PHYSIOLOGY(2ND STAGE)

THE NERVOUS SYSTEM (1)

The nervous system: Consists of:

I. Central nervous system (CNS) includes the

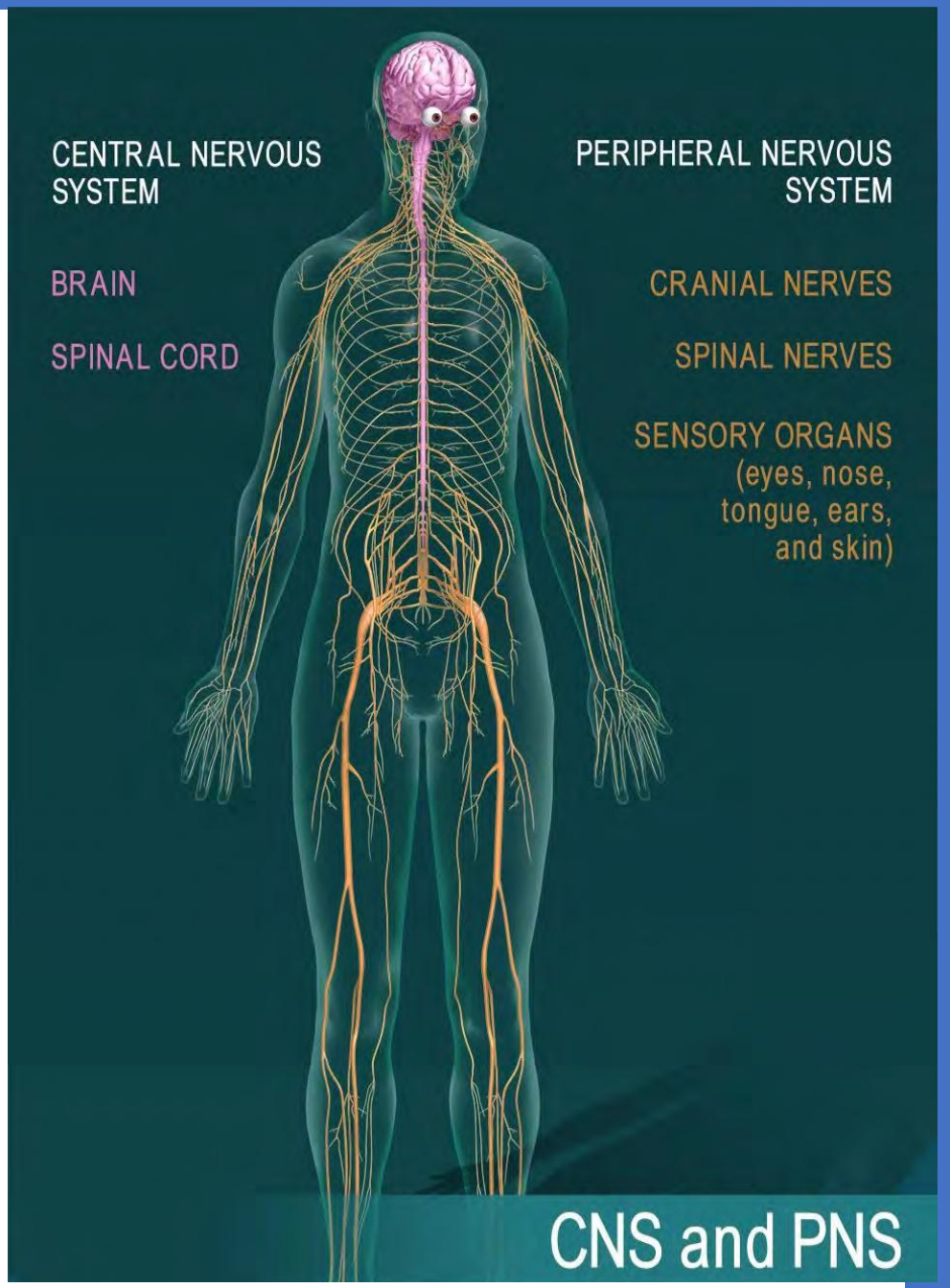
- Brain
- spinal cord.

The human brain is composed of three major parts

- Cerebrum
- Cerebellum
- Brainstem

II. Peripheral nervous system (PNS) includes:

- The cranial nerves arising from the brain
- The spinal nerves arising from the spinal cord.



- Together, the central nervous system (CNS) and the peripheral nervous systems (PNS) transmit and process sensory information and coordinate bodily functions.

KEY CONCEPT

- The central nervous system interprets information, and the peripheral nervous system gathers and transmits information.

Anatomy of a nervous system

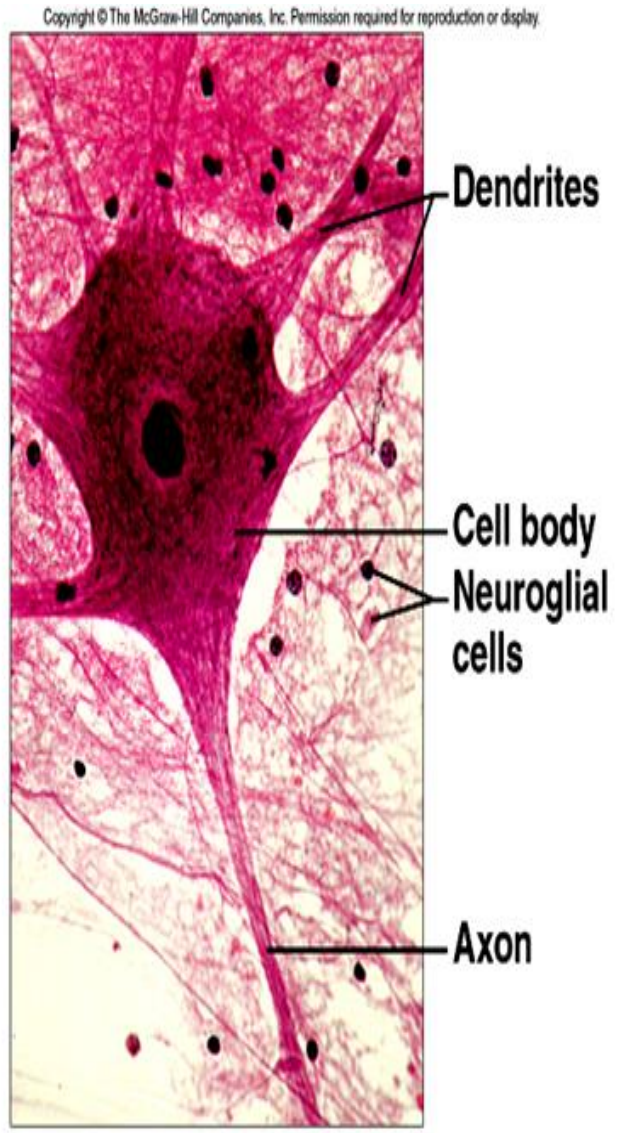
The nervous system is composed of only two principal types of cells:

