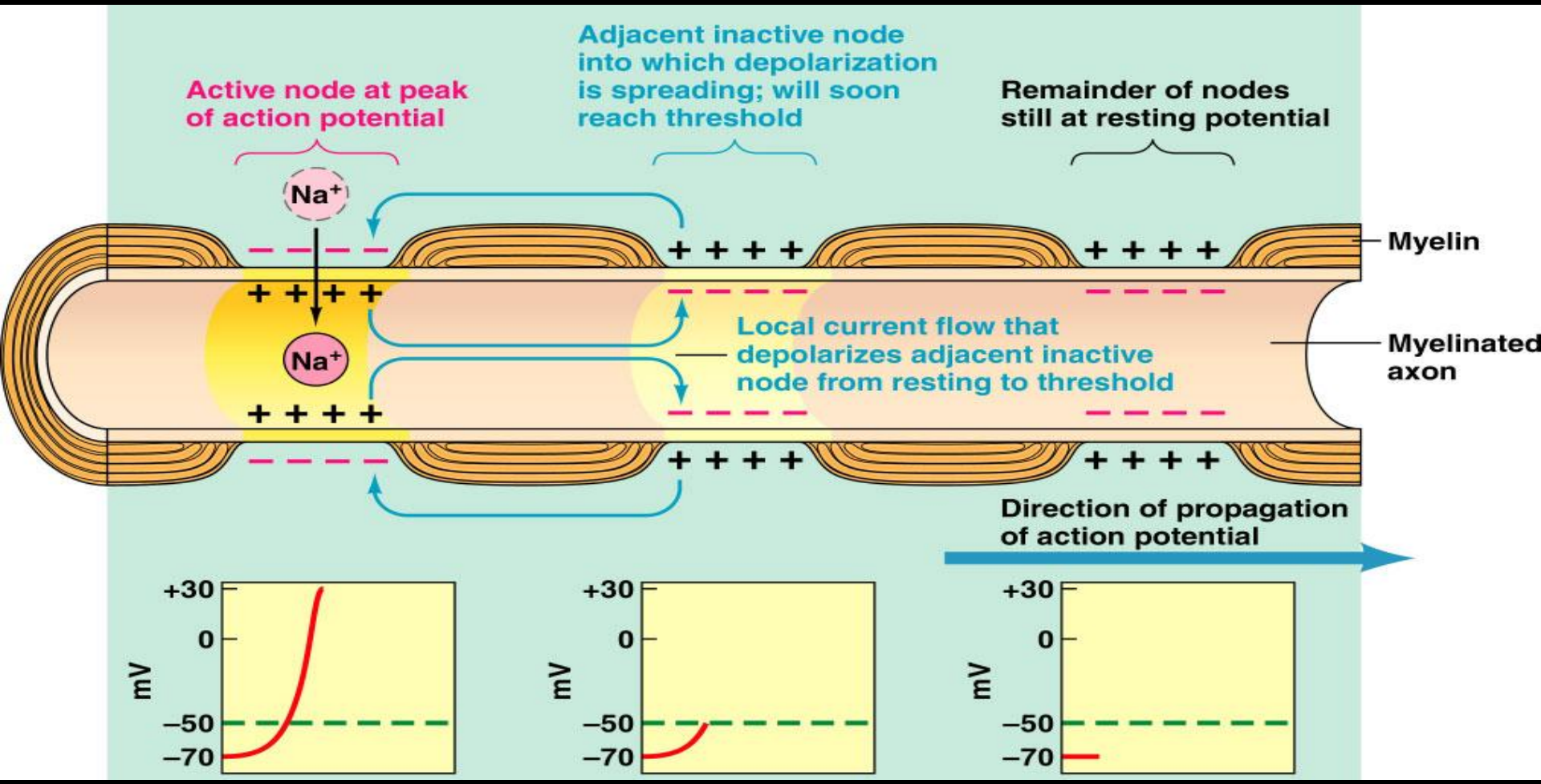


Depolarized potential = +30 mV (due to influx of Na^{++})

Resting potential = -70mV

hwenger04

PROPOGATING THE ACTION POTENTIAL ON MYELINATED AXONS



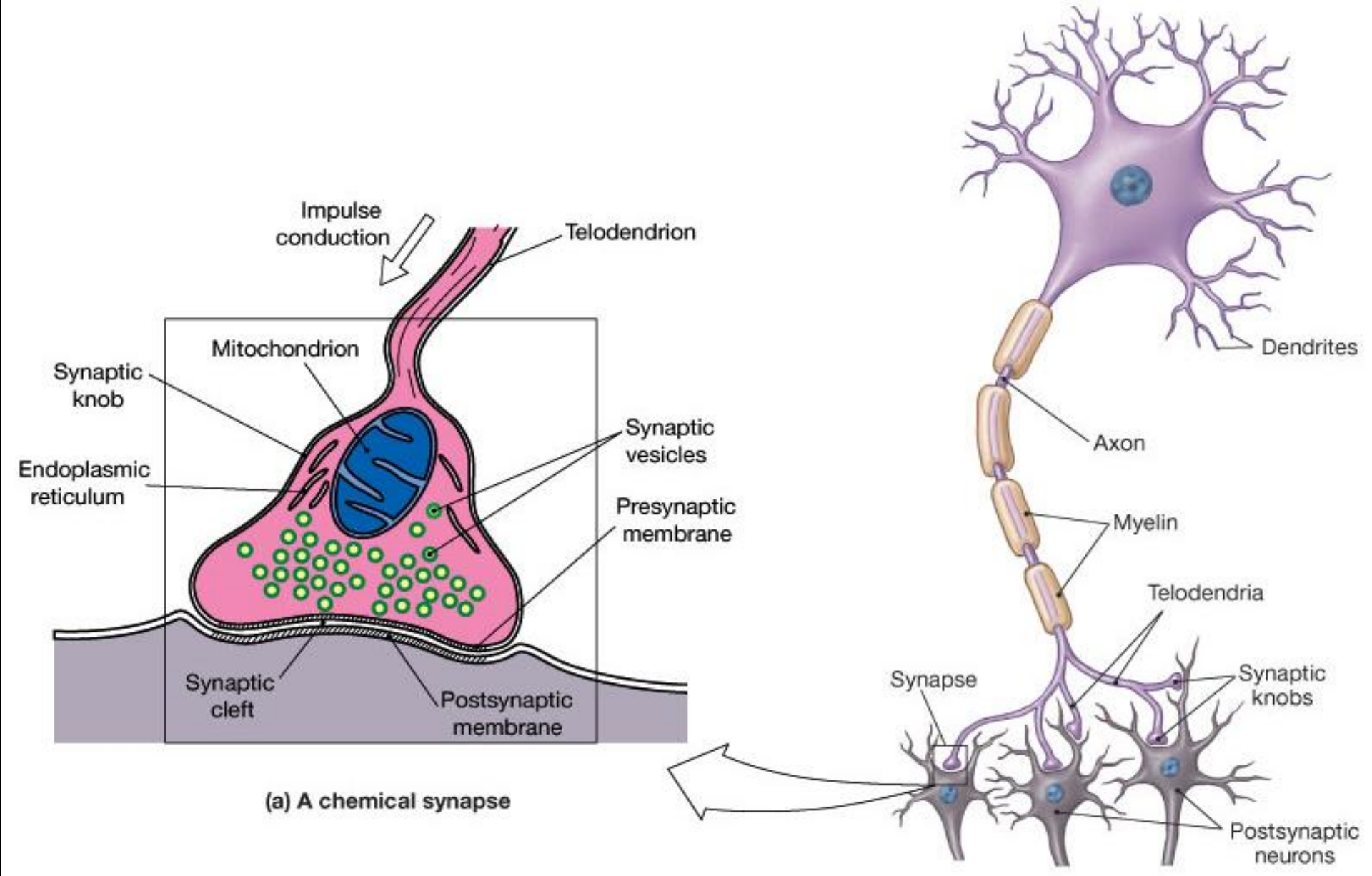
Impulses can travel up to 140 m/s (300 mph)

Myelinated fibres 5-7 times faster than unmyelinated fibres

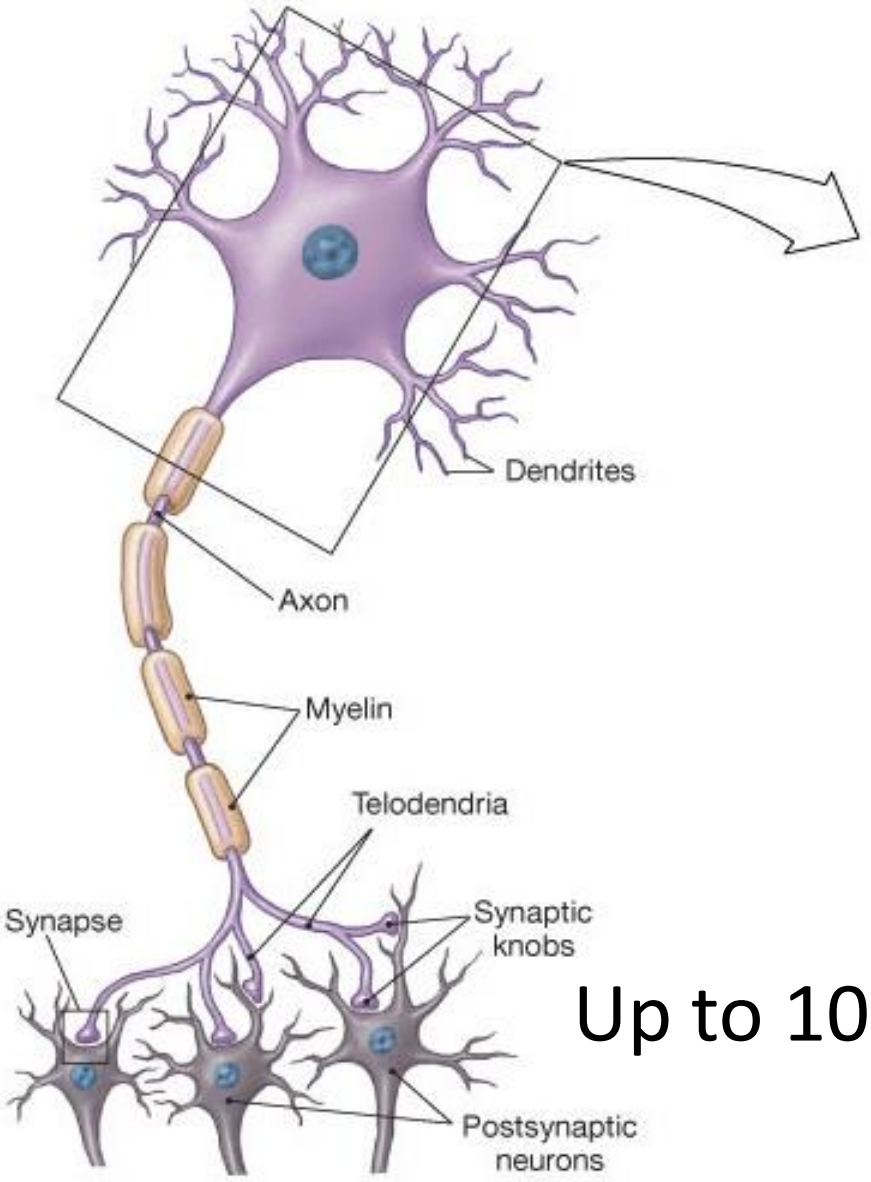
hwenger04

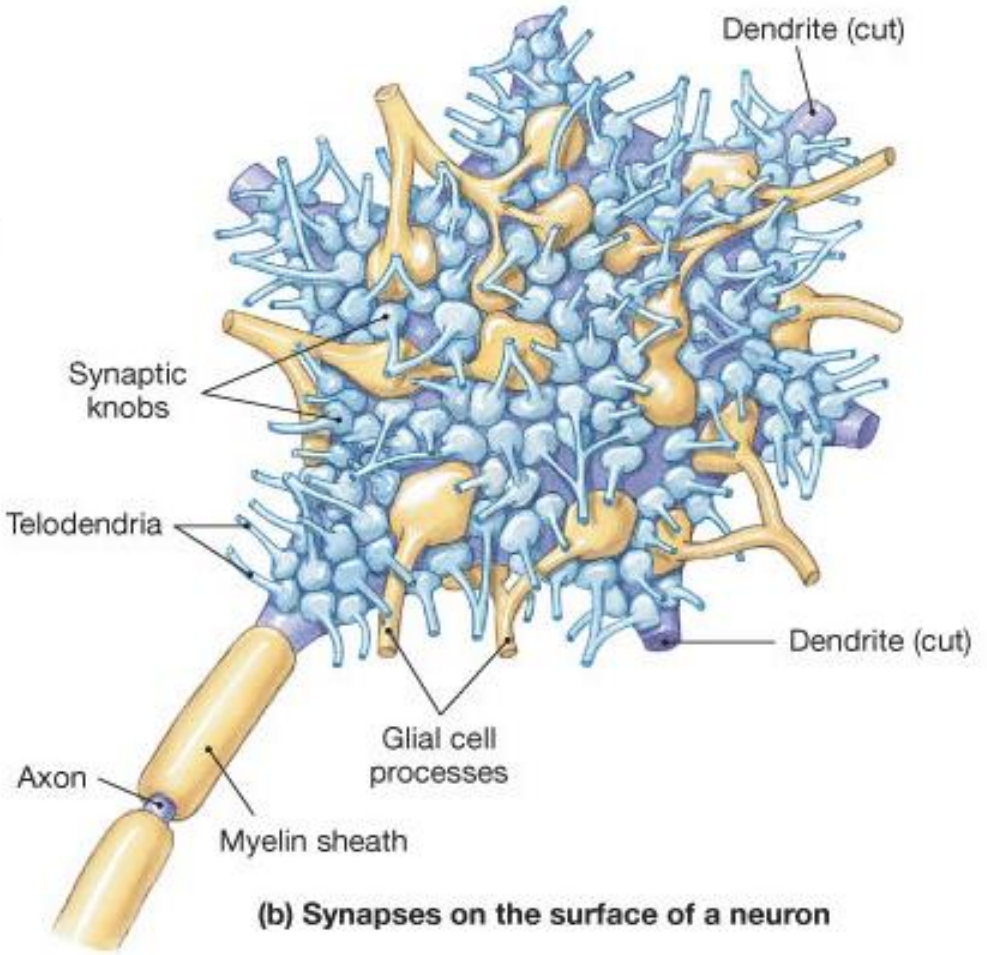
Synaptic Communication

The Structure of a Synapse



The Structure of a Synapse





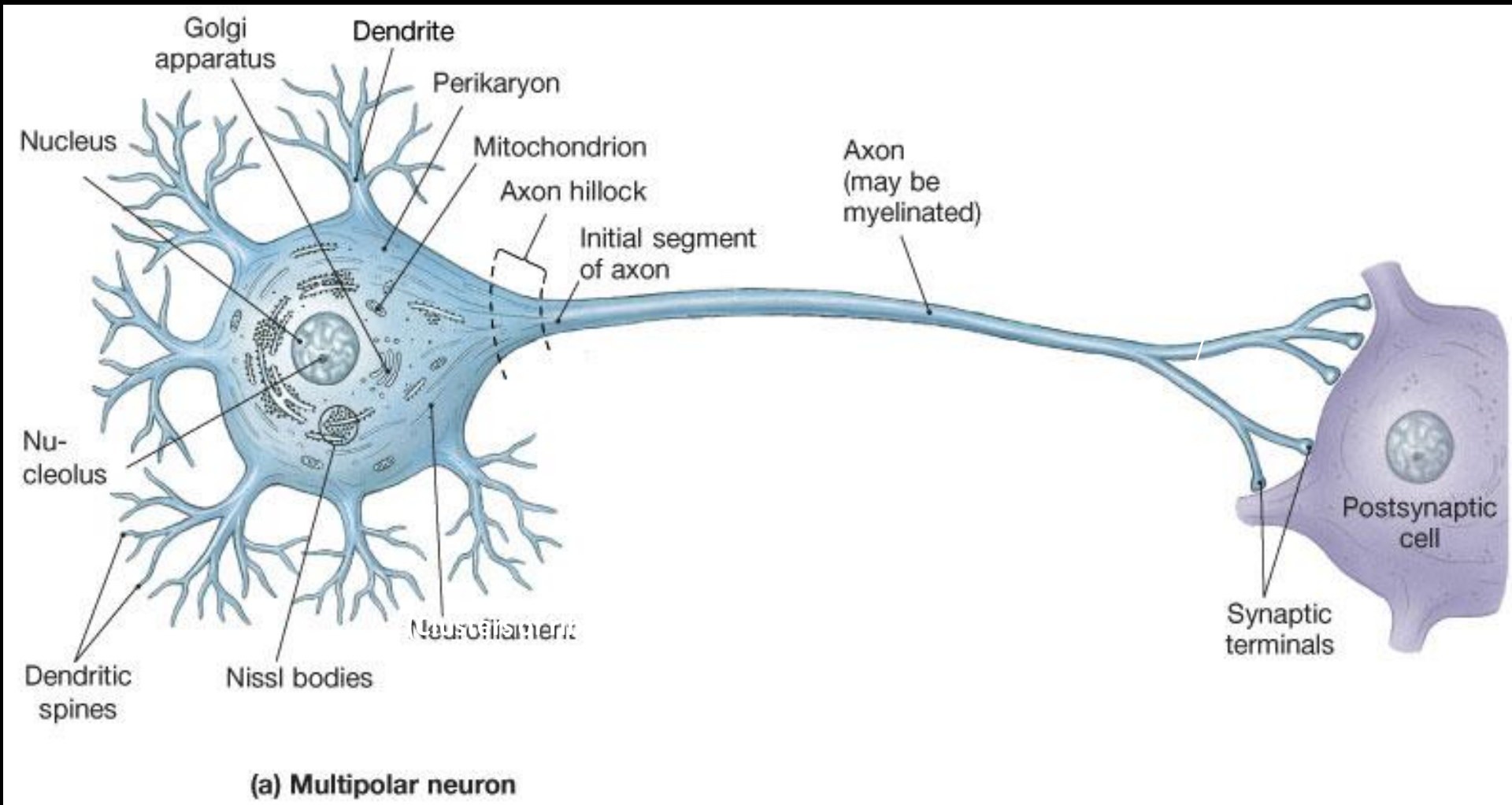
Up to 1000 connections!

How neurons communicate

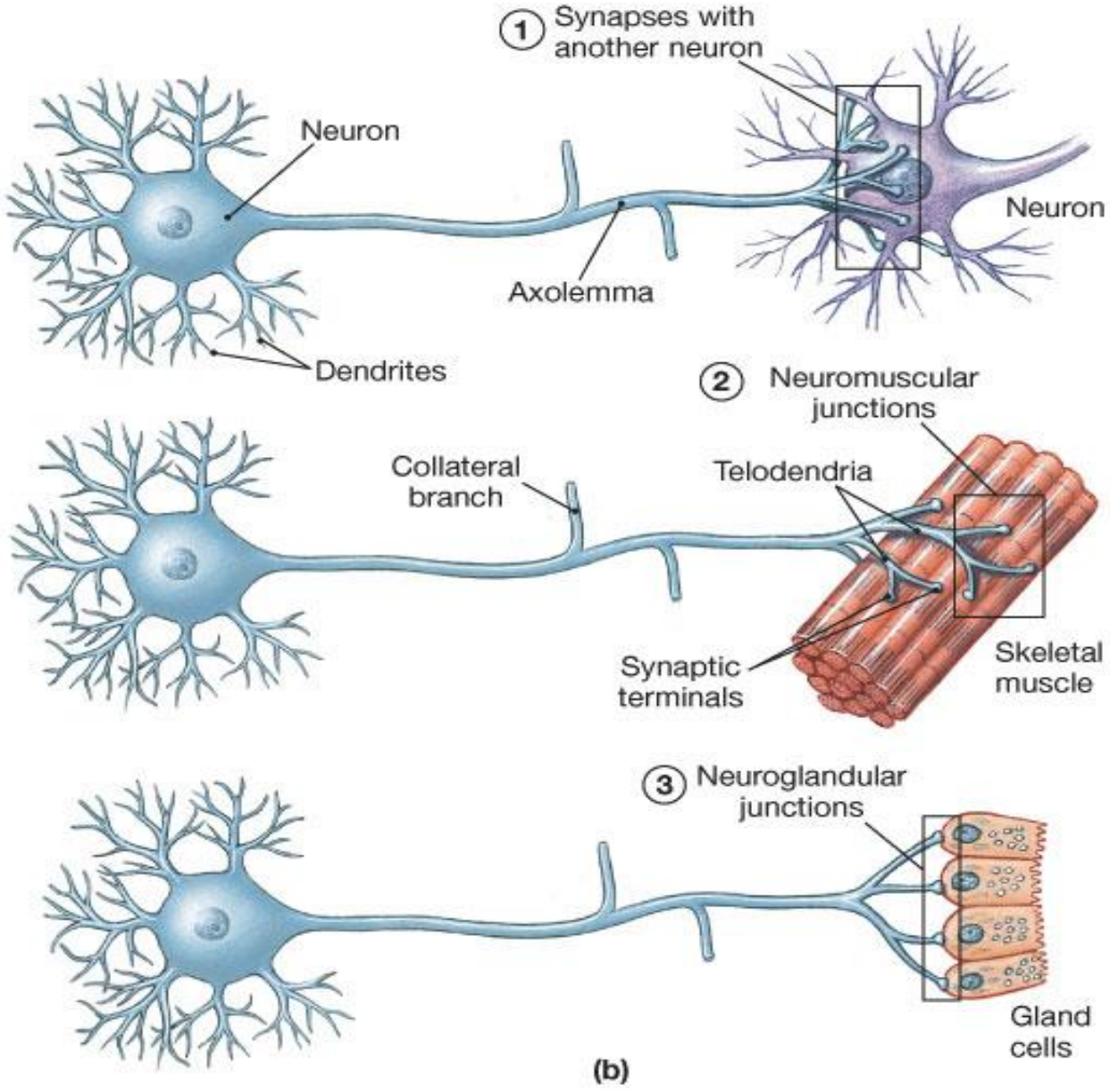
- https://www.youtube.com/watch?v=o9p2ou1IyC0

Anatomy of a Representative Neuron

- A neuron has a cell body, some branching dendrites and a single axon.



Neurons can connect with:

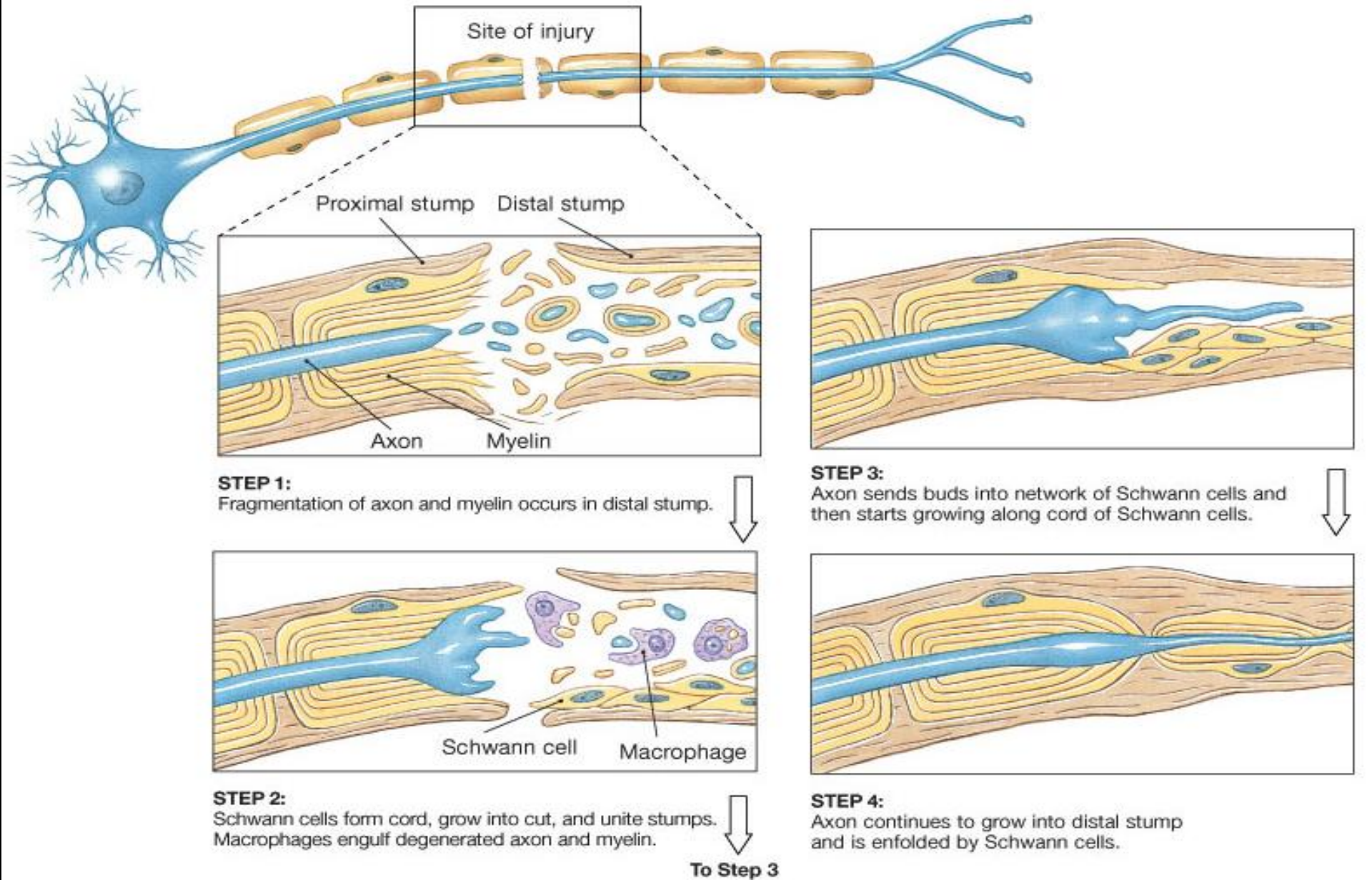


Steps at chemical synapse

- Action potential at presynaptic neuron synaptic knob
- Release of neurotransmitters (40-50 types)
- Neurotransmitter binds to receptors on postsynaptic neuron
- Change in permeability of postsynaptic neuron
  - *Excitatory or inhibitory effects*
- Degree of excitation may initiate action potential
- Effects of neurotransmitter fades rapidly
  - *Enzymes break down neurotransmitters quickly*

Neural Regeneration

Nerve Regeneration in PNS after Injury



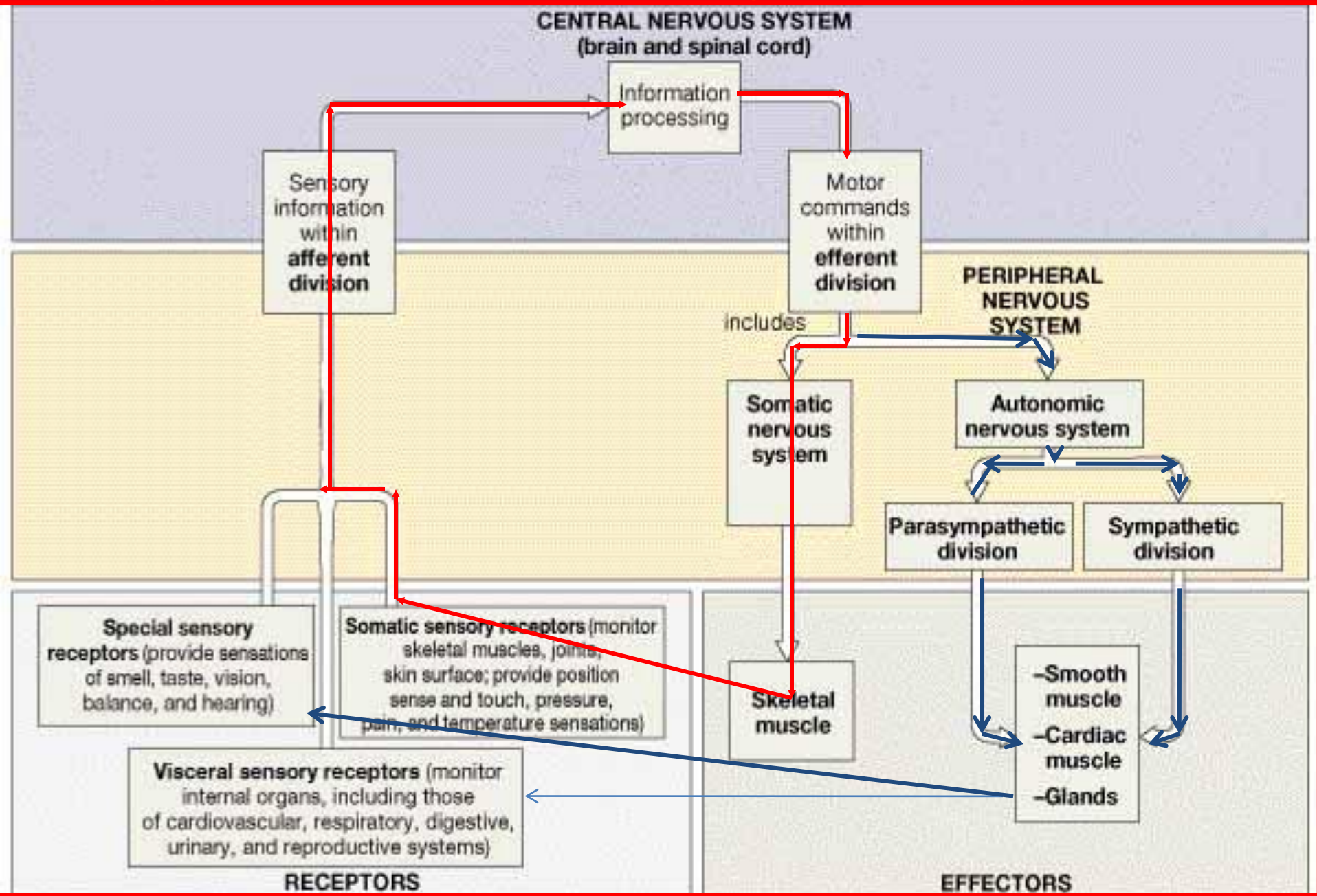
Regeneration in PNS (cont)

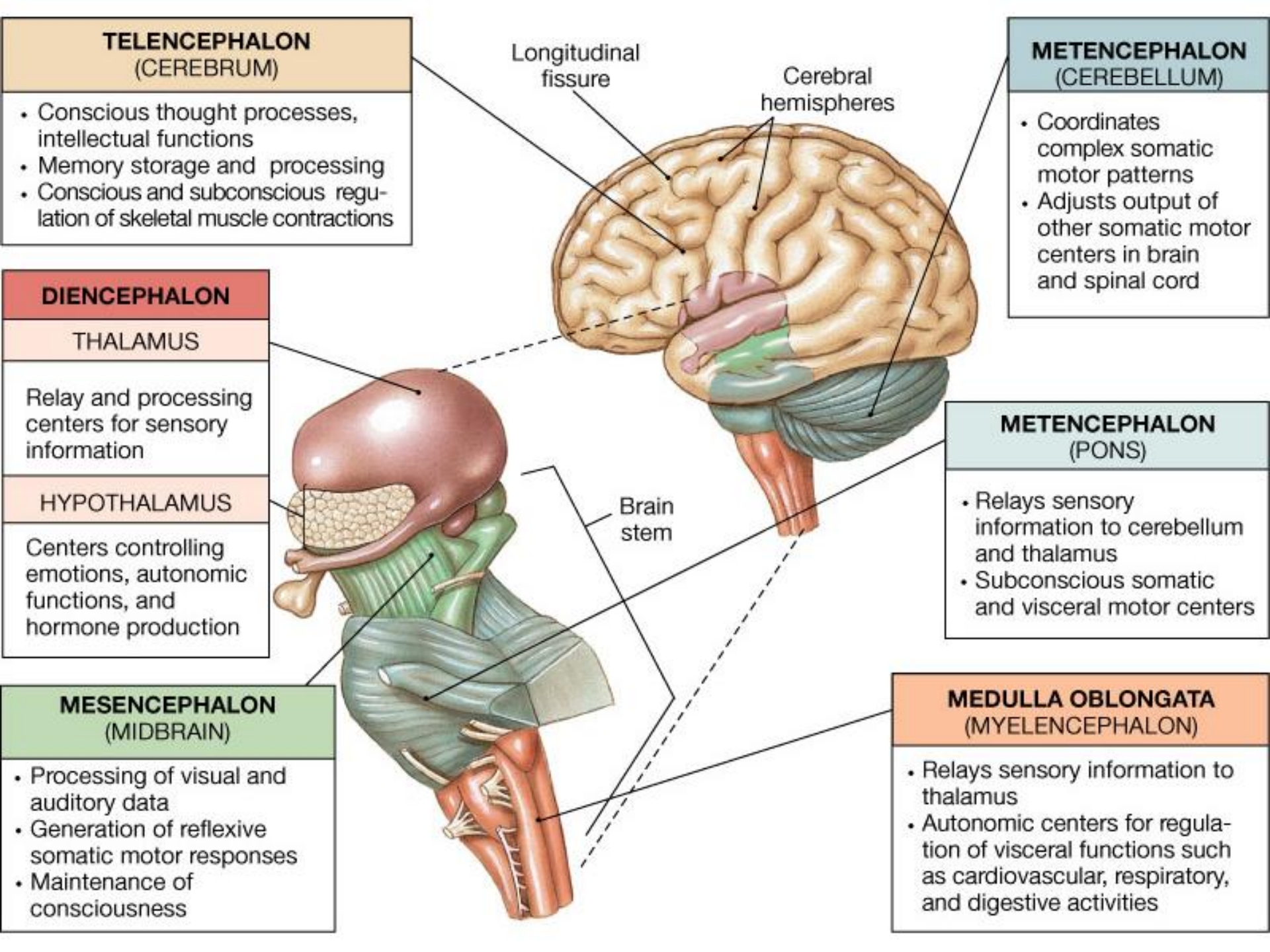
- Limited ability in PNS
- Severed peripheral nerve successfully regenerates a fraction of the axons
  - *Function is permanently impaired*
  - *Schwann cells participate*
- Wallerian degeneration
  - *Loss of axon distal to damage*

Regeneration in CNS

- More complicated than PNS regeneration
- Far more limited
- More axons involved
- Astrocytes produce scar tissue preventing axonal regrowth
- Astrocytes release chemicals blocking regrowth

Figure *13-02:Functional overview of the Nervous System*



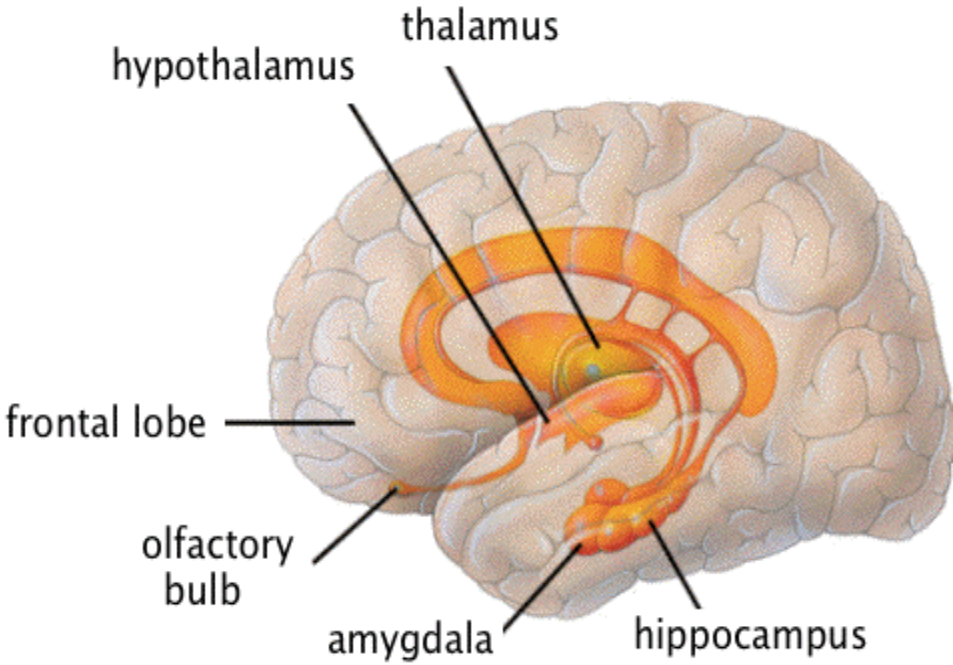

TELENCEPHALON
(CEREBRUM)
• Conscious thought processes, intellectual functions
• Memory storage and processing
• Conscious and subconscious regulation of skeletal muscle contractions
Longitudinal fissure
Cerebral hemispheres
METENCEPHALON
(CEREBELLUM)
• Coordinates complex somatic motor patterns
• Adjusts output of other somatic motor centers in brain and spinal cord
DIENCEPHALON
THALAMUS
Relay and processing centers for sensory information
HYPOTHALAMUS
Centers controlling emotions, autonomic functions, and hormone production
Brain stem
METENCEPHALON
(PONS)
• Relays sensory information to cerebellum and thalamus
• Subconscious somatic and visceral motor centers
MESENCEPHALON
(MIDBRAIN)
• Processing of visual and auditory data
• Generation of reflexive somatic motor responses
• Maintenance of consciousness
MEDULLA OBLONGATA
(MYELENCEPHALON)
• Relays sensory information to thalamus
• Autonomic centers for regulation of visceral functions such as cardiovascular, respiratory, and digestive activities

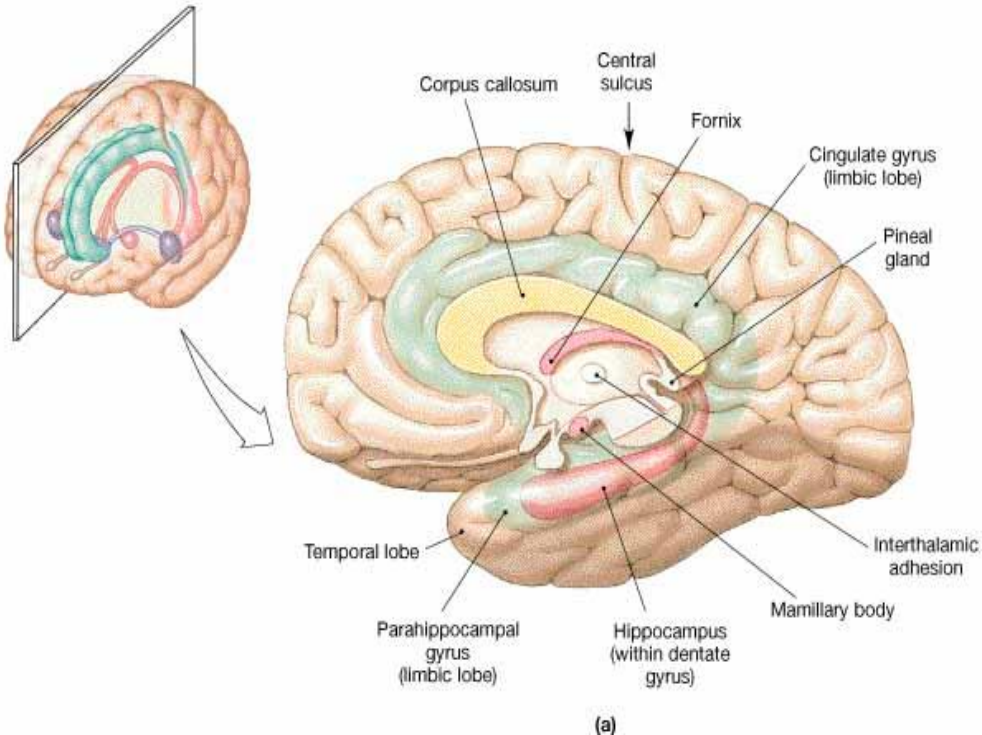
The Limbic system

A collection of different structures with a similar function.

Function:

Processing of memories, creation of emotional states, drives, and associated behaviours



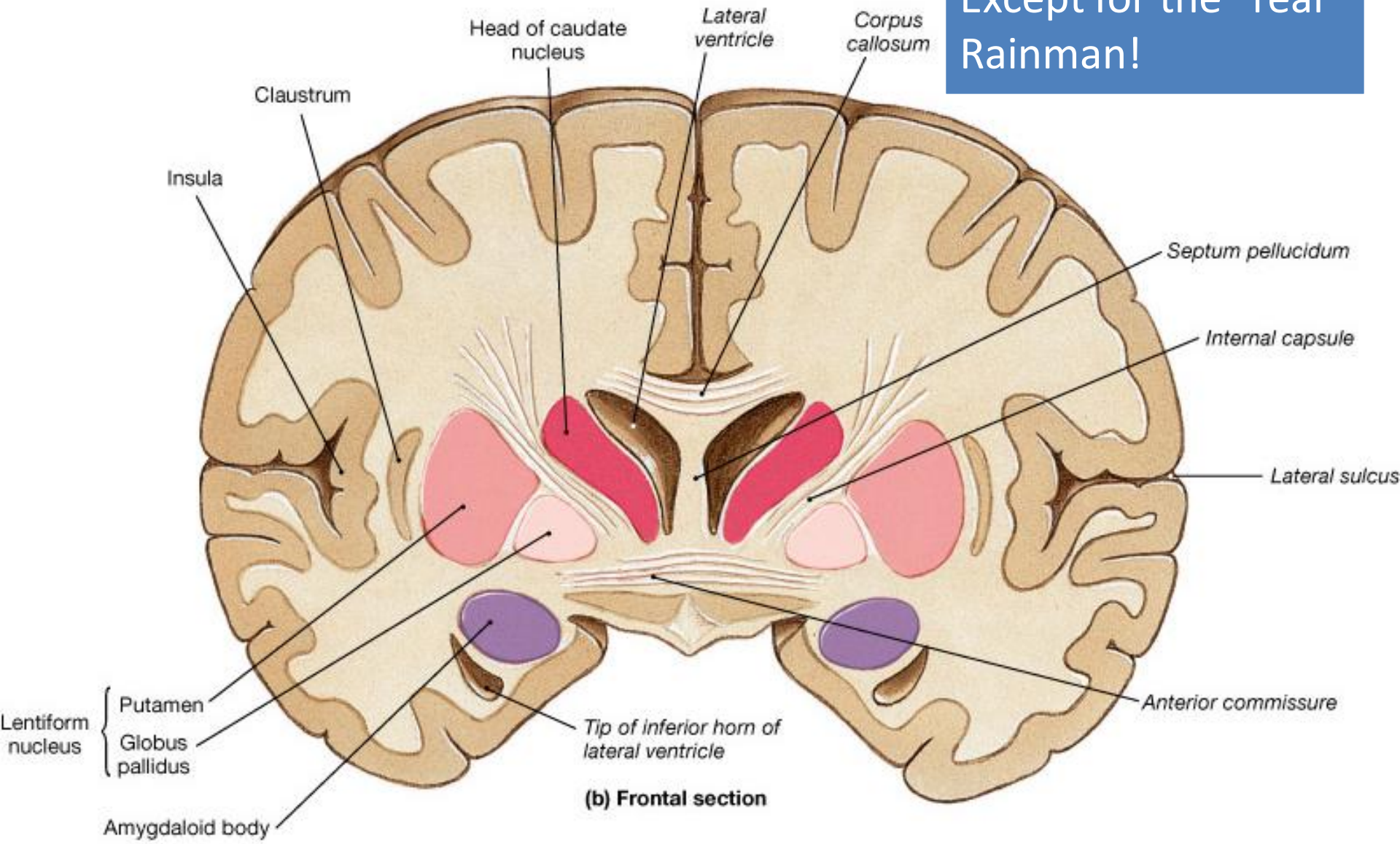


The main parts of the Brain and what they do

- https://www.youtube.com/watch?v=kMKc8nfPATI

Cerebral Cortex

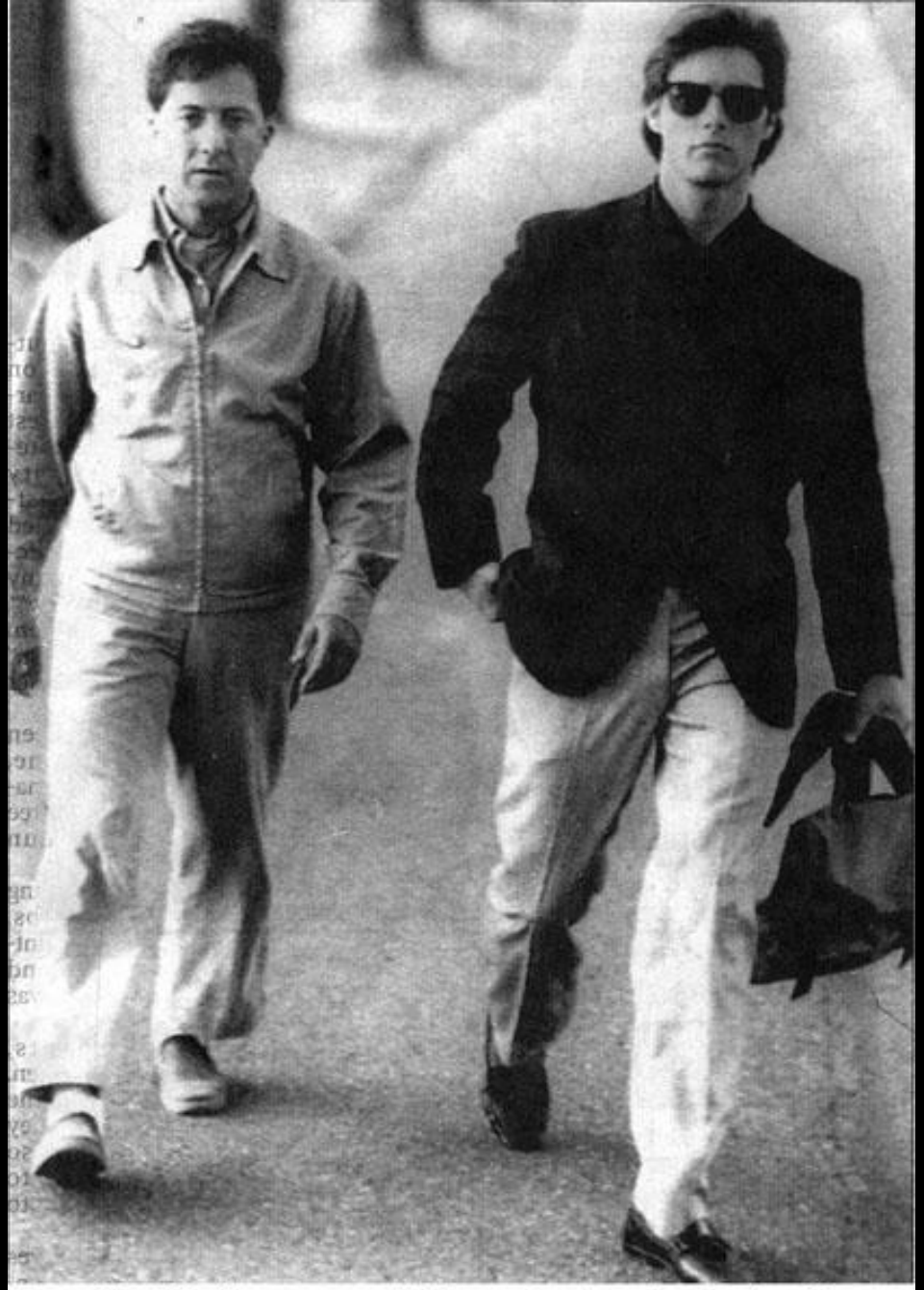
Except for the "real" Rainman!



