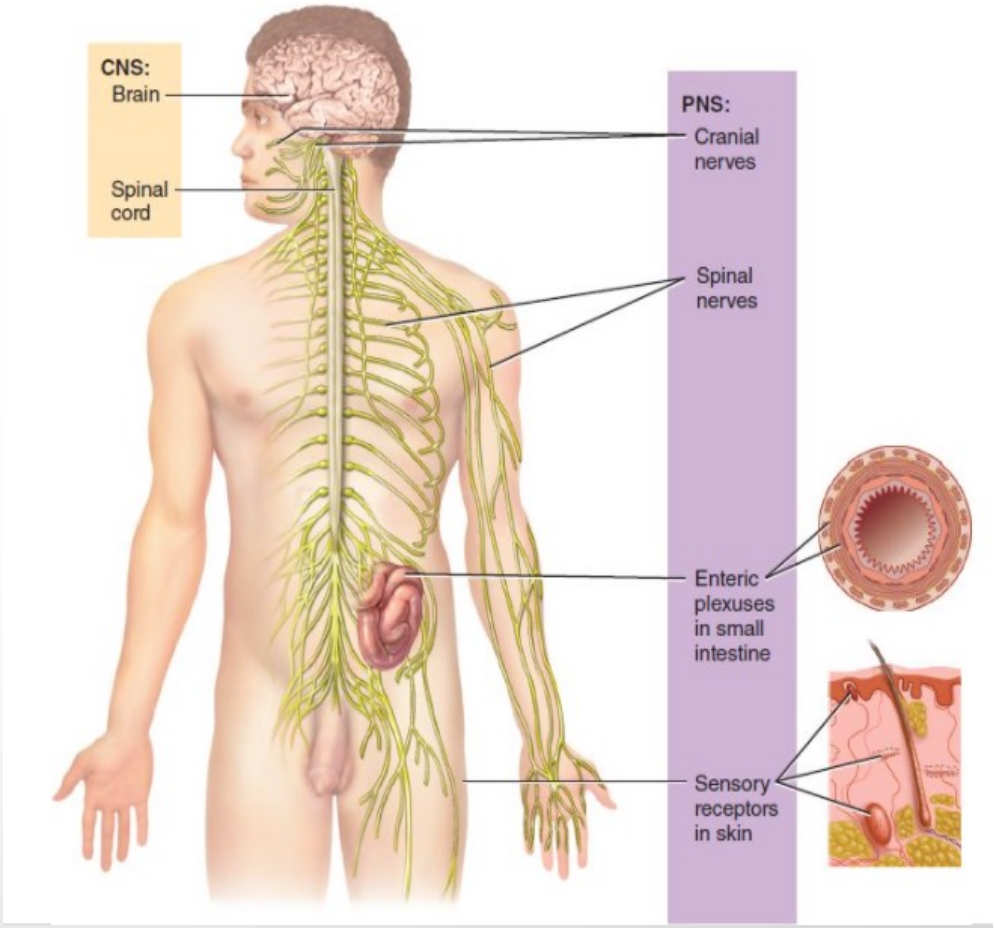
NERVOUS TISSUE

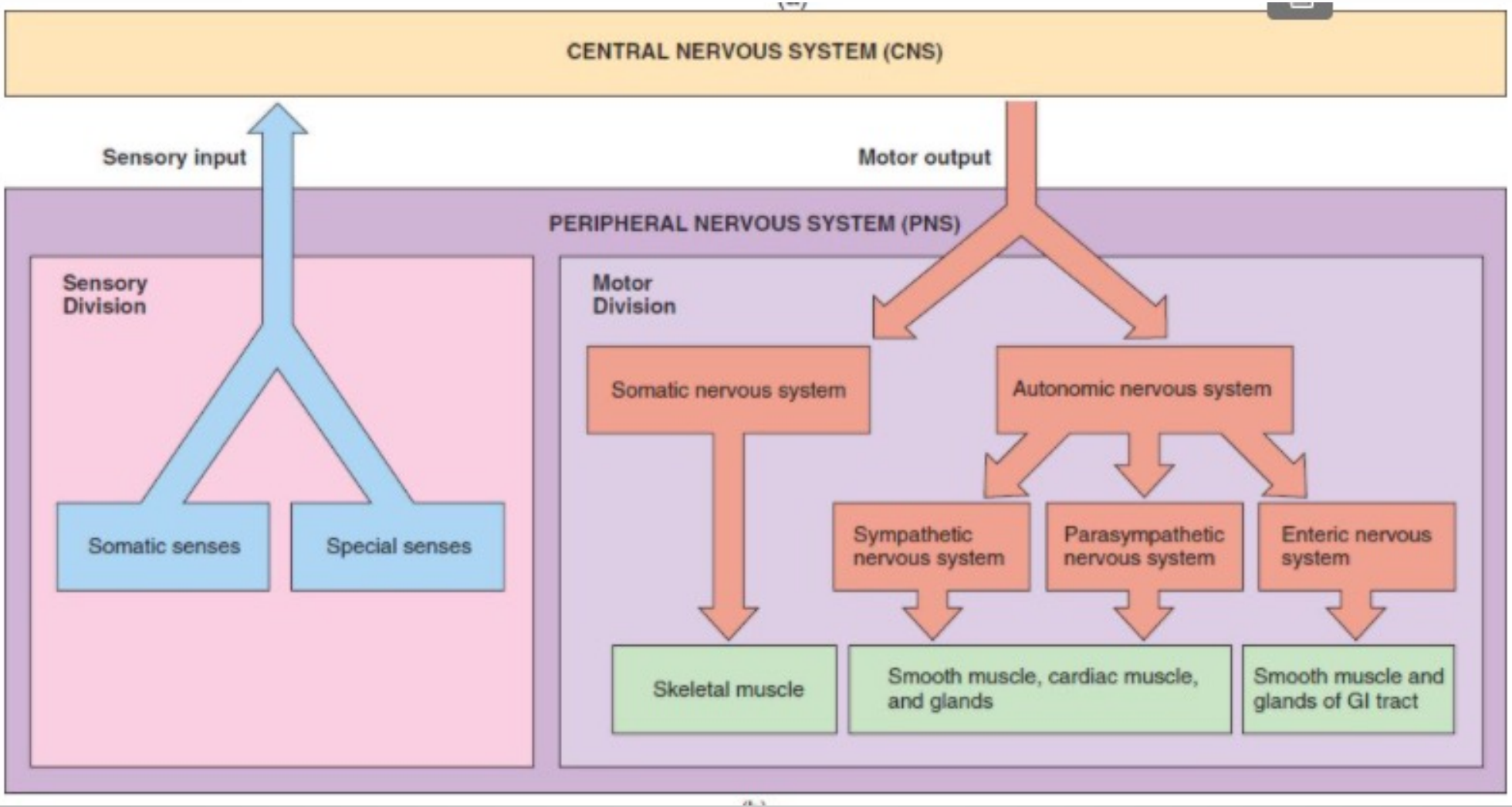
STRUCTURE AND ORGANIZATION

1. **Central nervous system** (CNS): brain and spinal cord
2. **Peripheral nervous system** (PNS): cranial, spinal, and peripheral nerves, and Ganglia: small aggregates of nerve cells outside the CNS.

Cells in both central and peripheral:

- Neurons: have numerous long processes
- Glial cells: short processes: support and protect neurons.




CENTRAL NERVOUS SYSTEM (CNS)
Sensory input
Motor output
PERIPHERAL NERVOUS SYSTEM (PNS)
Sensory Division
Motor Division
Somatic nervous system
Autonomic nervous system
Somatic senses
Special senses
Sympathetic nervous system
Parasympathetic nervous system
Enteric nervous system
Skeletal muscle
Smooth muscle, cardiac muscle, and glands
Smooth muscle and glands of GI tract

DEVELOPMENT OF NERVE TISSUE

- The ectoderm, beginning in the third week of development (figure
- Epithelial neural plate---neural tube

NEURONS

- The functional unit in both the CNS and PNS

Cell body (perikaryon or soma)