1- Neurons cells

2- Supporting cells

1- Neurons cells Neurons are the basic structural and functional units of the nervous system.

They are specialized to respond to physical and chemical stimuli, conduct electrochemical impulses, and release chemical regulators. Most neurons cannot divide by mitosis.



2- Supporting cells : Supporting cells aid the functions of neurons and about five times more abundant than neurons.

In the CNS, supporting cells are called **neuroglia** or **glial cells.** They retain limited mitosis abilities , neuroglia that provide physical support, insulation, and nutrients for neurons.

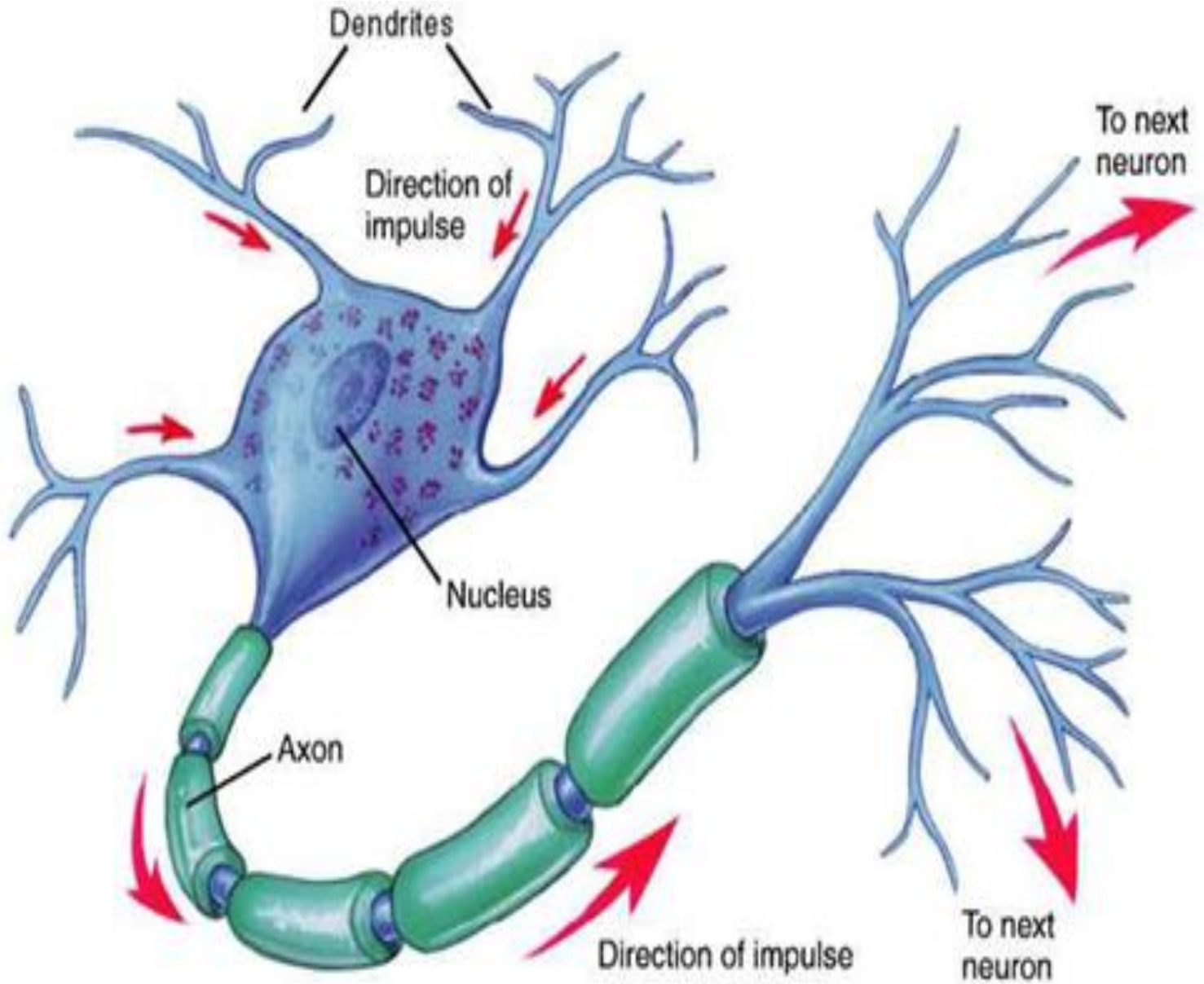
Neurons vary considerably in size and shape. They generally have

3: Principals' regions: **cell body, dendrites ,**and an **axon.**

A typical neuron has a rounded area called the **cell body**, and two types of extensions: **dendrites** and **axons**.

Dendrites, which may be numerous, receive input, and axons send information away from the cell in the form of impulses.

Most neurons have only one axon.

