جامعة المستقبل
AL MUSTAQBAL UNIVERSITY
كلية العلوم
قسم الأنظمة الطبية الذكية

General Anatomy and Physiology

(L9) The Nervous System

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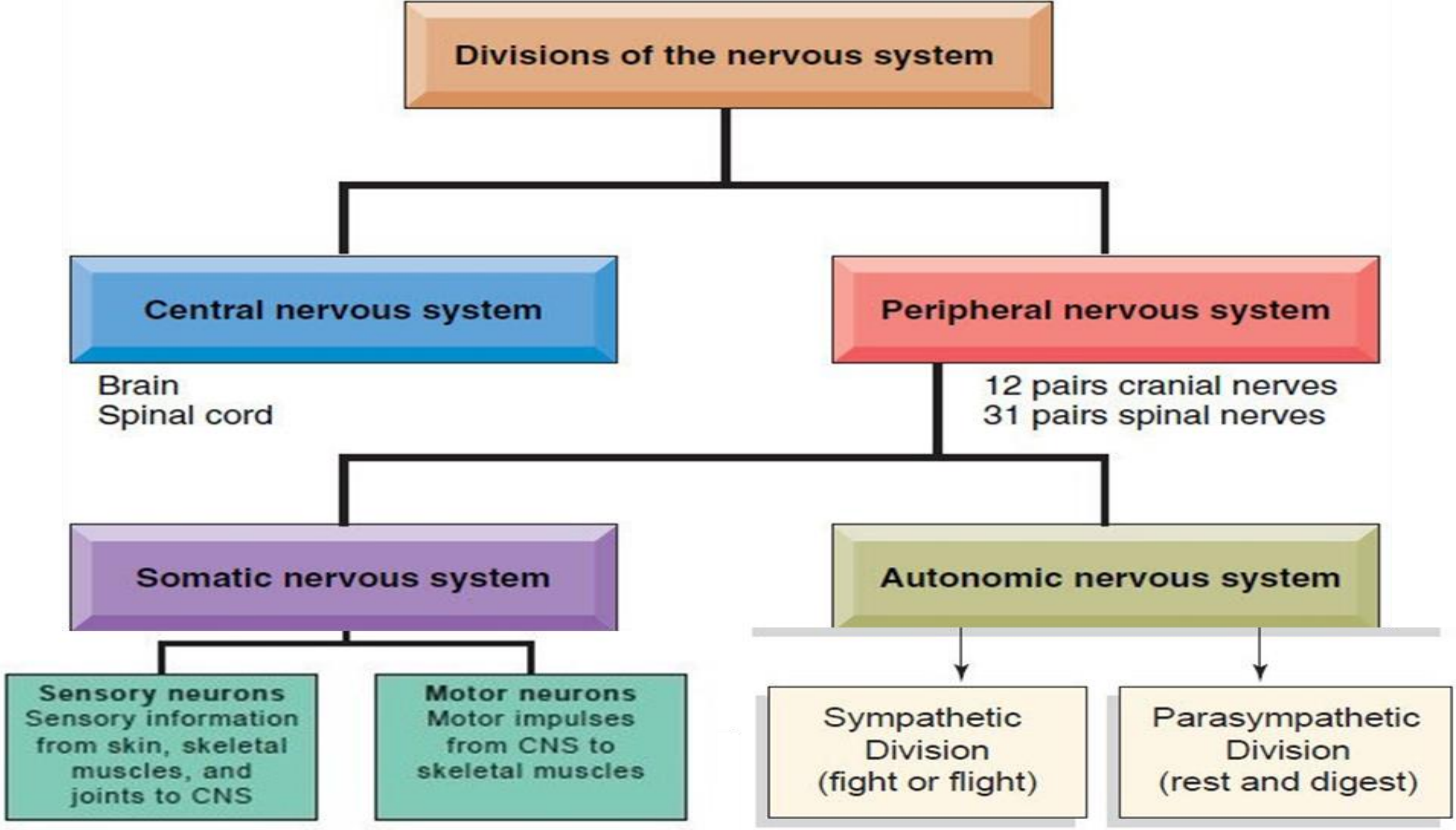
The Nervous System

Components : Brain, spinal cord, nerves, sensory receptors

I / The Central Nervous System (CNS) : consists of the **brain and the spinal cord**,

- **II/ The Peripheral Nervous System (PNS) :** the peripheral nervous system consists of **All the neural tissue outside CNS** , this includes:
  - Afferent division (sensory input)
  - Efferent division (motor output)
- **PNS** can be divided into:
  - **Somatic nervous system,**
  - **Autonomic nervous system**


Divisions of the nervous system
Central nervous system
Brain
Spinal cord
Peripheral nervous system
12 pairs cranial nerves
31 pairs spinal nerves
Somatic nervous system
Autonomic nervous system
Sensory neurons
Sensory information from skin, skeletal muscles, and joints to CNS
Motor neurons
Motor impulses from CNS to skeletal muscles
Sympathetic Division (fight or flight)
Parasympathetic Division (rest and digest)

Introduction

- The human central nervous system (CNS) contains about 10^{11} (100 billion) **neurons**.
- It also contains 10–50 times this number of **glial cells**.
- The neurons are the basic building blocks of the nervous system.

