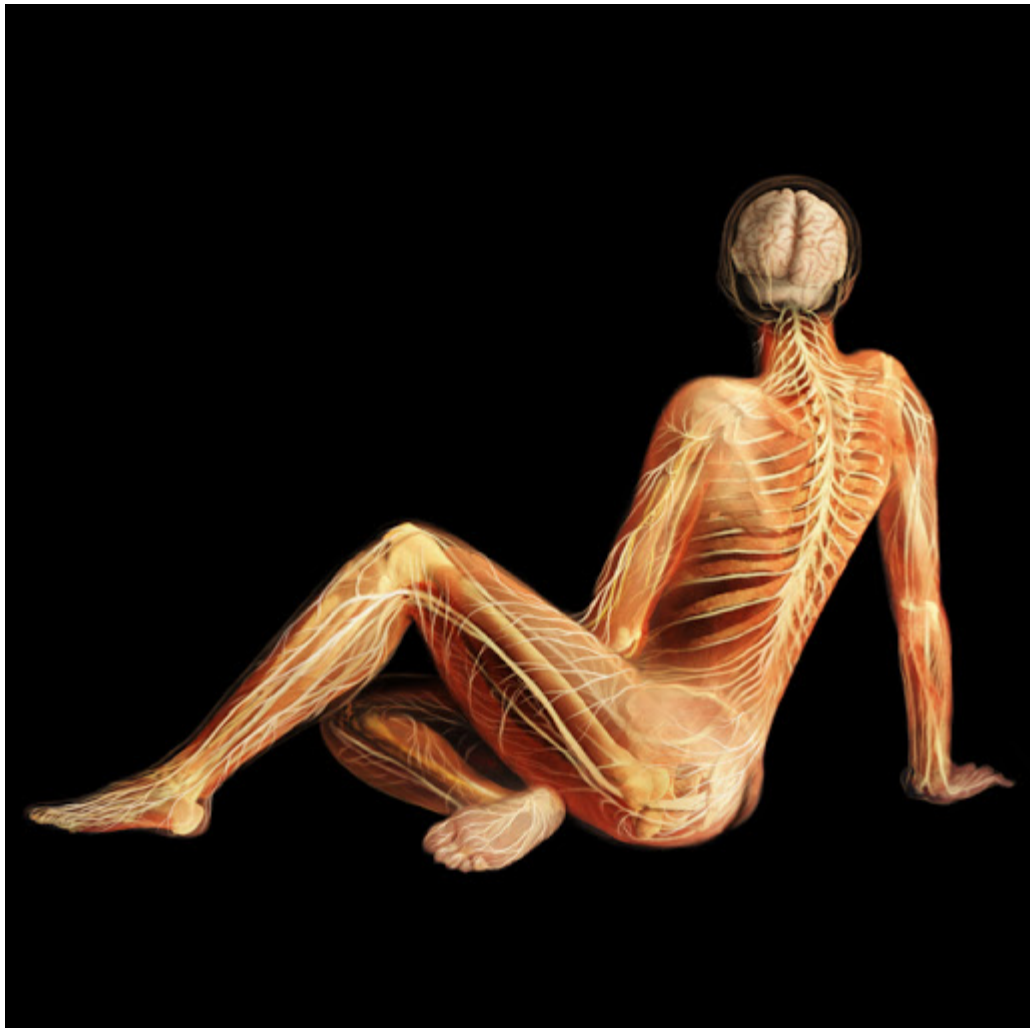
2. Nervous System

Marjorie D. Shaw, Ph.D.

OLLI Spring, 2021

Study Group 426: The Human Body

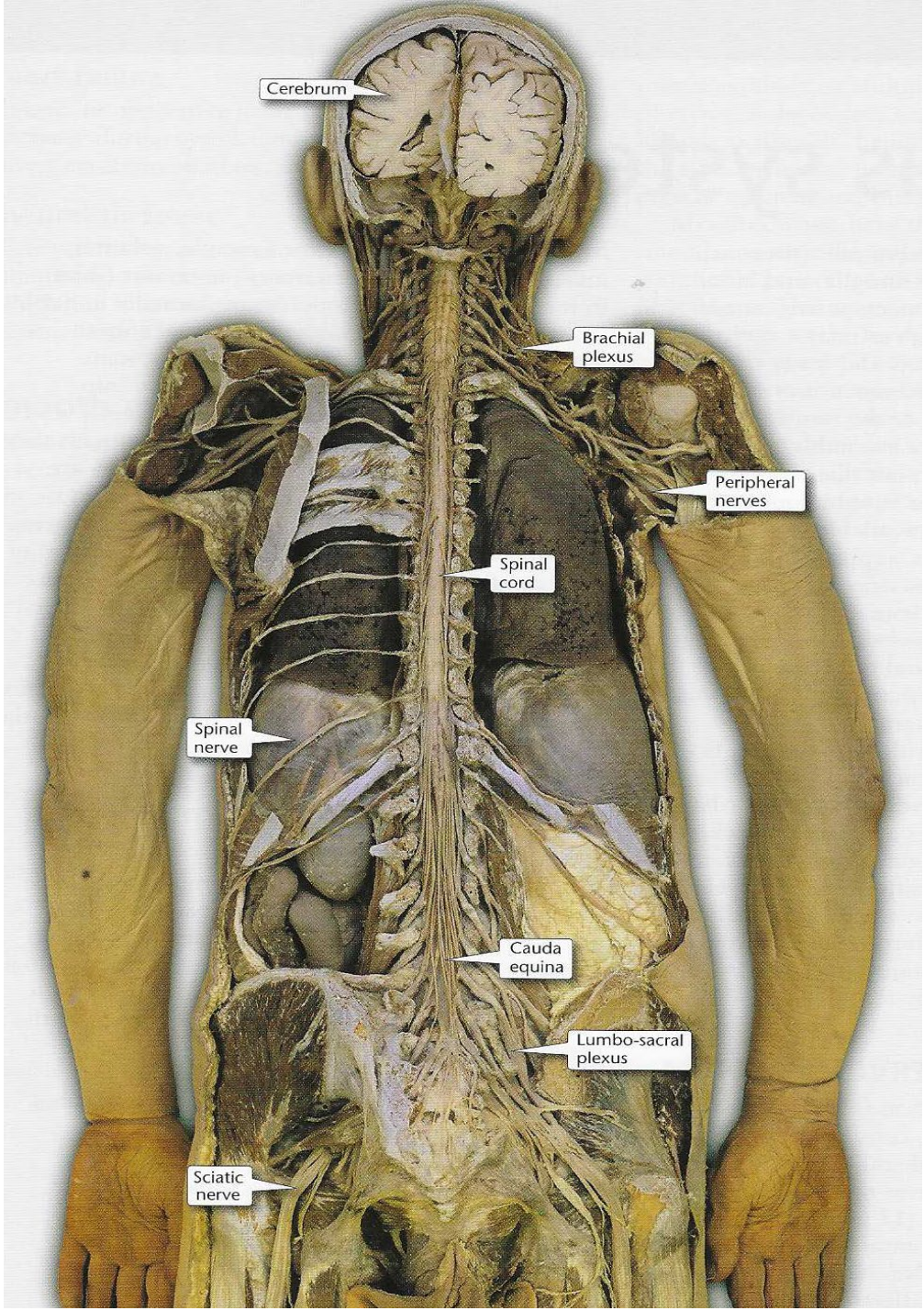


Alexander Tsiaris

Central vs Peripheral

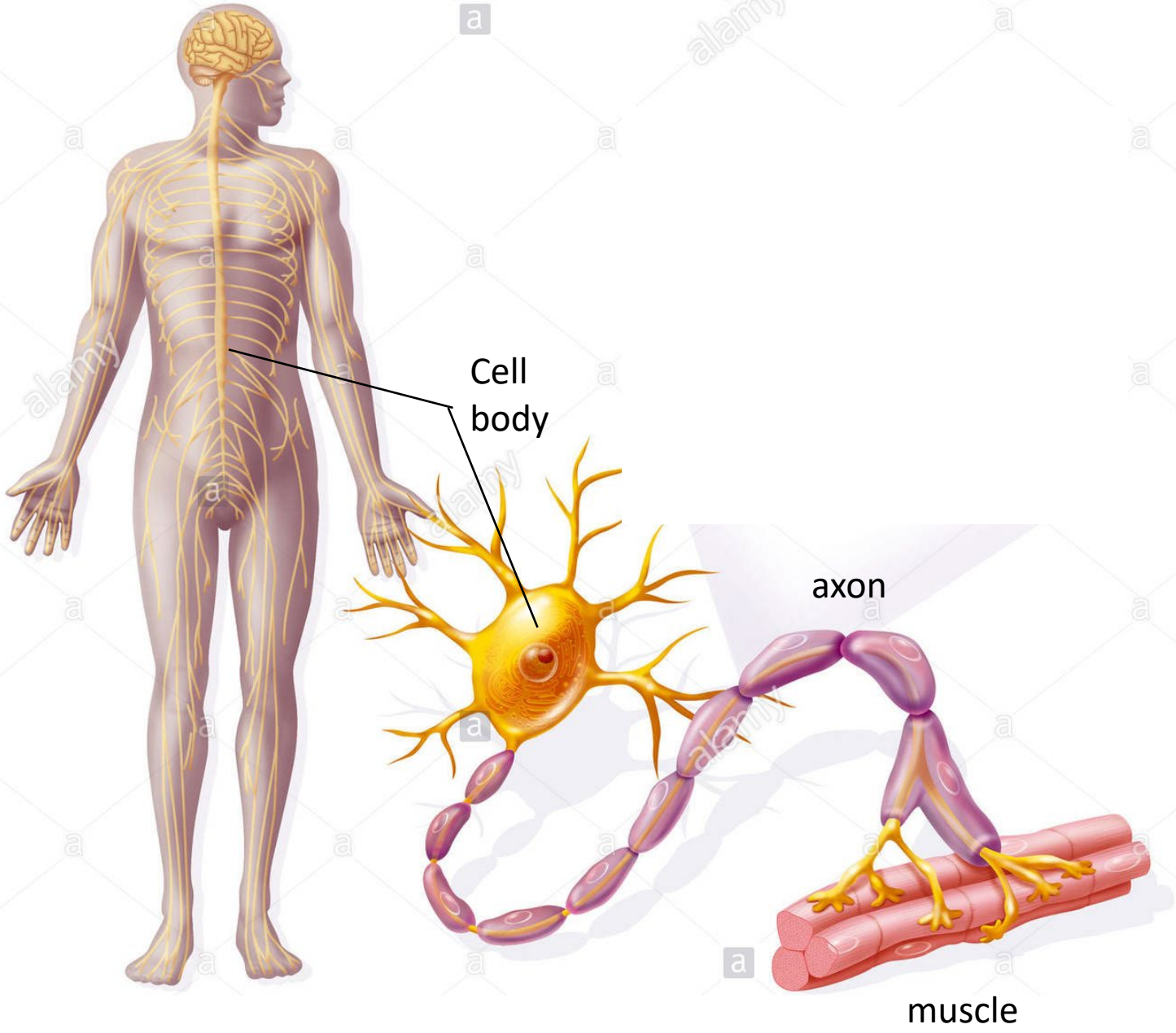
CNS (brain and spinal cord) are enclosed in bone (skull and vertebral column). Must receive information from periphery, integrate it with state of the organism and send signals back out to periphery to create actions.

Somatic vs autonomic:
Voluntary control of skeletal muscles vs unconscious control of cardiac muscle, smooth muscle and glands.

