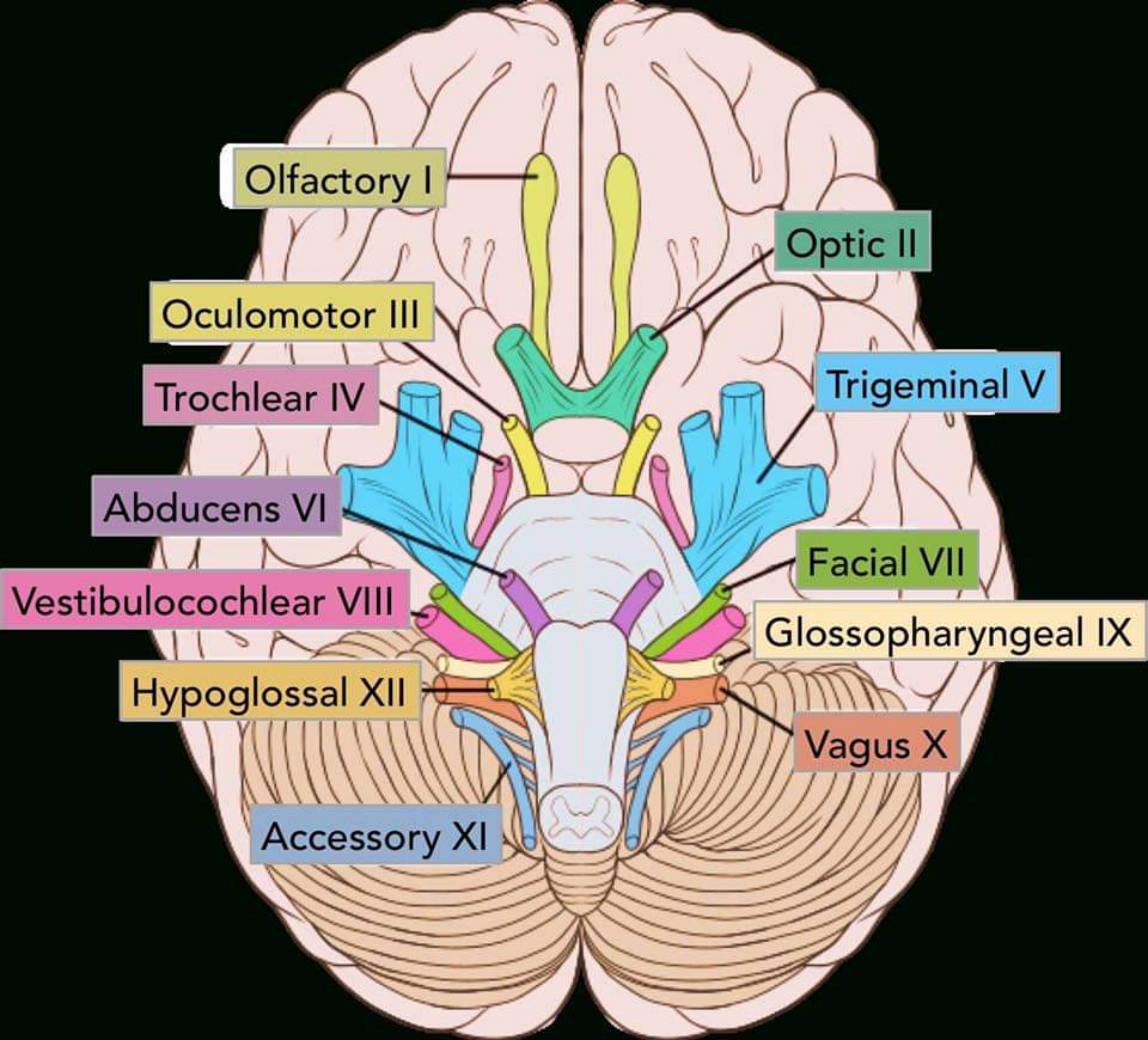
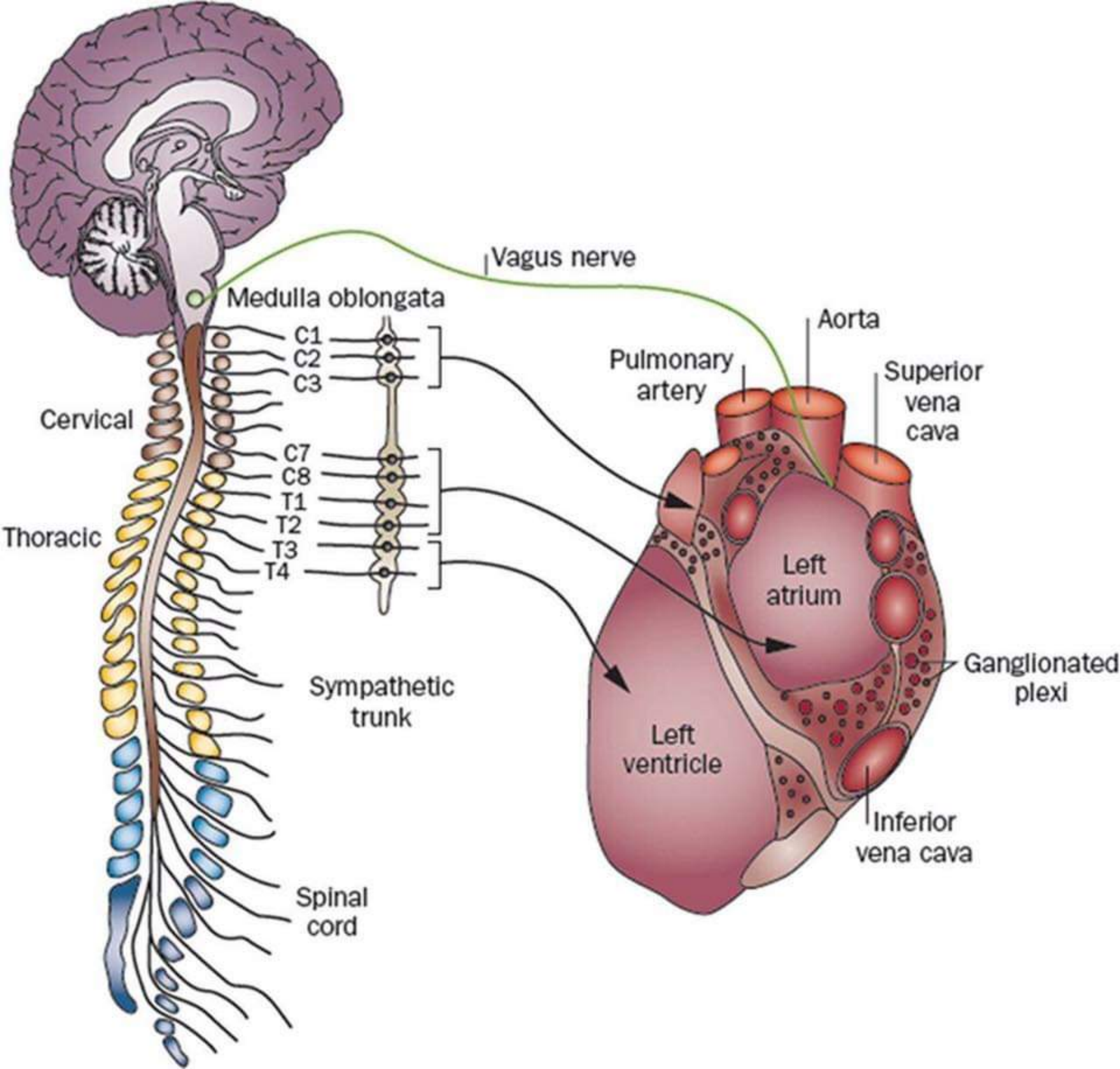
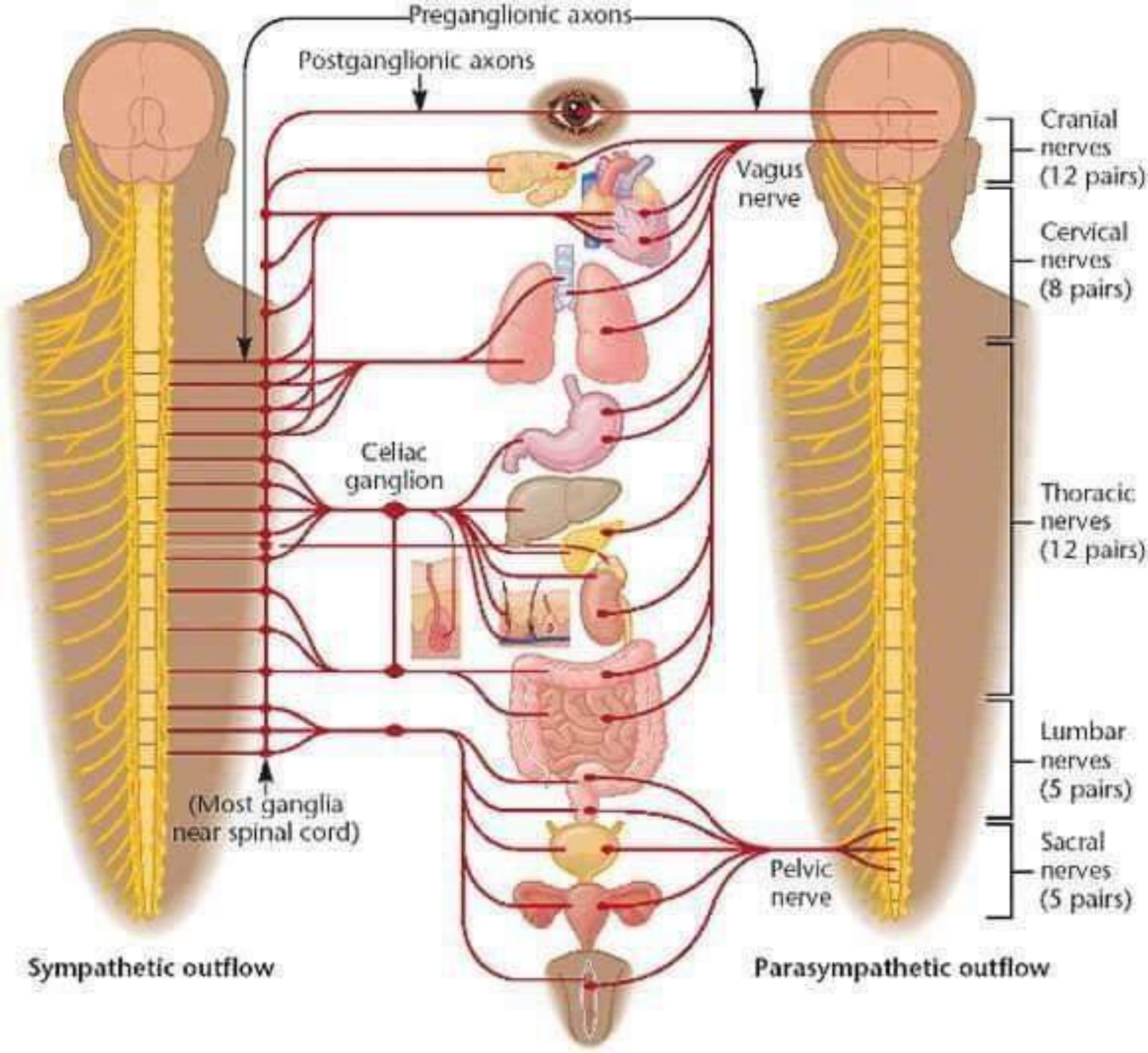
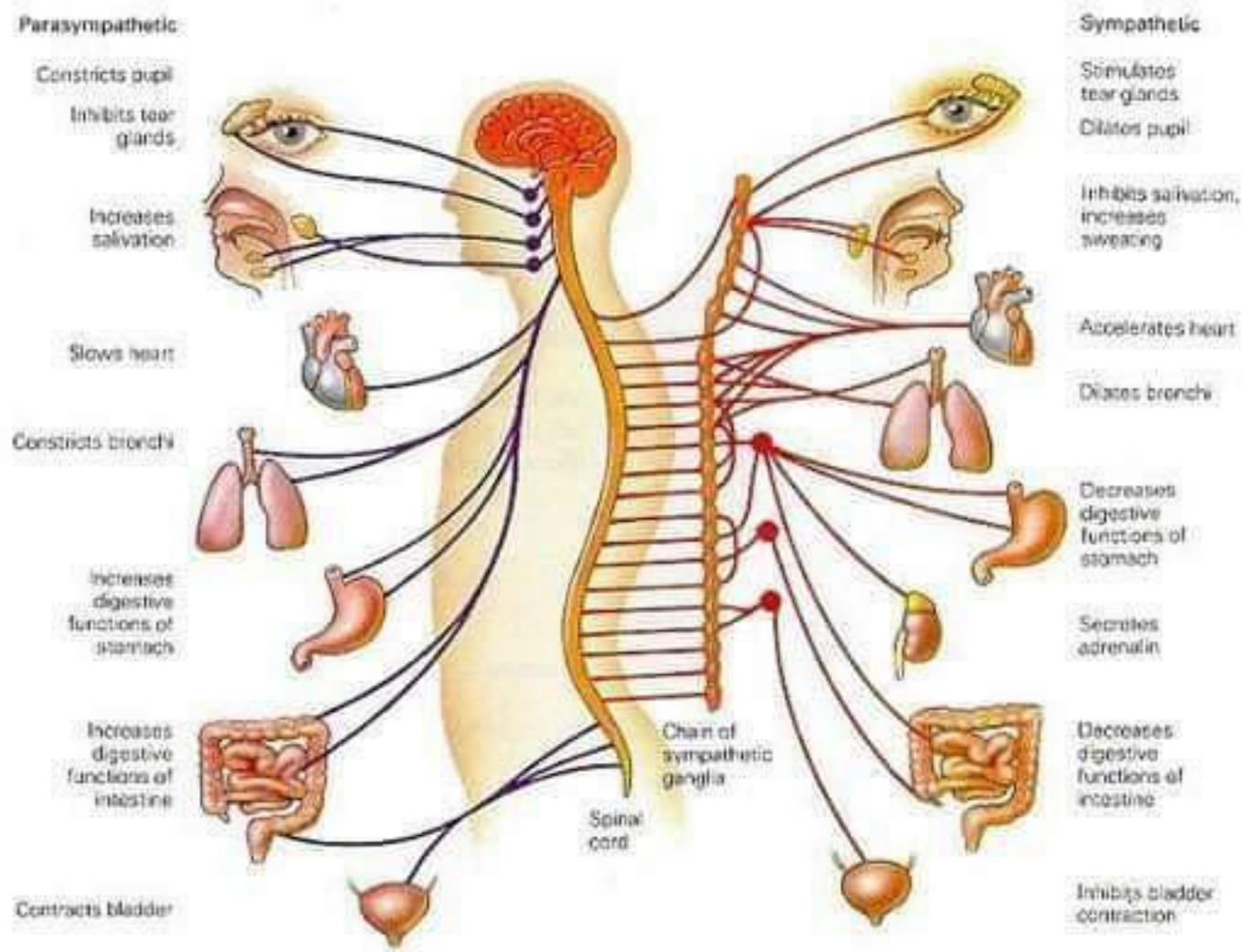

Olfactory I
Optic II
Oculomotor III
Trochlear IV
Trigeminal V
Abducens VI
Facial VII
Vestibulocochlear VIII
Glossopharyngeal IX
Hypoglossal XII
Vagus X
Accessory XI

