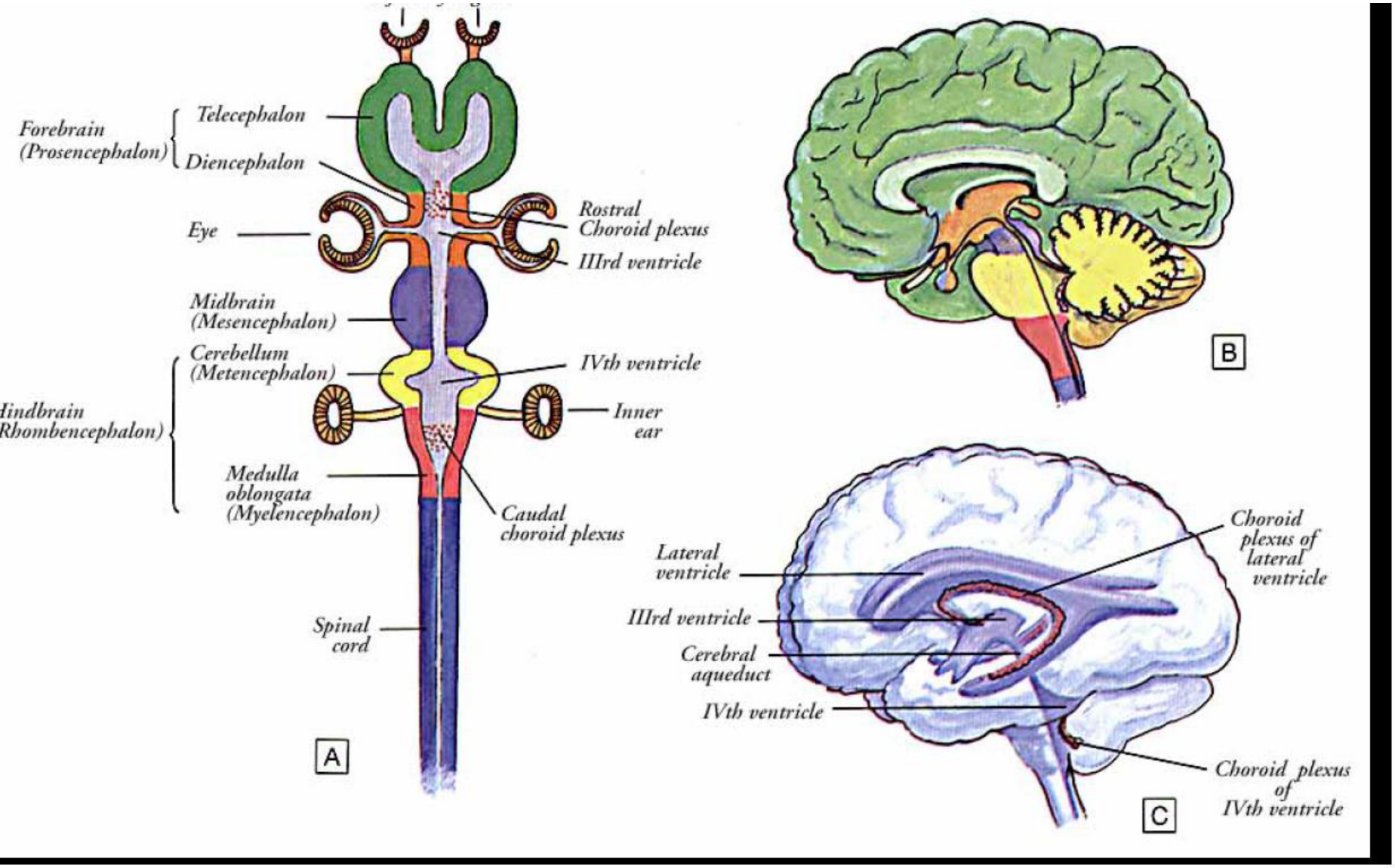
Classification of nervous system

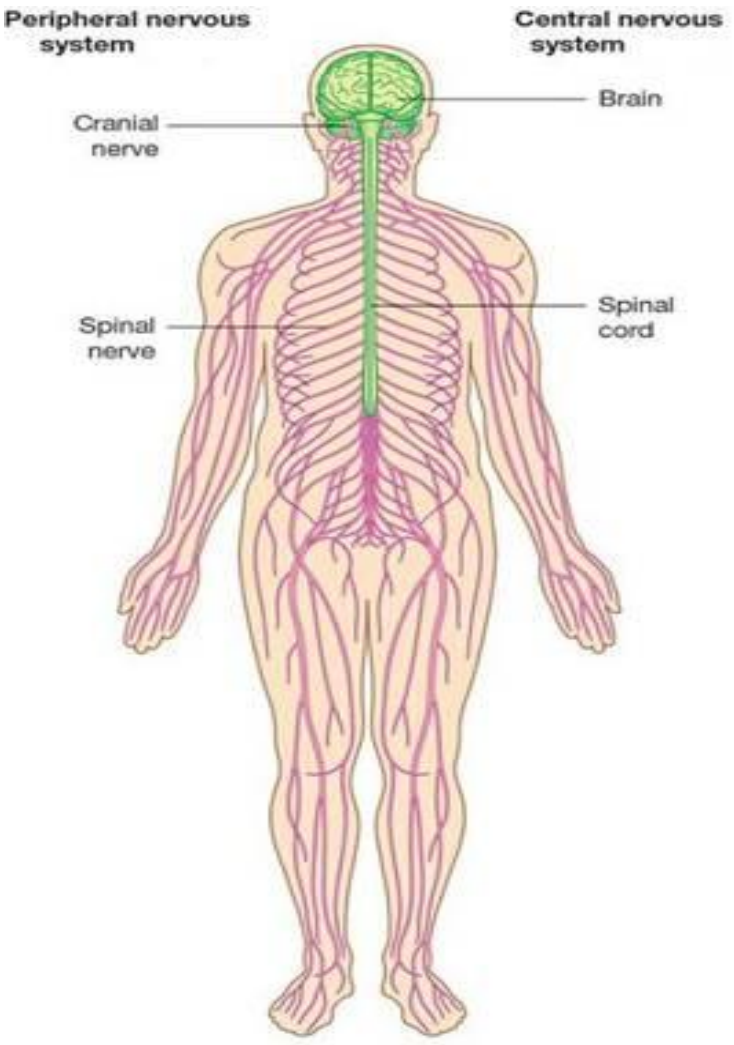

Forebrain
(Prosencephalon)
Telecephalon
Diencephalon
Eye
Rostral
Choroid plexus
IIIrd ventricle
Midbrain
(Mesencephalon)
Cerebellum
(Metencephalon)
IVth ventricle
Hindbrain
(Rhombencephalon)
Inner
ear
Medulla
oblongata
(Myelencephalon)
Caudal
choroid plexus
Spinal
cord
A
B
Lateral
ventricle
Choroid
plexus of
lateral
ventricle
IIIrd ventricle
Cerebral
aqueduct
IVth ventricle
Choroid plexus
of
IVth ventricle
C

Anatomically classification

- ❖ Central nervous system (CNS)., include brain & spinal cord.
- ❖ Peripheral nervous system (PNS)., include
- ➢ Ganglia
- ➢ Nerve fiber