Excitability of neurons: which involves the genesis of electrical signals that enable neurons to integrate and transmit impulses.

The functional unit of the nervous system is the nerve cell **(Neuron).**

Neurons are highly specialized nerve cells , that are capable of transmitting the information in chemical and electrical form from the brain to the body and vice versa.

The nervous system contains **Glial cells** which provide support and nutrition to the system.

These cells help maintain the health of the neurons and also aid in message transmission.

There are 3 main types of neurons:

Sensory neuron (Afferent Neurons) : Detect stimuli

- Receptor AP CNS

Interneurons : Relay sensory signals to brain then return message back to motor neurons. (cells that make decision)

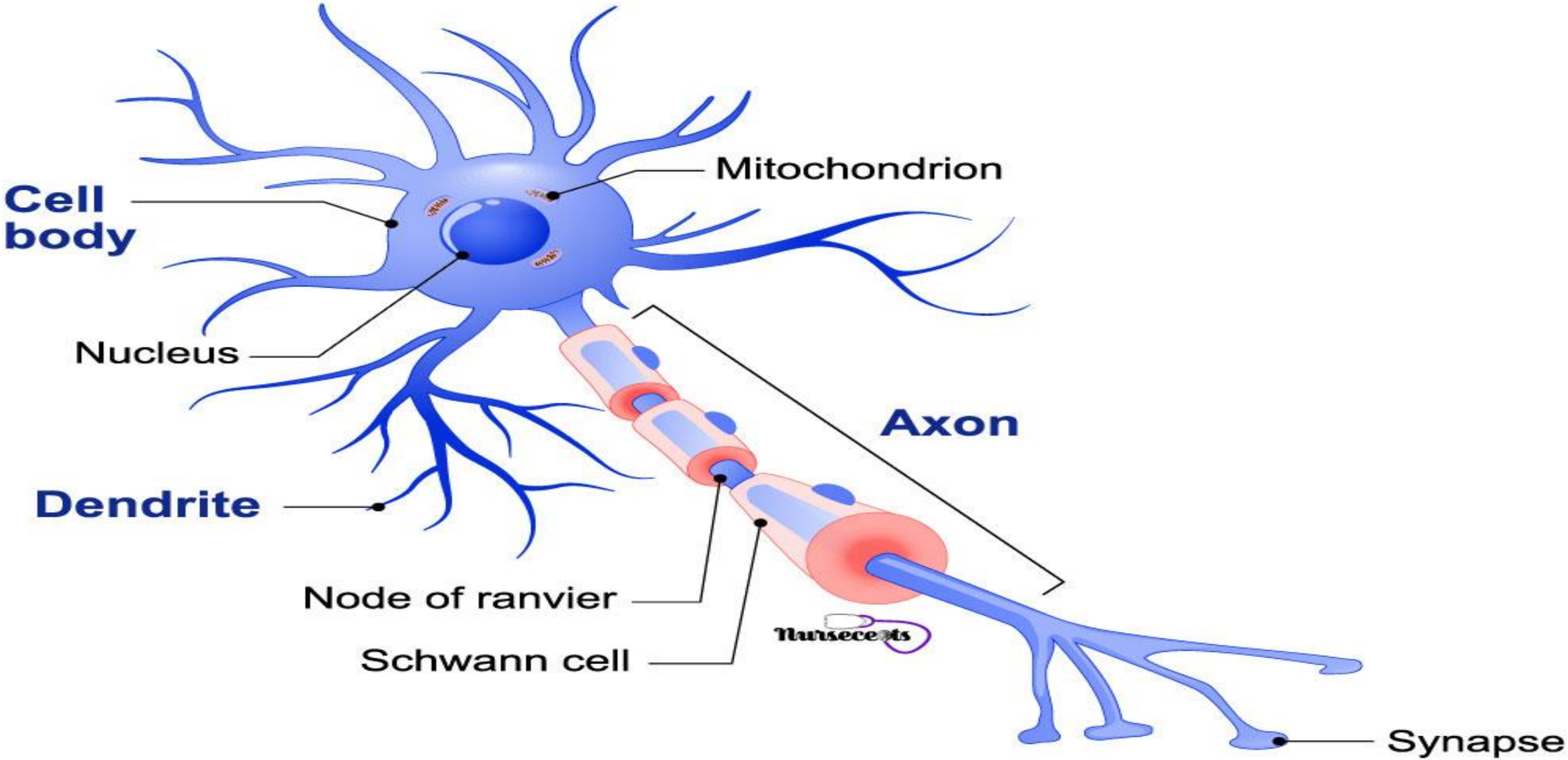
- Located entirely within the CNS
- Transmit AP from one neuron to other

Motor neuron (Efferent Neurons) : Pass message from brain to rest of body for muscle response

CNS AP Effector

- **The types of nerve fibers:**
  - **Ascending (Sensory, Afferent)**
    - Carry sensory informations from sensory neurons of body to brain
    - touch, pressure, pain, temperature
  - **Descending (Motor, Efferent)**
    - Carry motor instructions from brain to spinal cord
    - Contraction of muscles and secretion of glands
    - control precise, skilled movement = writing, maintain balance, create movement