A Megasavant

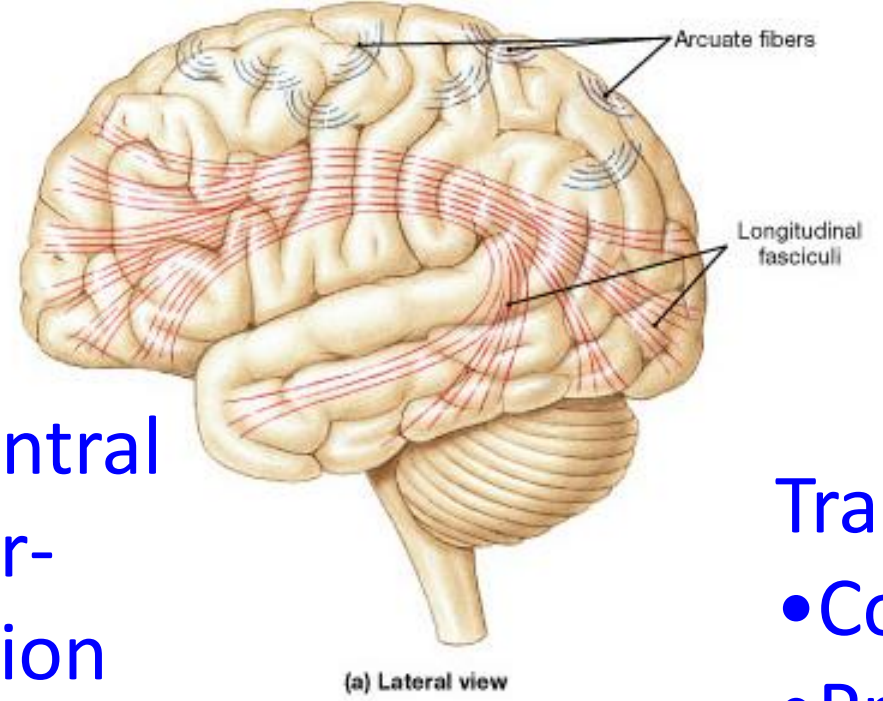
Diagnostic imaging has shown Kim Peek's brain is a single hemisphere.

He is able to read two pages simultaneously. The left eye reads the left page and the right eye the right page in a matter of SECONDS!!!!!

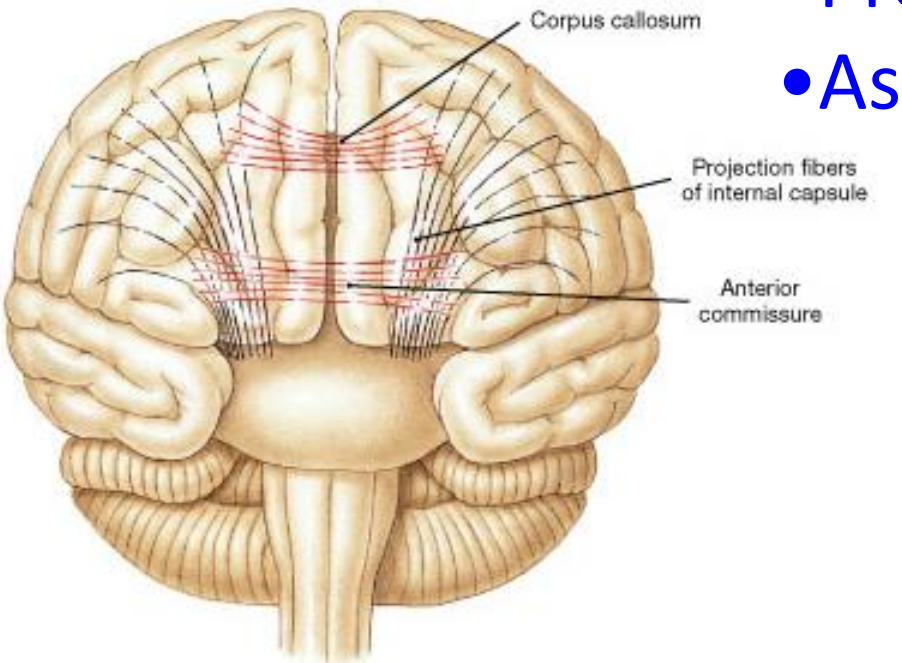


Dustin Hoffman and Tom Cruise in Rain Man, based loosely on Kim Peek's life.

Fig 15.10: Central White Matter- Communication Tracts



(a) Lateral view

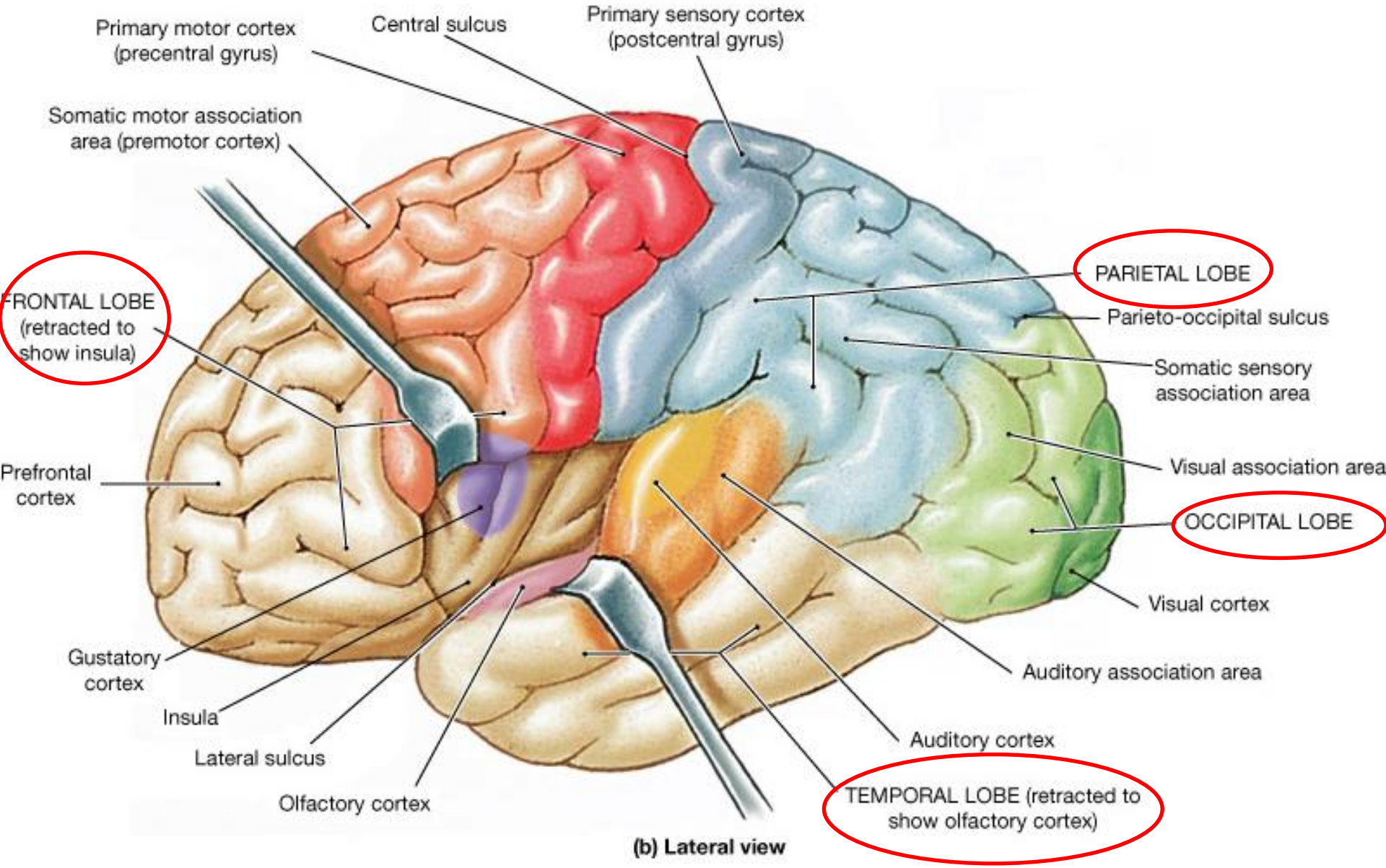


(b) Anterior view

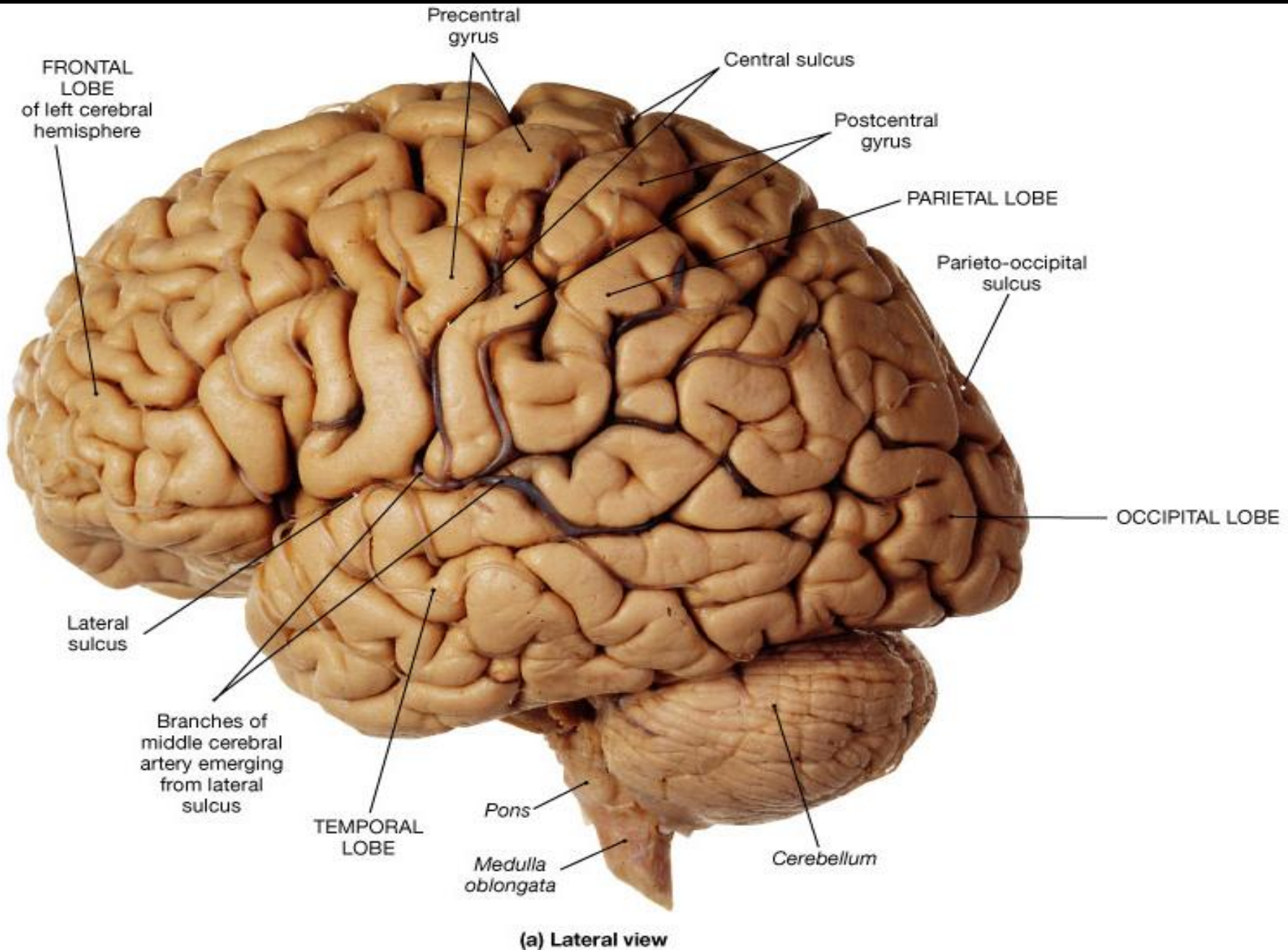
Tracts:

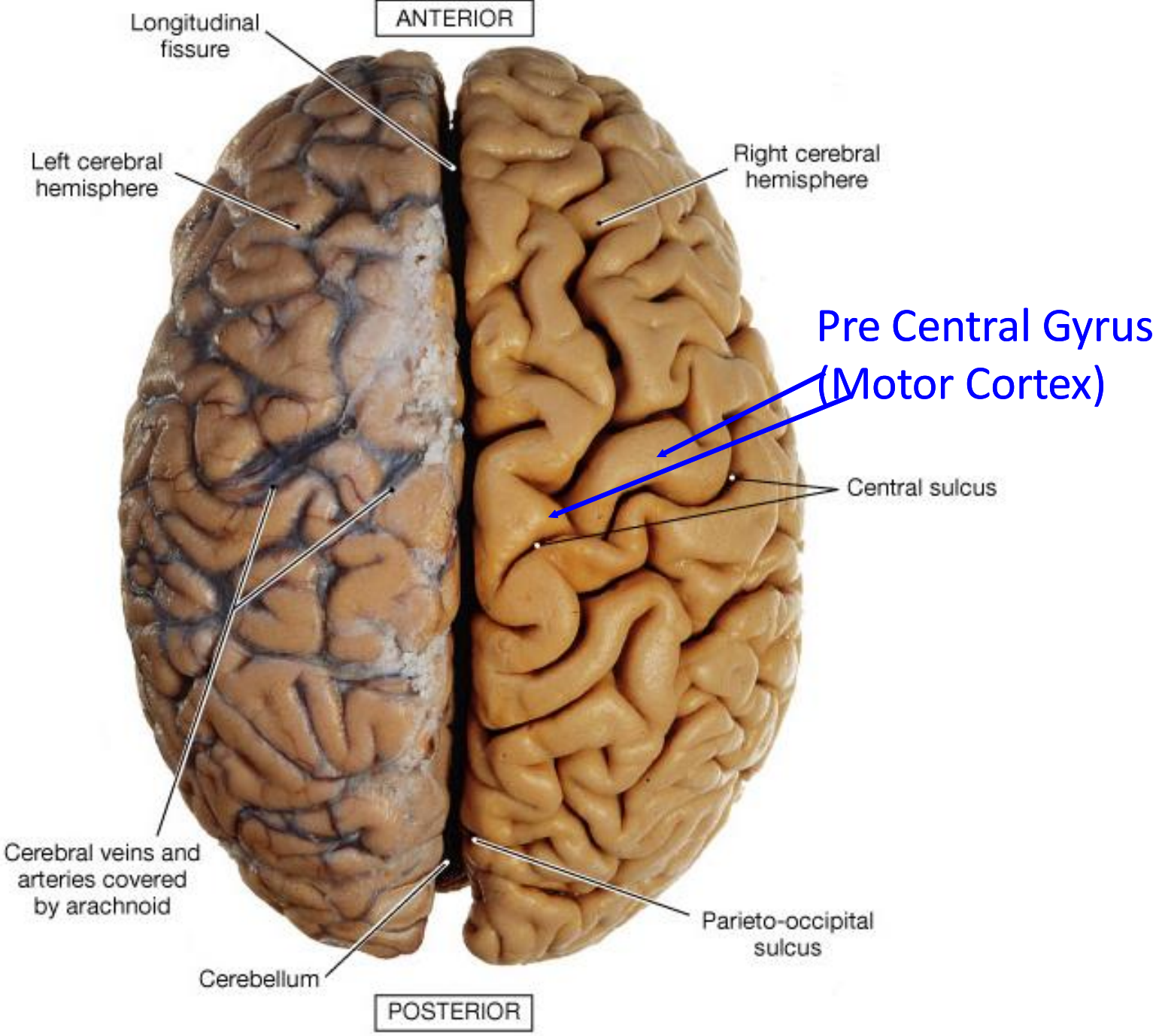
- Commisural
- Projection
- Association

anatomical and functional landmarks



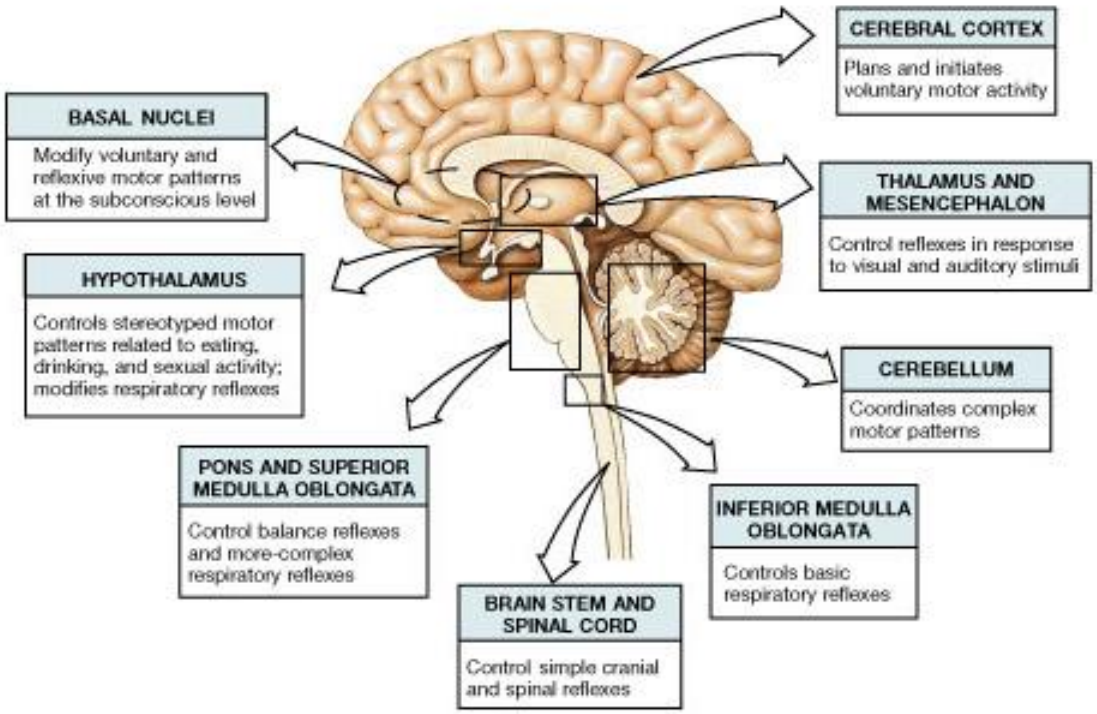
Cerebral hemispheres (lateral view)





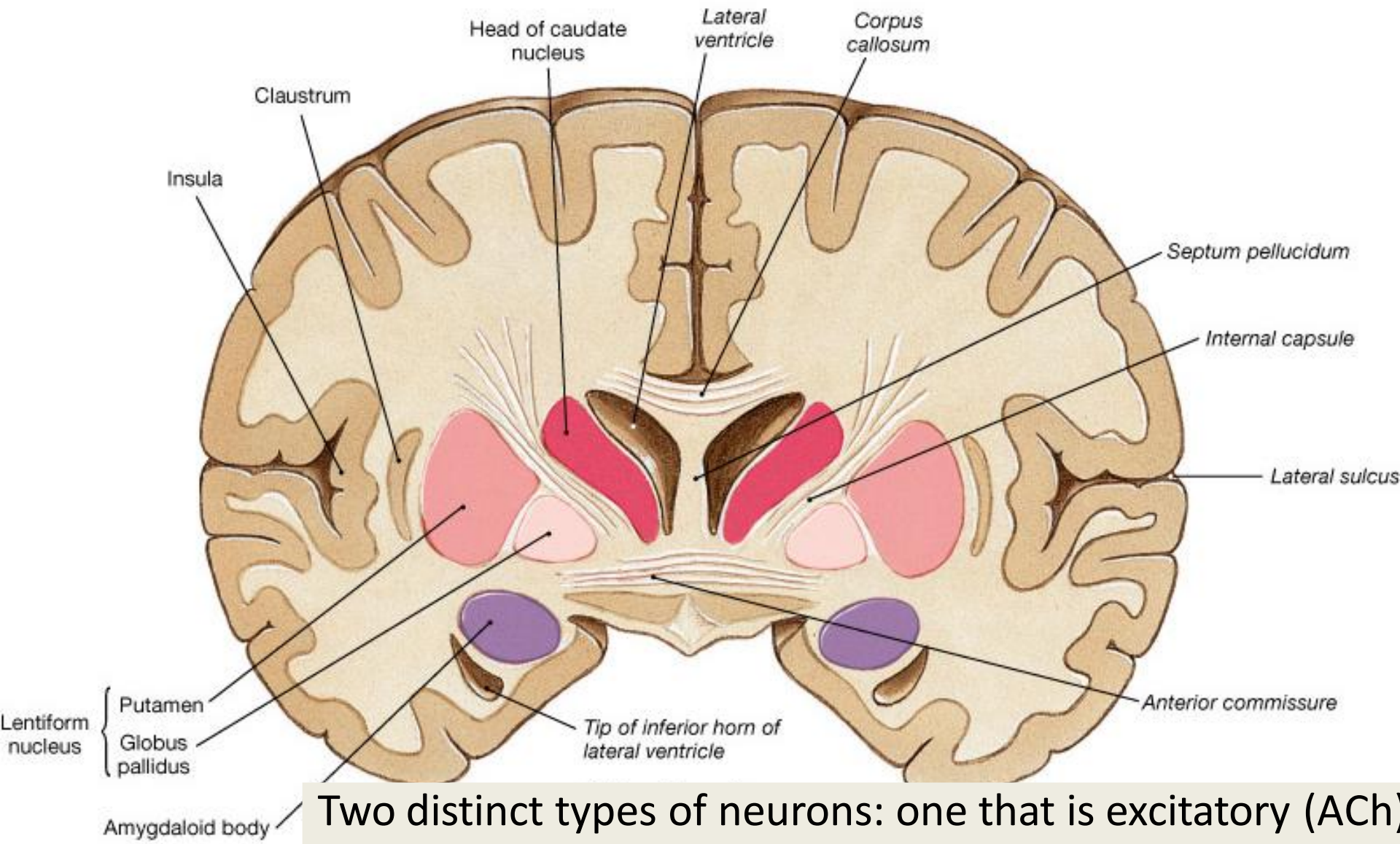
(a) Superior view

Levels of somatic motor control

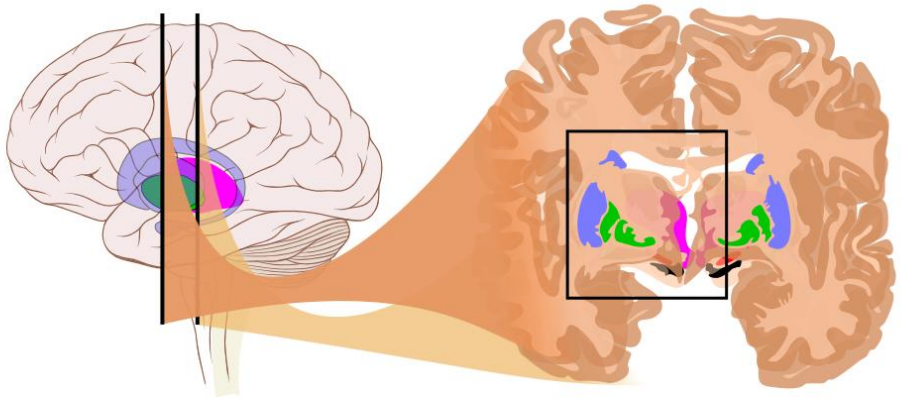


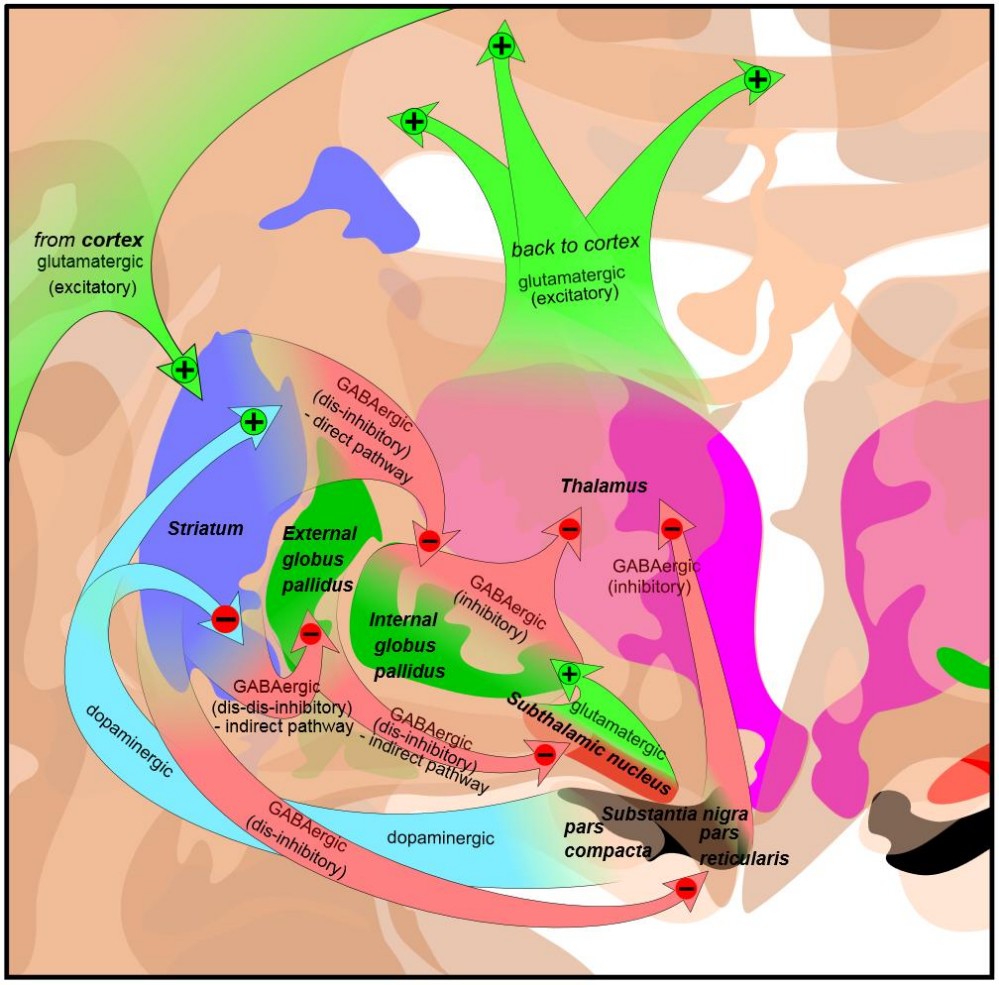
(a) Levels of somatic motor control

Frontal section of basal nuclei/ganglia



Two distinct types of neurons: one that is excitatory (ACh) and one that is inhibitory (GABA). Excitatory usually inactive (dopamine from substantia nigra)

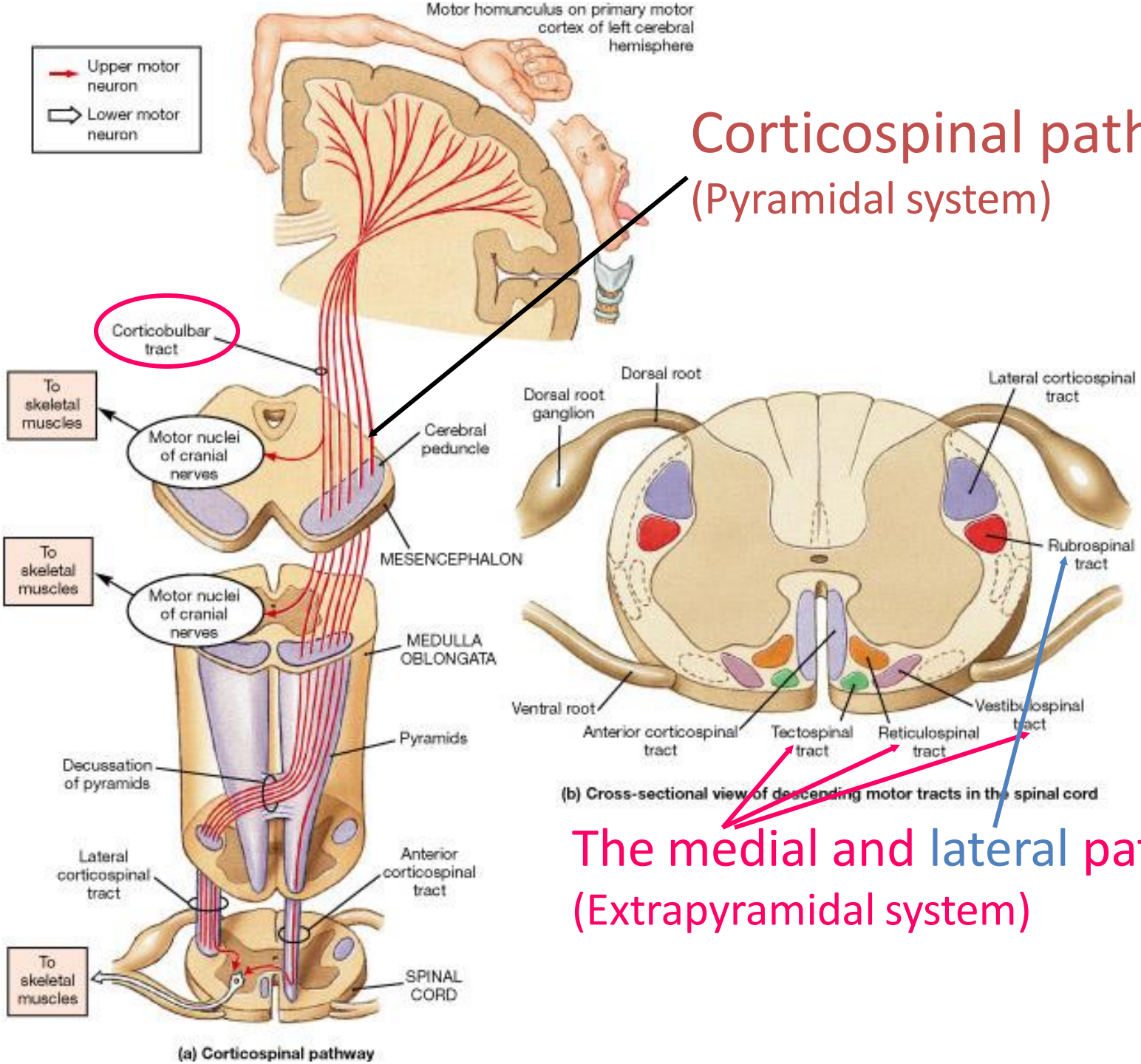




- The basal ganglia are responsible for voluntary motor control, procedural learning, and eye movement, as well as cognitive and emotional functions.

Source: Boundless. “The Role of the Basal Ganglia in Movement.” *Boundless Anatomy and Physiology*. Boundless, 12 Oct. 2016. Retrieved 09 Nov. 2016 from https://www.boundless.com/physiology/textbooks/boundless-anatomy-and-physiology-textbook/peripheral-nervous-system-13/motor-pathways-135/the-role-of-the-basal-ganglia-in-movement-724-8216/

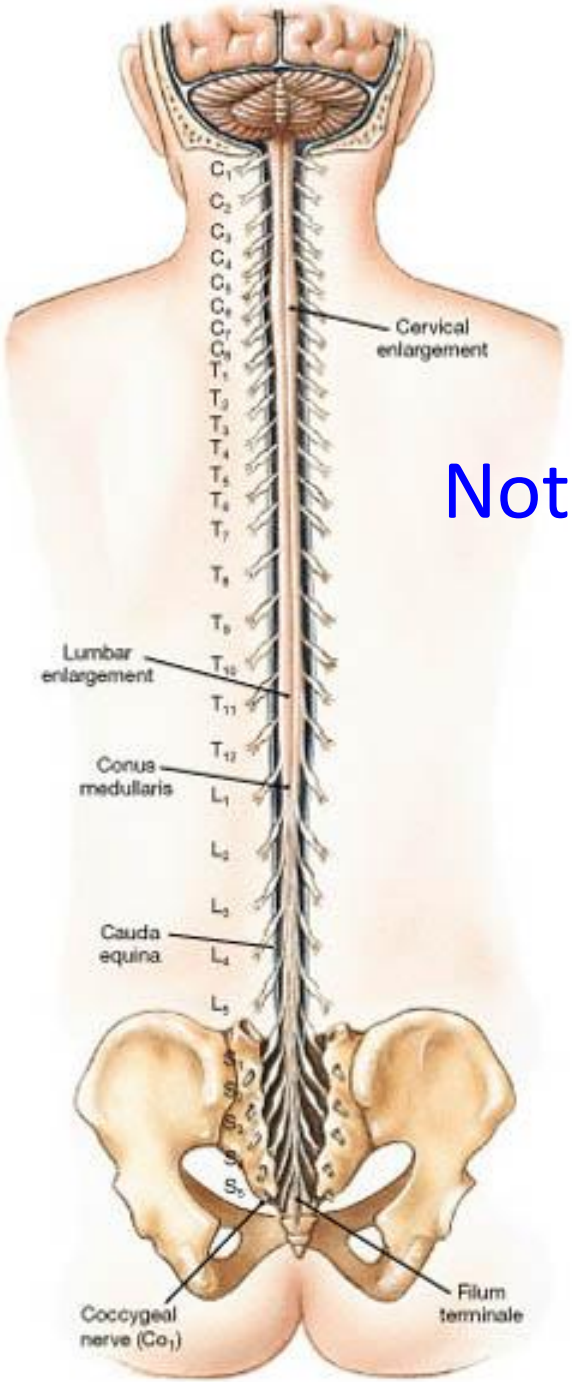
Corticospinal pathway
(Pyramidal system)



The medial and lateral pathways
(Extrapyramidal system)

Homunculus

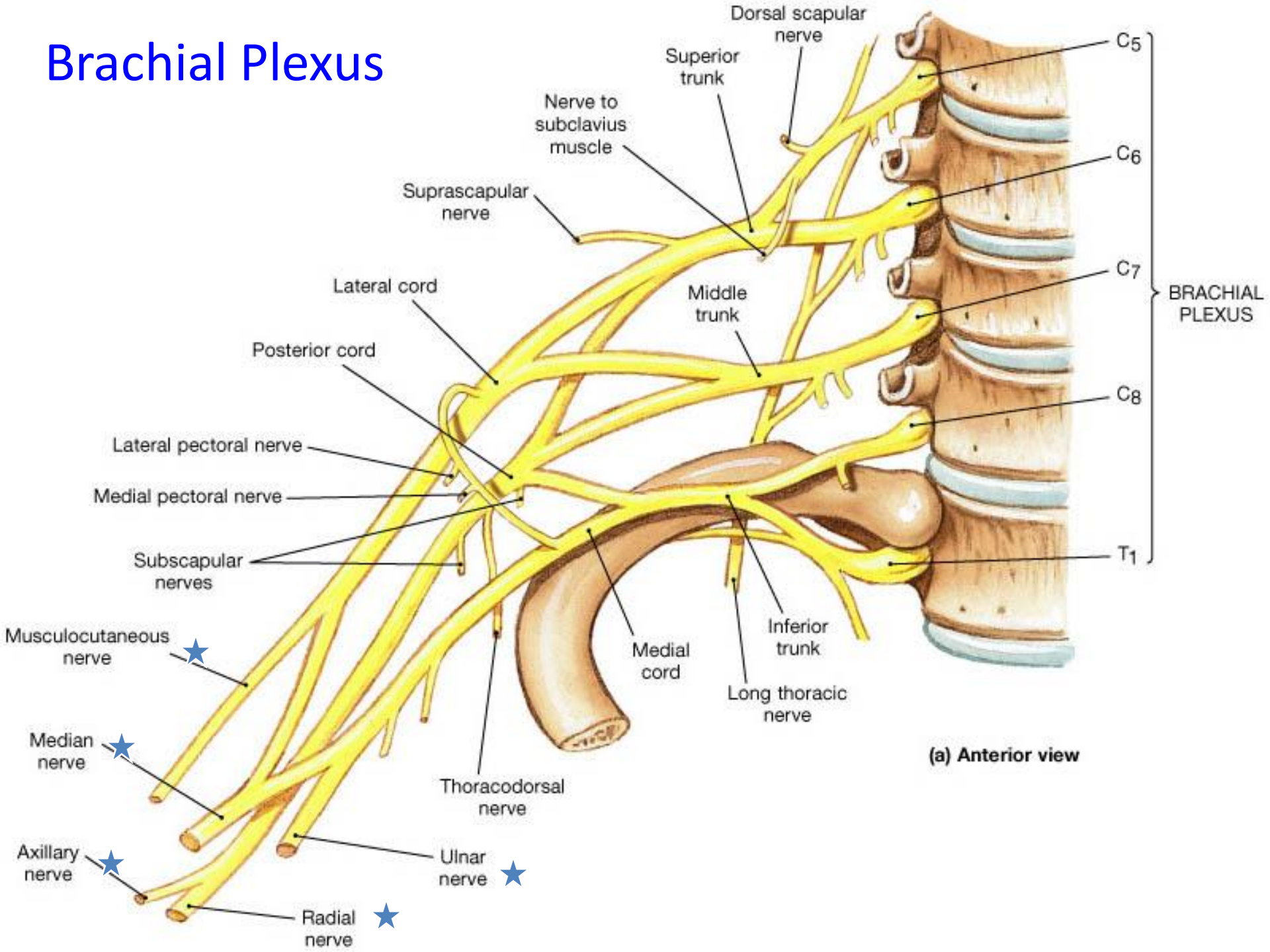
Spinal Cord



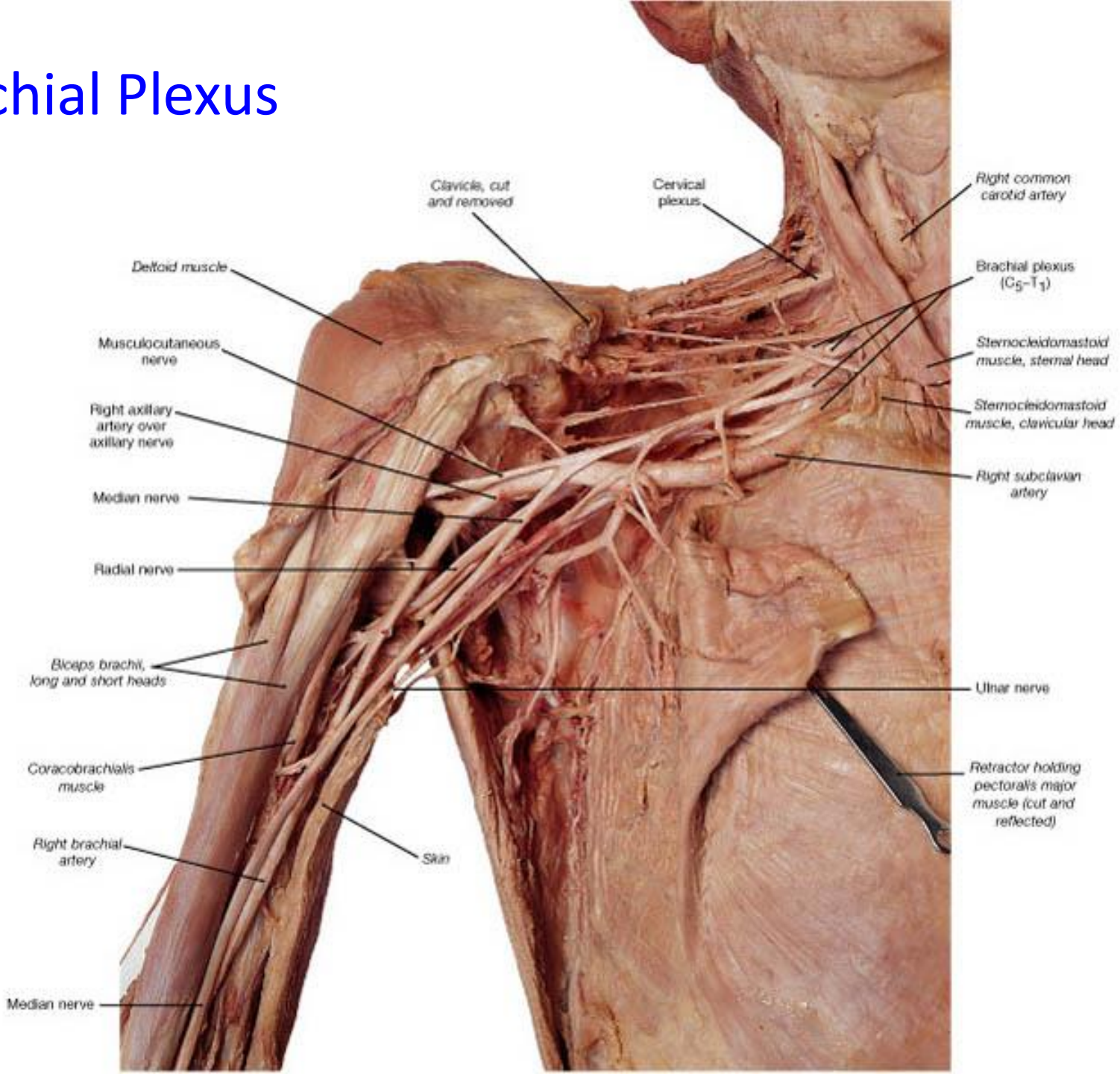
(a) Spinal cord, posterior vew

Note #Spinal Nerves

Brachial Plexus



Brachial Plexus



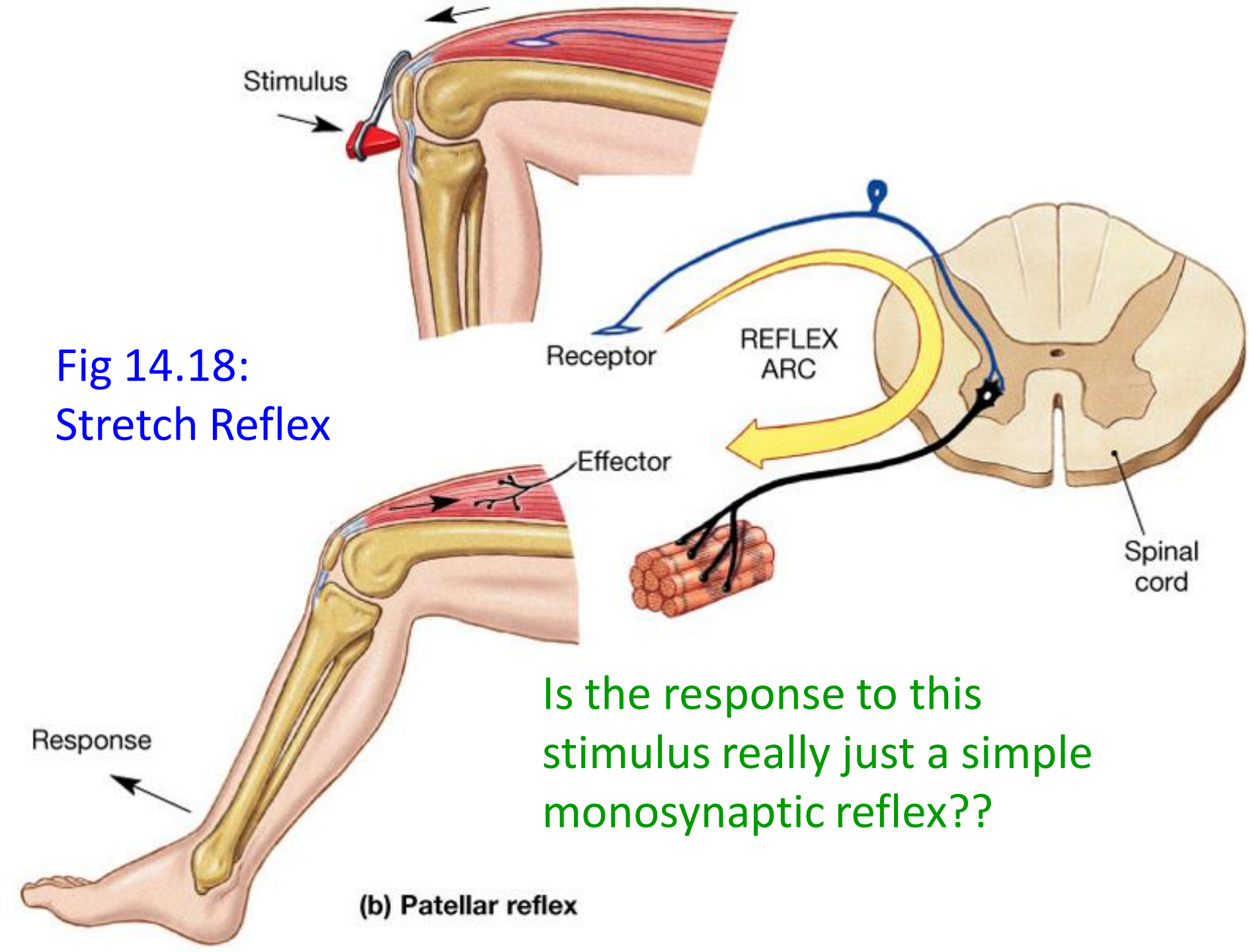
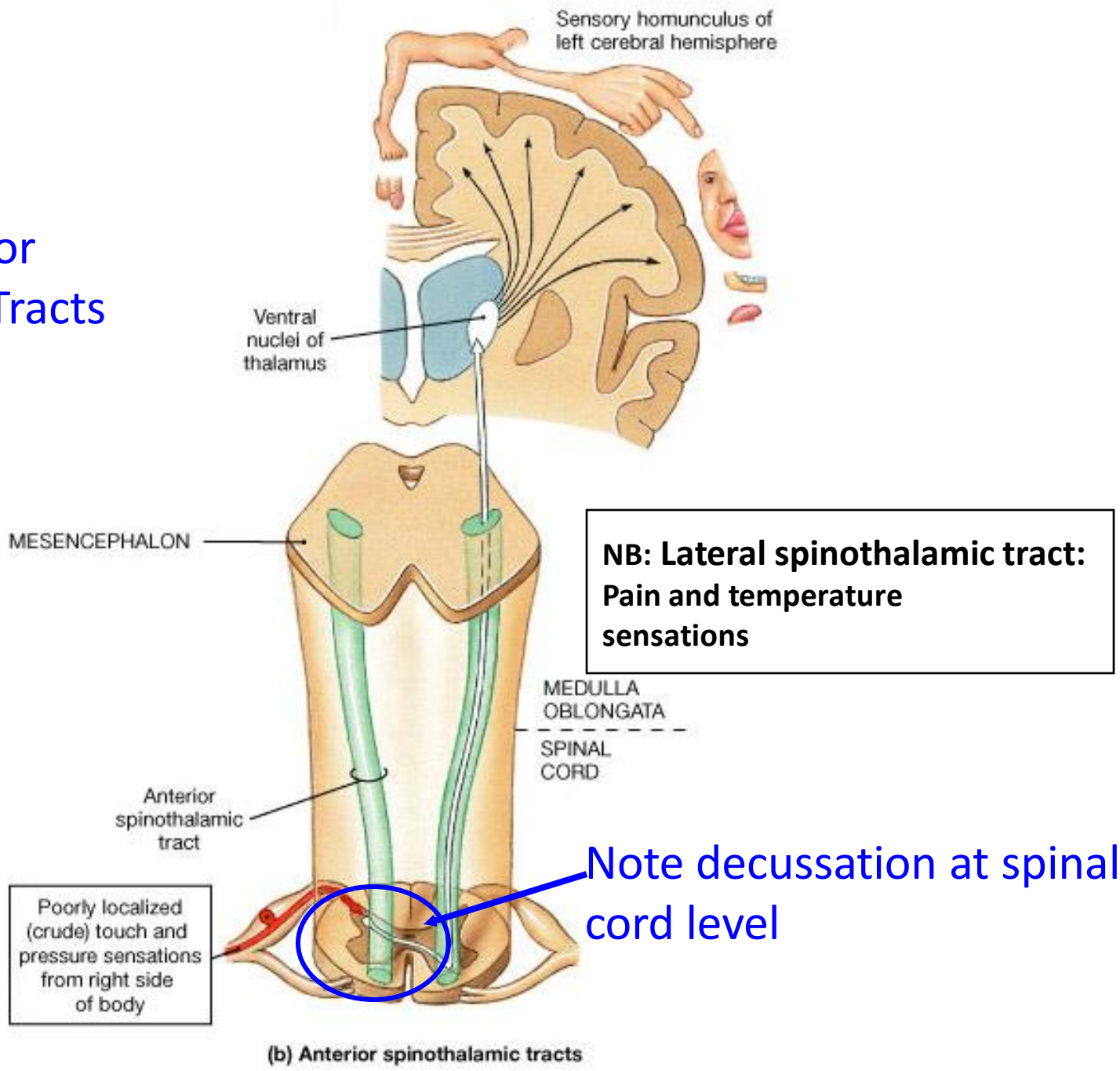


Fig 14.18:
Stretch Reflex

Is the response to this stimulus really just a simple monosynaptic reflex??