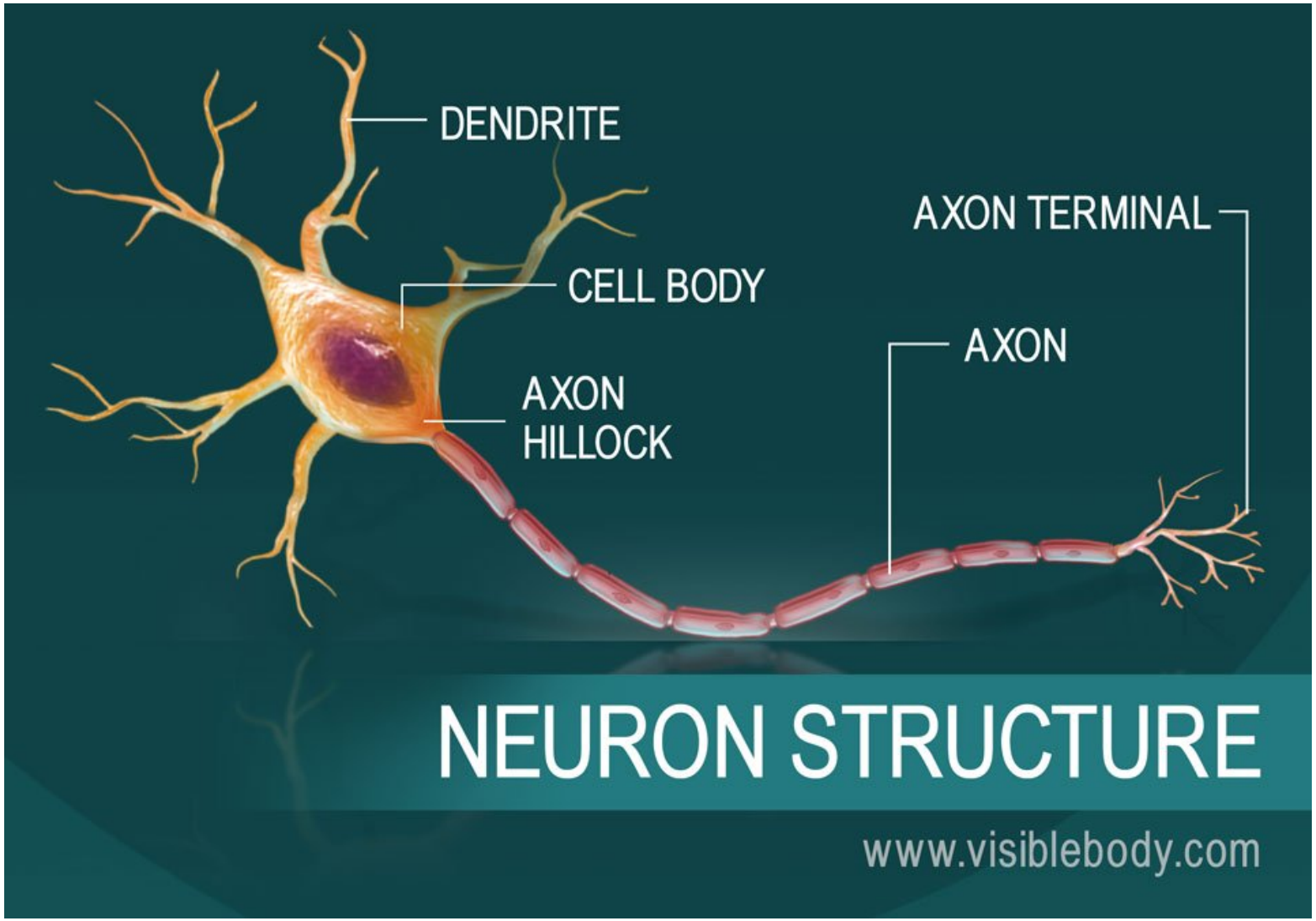


Motor Neurons

Motor neurons have cell bodies in CNS, but transmit signals on axons to muscles far away.

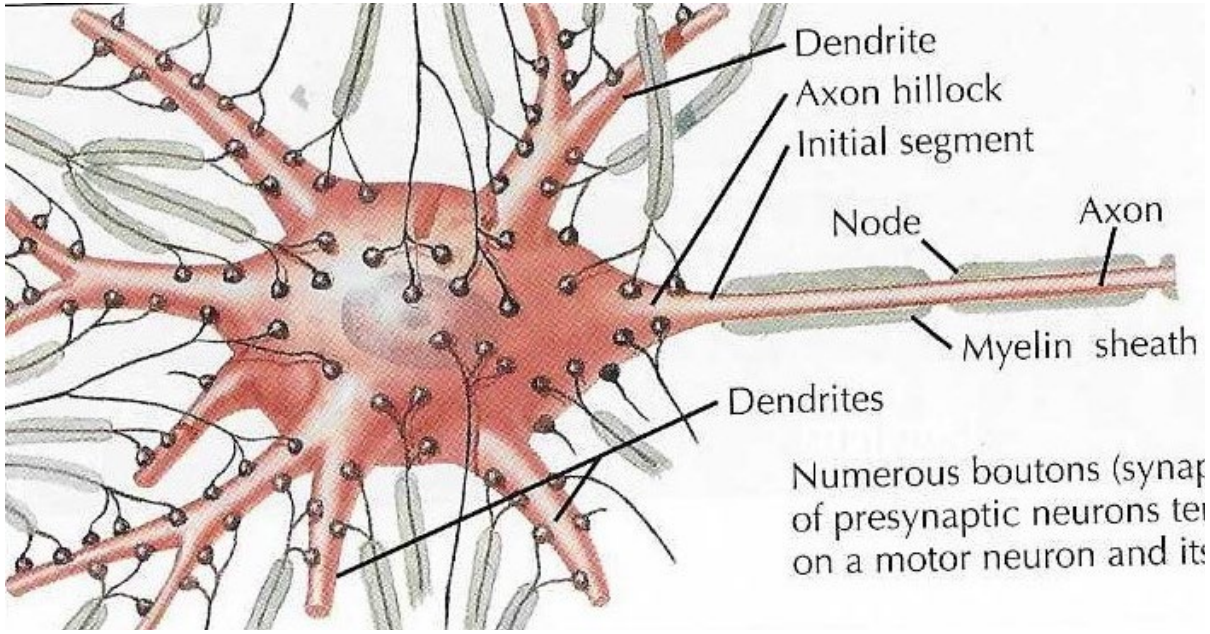


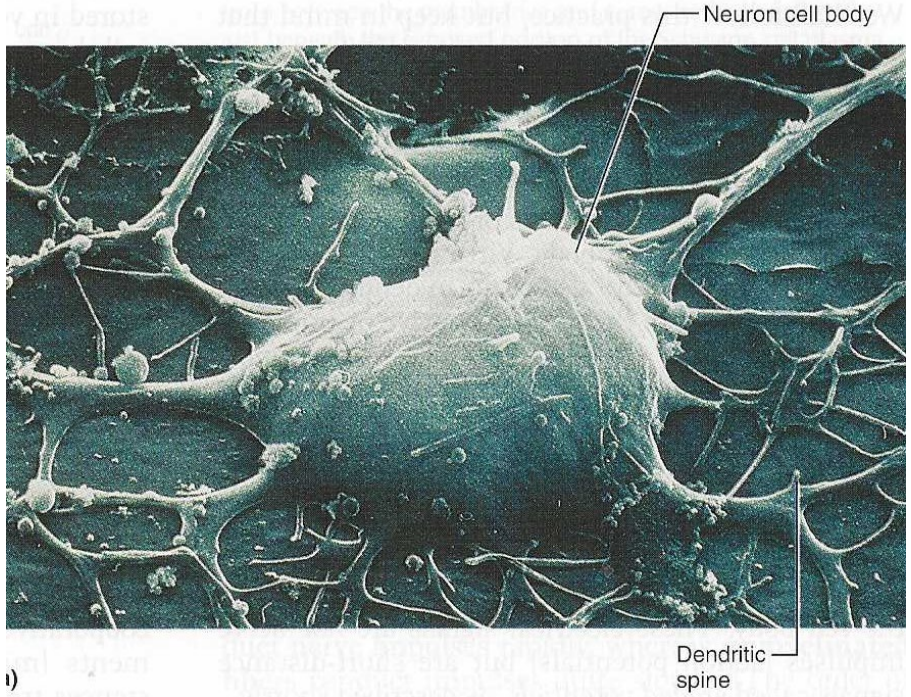
Parts of a Neuron



Fire?

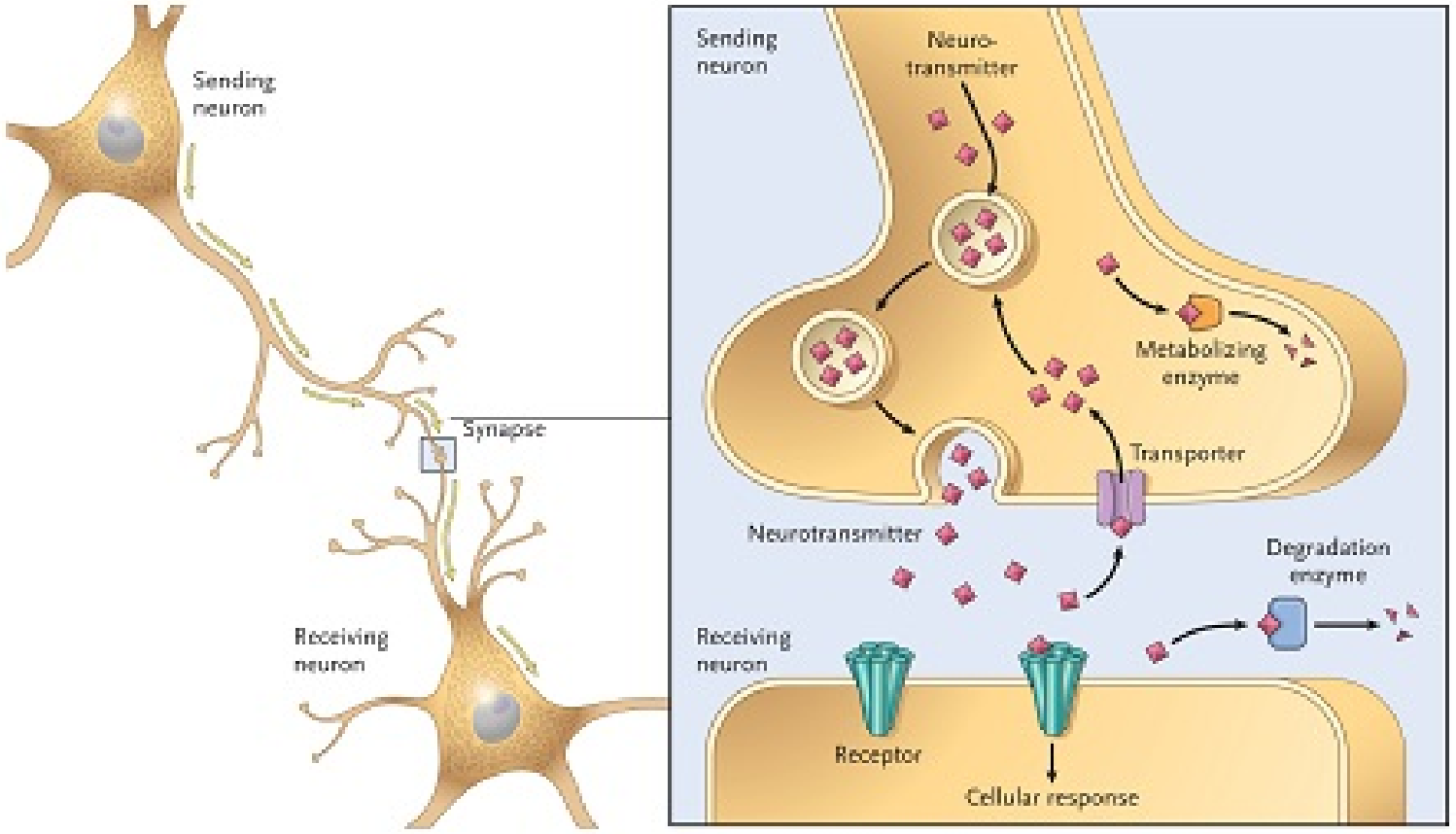
Dendrites receive incoming signals from other neurons, some excitatory and some inhibitory. If the sum of all inputs is **GO** at the axon hillock, a signal is sent down the axon.





Synapses

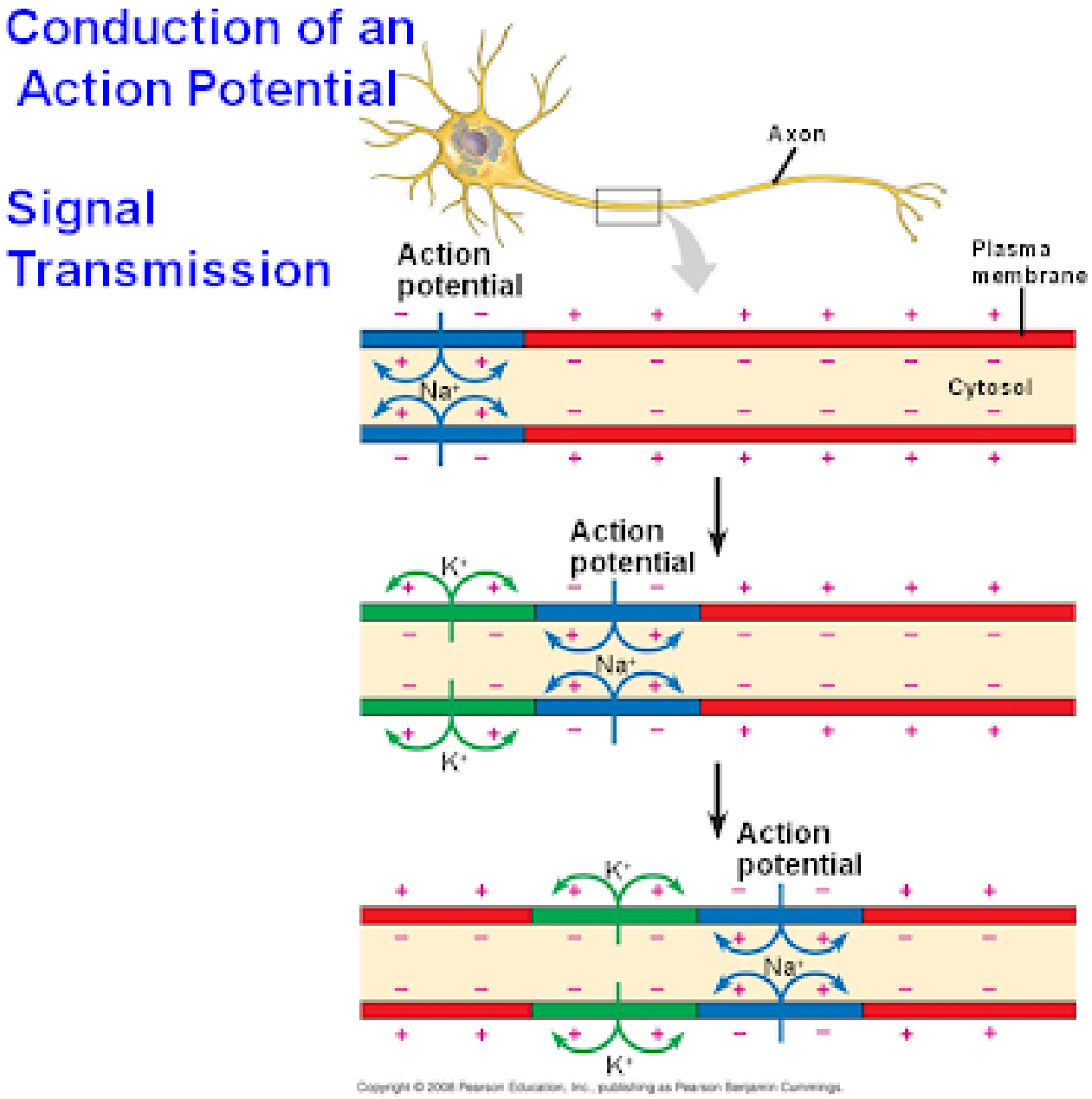
Neurotransmitters are made in the cell body and transported to the synaptic ending. They are packaged in **vesicles** and (when the axon fires) released into the synaptic cleft, where they diffuse to the receiving neuron. There are many kinds of transmitters (acetylcholine, serotonin, dopamine etc.) and many specialized receptors (excitatory, inhibitory, modulatory).