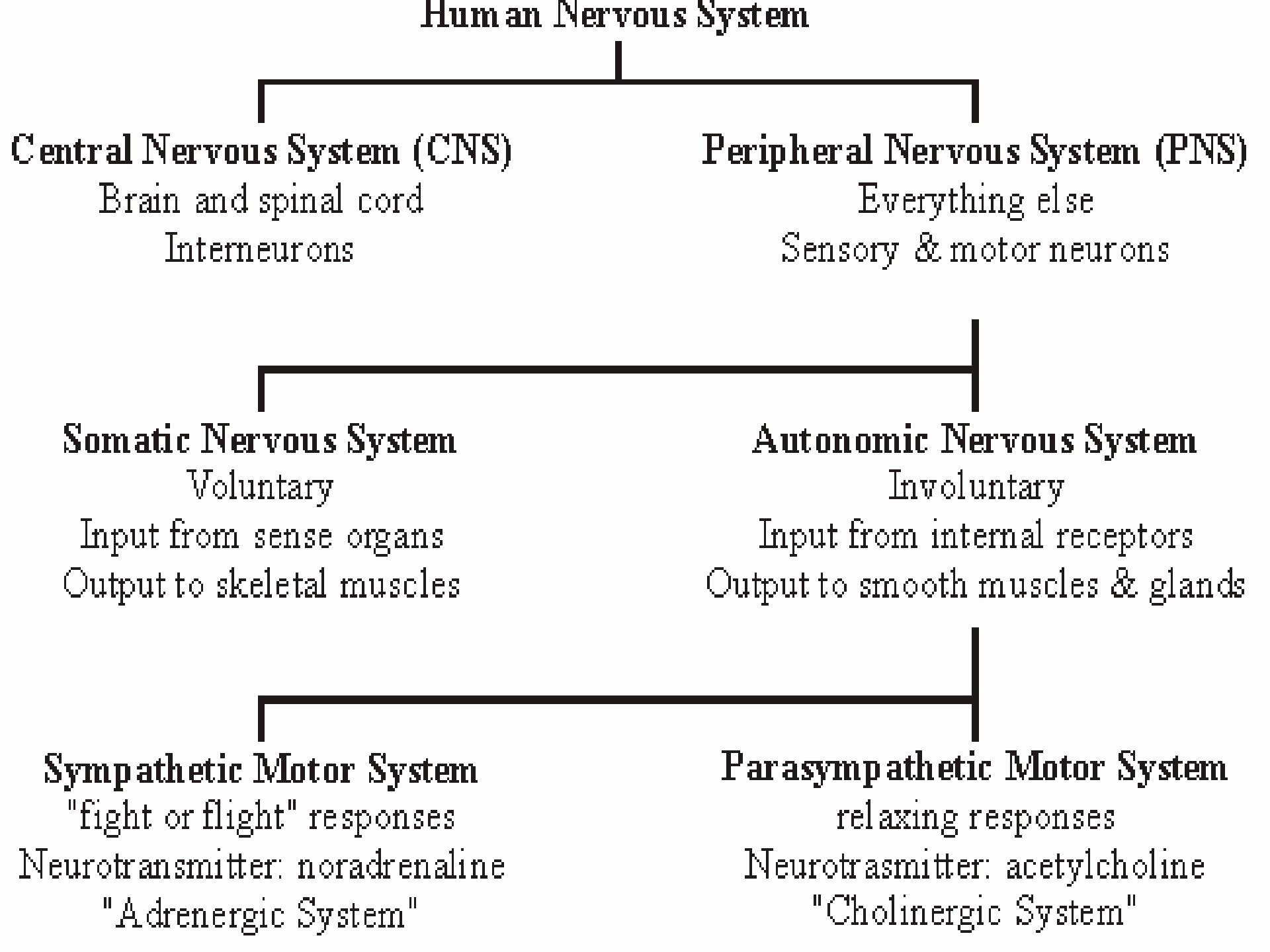
A- cranial nerve fiber (12 pairs)

B- spinal nerve fiber (31 pairs)



Functionally classification

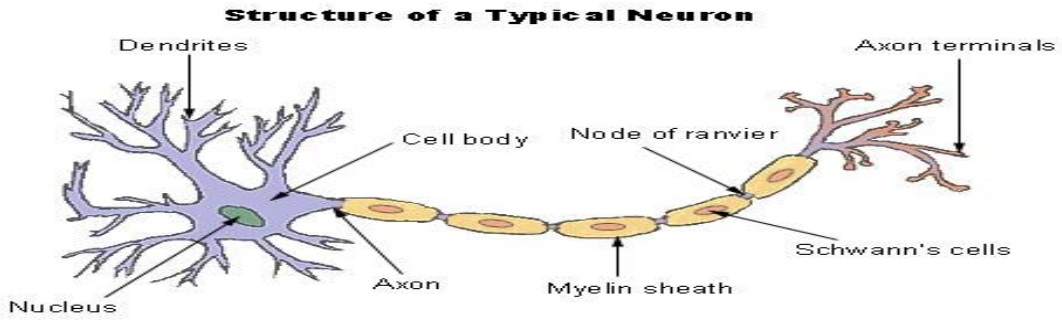
- somatic nerve system (control voluntary activities of the body)
- Autonomic nerve system (control involuntary of the body) & its divided into :
  - Sympathetic motor system (fight & flight responses)
  - Parasympathetic motor system (relaxing responses)


Human Nervous System
Central Nervous System (CNS)
Brain and spinal cord
Interneurons
Peripheral Nervous System (PNS)
Everything else
Sensory & motor neurons
Somatic Nervous System
Voluntary
Input from sense organs
Output to skeletal muscles
Autonomic Nervous System
Involuntary
Input from internal receptors
Output to smooth muscles & glands
Sympathetic Motor System
"fight or flight" responses
Neurotransmitter: noradrenaline
"Adrenergic System"
Parasympathetic Motor System
relaxing responses
Neurotrasmitter: acetylcholine
"Cholinergic System"

Structurally classification

Nerve cells divided into :

- ***Nerve cells (Neurons):*** which usually show long processes



- ***Glial cells:*** which have short processes, support & protect neurons & participate in neuron activity, neural nutrition & the defense processes of the central nervous system **(CNS)**

Nerve fibers divided into

- A- ***Myelinated fiber***: found in peripheral nervous system which covered by Schwann cells ,the myelin sheath show gaps along its called the nodes of Ranvier which represent the space between adjacent Schwann cells along the length of the axon

- B-***Unmyelinated fibers***: found in both Peripheral & central nervous system , its not covered by myelin sheath & there is no nodes of Ranvier.