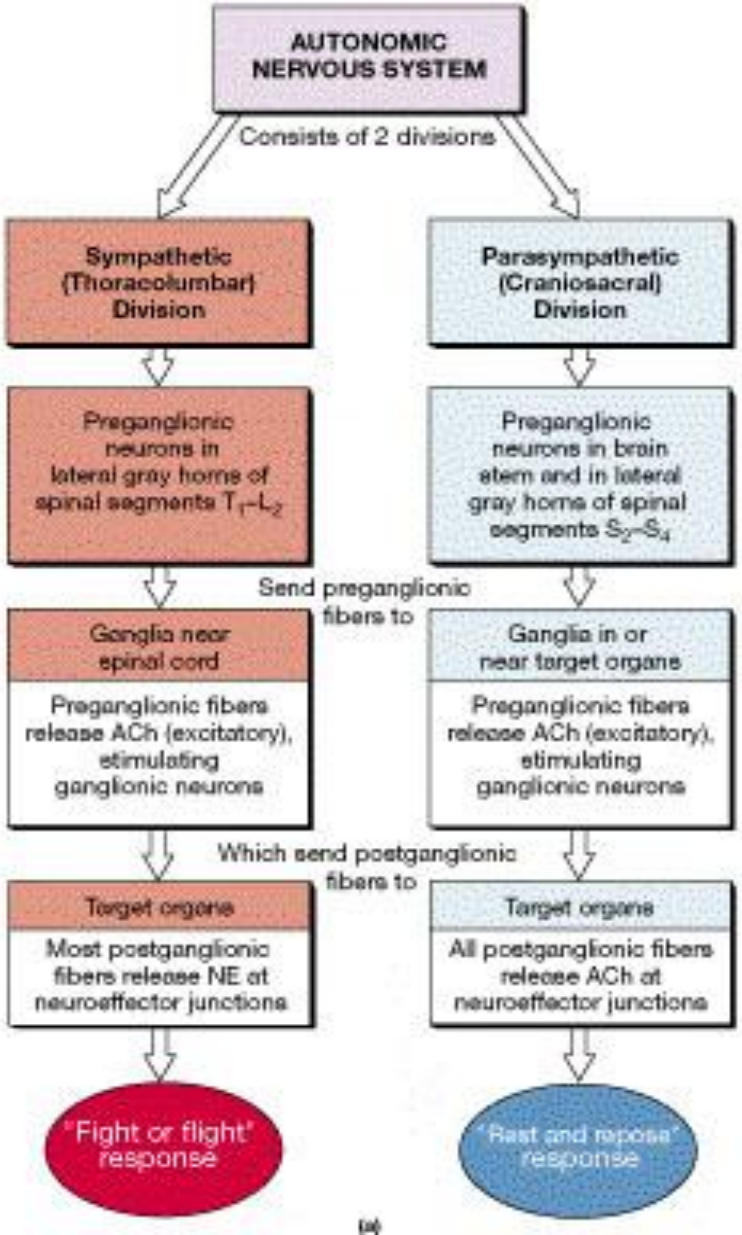
Fig 16.2: Anterior Spinothalamic Tracts



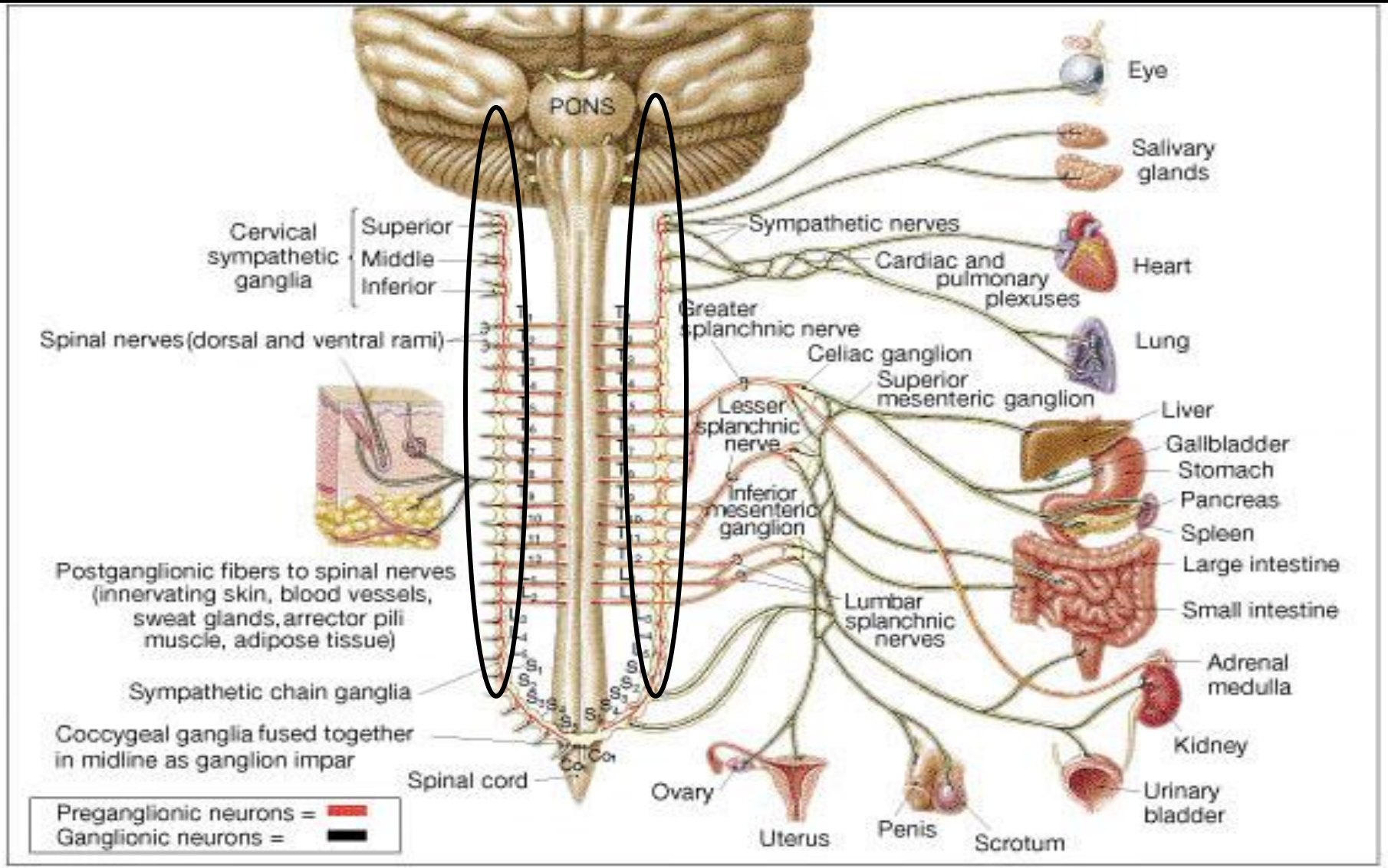
NB: Lateral spinothalamic tract: Pain and temperature sensations

Note decussation at spinal cord level

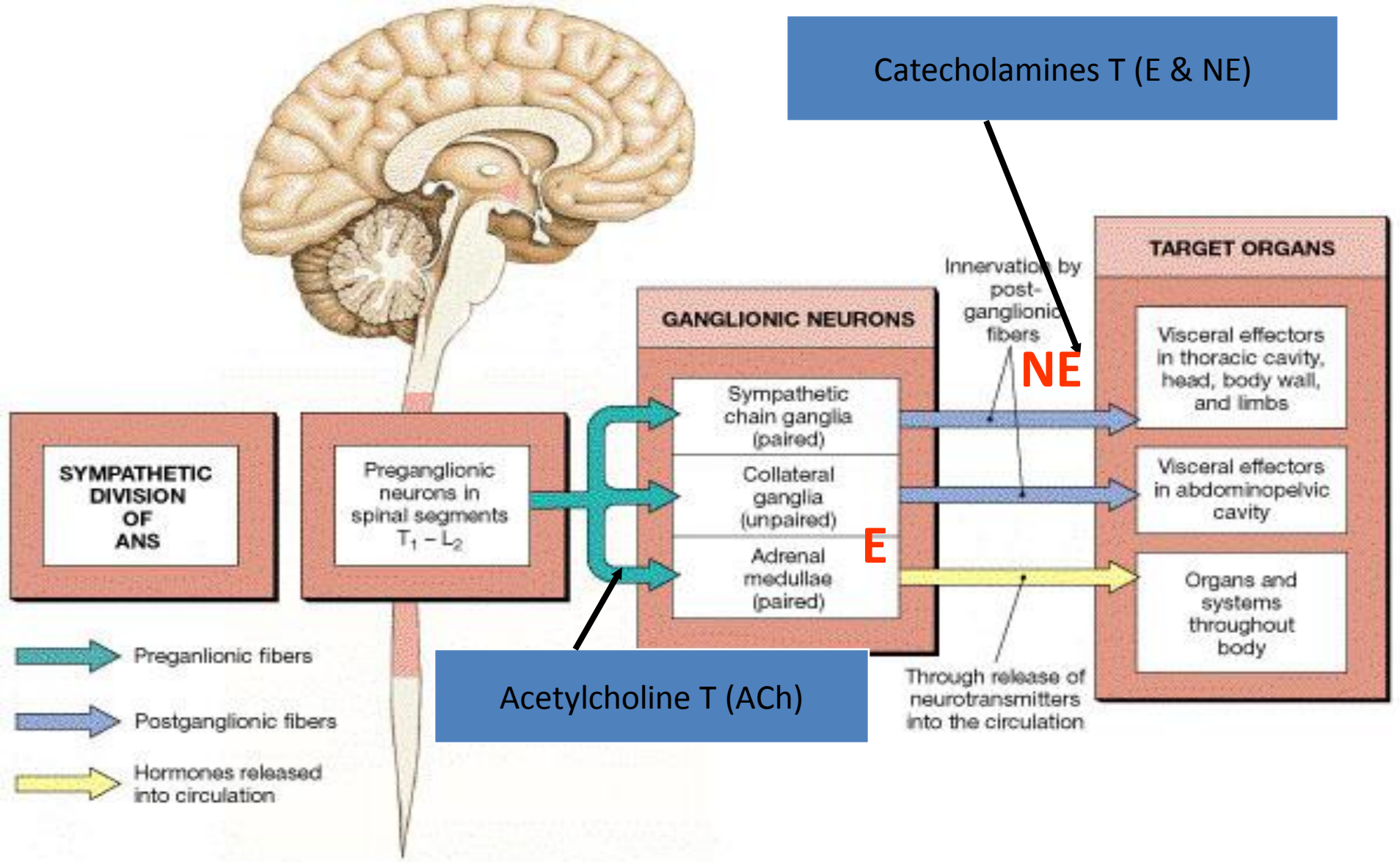
Autonomic Nervous System (ANS)



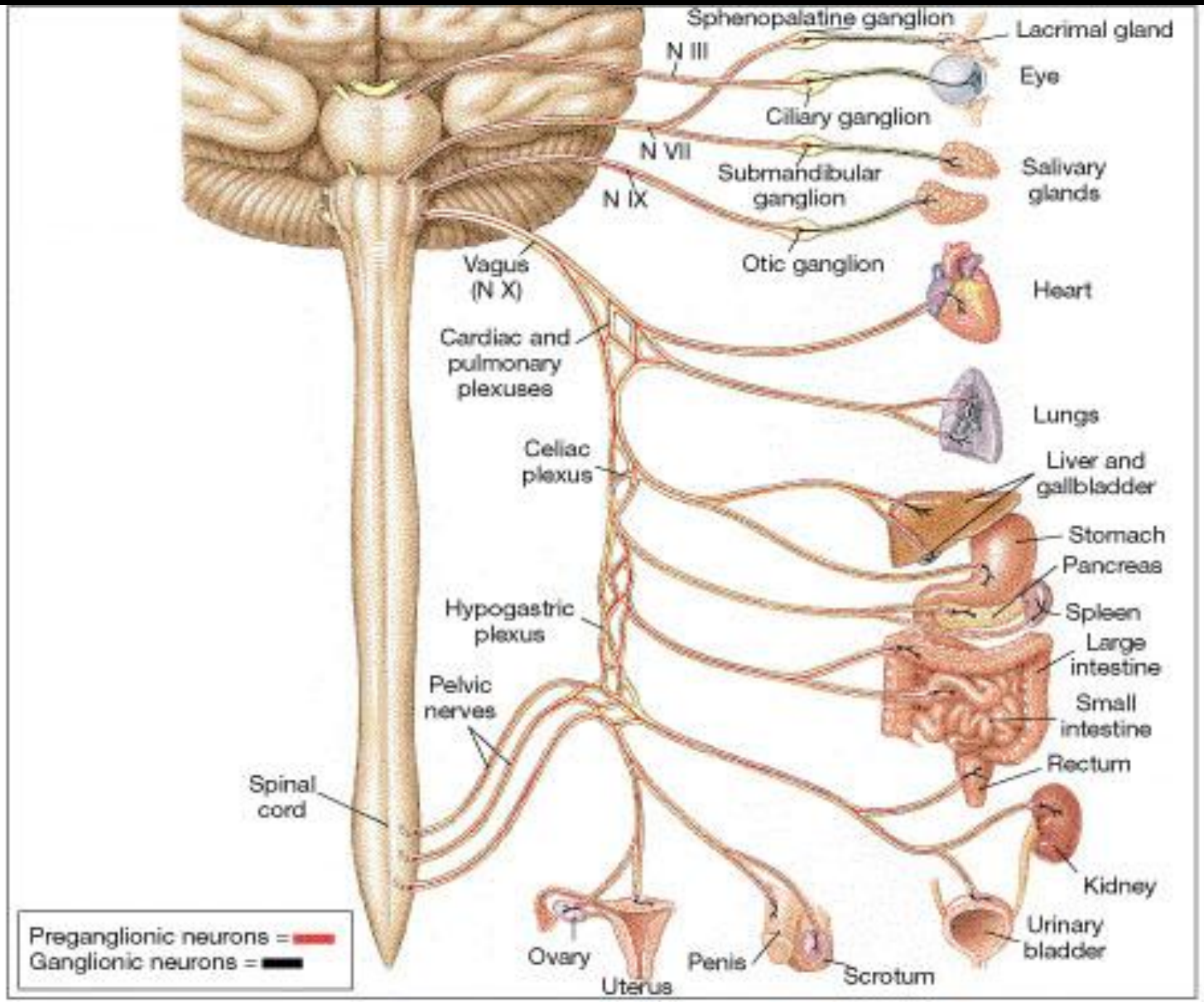
Distribution of sympathetic postganglionic fibers (sympathetic chain)



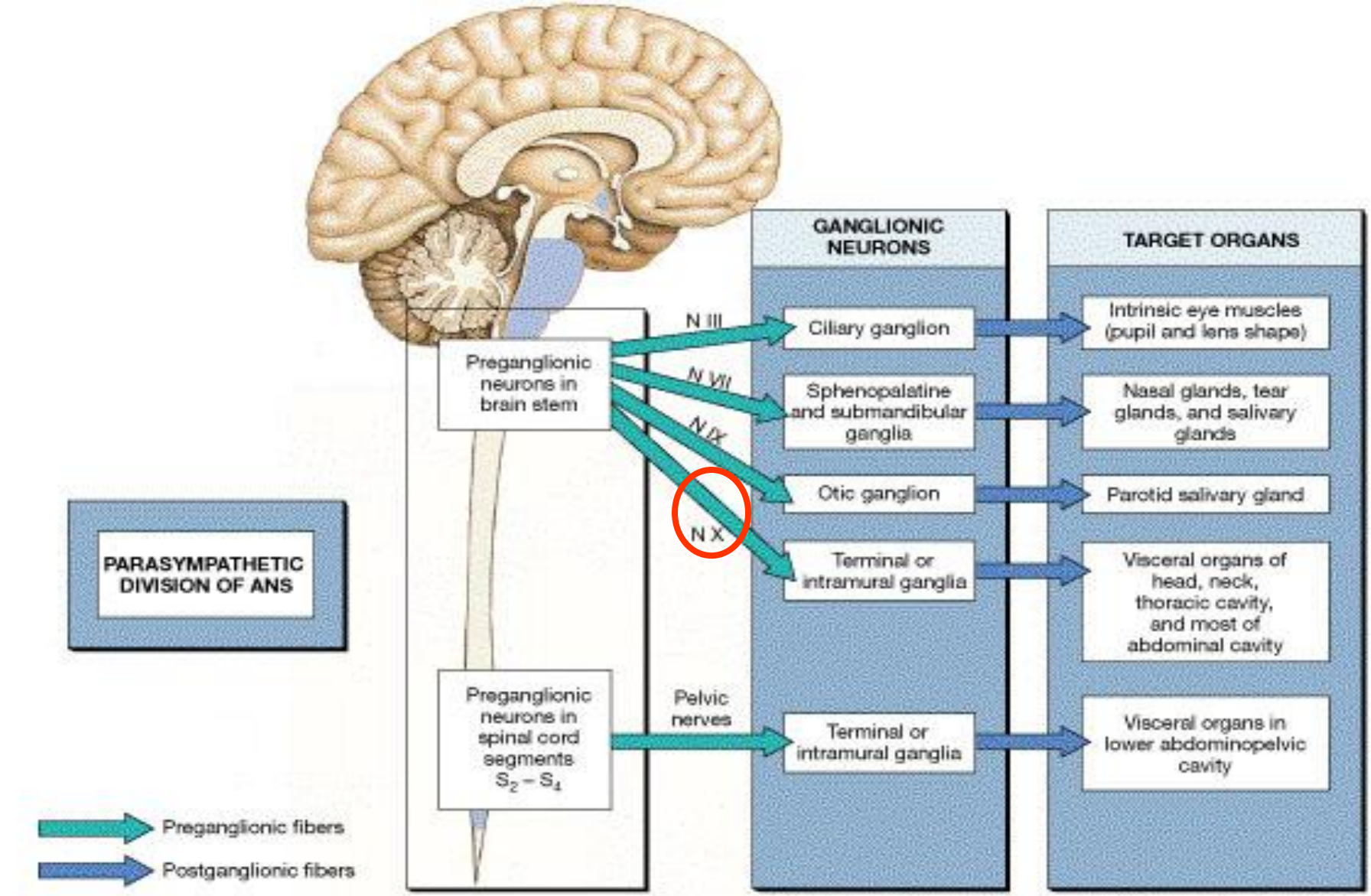
Sympathetic *division of ANS*



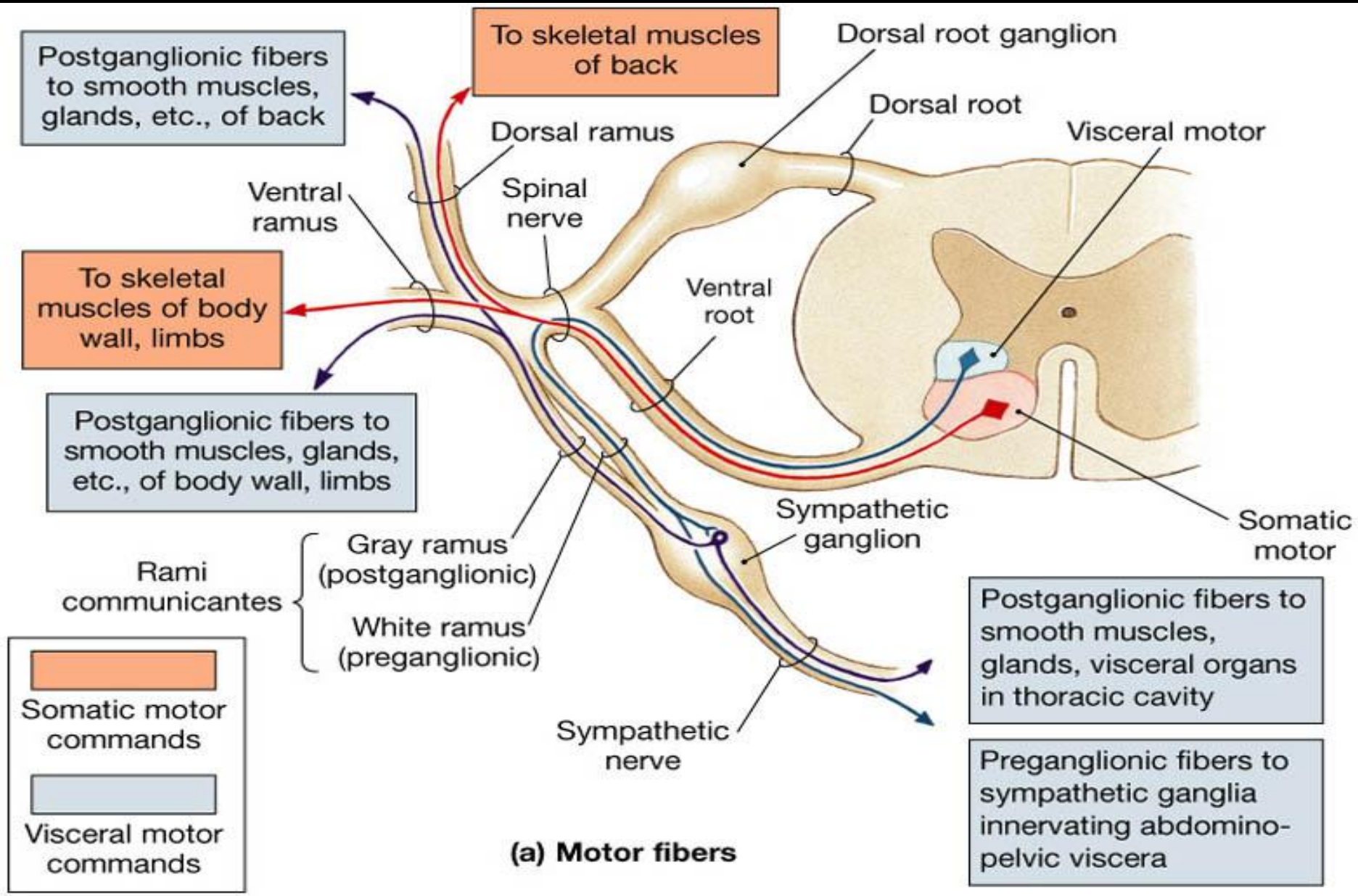
Parasympathetic system (cranio-sacral division)



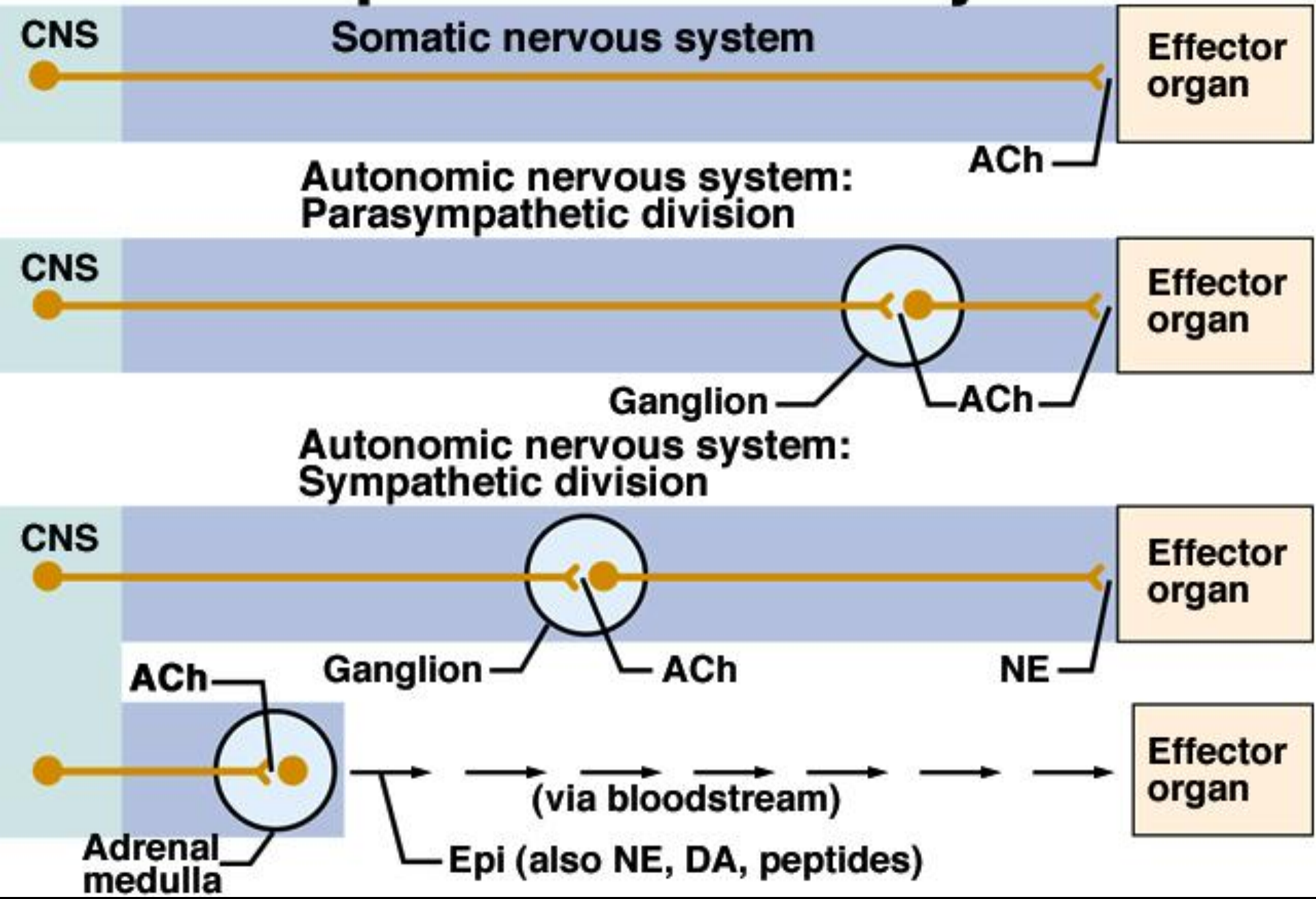
*Organization of **parasympathetic** nervous system*



Peripheral Distribution of Spinal nerves (Motor)



Peripheral nervous system

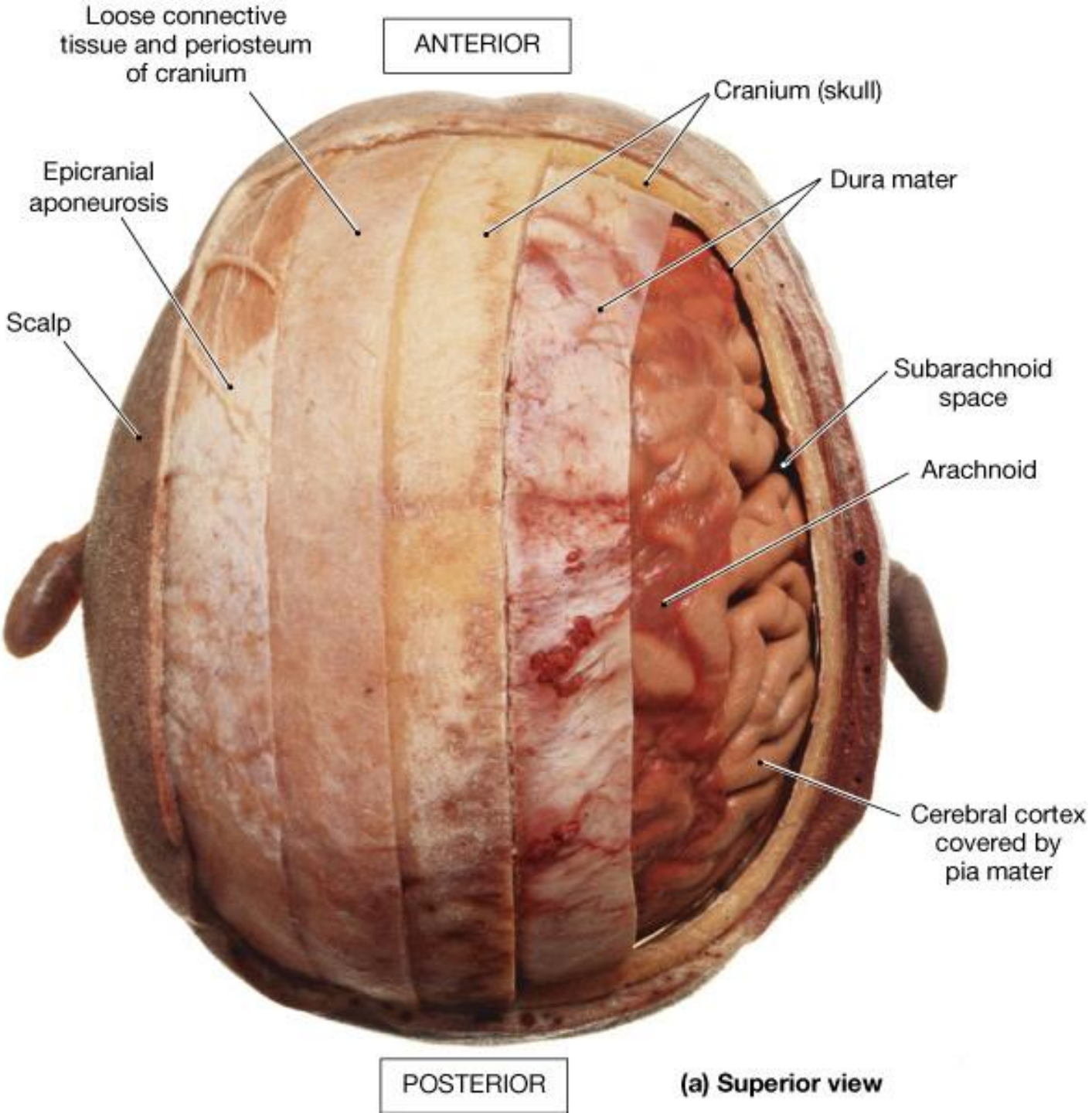


Protection of the brain

Bone (Skull)

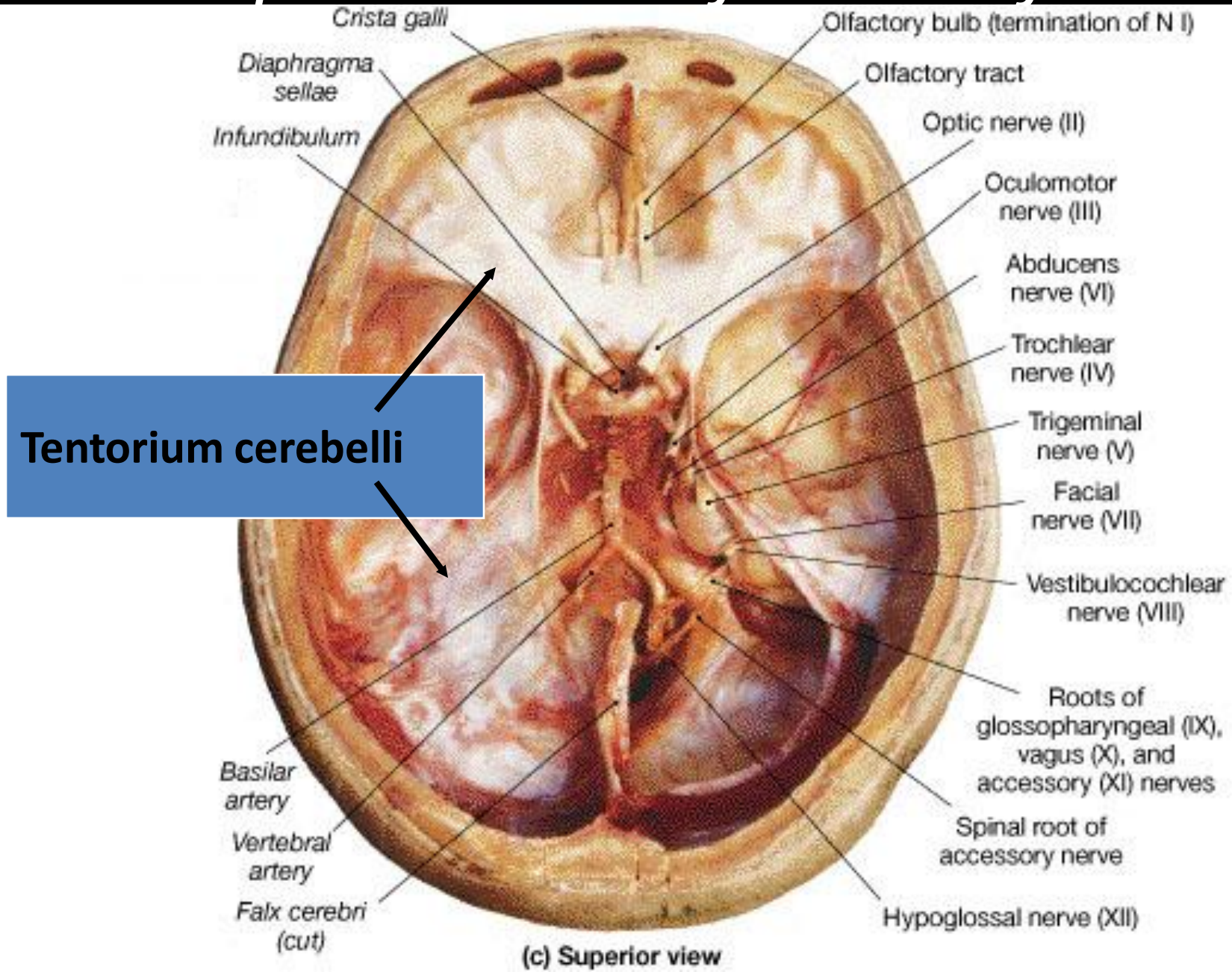
Connective tissue (meninges)

Fluid (CSF)