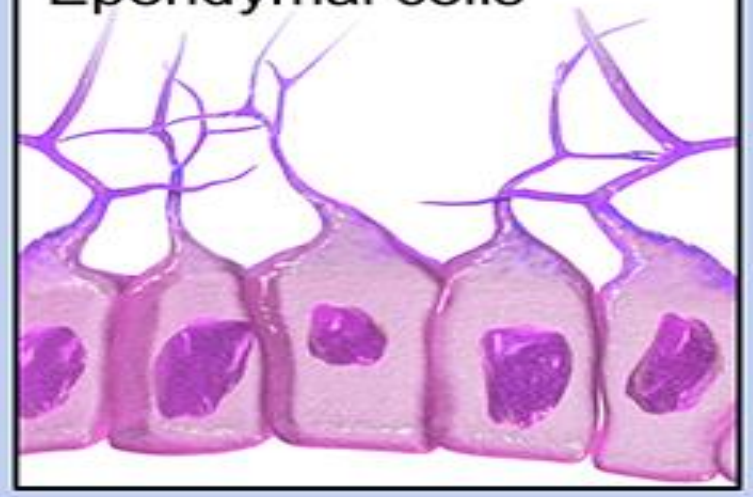
NEURON


Cell body
Mitochondrion
Nucleus
Axon
Dendrite
Node of ranvier
Schwann cell
Synapse