Signal is Electrical

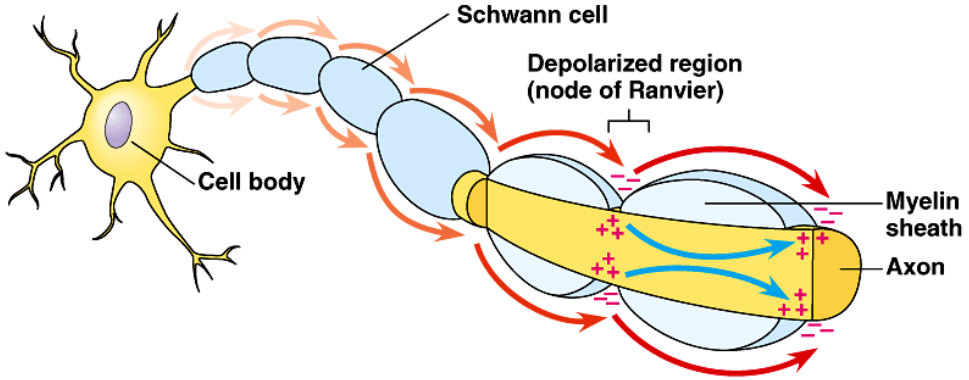
A resting axon has more + charged sodium ions outside than inside. The action potential opens channels in the membrane, letting positive charges in. This opens the next channels, letting Na+ in, opening the next channels.

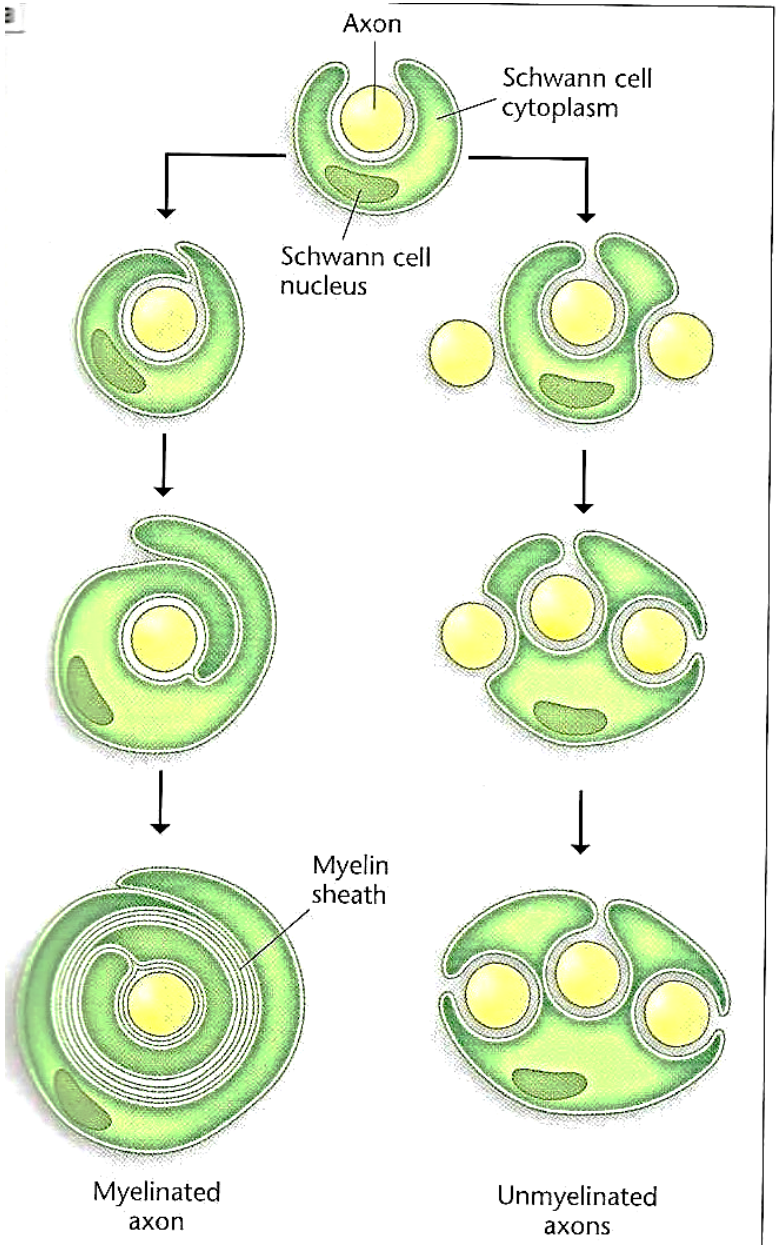
Ionic environment must be precisely controlled! Axons must be protected by glial cells.

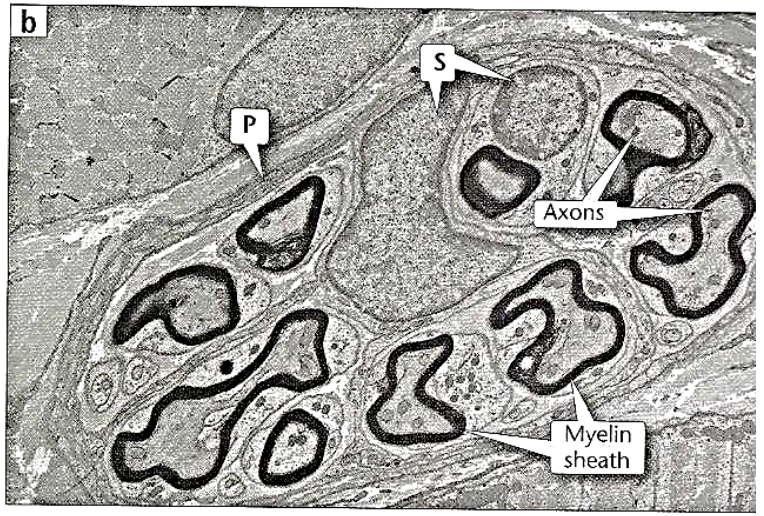


Glia make Myelin

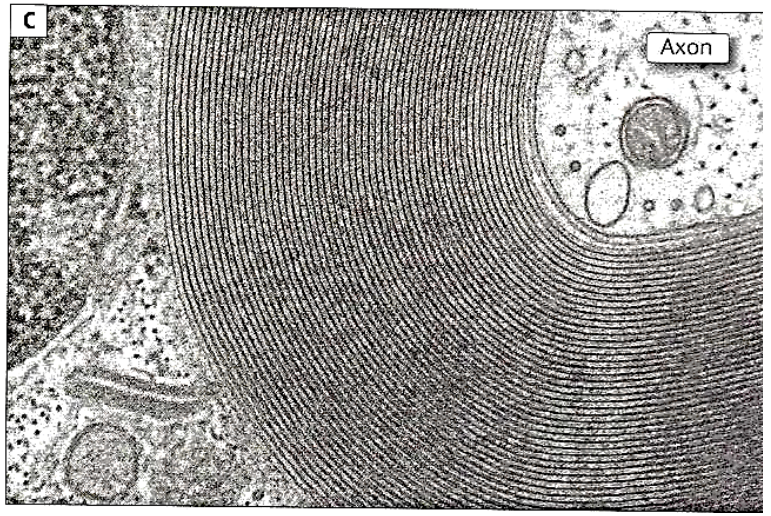
Glial cells (Schwann cells in periphery) wrap around the axon, controlling ionic environment, providing insulation and speeding up signal.





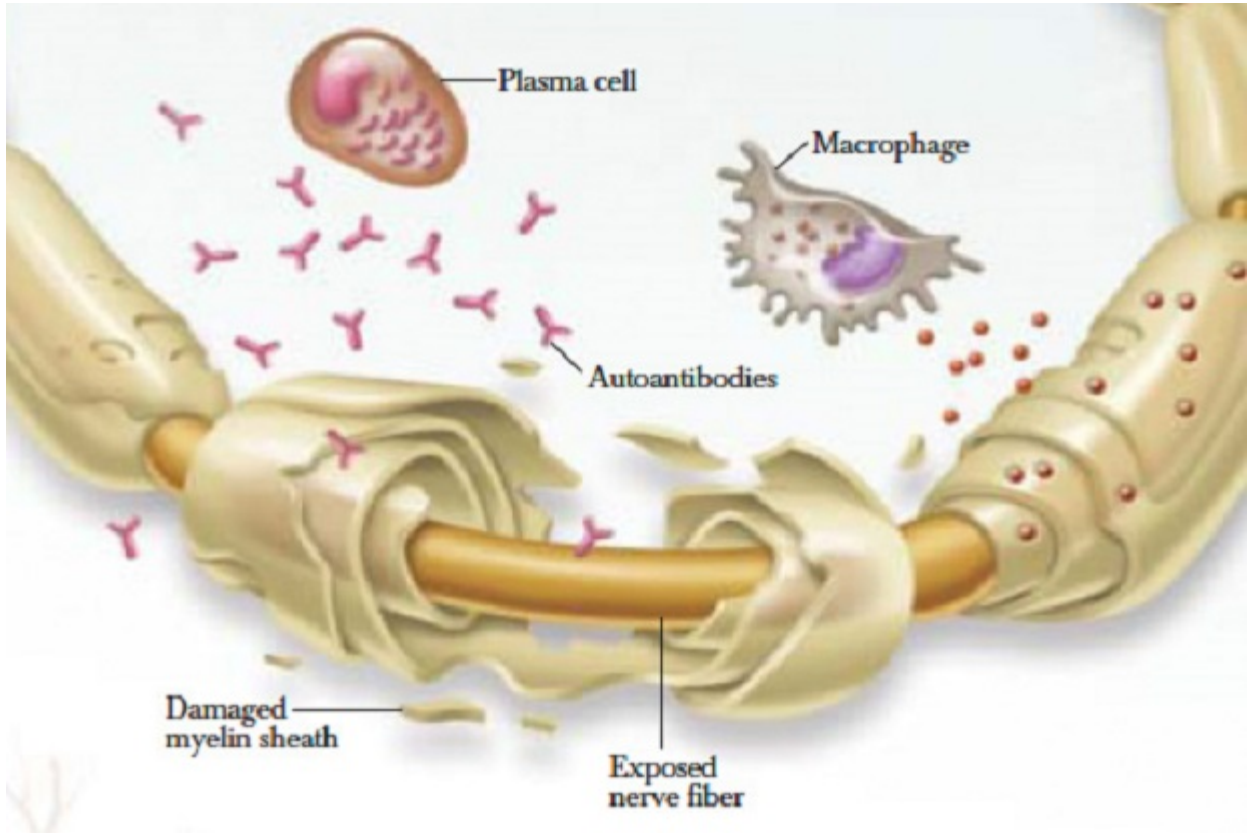


▲ **Fig 7.12b Myelinated axons.** Electron micrograph of myelinated axons invested with myelin sheaths. Schwann cell nucl (**S**) are surrounded by the cell cytoplasm. The nerve fibers are enclosed by a thin covering of perineurium (**P**). × 4,000.