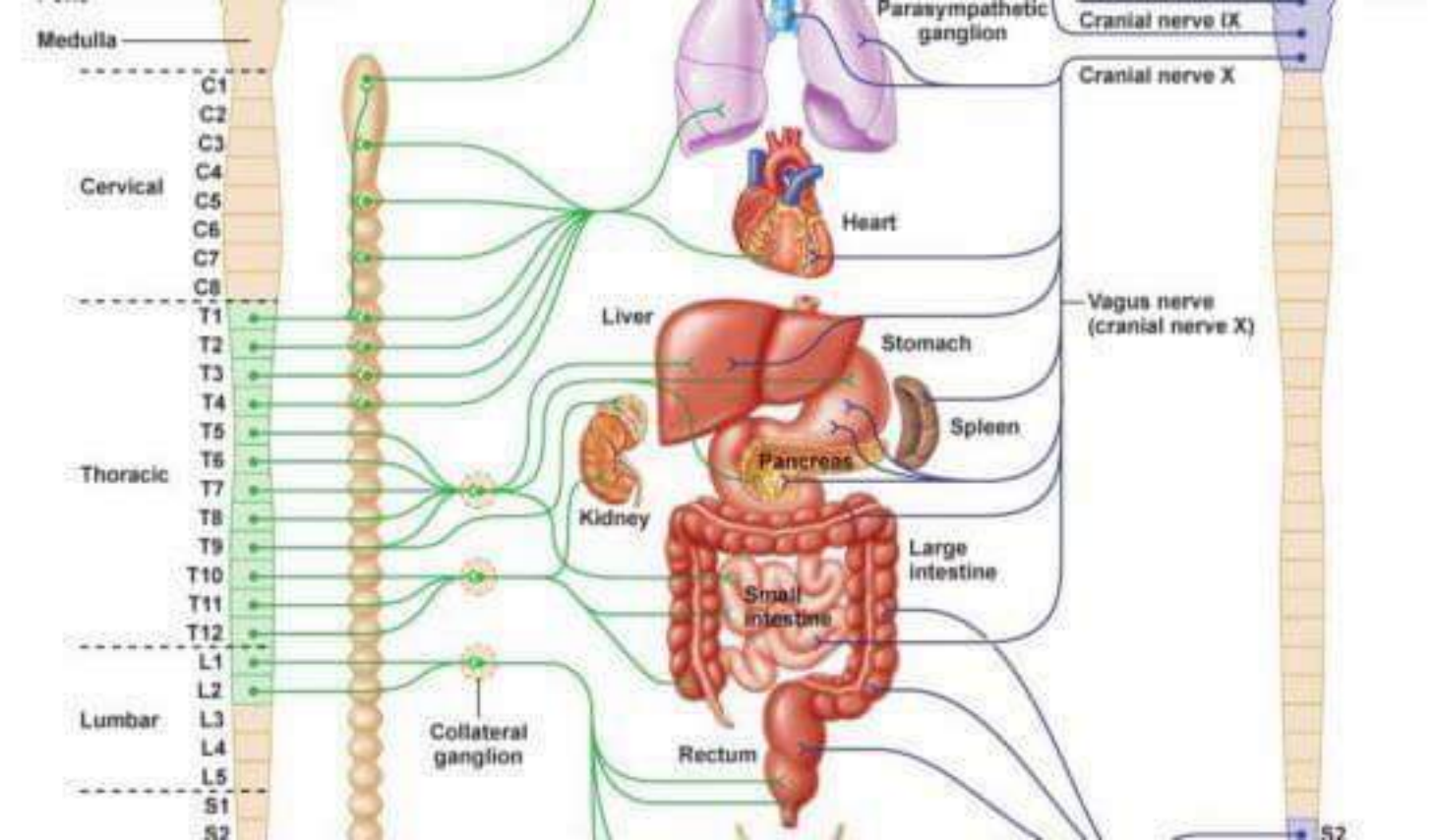

Vagus nerve
Medulla oblongata
C1
C2
C3
Cervical
C7
C8
T1
T2
T3
T4
Thoracic
Sympathetic trunk
Spinal cord
Aorta
Pulmonary artery
Superior vena cava
Left atrium
Ganglionated plexi
Left ventricle
Inferior vena cava


Preganglionic axons
Postganglionic axons
Vagus nerve
Cranial nerves (12 pairs)
Cervical nerves (8 pairs)
Celiac ganglion
Thoracic nerves (12 pairs)
Lumbar nerves (5 pairs)
Sacral nerves (5 pairs)
(Most ganglia near spinal cord)
Pelvic nerve
Sympathetic outflow
Parasympathetic outflow

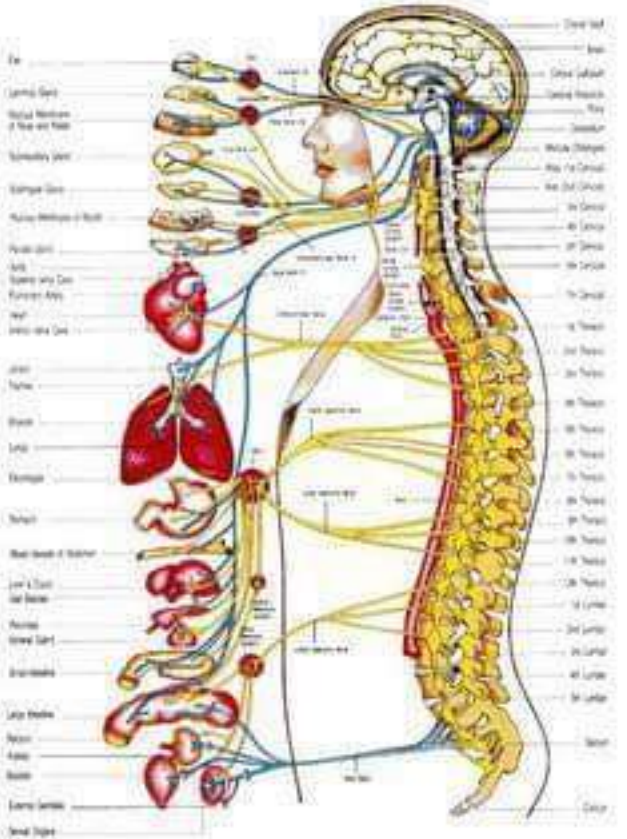
The Autonomic Nervous System

The parasympathetic nervous system, which regulates day-to-day internal processes and behavior, is shown on the left. The sympathetic nervous system, which regulates internal processes and behavior in stressful situations, is shown on the right. Note that, on their way to and from the spinal cord, the nerve fibers of the sympathetic nervous system innervate, or make connections with ganglia, specialized clusters of neuron chains.

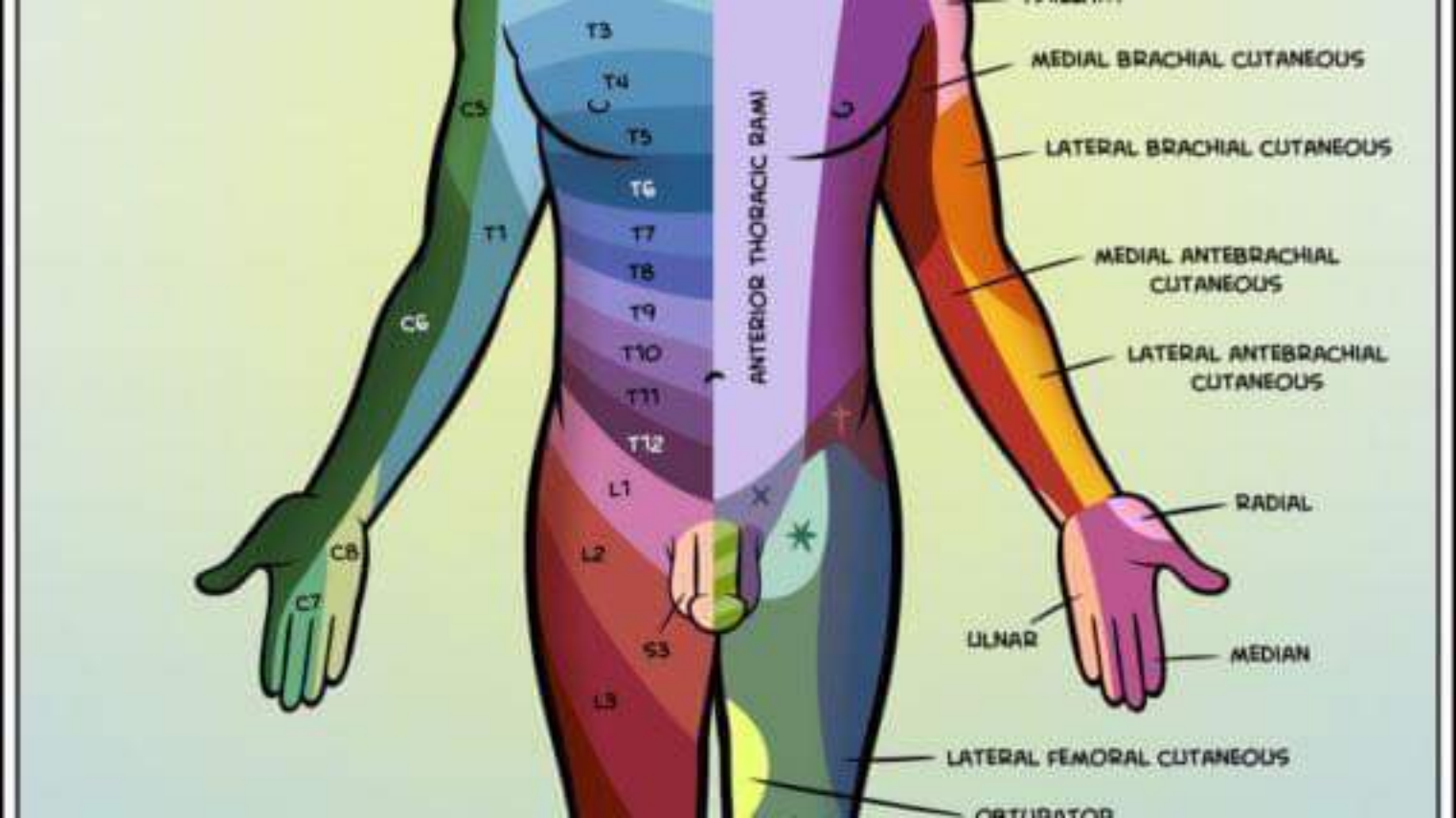


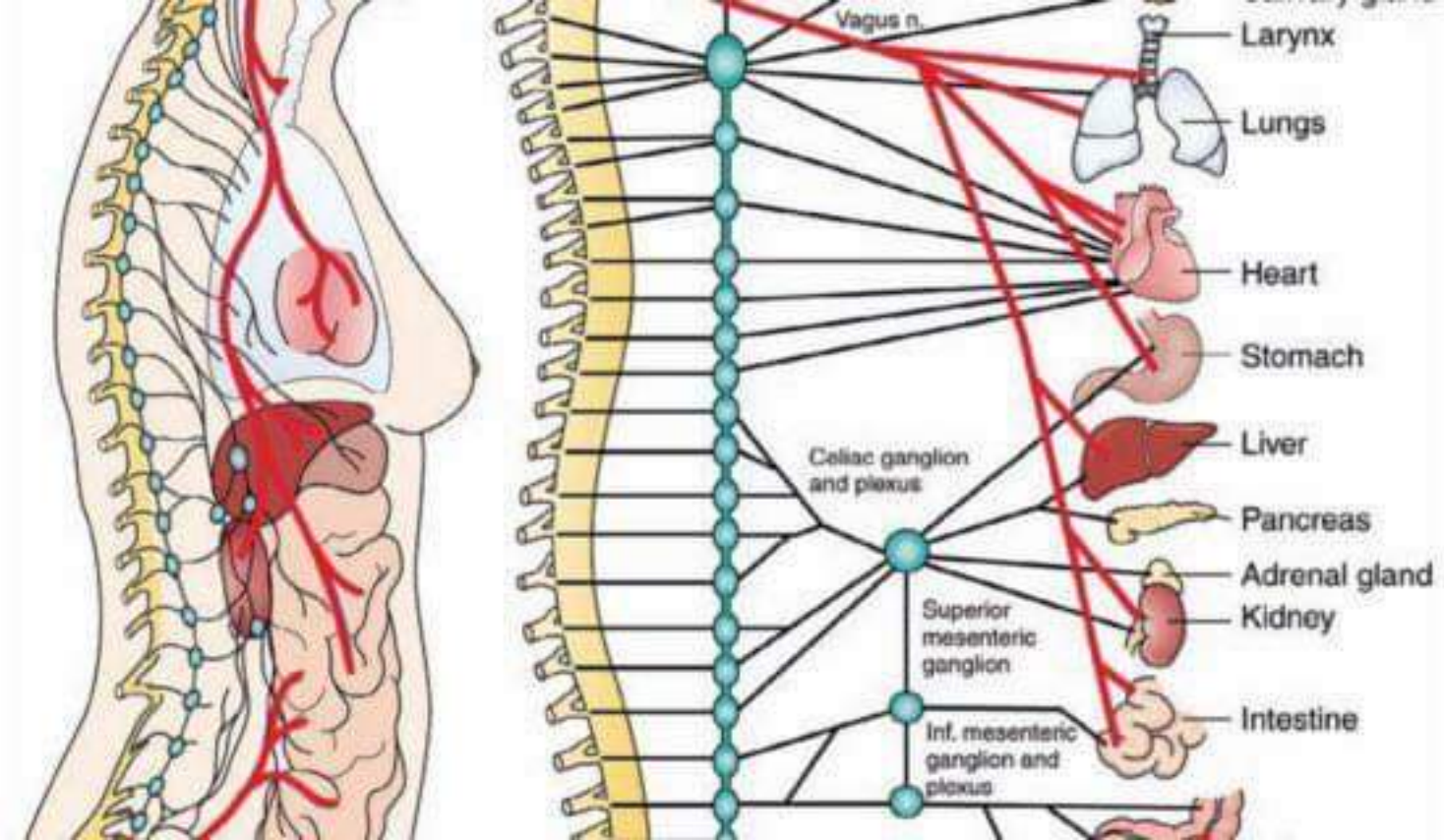

Medulla
C1
C2
C3
C4
C5
C6
C7
C8
Cervical
T1
T2
T3
T4
T5
T6
T7
T8
T9
T10
T11
T12
Thoracic
L1
L2
L3
L4
L5
Lumbar
S1
S2
Collateral ganglion
Parasympathetic ganglion
Cranial nerve IX
Cranial nerve X
Heart
Liver
Stomach
Spleen
Pancreas
Kidney
Large intestine
Small intestine
Rectum
Vagus nerve (cranial nerve X)