Central nervous system

- **Brain**

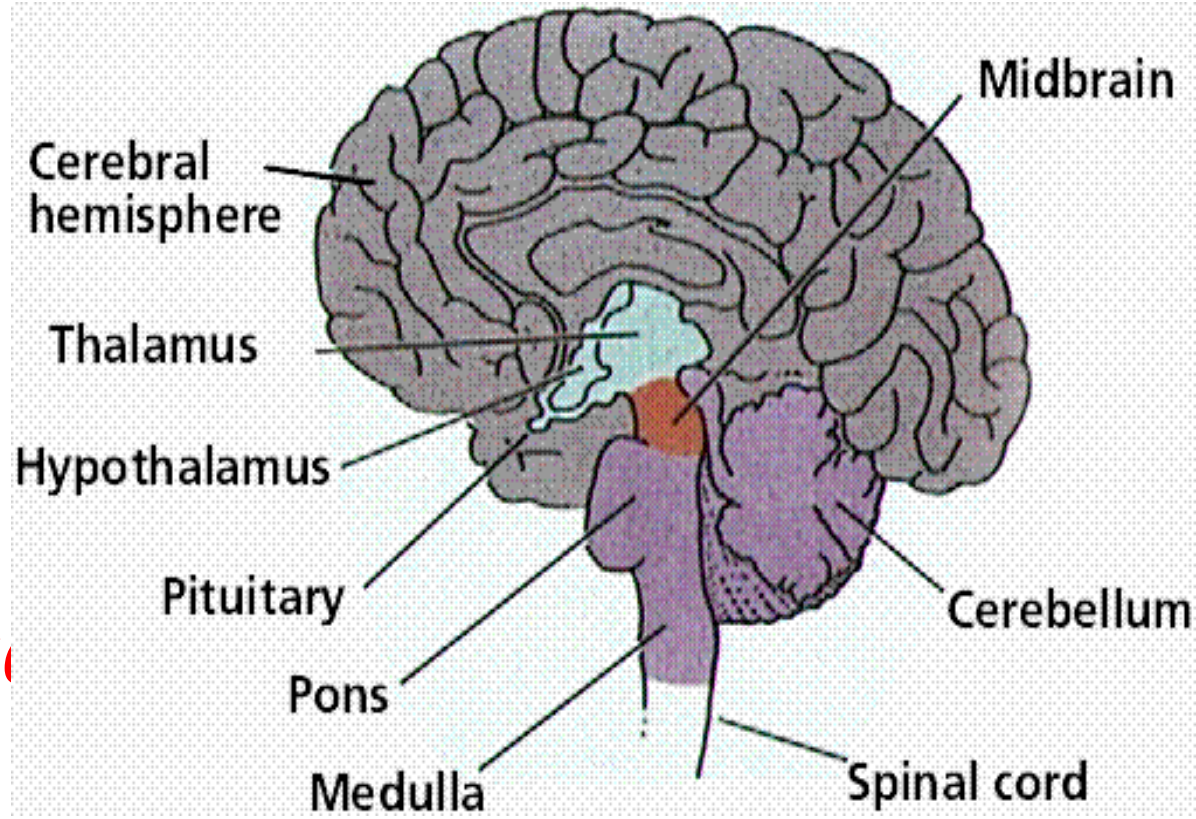
Its divided into :

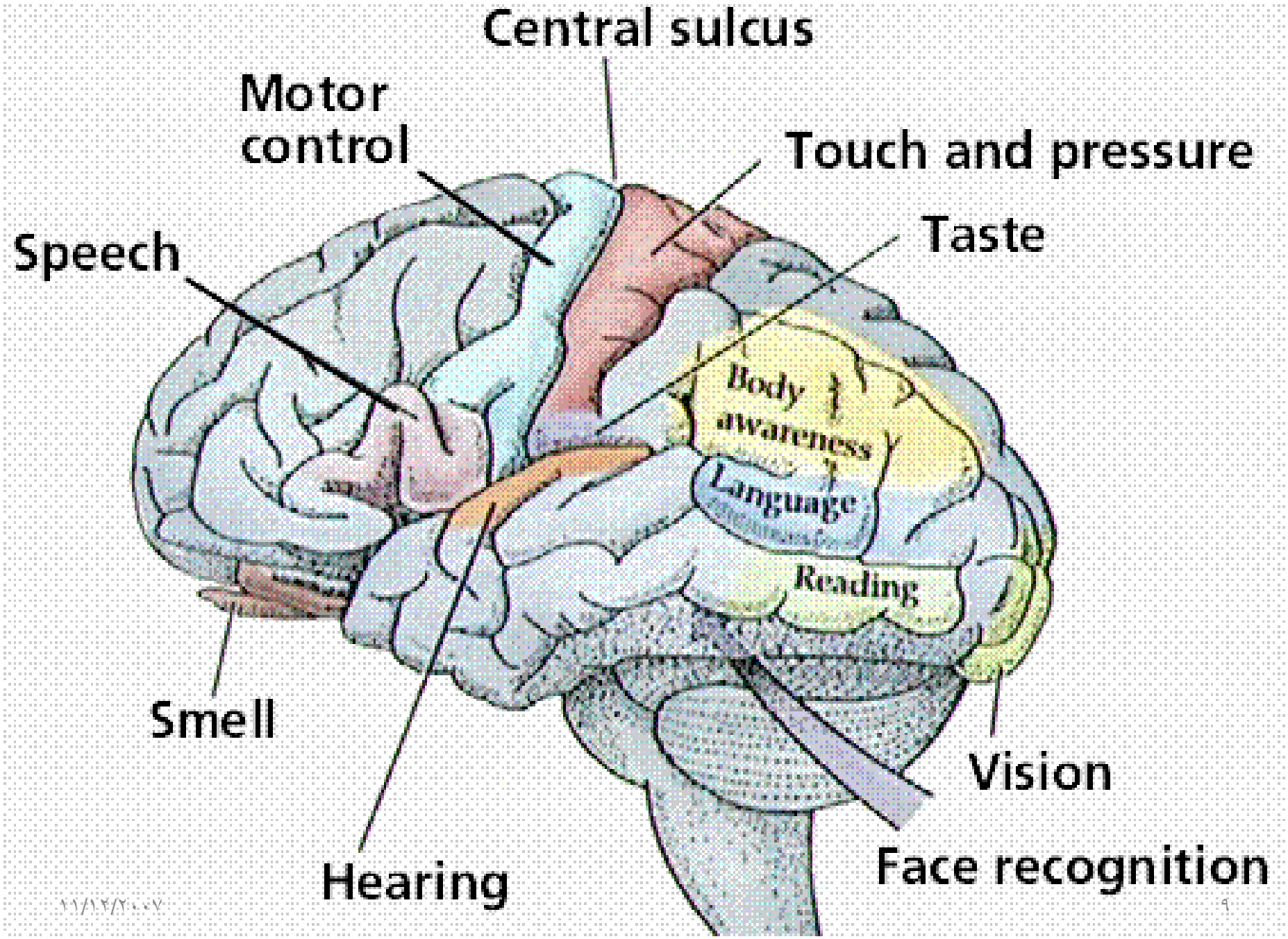
- **Cerebrum**
- **Cerebellum**
- ***Brain stem***