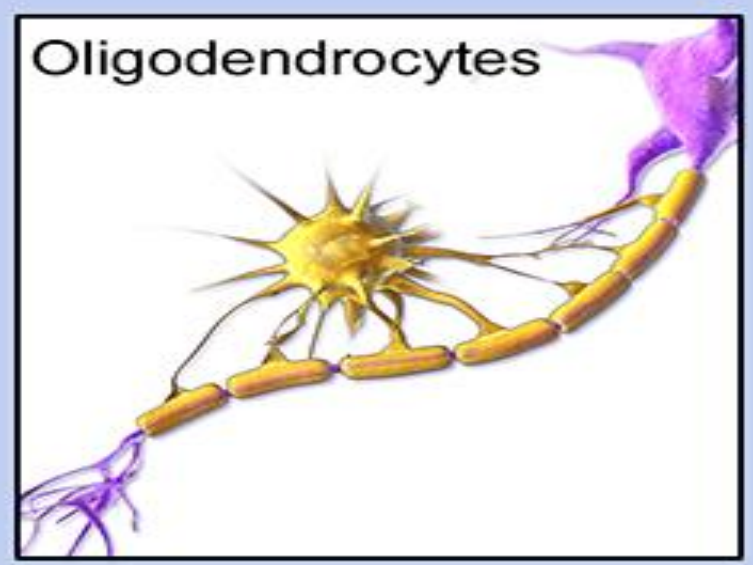
Types of Neuroglia

Central Nervous System

Ependymal cells

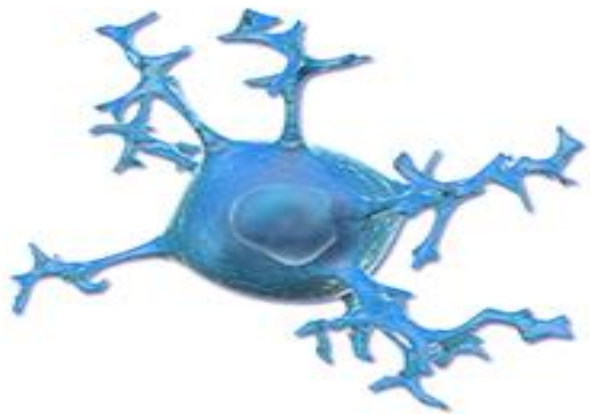


Oligodendrocytes



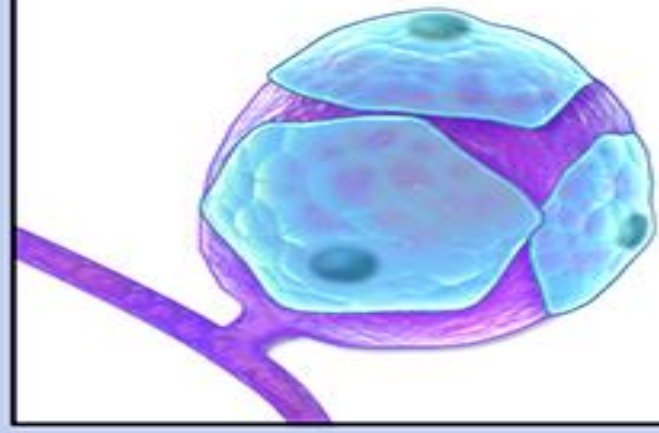
Astrocytes

Microglia

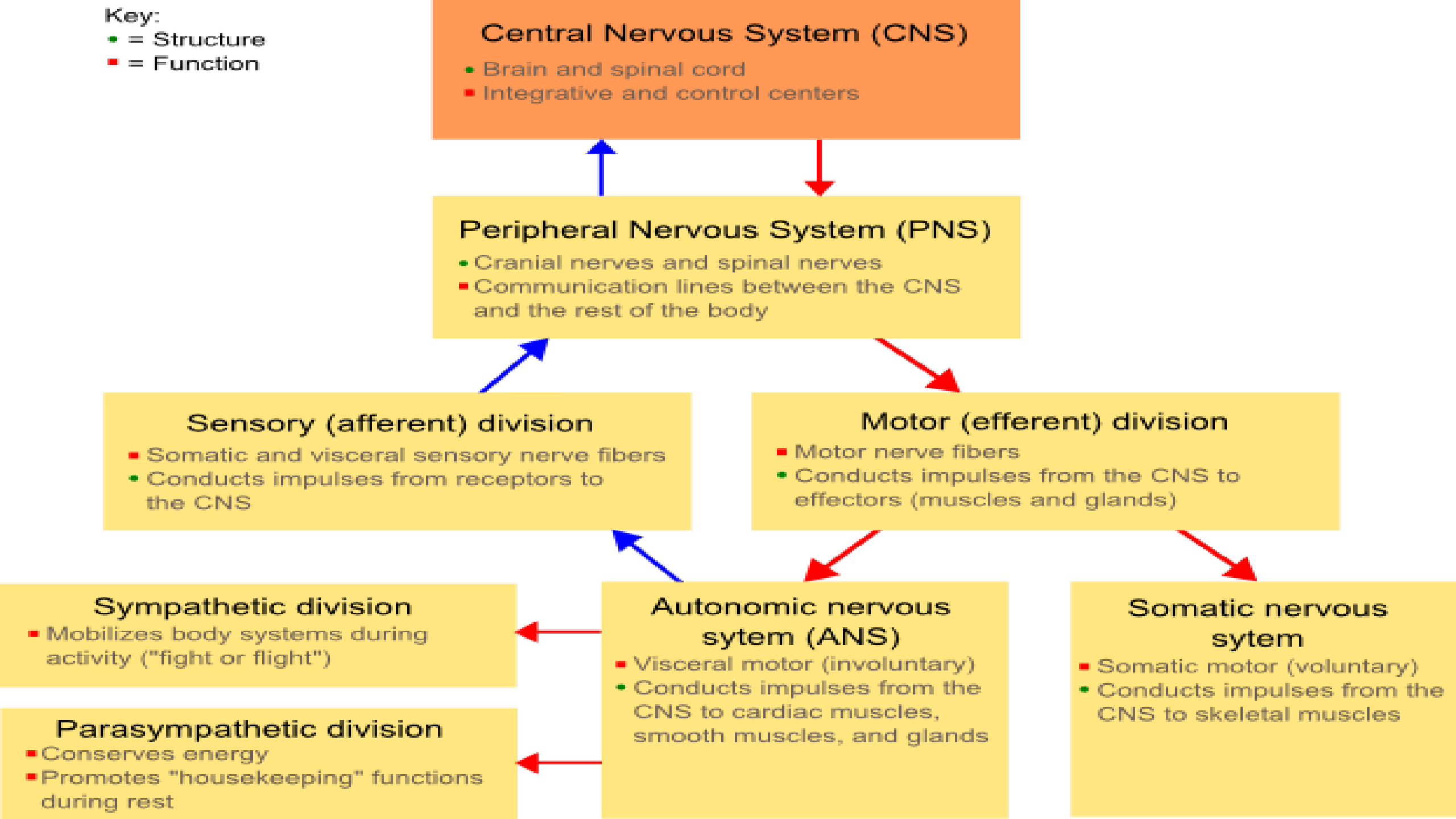


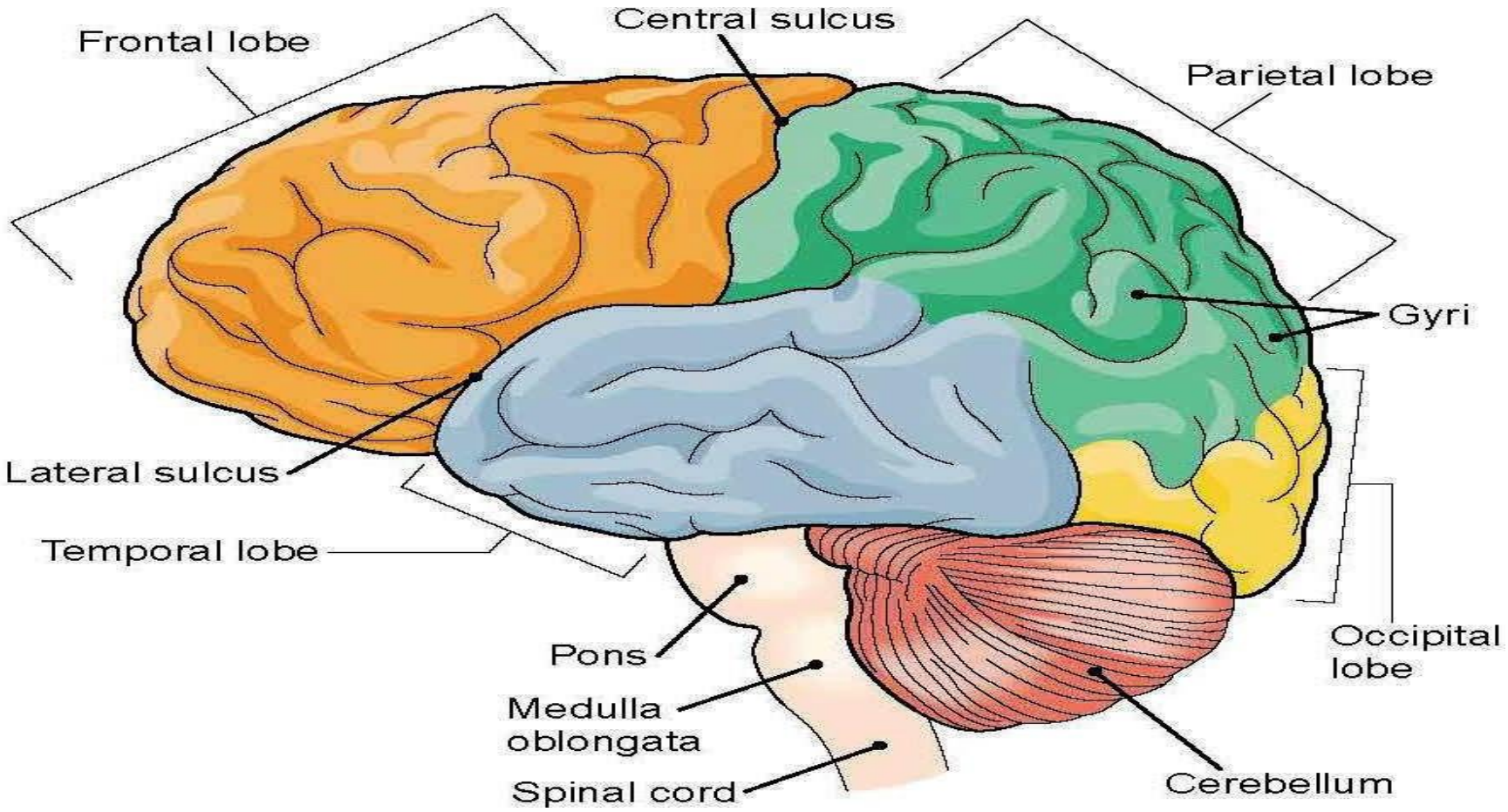
Peripheral Nervous System

Satellite cells



Schwann cells


Key:
• = Structure
▪ = Function
Central Nervous System (CNS)
• Brain and spinal cord
▪ Integrative and control centers
Peripheral Nervous System (PNS)
• Cranial nerves and spinal nerves
▪ Communication lines between the CNS and the rest of the body
Sensory (afferent) division
▪ Somatic and visceral sensory nerve fibers
• Conducts impulses from receptors to the CNS
Motor (efferent) division