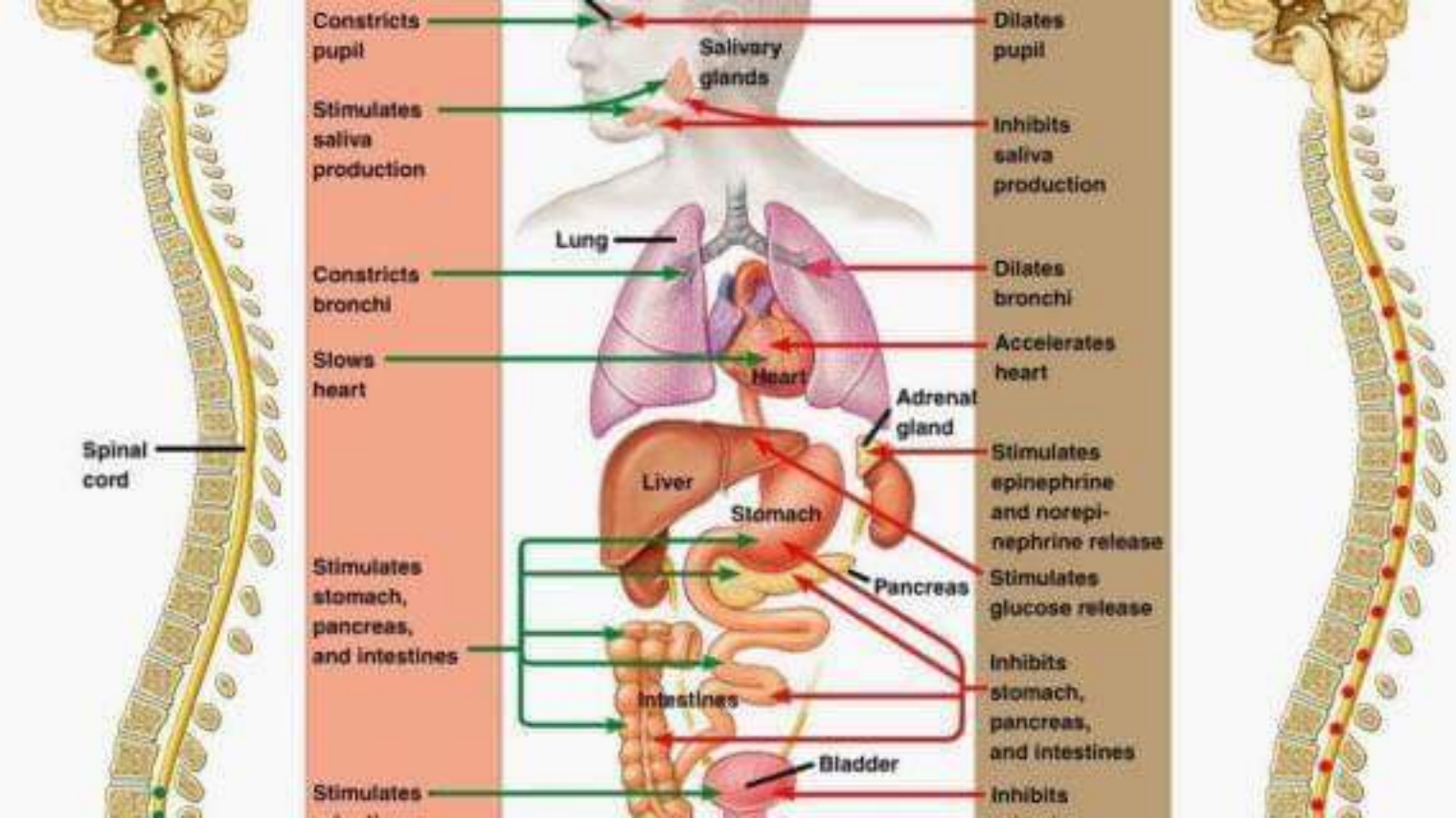
NERVOUS

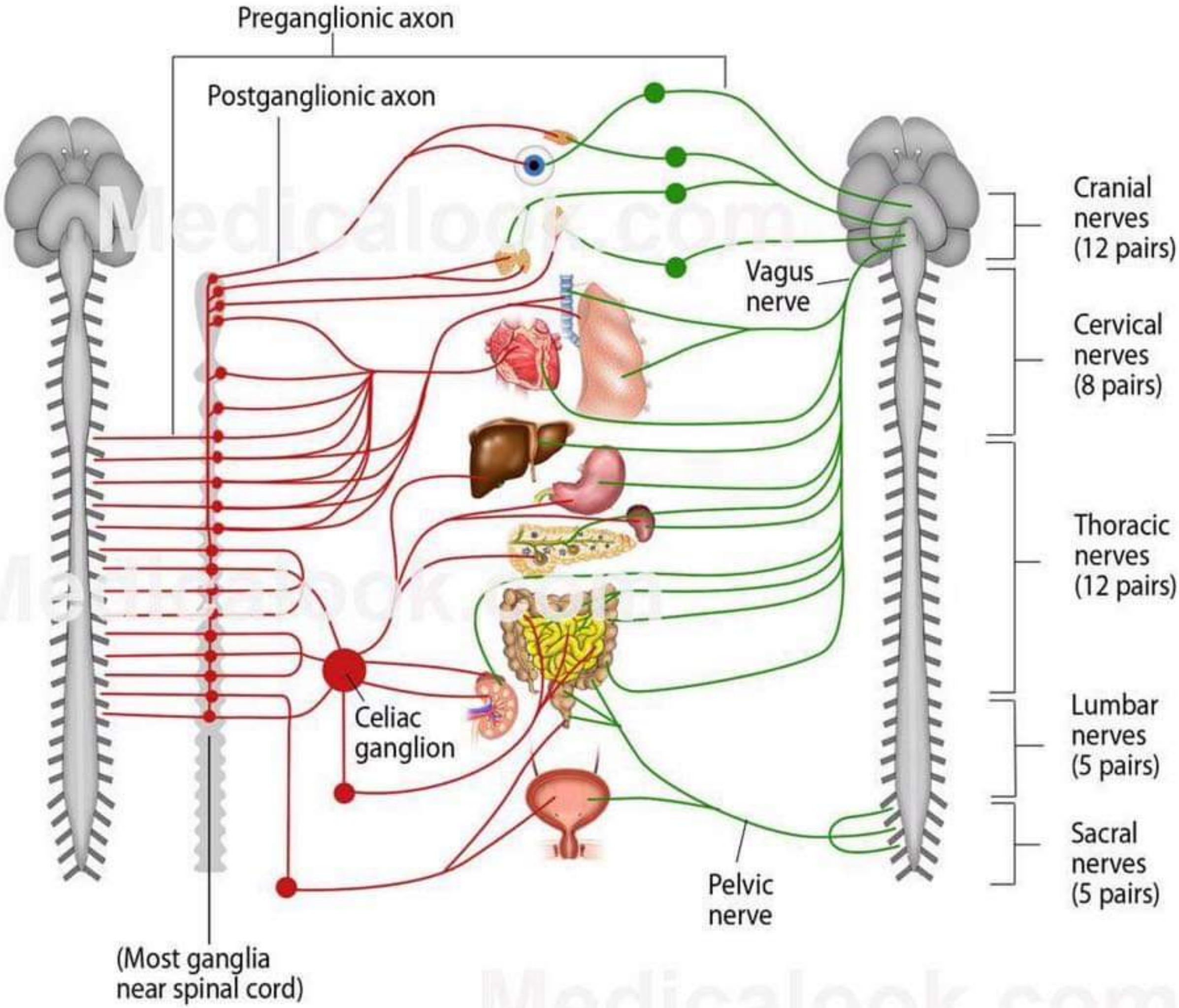


SYSTEM


T3
T4
T5
T6
T7
T8
T9
T10
T11
T12
L1
L2
L3
S3
C5
C6
C7
C8
T1
ANTERIOR THORACIC RAMI
MEDIAL BRACHIAL CUTANEOUS
LATERAL BRACHIAL CUTANEOUS
MEDIAL ANTEBRACHIAL CUTANEOUS
LATERAL ANTEBRACHIAL CUTANEOUS
RADIAL
ULNAR
MEDIAN
LATERAL FEMORAL CUTANEOUS

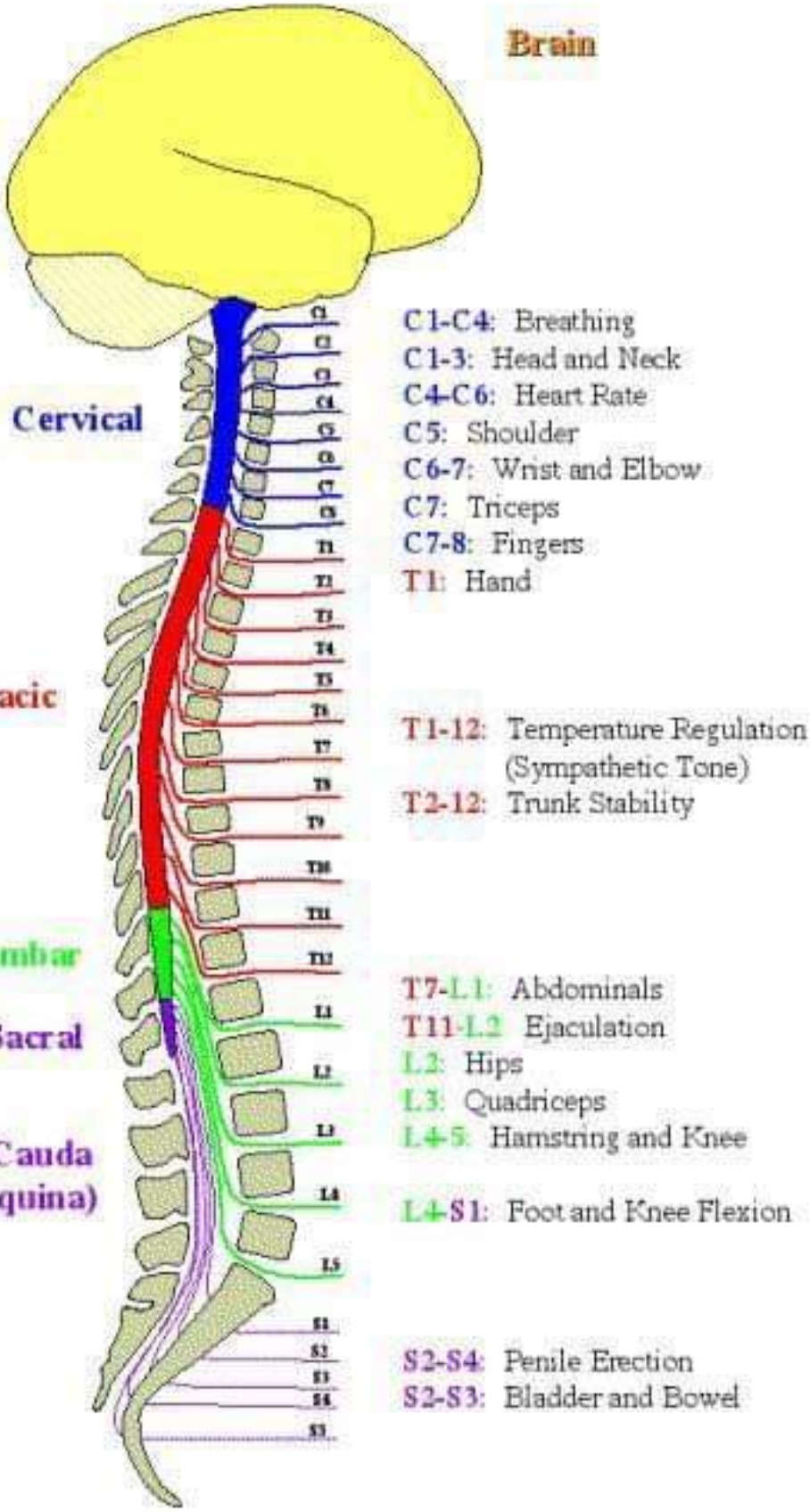

Vagus n.
Larynx
Lungs
Heart
Stomach
Liver
Celiac ganglion and plexus
Pancreas
Adrenal gland
Kidney
Superior mesenteric ganglion
Intestine
Inf. mesenteric ganglion and plexus


Constricts pupil
Dilates pupil
Salivary glands
Stimulates saliva production
Inhibits saliva production
Lung
Constricts bronchi
Dilates bronchi
Slows heart
Accelerates heart
Heart
Adrenal gland
Spinal cord
Liver
Stimulates epinephrine and norepi-nephrine release
Stomach
Pancreas
Stimulates glucose release
Stimulates stomach, pancreas, and intestines
Inhibits stomach, pancreas, and intestines
Intestines
Bladder
Stimulates
Inhibits