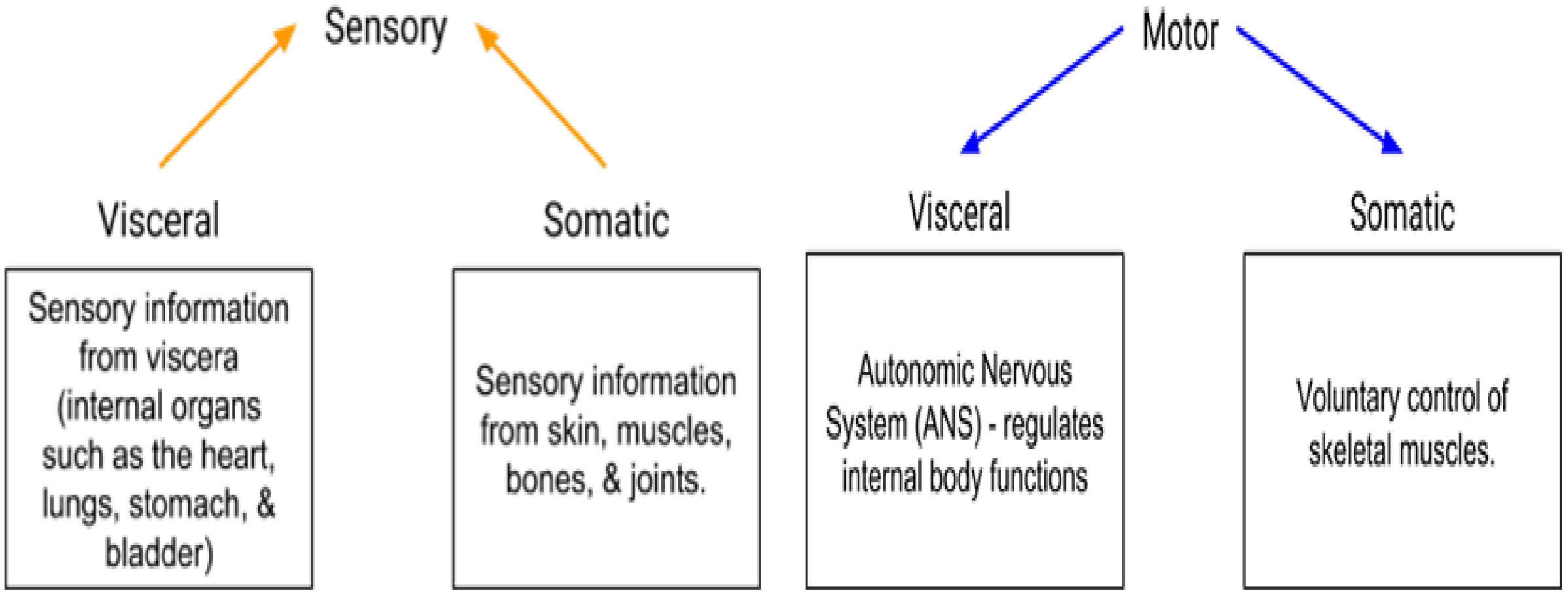

Dendrites
Direction of impulse
To next neuron
Nucleus
Axon
Direction of impulse
To next neuron

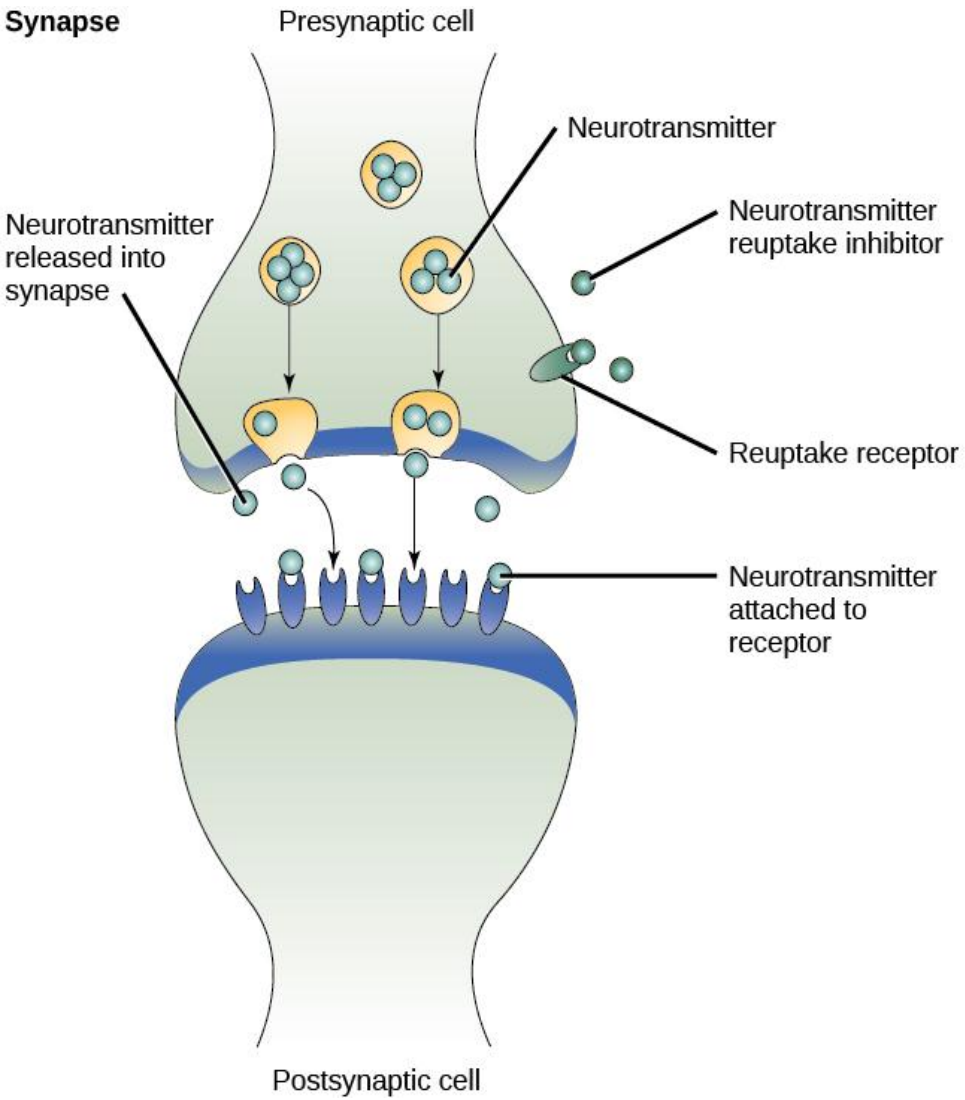
Classification of neurons according their function:

1- Sensory or afferent neurons They are the nerve cells that are activated by sensory input from the environment.