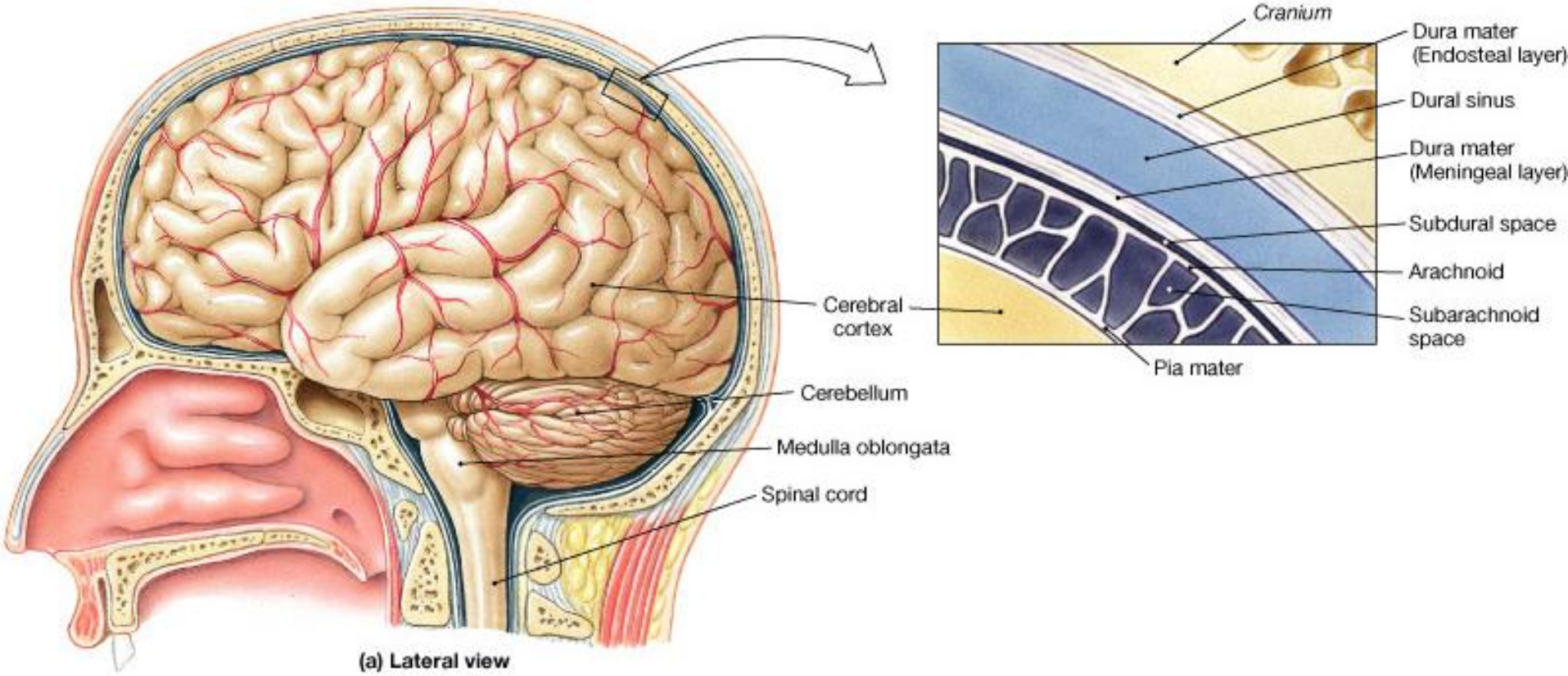


(a) Superior view

Superior view of cranial fossa

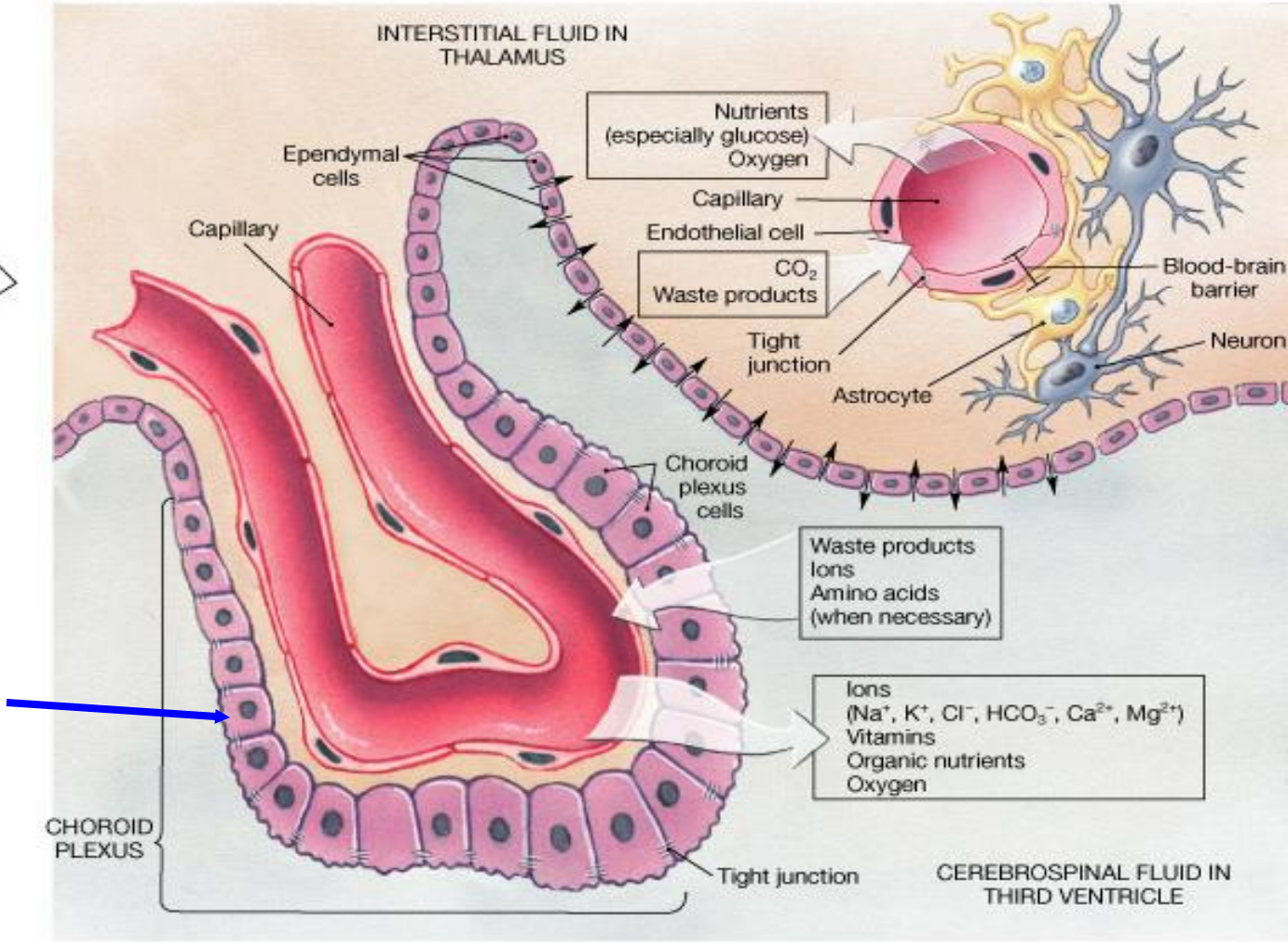


Brain, cranium & meninges

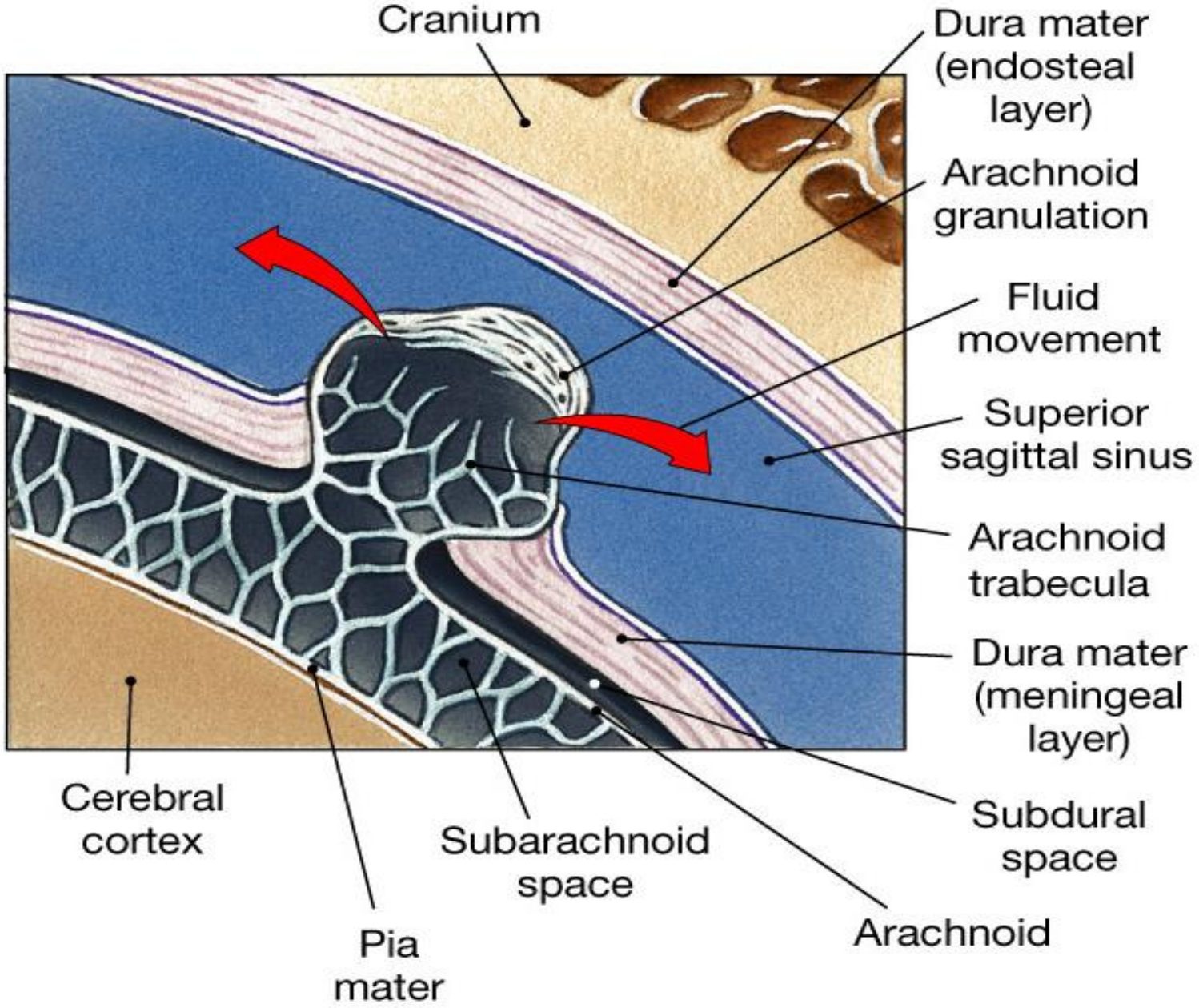


Choroid plexus & brain barrier

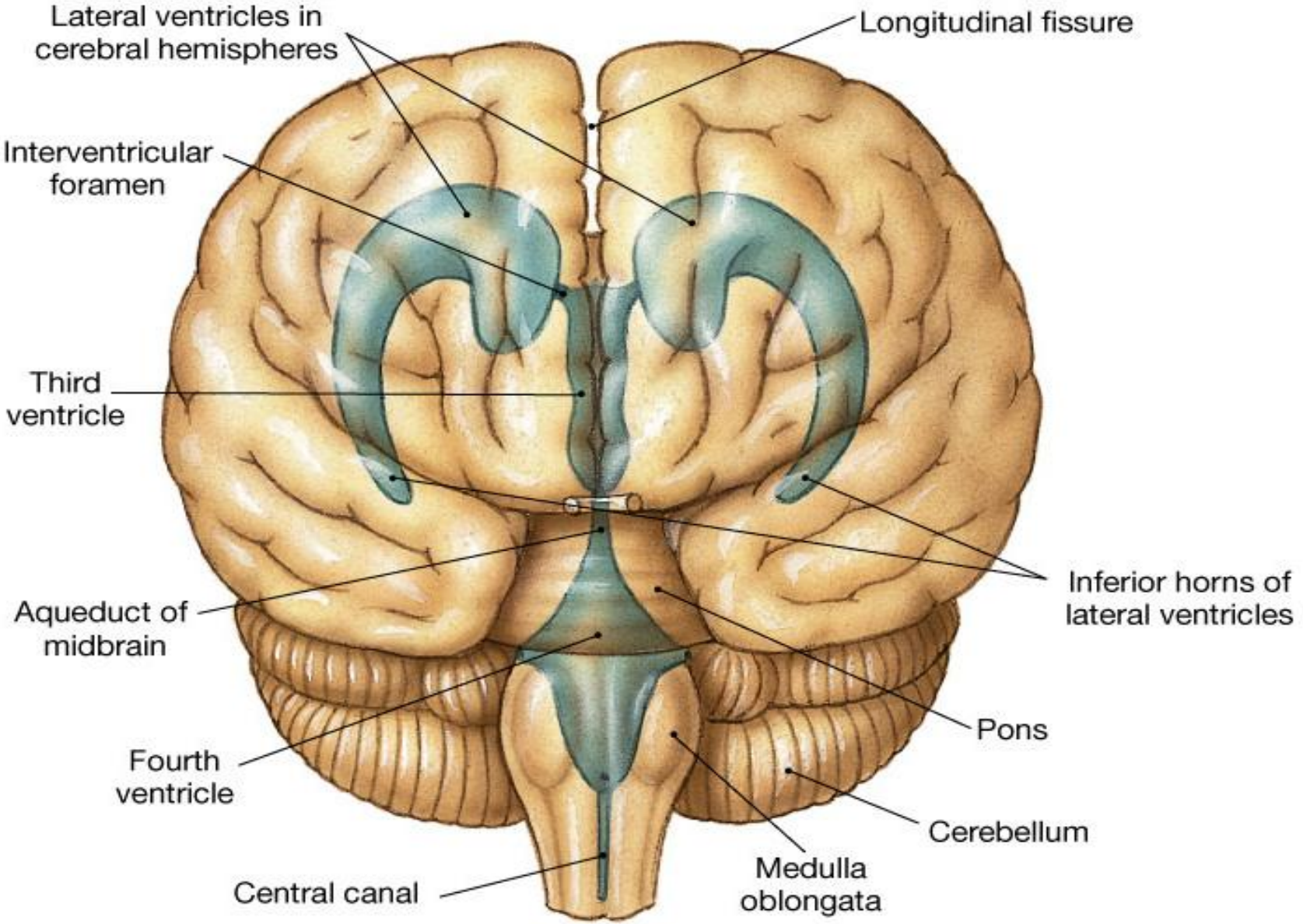
Ependymal Cells



Arachnoid granulation & CSF

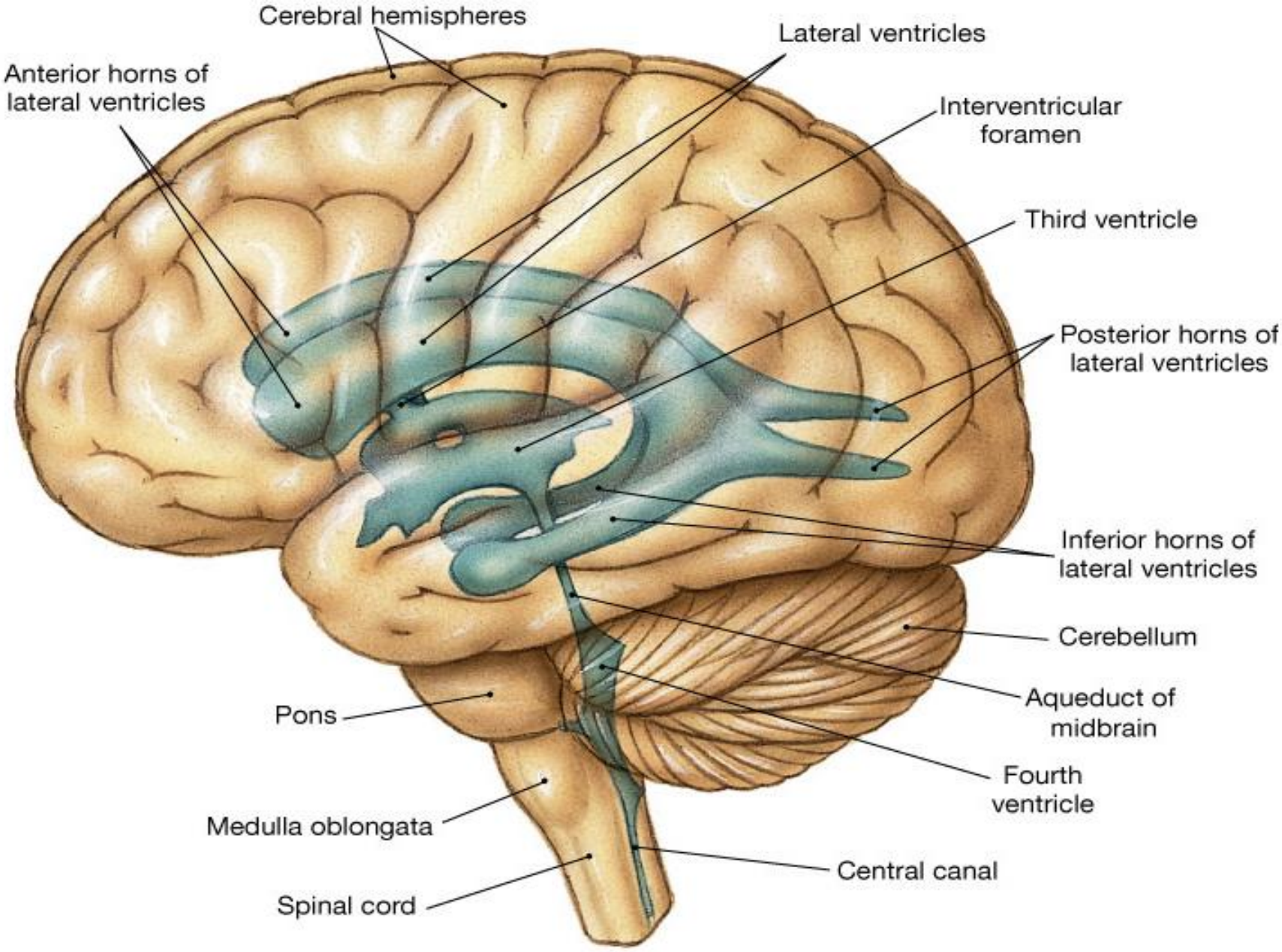


Anterior view - Ventricles

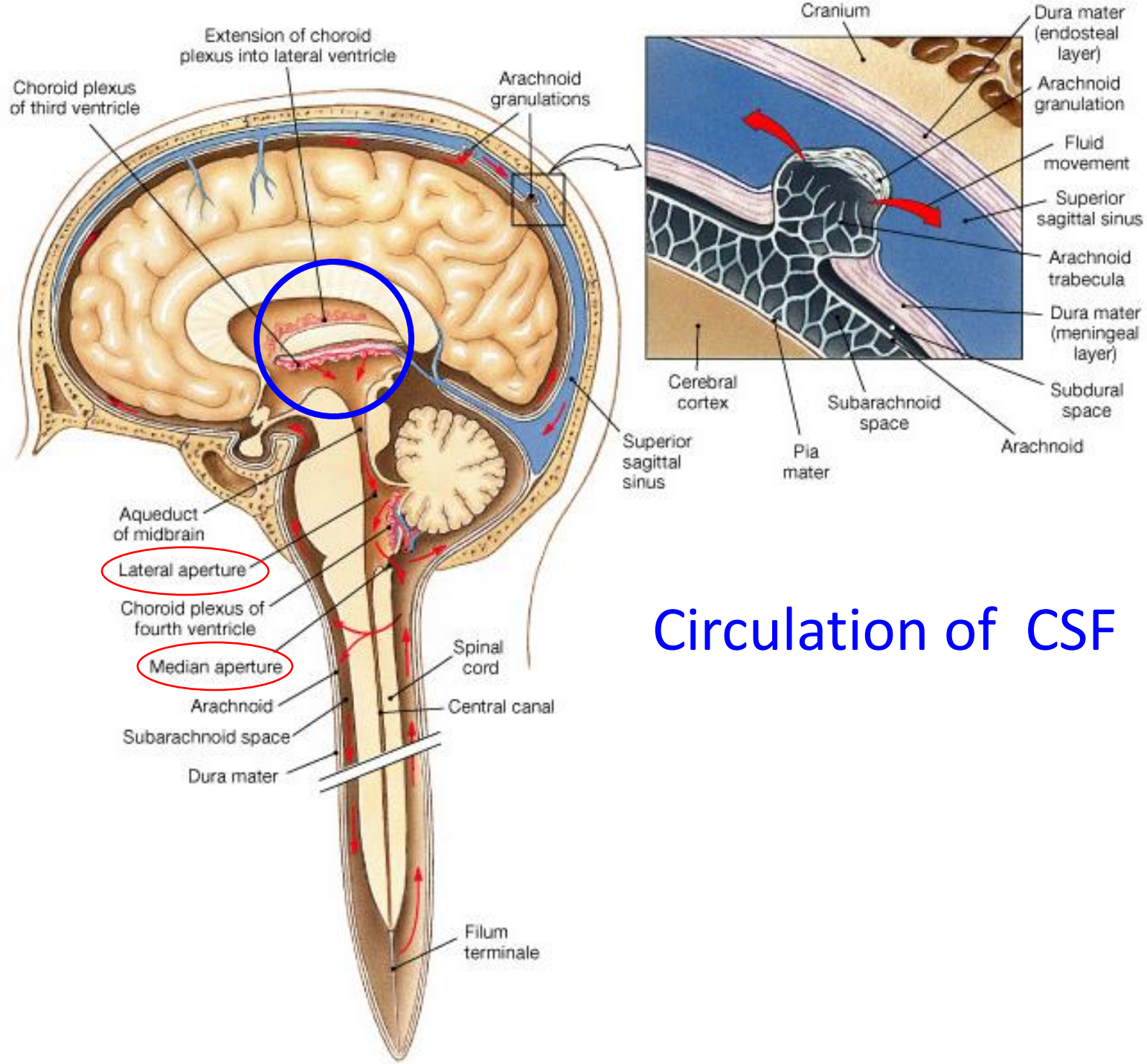


(c) Anterior view

Ventricles of the brain



(a) Lateral view



Circulation of CSF

Hydrocephalus

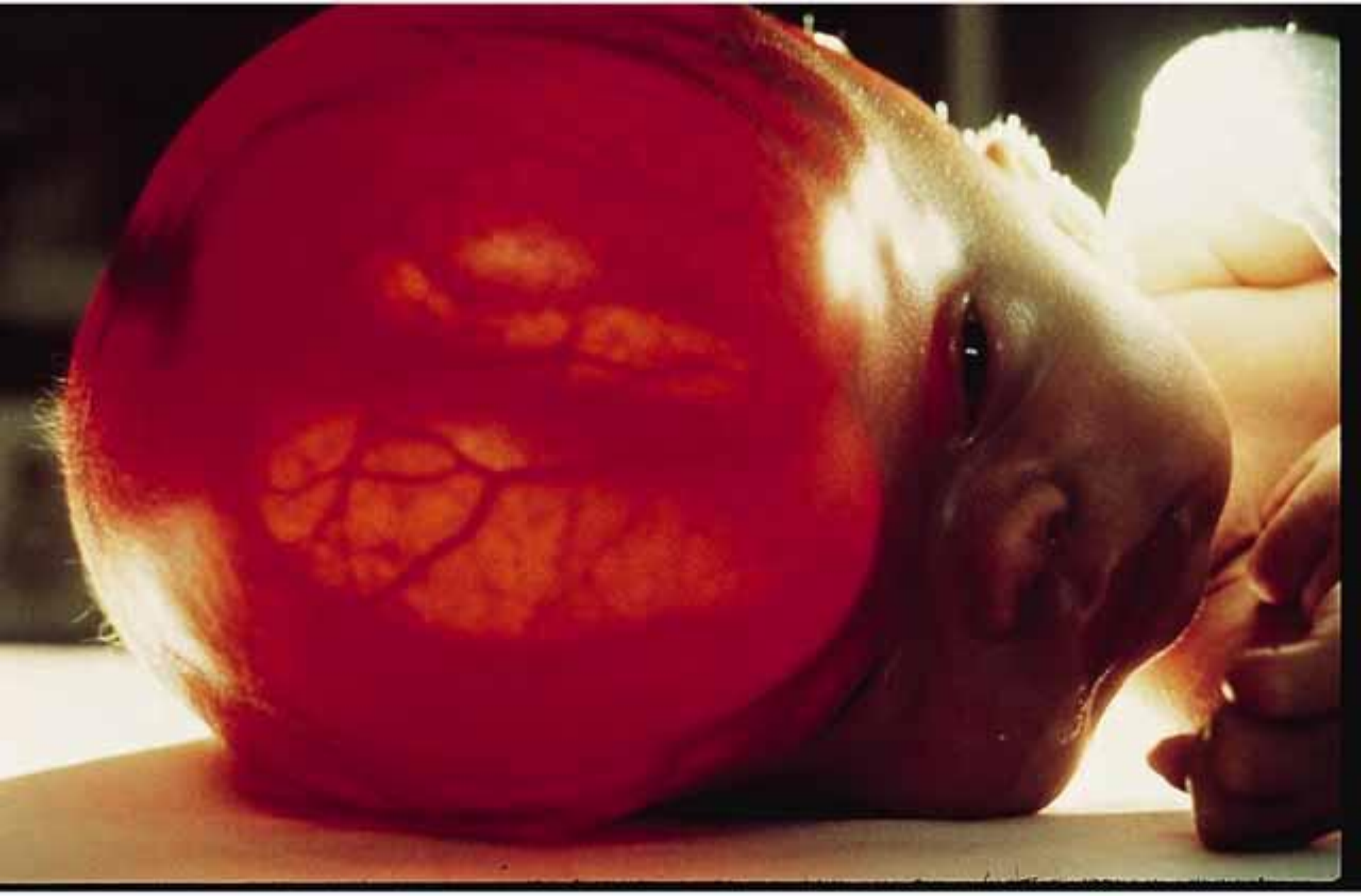
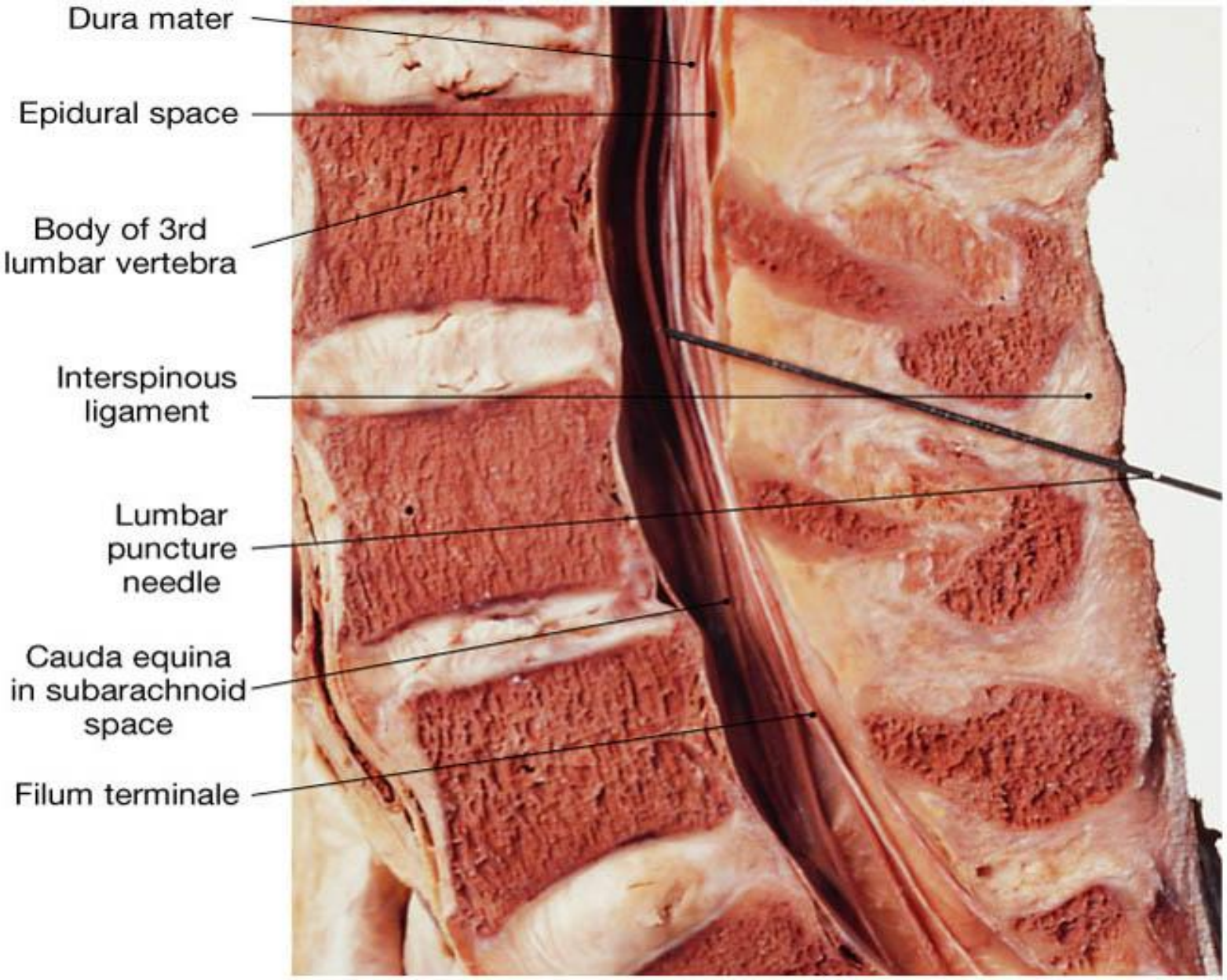
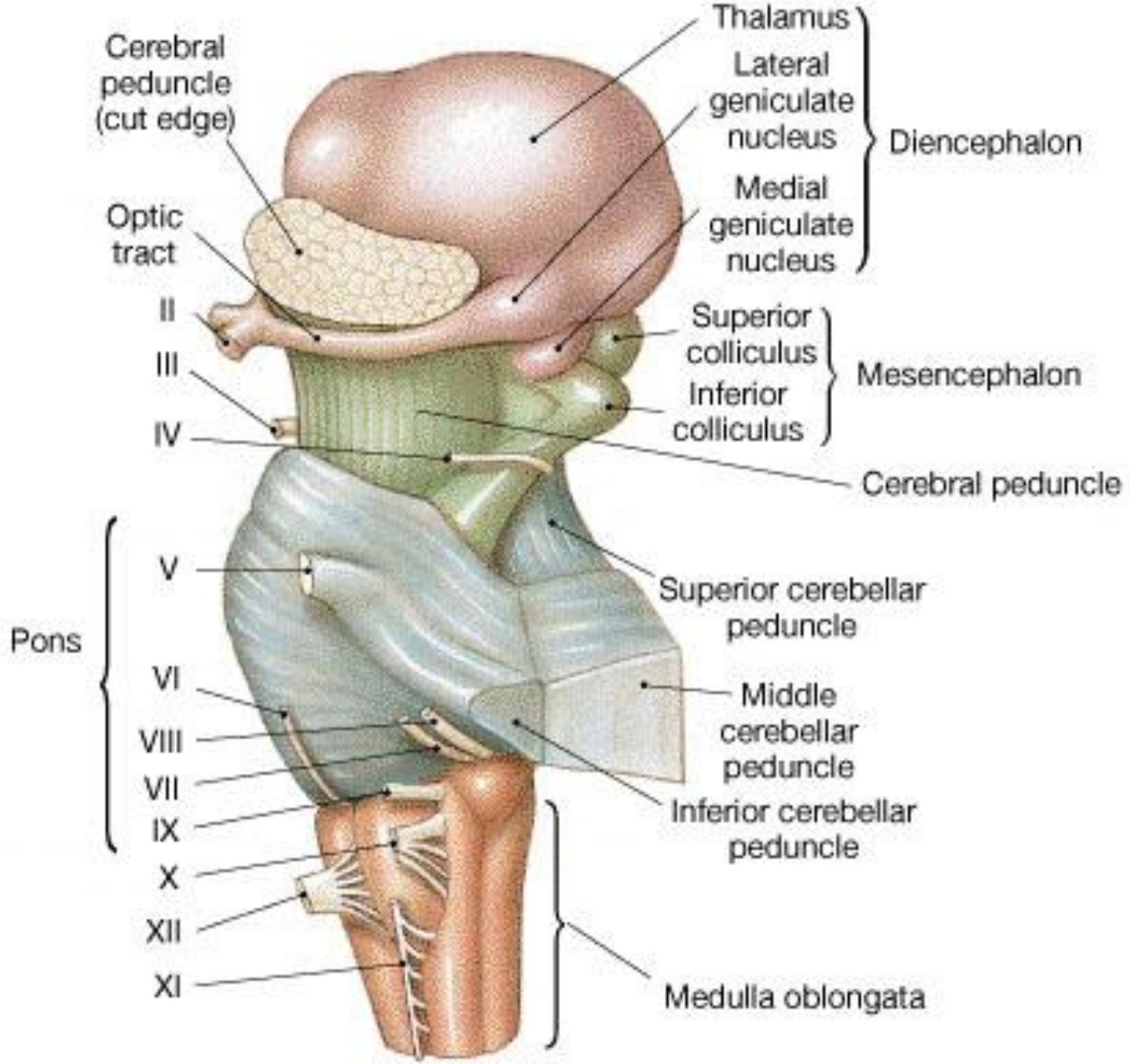


Fig 14.4 Lumbar Puncture (Spinal tap)



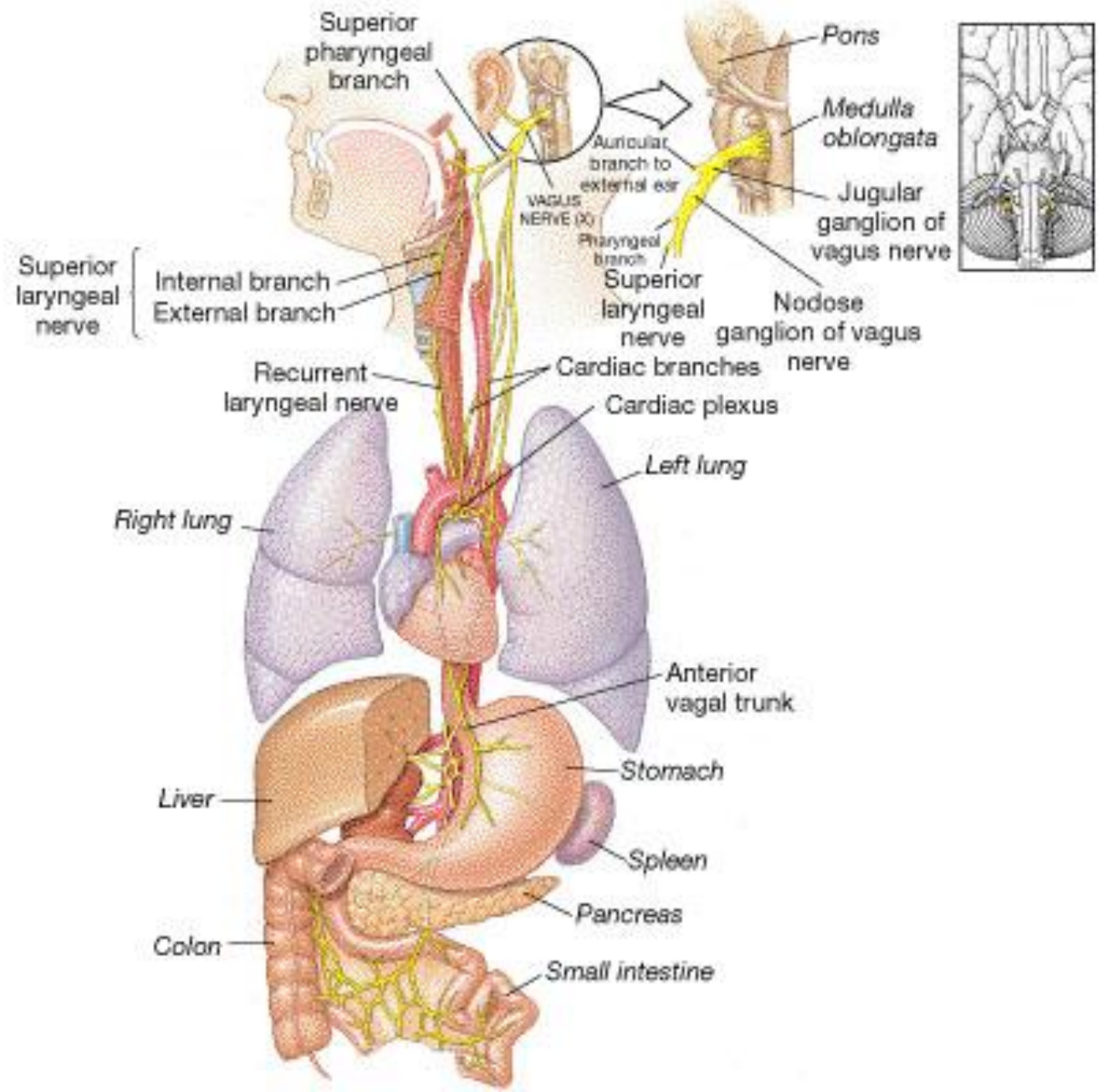
The twelve cranial nerves

The 12 Cranial nerves

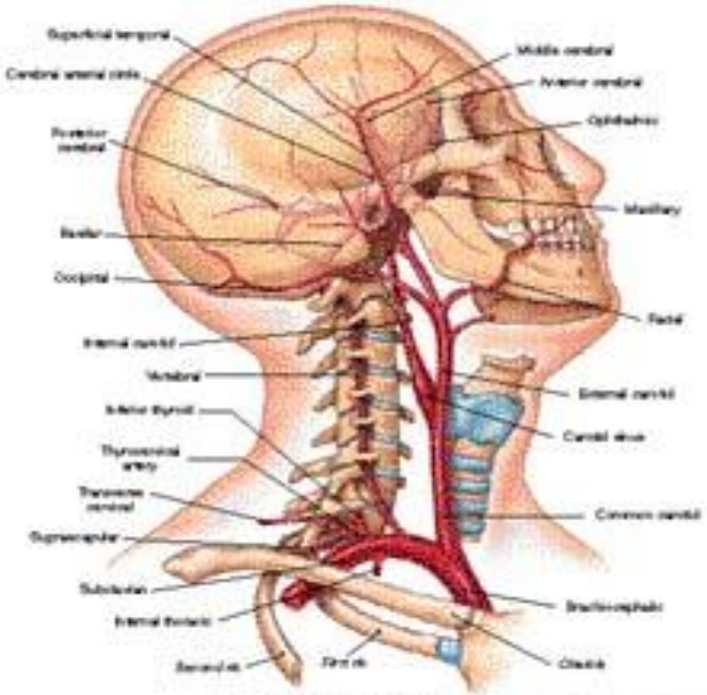


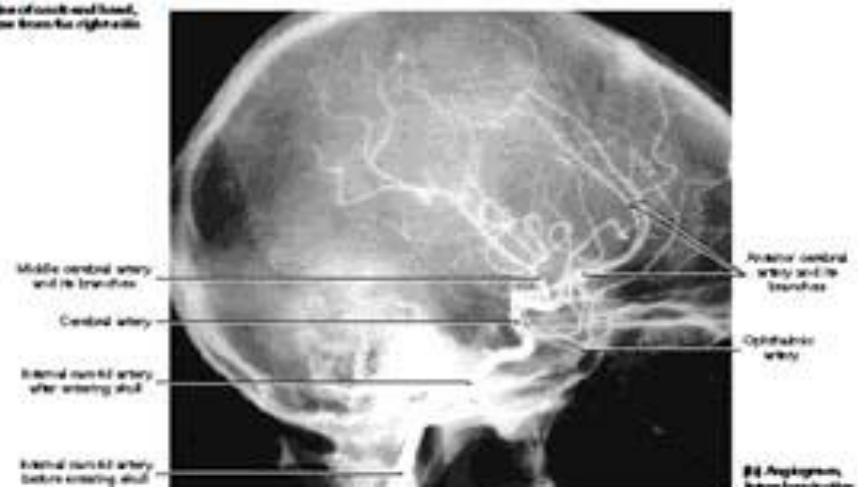
(a) Lateral view

The vagus nerve X (the wanderer)

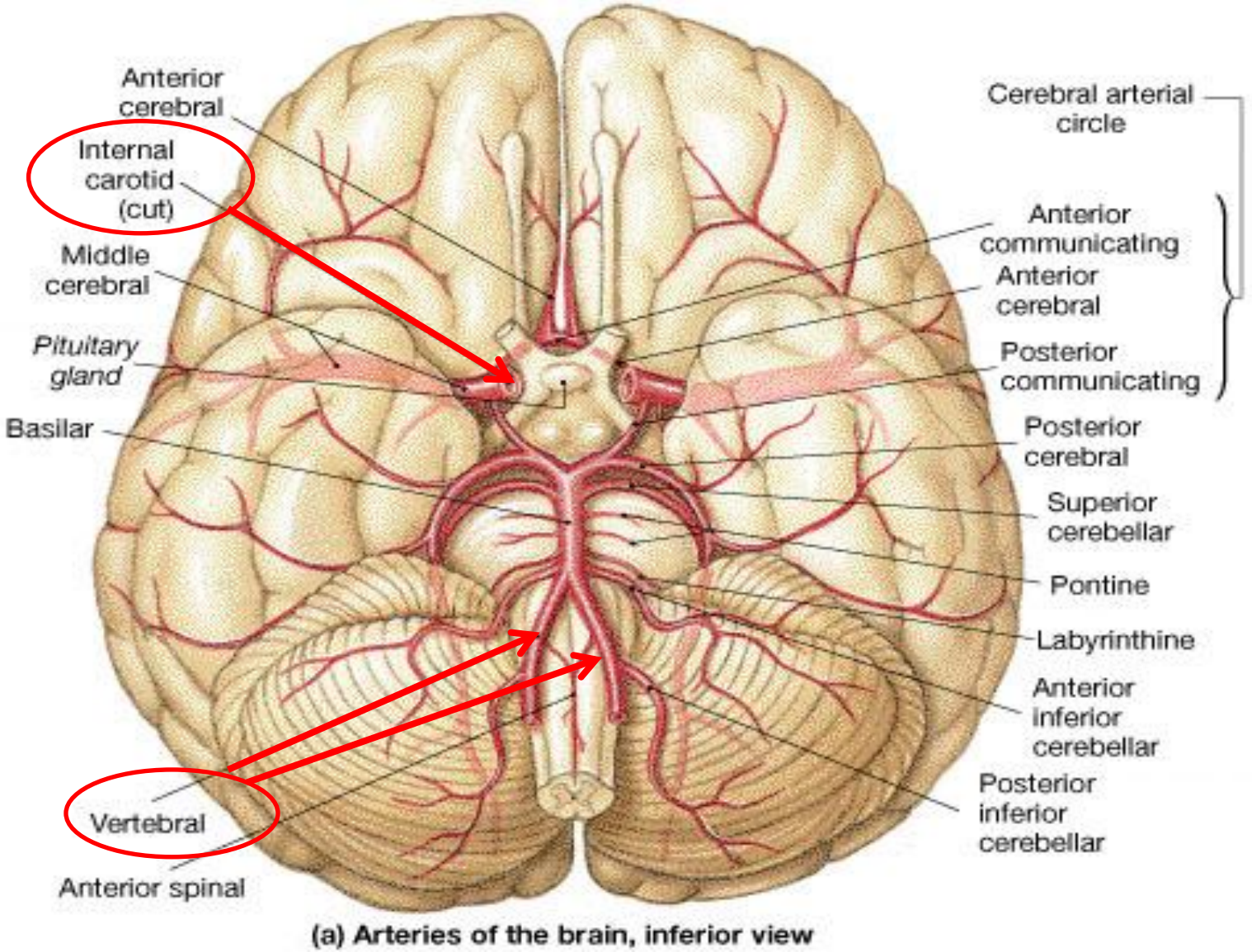


Blood flow to the brain



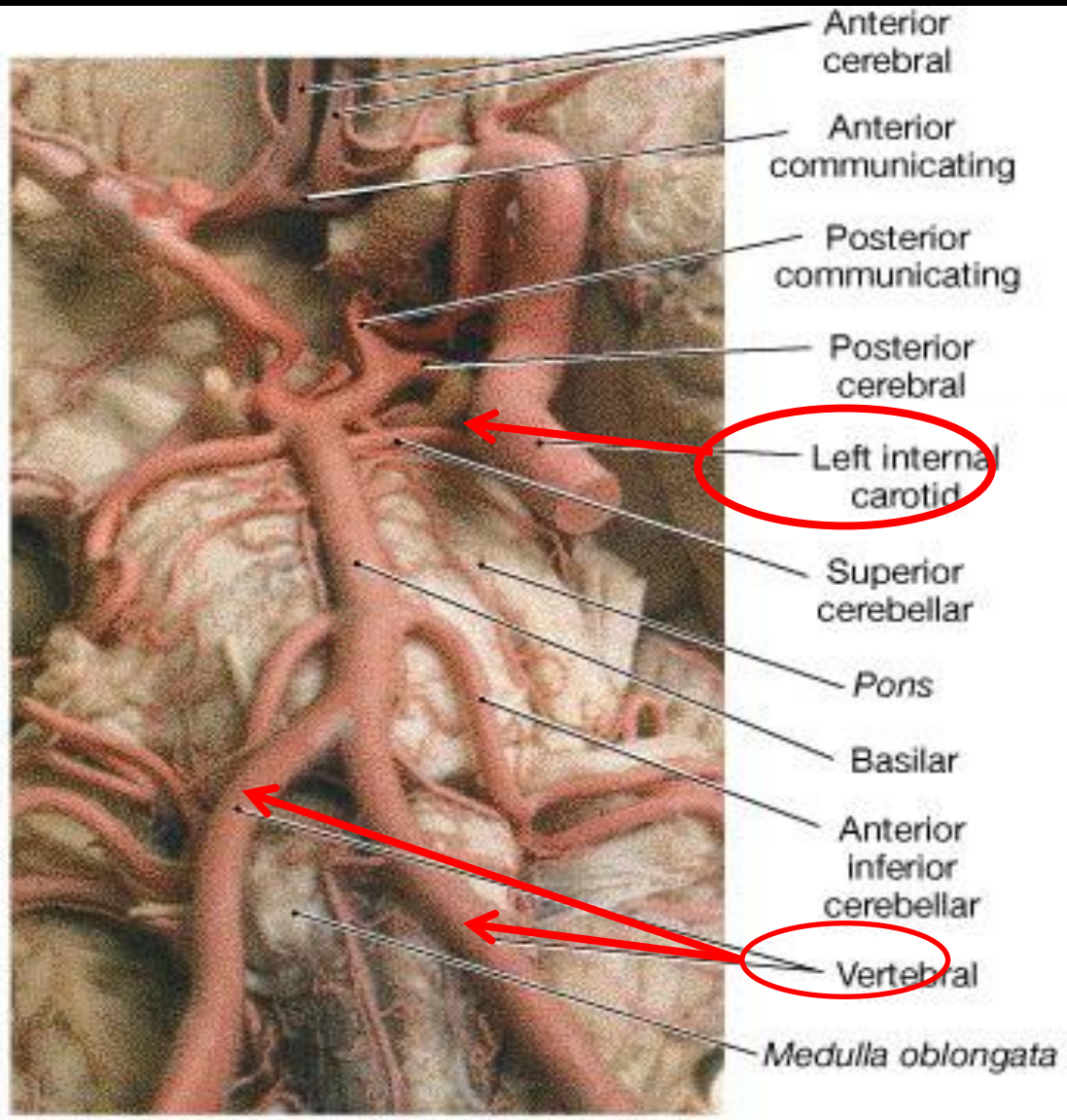


The Circle of Willis



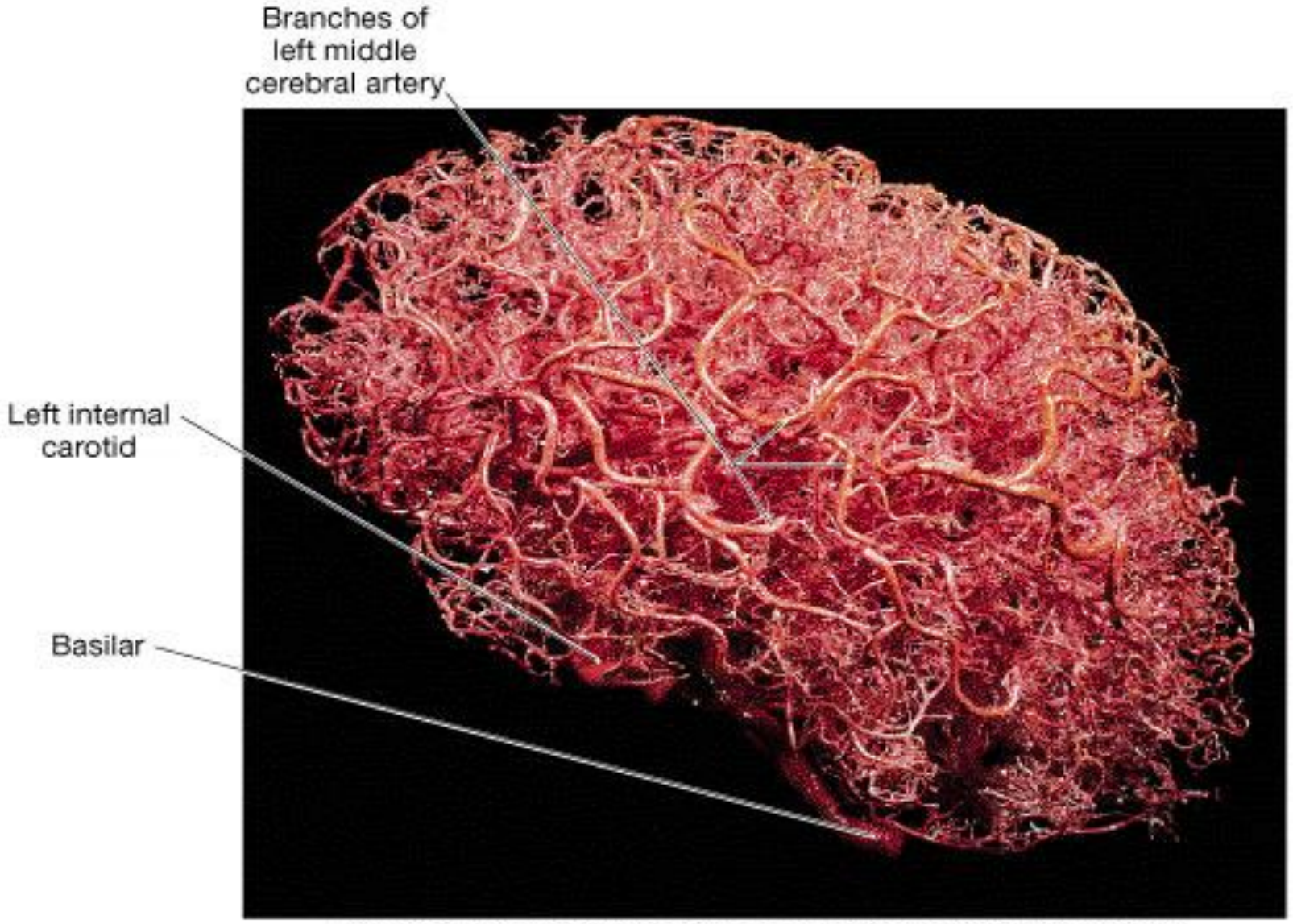
(a) Arteries of the brain, inferior view

Circle of Willis (up close)



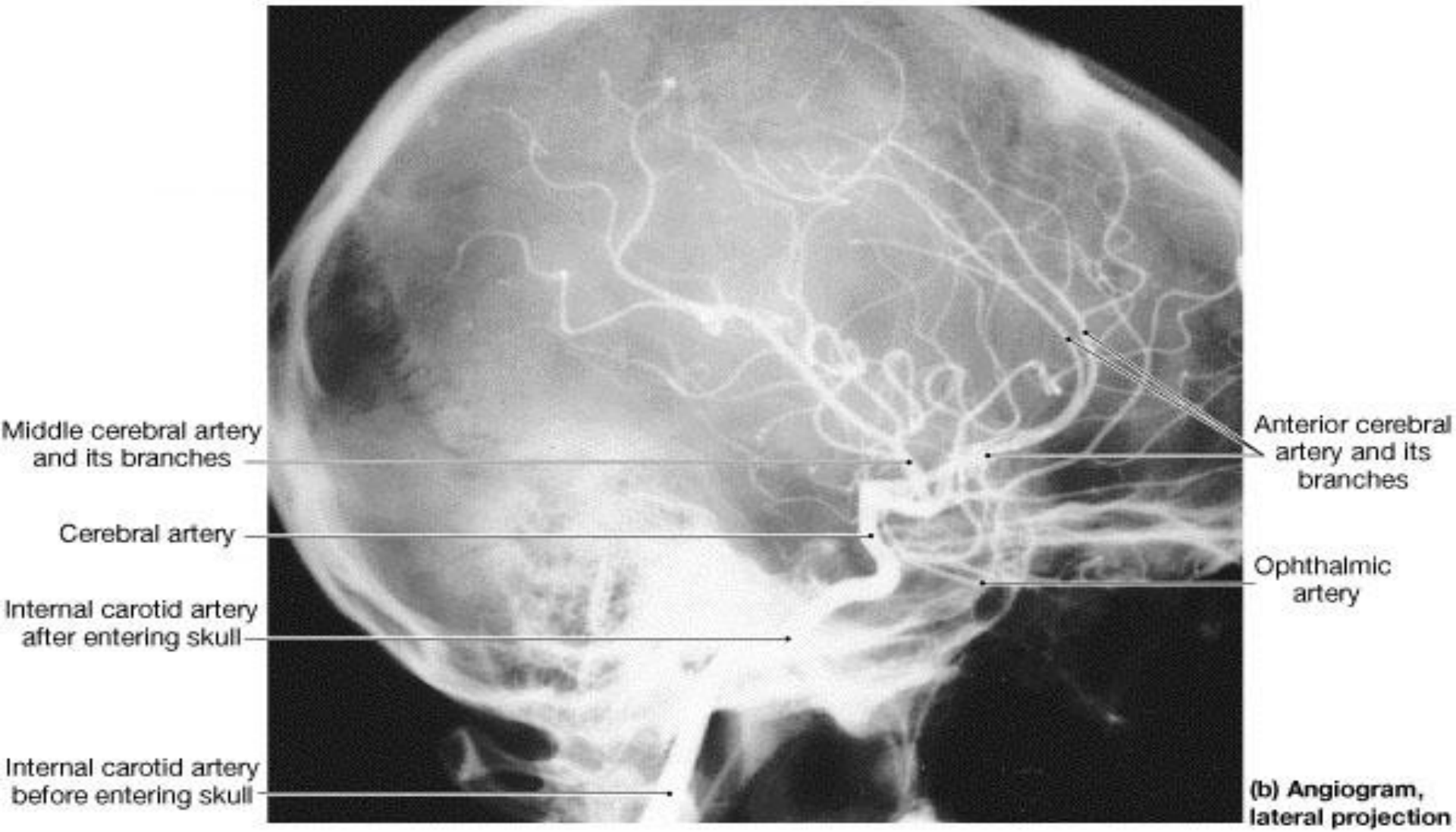
(b) Arteries injected to show cerebral arterial circle

That’s a lot of blood vessels!



(c) Corrosion cast of cerebral arteries, left cerebral hemisphere

Angiogram of blood flow to the brain

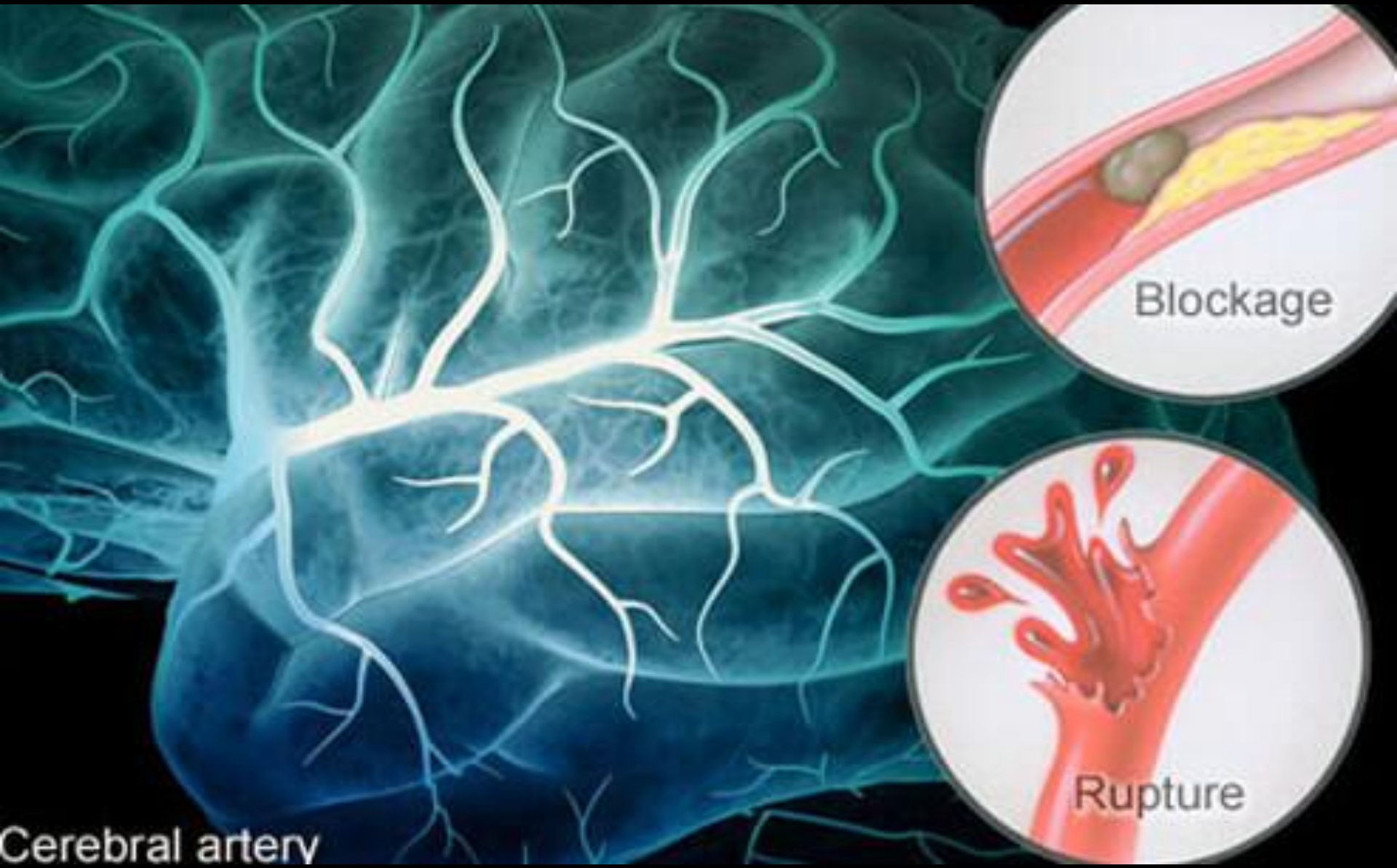


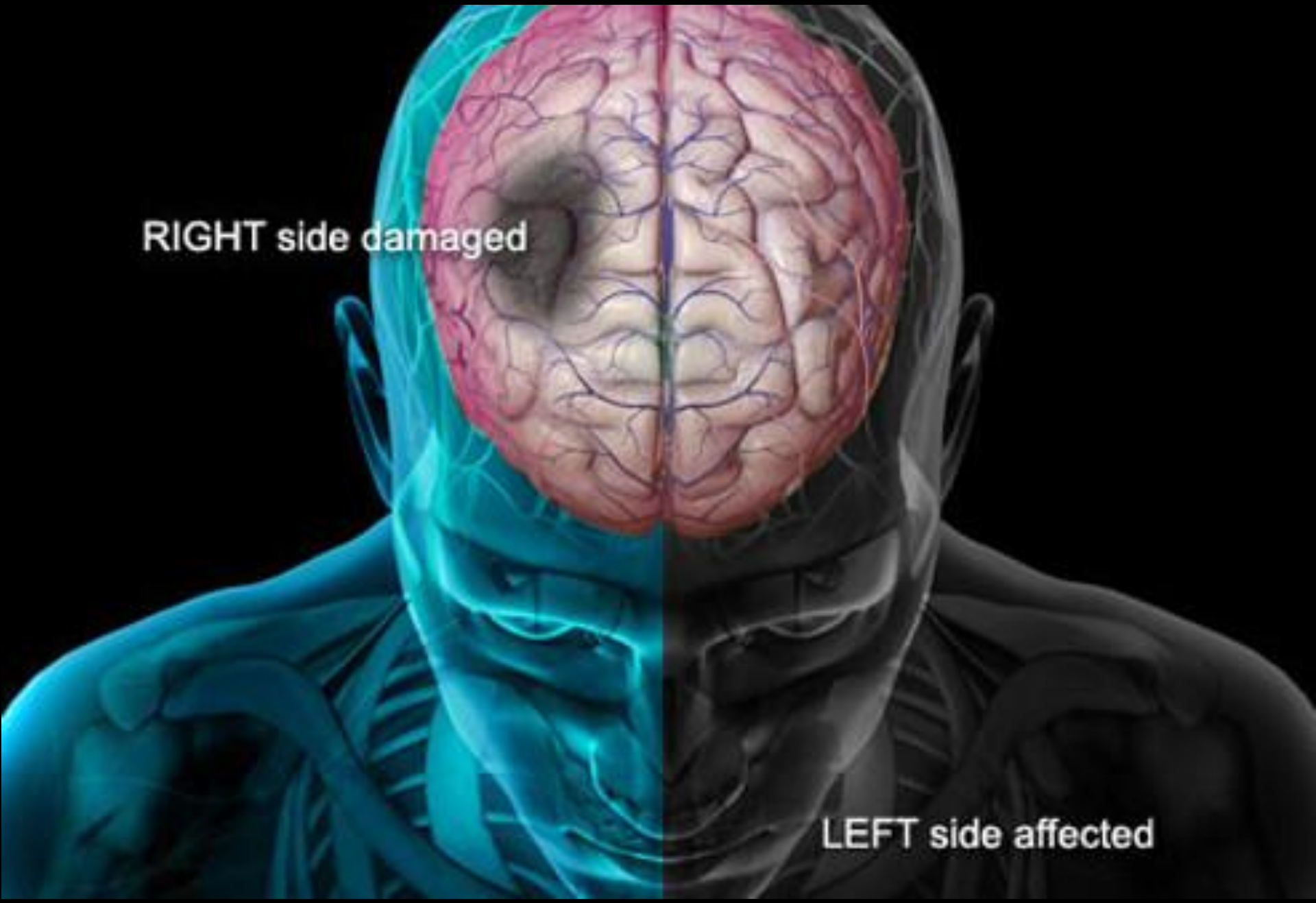

Next!
Some medical conditions associated with aging!
But first a short break

Neurodegenerative Diseases
MedicineNet.com

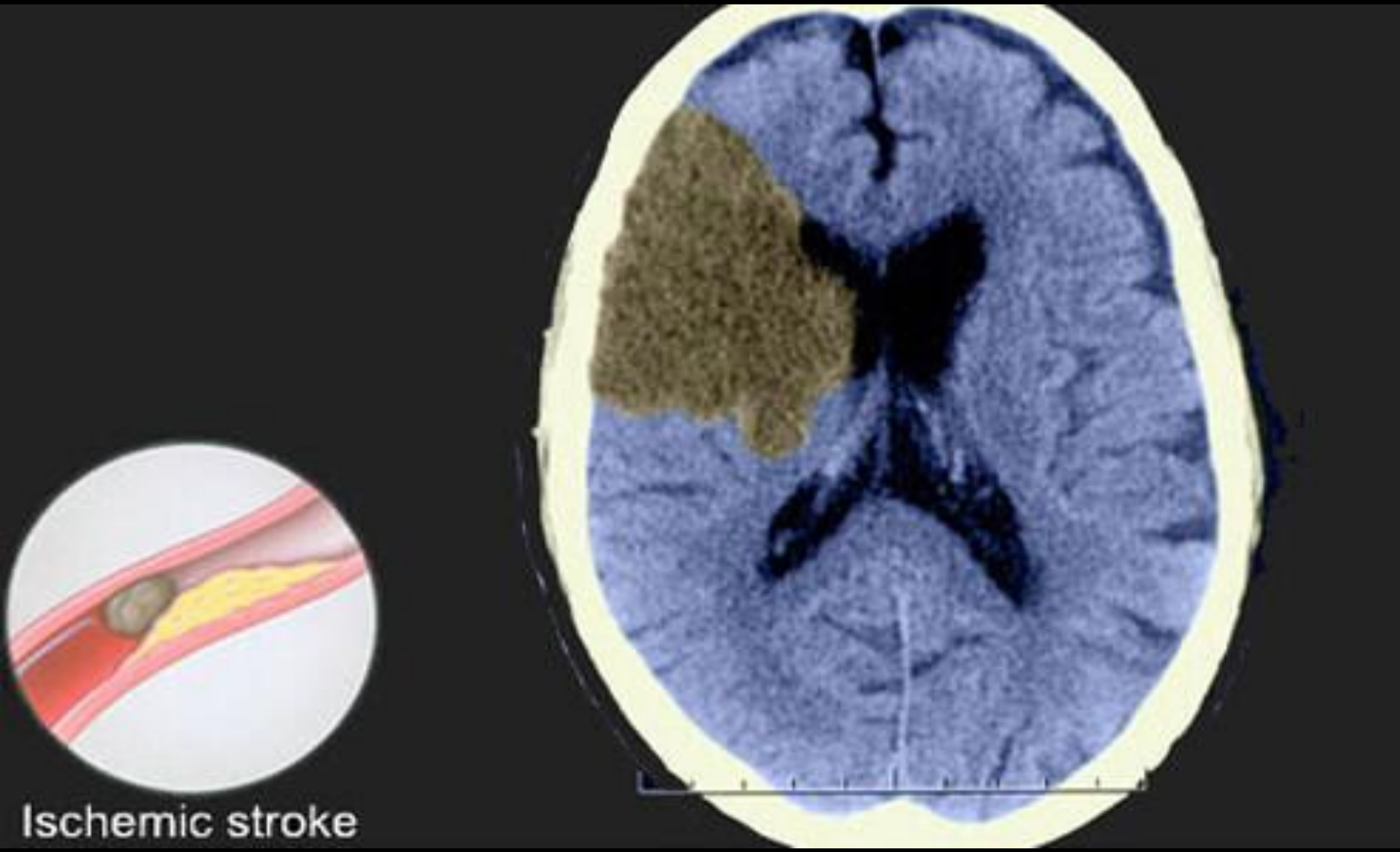
- Stroke
- Parkinson's Disease
- Huntington's Disease
- Dementia (Alzheimer's)
- Motor neuron diseases (amyotrophic lateral sclerosis [ALS], multiple sclerosis [MS])
- Cancer (tumour)
- Meningitis
- Other?