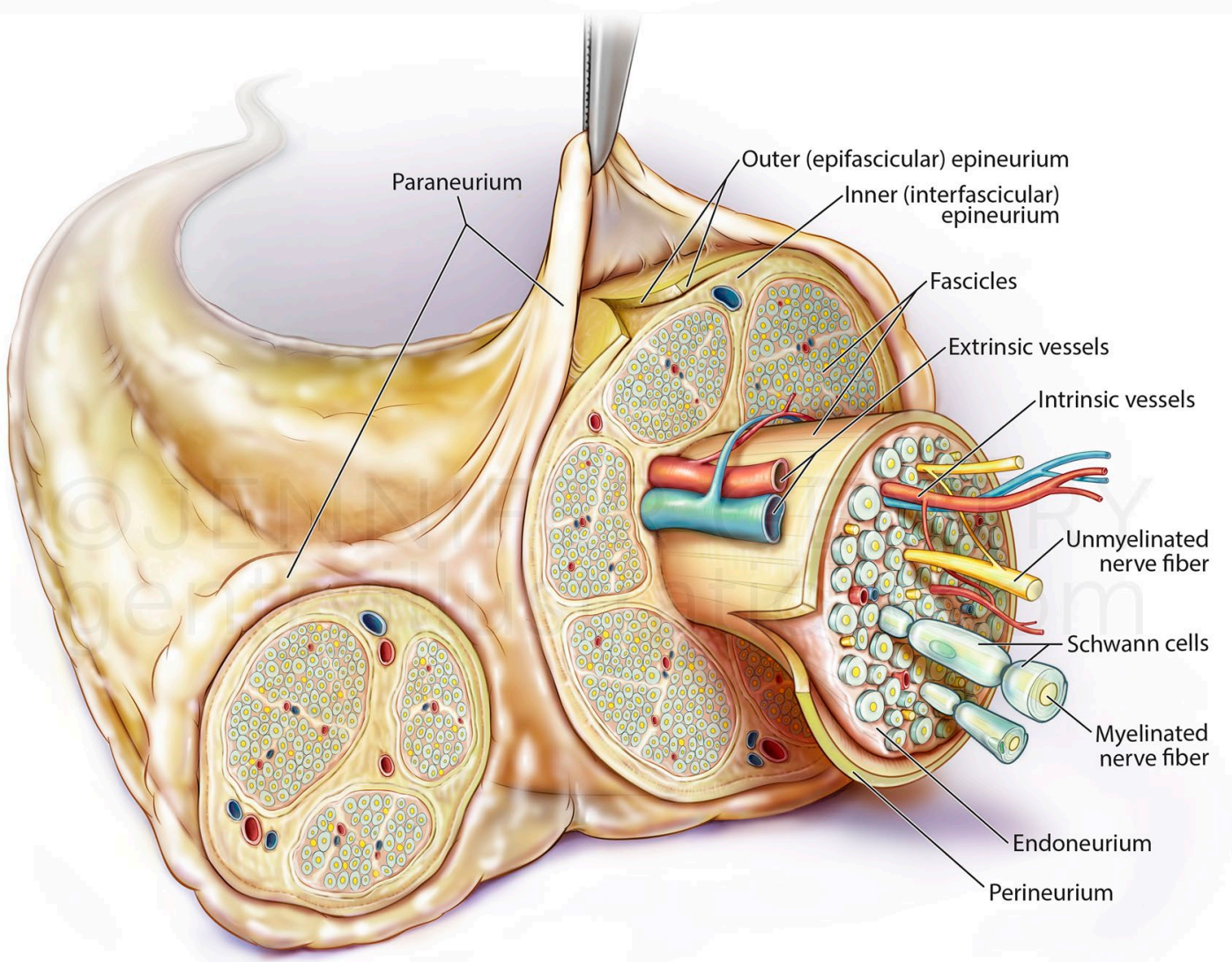
Demyelination Diseases

Multiple sclerosis ; Guillain-Barre: autoimmune destruction and inflammation. Loss of myelin disrupts signal transmission and muscle coordination.



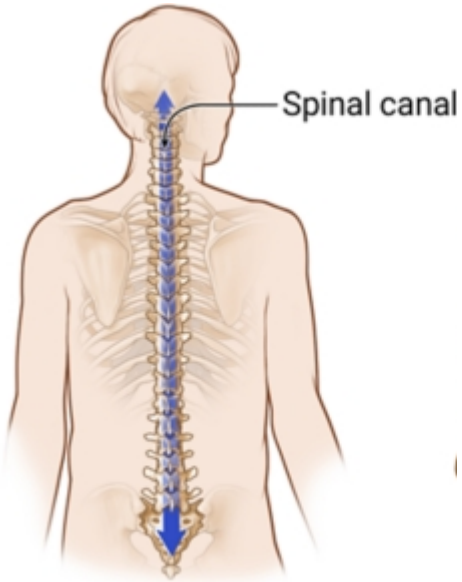
Nerves Need Blood

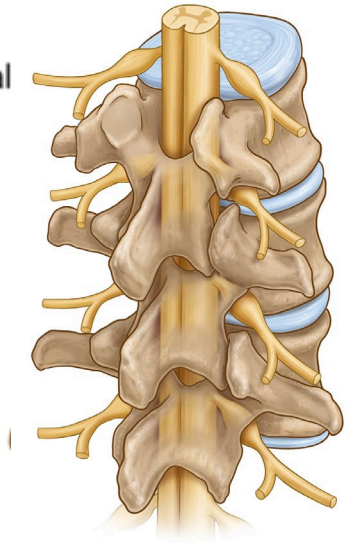
A nerve is a bundle of axons, wrapped up in protective connective tissue, and nourished by blood vessels. High blood sugar damages small arteries (diabetes), and loss of blood damages the axon, resulting in loss of muscle control and sensation.