▪ Motor nerve fibers
• Conducts impulses from the CNS to effectors (muscles and glands)
Sympathetic division
▪ Mobilizes body systems during activity ("fight or flight")
Parasympathetic division
▪ Conserves energy
▪ Promotes "housekeeping" functions during rest
Autonomic nervous sytem (ANS)
▪ Visceral motor (involuntary)
• Conducts impulses from the CNS to cardiac muscles, smooth muscles, and glands
Somatic nervous sytem
▪ Somatic motor (voluntary)
• Conducts impulses from the CNS to skeletal muscles



The brain (The nervous tissue contained within the cranium) **has four major divisions:**

1. Brainstem: connects the brain to the spinal cord

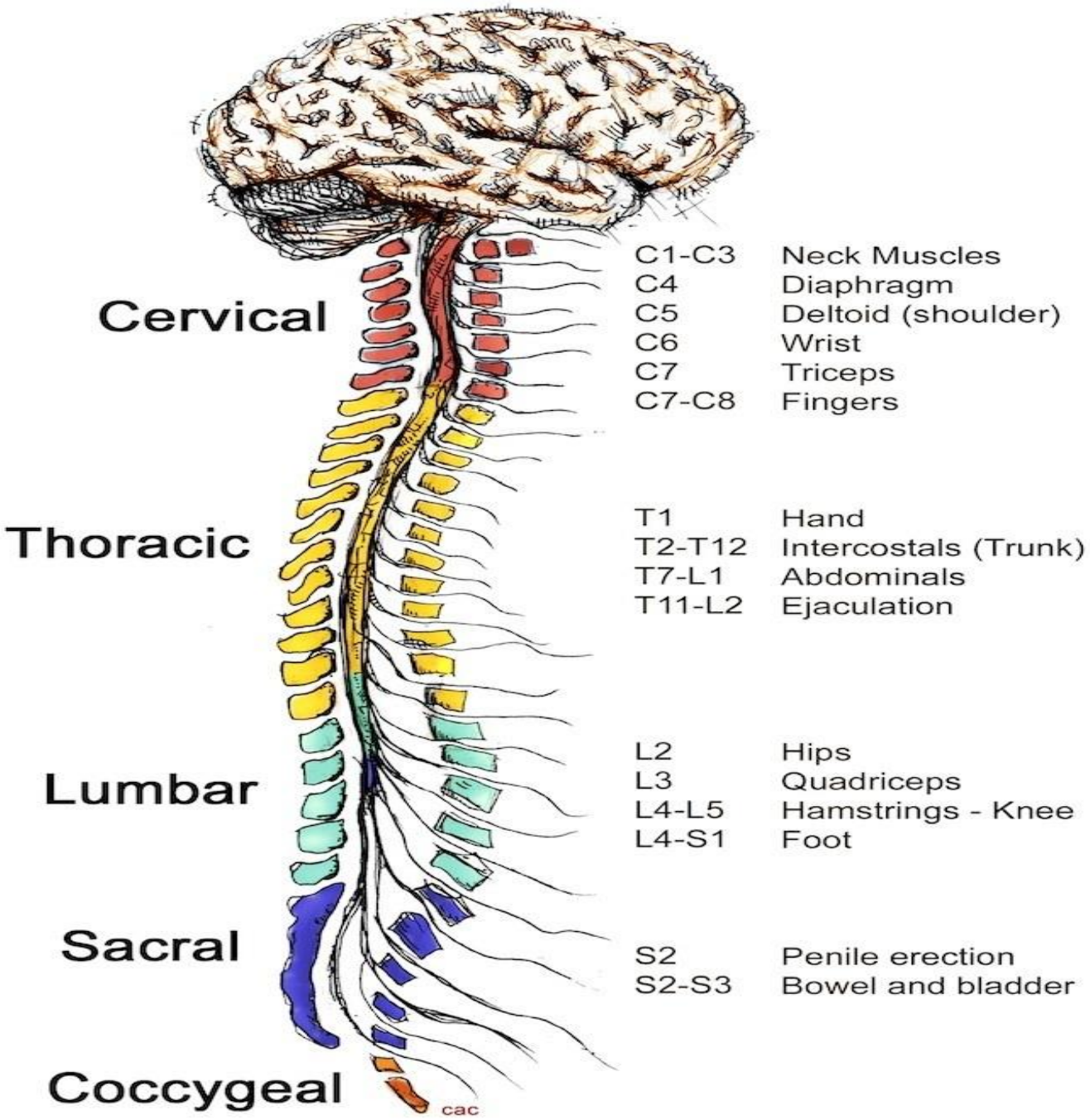
2. Cerebrum: has two hemispheres, with an outer portion called the cerebral cortex.