2.Motor or efferent neurons they transmit signals from the CNS to skeletal muscle to either directly or indirectly control muscle movements. Motor neurons allow us to act in response to external stimuli.

3.Association neurons or interneurons are located entirely within CNS and serve the associative or integrative they connect spinal motor and sensory neurons. They are multipolar, just like motor neurons.

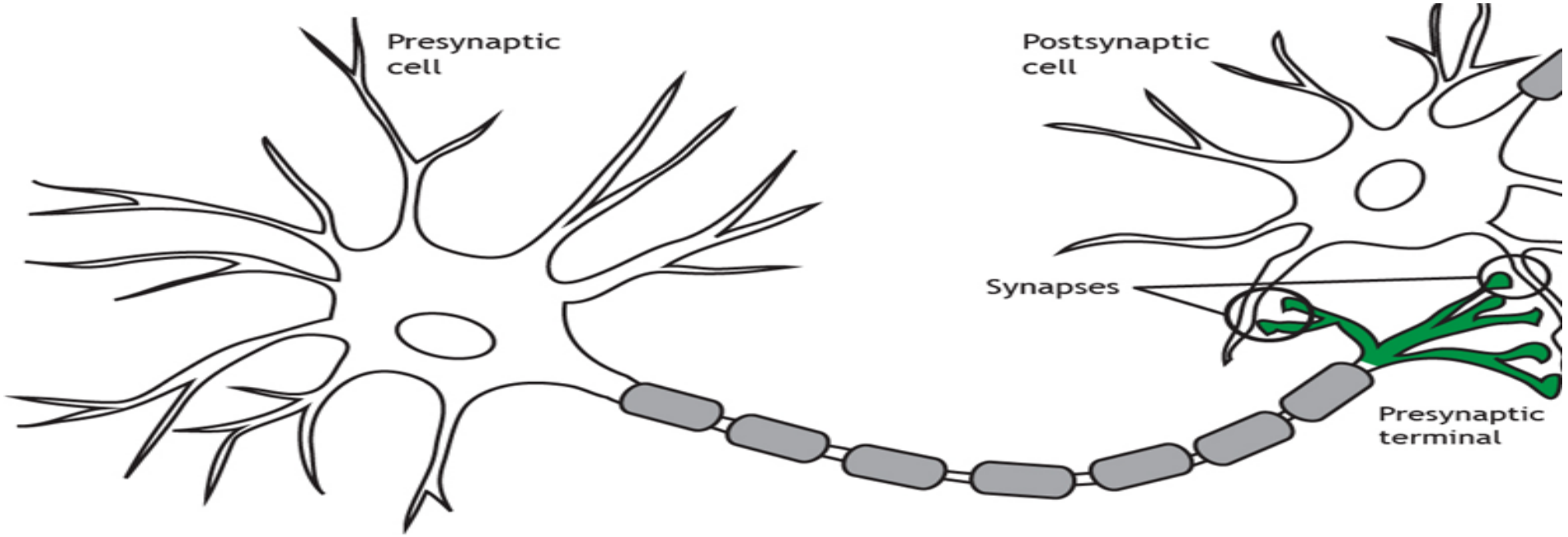

Sensory
Motor
Visceral
Somatic
Visceral
Somatic
Sensory information from viscera (internal organs such as the heart, lungs, stomach, & bladder)
Sensory information from skin, muscles, bones, & joints.
Autonomic Nervous System (ANS) - regulates internal body functions
Voluntary control of skeletal muscles.

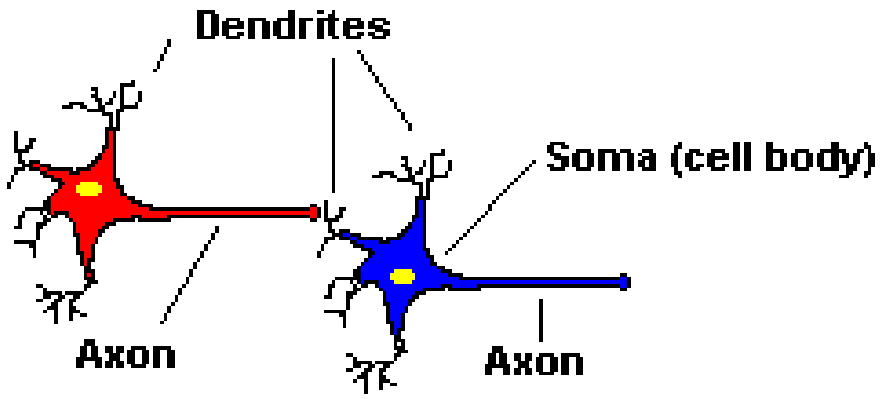


Synapse

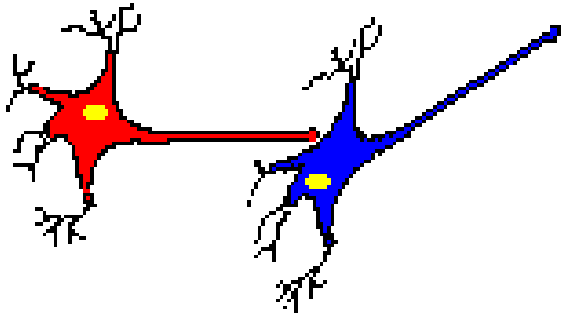
An important part of the nervous system at the cellular level is not a cell at all, but the small space between a neuron and the cell(s) with which it communicates, called a **synapse** .