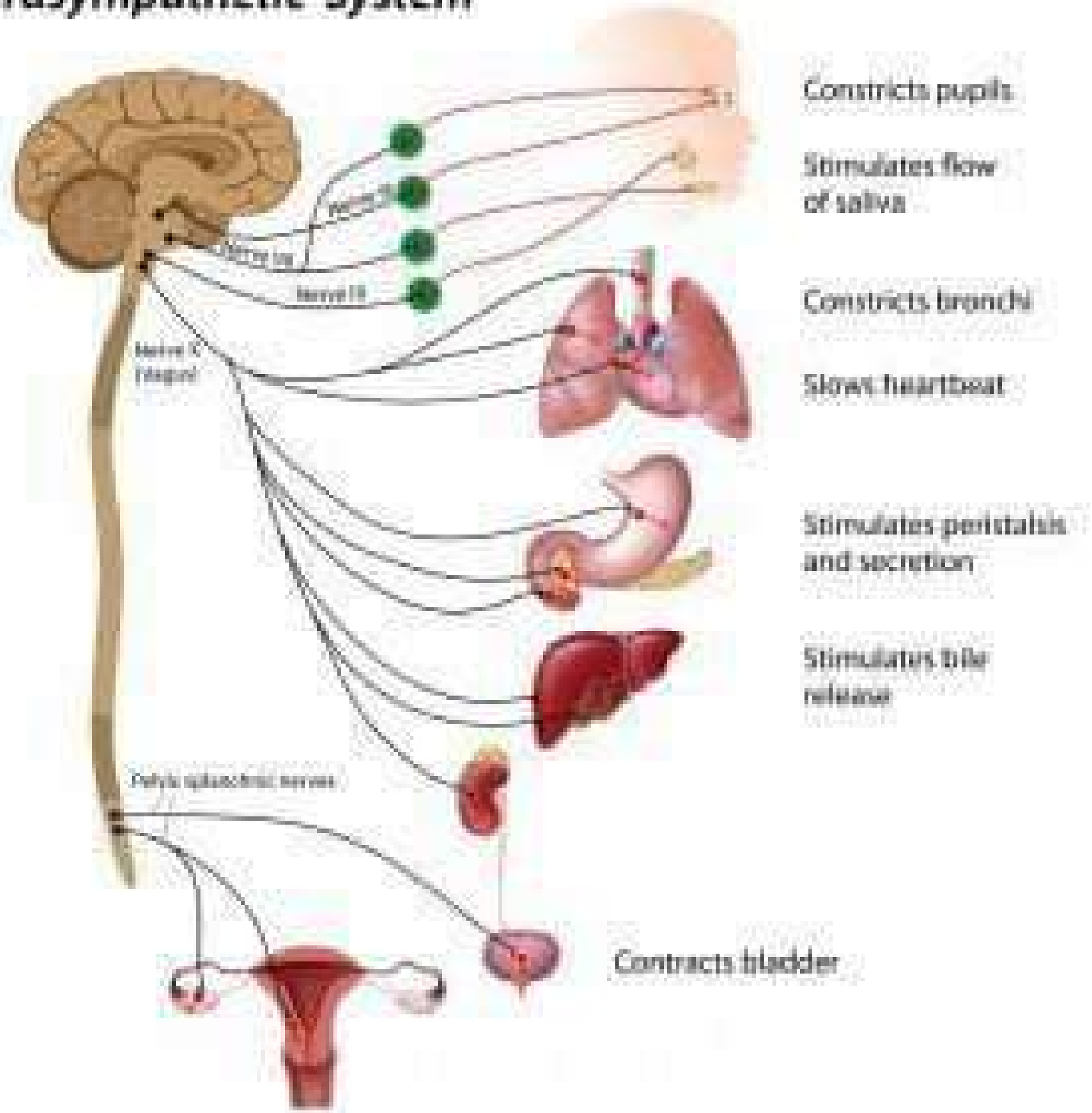


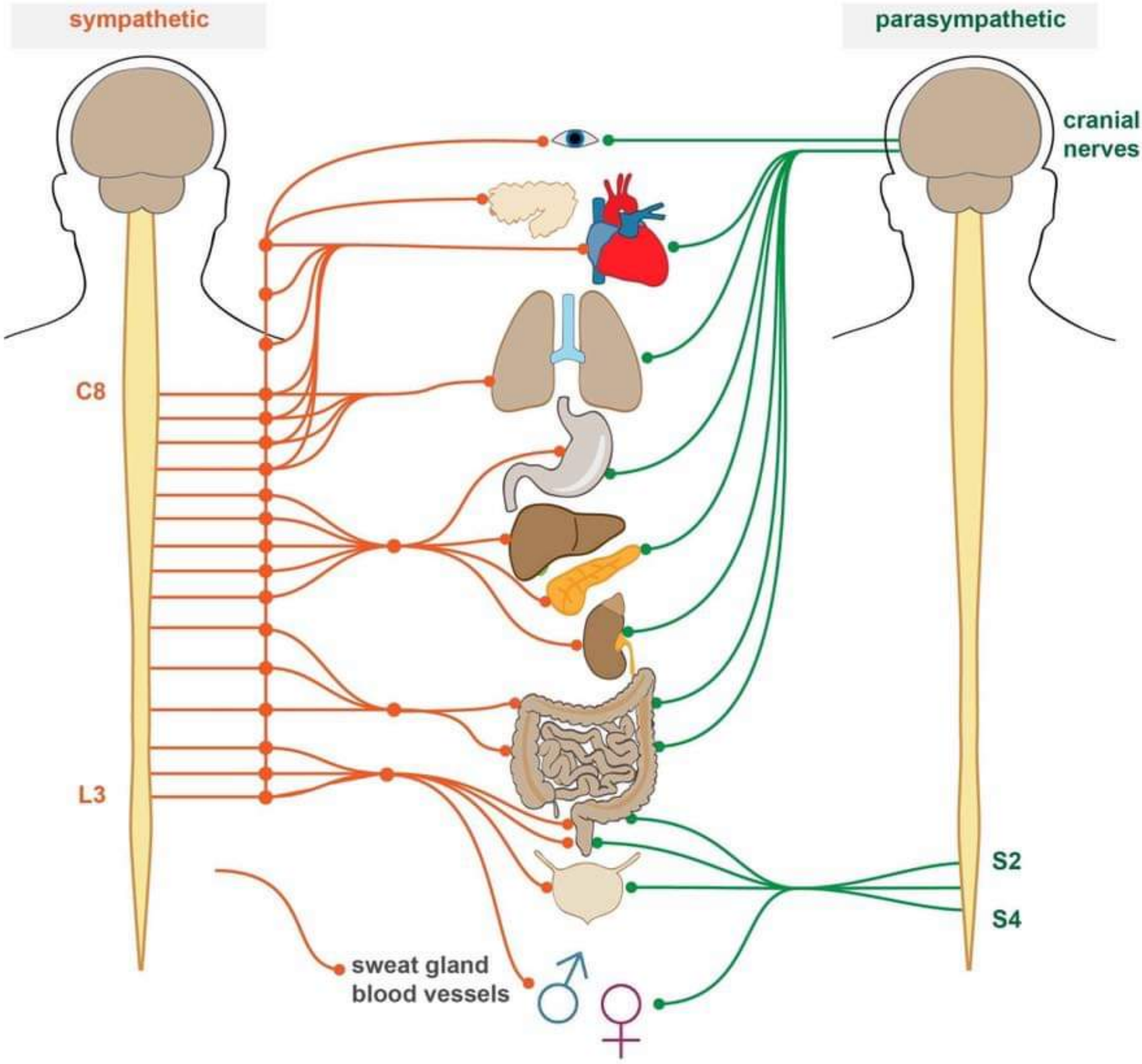
Sympathetic outflow

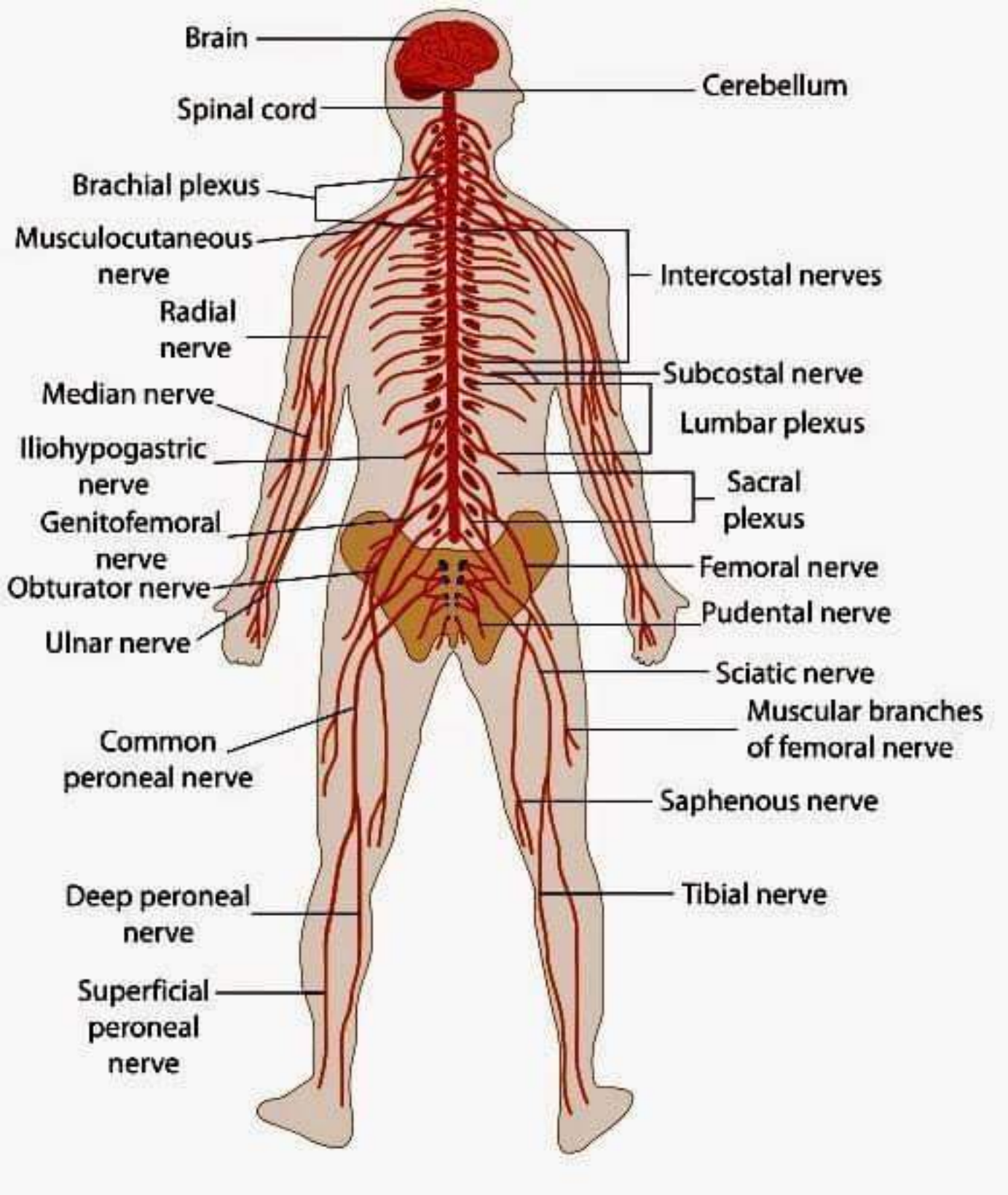
Parasympathetic outflow

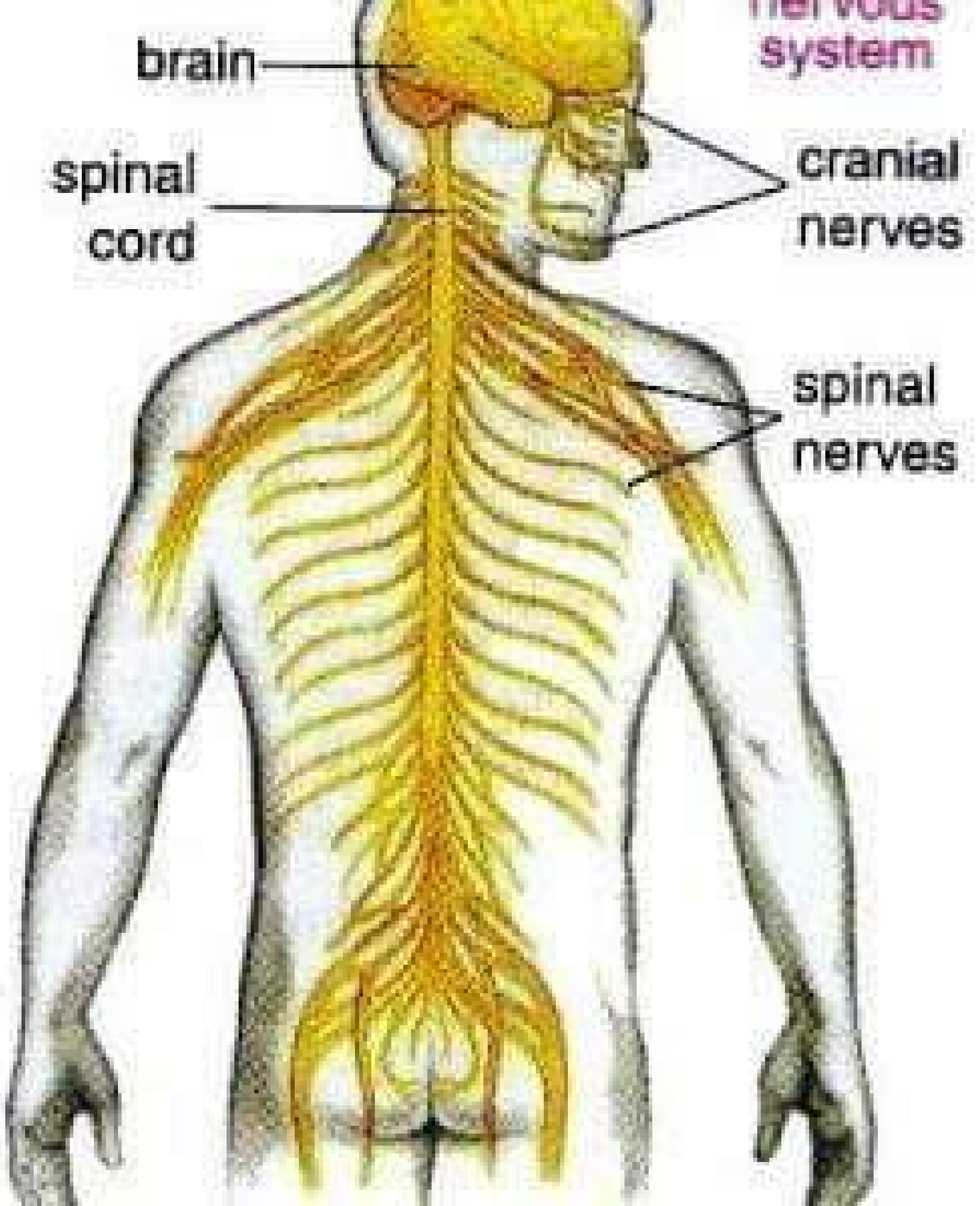

Brain
Cervical
Thoracic
Lumbar
Sacral
(Cauda Equina)
C1-C4: Breathing
C1-3: Head and Neck
C4-C6: Heart Rate
C5: Shoulder
C6-7: Wrist and Elbow
C7: Triceps
C7-8: Fingers
T1: Hand
T1-12: Temperature Regulation (Sympathetic Tone)
T2-12: Trunk Stability
T7-L1: Abdominals
T11-L2 Ejaculation
L2: Hips
L3: Quadriceps
L4-5: Hamstring and Knee
L4-S1: Foot and Knee Flexion
S2-S4: Penile Erection
S2-S3: Bladder and Bowel

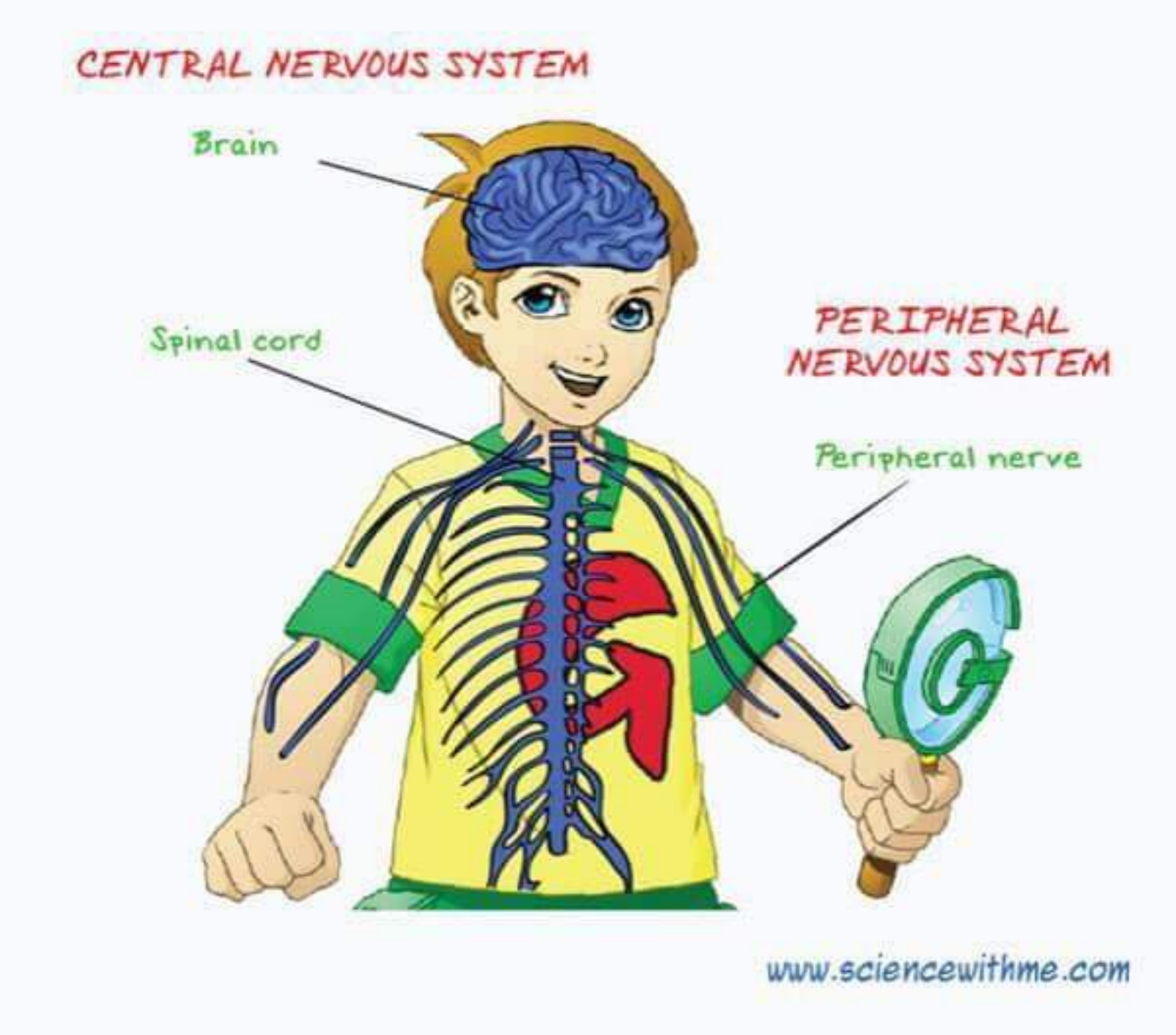
Parasympathetic System



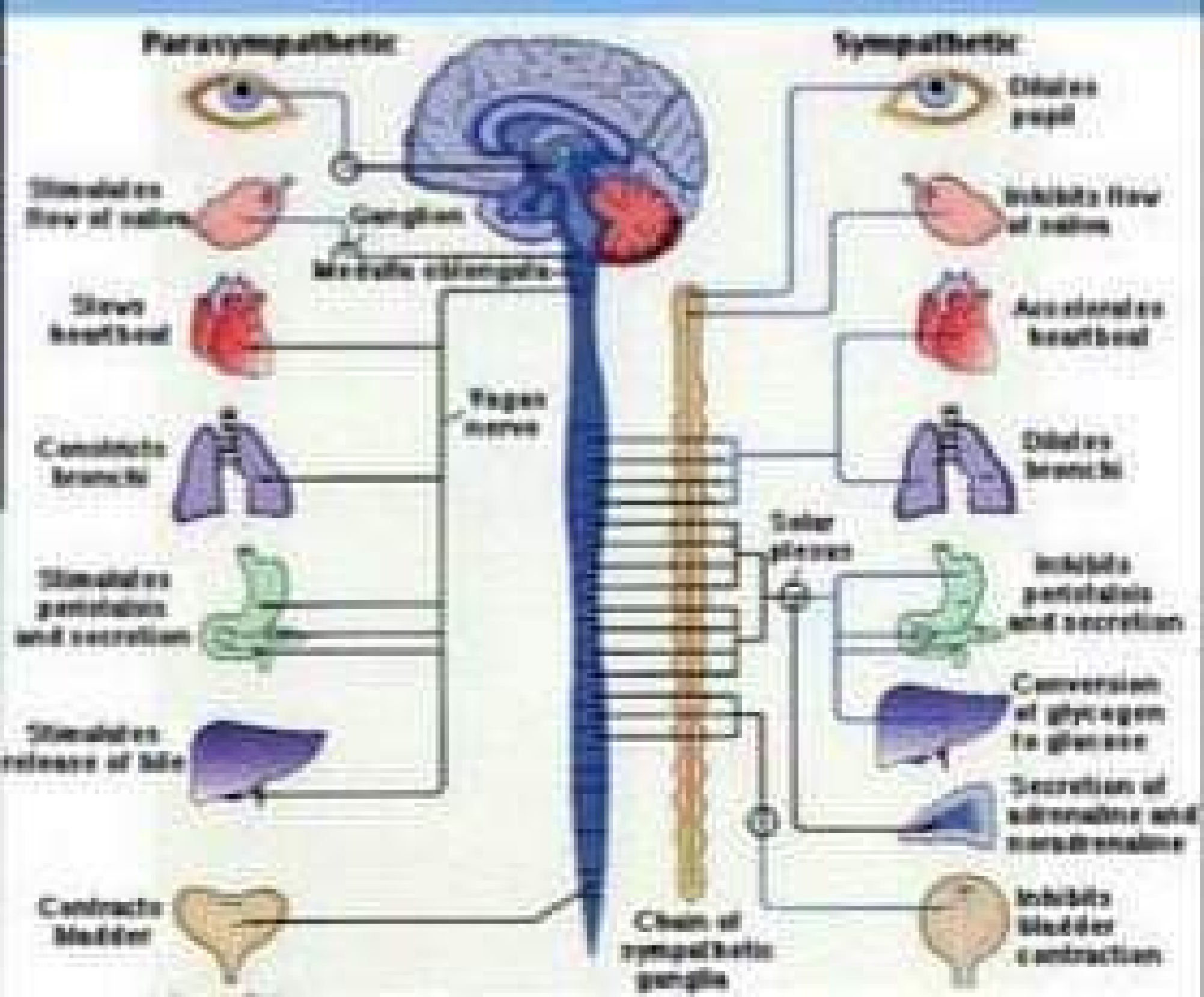

sympathetic
parasympathetic
cranial nerves
C8
L3
S2
S4
sweat gland
blood vessels


Brain
Cerebellum
Spinal cord
Brachial plexus
Musculocutaneous nerve
Intercostal nerves
Radial nerve
Subcostal nerve
Median nerve
Lumbar plexus
Iliohypogastric nerve
Sacral plexus
Genitofemoral nerve
Femoral nerve
Obturator nerve
Pudental nerve
Ulnar nerve
Sciatic nerve
Muscular branches of femoral nerve
Common peroneal nerve
Saphenous nerve
Tibial nerve
Deep peroneal nerve
Superficial peroneal nerve