1-Medulla oblong

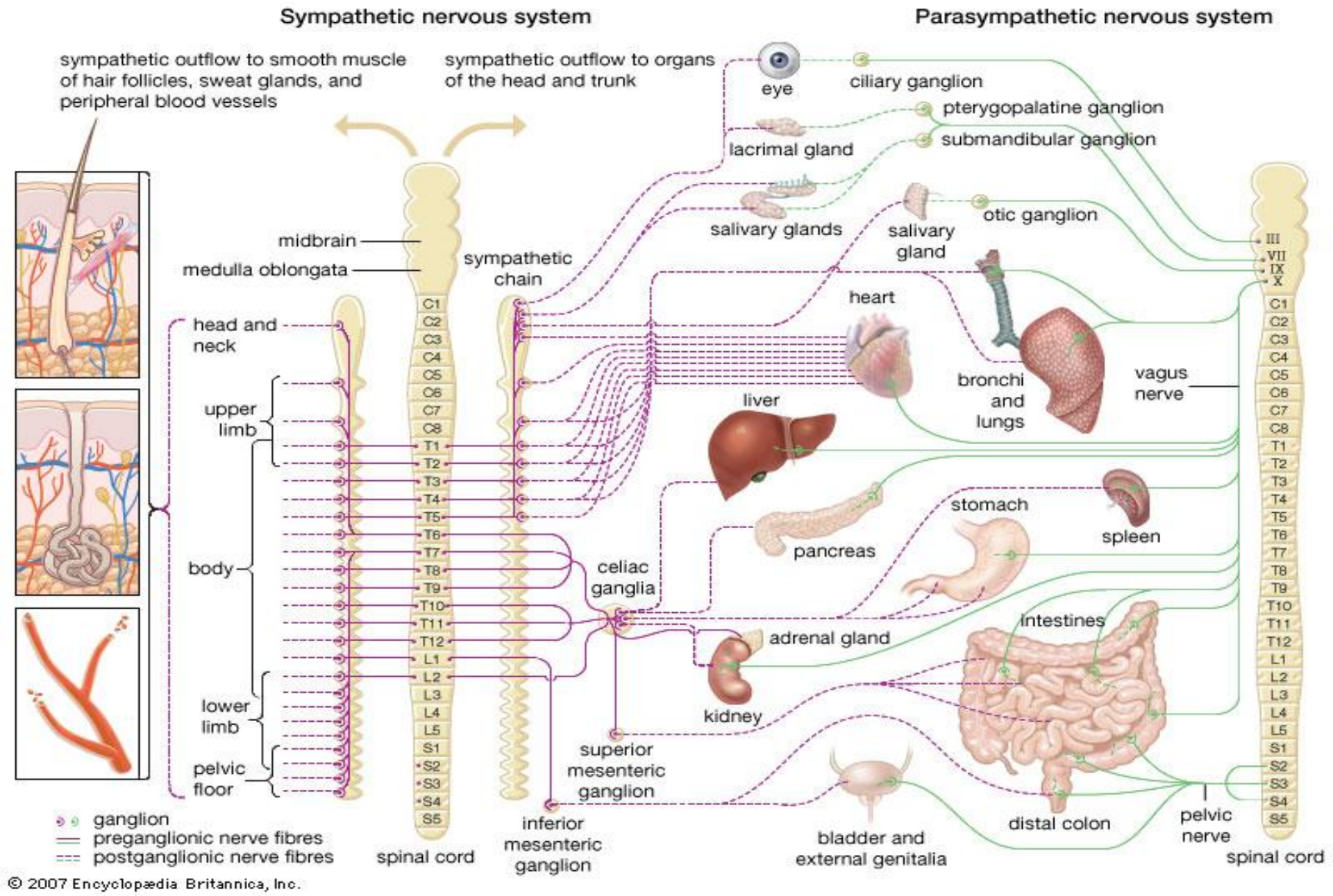
2-pons

3-Mid brain

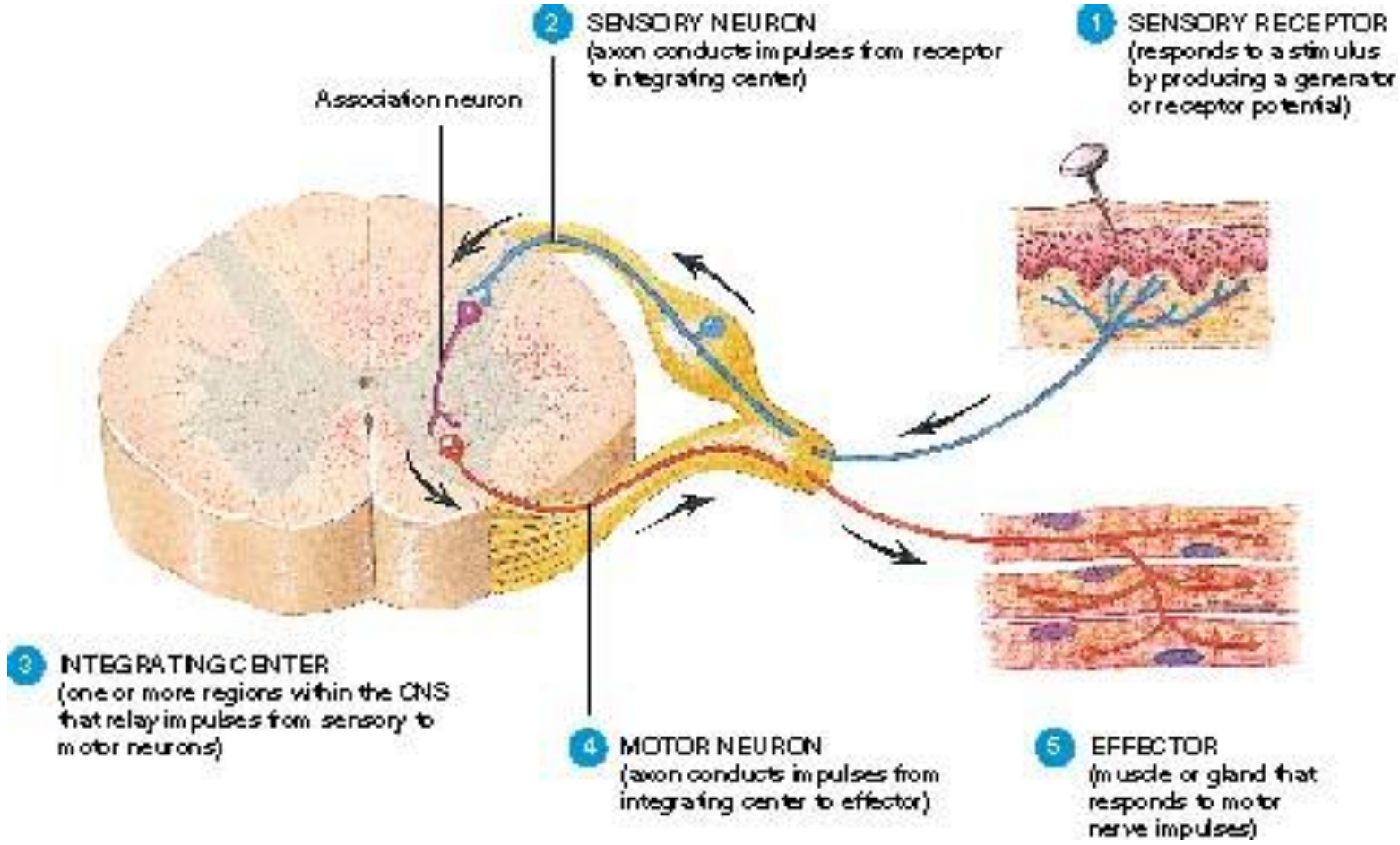



Central sulcus
Motor control
Touch and pressure
Speech
Taste
Body awareness
Language
Reading
Smell
Vision
Hearing
Face recognition