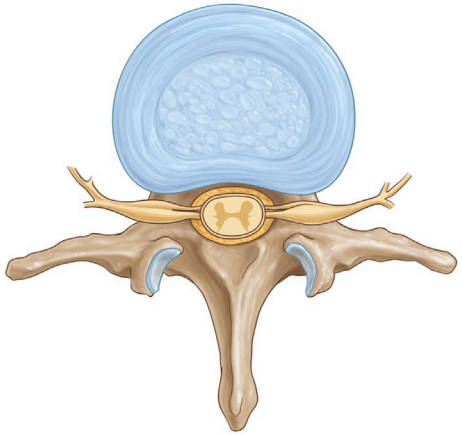


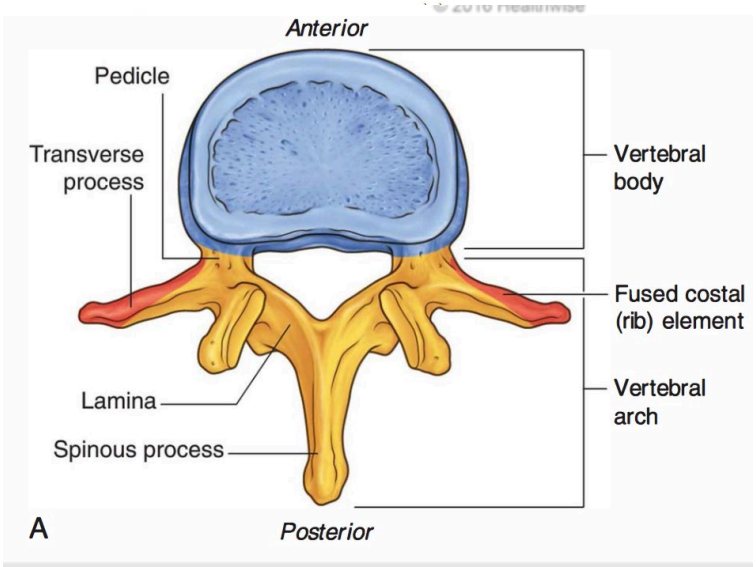
Spinal Cord

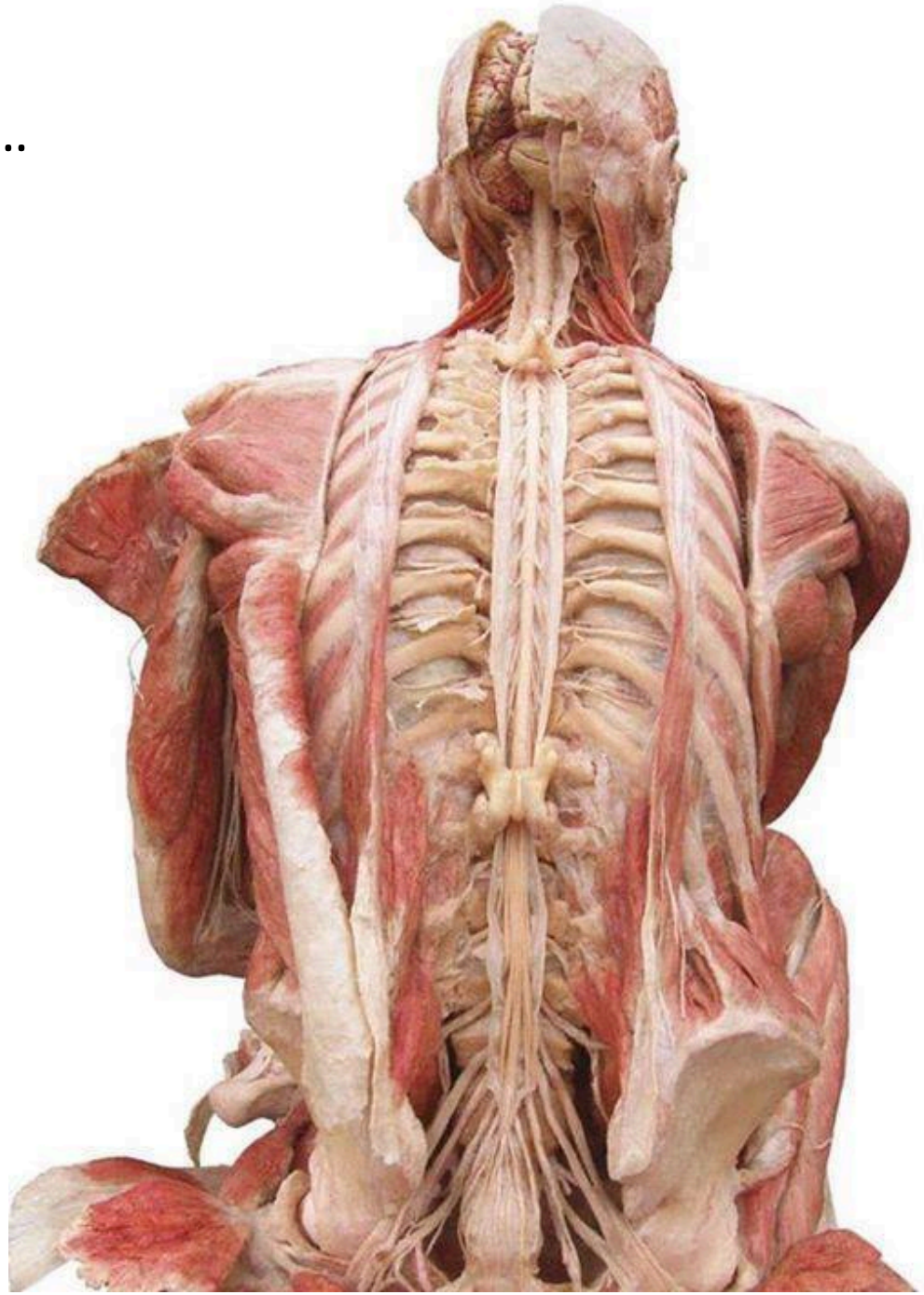
Protected by vertebrae…





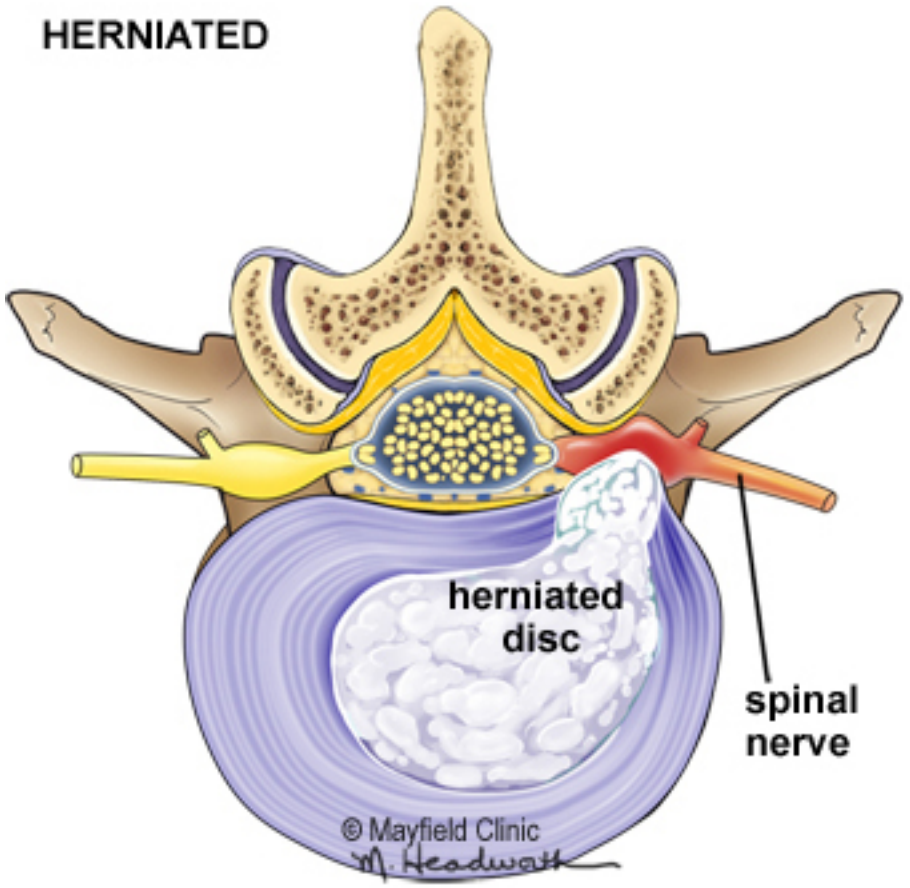


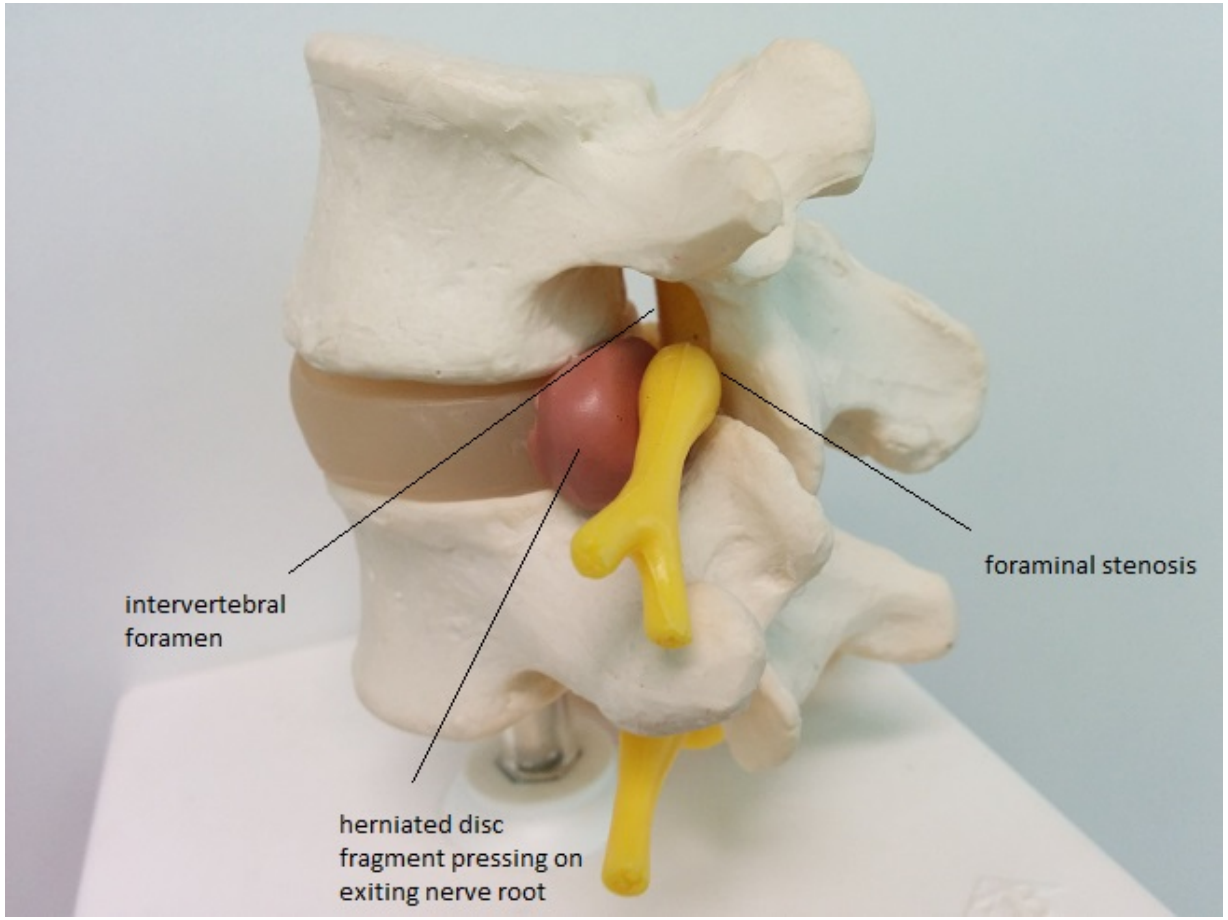




Spinal Nerves

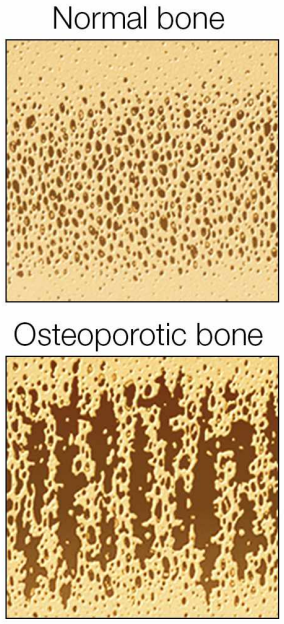
But may be damaged by vertebrae

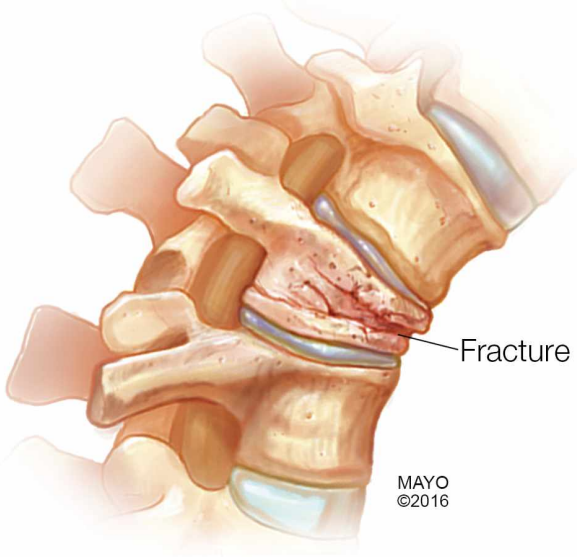




Ageing Vertebrae

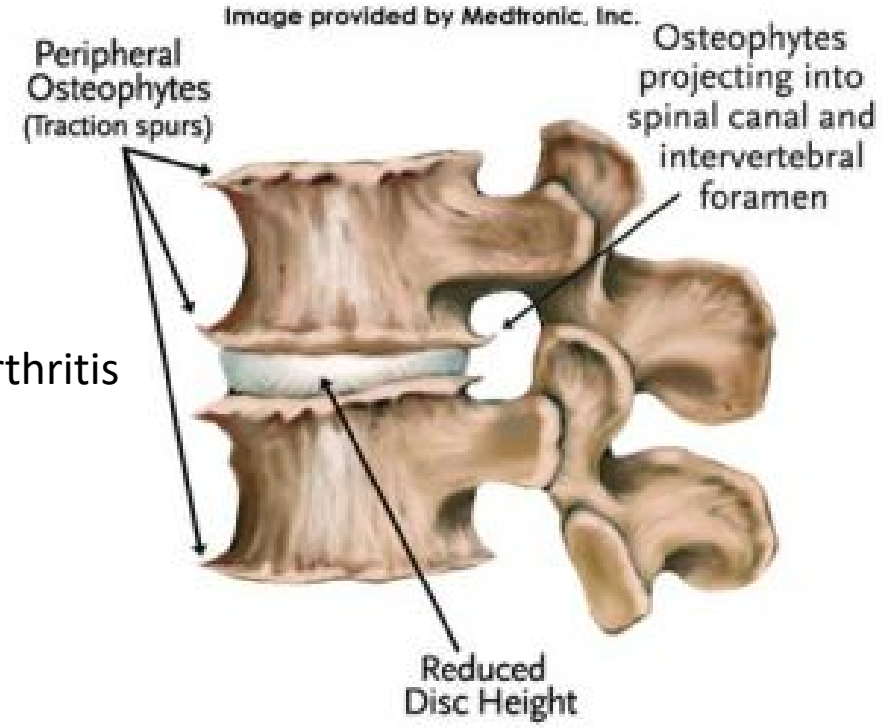
Osteoporosis, tumor infiltration: compression fracture