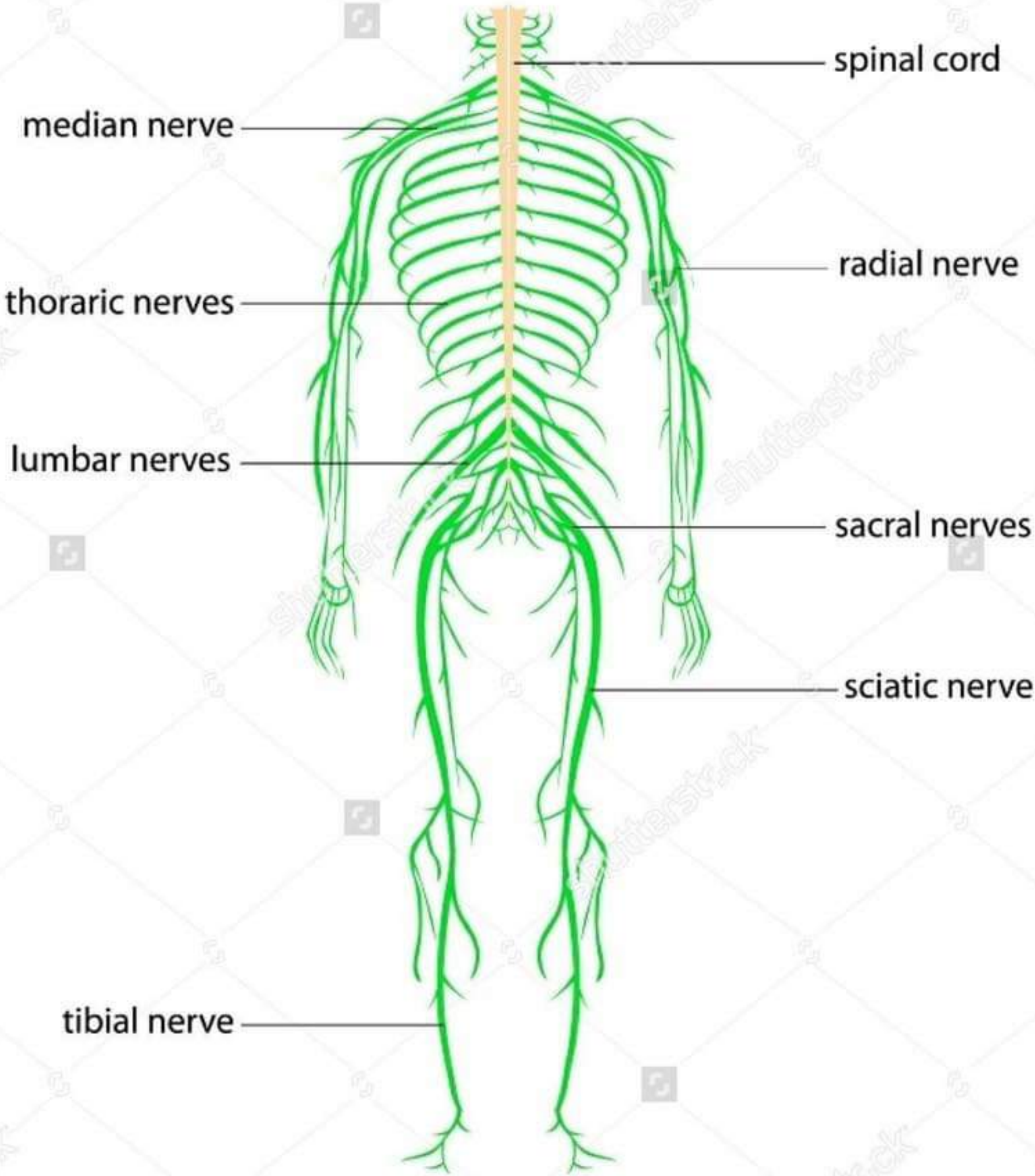

nervous system
brain
spinal cord
cranial nerves
spinal nerves


CENTRAL NERVOUS SYSTEM
Brain
Spinal cord
PERIPHERAL NERVOUS SYSTEM
Peripheral nerve
www.sciencewithme.com

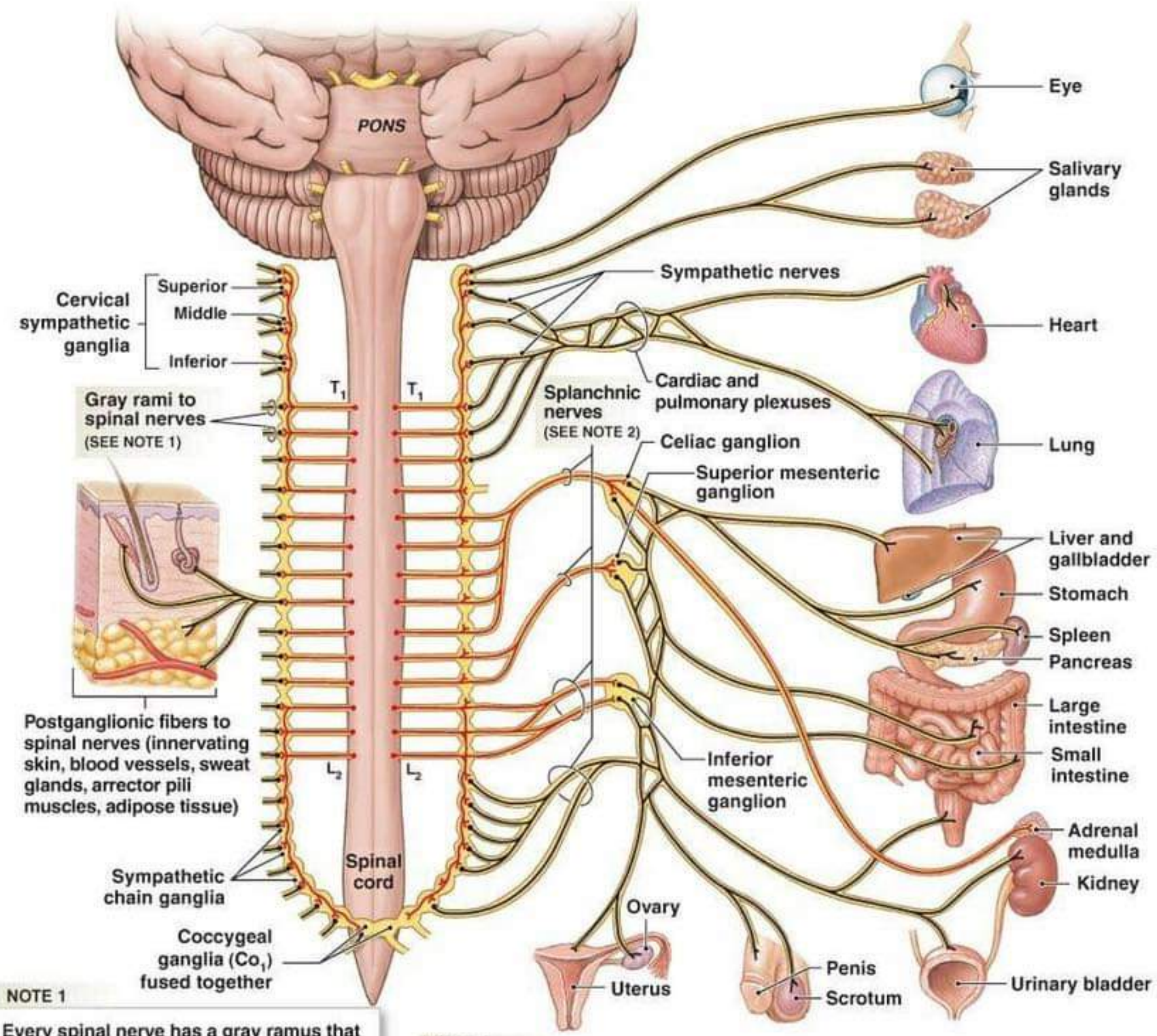
HUMAN NERVOUS SYSTEM


Parasympathetic
Sympathetic
Dilates pupil
Stimulates flow of saliva
Ganglion
Medulla oblongata
Inhibits flow of saliva
Slows heartbeat
Accelerates heartbeat
Vagus nerve
Constricts bronchi
Dilates bronchi
Solar plexus
Stimulates peristalsis and secretion
Inhibits peristalsis and secretion
Conversion of glycogen to glucose
Stimulates release of bile
Secretion of adrenaline and noradrenaline
Contracts bladder
Chain of sympathetic ganglia
Inhibits bladder contraction

Human Nervous System



The innervation of the sympathetic division: at left, the distribution of nerves to the skin, skeletal muscles, and tissues of the body wall; at right, the distribution of nerves to visceral organs



NOTE 1

Every spinal nerve has a gray ramus that carries sympathetic postganglionic fibers for distribution in the body wall and limbs. In the head and neck, postganglionic sympathetic fibers leaving the superior cervical sympathetic ganglia supply the regions innervated by cranial nerves III, VII, IX, and X.

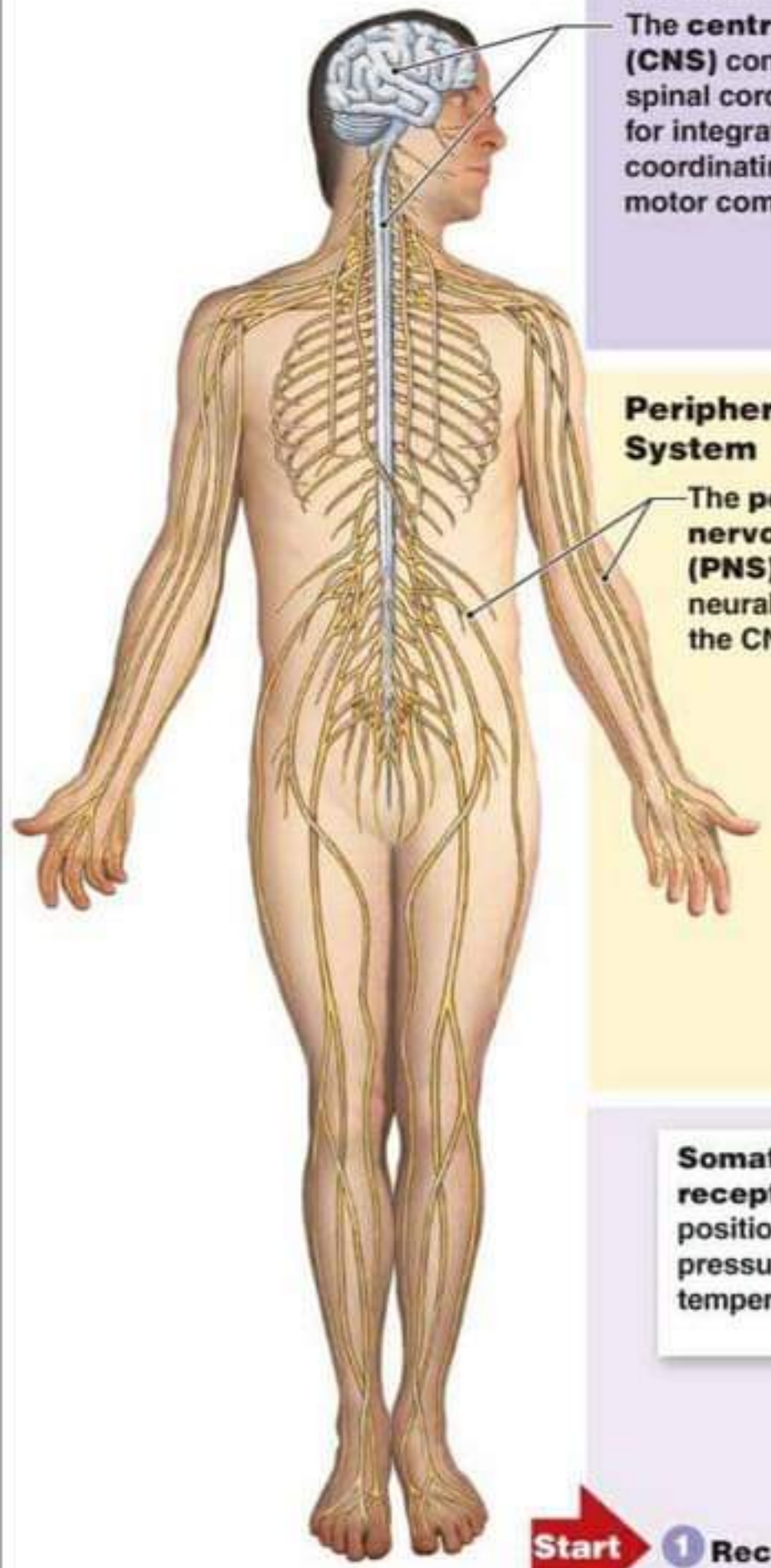
NOTE 2

Preganglionic fibers on their way to the collateral ganglia form the **splanchnic** (SPLANK-nik) **nerves**. Postganglionic fibers innervating structures in the thoracic cavity, such as the heart and lungs, form bundles known as **sympathetic nerves**.

KEY

— Preganglionic neurons
— Ganglionic neurons

The major components and functions of the nervous system



Central Nervous System

The **central nervous system (CNS)** consists of the brain and spinal cord and is responsible for integrating, processing, and coordinating sensory data and motor commands.

Peripheral Nervous System

The **peripheral nervous system (PNS)** includes all the neural tissue outside the CNS.

Start

1 **Receptors** are sensory structures that detect changes in the internal or external environment.

Somatic sensory receptors provide position, touch, pressure, pain, and temperature sensations.

Special sensory receptors provide sensations of smell, taste, vision, balance, and hearing.

Visceral sensory receptors monitor internal organs.

2 The **sensory division** of the PNS brings information to the CNS from receptors in peripheral tissues and organs.

3 **Information processing** includes the integration and distribution of information in the CNS.

4 The **motor division** of the PNS carries motor commands from the CNS to peripheral tissues and systems.

includes

The **somatic nervous system (SNS)** controls skeletal muscle contractions.

The **autonomic nervous system (ANS)** provides automatic regulation of smooth muscle, cardiac muscle, glands, and adipose tissue.