Biological messenger molecules called **neurotransmitters** convey neural information across synapses.

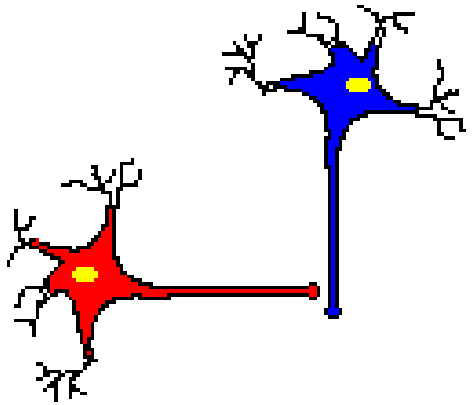




Axodendritic Synapse



Axosomatic Synapse



Axoaxonic Synapse

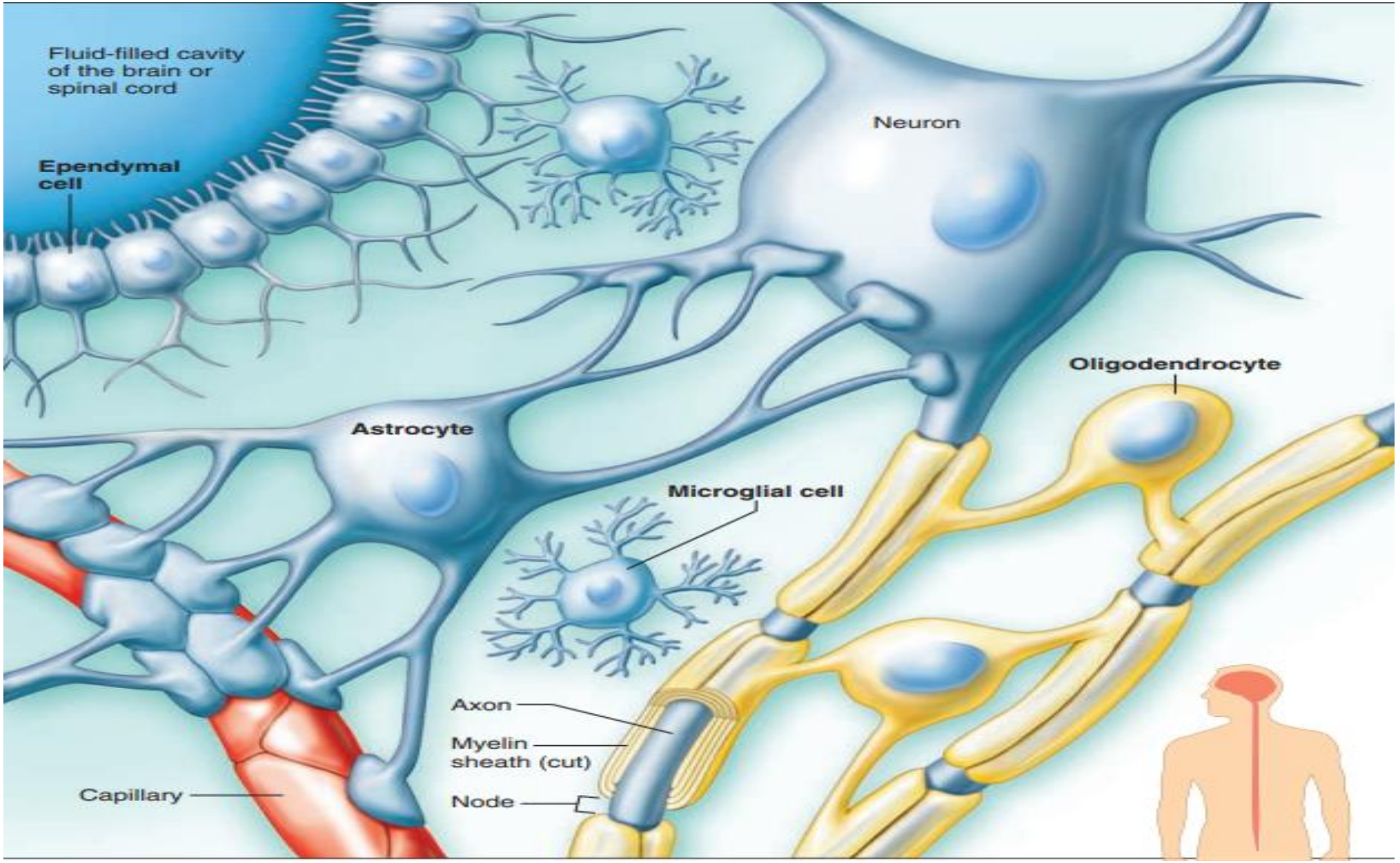
2- Supporting cells:. Neuroglia differ from neurons

- Neuroglia have no action potentials and cannot transmit nerve impulses
- Neuroglia can divide (they are the source of tumors of nervous system)
- Neuroglia do not form synapses
- Neuroglia form the myelin sheathes of axons.

- **Neuroglia** Neurons cannot exist without neuroglia, which fill spaces, provide structural frameworks, produce the components of the electrical insulator myelin, and carry on phagocytosis.
- Neuroglia in the central nervous system are of the following types:
- **1. Schwann cells** , which form myelin sheaths around peripheral axons.
- **2. Microglial cells** are scattered throughout the central nervous system. They support neurons and phagocytize bacterial cells and cellular debris, and form scars in areas of damage.
- **3. Oligodendrocytes** align along axons (nerve fibers). They provide insulating layers of myelin, called a myelin sheath around axons within the brain and spinal cord.

4.Astrocytes, commonly found between neurons and blood vessels, provide structural support, join parts by their abundant cellular processes, and help regulate the concentrations of nutrients and ions within the tissue. Astrocytes also form scar tissue that fills spaces following injury to the CNS.