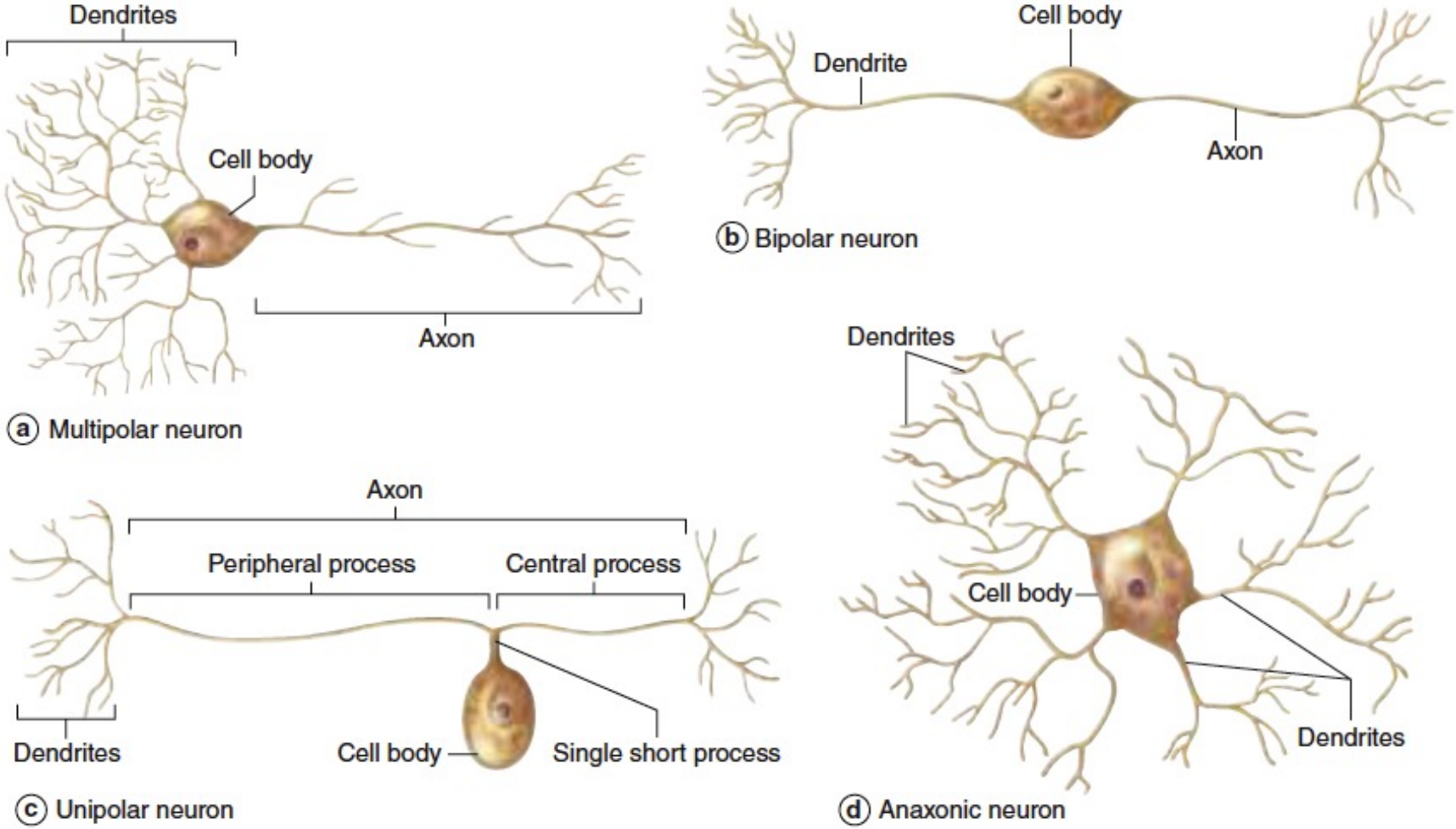
- Contains the nucleus and most of the cell's organelles
- The synthetic or trophic center for the entire neuron.

Dendrites: numerous elongated processes extending from the perikaryon and specialized to receive stimuli from other neurons.

Axon: a single long process ending at synapses specialized to generate and conduct nerve impulses to other cells (nerve, muscle, and gland cells).

NEURON CLASSIFICATION-STRUCTURALLY

1. Multipolar neurons: one axon and two or more dendrites, most common.
2. Bipolar neurons: one dendrite and one axon, sensory neurons of the retina, the olfactory epithelium, and the inner ear.
3. Unipolar or pseudounipolar neurons: single process that bifurcates close to the perikaryon; longer branch extending to a peripheral ending and the other toward the CNS. All other sensory neurons.
4. Anaxonic neurons: many dendrites but no true axon, do not produce action potentials, but regulate electrical changes of adjacent CNS neurons.