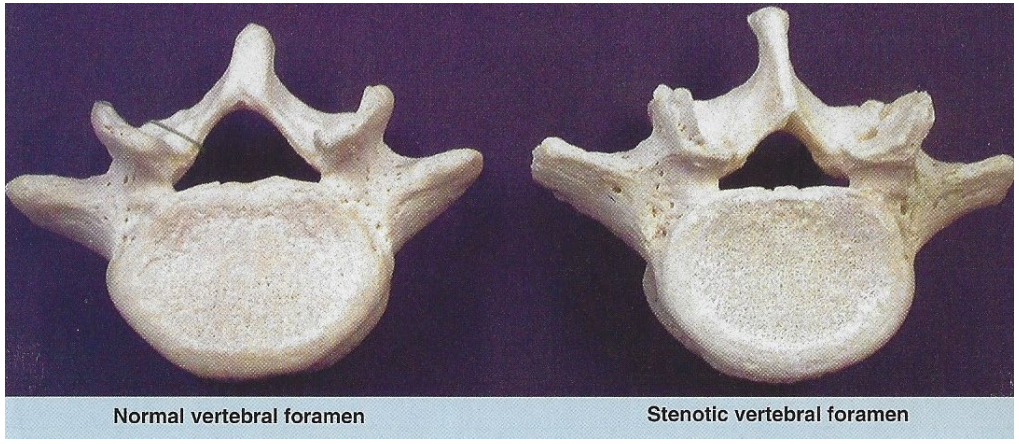


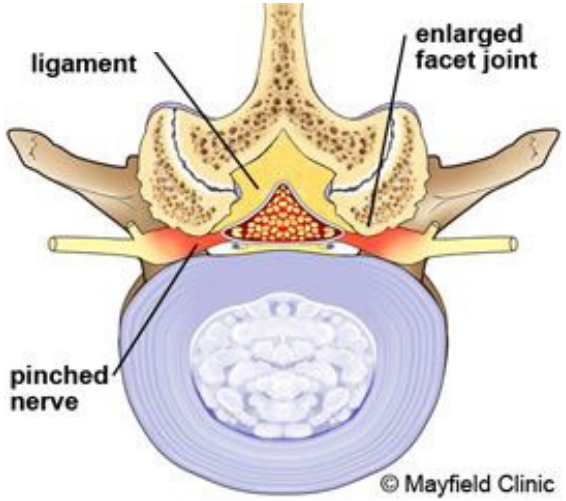
Osteophytes

Osteoarthritis

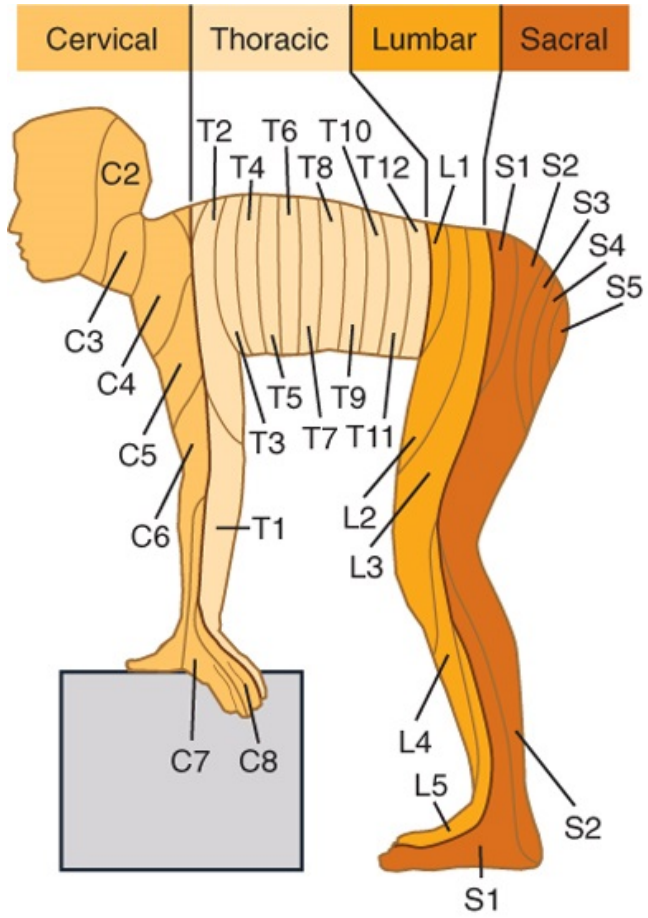


Stenosis: bone or ligaments

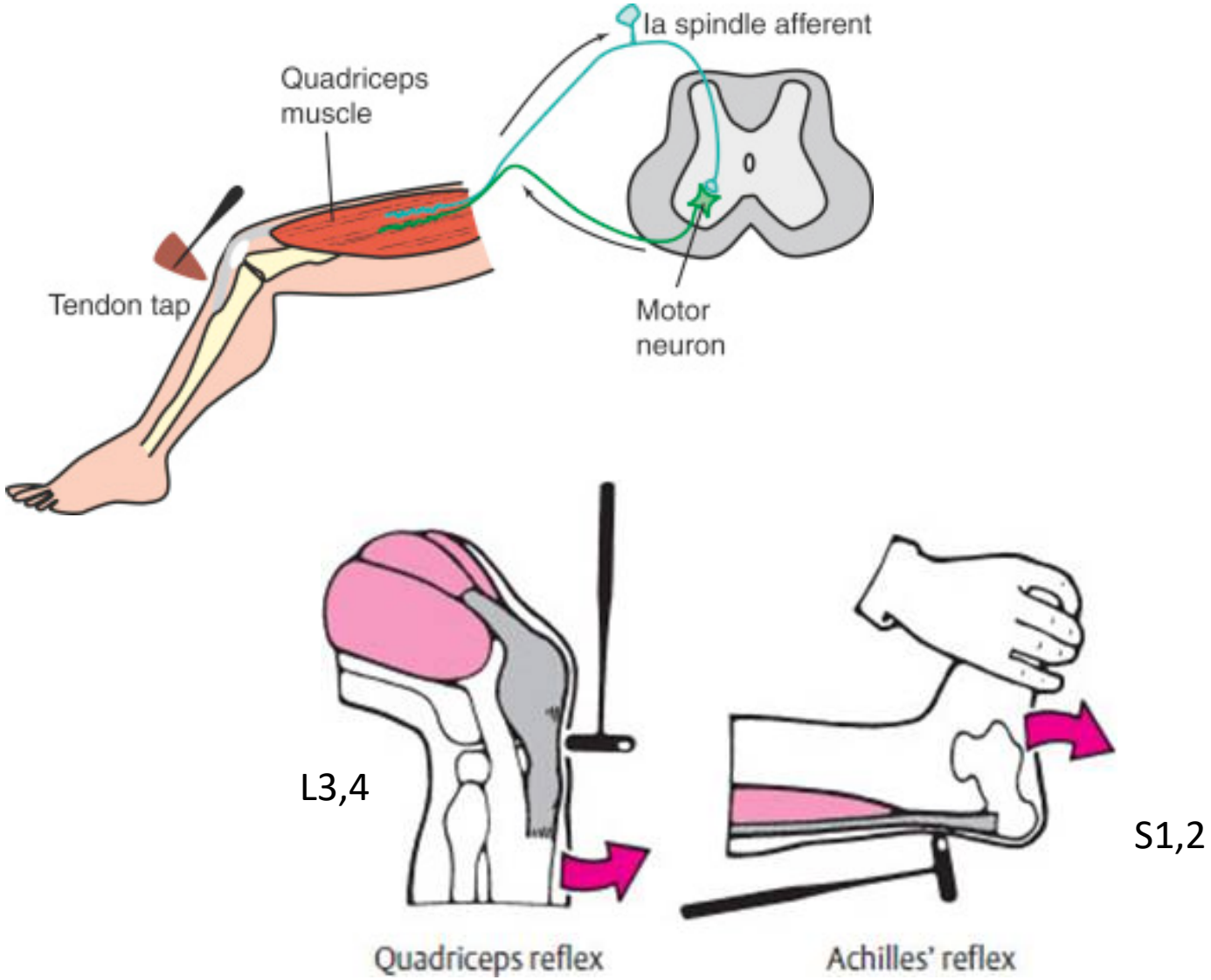




Spinal Nerve Exams



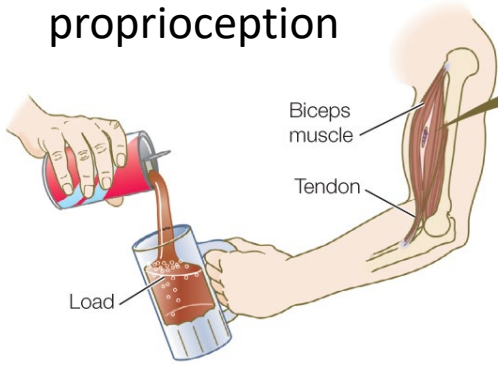
Sensory (skin)

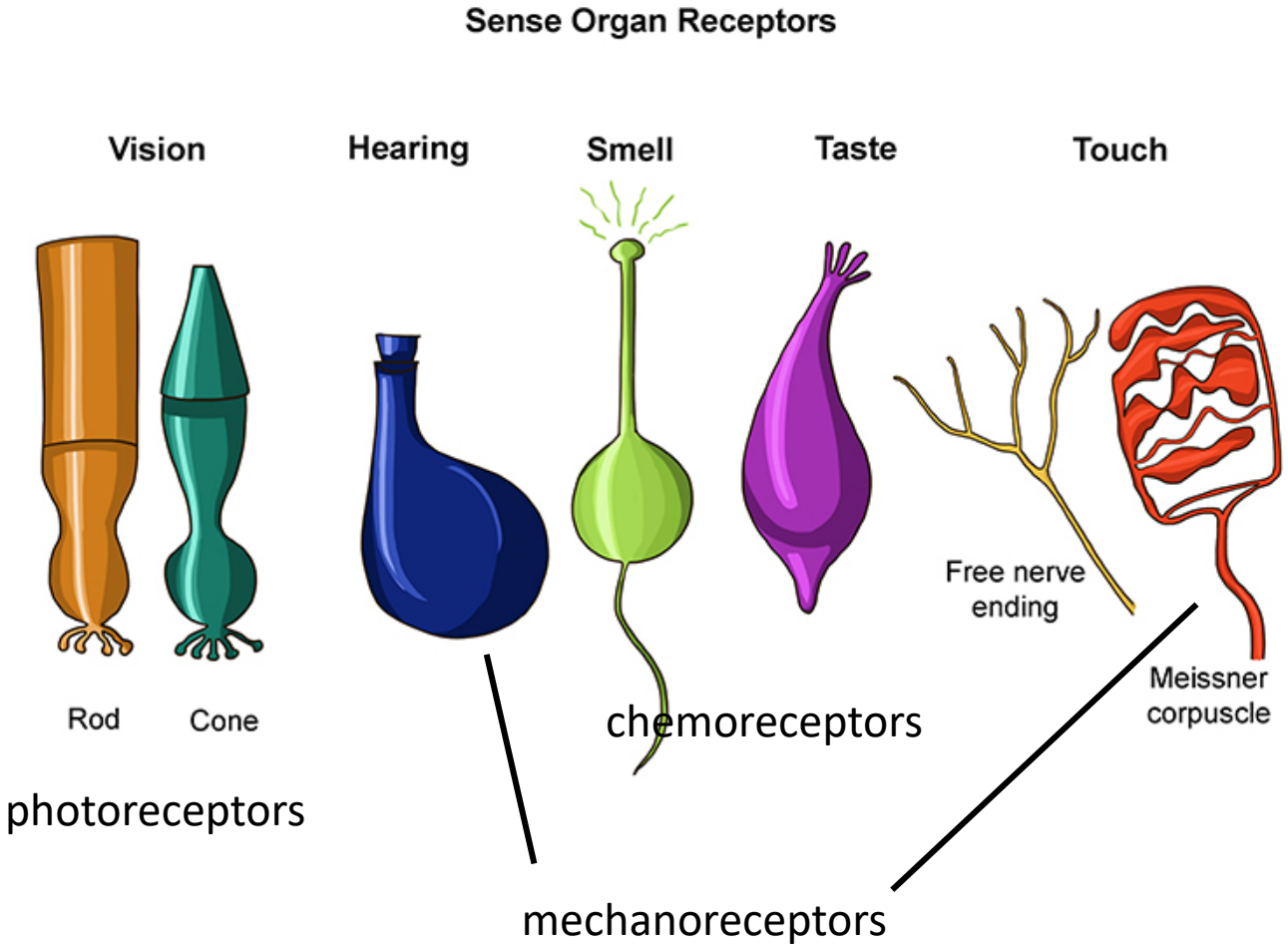


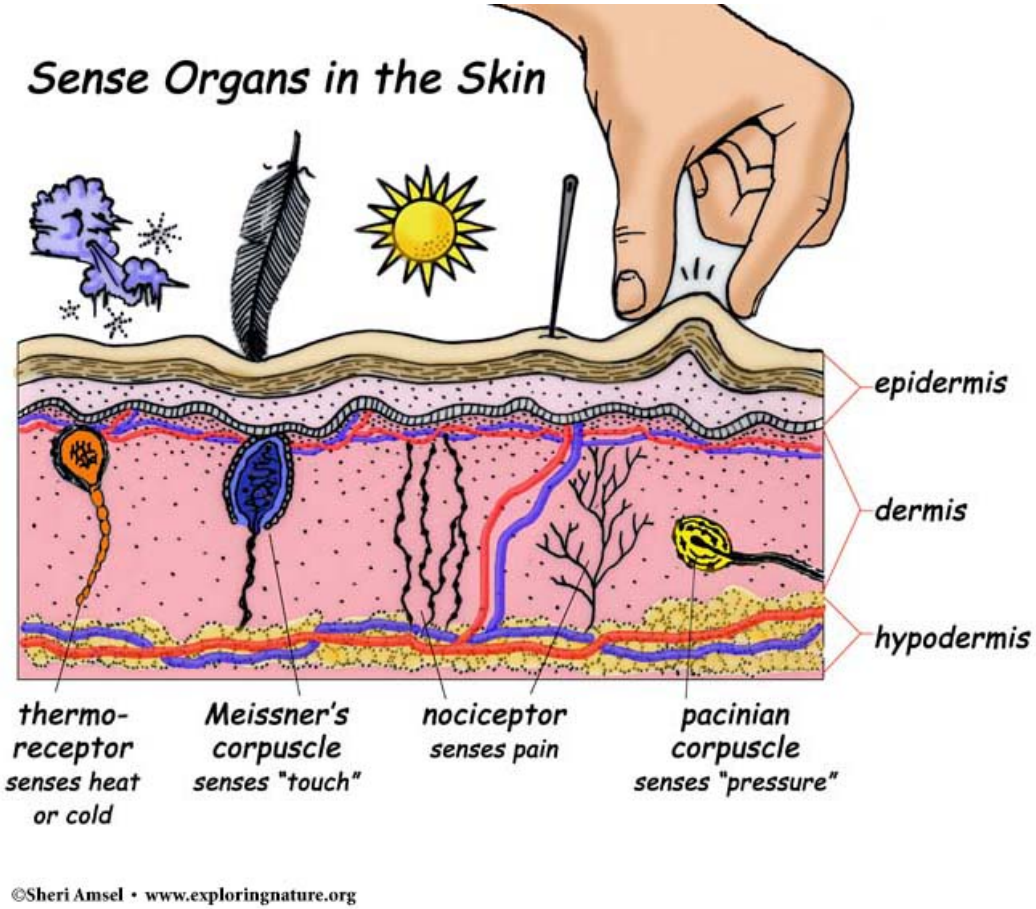
Reflexes: muscle sensory and motor

What Do the Senses tell the CNS?