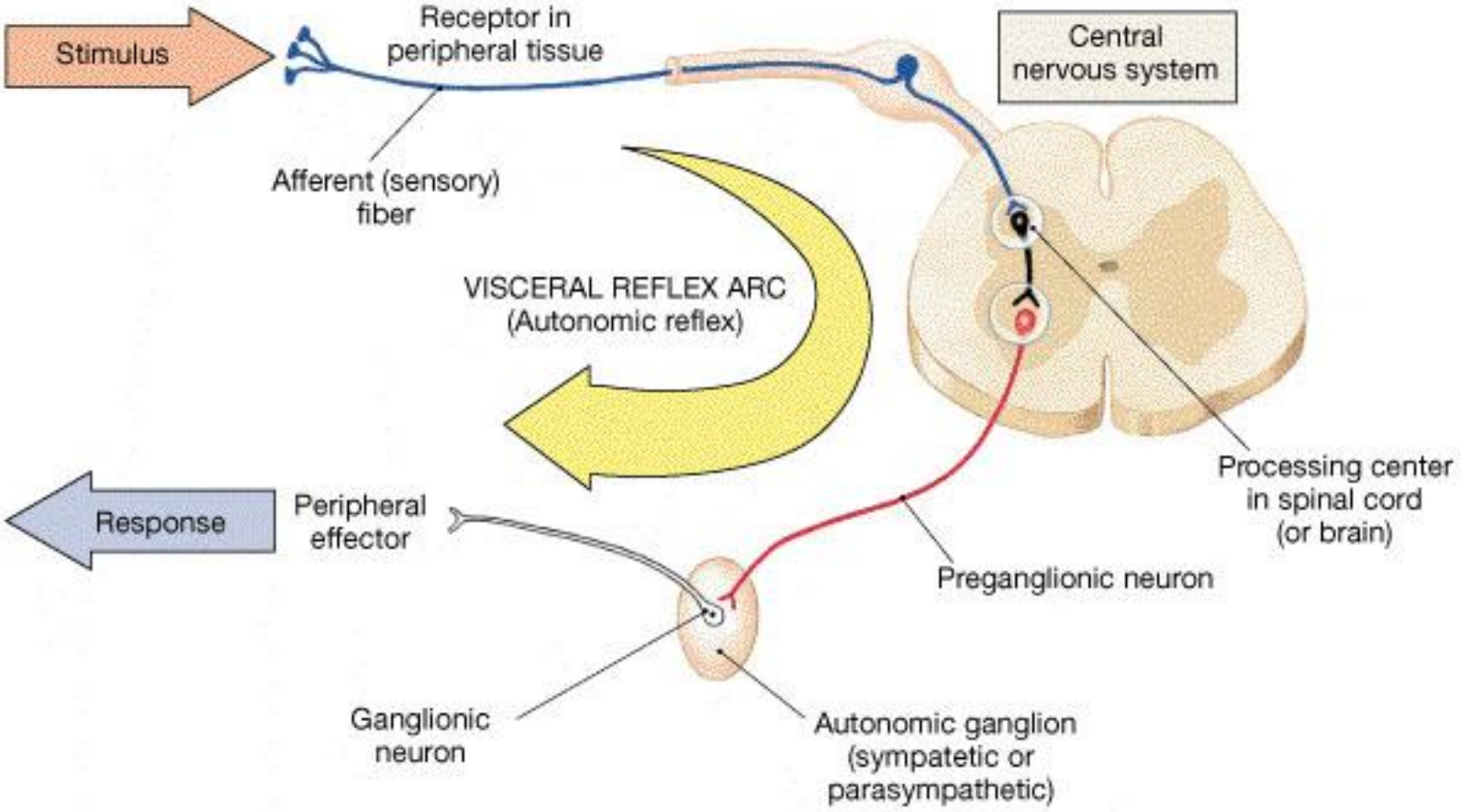
autonomic nervous system



Basic Structure of a Somatic Reflex



Basic Structure of a Visceral Reflex



Compare this anatomy to that of a somatic reflex arc.

Autonomic Nervous System

- **Is the part of the NS concerned with the innervations of *involuntary structures* as the heart, smooth muscles & glands throughout the body.**
- **It is distributed throughout the central & peripheral NS.**
- **The ANS is divided into:-**

1) **Sympathetic.**
2) **Parasympathetic.**

- **Both having afferent & efferent nerve fibers.**

Organization of the Autonomic Nervous System (ANS)

1. Central components
   - *A. hypothalamus*
   - *B. brain stem*
   - *C. spinal cord*
2. Peripheral components
   - A. sympathetic nerves
   - B. parasympathetic nerves

Functions

- ***Mediate neuronal regulation of internal environment.***
- ***Coordinate body function necessary for survival.***
- ***Regulate removal of waste products from the body.***
- ***Prepare the body for normal and life-threatening stress.***

- *functions done via control over :-*

1. *smooth m.*
2. *heart m*
3. *glands.*

The sympathetic system includes the two ganglionated trunks and their branches, plexuses and subsidiary ganglia.

- **It has a much wider distribution than the parasympathetic, for it innervates:**
- **all sweat glands,**
- **arrectores pilorum,**

sympathetic system includes also

- muscular walls of many blood vessels, the heart, lungs and respiratory tree, the abdomino-pelvic viscera, the oesophagus
- muscles of the iris in the eye, and non-striated muscle of the urogenital tract, the eyelids and elsewhere.

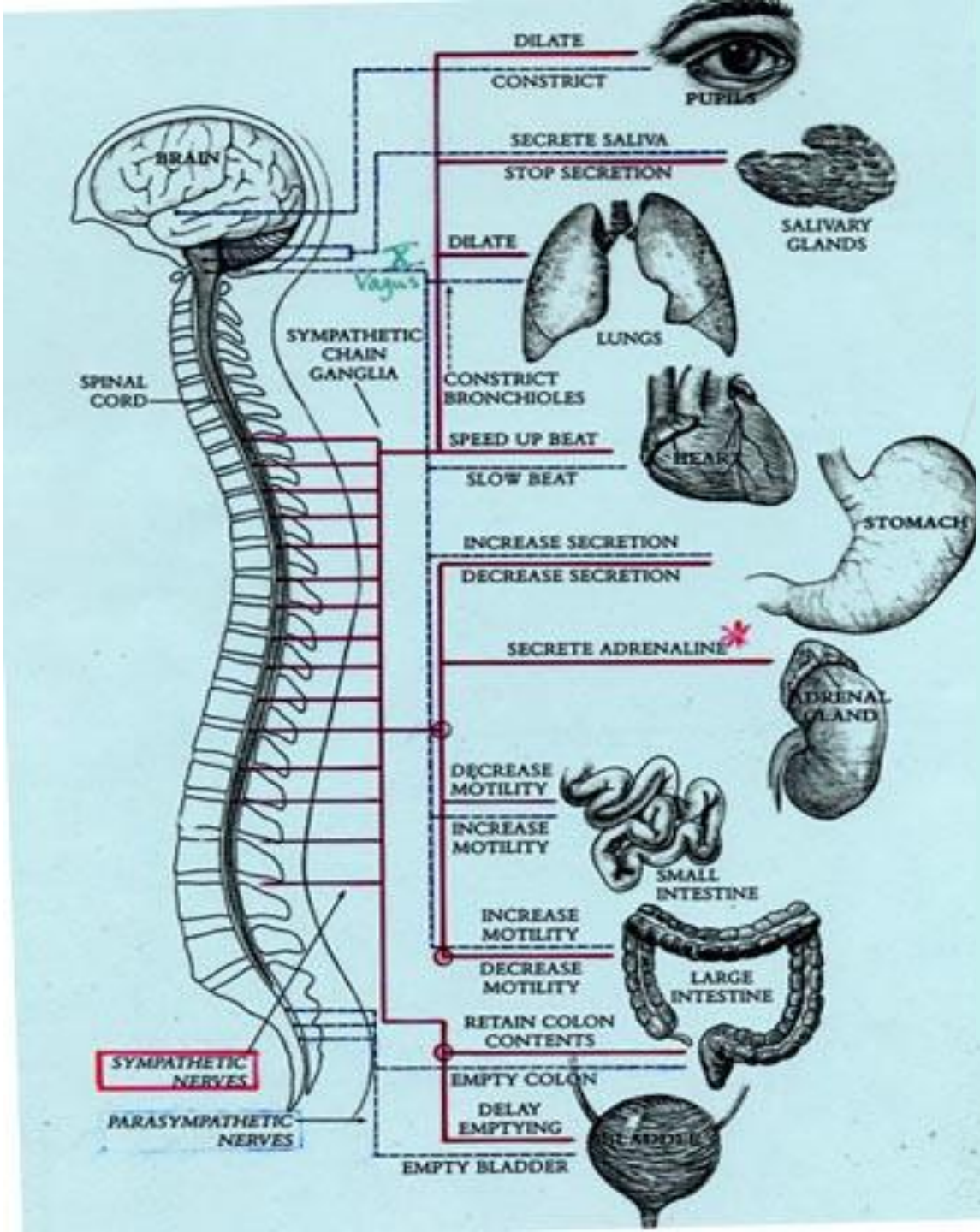
The *activities of the Symp. Part of the ANS*, prepare the body for emergency; as:-