Shown are the four main types of neurons, with short descriptions. **(a)** Most neurons, including all motor neurons and CNS interneurons, are **multipolar**. (**b**) **Bipolar neurons** include sensory neurons of the retina, olfactory mucosa, and inner ear. **(c)** All other sensory neurons are **unipolar** or **pseudounipolar**. **(d) Anaxonic** neurons of the CNS lack true axons and do not produce action potentials, but regulate local electrical changes of adjacent neurons.

NEURON CLASSIFICATION-FUNCTIONALLY

- Sensory neurons (afferent), receiving stimuli from receptors throughout the body.
- Motor neurons(efferent): sending impulses to effector organs muscle fibers and glands.

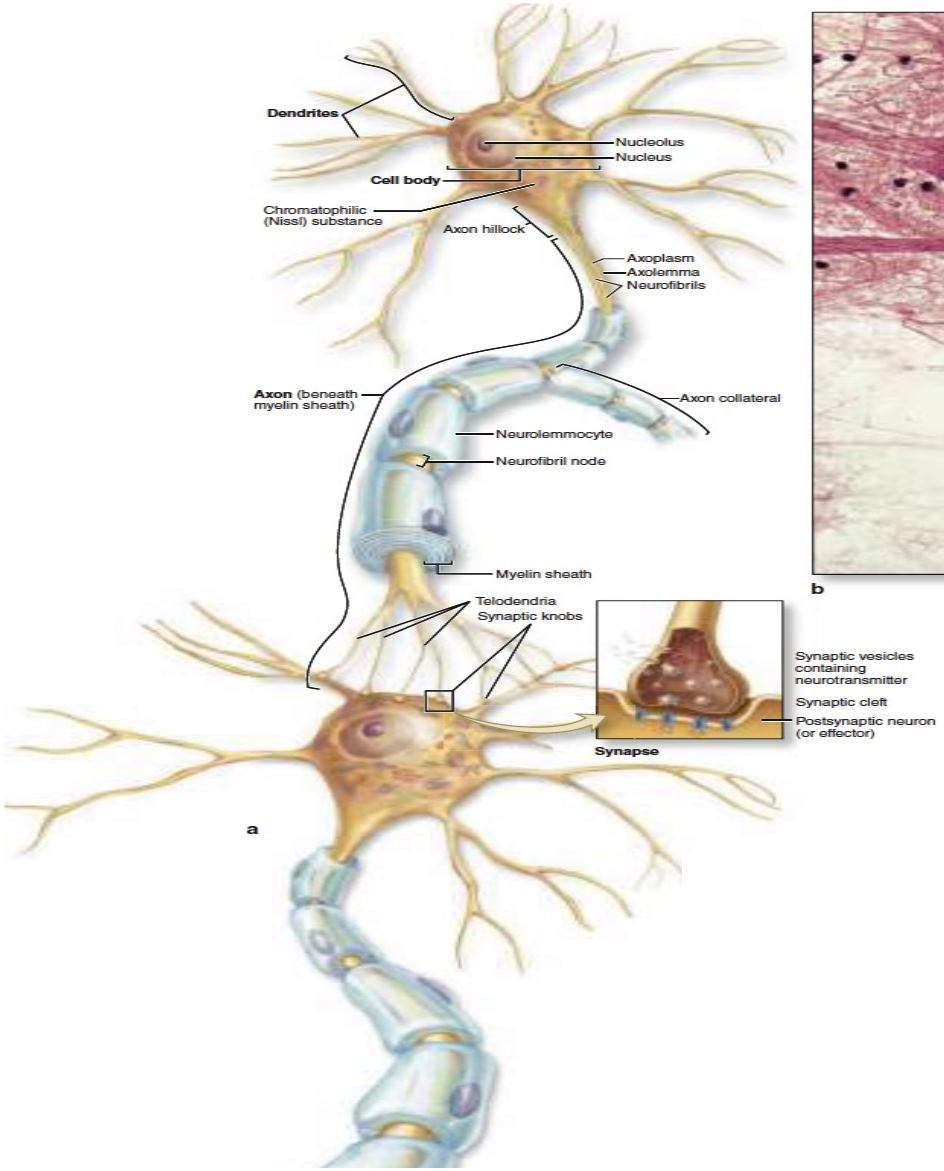
1. Somatic motor nerves--- voluntary -- skeletal muscle;