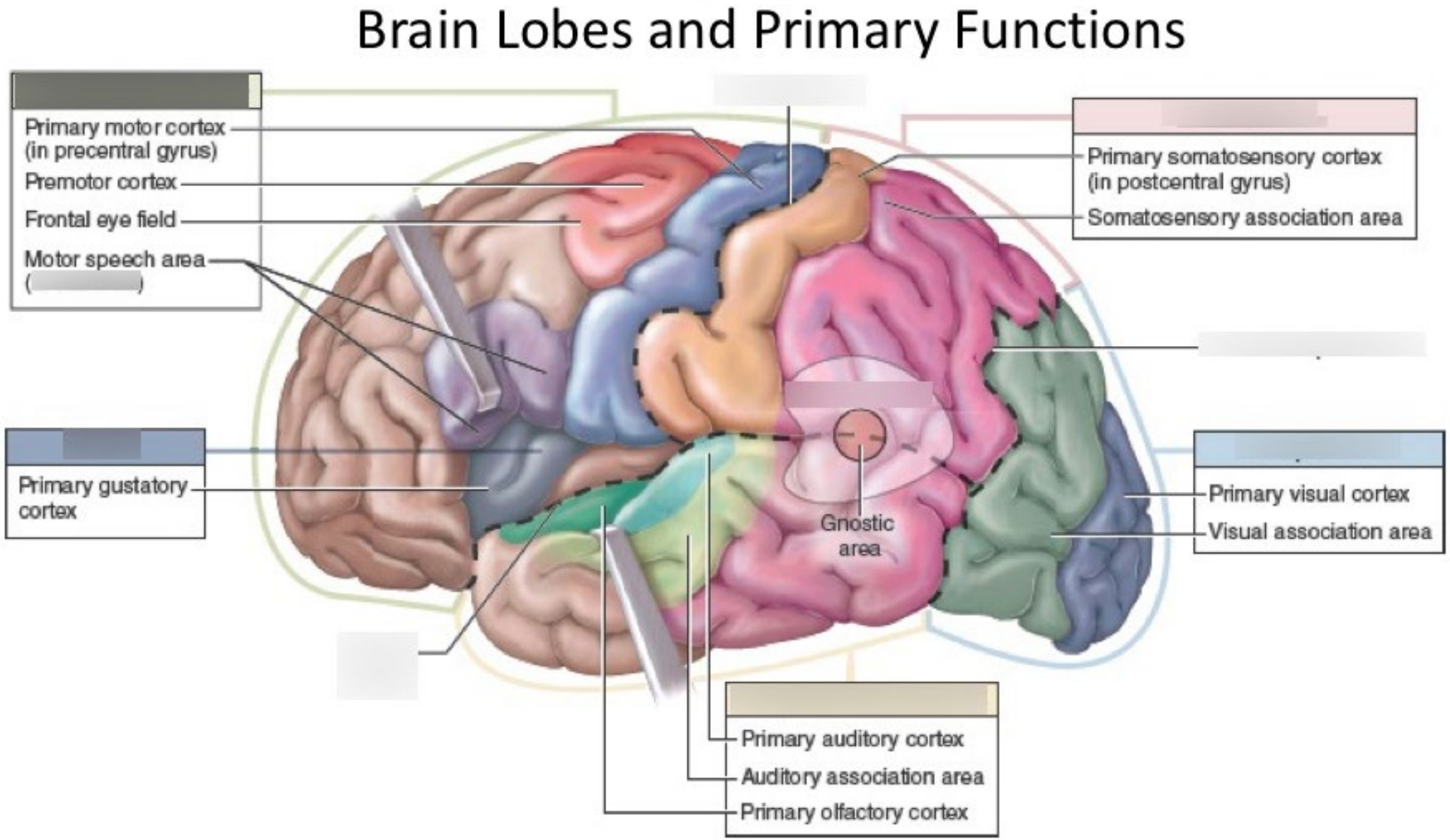
proprioception





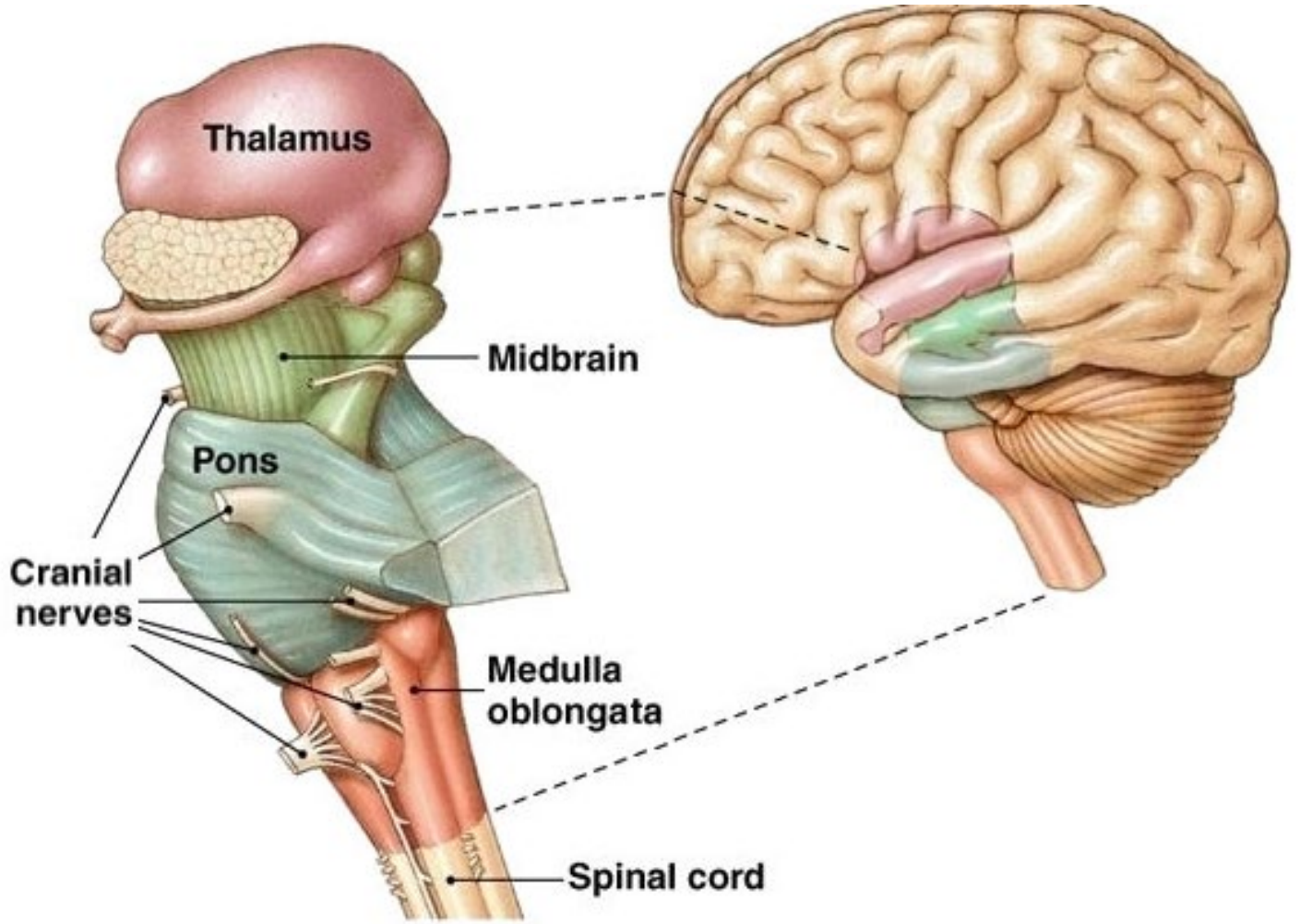


Brain: localized functional areas in cerebral cortex



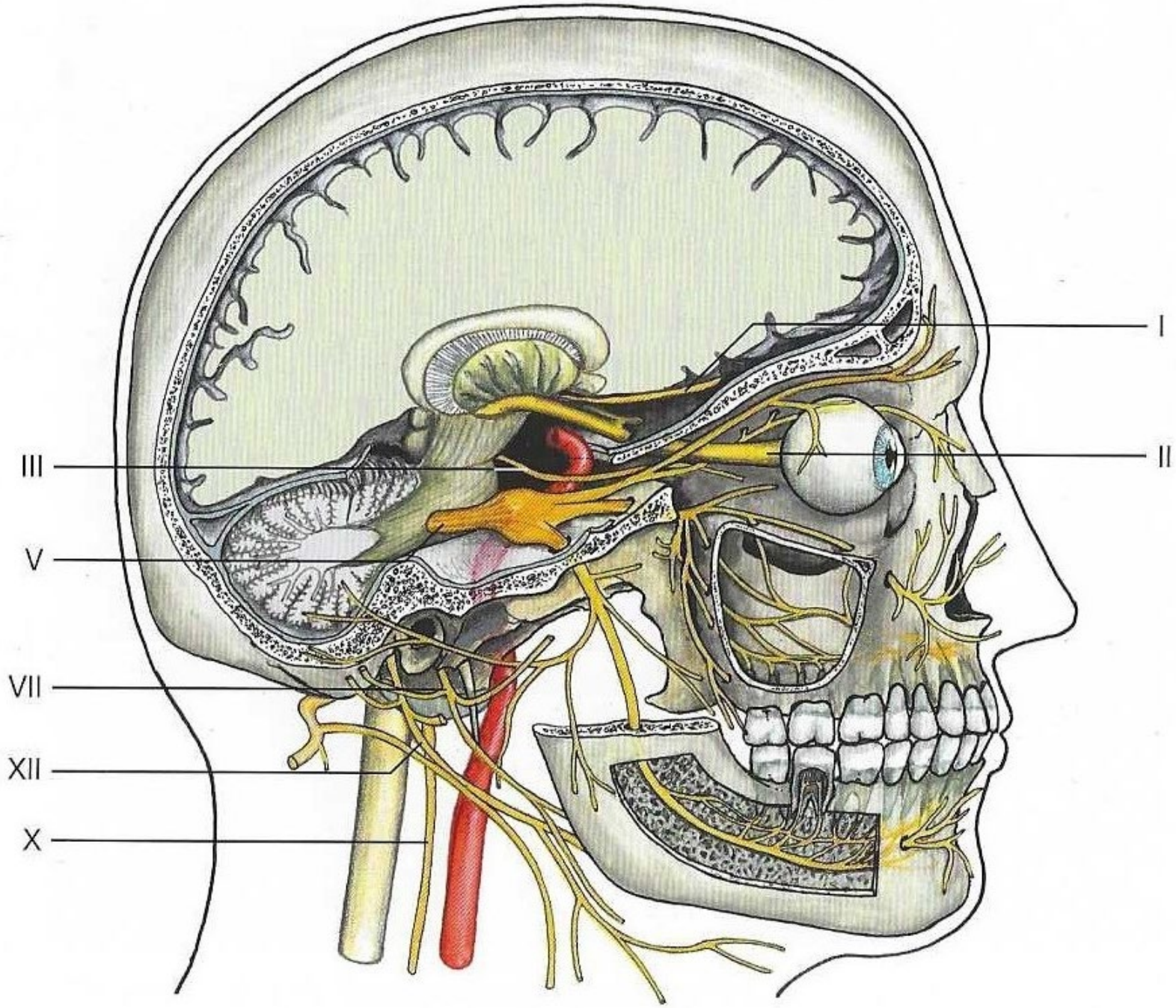
Brainstem

Contains centers that coordinate visceral functions: respiration, heart beat, blood pressure, emesis, micturition etc. Source of cranial nerves.



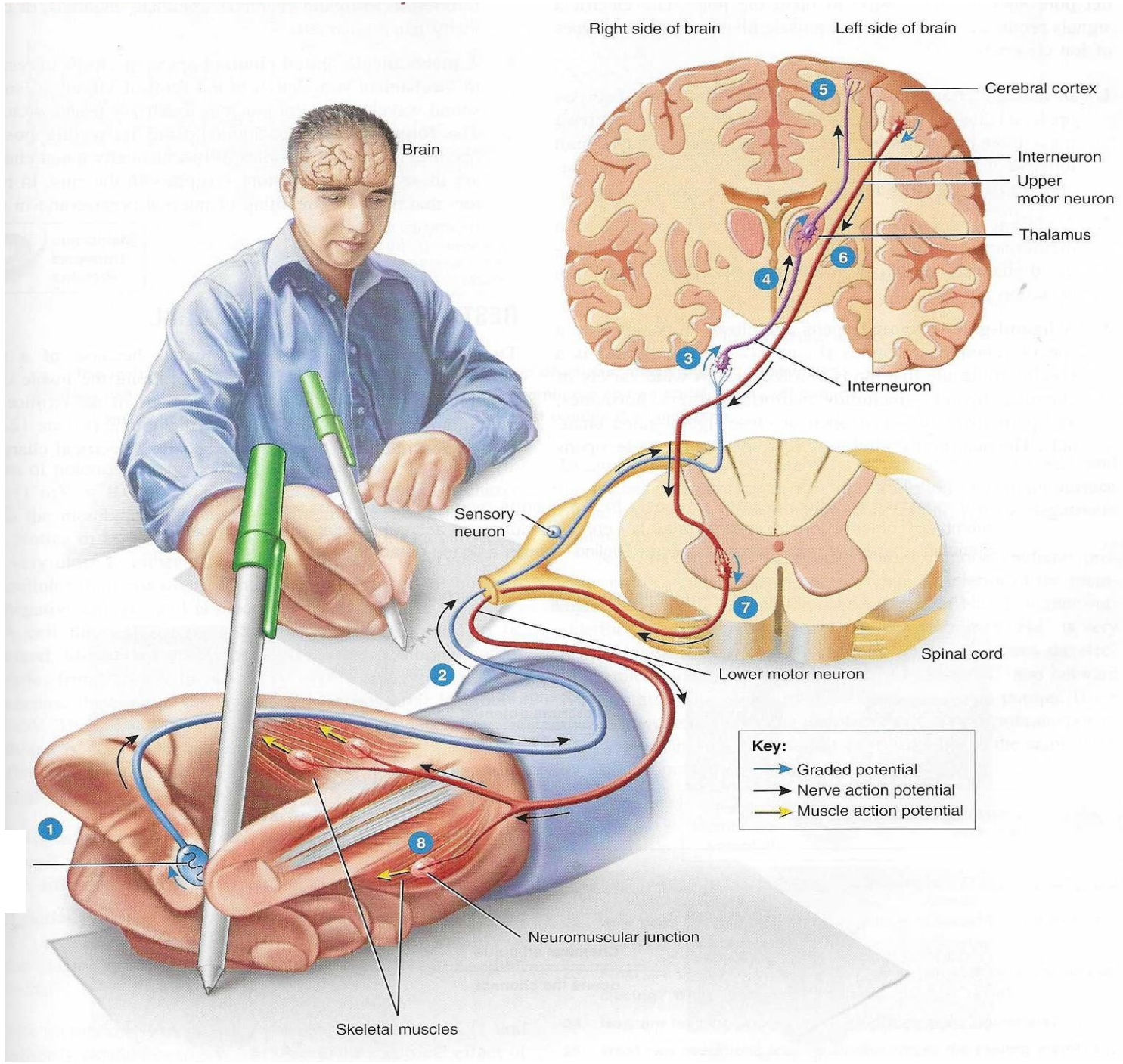
XII Cranial Nerves

Connect the brainstem to the facial senses, muscles and glands (except vagus, which controls the viscera).