3. Cerebellum: coordinates musculoskeletal movement

4. Diencephalon: the deep portion of the brain

The spinal cord is the highway for communication between the body and the brain. When the spinal cord is injured, the exchange of information between the brain and other parts of the body is disrupted.

Most systems and organs of the body control just one function, but the central nervous system does many jobs at the same time. It controls all voluntary movement, such as speech and walking, and involuntary movements, such as blinking and breathing. It is also the core of our thoughts, perceptions, and emotions



Protective Structures

Since the CNS is so important, it is protected by a number of structures. First, the entire CNS is enclosed in **bone**. The brain is protected by the **skull**. The spinal cord is encased by the vertebrae that make up the **spinal column**.

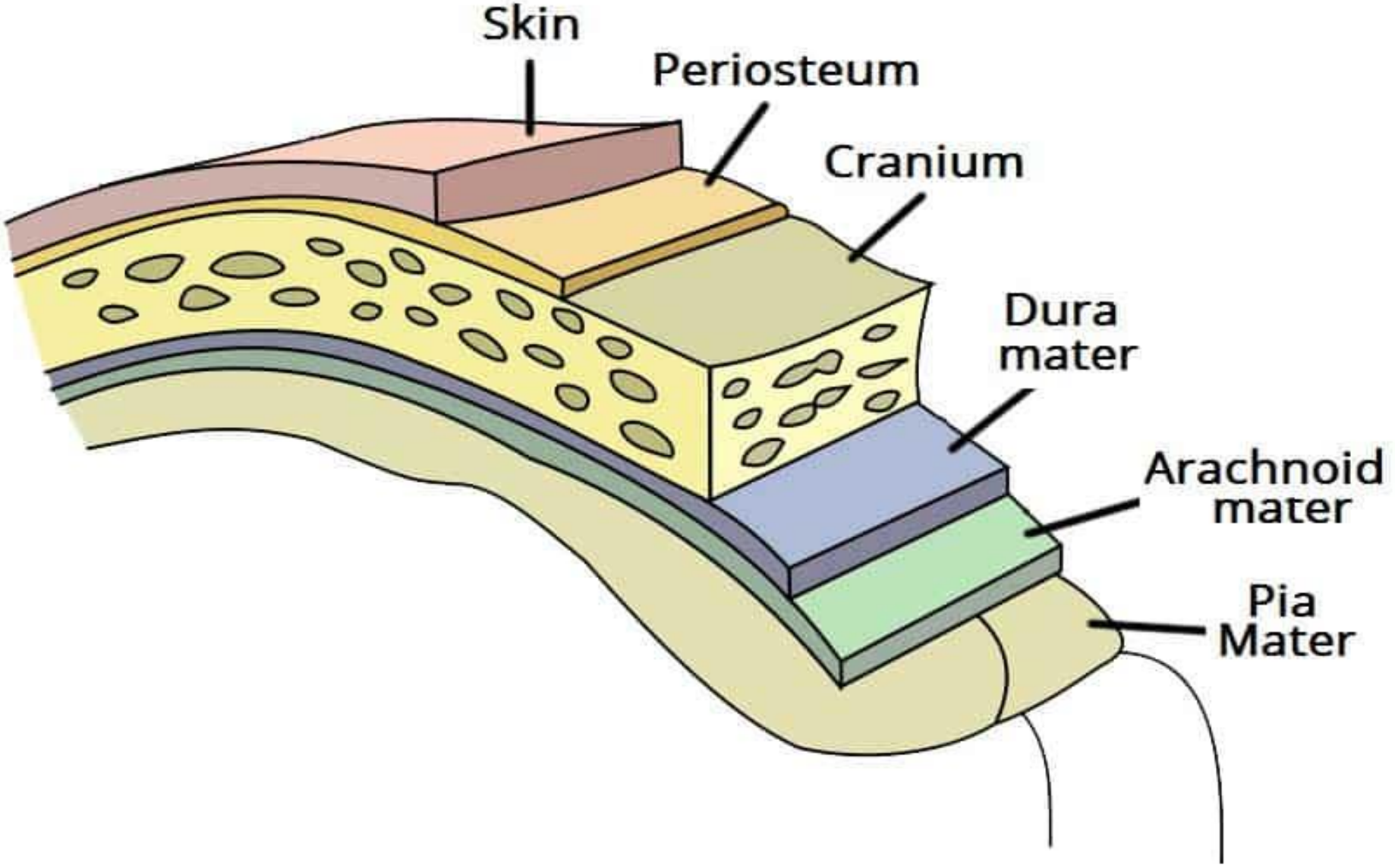
The brain and spinal cord are both covered with a protective tissue known as **meninges**. There are three layers of meninges protecting the brain and spinal cord:

Dura mater: From the Latin words meaning "hard mother," this is the top layer of the meninges found directly under the bones of the skull and vertebrae.

Arachnoid mater: The second layer of the meninges is a spider-like, transparent membrane.

Pia mater: From the Latin for "soft mother," this protective layer is the innermost layer of the meninges.

The entire CNS is also immersed in a substance known as **cerebrospinal fluid (CSF)**, which forms a chemical environment that allows nerve fibers to transmit information effectively as well as offering yet another layer of protection from potential damage.



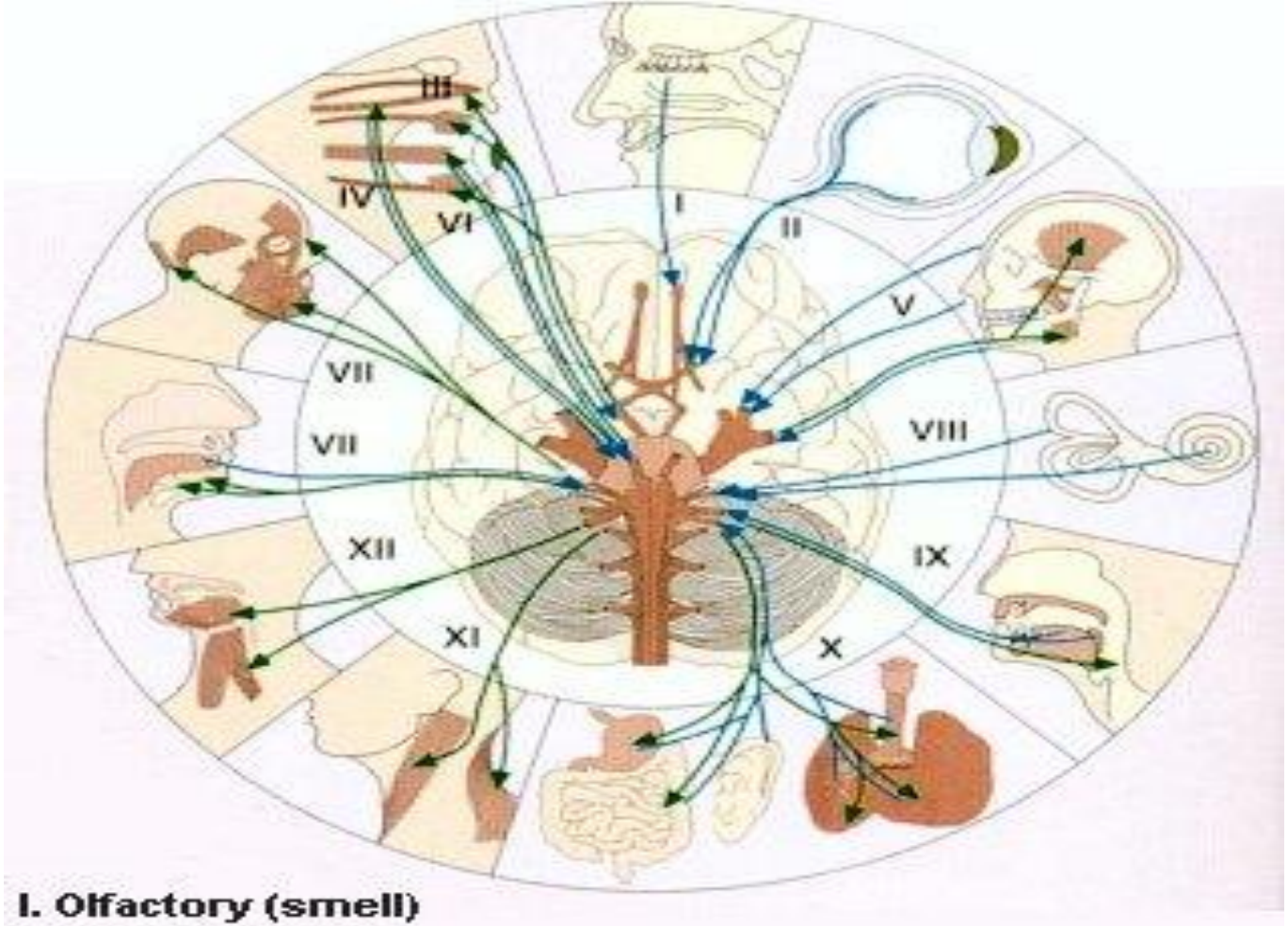
Overview of the meninges, and their relationship to the skull and brain