Causes of Stroke!

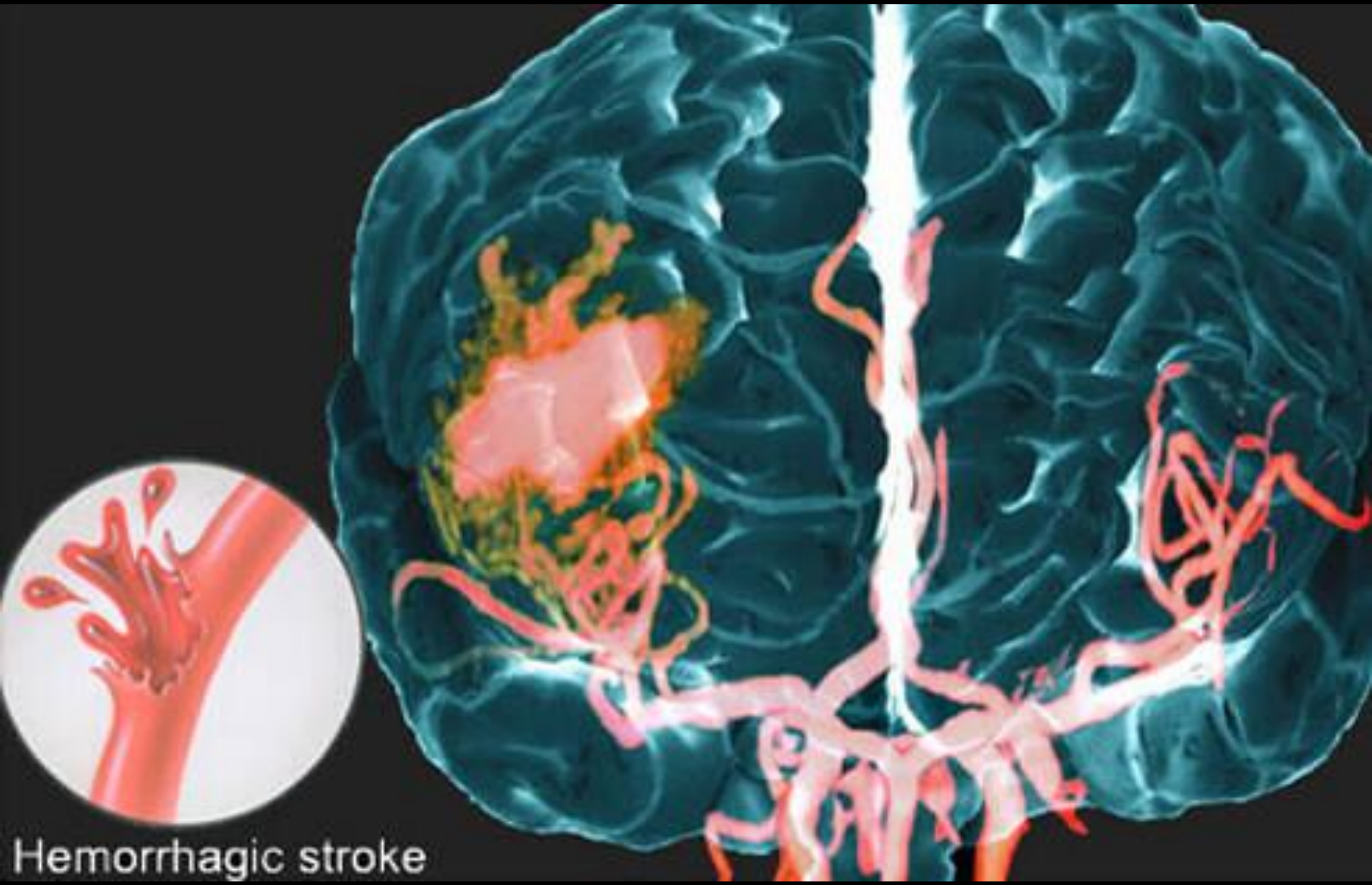



RIGHT side damaged
LEFT side affected

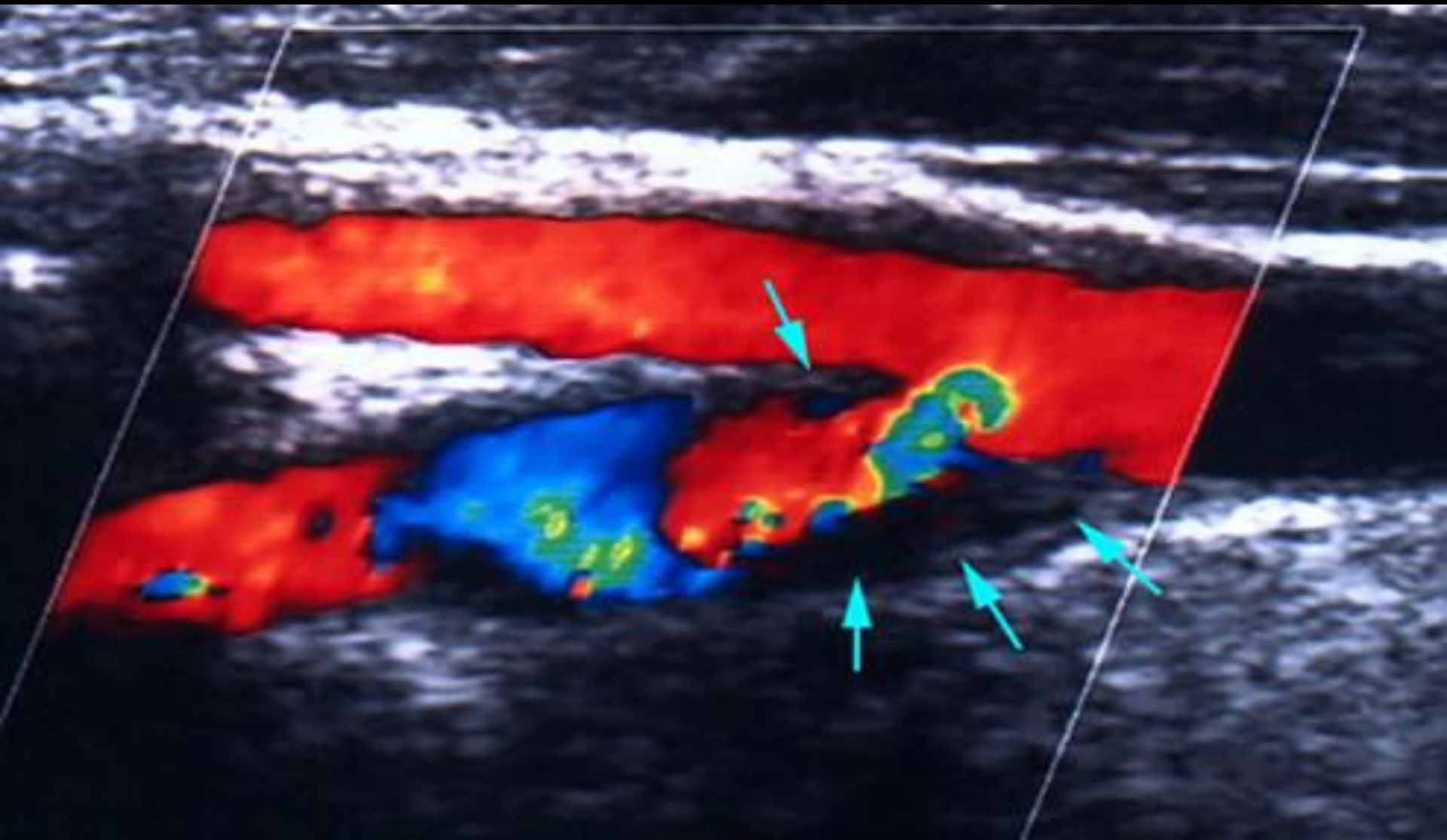
Ischemic Stroke



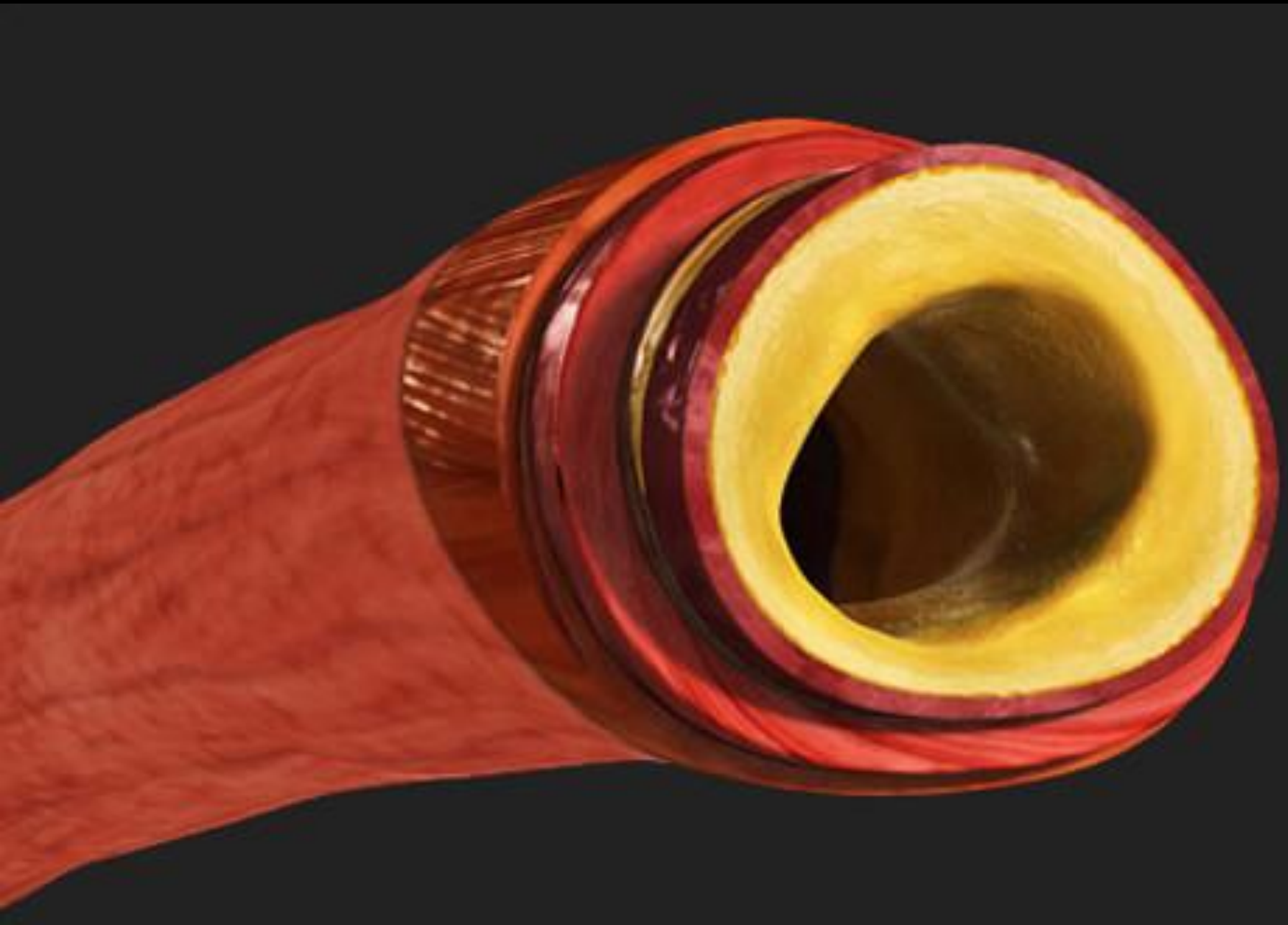
Hemorrhagic Stroke



Mini strokes (Transient Ischemic Attacks: TIA's)



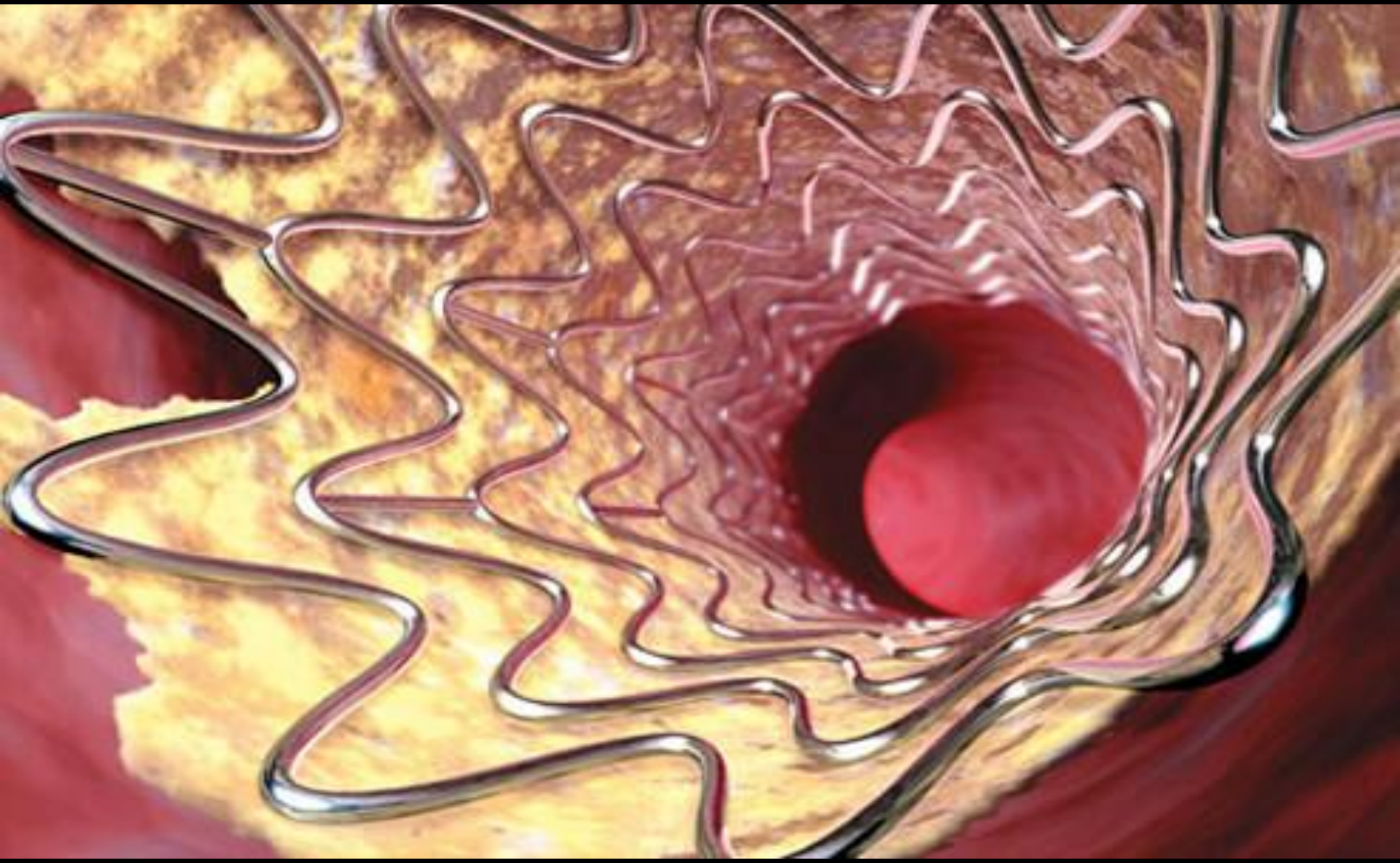
Atherosclerosis



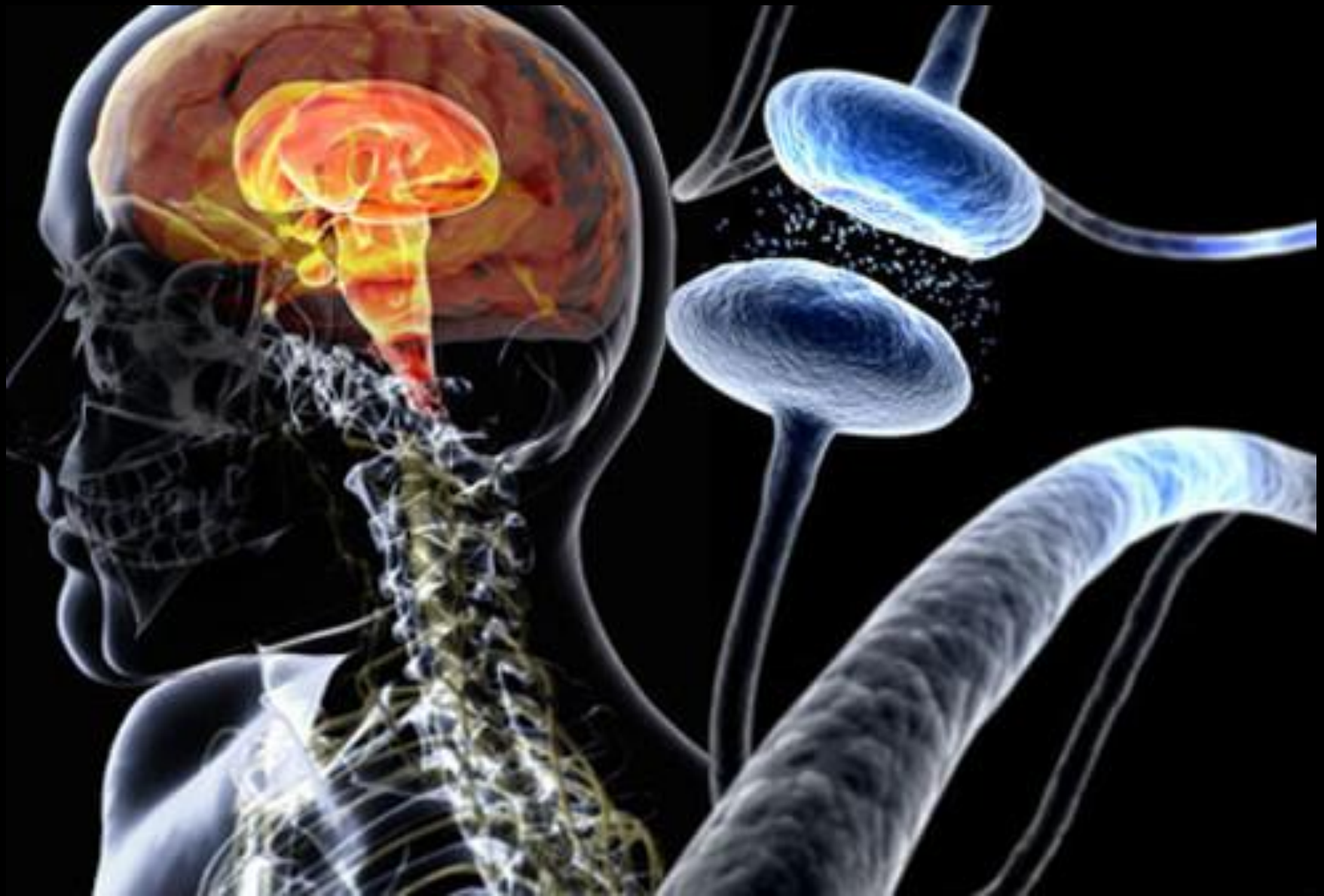
Treatments

Medications

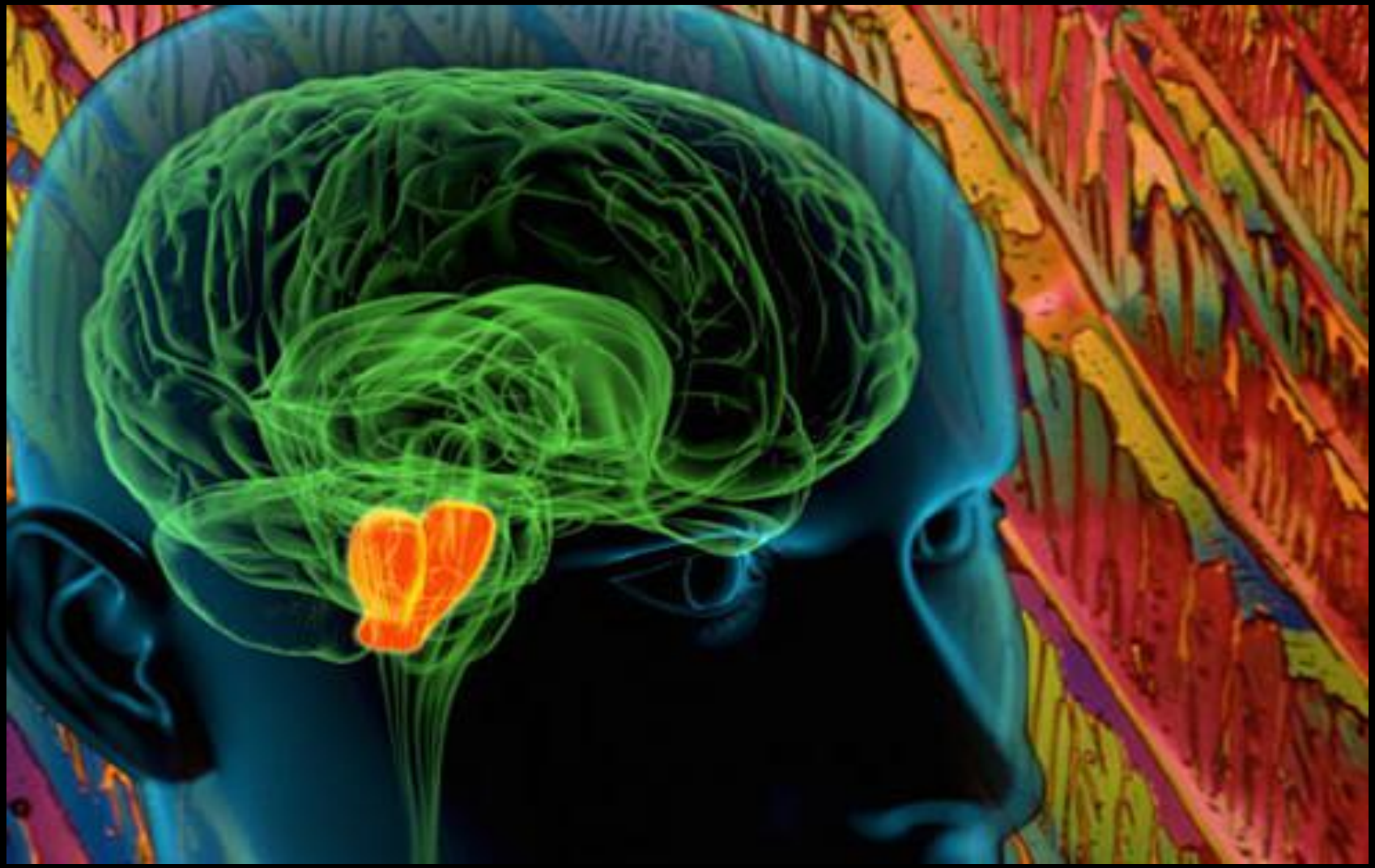
Surgical: Balloon and stint



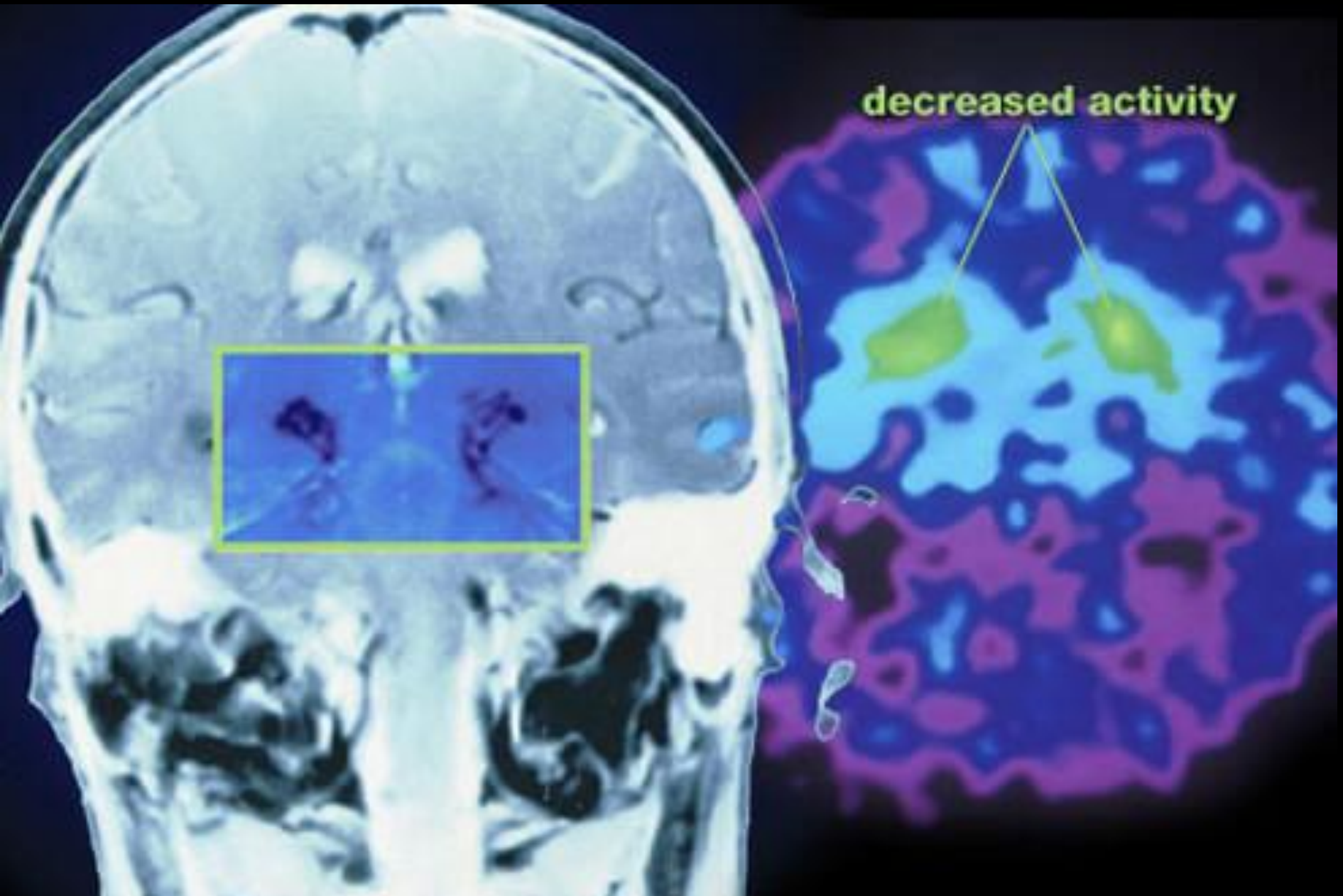
Parkinson's Disease



Parkinson's Disease Causes



Substantia Nigra → dopamine

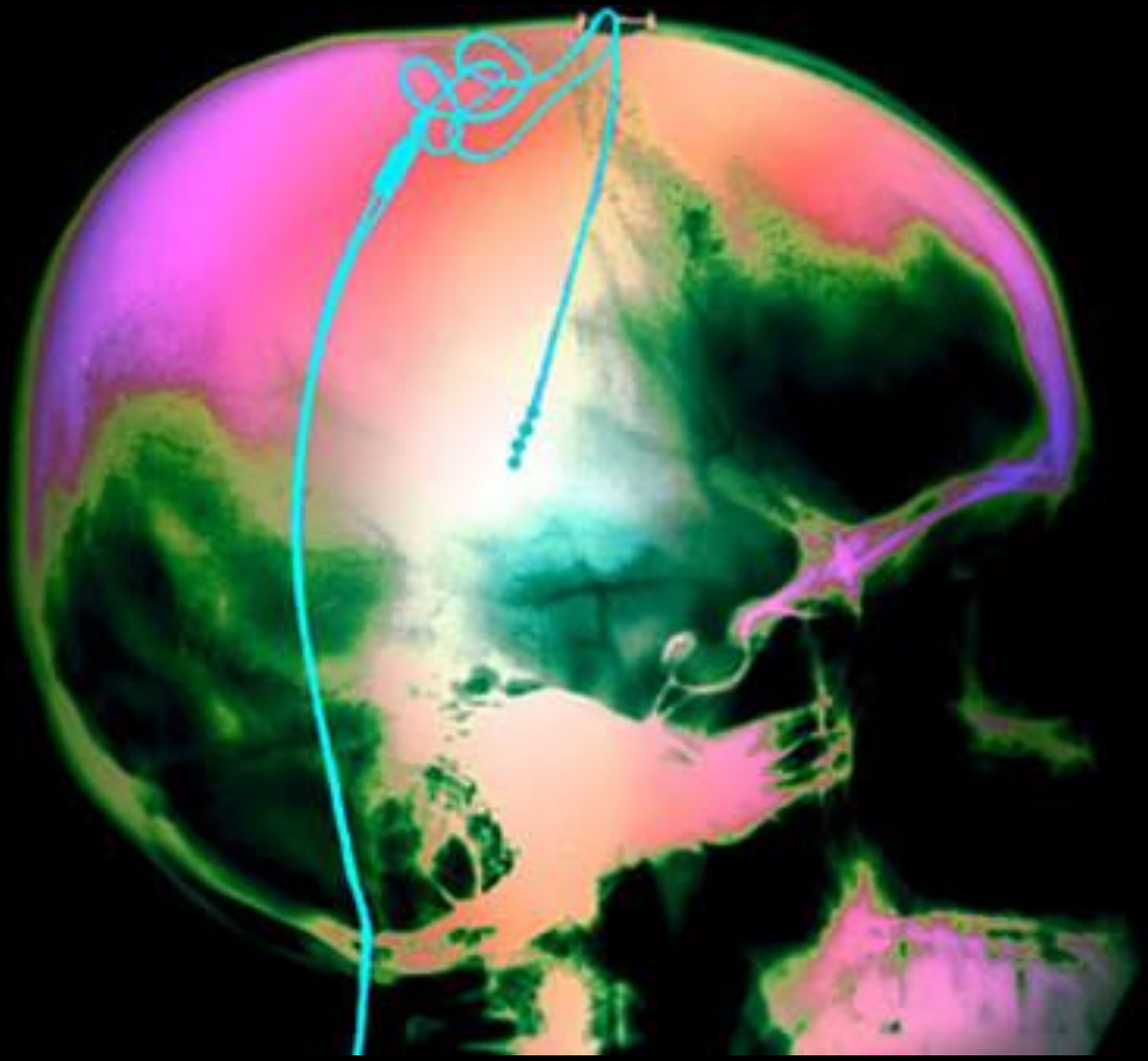

decreased activity

Treatment

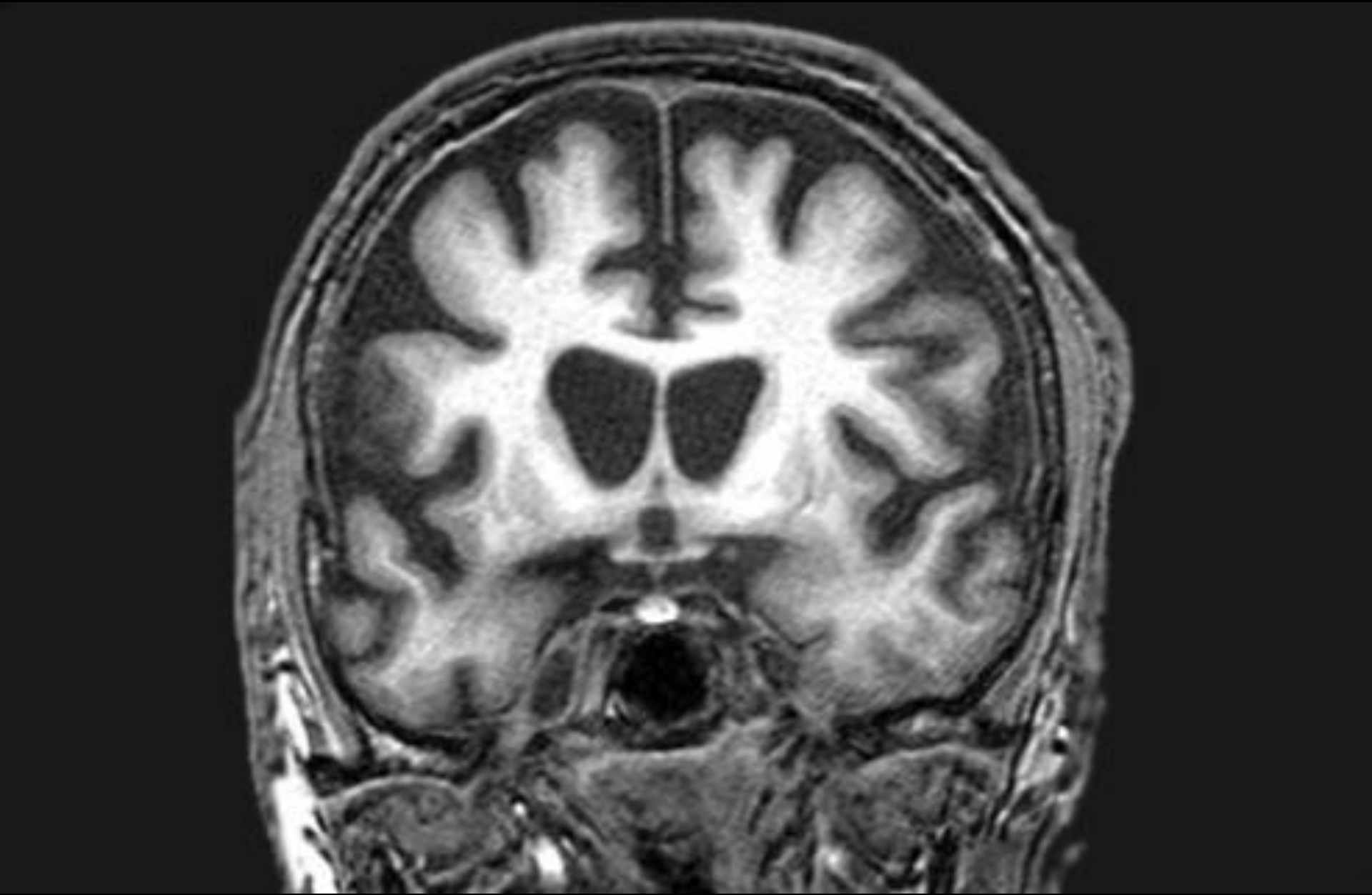
Parkinson's Treatment: ***Levodopa***

Levodopa, in the form of carbidopa and levodopa combined in a single tablet, has been the most effective medication to reduce or temporarily stop Parkinson's disease symptoms. The brain tissue converts this drug to dopamine. However, over time (about 6 years) the symptomatic reduction caused by the drug starts to fade and higher doses and other medications may be added. In addition, side effects of levodopa may develop (nausea, vomiting, mental changes, and involuntary movements), especially with use over years. These side effects can be reduced by slowly increasing the medication dose over time.

Parkinson's Surgery: Deep Brain Stimulation



Huntington’s Disease



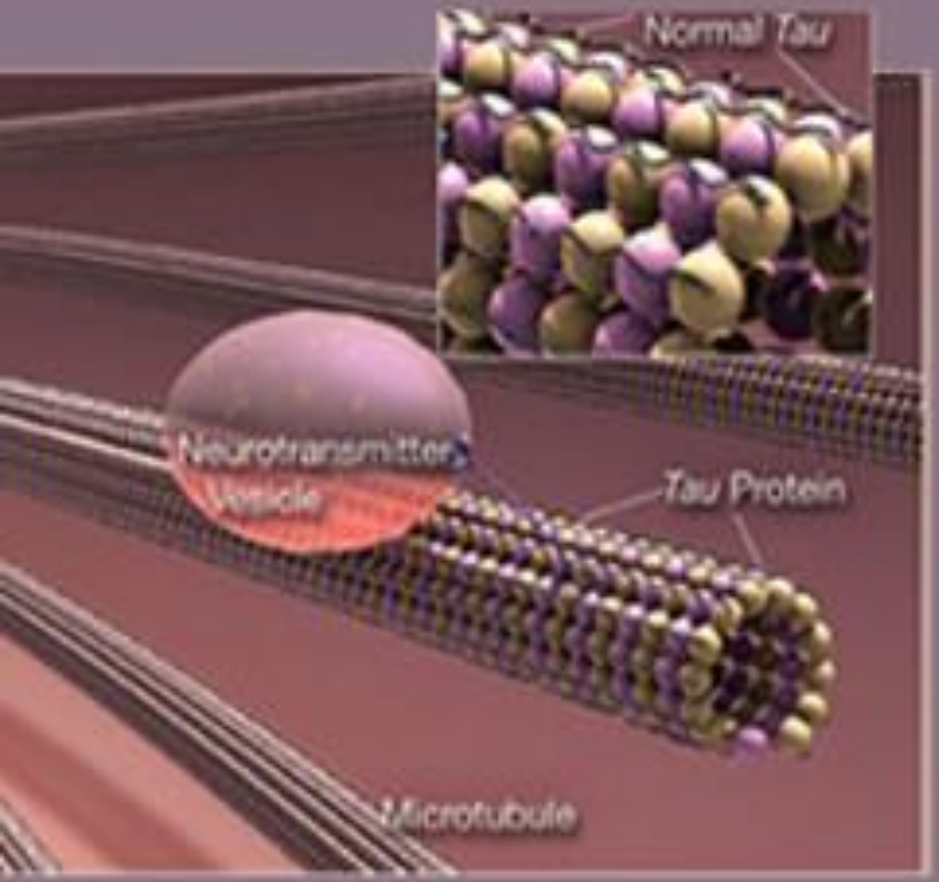
Dementia

Alzeimer disease

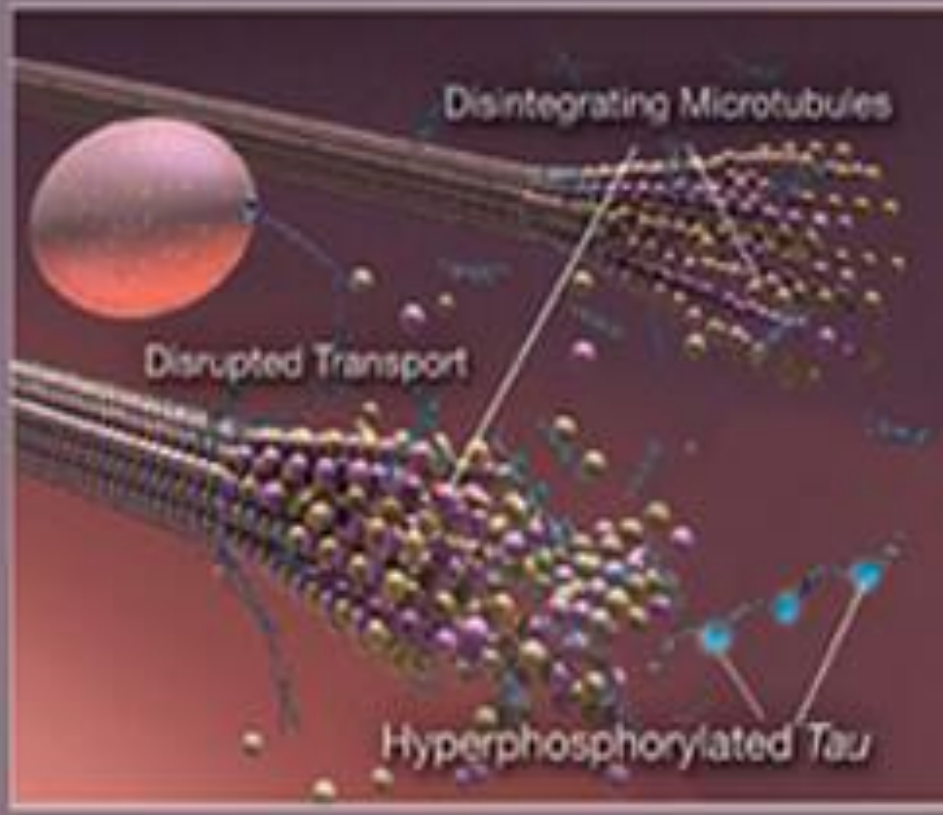
https://en.wikipedia.org/wiki/Alzheimer%27s_disease

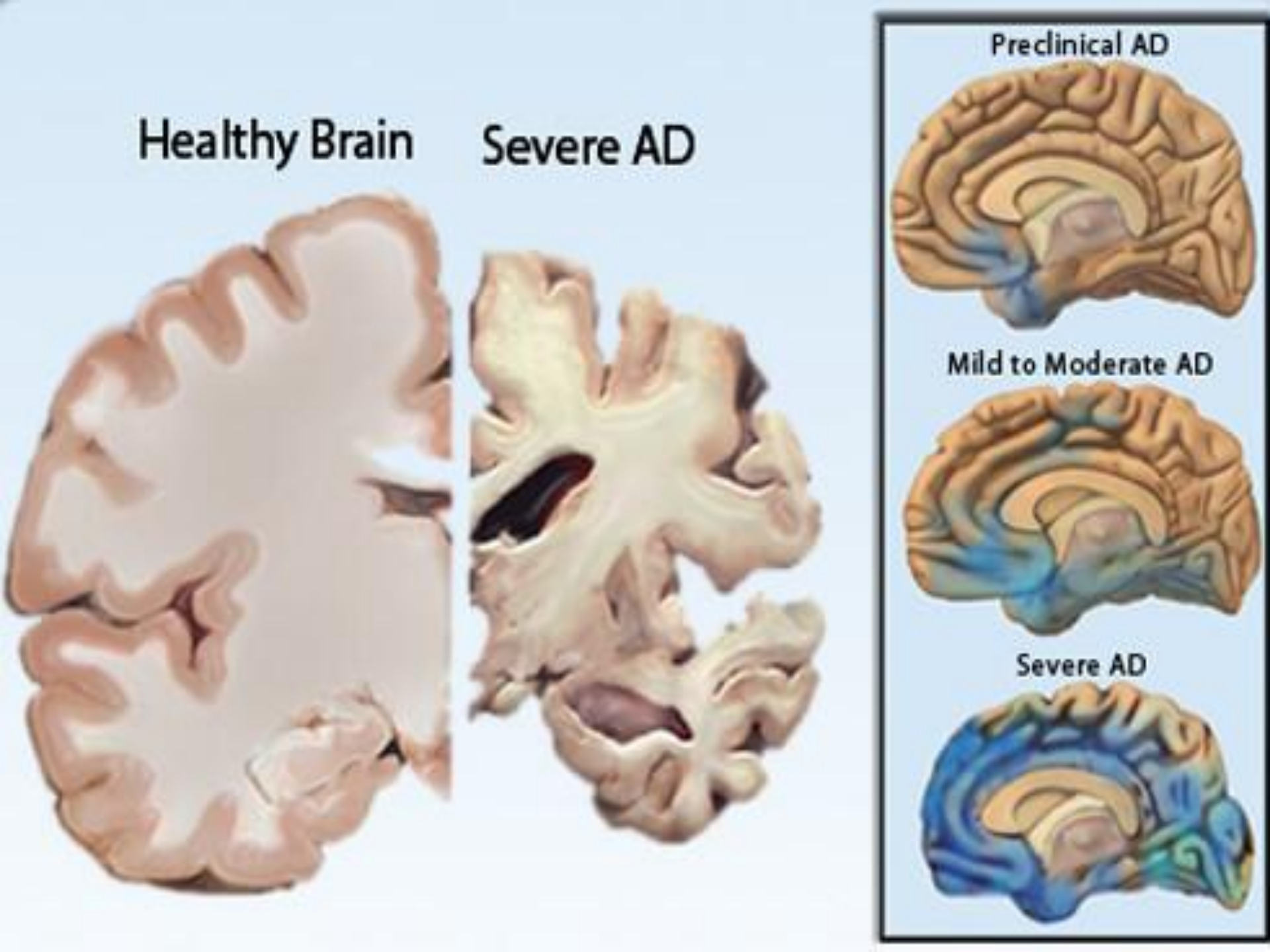
Types of Dementia	
Cortical Dementia	Dementia where the brain damage primarily affects the brain's cortex, or outer layer. Cortical dementias tend to cause problems with memory, language, thinking, and social behavior.
Subcortical Dementia	Dementia that affects parts of the brain below the cortex. Subcortical dementia tends to cause changes in emotions and movement in addition to problems with memory.
Progressive Dementia	Dementia that gets worse over time, gradually interfering with more and more cognitive abilities.
Primary Dementia	Dementia such as Alzheimer's disease that does not result from any other disease.
Secondary Dementia	Dementia that occurs as a result of a physical disease or injury.