1) **It accelerate the *heart rate.***
2) **Cause constriction of peripheral *blood vessels*.**
3) **Raises the *blood pressure*.**
4) **The Symp. Part of the ANS brings about redistribution of the blood, so that it leaves areas of skin & intestine & becomes available to the *brain, heart & skeletal muscles.***
5) **At the same time, it inhibits peristalsis of the *intestinal tact & close the sphincters.***

- The ***activities of the Para-Symp. Part of the ANS*** aim at conserving & restoring energy.

1) They slow the ***heart rate***.
2) Increase ***peristalsis*** of intestine & glandular activities.
3) Open the ***sphincters.***

The Hypothalamus of the brain controls the ANS & integrates the activities of the autonomic & the neuroendocrine systems; thus ***preserving homeostasis in the body.***



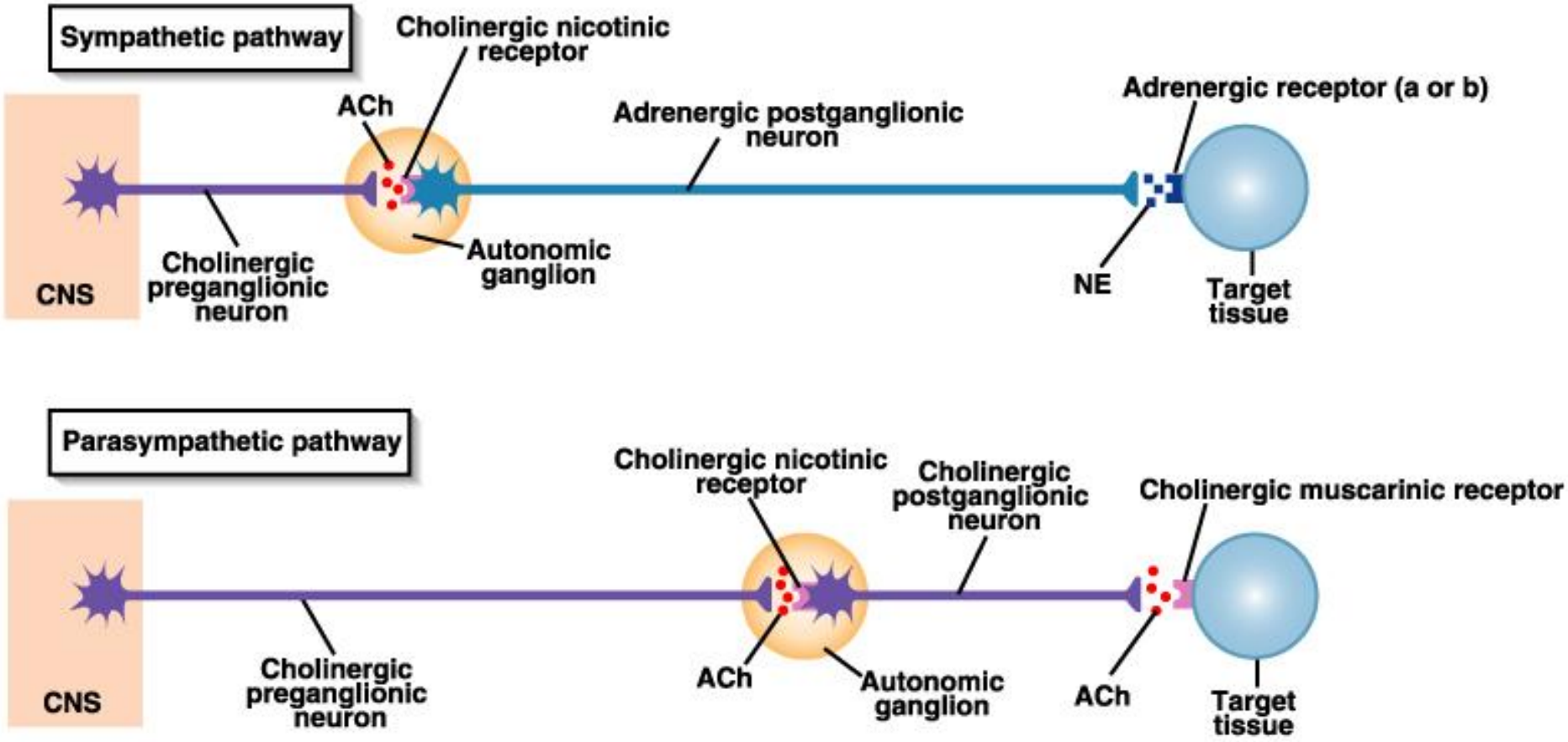
ANS Innervation of visceral organs

Subdivisions of the Autonomic Nervous System

Primary Neurotransmitter

nor pinephrine
epinephrine
(~20%)