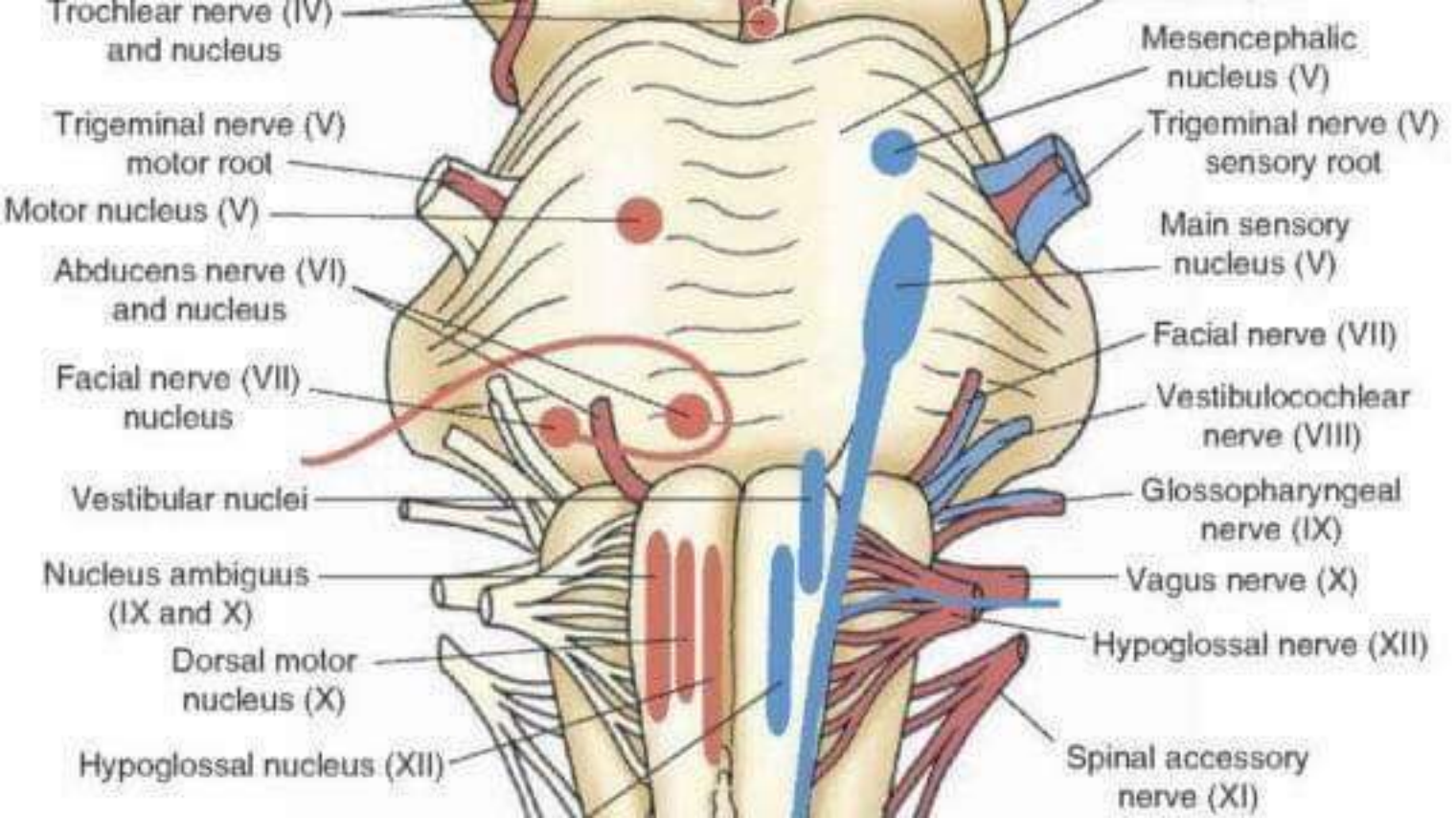
Skeletal muscle

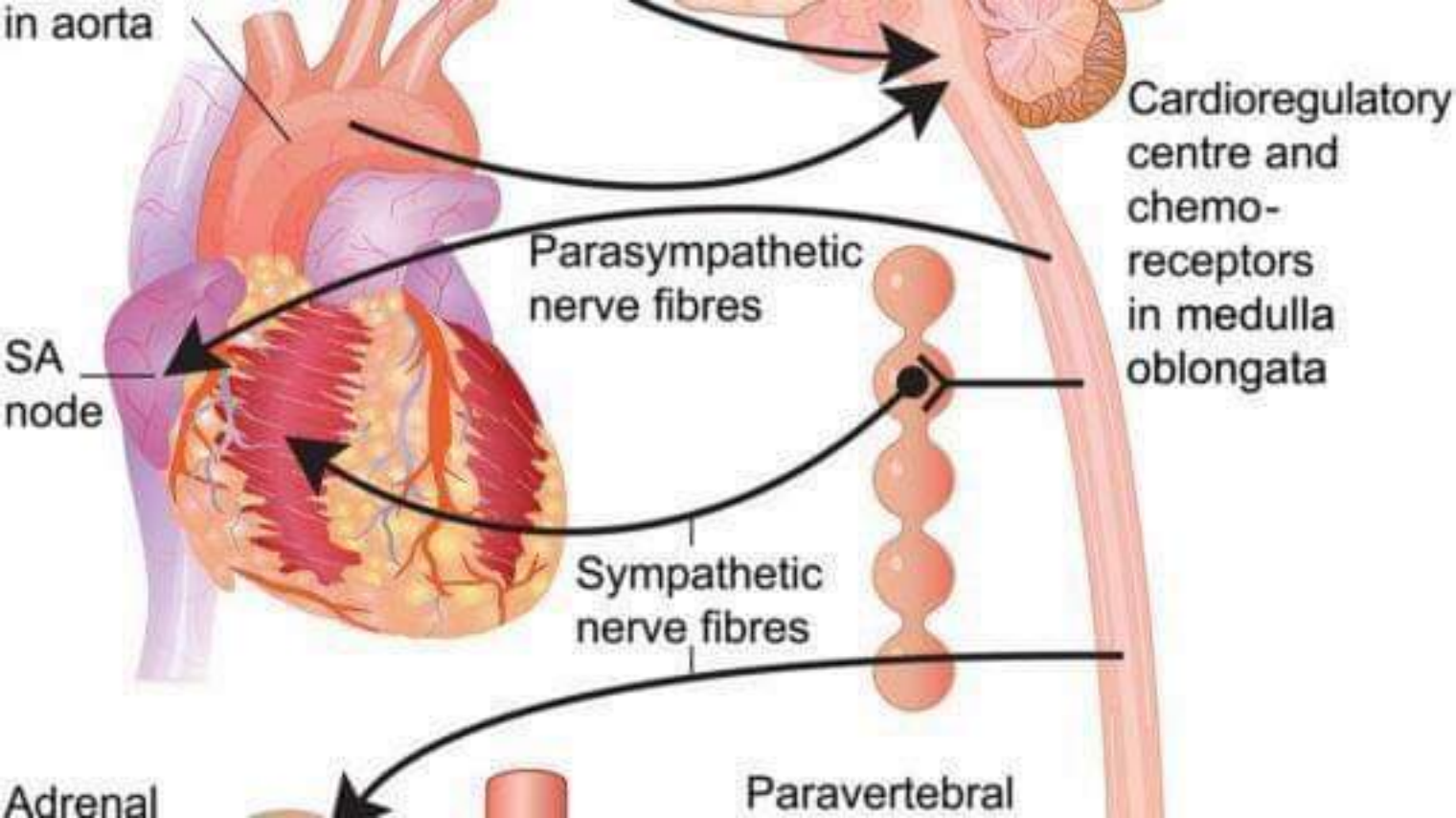
- Smooth muscle
- Cardiac muscle
- Glands
- Adipose tissue

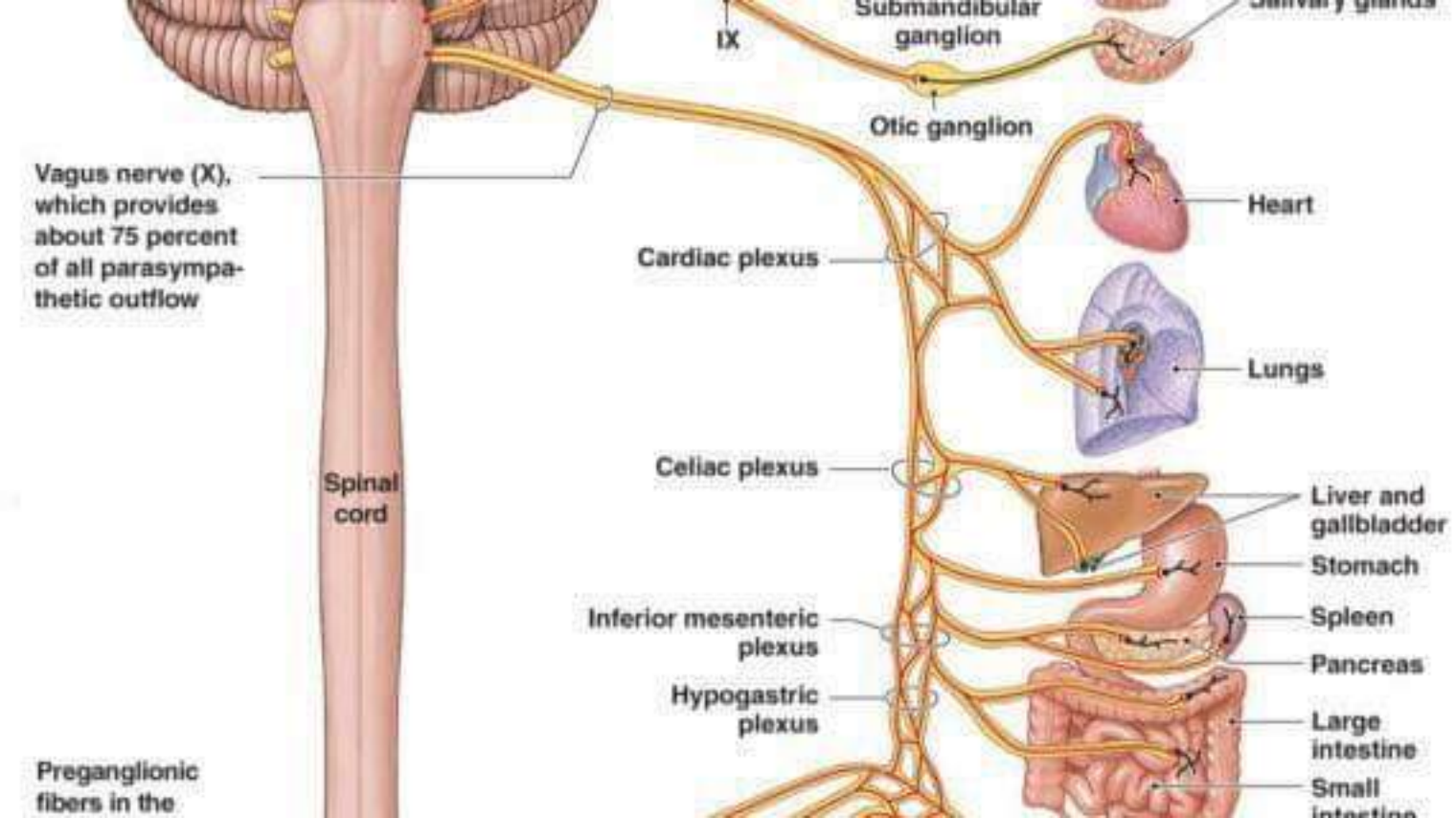
5 **Effectors** are target organs whose activities change in response to neural commands.

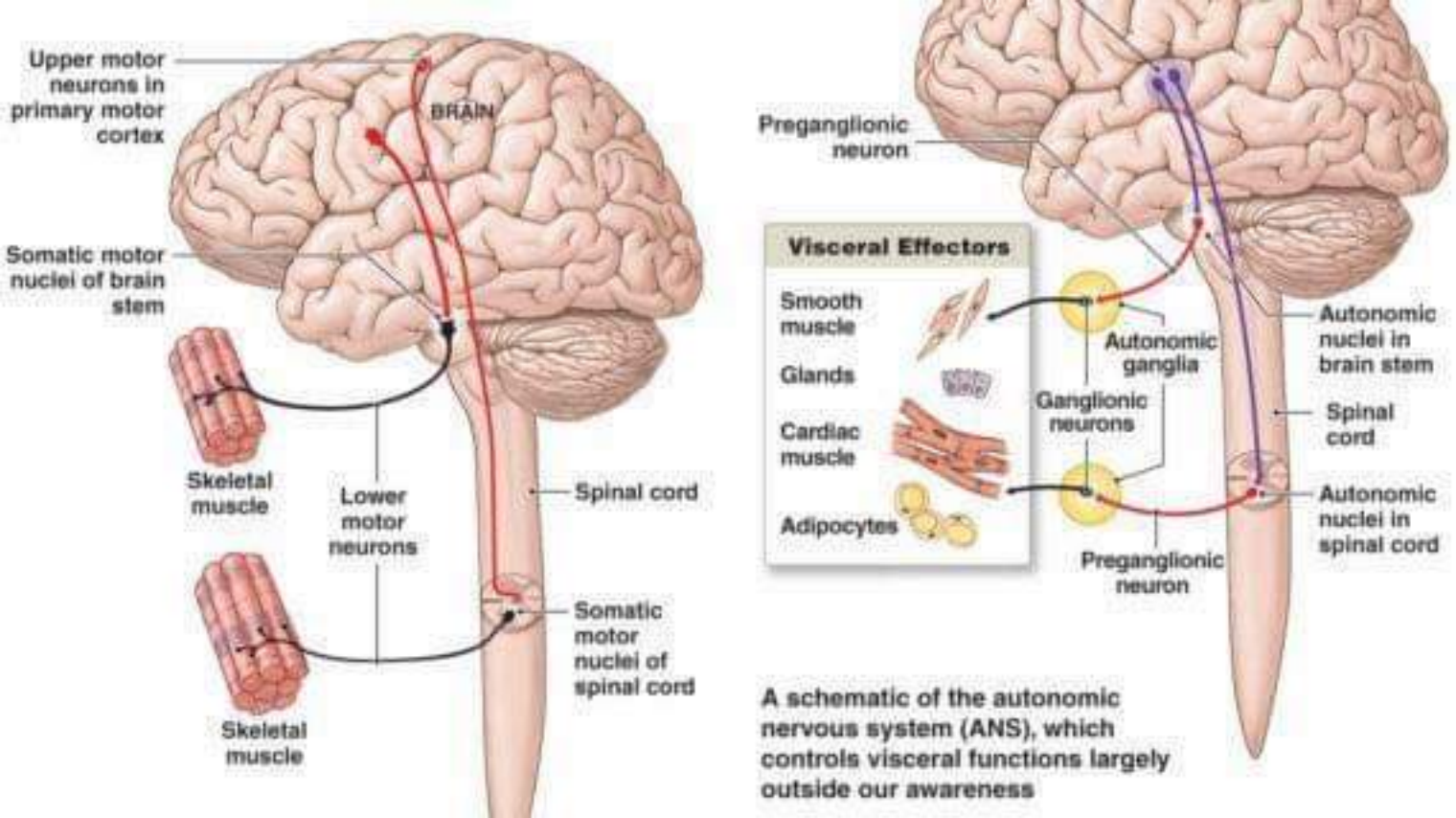

ulnar nerve
radial nerve
iliohypogastric nerve
ilioinguinal nerve
genitofemoral nerve
lateral femoral cutaneous nerve
femoral nerve
obturator nerve
superior gluteal nerve
inferior gluteal nerve
sciatic nerve
median nerve
ulnar nerve
pudendal nerve
T8
T9
T10
T11
T12
L1
L2
L3
L4
L5
S1
S2
S3
S4
S5
Co1
median nerve
ulnar nerve
radial nerve
deep branch of radial nerve
lateral cutaneous nerve of forearm
superficial branch of radial nerve
median nerve
dorsal digital nerve
ulnar nerve
tibial nerve
posterior femoral
S2, S3, S4 pudendal nerve
C5, C6, C7, C8 radial nerve
L4, L5, S1, S2, S3 sciatic nerve
C6, C7, C8 superficial branch of radial nerve
L4, L5, S1 superior gluteal nerve
L4, L5, S1, S2, S3 tibial nerve
C8, T1 ulnar nerve
II
thalamus
III
I
IV