Inside a Healthy Neuron

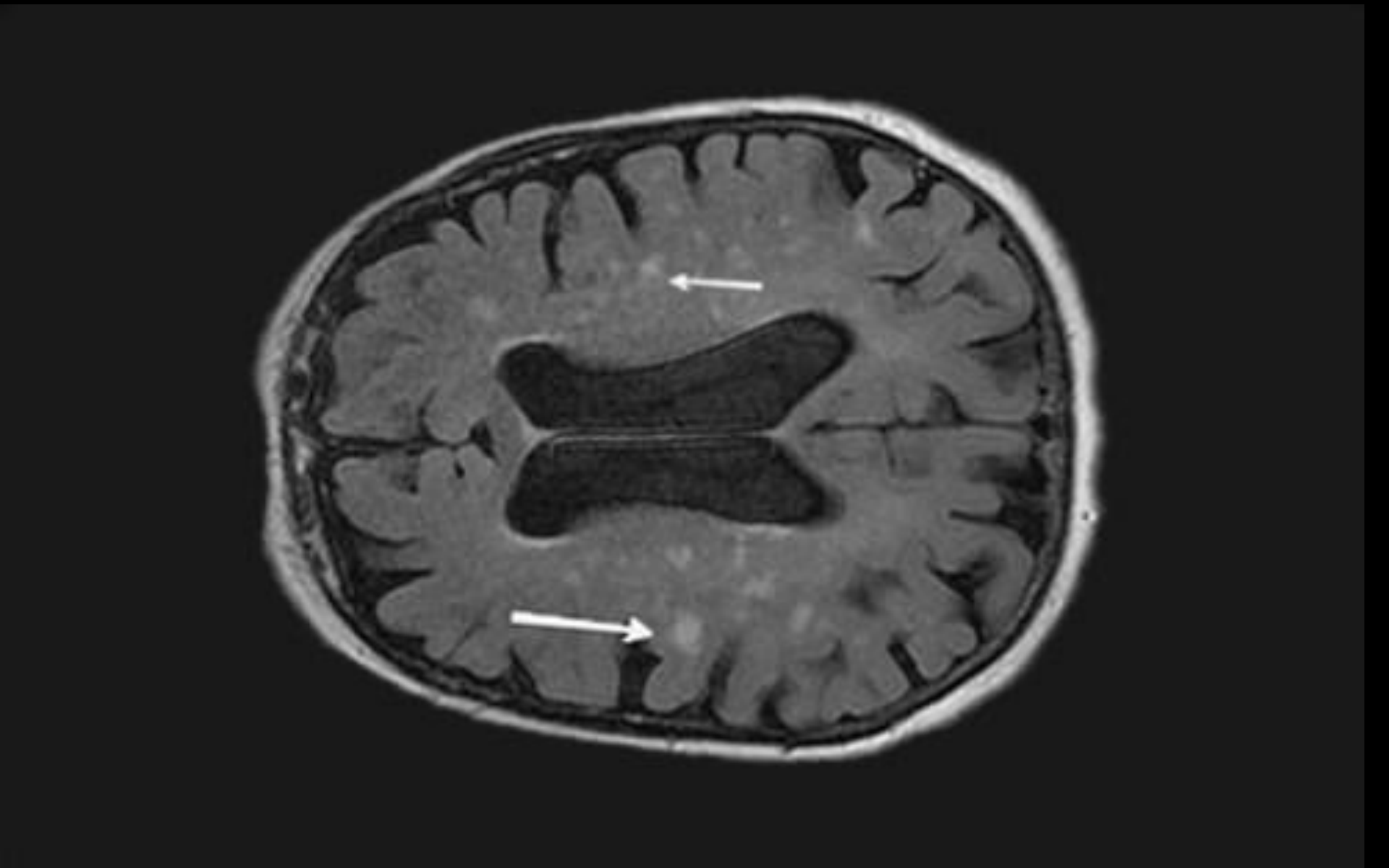


Inside a Diseased Neuron

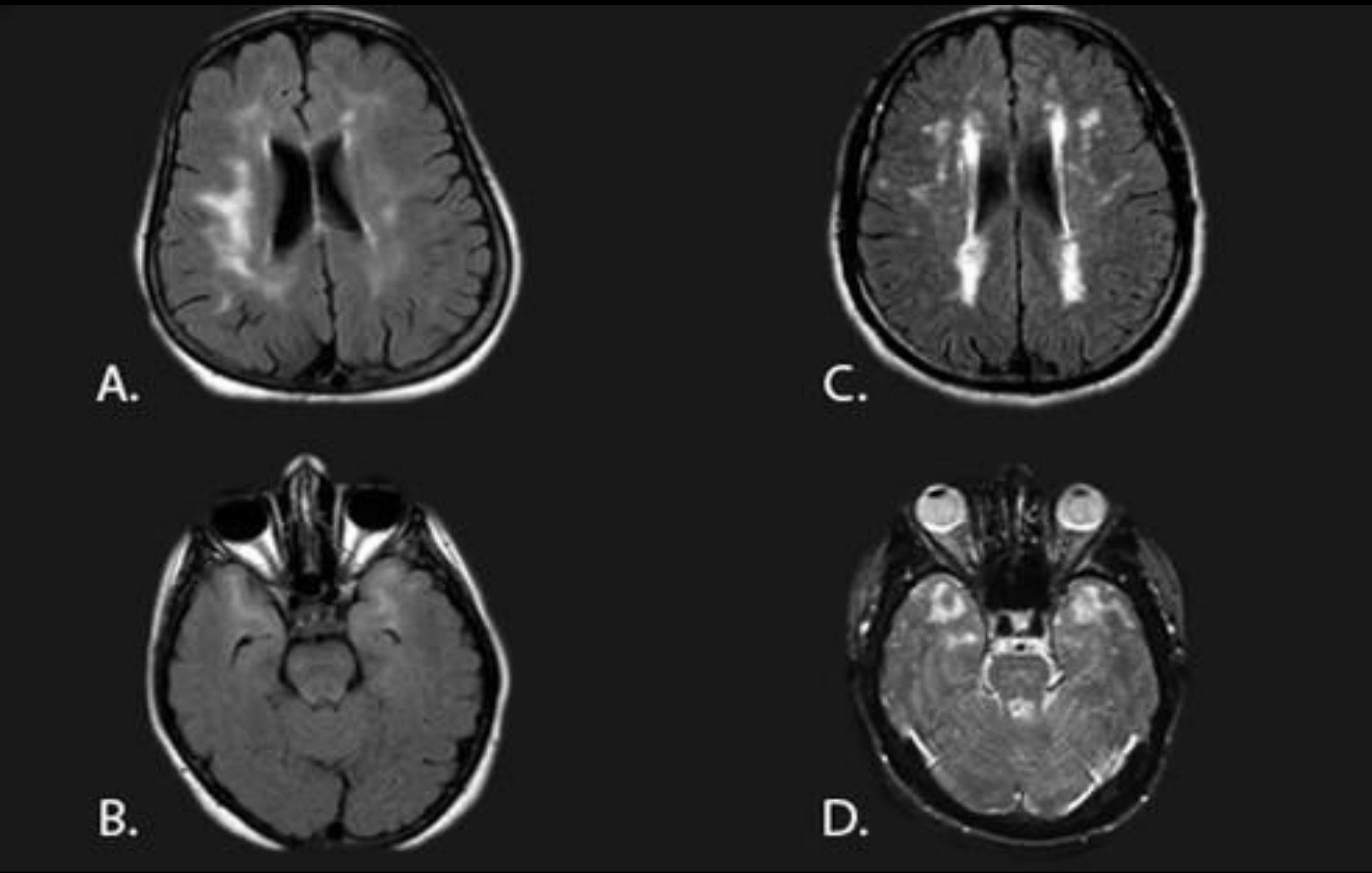



Healthy Brain
Severe AD
Preclinical AD
Mild to Moderate AD
Severe AD

Vascular Dementia

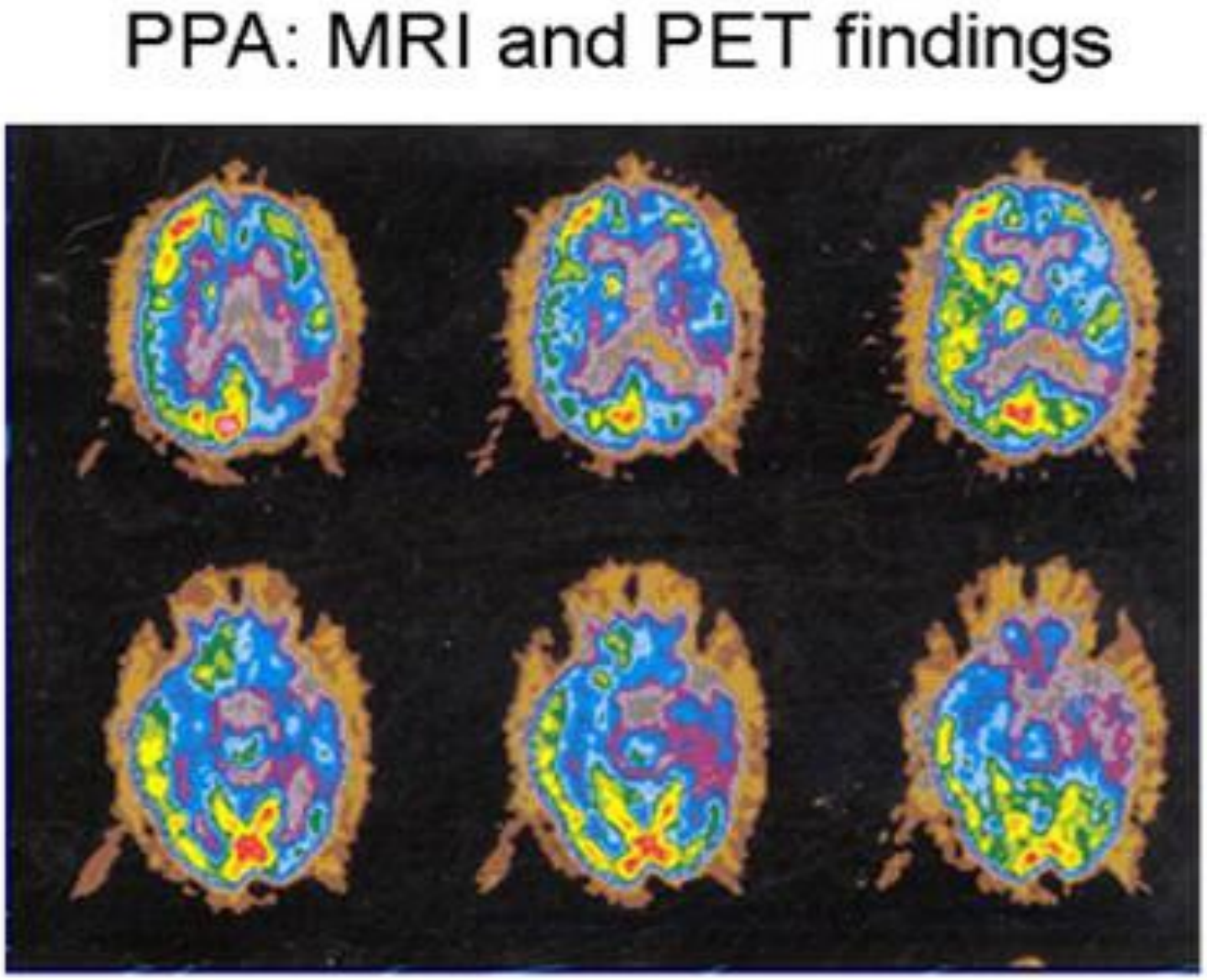


Multi-Infarct Dementia



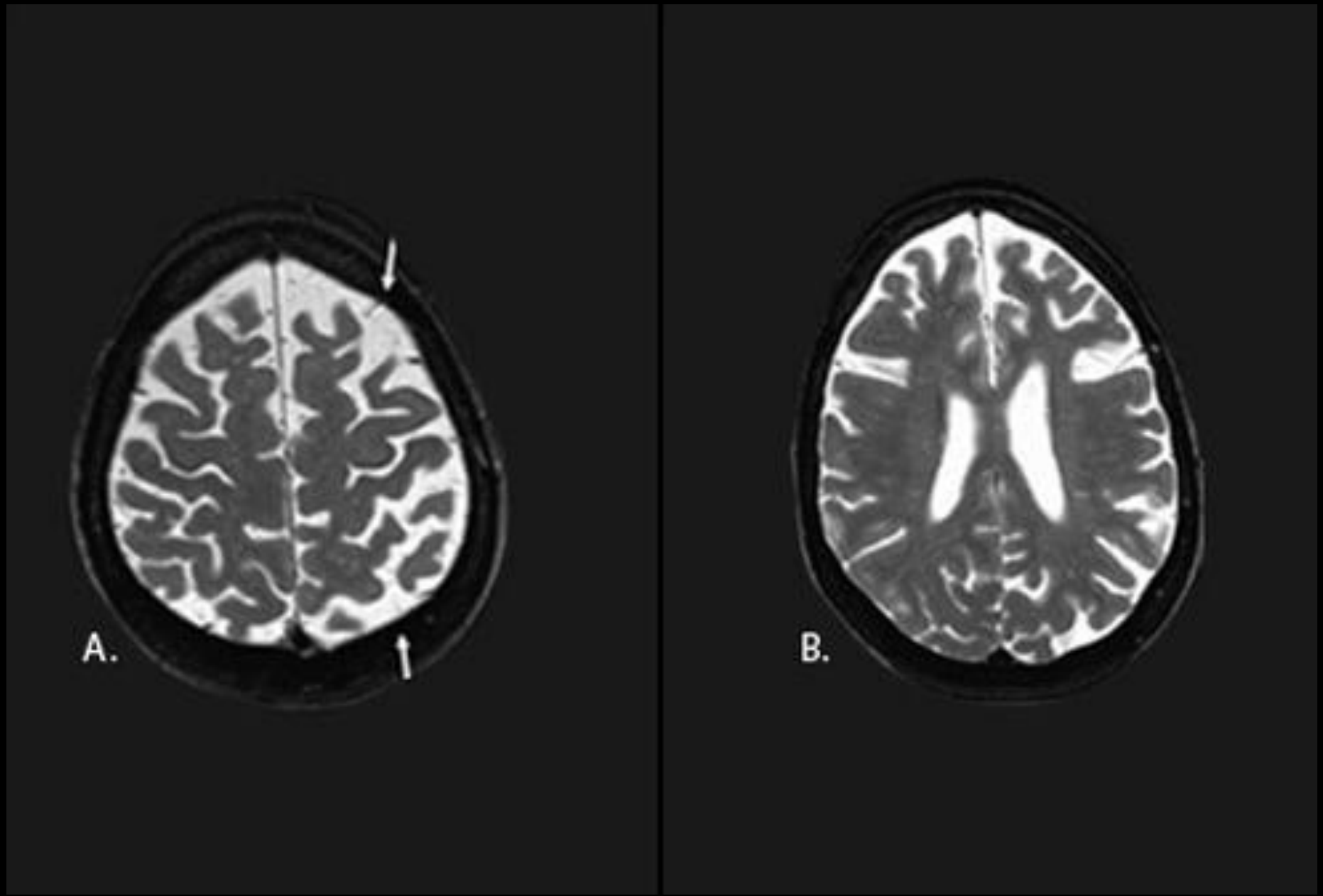
Lewy Body Dementia

Frontotemporal dementia (FTD)
Pick's Disease

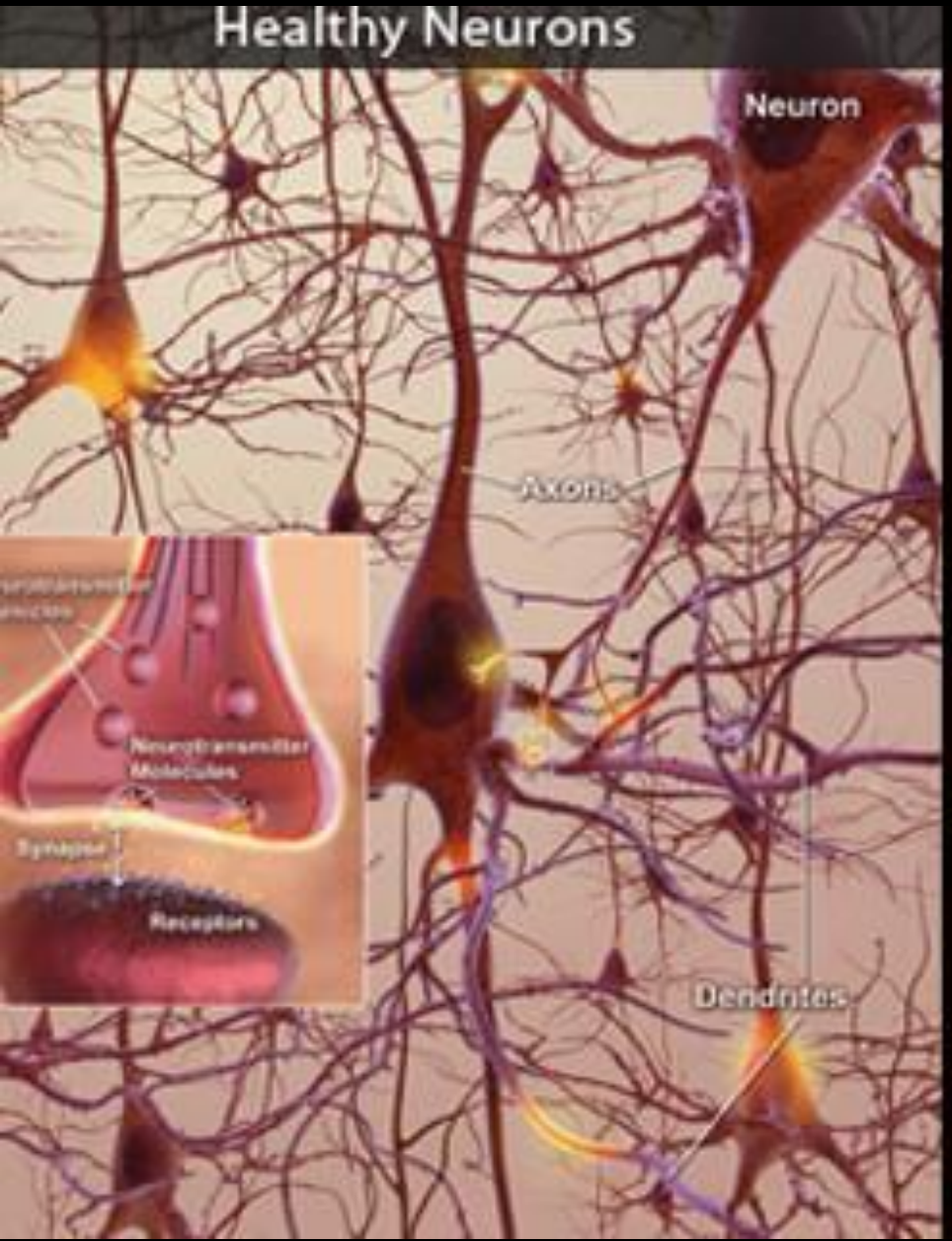


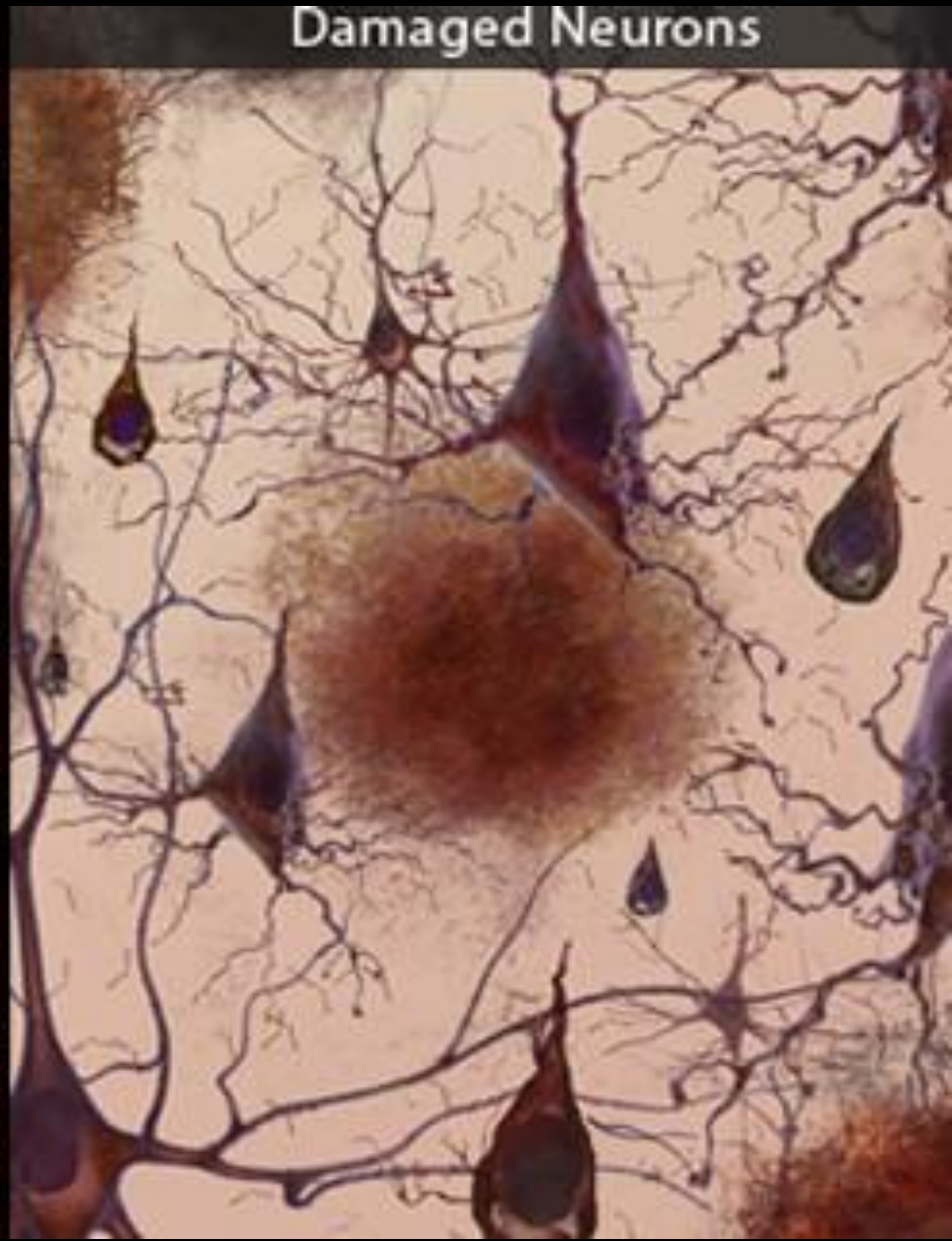
Dementia Pugilistica

Corticobasal Degeneration (CBD)

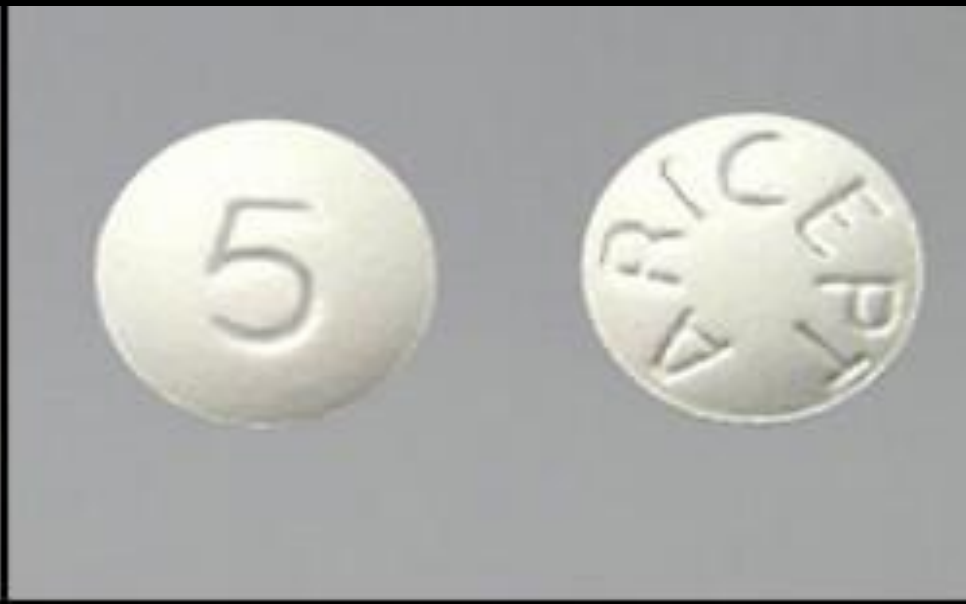


Causes





Treatments



Motor Neuron Disease
Terminology

Lower motor neuron ⟷ **Upper motor neuron**

Progressive Muscular Atrophy	Amyotrophic Lateral Sclerosis	Primary Lateral Sclerosis

Lou Gehrig's Disease (ALS)

- Stephen Hawking is a famous theoretical physicist who has ALS

Amyotrophic Lateral Sclerosis
Clinical Presentation

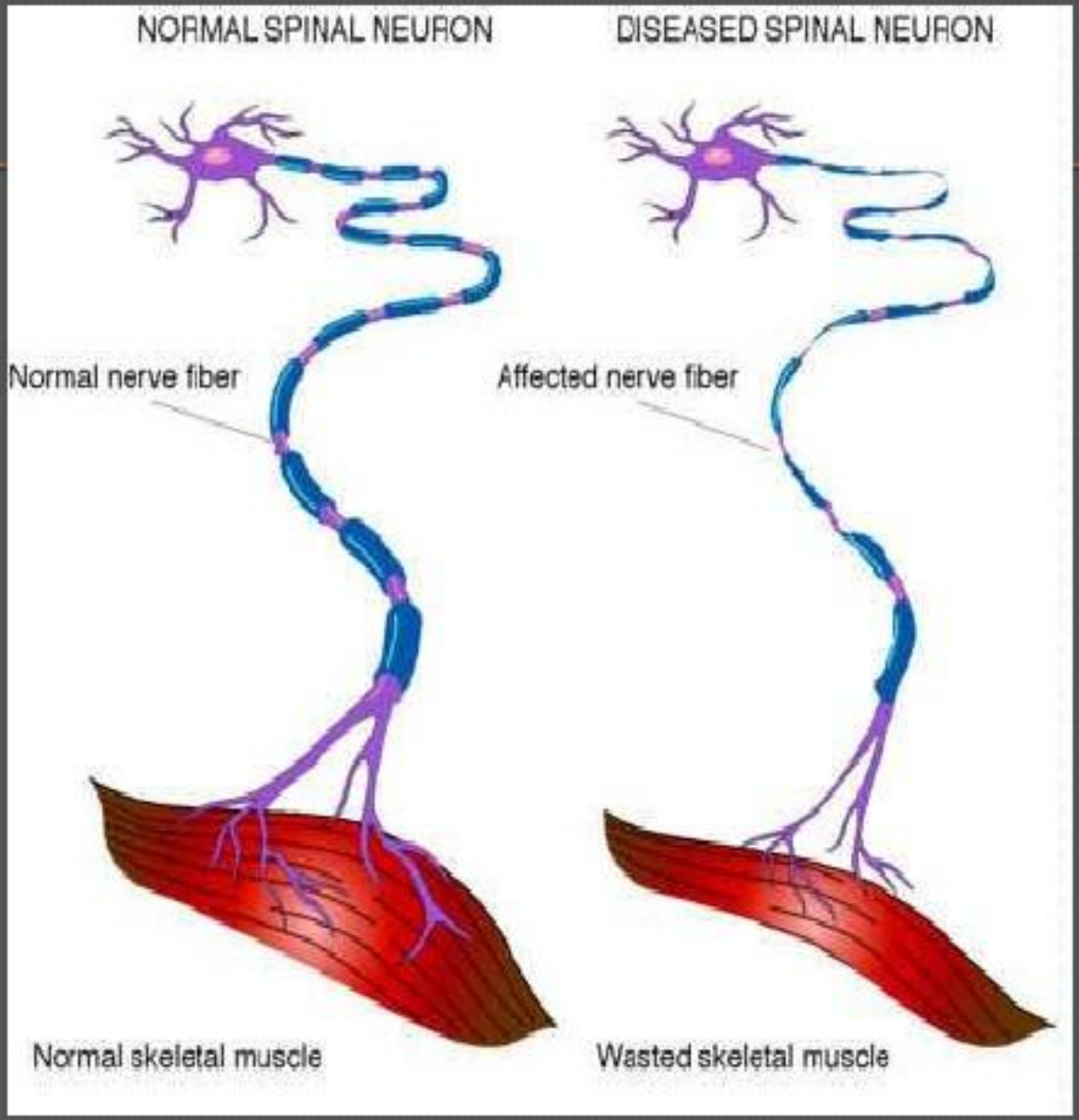
- Lower motor neuron signs
  - Weakness, muscle wasting, hyporeflexia, muscle cramps, fasciculations
- Upper motor neuron signs
  - Spasticity, hyperreflexia, weakness

Amyotrophic Lateral Sclerosis
Pathology

- Degeneration and death of motor nerves
  - Upper Motor Neuron
    - within brain/spinal cord
  - Lower Motor Neurons
    - leaves brain (stem)/spinal cord
- Relatively spared
  - Eye movements and bowel/bladder function

Lou Gehrig's Disease (ALS)

- ALS occurs when neurons in the brain's motor cortex and in the spinal cord die.
- The neurons that die are responsible for controlling voluntary muscles and the ability to move.
- The person will become weak and paralyzed.
- There is probably a genetic link because this disease runs in families.


NORMAL SPINAL NEURON
DISEASED SPINAL NEURON
Normal nerve fiber
Affected nerve fiber
Normal skeletal muscle
Wasted skeletal muscle

What is ALS?

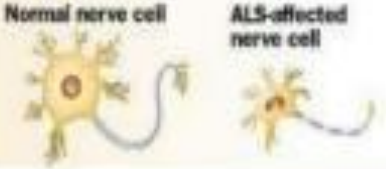
ALS (Amyotrophic Lateral Sclerosis), also known as Lou Gehrig's disease, is a fatal disease of the nervous system, characterized by progressive muscle weakness resulting in paralysis.

What are motor neurons?

Motor neurons are nerve cells in the brain and spinal cord that attach to muscles and control voluntary movement.

How does ALS progress?

When motor neurons gradually degenerate and die, the muscles no longer receive nerve impulses. As a result of the nerve death, the muscles shrink and waste away.



A closer look at a healthy nervous system

Nervous system

The basic unit of the nervous system is a highly specialized cell, known as a neuron. Its main purpose is to transport messages from one part of the body to another in the form of nerve impulses.

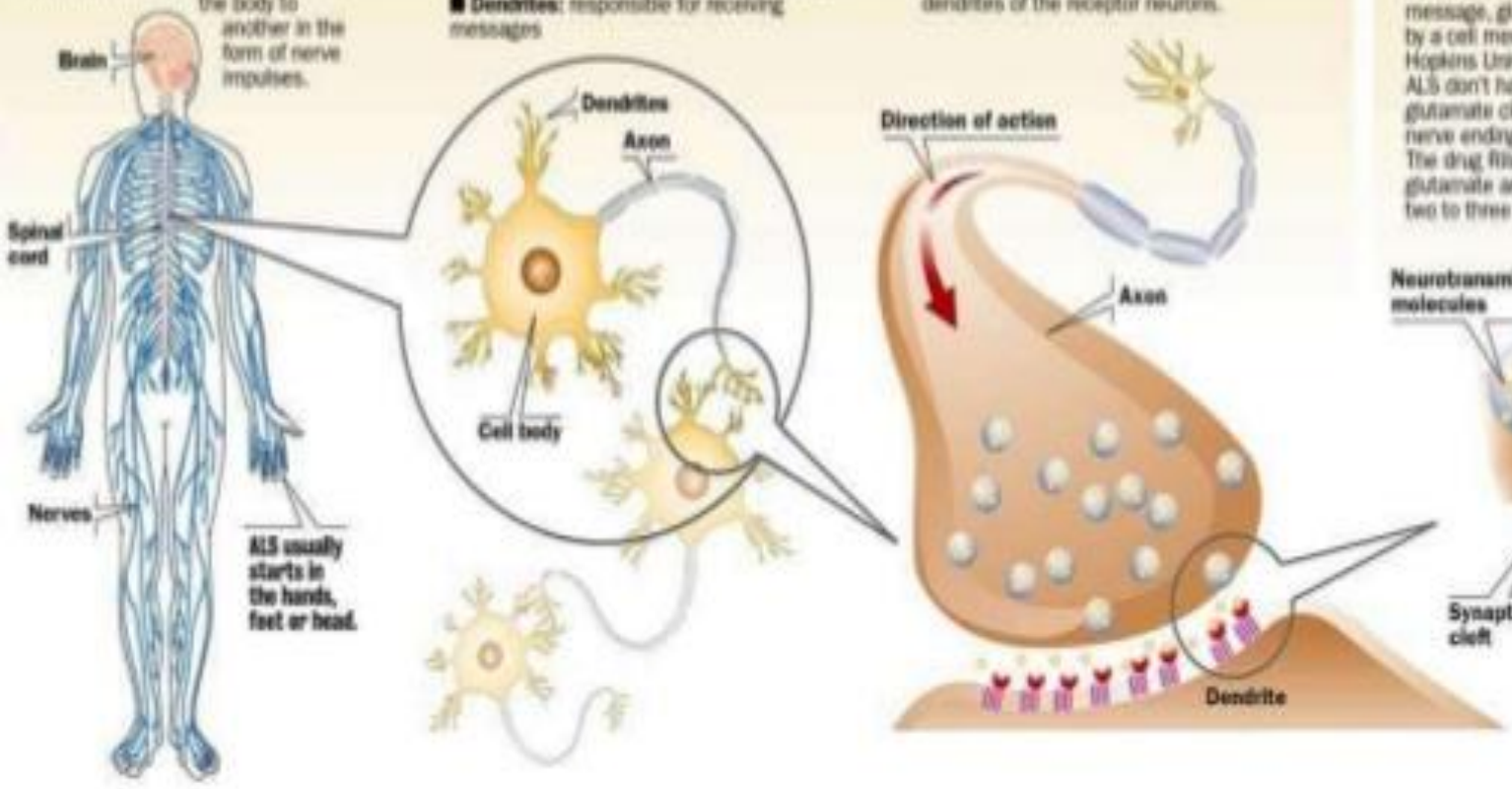
Motor neuron

A motor neuron is made up of three main functional parts.

- **Cell body:** biosynthetic center of the cell
- **Axon:** responsible for sending messages
- **Dendrites:** responsible for receiving messages

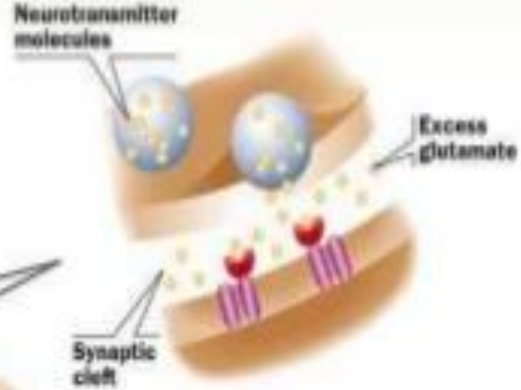
Nerve impulse

A nerve impulse is transmitted when the terminal fibers of one neuron's axon release chemicals called neurotransmitters that attach to dendrites of the receptor neurons.



A possible cause of ALS: Too much glutamate

Scientists aren't sure what causes ALS, but glutamate poisoning is a popular theory. Glutamate is an amino acid that acts as a neurotransmitter, allowing motor neurons to "talk" to one another. After transmitting a message, glutamate is supposed to be vacuumed up by a cell membrane protein. But researchers at Johns Hopkins University in Baltimore suggest people with ALS don't have enough of that protein. Over time, glutamate clogs the synaptic cleft, the space between nerve endings, and chokes motor neurons to death. The drug Rilutek slows the body's production of glutamate and keeps ALS patients alive for an extra two to three months.



Dulce Tenatoloko/Huntsville Times


Normal
ALS

Signs and Symptoms

Depend on the location of the disease **ALS** divides into three areas: lower motor neuron, corticospinal tract, and corticobulbar tract dysfunction

Regardless the part of the body first affected by the disease, muscle hypotonicity and atrophy spread to other somatic effectors as the disease progresses (Atchison & Dirette, 2007).

Patients have increasing problems with moving, swallowing (dysphagia), and speaking or forming words (dysarthria) (Wijesekera & Leigh, 2010).

Diagnosis of Lou Gehrig's Disease (ALS)

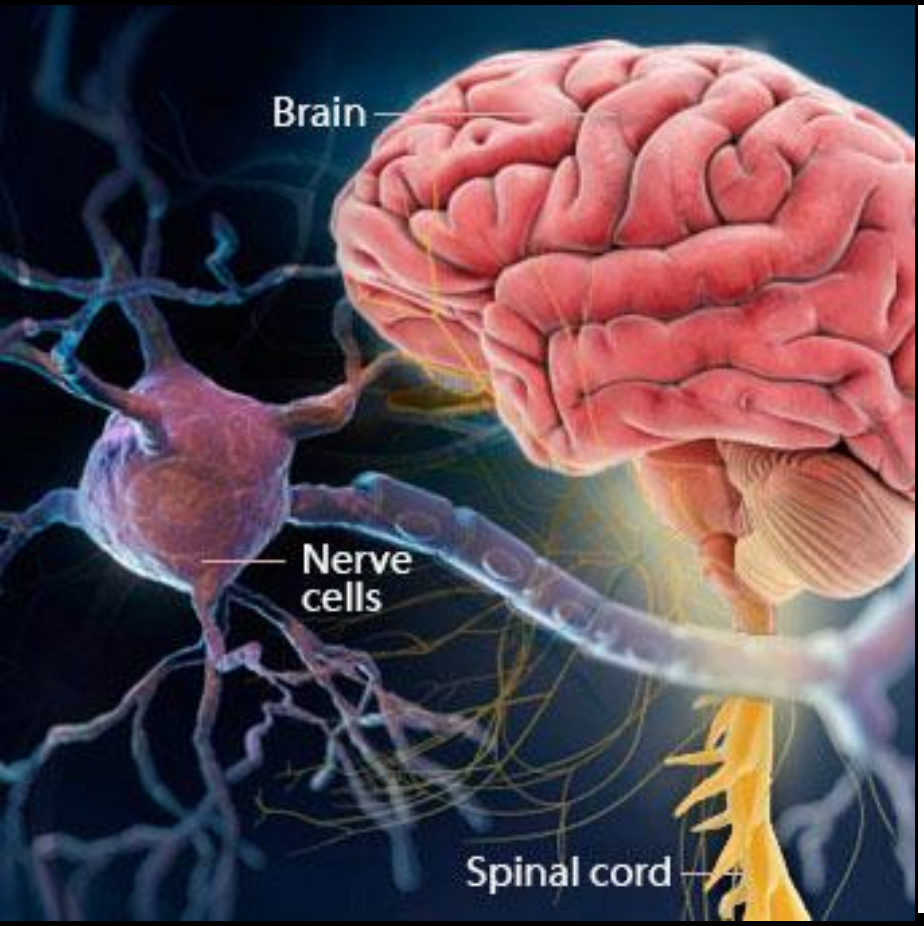
- It is difficult to diagnose ALS because the symptoms are similar to those of other neuromuscular disorders, many of which are treatable.
- The diagnosis is usually based on a complete neurological examination and clinical tests. If a person has ALS, the neurological examination would usually show evidence of muscle weakness (either in small areas or in more widespread areas, depending on how far advanced the ALS is).
- It also would reveal if there is muscle atrophy (wasting or loss of *muscle* tissue resulting from disease or lack of use).
- The muscles may also be so stiff when the doctor moves them that they continue to move in abnormal ways afterwards.
- When the doctor checks the "knee jerk" reaction, the movement of the leg is much quicker than in normal patients. Because ALS affects voluntary muscles, the exam usually does not reveal any differences from normal in the sense (vision, hearing, taste, smell, and touch).

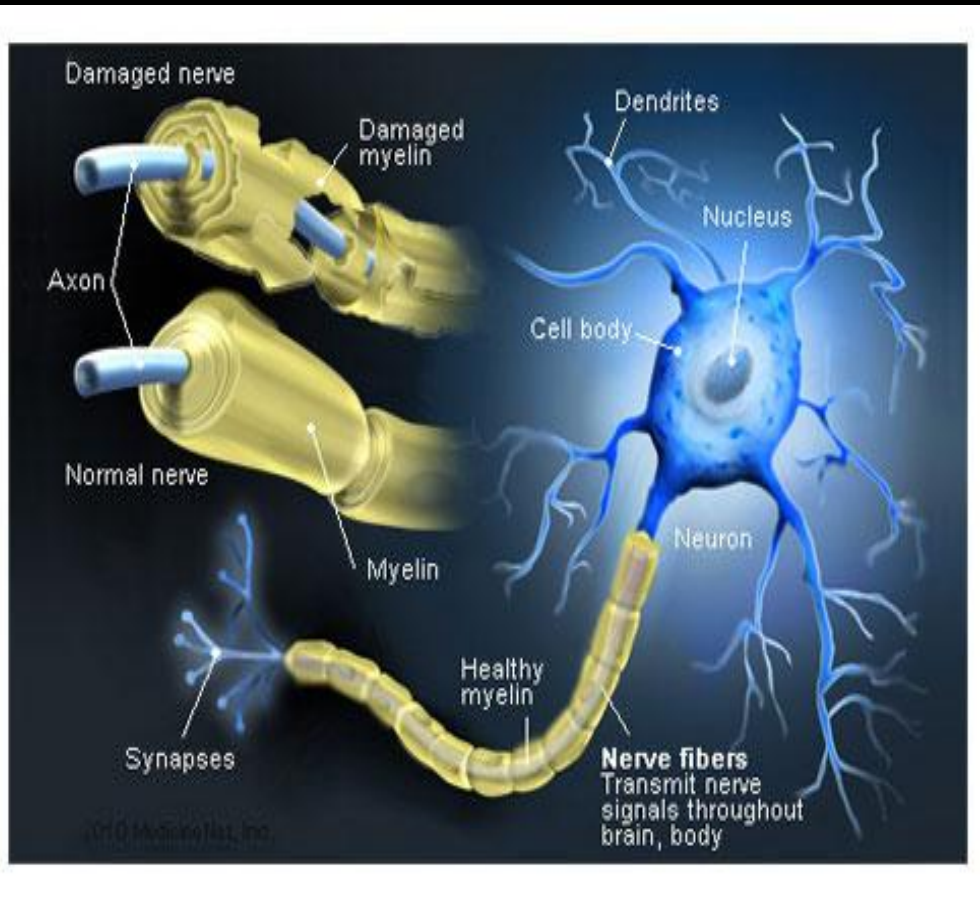
Prognosis & Treatment

- Currently there is no known medical cure to alter the fatal progression of ALS.
- Gradual death 1-5 years from diagnosis due to respiratory problems, though course is progressive and rapid.
- Riluzole remains to be the only compound licensed for use since it reduces damage to motor neurons by decreasing the release of glutamate and modifies the rate of evolution (Corcia & Meininger, 2008).
- Anti-inflammatory medications
- Antispasmodic
- Non-invasive ventilator support
- Multidisciplinary teams (including OT) may increase quality and length of life.

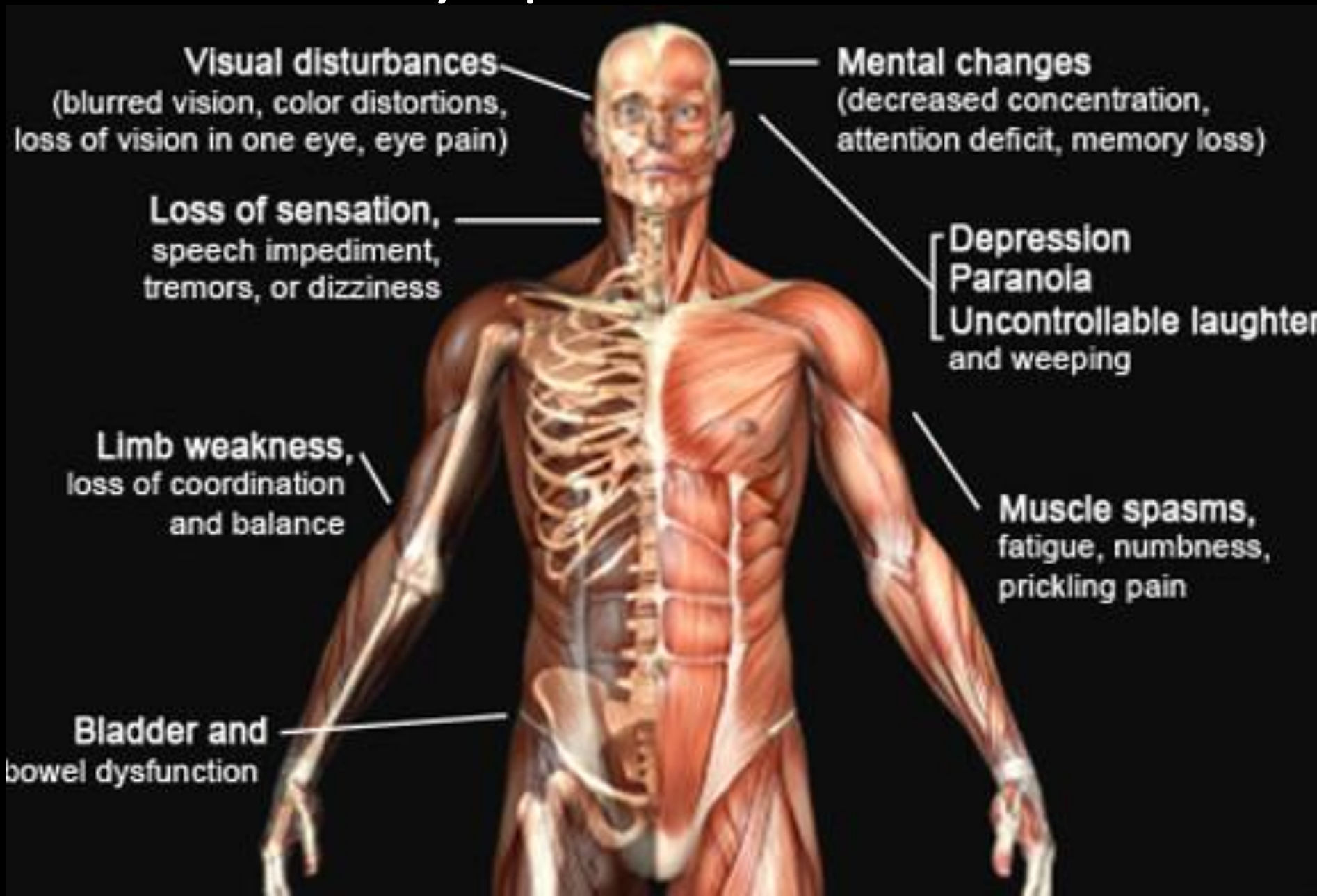
Multiple Sclerosis

What is MS?