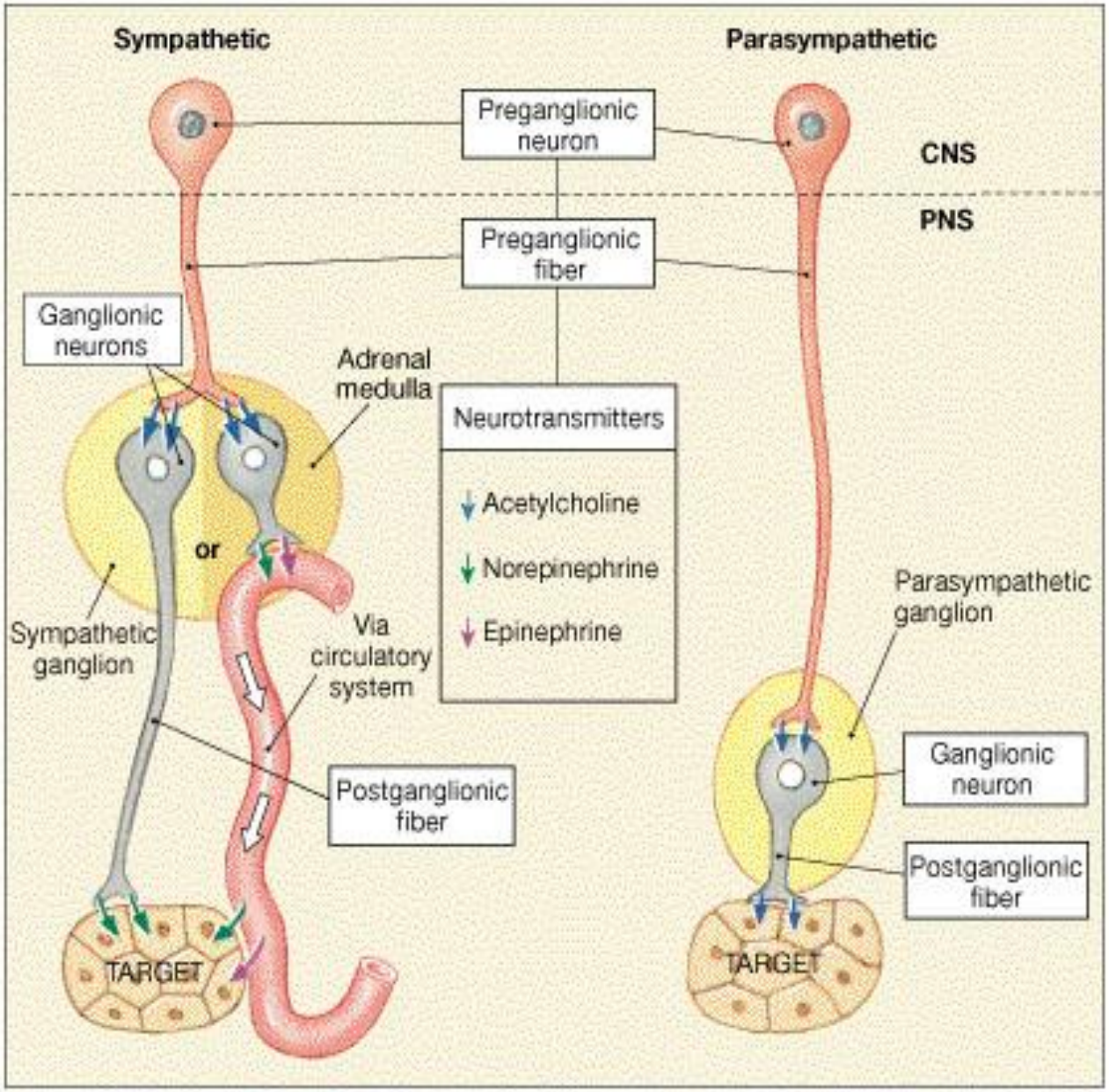
acetylcholine


Sympathetic pathway
Cholinergic nicotinic receptor
ACh
Adrenergic postganglionic neuron
Adrenergic receptor (a or b)
CNS
Cholinergic preganglionic neuron
Autonomic ganglion
NE
Target tissue
Parasympathetic pathway
Cholinergic nicotinic receptor
Cholinergic postganglionic neuron
Cholinergic muscarinic receptor
CNS
Cholinergic preganglionic neuron
ACh
Autonomic ganglion
ACh
Target tissue

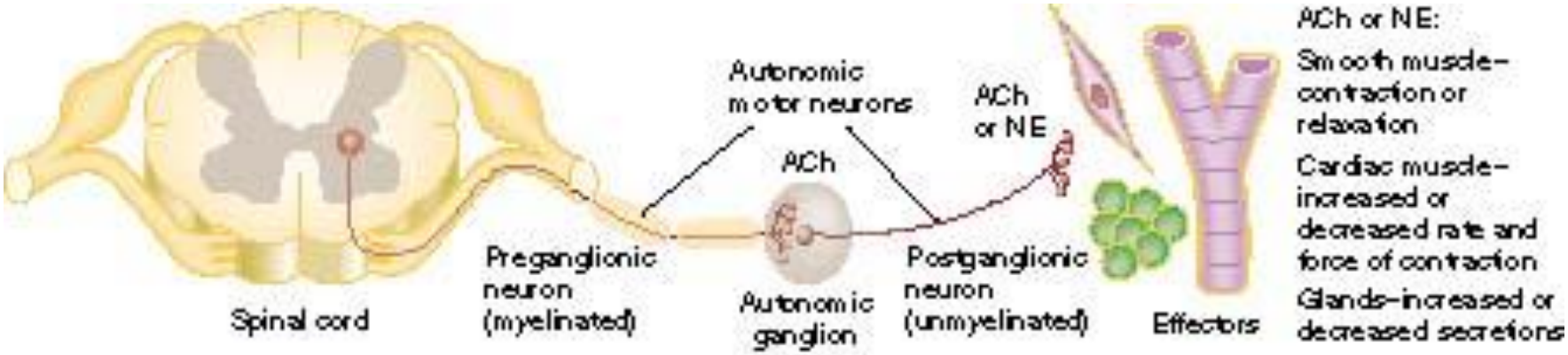
Exceptions

- ***Postganglionic neurons that innervate sweat glands and blood vessels of skeletal muscles release ACh not NE.***

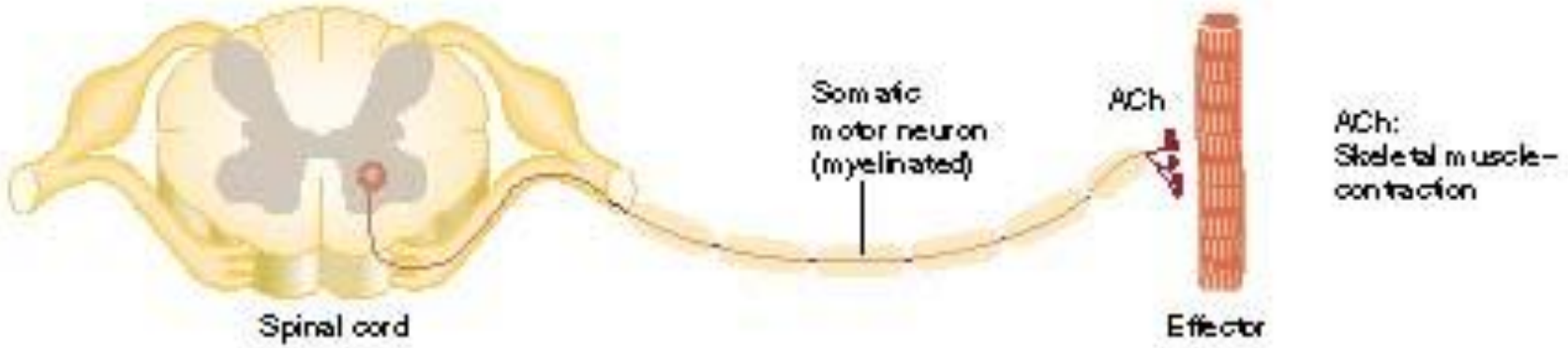
Anatomy of the Motor Output in Sympathetic and Parasympathetic nerves