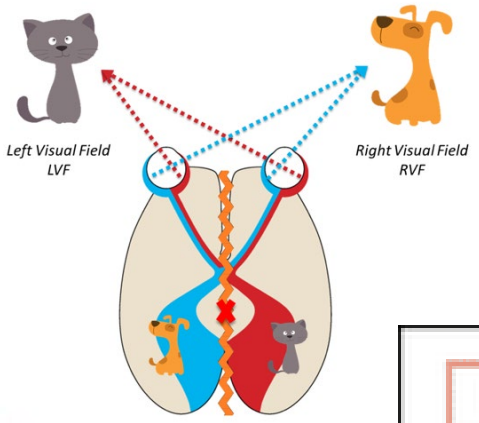


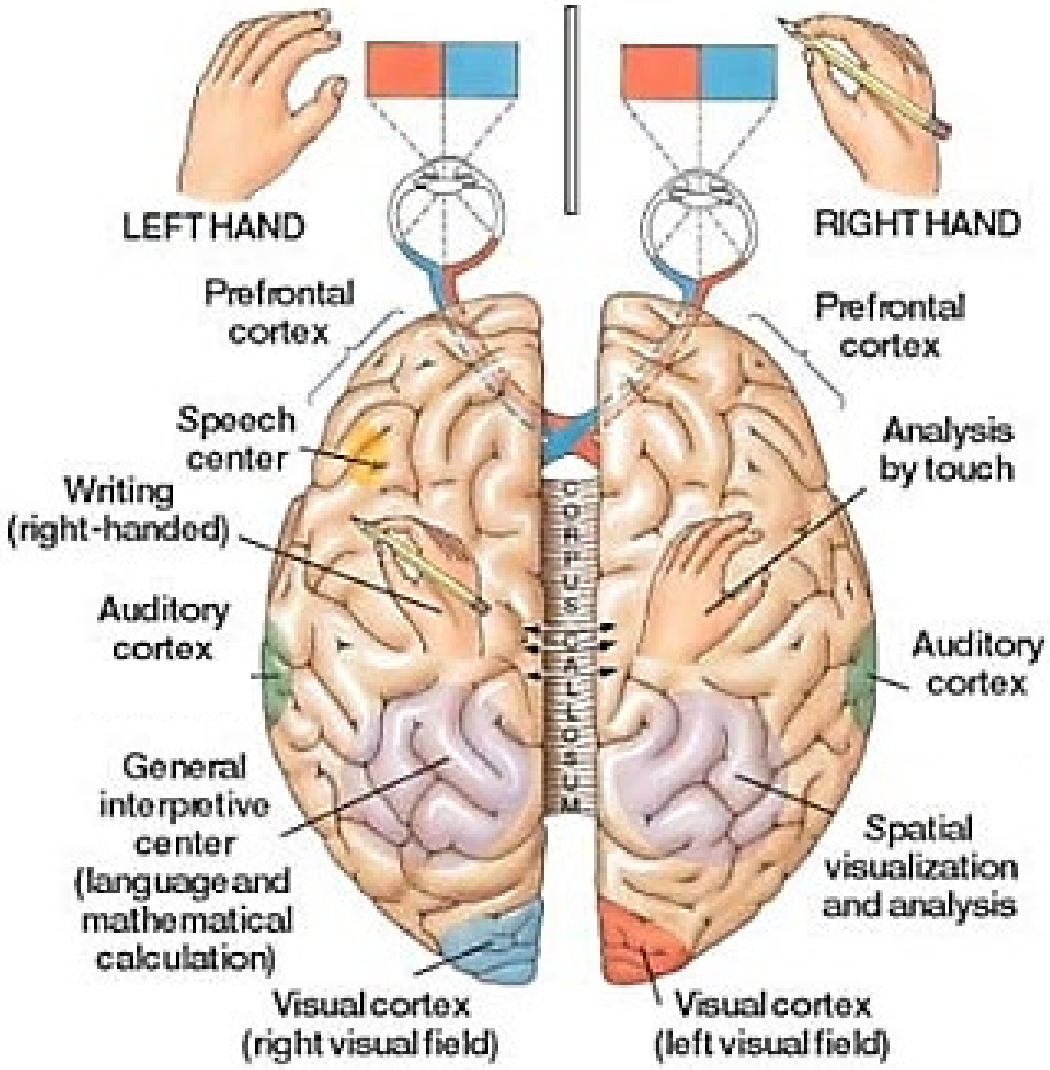
Integration

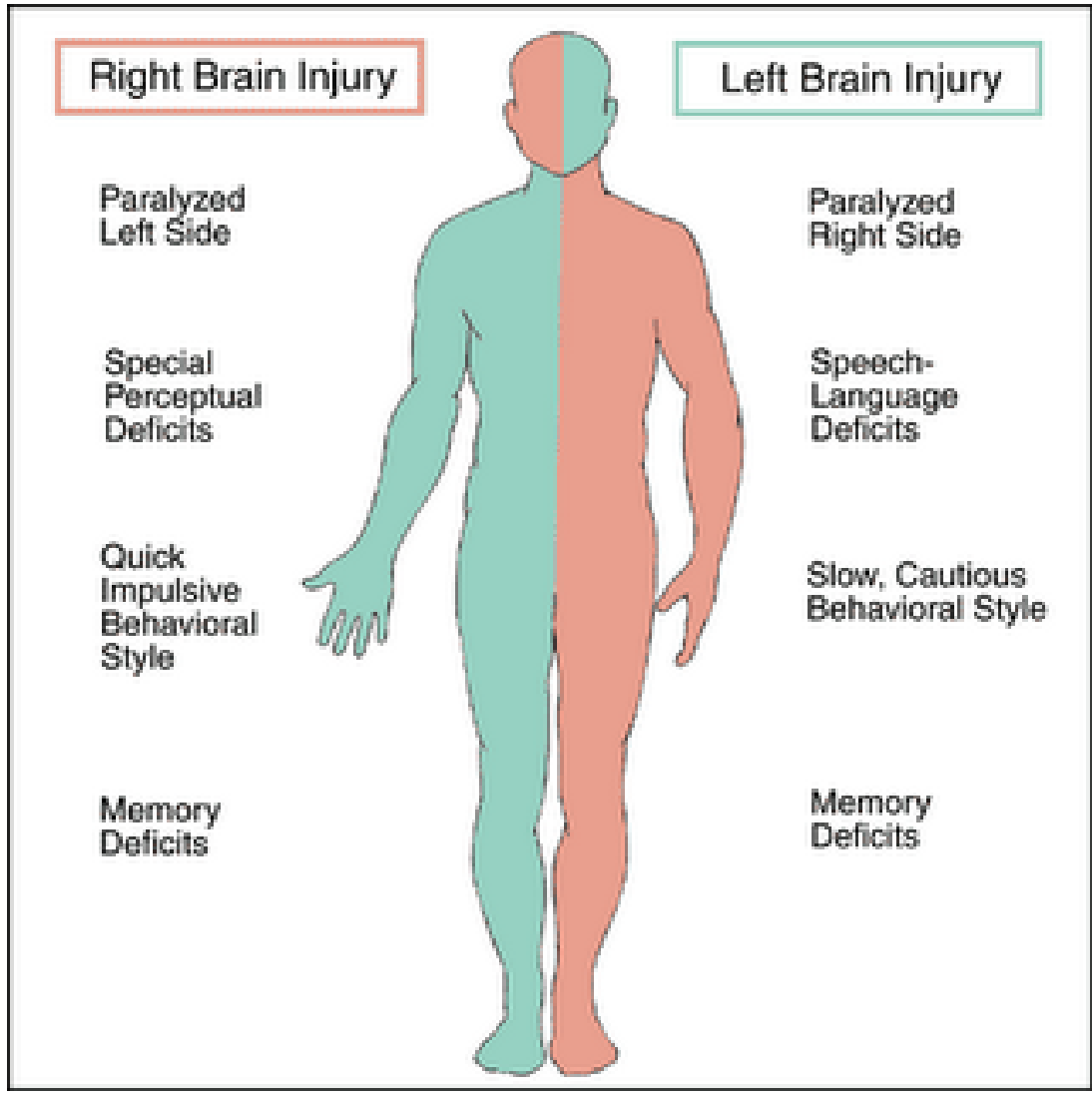
Sensory information from many sources are sent to brain areas. Integrated with information from other parts of the brain on intent, context etc. to motor areas. Signal sent to muscles.



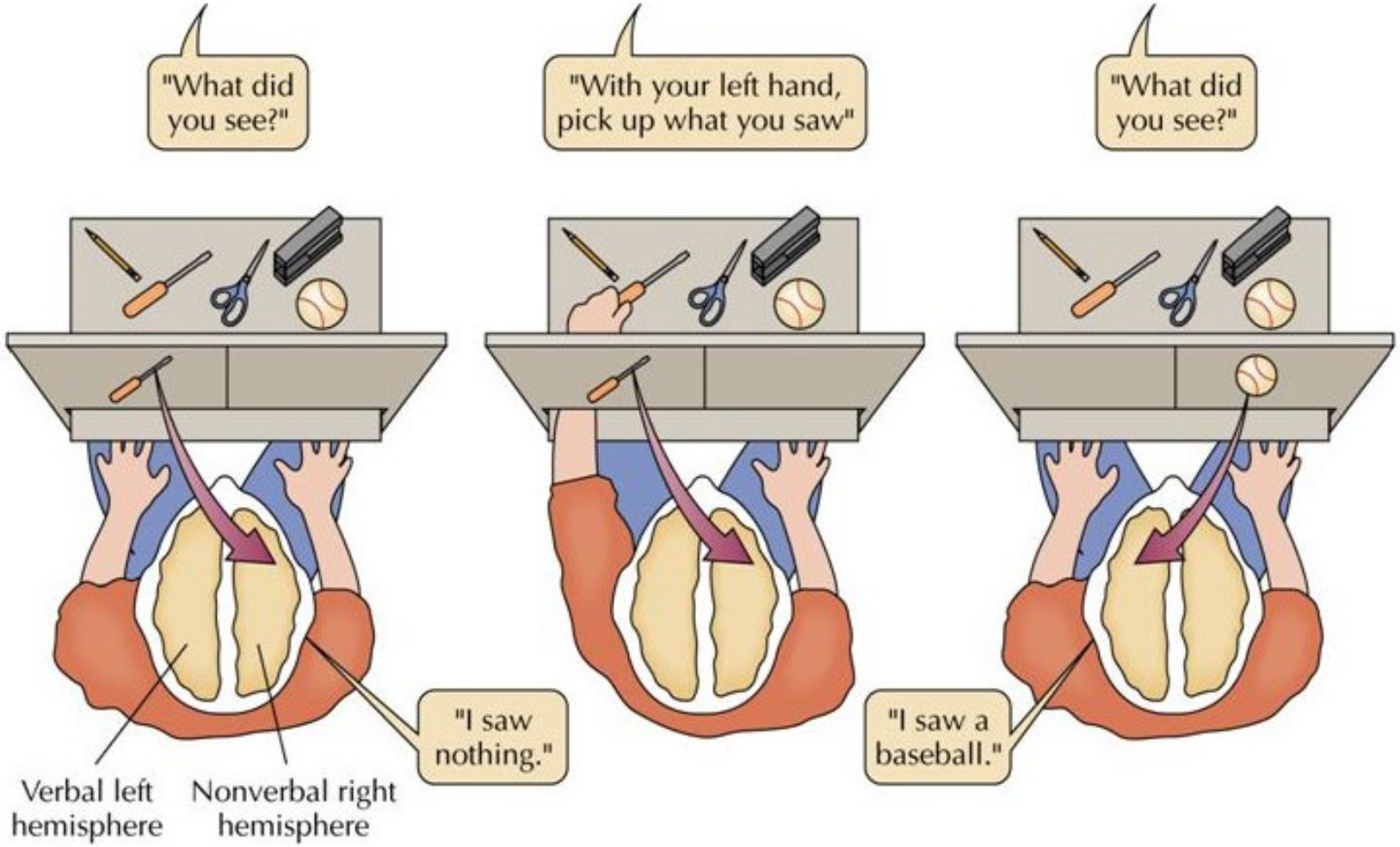
Crossed Projections







Split Brain Studies



[Could he pick up the baseball with his left hand? With his right hand?]

Sensory Analysis: Reading