5. Ependymal cells form an epithelial-like membrane that covers specialized brain parts (choroid plexuses) and form the inner linings that enclose spaces in the brain (ventricles) and spinal cord (central canal).


Fluid-filled cavity of the brain or spinal cord
Ependymal cell
Neuron
Oligodendrocyte
Astrocyte
Microglial cell
Axon
Myelin sheath (cut)
Node
Capillary

Synapse

A synapse: the site of transmission of electric nerve impulses between two nerve cells (neurons) or between a neuron and a gland or muscle cell (effector). A synaptic connection between a neuron and a muscle cell is called **myoneural** or a **neuromuscular junction.**

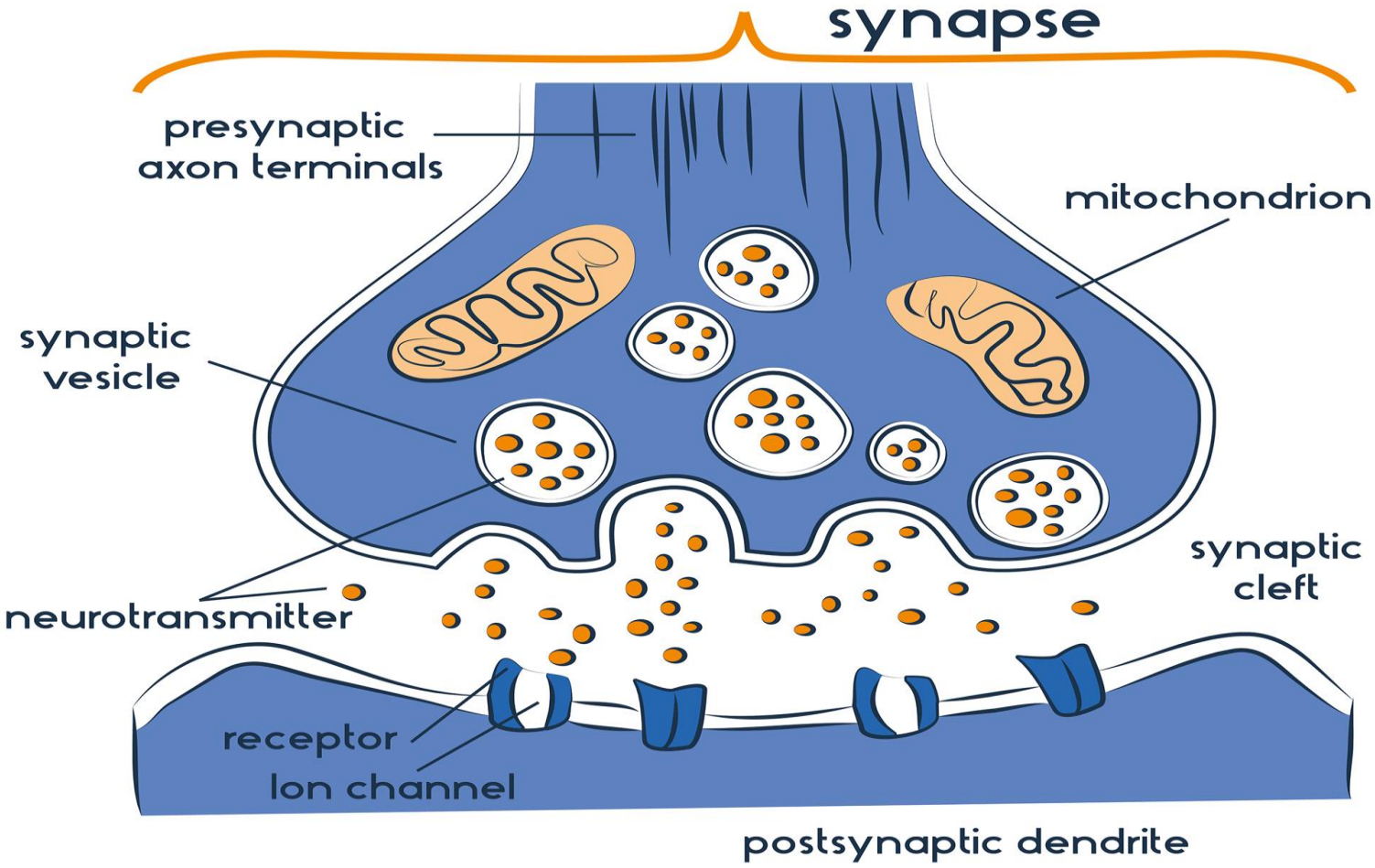
Types of synapses :

1. Electrical synapses (gap junctions).

2.Chemical synapses

Electrical Synapse—faster than chemical synapse

- Presynaptic neuron - conducts impulses toward synapse
- Postsynaptic neuron - transmits impulses away from the synapse



- **The Synapse** As in the case of a motor neuron and a skeletal muscle fiber, the functional connection between two neurons is called a **synapse**. The neurons at a synapse are not in direct physical sender, are separated by a gap called a **synaptic cleft.**
- Communication along a nerve pathway must cross these gaps .When you receive a text message, the person texting is the sender, and you are the receiver. Similarly, the neuron conducting the impulse to the synapse is the sender, or presynaptic neuron. The neuron that receives input at the synapse is the receiver, or postsynaptic neuron. The process whereby this message crosses the synaptic cleft is called **synaptic transmission.**

- Synaptic transmission is a one-way process carried out by biochemicals called **neurotransmitters**. The distal ends of axons have one or more extensions called **synaptic knobs**, absent in dendrites, which contain many membranous sacs called **synaptic vesicles**. When an impulse reaches a synaptic knob, some of the synaptic vesicles release neurotransmitter .
- The neurotransmitter diffuses across the synaptic cleft and reacts with specific receptors on the postsynaptic neuron membrane. Once the neurotransmitter binds to receptors on a postsynaptic cell, the effect is either excitatory (stimulating an impulse) or inhibitory (preventing an impulse).