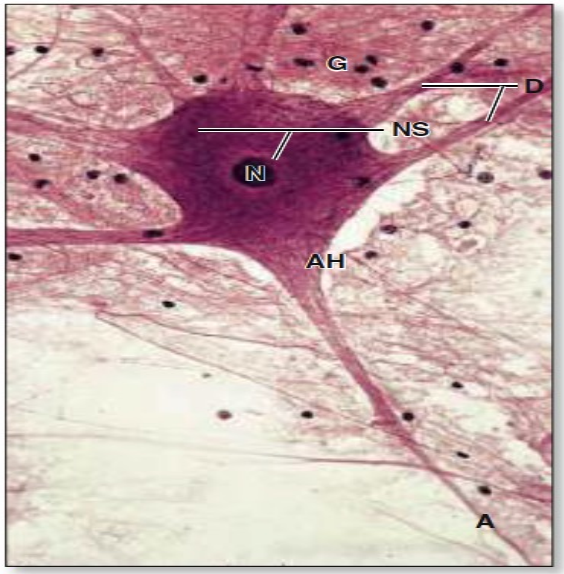
2.Autonomic motor nerves-- involuntary or unconscious--- glands, cardiac muscle, and smooth muscle.

- Interneurons establish relationships among other neurons, forming complex functional networks or circuits in the CNS. Interneurons are either multipolar or anaxonic and comprise 99% of all neurons in adults.

CELL BODY (PERIKARYON OR SOMA)

- Contains the nucleus and surrounding cytoplasm.
- It acts as a trophic center.
- Most are in contact with a great number of nerve endings conveying excitatory or inhibitory stimuli.
- Large, euchromatic nucleus with a prominent nucleolus (intense synthetic activity)
- Nissl bodies NB (nissl substance, chromatophilic substance): numerous free polyribosomes and highly developed RER.
- The amount of NB varies with the type and functional state of the neuron---abundant in large nerve cells (motor neurons)
- The Golgi apparatus is located only in the cell body.
- Mitochondria can be found throughout the cell and are usually abundant in the axon terminals.


Dendrites
Nucleolus
Nucleus
Cell body
Chromatophilic (Nissl) substance
Axon hillock
Axoplasm
Axolemma
Neurofibrils
Axon (beneath myelin sheath)
Axon collateral
Neurolemmocyte
Neurofibril node
Myelin sheath
Telodendria
Synaptic knobs
Synaptic vesicles containing neurotransmitter
Synaptic cleft
Postsynaptic neuron (or effector)
Synapse
a


G
D
NS
N
AH
A

b

DENDRITES

- short, small processes emerging and branching off the soma.
- Covered with many synapses.
- Are the principal signal reception and processing sites on neurons.
- The large number and extensive arborization--- signals from many other nerve cells.
- Dendrites become much thinner as they branch.

AXONS

- Most neurons have only one axon
- Axonal processes vary in length and diameter ---type of neuron.
- Axolemma: plasma membrane, and axoplasm: its contents.
- Axon hillock: pyramid-shaped region of the perikaryon where axons originate from.
- Initial segment: concentrated ion channels which generate the action potential
- Axons branch less than dendrites---but undergo terminal arborization.
- Axons of interneurons and some motor neurons also have major branches called collaterals that end at smaller branches with synapses influencing the activity of many other neurons.
- Terminal bouton: Small axonal branch ends with a dilation-- contacts another neuron or non-nerve cell.

- **Axoplasm** contains mitochondria, microtubules, neurofilaments, and transport vesicles, but very few polyribosomes or cisternae of RER (dependence of axoplasm on the perikaryon).
- anterograde transport: away from cell body. Organelles and macromolecules synthesized in the cell body move along axonal microtubules via kinesin from the perikaryon to the synaptic terminals.
- Retrograde transport: toward cell body. in the opposite direction along microtubules via dynein carries certain other macromolecules---endocytosis (including viruses and toxins).
- Anterograde and retrograde transports: 50-400 mm/d.