NECK REGION	C1	Scalp, bones of the face, brain, inner and middle ear, sympathetic nervous system.	☐ High blood pressure ☐ migraine headaches ☐ nervous breakdowns ☐ amnesia ☐ chronic tiredness ☐ dizziness
	C2	Eyes, optic nerves, auditory nerves, sinuses, mastoid bones, tongue, forehead.	☐ Sinus trouble ☐ allergies ☐ pain around the eyes ☐ earache ☐ fainting spells ☐ certain cases of blindness ☐ crossed eyes ☐ deafness
	C3	Cheeks; outer ear, face bones, teeth, trifacial nerve.	☐ Neuralgia ☐ neuritis ☐ acne or pimples ☐ eczema
	C4	Nose, lips, mouth, eustachian tube.	☐ Hay fever ☐ runny nose ☐ hearing loss ☐ adenoids
	C5	Vocal cords, neck glands, pharynx.	☐ Laryngitis ☐ hoarseness ☐ throat conditions such as sore throat or quinsy
	C6	Neck muscles, shoulders, tonsils.	☐ Stiff neck ☐ pain in upper arm ☐ tonsilitis ☐ chronic cough ☐ croup
	C7	Thyroid gland, bursae in the shoulder, elbows.	☐ Bursitis ☐ colds ☐ thyroid conditions
MID-BACK	T1	Arms from the elbows down, including hands, wrists, and fingers, esophagus and trachea.	☐ Asthma ☐ cough ☐ difficult breathing ☐ shortness of breath ☐ pain in lower arms and hands
	T2	Heart, including its valves and covering, coronary arteries.	☐ Functional heart conditions and certain chest conditions
	T3	Lungs, bronchial tubes, pleura, chest, breast.	☐ Bronchitis ☐ pleurisy ☐ pneumonia ☐ congestion ☐ influenza
	T4	Gallbladder, common duct.	☐ Gallbladder conditions ☐ jaundice ☐ shingles
	T5	Liver, solar plexus, circulation (general).	☐ Liver conditions ☐ fevers ☐ blood pressure problems ☐ poor circulation ☐ arthritis
	T6	Stomach.	☐ Stomach troubles including: ☐ nervous stomach ☐ indigestion ☐ heartburn ☐ dyspepsia
	T7	Pancreas, duodenum.	☐ Ulcers ☐ gastritis
	T8	Spleen.	☐ Lowered resistance
	T9	Adrenal and suprarenal glands.	☐ Allergies ☐ hives
	T10	Kidneys.	☐ Kidney troubles ☐ hardening of the arteries ☐ chronic tiredness ☐ nephritis ☐ pyelitis
	T11	Kidneys, ureters.	☐ Skin conditions such as acne ☐ pimples ☐ eczema ☐ boils
	T12	Small intestines, lymph circulation.	☐ Rheumatism ☐ gas pains ☐ certain types of sterility
LUMBAR SPINE	L1	Large intestines, inguinal rings.	☐ Constipation ☐ colitis ☐ dysentery ☐ diarrhea ☐ severe ruptures or hernias
	L2	Appendix, abdomen, upper leg.	☐ Cramps ☐ difficult breathing ☐ minor varicose veins

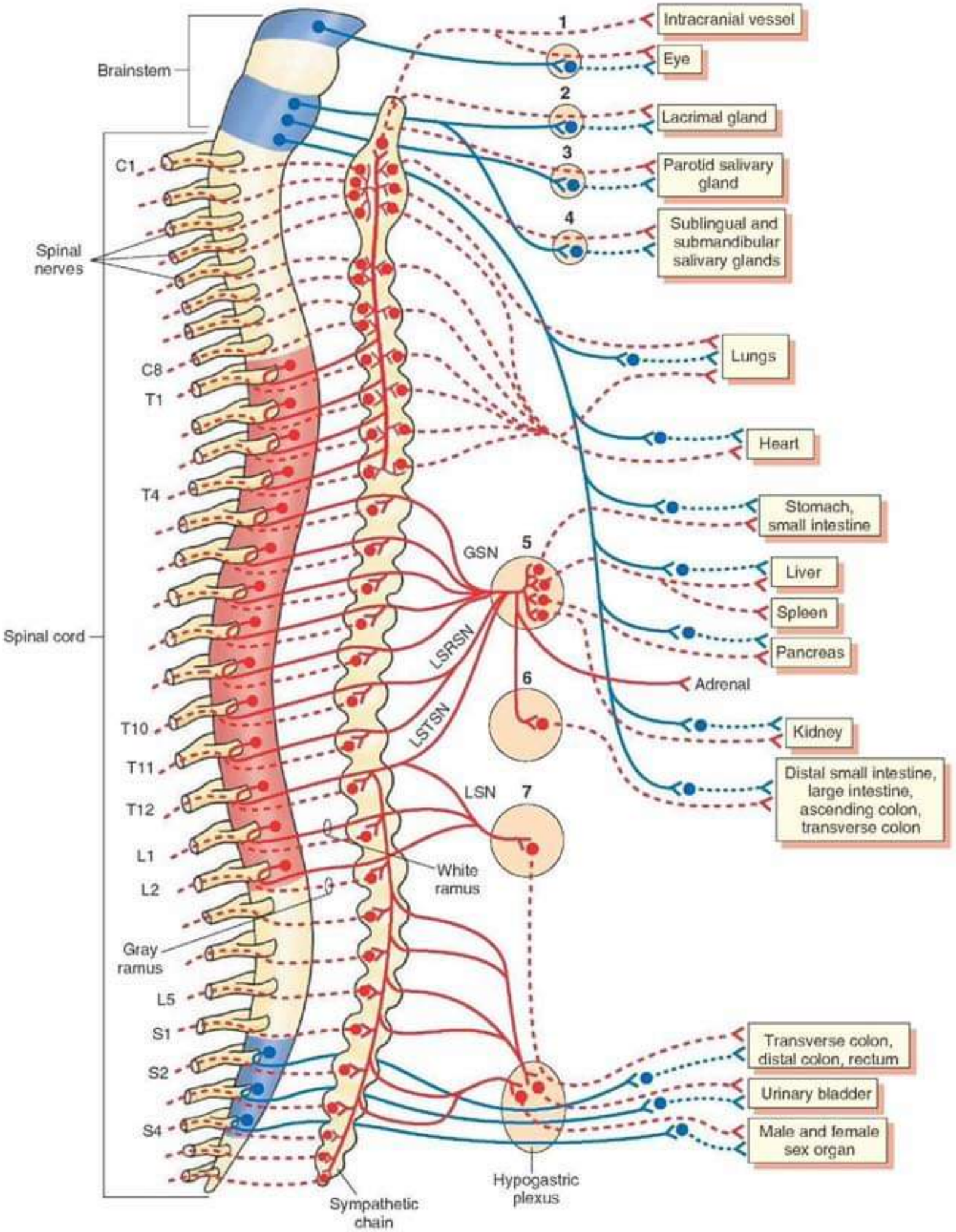

Trochlear nerve (IV) and nucleus
Trigeminal nerve (V) motor root
Motor nucleus (V)
Abducens nerve (VI) and nucleus
Facial nerve (VII) nucleus
Vestibular nuclei
Nucleus ambiguus (IX and X)
Dorsal motor nucleus (X)
Hypoglossal nucleus (XII)
Mesencephalic nucleus (V)
Trigeminal nerve (V) sensory root
Main sensory nucleus (V)
Facial nerve (VII)
Vestibulocochlear nerve (VIII)
Glossopharyngeal nerve (IX)
Vagus nerve (X)
Hypoglossal nerve (XII)
Spinal accessory nerve (XI)


in aorta
Cardioregulatory centre and chemo-receptors in medulla oblongata
Parasympathetic nerve fibres
SA node
Sympathetic nerve fibres
Adrenal
Paravertebral


IX
Submandibular ganglion
Salivary glands
Otic ganglion
Vagus nerve (X), which provides about 75 percent of all parasympathetic outflow
Heart
Cardiac plexus
Lungs
Spinal cord
Celiac plexus
Liver and gallbladder
Stomach
Inferior mesenteric plexus
Spleen
Pancreas
Hypogastric plexus
Large intestine
Small intestine
Preganglionic fibers in the



A schematic of the autonomic nervous system (ANS), which controls visceral functions largely outside our awareness



Sympathetic fibers — Preganglionic
Parasympathetic fibers — Postganglionic

Ganglia:

1 = Ciliary
2 = Pterygopalatine
3 = Otic
4 = Submandibular
5 = Celiac
6 = Superior mesenteric
7 = Inferior mesenteric

Nerves:

GSN = Greater splanchnic nerve
LSRSN = Lesser splanchnic nerve
LSTSN = Least splanchnic nerve
LSN = Lumbar splanchnic nerve

and Parasympathetic Divisions

Come from different regions of the CNS

- **Sympathetic**—from the **thoracolumbar** region
- **Parasympathetic**—from the **craniosacral** region

Differing locations of ganglia

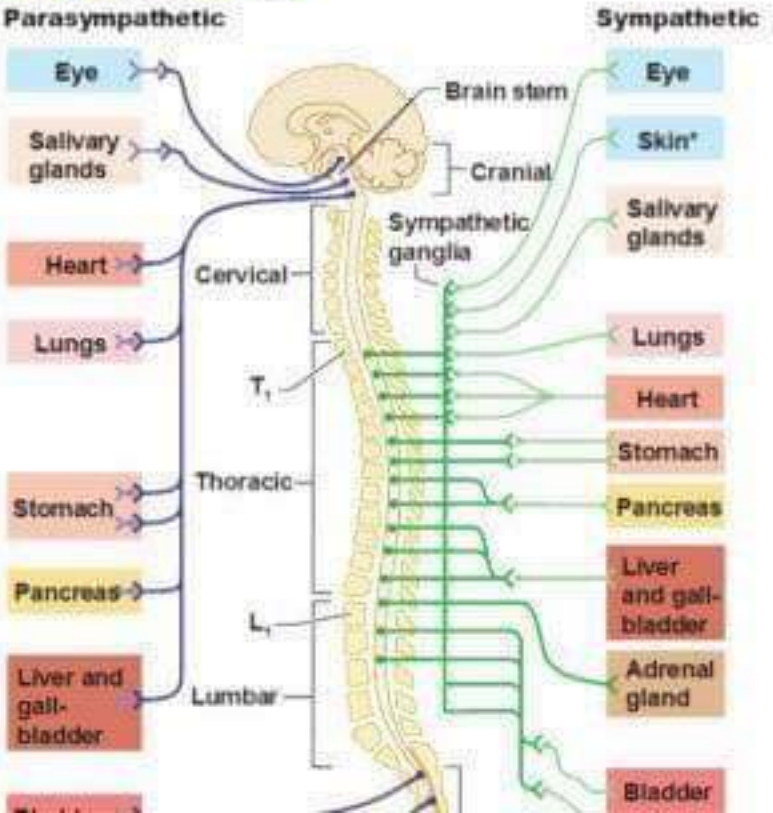
- Sympathetic – close to spinal cord in a chain
- Parasympathetic – close to target organs

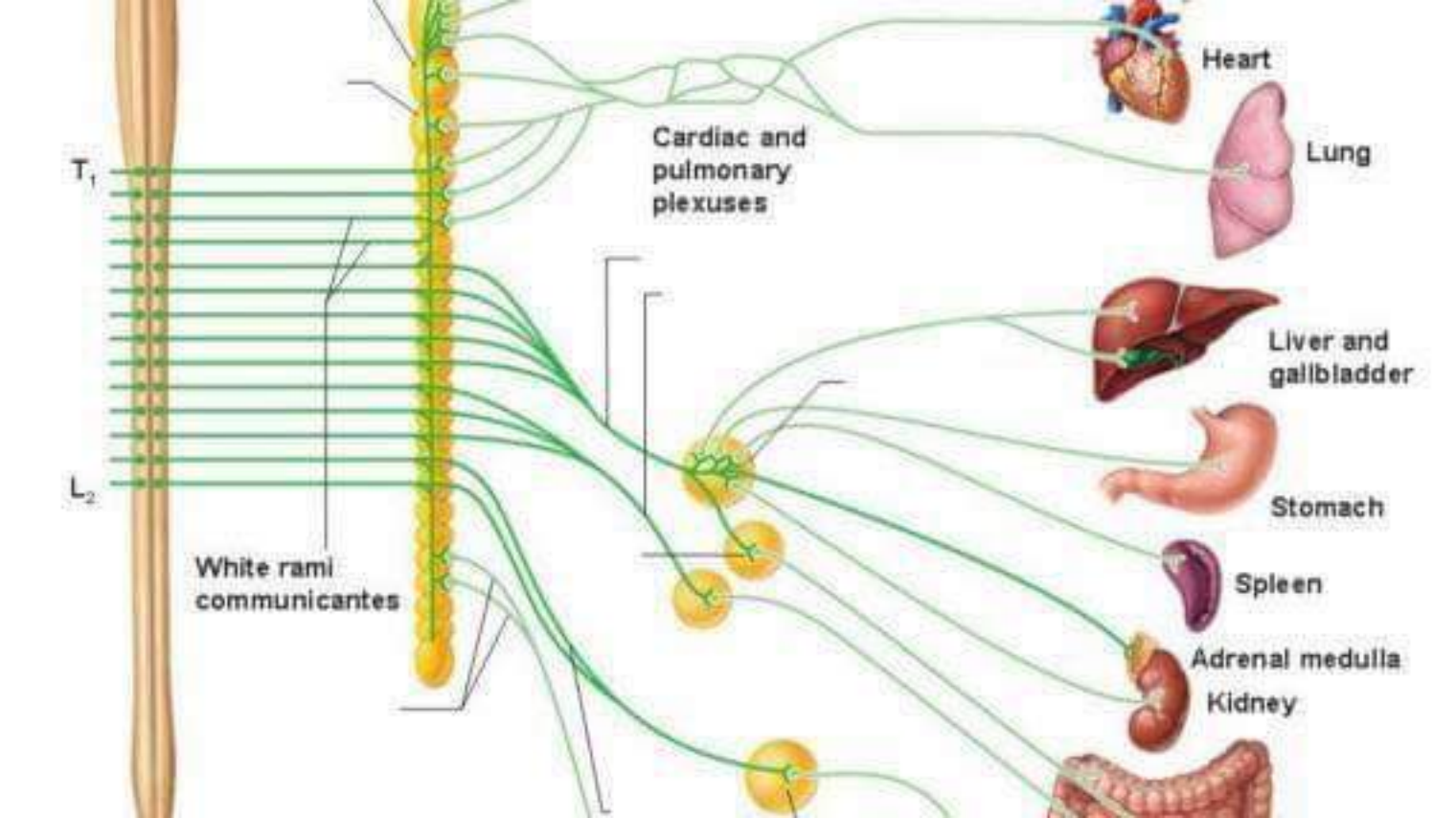
Differing lengths of *postganglionic* fibers

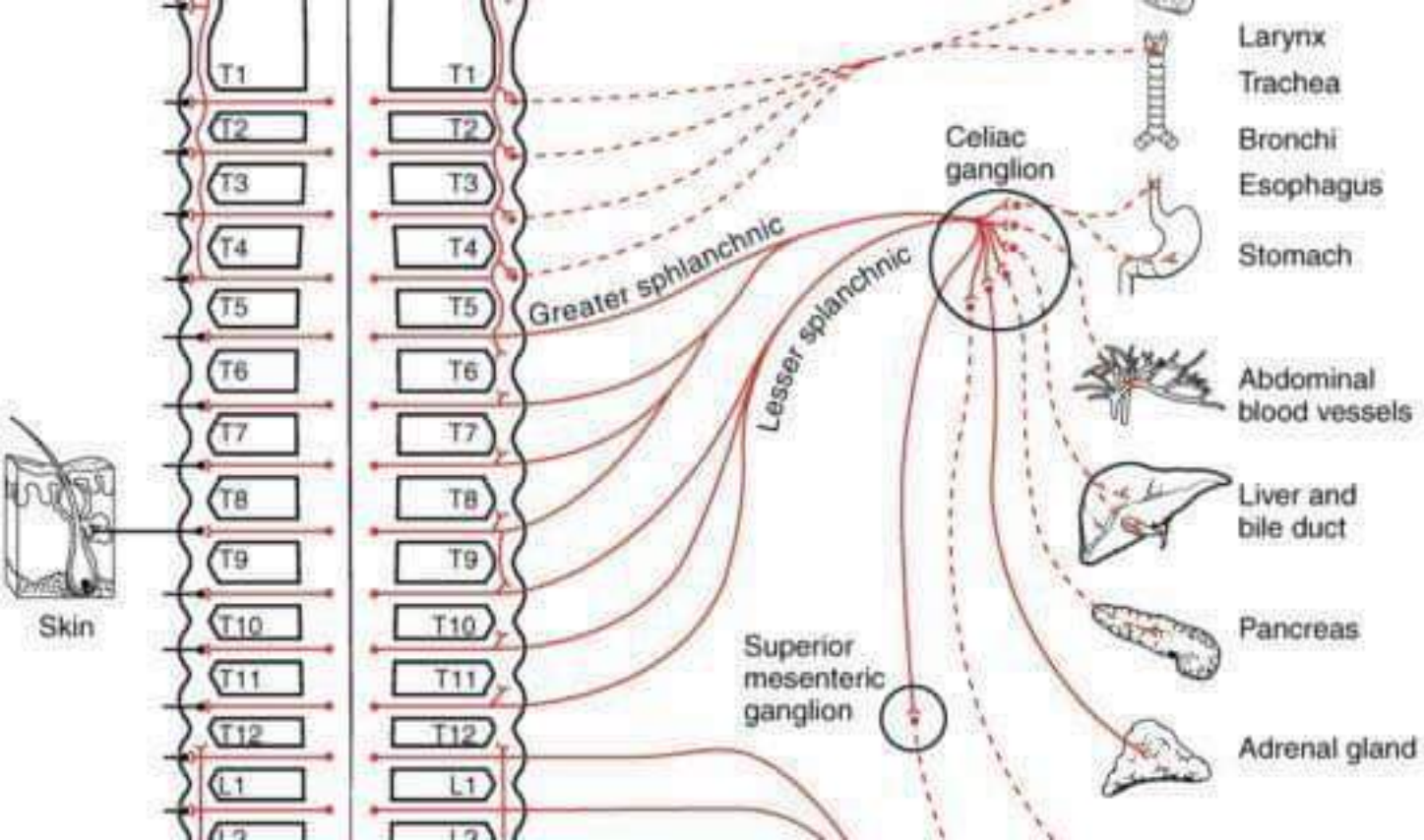
- Sympathetic – Long
- Parasympathetic – Short