Major Neurotransmitters in the Body

Neurotransmitter	Role in the Body
Acetylcholine	A neurotransmitter used by the spinal cord neurons to control muscles and by many neurons in the brain to regulate memory. In most instances, acetylcholine is excitatory.
Dopamine	The neurotransmitter that produces feelings of pleasure when released by the brain reward system. Dopamine has multiple functions depending on where in the brain it acts. It is usually inhibitory.
GABA(gamma-aminobutyric acid)	The major inhibitory neurotransmitter in the brain.
Glutamate	The most common excitatory neurotransmitter in the brain.
Glycine	A neurotransmitter used mainly by neurons in the spinal cord. It probably always acts as an inhibitory neurotransmitter.
Norepinephrine	Norepinephrine acts as a neurotransmitter and a hormone. In the peripheral nervous system, it is part of the flight-or-flight response. In the brain, it acts as a neurotransmitter regulating normal brain processes. Norepinephrine is usually excitatory, but is inhibitory in a few brain areas.
Serotonin	A neurotransmitter involved in many functions including mood, appetite, and sensory perception. In the spinal cord, serotonin is inhibitory in pain pathways.

1. What are the two major types of cells that form nervous tissue?

2. What are the two major subdivisions of the nervous system?

Peripheral nervous system (PNS) :includes the:

1) **Cranial nerves** arising from the brain
2) **Spinal nerves** arising from the spinal cord

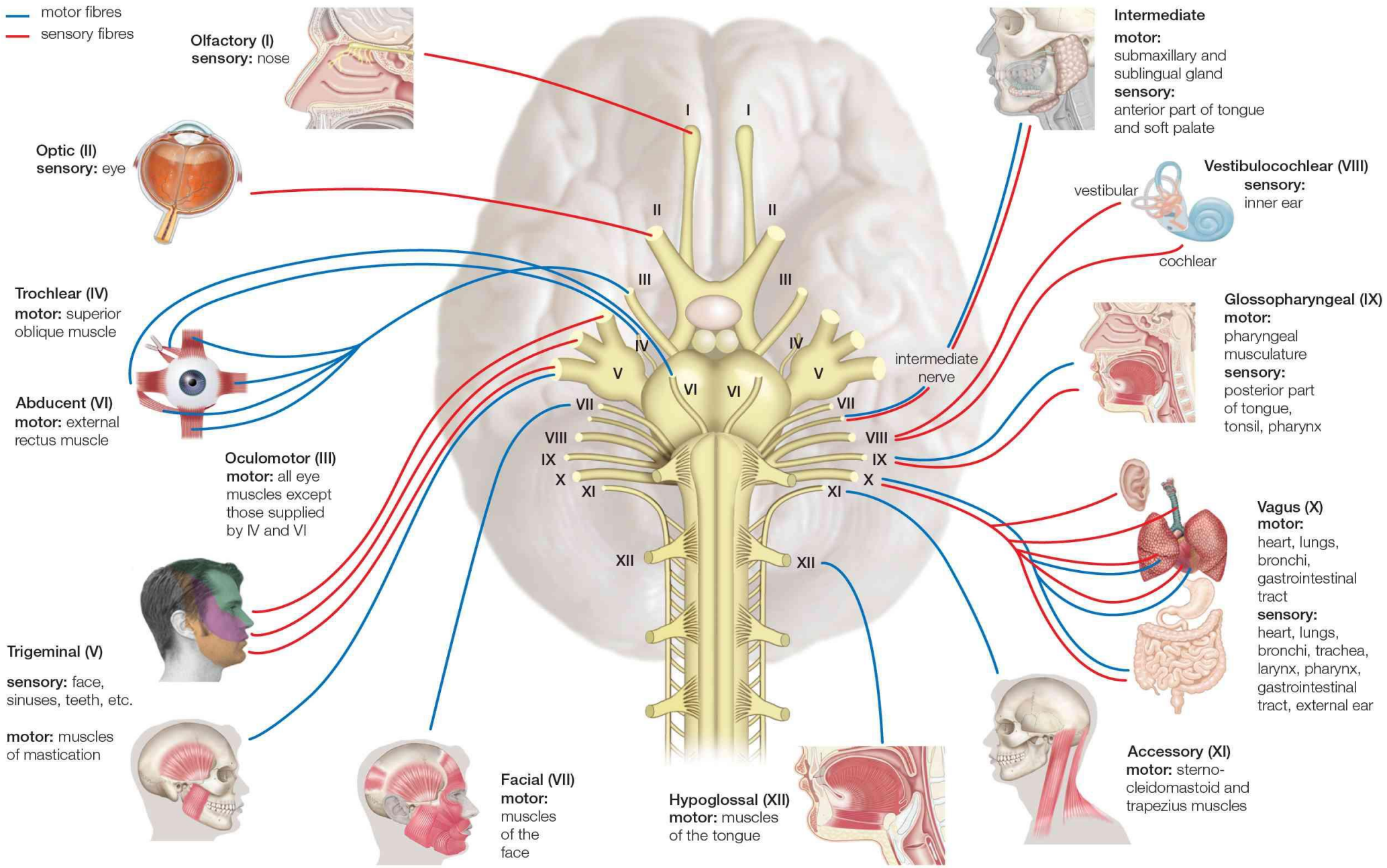
The cranial nerves are a set of **12** paired nerves that arise directly from the brain. The first two nerves (**olfactory** and **optic**) arise from the cerebrum, whereas the remaining ten emerge from the brain stem.