Brain
Nerve cells
Spinal cord


Damaged nerve
Damaged myelin
Dendrites
Nucleus
Axon
Cell body
Normal nerve
Myelin
Neuron
Healthy myelin
Synapses
Nerve fibers
Transmit nerve signals throughout brain, body

Symptoms of MS



Types of Multiple Sclerosis

- Relapsing-remitting (RR) MS
- Primary-progressive (PP) MS
- Secondary-progressive (SP) MS
- Progressive-relapsing (PR) MS

Symptoms and treatment


BETASERON


Interferon beta-1a
AVONEX
BIOGEN


Rebif
(interferon beta-1a)
44 mcg/0.5 mL
serono


EXTAVIA
interferon beta-1b
0.3 mg
For subcutaneous use only
Rx only

Multiple Sclerosis (MS) Treatment

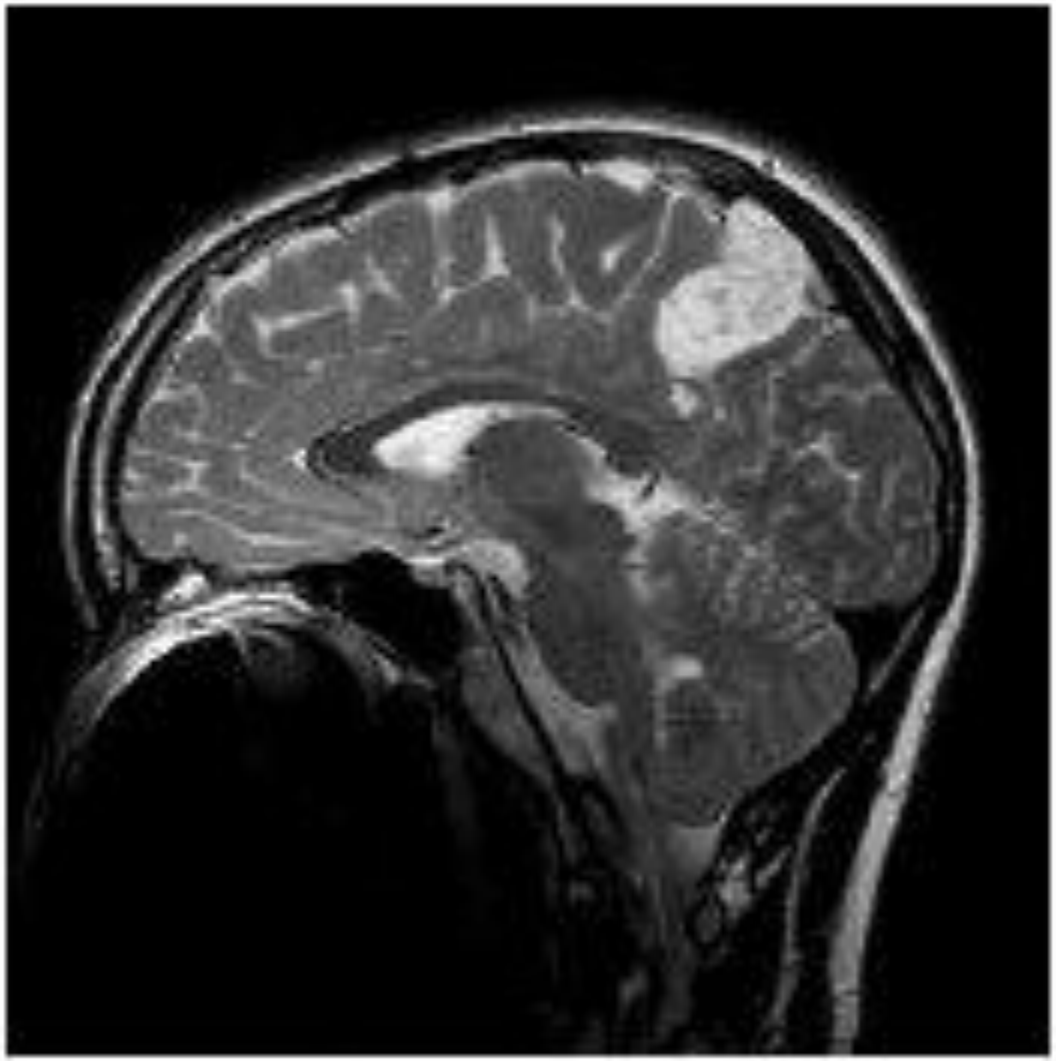
Difficulty Walking (slowness)	dalfampridine (Ampyra)	dalfampridine (Ampyra) was FDA- approved in 2010 to improve walking in patients with MS. Physical therapy, orthotic equipment, and walking aids also may be of benefit.
Muscle Spasticity	baclofen (Lioresal); tizanidine (Zanaflex); diazepam (Valium); clonazepam (Klonopin); dantrolene (Dantrium)	Physical therapy also may provide benefit. Most drug are given by mouth. Some drugs are given via spinal pumps.
Weakness	none	Physical therapy and exercise are used primarily. Foot braces, canes or walkers are of benefit.
Eye Problems	methylprednisolone (Solu-Medrol)	Solu-Medrol is given during the acute attack intravenously, sometimes followed by a corticosteroid by mouth.
Fatigue, Emotional Outbursts	Anti-depressants amantadine (Symmetrel) for fatigue; modafinil (Provigil) for fatigue	Decrease or avoid physical activity and heat exposure. Amitriptyline is used for sudden

Multiple Sclerosis (MS) Treatment		
Pain	aspirin; Ibuprofen; acetaminophen; anti-convulsants; anti-depressants	Aspirin, NSAIDs, acetaminophen, or physical therapy are used for muscle and back pain. Anti-convulsants, like carbamazepine (Tegretol) or gabapentin (Neurontin) are used for face or limb pain. Anti-depressants or electrical stimulation are used for prickling pain, intense tingling, and burning.
Bladder Dysfunction	Antibiotics; Vitamin C; oxybutynin (Ditropan)	Antibiotics are used to manage infections. Vitamin C and cranberry juice are used to prevent infections. Catheters are used to relieve retention of urine. Oxybutynin (Ditropan, Ditropan LX, Oxytrol) or tolterodine (Detrol, Detrol LA) is used for bladder dysfunction.
Constipation		Increase fluids and fiber
Sexual Dysfunction	sildenafil (Viagra), tadalafil (Cialis), vardenafil (Levitra), papaverine, Vaginal gels	For males, erectile dysfunction drugs, papaverine, penile implant, or electrostimulation are used. For females, vaginal gels or a vibrating device are used.
Tremors		Often resistant to treatment. Sometimes drugs or surgery are used if tremors are severe.

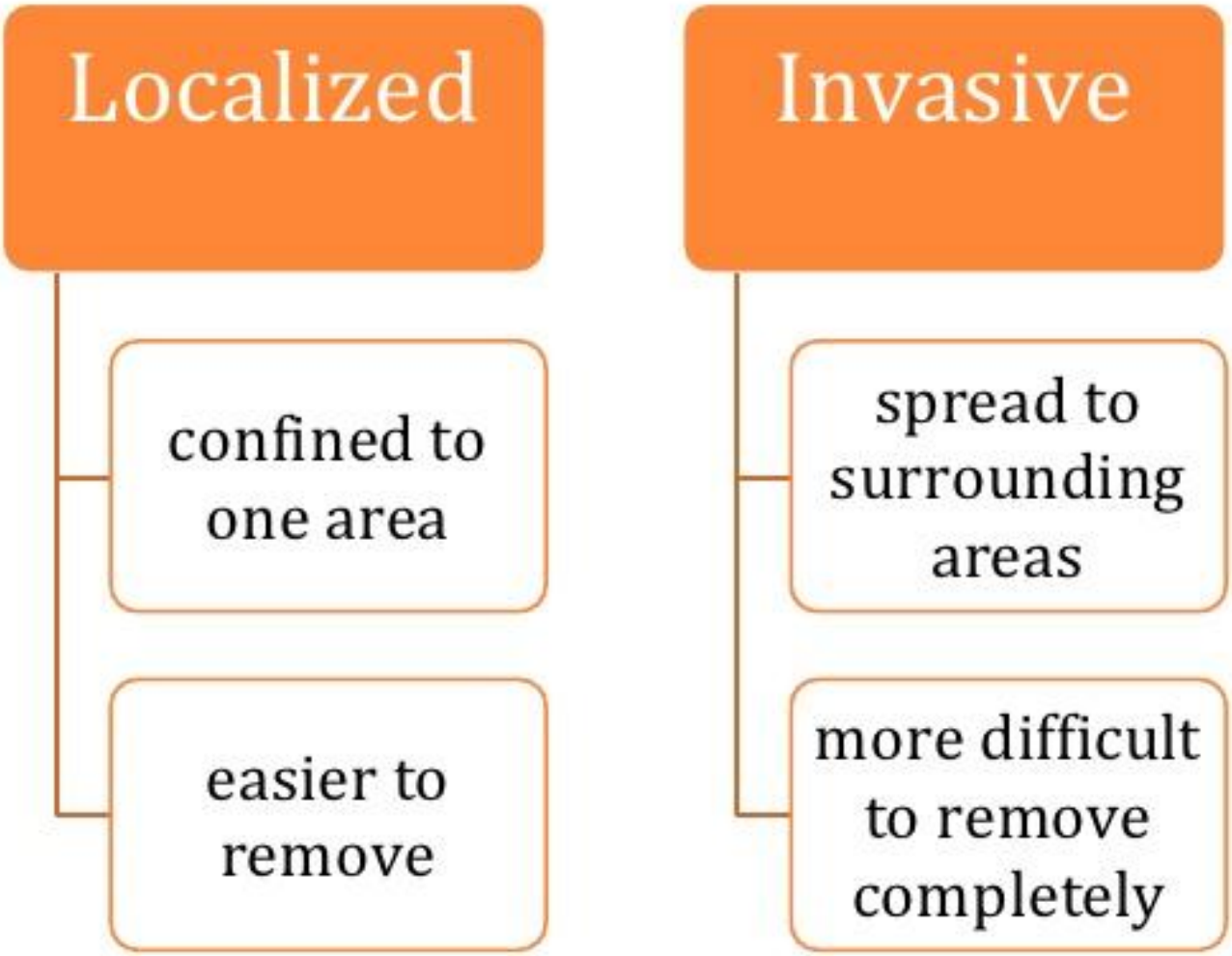
What Is a Brain Tumor?

(From “slide share.net”)

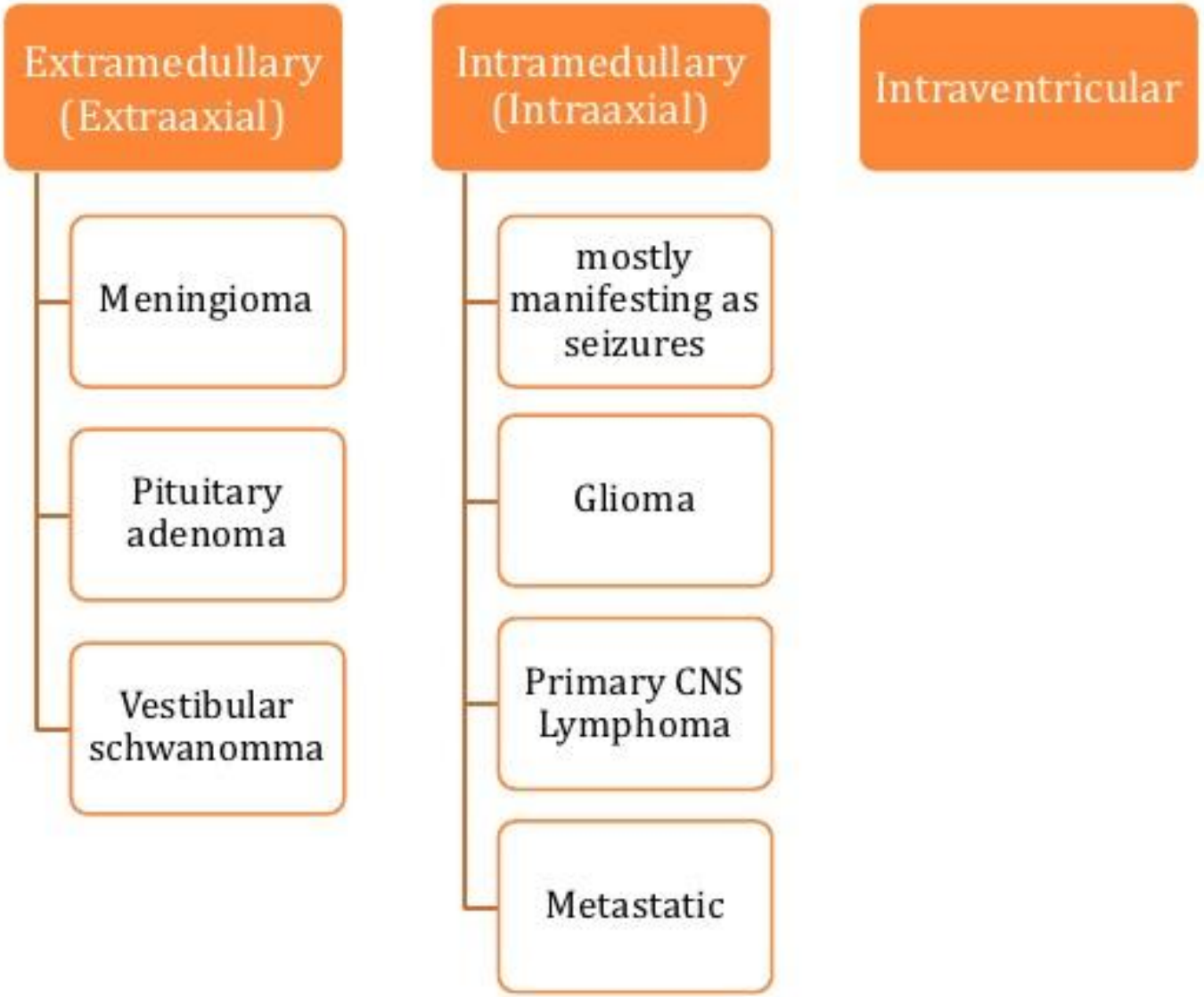
Oligodendroglioma



LOCALIZED VS. INVASIVE



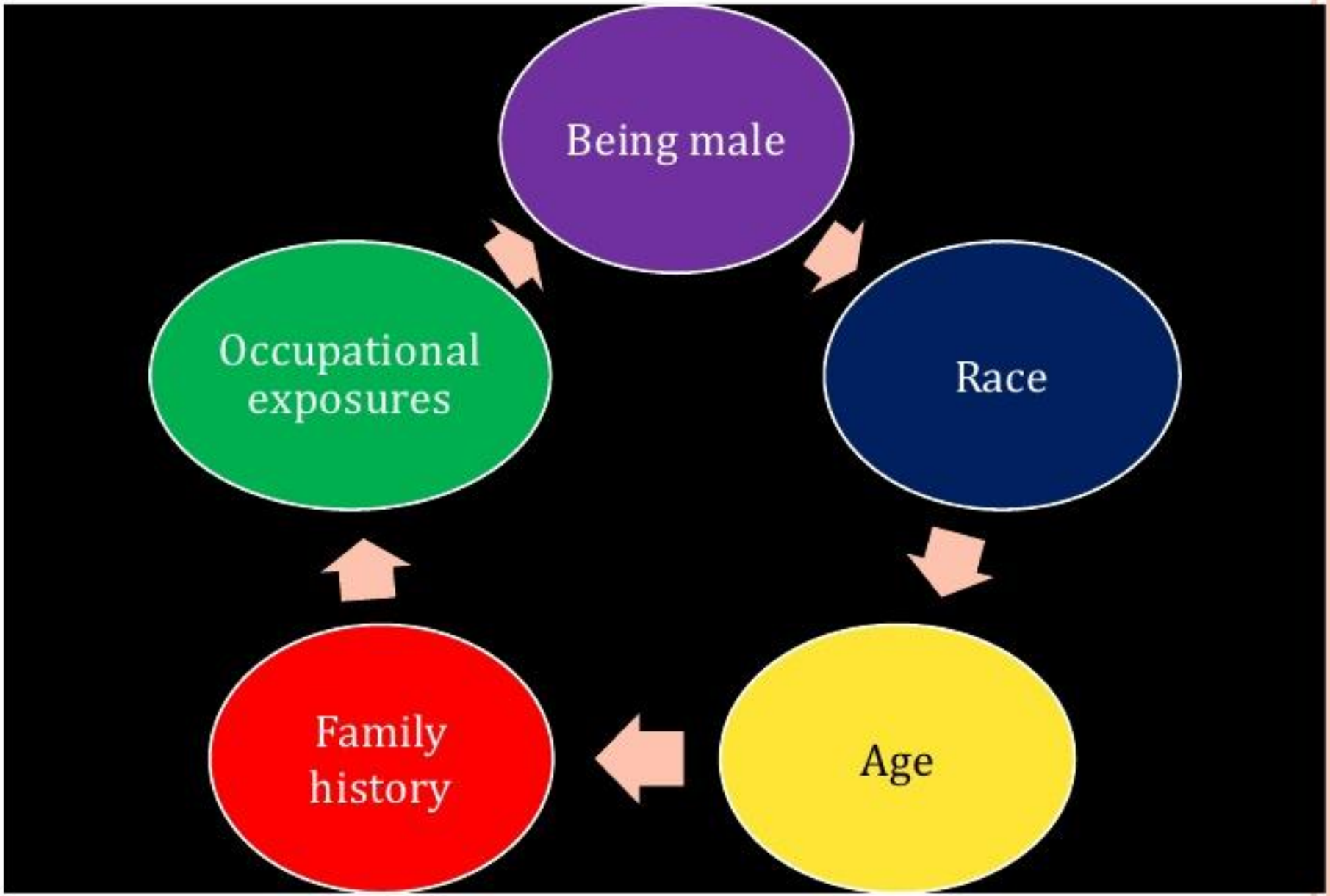
THEY CAN ALSO BE:



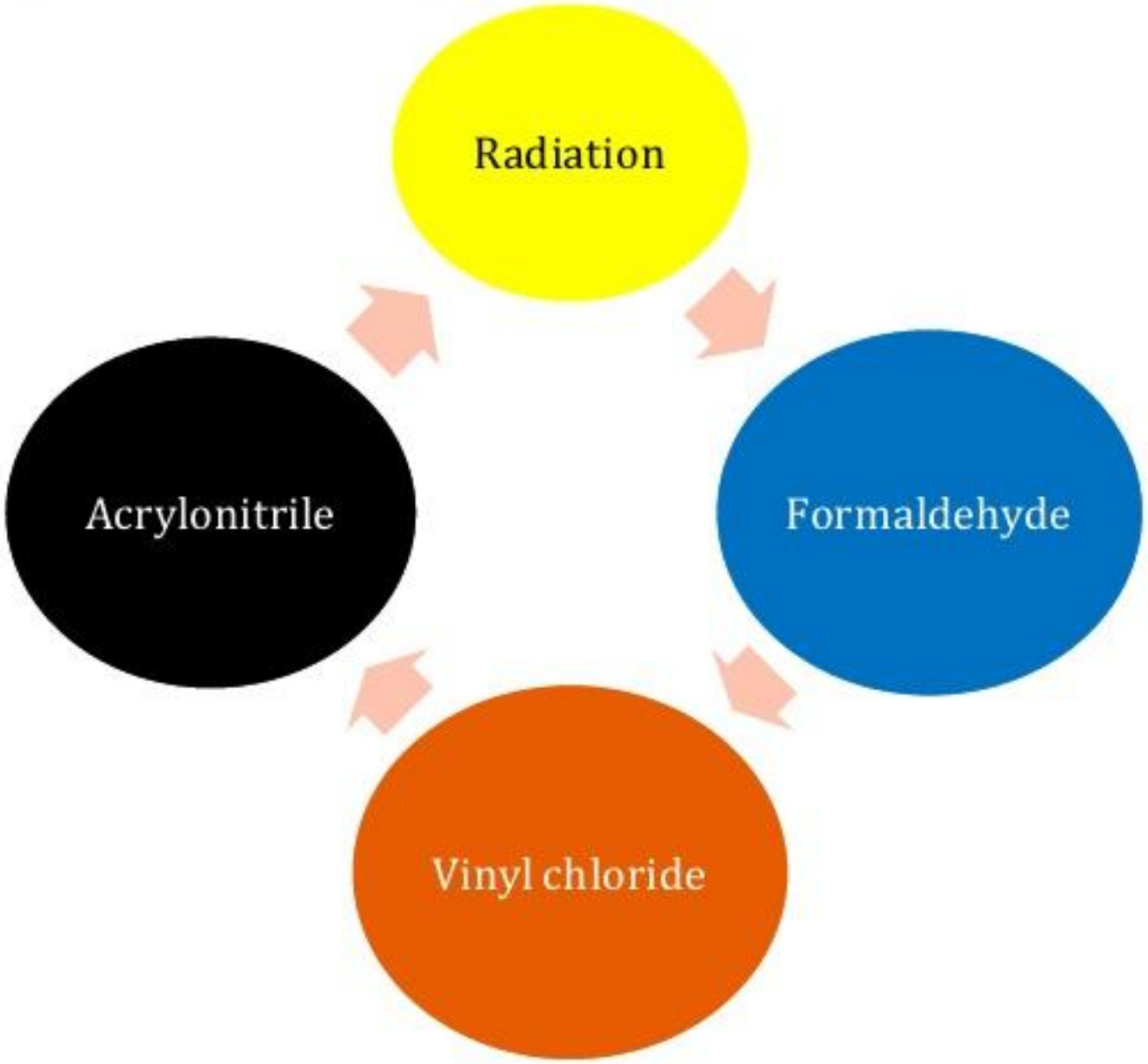
WHO Histologic Classification of Tumors of the CNS

1. Tumors of Neuroepithelial Tissue
2. Tumors of Cranial and Spinal Nerves
3. Tumors of the Meninges
4. Tumors of Uncertain Histogenesis
    1. Hemangioblastoma from primitive vascular structures
5. Lymphomas and Hematopoietic Neoplasm
6. Germ Cell Tumor
    1. Ex: Germinoma – common in pineal gland area
7. Cysts and Tumor-like lesions
    1. Usually in the third ventricle
8. Tumors of the Sellar Regions
9. Local Extension from Regional Tumors
10. Metastatic Tumors

What Causes a Brain Tumor?

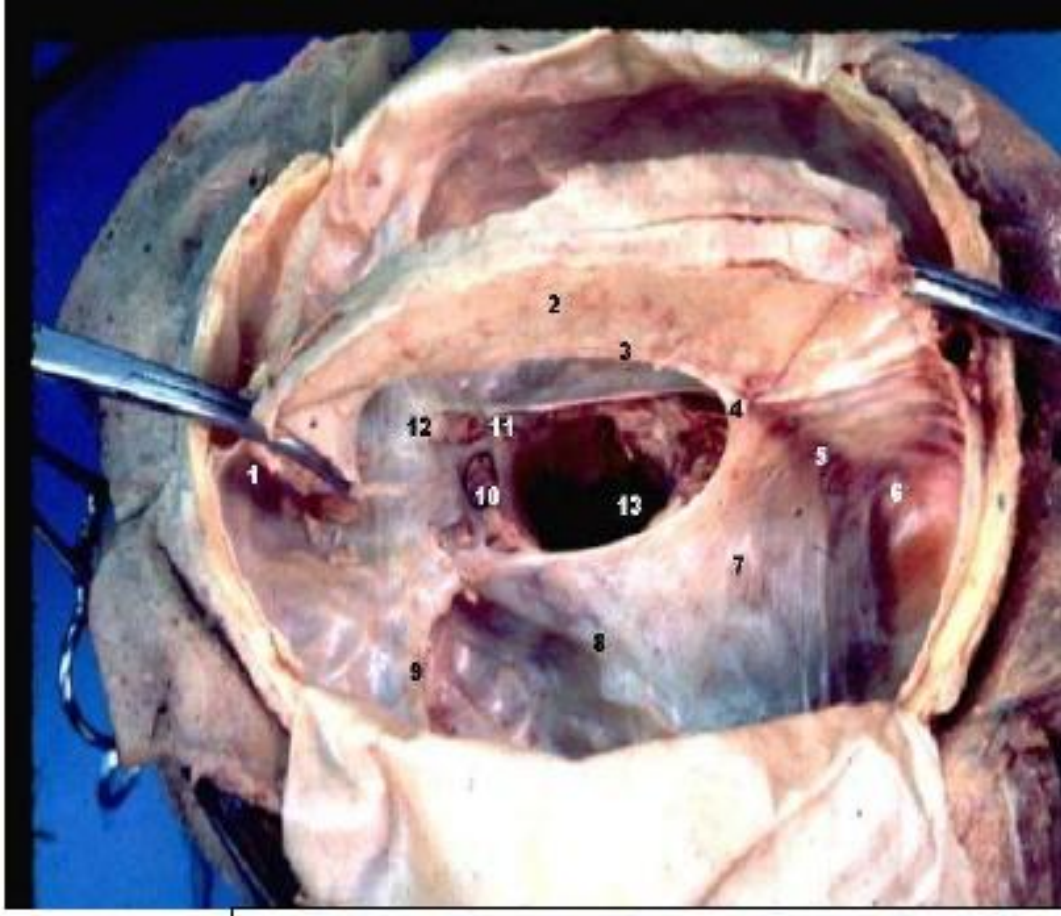


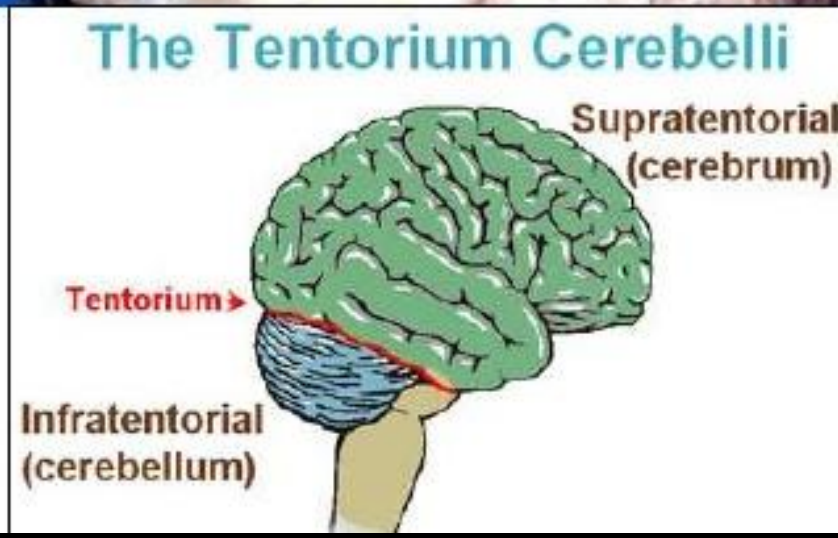
Occupational exposures



Age Incidence

- Adults
  - - Supratentorial: 80-85%
  - - Intratentorial: 15-20%
- - Children
  - - Intratentorial: 60%
  - - Supratentorial: 40%





Treatment of Brain Tumors

Surgery

Brachytherapy

Radiotherapy

Chemotherapy

Gamma knife

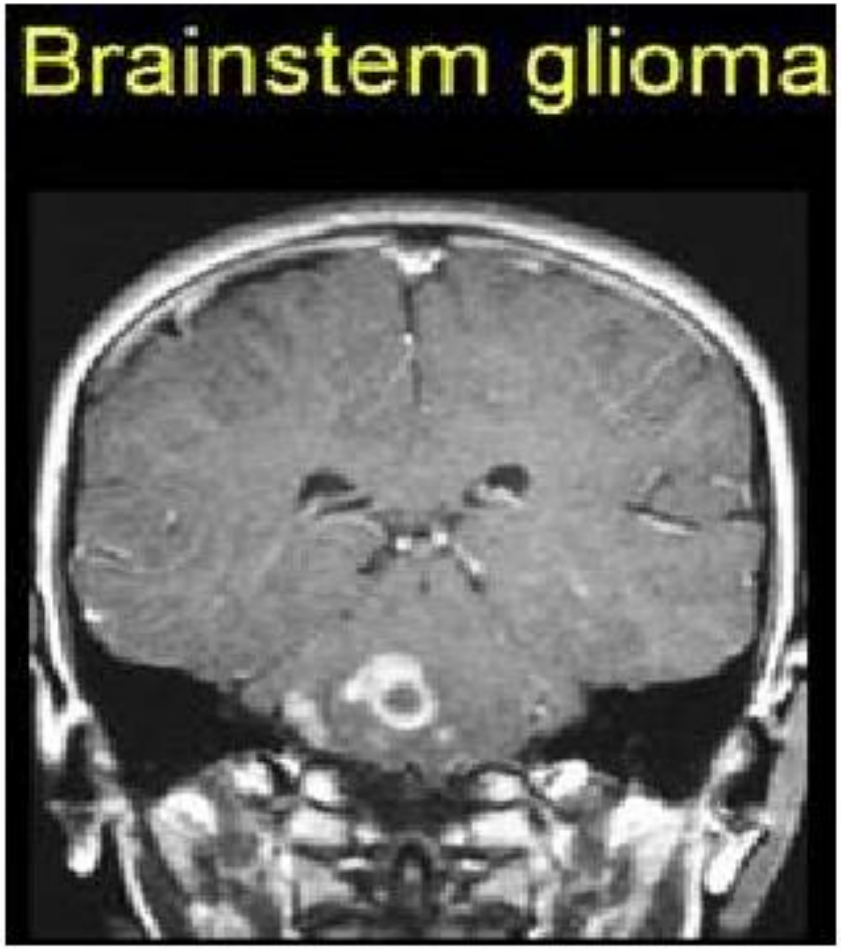
Common types of brain tumors

I. GLIOMAS

- - Most common primary brain tumor
- - 50% of all symptomatic brain tumors
- - Incidence increases with advancing age
- - Peak in 8th and 9th decades
- - No known environmental factors
- - No behavioral lifestyle choices
- - Ionizing radiation: the only clear risk factor
- - Originate from glial cells or their stem cell precursors

GLIOMAS

- Include:
  - a. Astrocytoma
  - b. Oligodendroglioma
  - c. Ependymoma
- - WHO Classification Basis
  - a. Increased cellularity
  - b. Nuclear atypia
  - c. Endothelial proliferation
  - d. Necrosis



A. Astrocytoma

- - Most common glioma
- - Cerebral astrocytoma (more in adults)
  - - Behavioral changes
  - - Seizures
  - - Hemiparesis
  - - Language difficulty
- - Cerebellar astrocytoma (more in children)
  - - Hemisphere
  - - Ataxia
- - Brain stem (children)
  - - Pons
  - - CN deficits

B. Oligodendroglioma

- Derived from oligodendrocytes or their precursors
  - Oligodendrocytes produce the white matter in the brain
- 5-7% of all intracranial gliomas
- Most often in the 3rd and 4th decades
- Males:females = 2:1
- Found primarily in cerebral hemispheres, within the brain parenchyma
- Highly infiltrative
- May metastasize distantly in ventricular & subarachnoid spaces like the GBM (CSF seeding)
- Round regular “fried-egg” cells

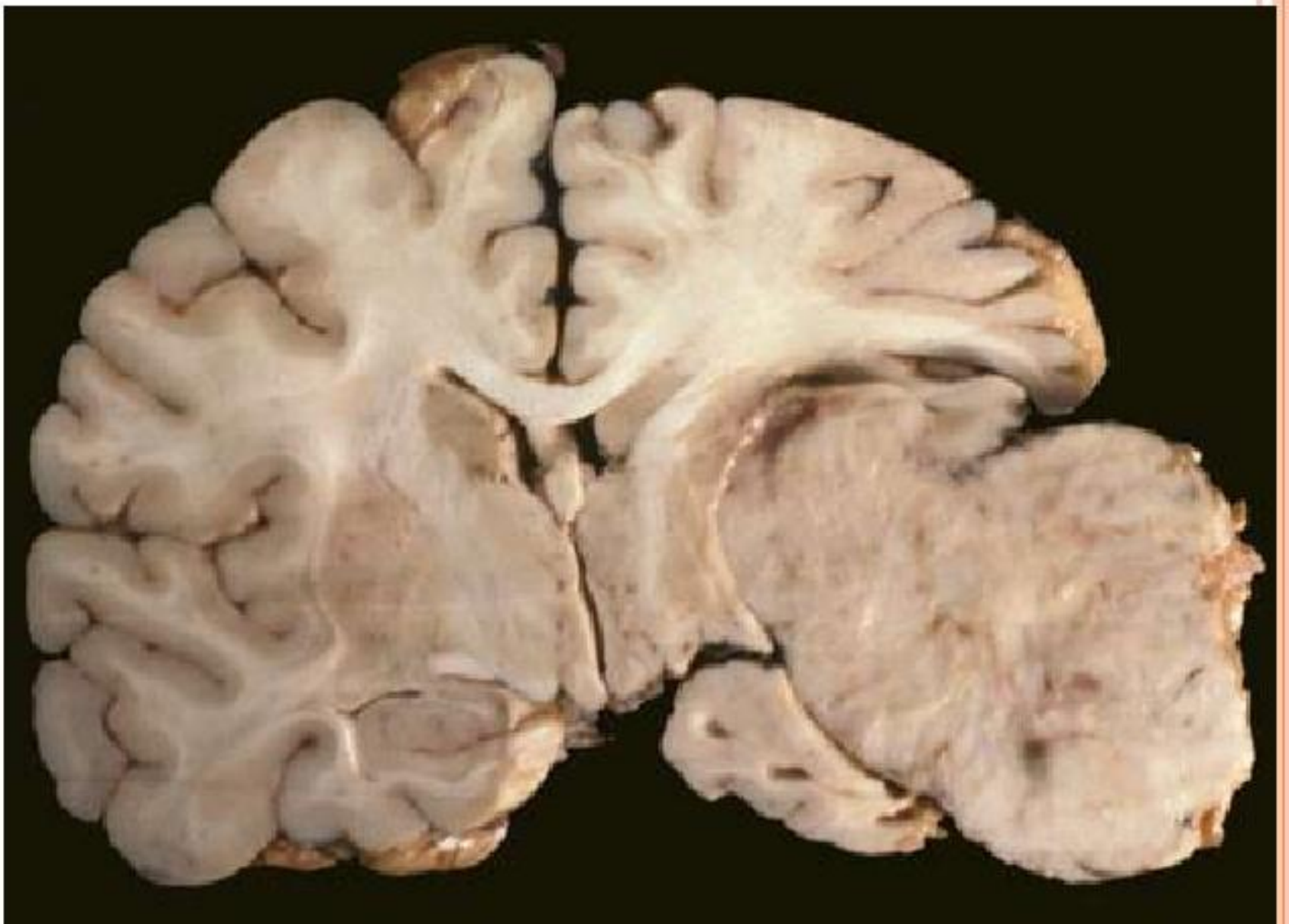
C. Ependymoma

- Arise from ependymal cells (an intraventricular tumor)
- More common in children
  - 10% pediatric intracranial tumors
  - 5% of adult intracranial tumors
- Most common in the 4th ventricle
  - Ataxia, vertigo, increased ICP
- May grow in brain parenchyma without obvious attachment to the ventricular system
- Spinal lesions more common in adults
- Intracranial ependymomas predominate in children

II. MENINGIOMA

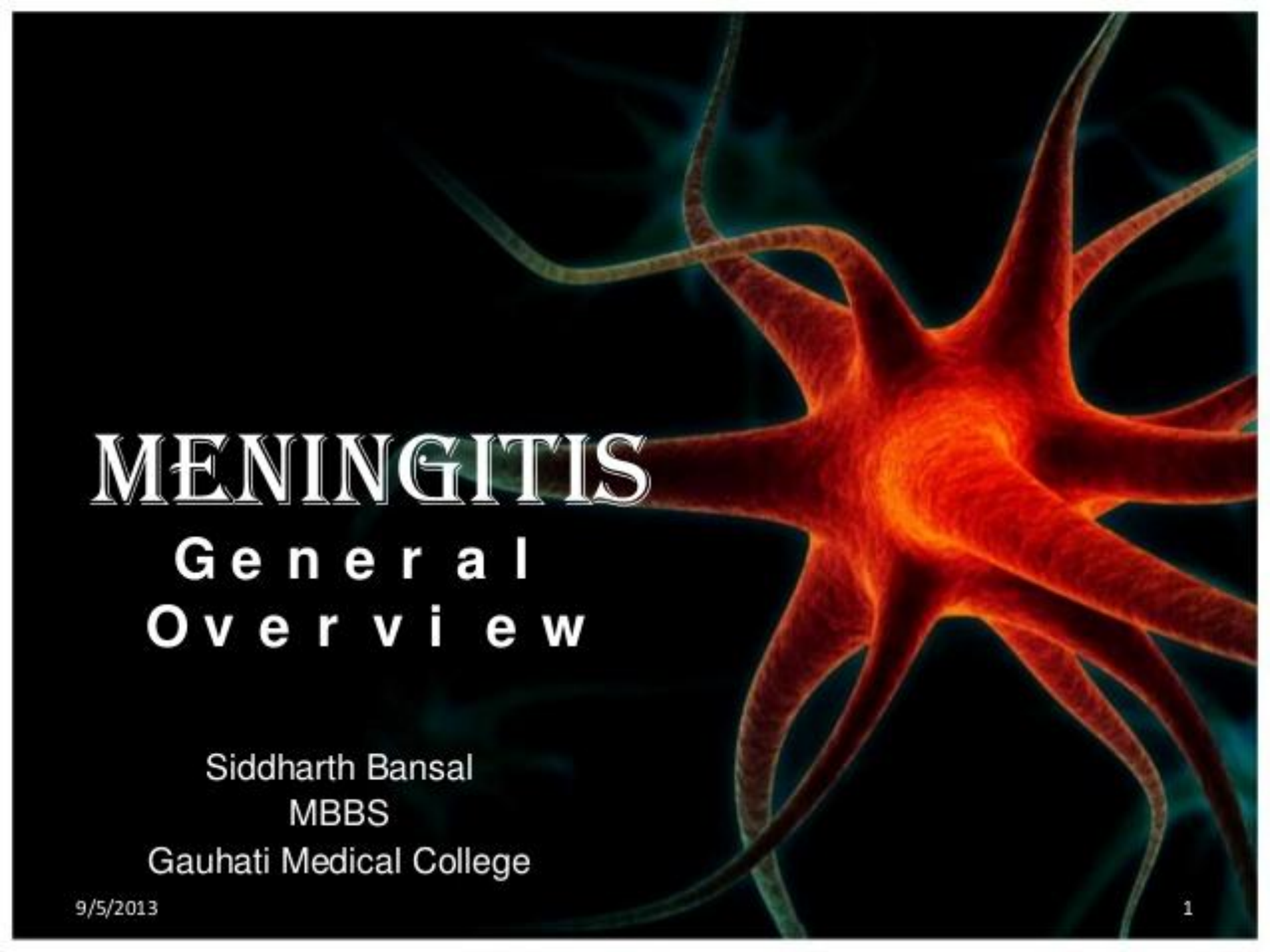
- Second most common primary brain tumor
- Originate from arachnoid cells (meningoepithelial cap cells normally seen in arachnoid villi)
- 20% of all intracranial tumors (with asymptomatic cases—40% or more)
- 7% of all posterior fossa tumors
- 3-12% of cerebellopontine angle tumors

MENINGIOMA



Prognosis of Astrocytomas

- Median survival
  - GBM: 1 year
  - Anaplastic astrocytoma: 3 years
  - Low-grade astrocytoma: 5 years
  - Others survive a decade or more
  - Most die from transformation of tumor to higher grade



MENINGITIS

General Overview

Siddharth Bansal
MBBS
Gauhati Medical College

Clinical description

- **Meningitis** is a disease caused by the inflammation of the protective membranes covering the brain and spinal cord known as the meninges.
- The inflammation is usually caused by an infection of the fluid surrounding the brain and spinal cord.
- Meningitis can be life-threatening because of the inflammation's proximity to the brain and spinal cord; therefore the condition is classified as a medical emergency.

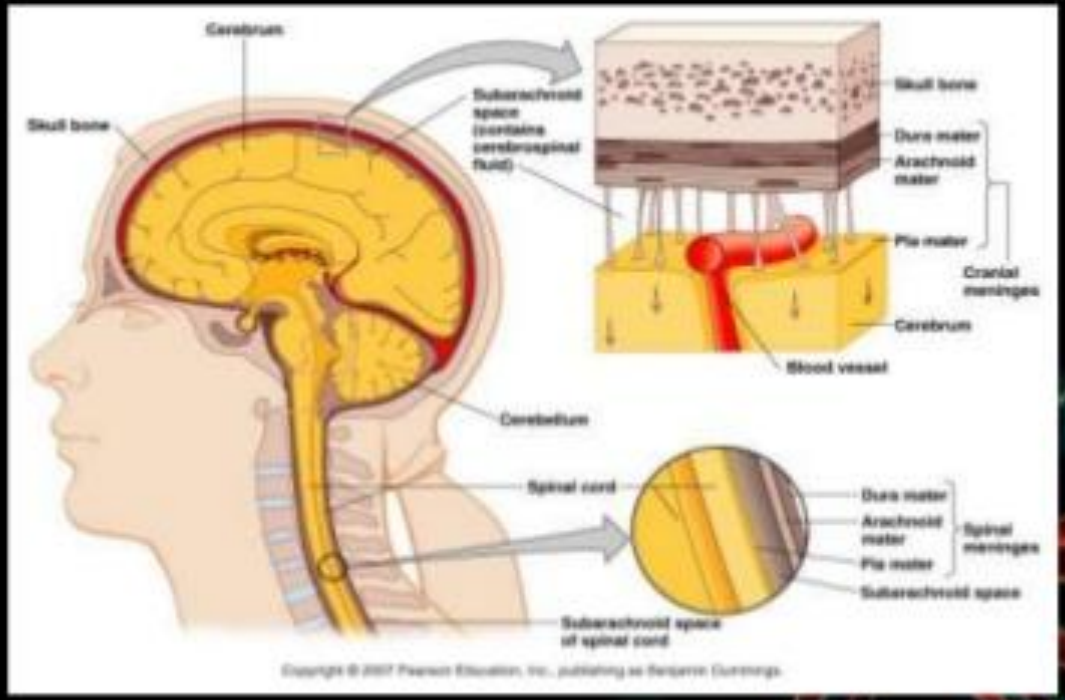
Meninges

The **meninges** is the system of membranes which envelops the central nervous system.

It has 3 layers:

1. **Dura mater**
2. **Arachnoid mater**
3. **Pia mater**

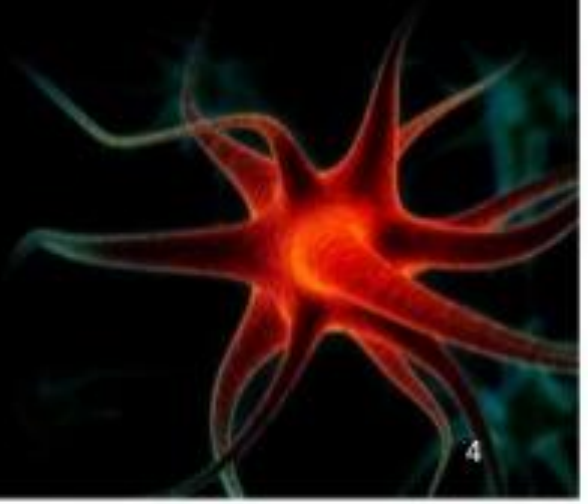
Subarachnoid space - is the space which exists between the arachnoid and the pia mater, which is filled with **cerebrospinal fluid.**



Causes of Meningitis

- Bacterial
- Viral
- Fungal
- Ricketsial (Rocky mountain spotted fever)
- Parasitic/ protozoal
- Physical injury
- Cancer
- Certain drugs (mainly, NSAID'S)

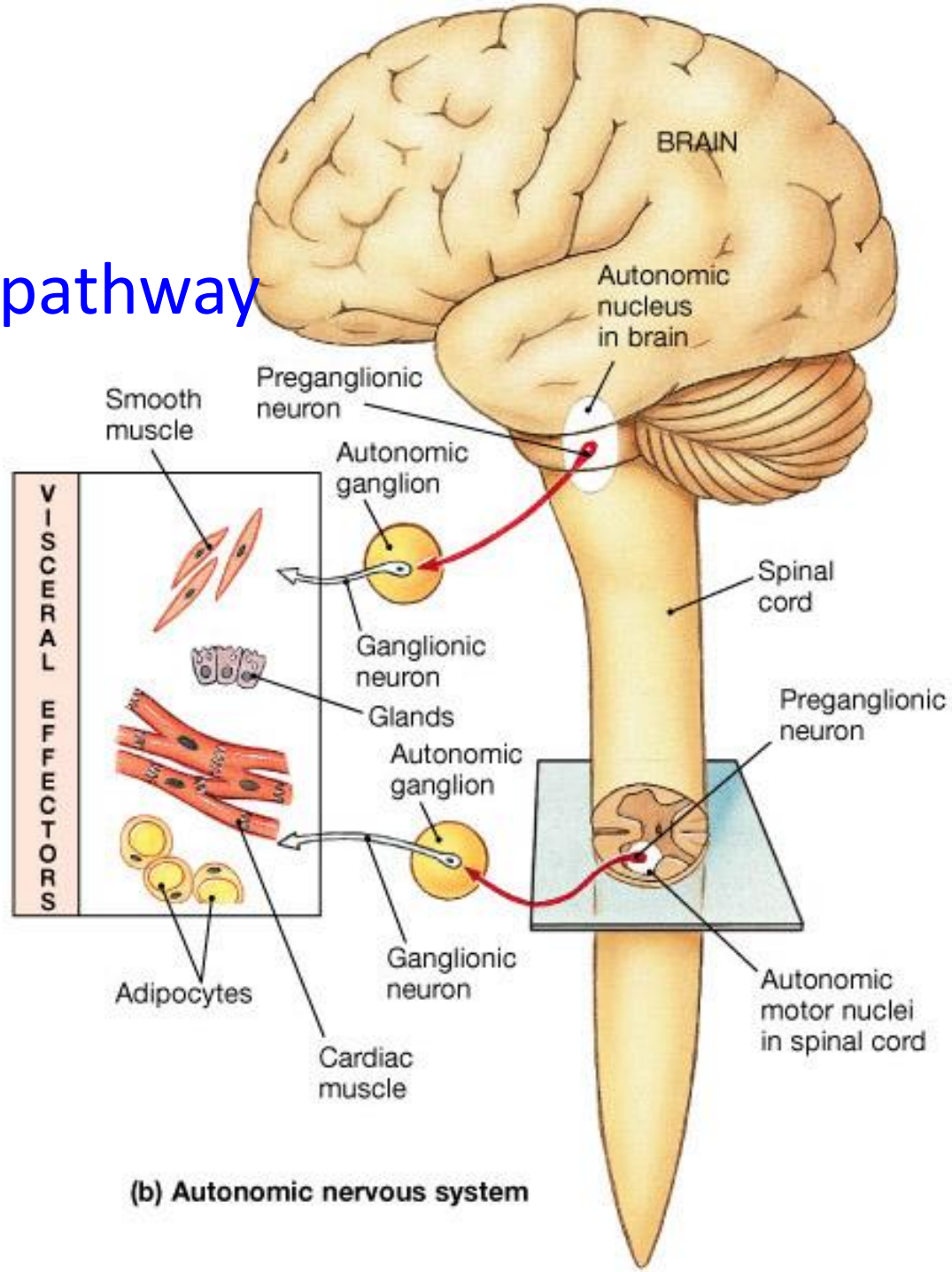
➢ Severity/treatment of illnesses differ depending on the cause. Thus, it is important to know the specific cause of meningitis.