Peripheral Nervous System (PNS)

- All parts of the nervous system lying outside the brain and spinal cord.
- The sensory and motor neurons that connect to the CNS
  - Function = to carry info between organs of the body and the CNS

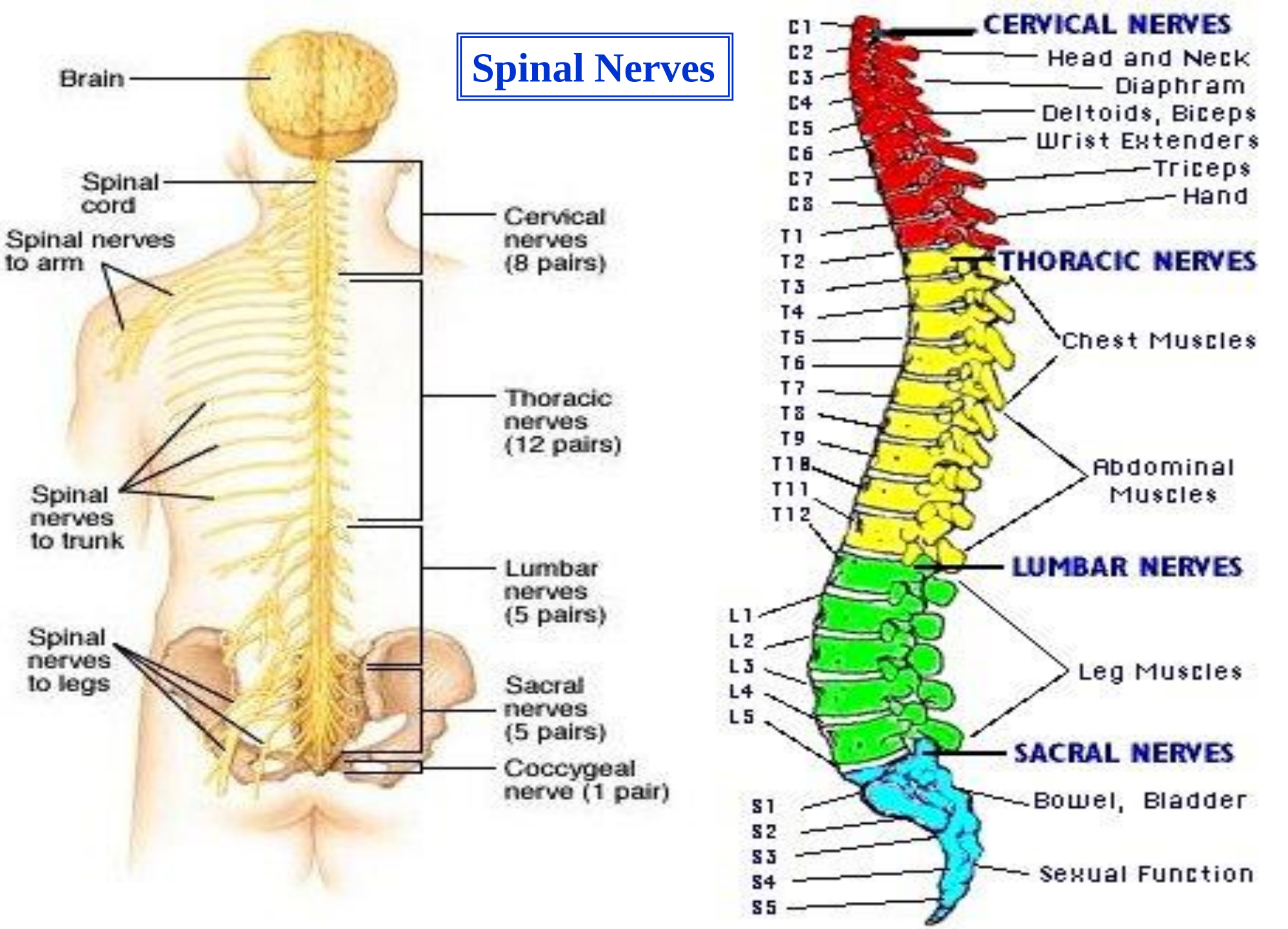
- Humans have
  - 12 paris of cranial nerves (sensory/motor/mixed) which control the head, face, neck, shoulders
    - Except VAGUS nerve – controls internal organs
  - 31 pairs of spinal nerves (mixed) which take impulses to and from the spinal cord

Cranial nerves



I. Olfactory (smell)
II. Optics (vision)
III, IV, VI. Oculomotor, Trachlear, Abducens
(eye movement)
V. Trigeminal (touch, pain)
VII. Facial (face muscles, taste)
VIII. Auditory (hearing)
IX. Glossopharyngeal (muscles of throat and larynx)
X. Vagus (internal organs)
XI. Spinal Accessory (neck muscles)
XII. Hypoglossal (tongue movements, taste)

Spinal Nerves



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THANK YOU!