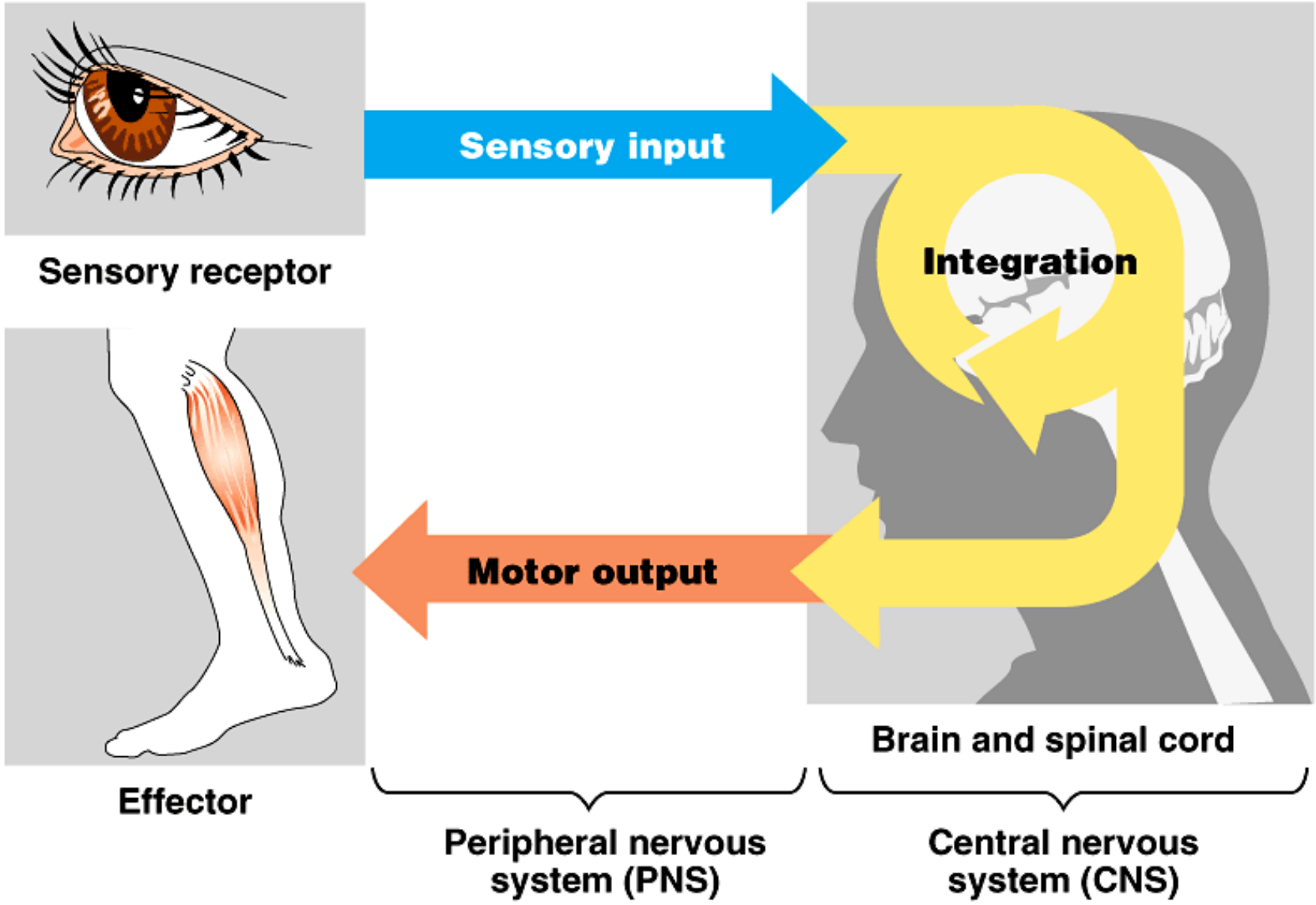
The names of the cranial nerves relate to their function, and they are also numerically identified in roman numerals (I-XII).

The **vagus** nerve is one of the most important; it extends to many of the organs in the chest and upper abdomen.

TABLE A2 The Cranial Nerves and Their Primary Functions *(Part 1)*

Cranial nerve	Name	Sensory and/or motor	Major function
I	Olfactory nerve	Sensory	Sense of smell
II	Optic nerve	Sensory	Vision
III	Oculomotor nerve	Motor	Eye movements; pupillary constriction and accommodation; muscles of eyelid
IV	Trochlear nerve	Motor	Eye movements
V	Trigeminal nerve	Sensory and motor	Somatic sensation from face, mouth, cornea; muscles of mastication
VI	Abducens nerve	Motor	Eye movements
VII	Facial nerve	Sensory and motor	Controls the muscles of facial expression; taste from anterior tongue; lacrimal and salivary glands
VIII	Vestibulocochlear (auditory) nerve	Sensory	Hearing; sense of balance
IX	Glossopharyngeal nerve	Sensory and motor	Sensation from pharynx; taste from posterior tongue; carotid baroreceptors
X	Vagus nerve	Sensory and motor	Autonomic functions of gut; sensation from pharynx; muscles of vocal cords; swallowing
XI	Spinal accessory nerve	Motor	Shoulder and neck muscles
XII	Hypoglossal nerve	Motor	Movements of tongue


motor fibres
sensory fibres
Olfactory (I)
sensory: nose
Optic (II)
sensory: eye
Trochlear (IV)
motor: superior oblique muscle
Abducent (VI)
motor: external rectus muscle
Oculomotor (III)
motor: all eye muscles except those supplied by IV and VI
Trigeminal (V)
sensory: face, sinuses, teeth, etc.
motor: muscles of mastication
Facial (VII)
motor: muscles of the face
Hypoglossal (XII)
motor: muscles of the tongue
Intermediate
motor: submaxillary and sublingual gland
sensory: anterior part of tongue and soft palate
intermediate nerve
Vestibulocochlear (VIII)
sensory: inner ear
vestibular
cochlear
Glossopharyngeal (IX)
motor: pharyngeal musculature
sensory: posterior part of tongue, tonsil, pharynx
Vagus (X)
motor: heart, lungs, bronchi, gastrointestinal tract
sensory: heart, lungs, bronchi, trachea, larynx, pharynx, gastrointestinal tract, external ear
Accessory (XI)
motor: sterno-cleidomastoid and trapezius muscles
I
II
III
IV
V
VI
VII
VIII
IX
X
XI
XII




Thanks!