Thank you

Questions?

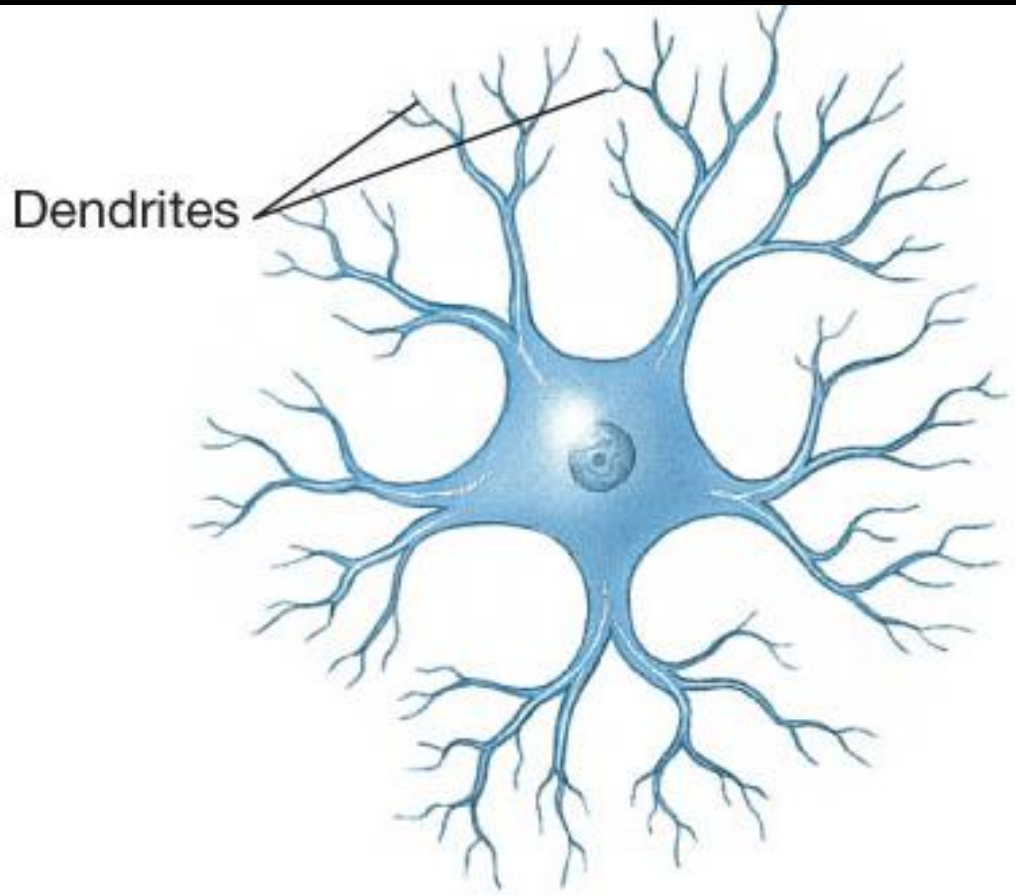
ANS motor pathway



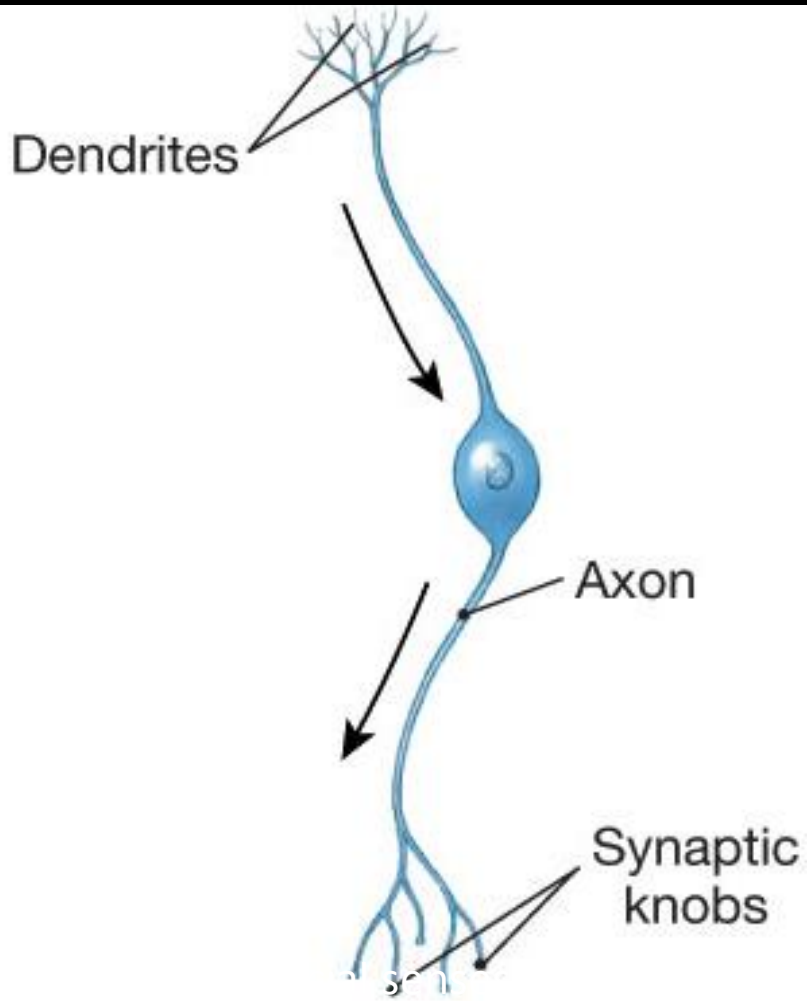
A Structural Classification of Neurons

- This classification is based on the placement of the cell body and the number of associated processes.

A Structural Classification of Neurons



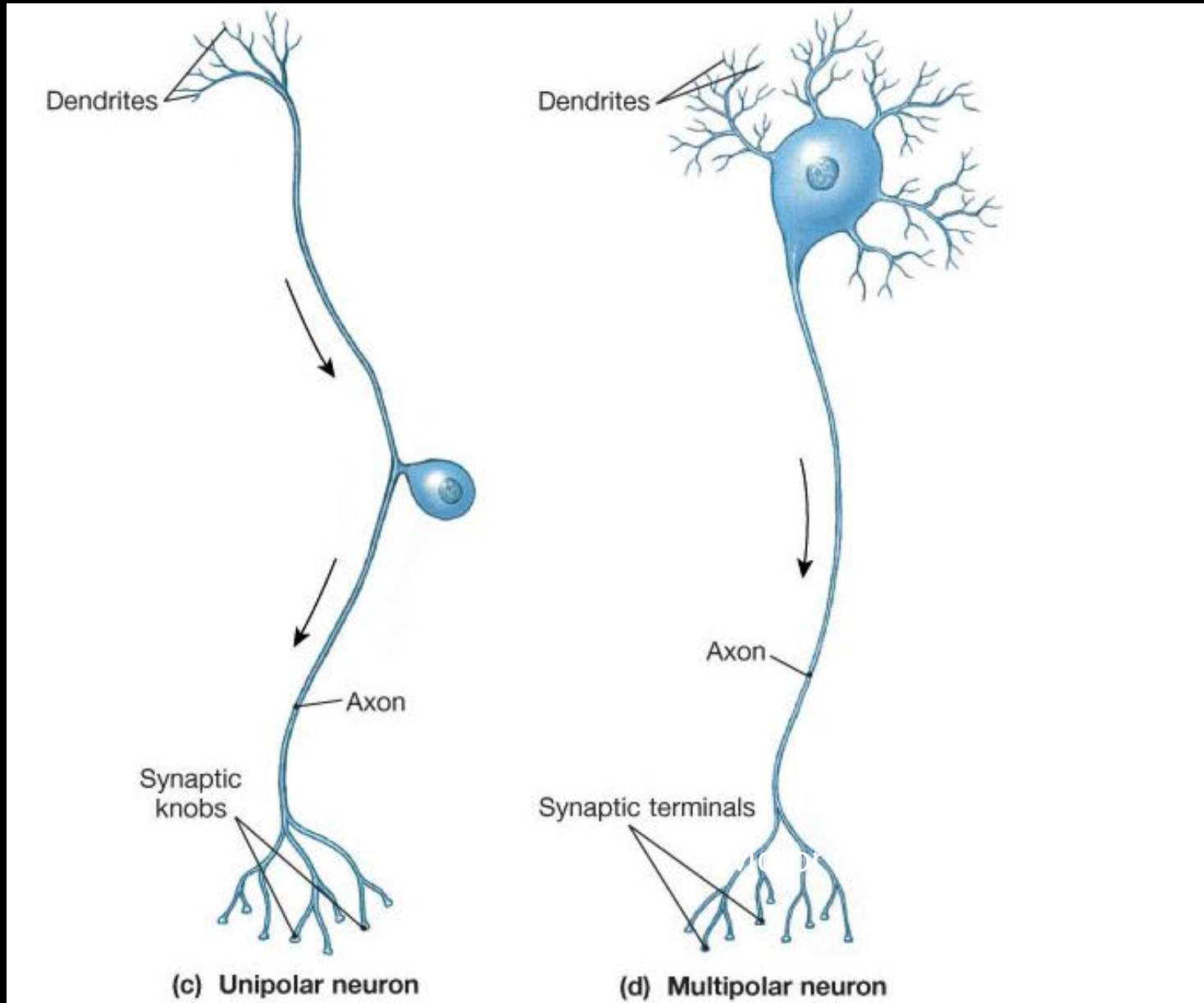
(a) Anaxonic neuron
(neurons found only in the CNS)



(b) Bipolar neuron

A Structural Classification of Neurons

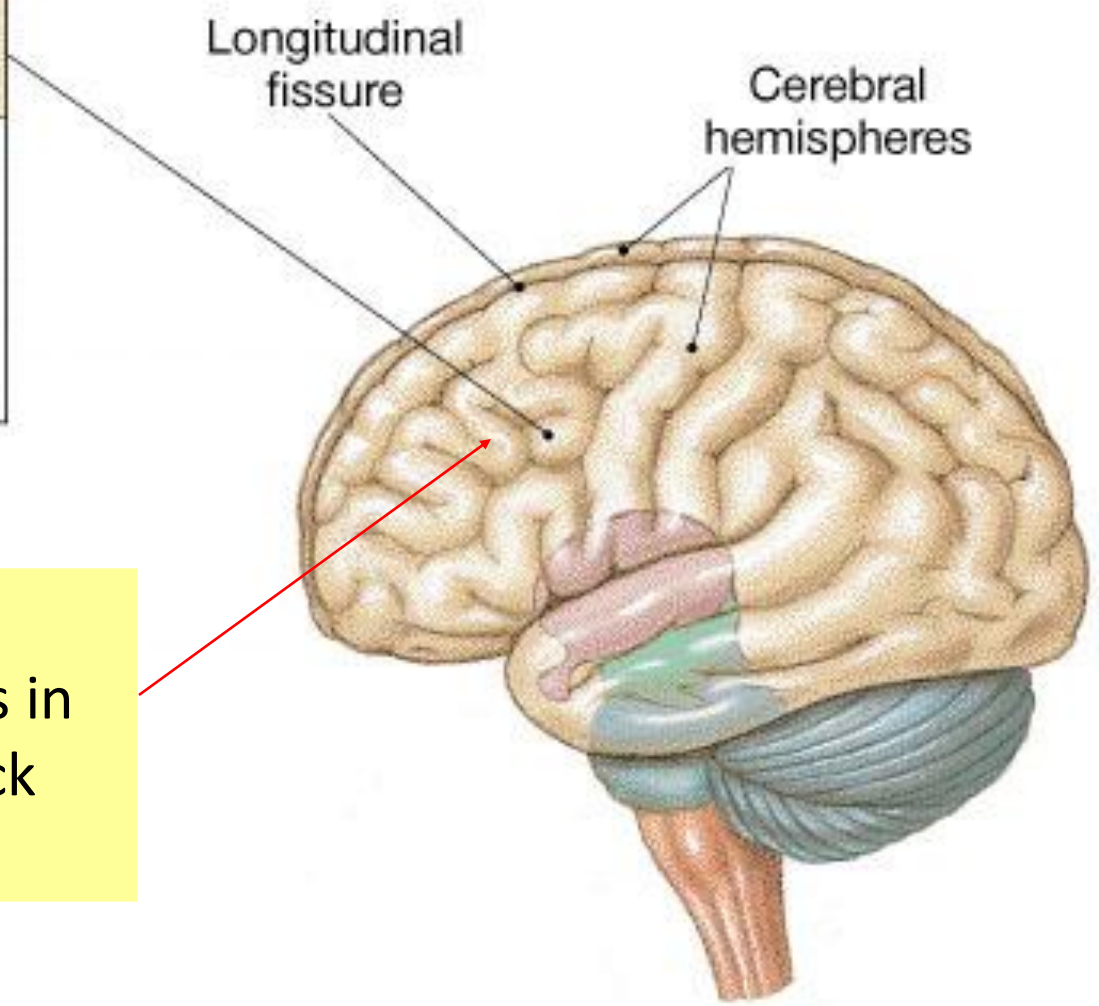
Sensory receptors



Telencephalon (cerebrum)

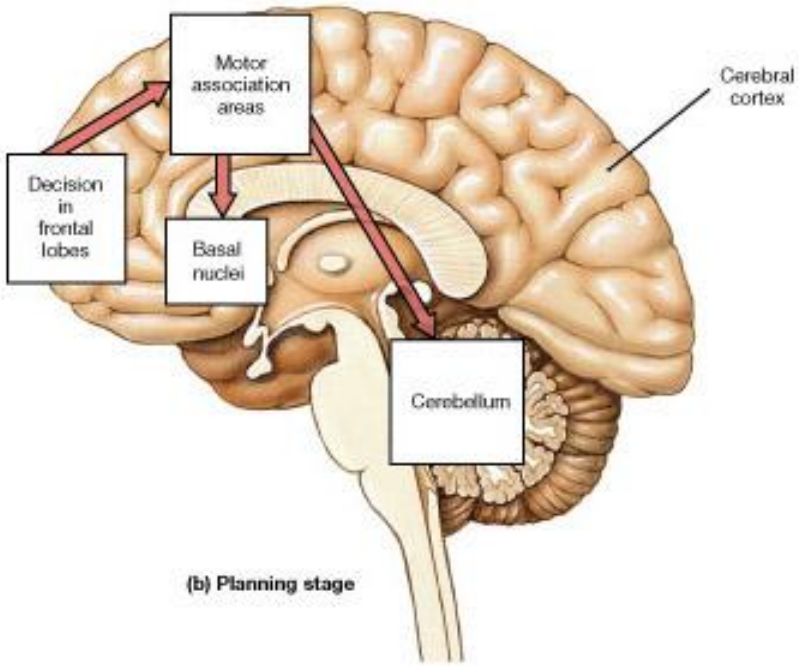
TELENCEPHALON
(CEREBRUM)

- Conscious thought processes, intellectual functions
- Memory storage and processing
- Conscious and subconscious regulation of skeletal muscle contractions

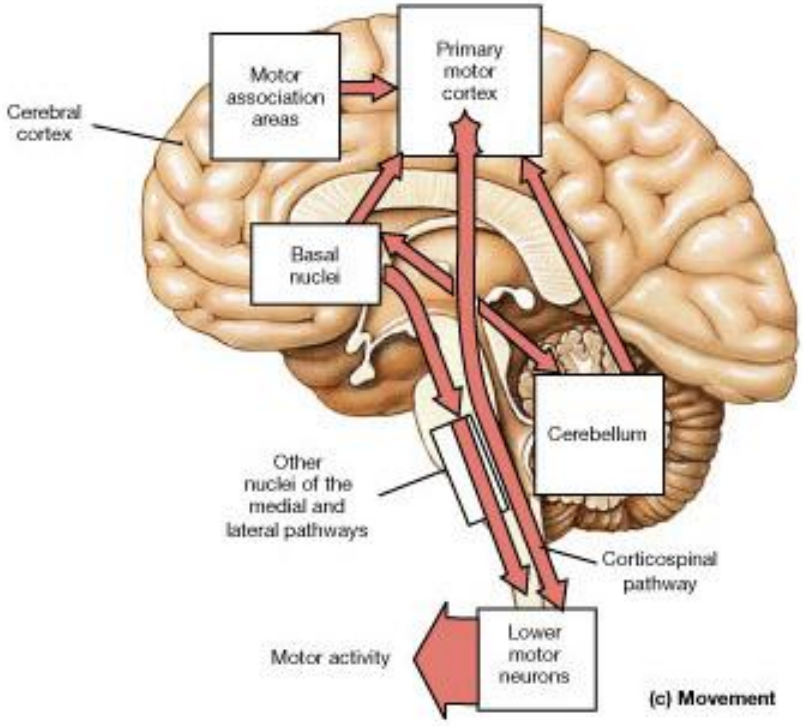


Volitional movement:
Decision to move starts in the frontal lobe e.g. pick up an object

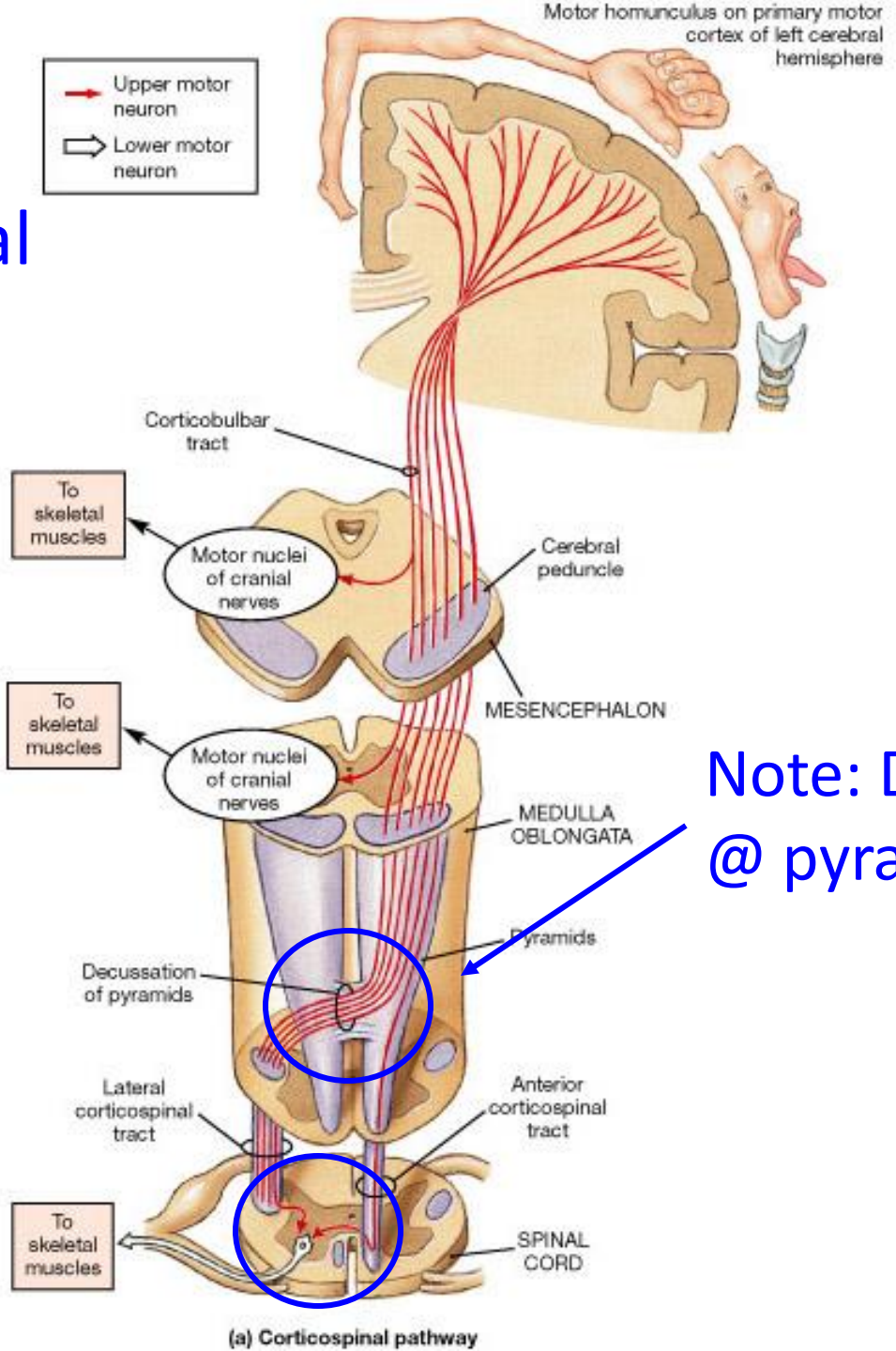
Somatic Motor Control: Planning Stage



Somatic Motor Control: Movement initiated



Corticospinal pathway

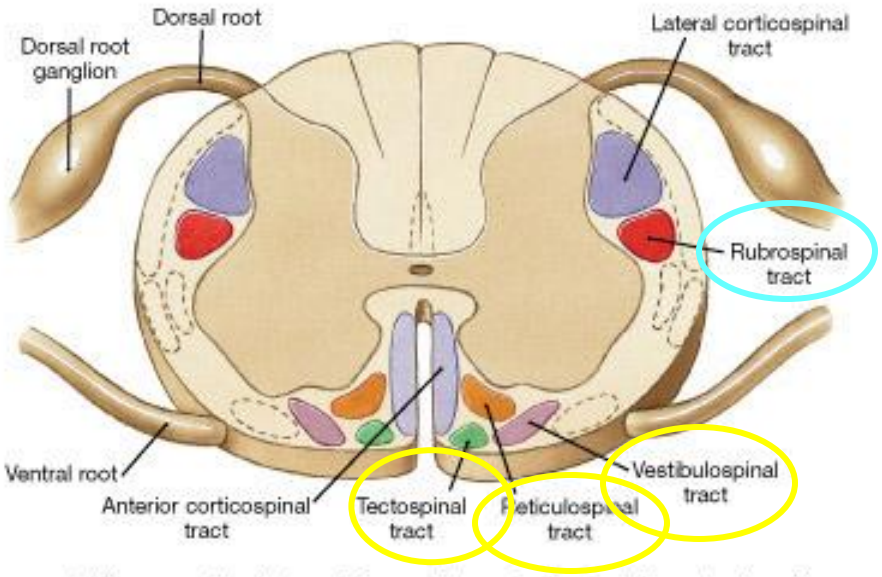


(a) Corticospinal pathway

Note: Decussation @ pyramids

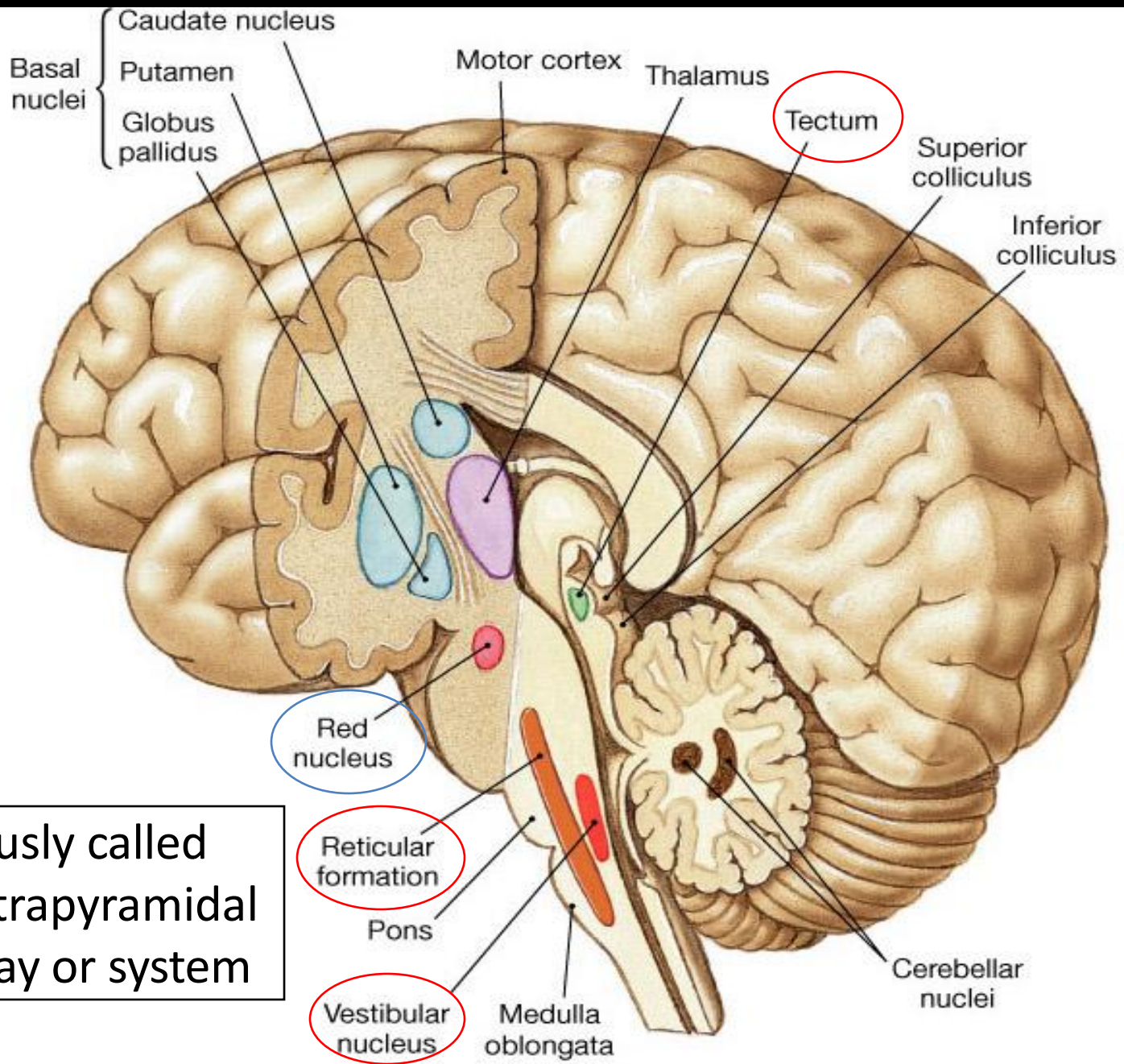
Descending tracts in the spinal cord

- Corticospinal pathways
- Medial and lateral pathways



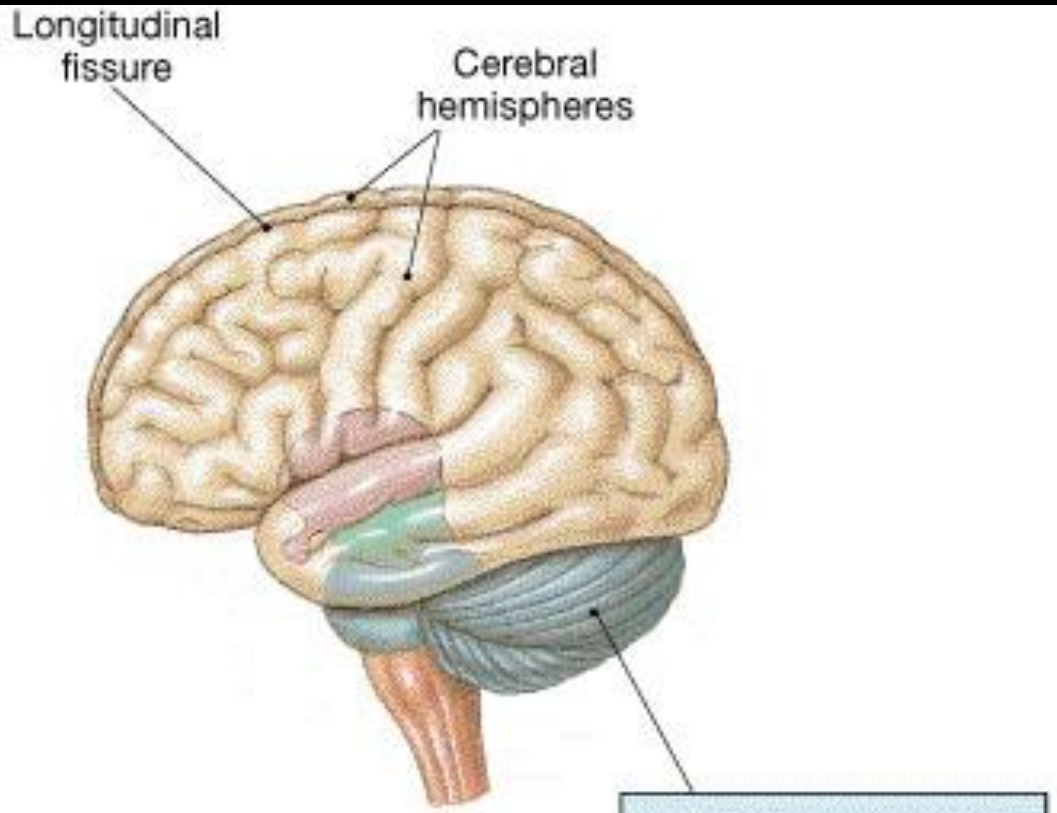
(b) Cross-sectional view of descending motor tracts in the spinal cord

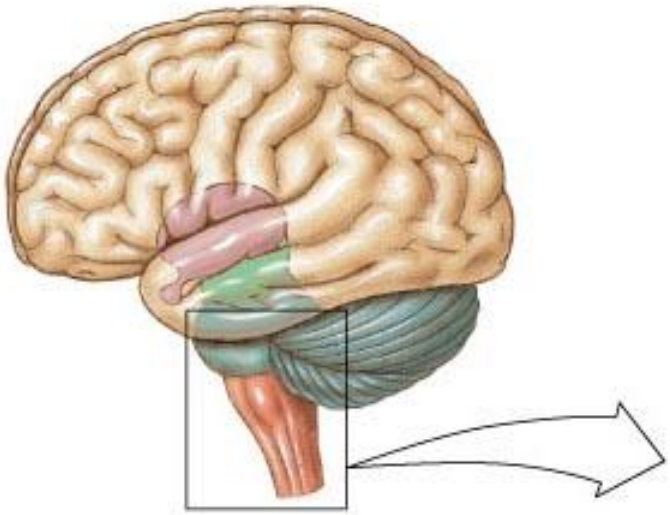
Nuclei of the medial and lateral pathways

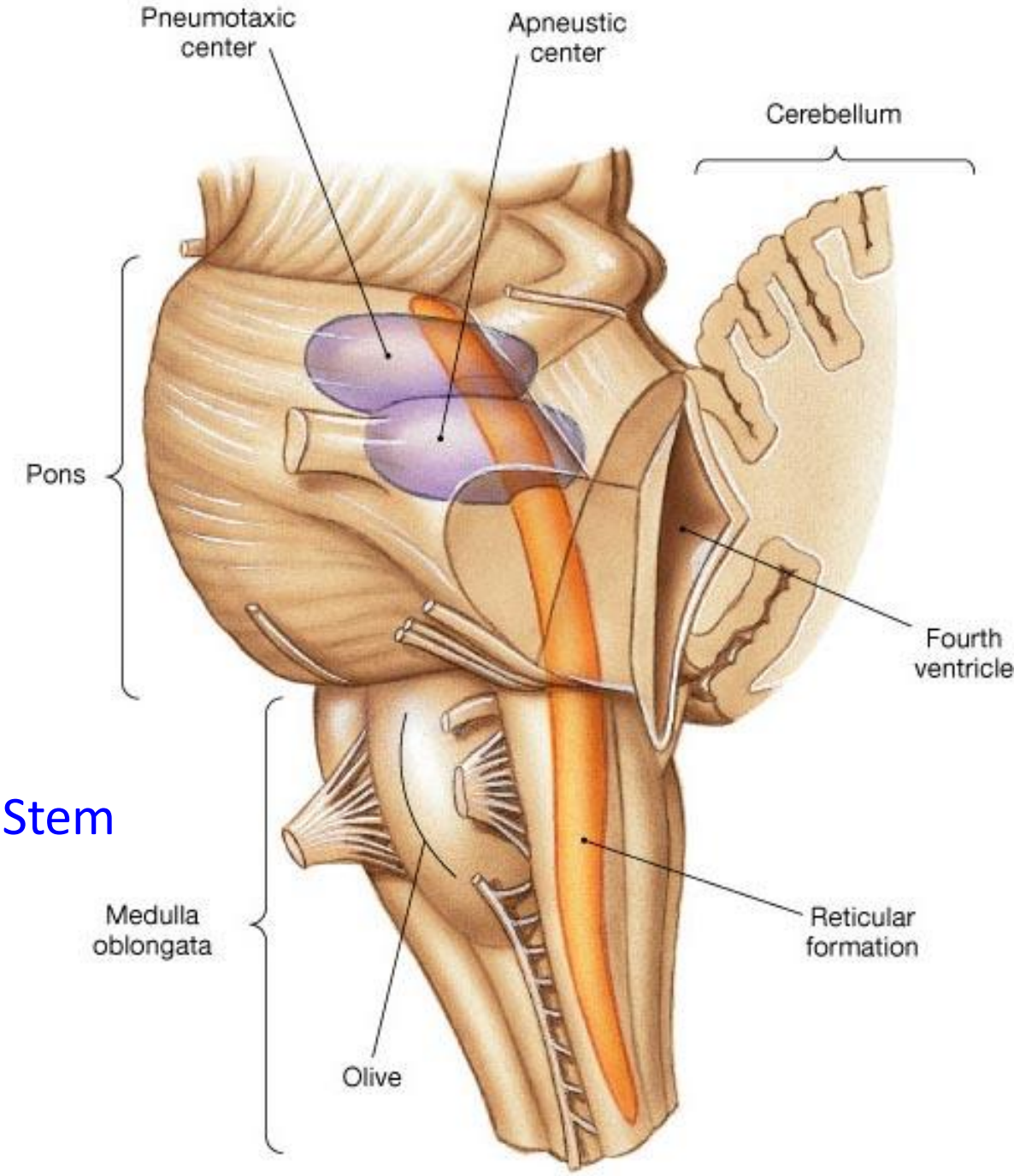


Previously called the Extrapyramidal pathway or system

Metencephalon (cerebellum)







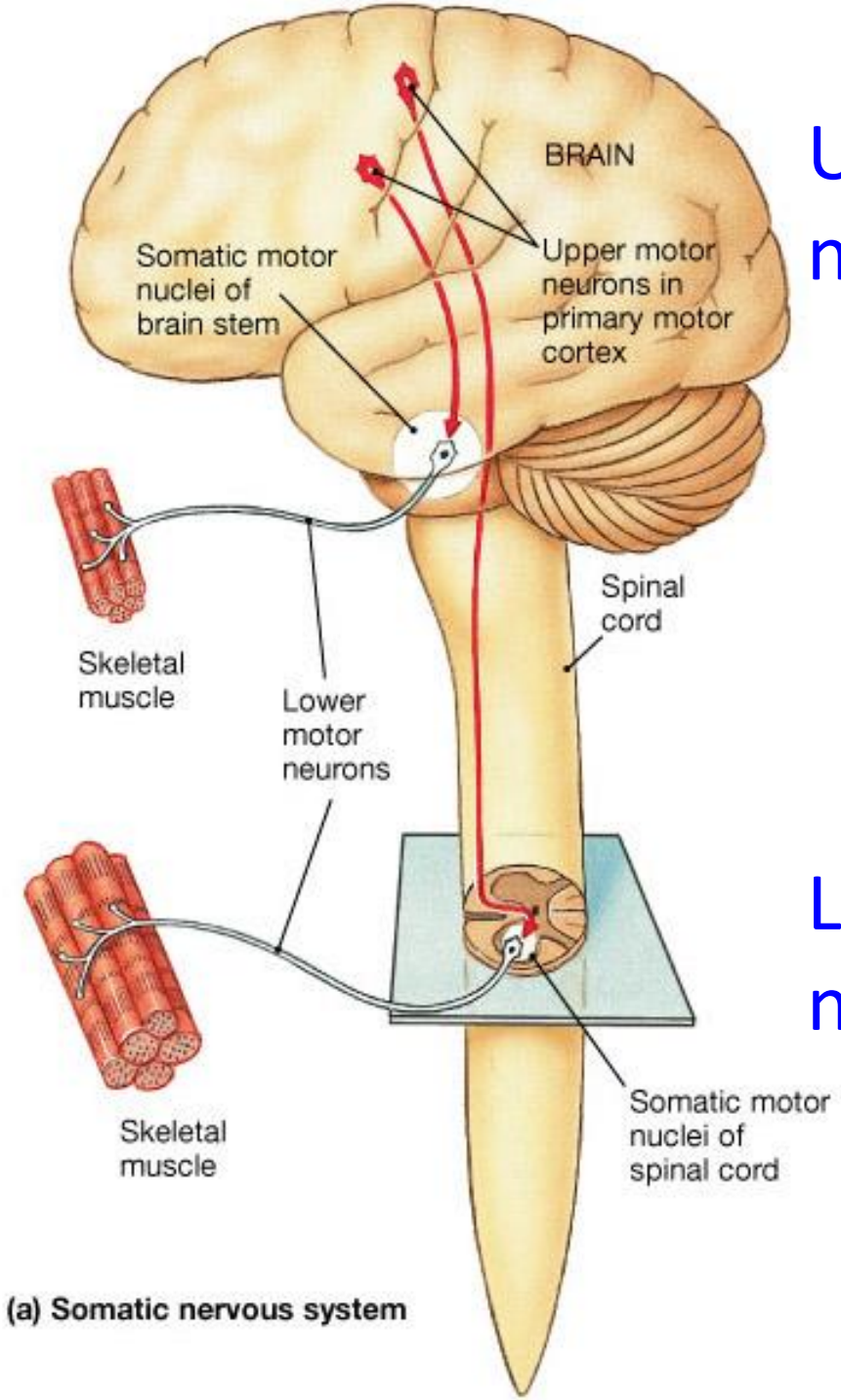
Medulla Oblongata

Connects S.Cord to Brain Stem

Cranial Nerves (VIII-XII)

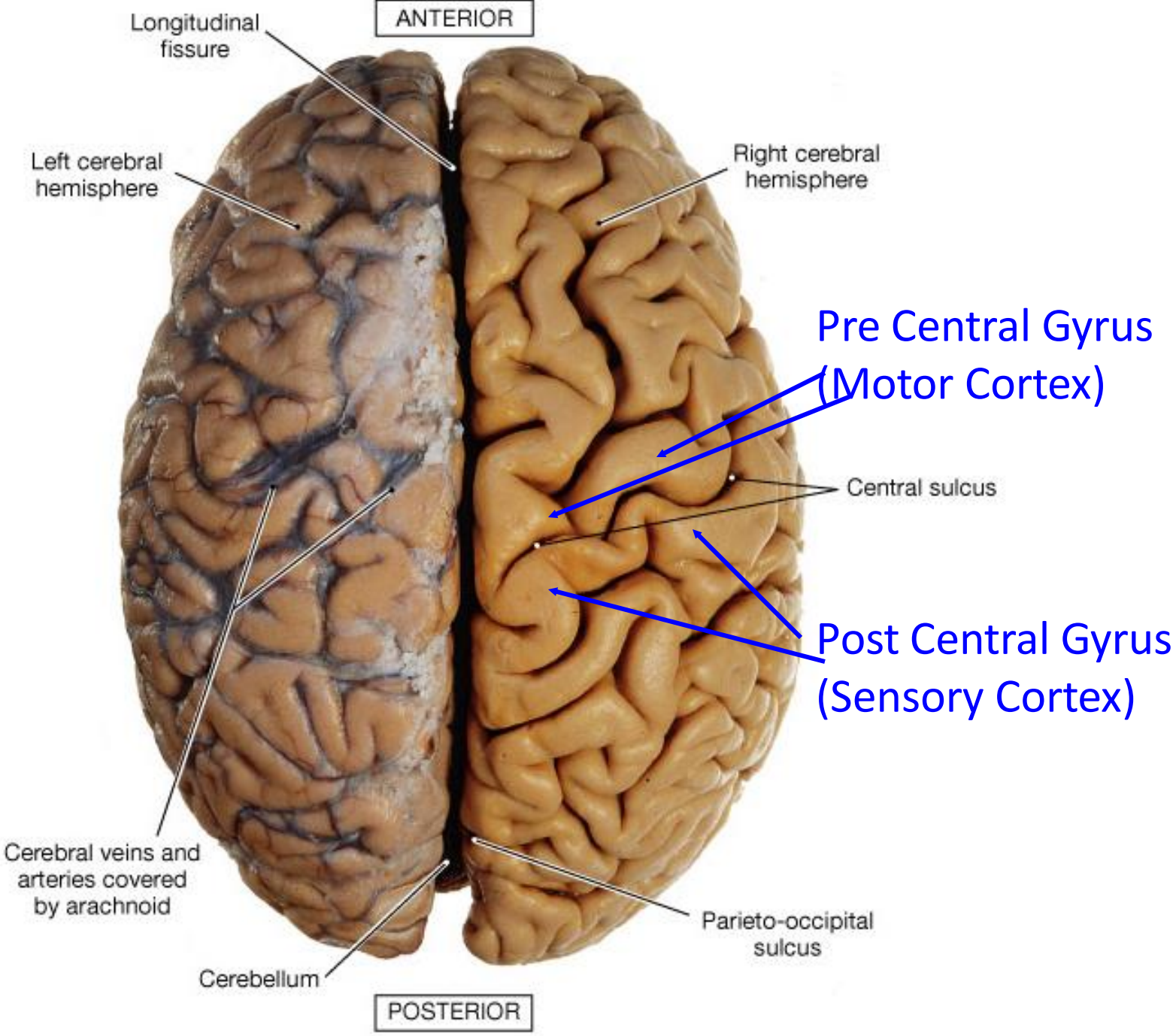
Somatic

nervous system



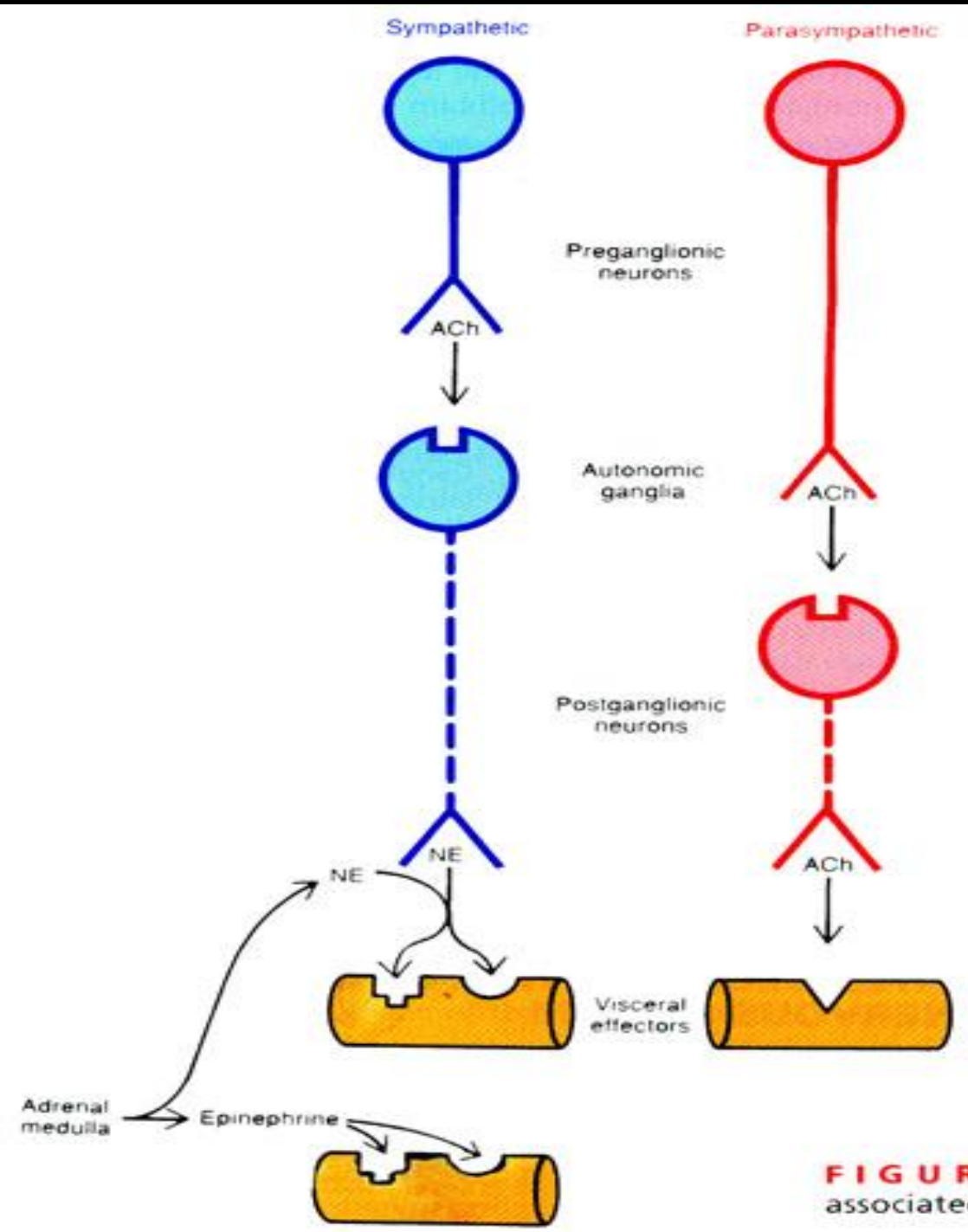
Upper motor neuron

Lower motor neuron



(a) Superior view

Neurotransmitters and receptors



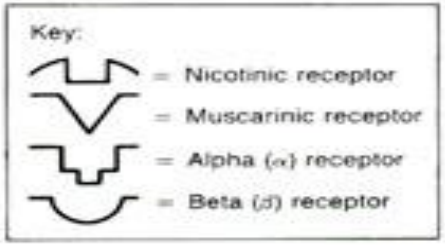


FIGURE 19-4 Neurotransmitters and receptors associated with the autonomic nervous system.

Alpha and Beta Receptors

- Most postganglionic **sympathetic** fibres release NE and are adrenergic
- However, a few secrete ACh (cholinergic)
- There are two types of receptors on target organs that are sensitive to E and NE. They are Alpha and Beta receptors
- Alpha and Beta receptors are usually stimulated by E although stimulation of some Beta receptors results in relaxation (e.g. blood vessels and airways)
- Only Alpha receptors seem affected by NE

Nicotinic and Muscarinic Receptors

- Nicotinic receptors are found on ganglion cells of **both sympathetic and parasympathetic** nervous systems as well as at **neuromuscular junctions**. They are always stimulated by the release of Ach
- Muscarinic receptors are found in the neuroeffector junctions in **parasympathetic** nervous system as well as at the few cholinergic junctions in the sympathetic system. The effects may be excitatory or inhibitory depending on the specific enzymes in the target organ.
- In the parasympathetic system the effects of Ach may be excitatory or inhibitory depending on receptor