Motor Neuron Pathways compared: Autonomic vs. Somatic

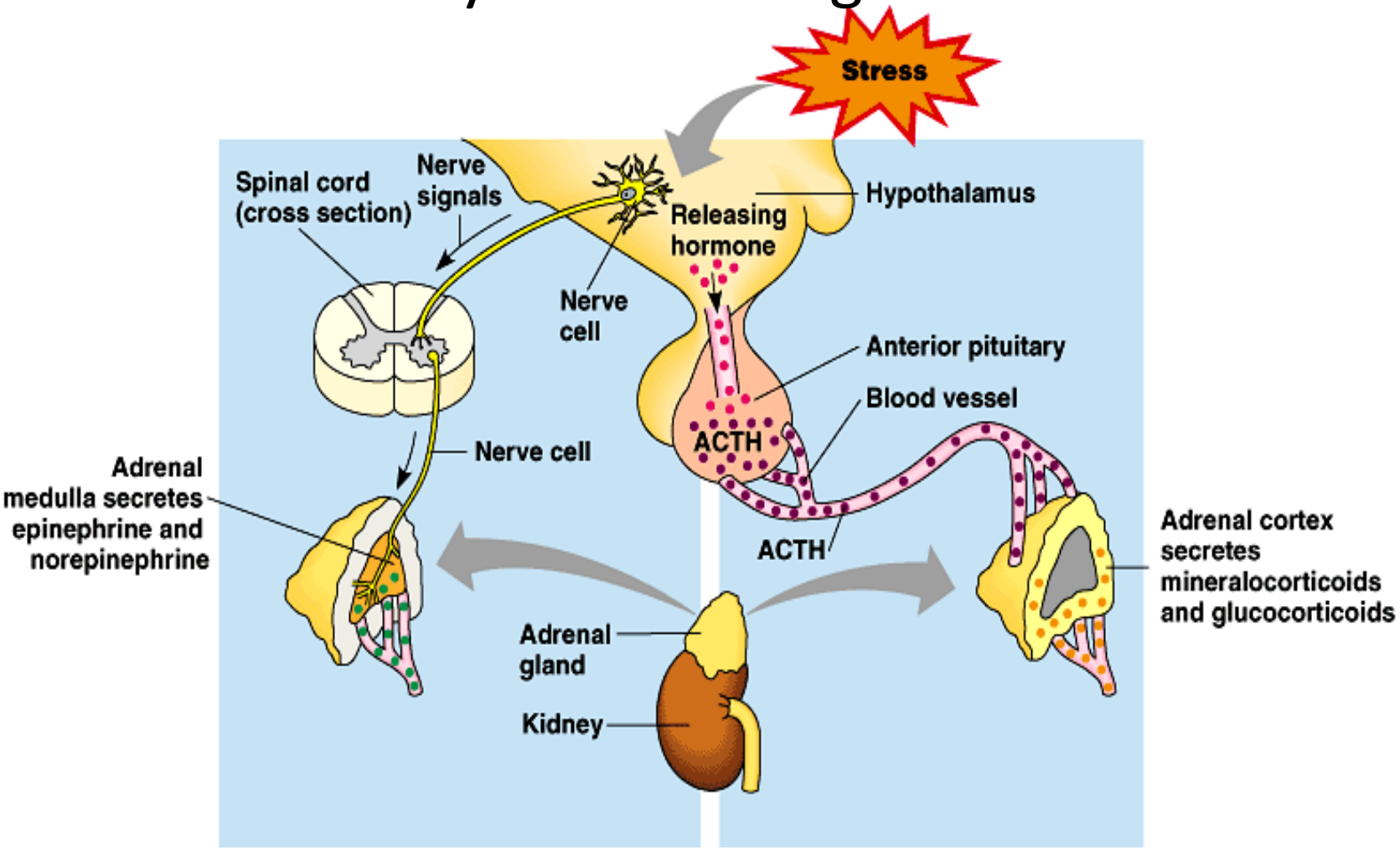


(a) Autonomic nervous system



(b) Somatic nervous system

Integration of the Nervous & Endocrine Systems during Stress



Describe the actions of the hormones listed in this figure.

Sympathetic Nervous System

Efferent Fibers:

- The gray matter of the spinal cord from T1-L2 segments possesses a ***lateral horn or column*** in which are located the cell bodies of the Symp. connector neurons.
- The connector cell fibers are called preganglionic as they pass to the peripheral ganglion, once the preganglionic fibers reach the ganglia in the symp. trunk, they may pass to the following destinations:

1. *They enter an excitor cell in the ganglion forming a synapse. The axons of the excitor neurons leave the ganglion & are non-myelinated.*
2. *Those fibers entering the ganglia of the symp. trunk high up in the thorax may travel up in the symp. trunk to the ganglia in the cervical region, where they synapse with excitor cells.*

1. *The preganglionic fibers may pass through the ganglia on the thoracic part of the symp. trunk without synapsing. These myelinated fibers from the three splanchnic nerves:*

a) *The greater splanchnic nerve arises from T5-T9 ganglia.*

b) *The lesser splanchnic nerve arises from T10-T11 ganglia.*

c) *The lowest splanchnic nerve arises from T12 ganglion.*

Horner synrome

- **Constriction o pupil , ptosis, enophthalmos, due to interruption of the stmpathetic nerve supply of the orbit.**
- **Causes :**
- **Affection of the stellate ganglia due to:-**
- **Lesion of the cervical spinal cord, or sympathetic trunk , tumor, or cervical rib.**

Afferent Fibers:

- *The afferent myelinated verve fibers travel from the viscera through the symp. ganglia without synapsing.*
- *They enter the spinal nerve via **rami communicantes** & reach their cell bodies in the posterior root ganglion of the corresponding spinal nerve.*
- *The central axons then enter the spinal cord & may form the afferent component of a local reflex arch.*

Parasympathetic Nervous System

Efferent fibers:

- *The connector cells of this part of the system are located in the **brain & the sacral segment of the spinal cord.***
- *Those in the brain form parts of the nuclei of origin of cranial nerves **III, VII, IX & X** & the axons emerges from the brain contained in the corresponding cranial nerves.*

- *The sacral connector cells are found in the gray matter of **the S2-S4 segment of the cord.***
- *The myelinated axons leave the spinal cord in the anterior nerve root of the corresponding spinal nerves, they then leave the sacral nerves & form the **pelvic splanchnic nerves.***

- **All the efferent are pregenglionic, & they synapse with excitor cells in the peripheral ganglia, which are usually situated close to the viscera they innervate.**
- **Characteristically, the postganglionic fibers are non-myelinated & relatively short compared with symp. post-ganglionic fibers.**

Afferent fibers:

- **The afferent myelinated fibers travel from the viscera to their cell bodies located either in the sensory ganglia of the cranial nerves or in the posterior root ganglia of the sacrospinal nerves.**
- **The central axons then enter the CNS & take part in the formation of local reflex arcs, or pass to higher centers of the ANS.**

Actions of the ANS on organs-

- Heart
  - Sympathetic fibers: increase the overall activity of the heart by increasing the rate and the force of heart contraction
  - Parasympathetic fibers: the opposite effects

- **Lungs**
  - **Bronchial muscles Bronchial glands Blood vessels**
- **Gastrointestinal system**
  - **stomach**
    - **motility and tone**
    - **sphincters**
    - **secretion**

- Intestine
  - motility and tone
  - sphincters
  - secretion
- Intrinsic eye muscles
  - iris muscles
  - ciliary muscle
- Blood vessels: coronary, skeletal muscle, etc.

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