Postganglionic branching

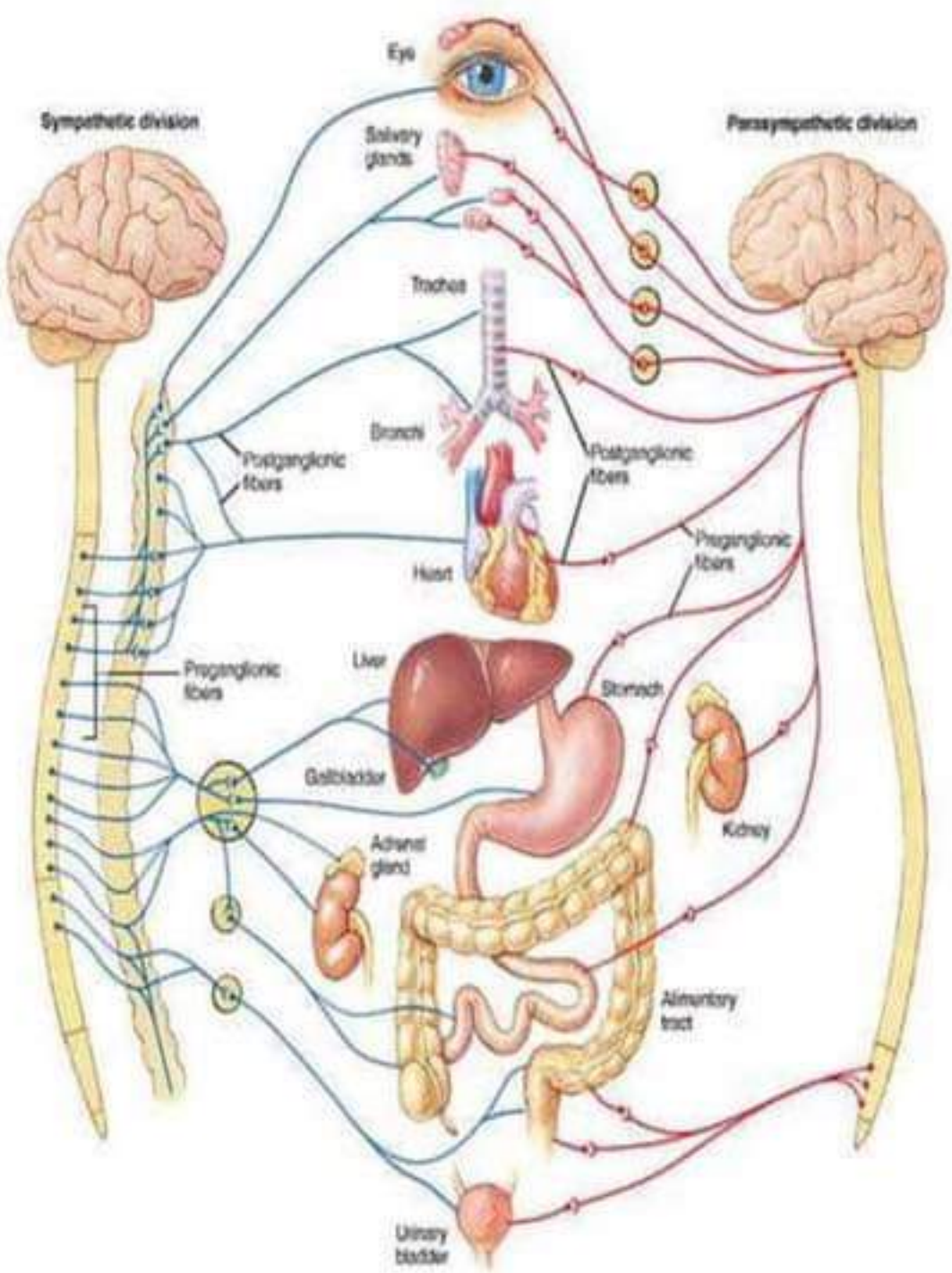
- Sympathetic – lots, so that multiple organs can be mobilized at once
- Parasympathetic – very little branching

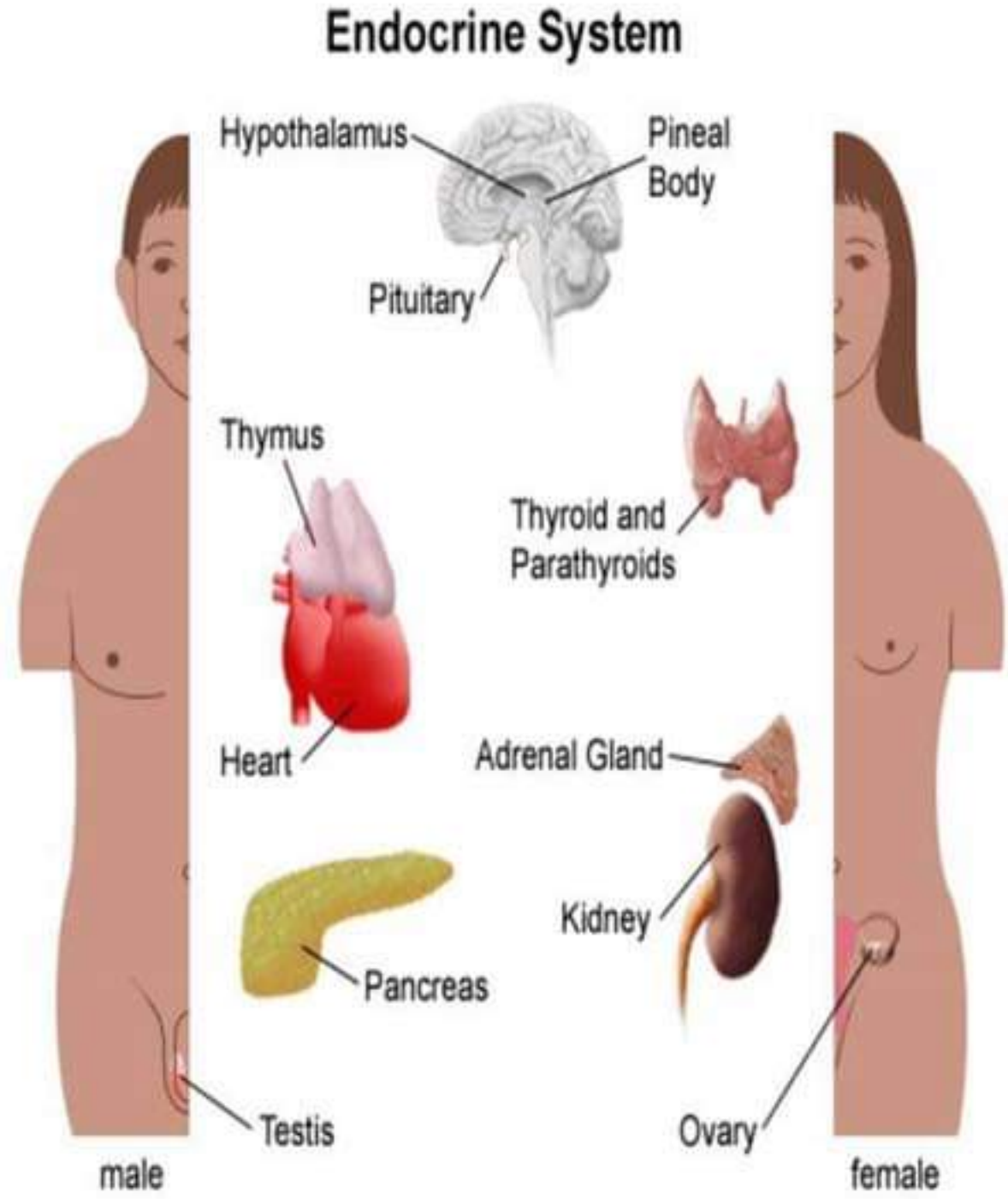



T1
L2
White rami communicantes
Cardiac and pulmonary plexuses
Heart
Lung
Liver and gallbladder
Stomach
Spleen
Adrenal medulla
Kidney


T1
T2
T3
T4
T5
T6
T7
T8
T9
T10
T11
T12
L1
L2
Skin
Greater splanchnic
Lesser splanchnic
Celiac ganglion
Superior mesenteric ganglion
Larynx
Trachea
Bronchi
Esophagus
Stomach
Abdominal blood vessels
Liver and bile duct
Pancreas
Adrenal gland

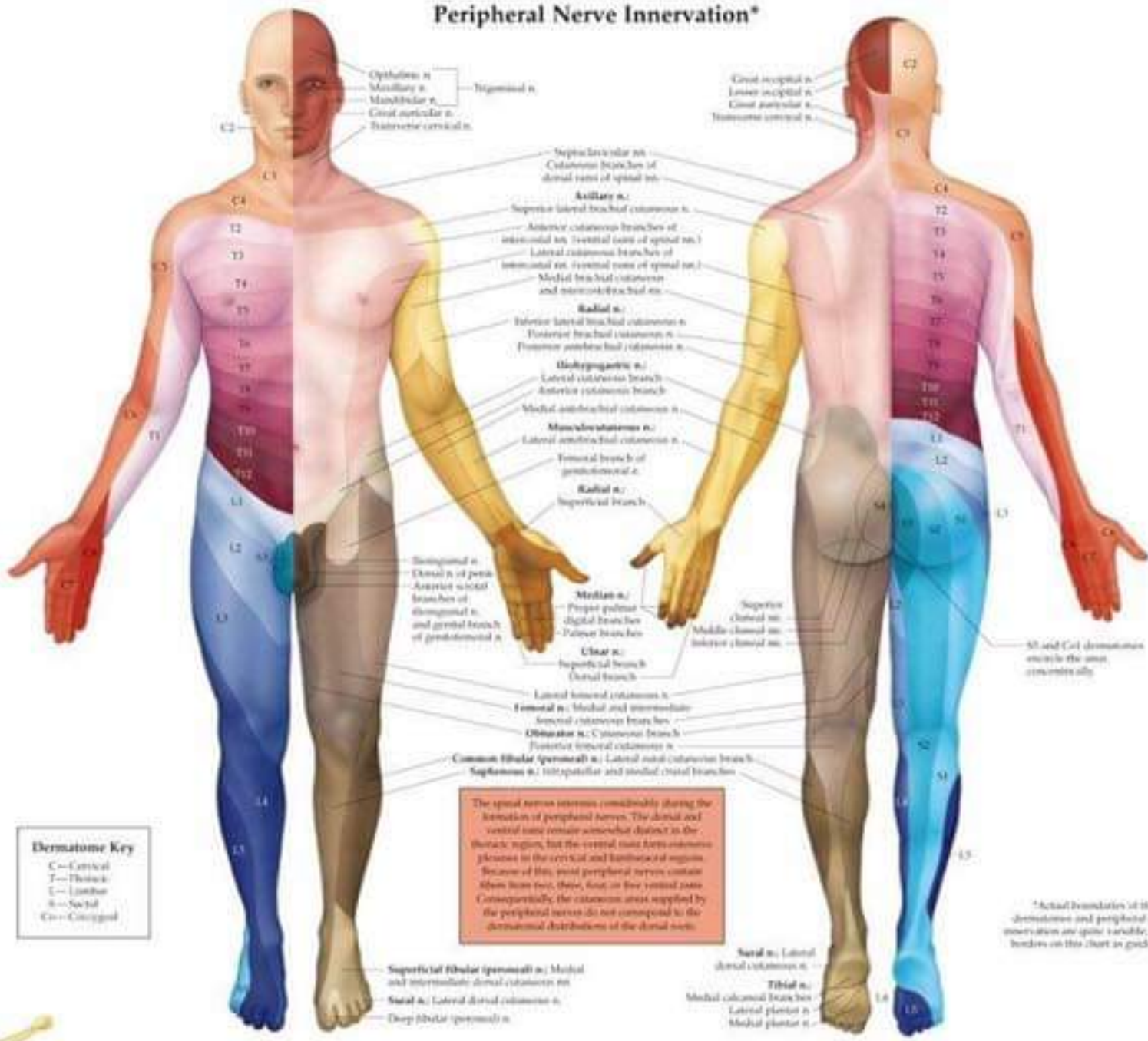
Nervous & Endocrine Systems





DERMATOMES

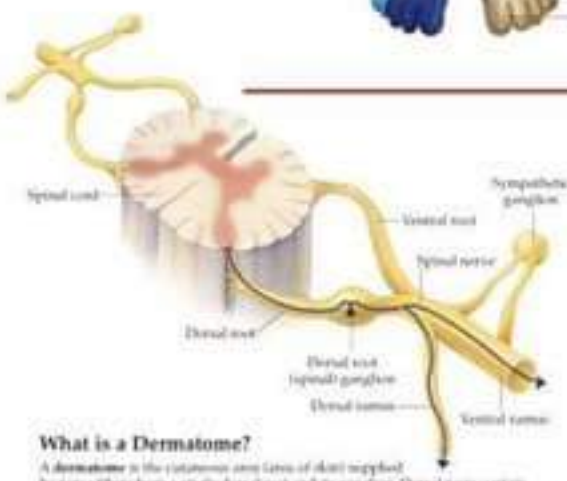
Cutaneous Areas of Peripheral Nerve Innervation*



The spinal nerves innervate considerably during the formation of peripheral nerves. The dorsal and ventral rami remain somewhat distinct in the thoracic region, but the ventral rami form extensive plexuses in the cervical and lumbosacral regions. Because of this, most peripheral nerves contain fibers from two, three, four, or five ventral rami. Consequently, the cutaneous areas supplied by the peripheral nerves do not correspond to the dermatomal distributions of the dorsal roots.

Dermatome Key
C—Cervical
T—Thoracic
L—Lumbar
S—Sacral
Co—Coccygeal

*Actual boundaries of the dermatomes and peripheral nerve innervation are quite variable; use the borders on this chart as guidelines.



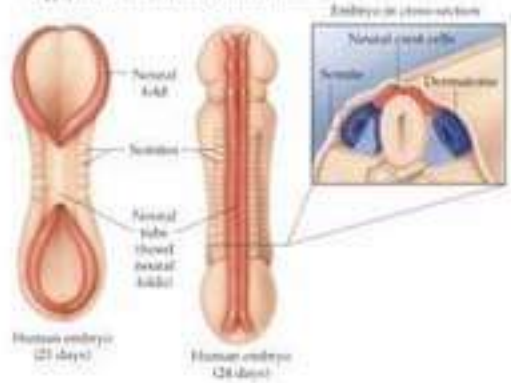
What is a Dermatome?

A **dermatome** is the cutaneous area (area of skin) supplied by nerve fibers from a single dorsal root and its ganglion. Dorsal roots contain afferent fibers, which carry sensory information from a source, such as the skin, to the spinal cord and brain. Dorsal roots join the ventral roots to form spinal nerves at every vertebral level of the spinal cord. From this point, nerve fibers from the dorsal roots disperse ventrally and dorsally to supply an entire segment of skin. In the torso, these segments, the dermatomes, form consecutive bands.

The dermatome map is an important diagnostic tool, especially concerning disorders of the peripheral nervous system. Any condition leading to symptoms, such as numbness, affecting specific dermatomes can be linked to the dorsal roots. Nerve fibers from each dorsal root spread out significantly, causing the dermatomes to overlap each other. Because most dermatomes are supplied by fibers of three or four dorsal roots, three consecutive nerve roots have to be damaged before the sensation of an entire dermatome is affected.

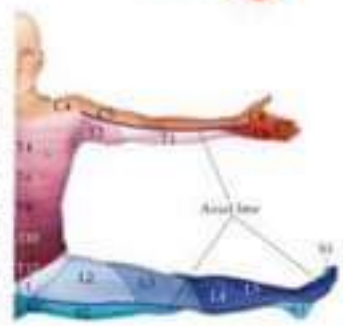
Development of Dermatomes

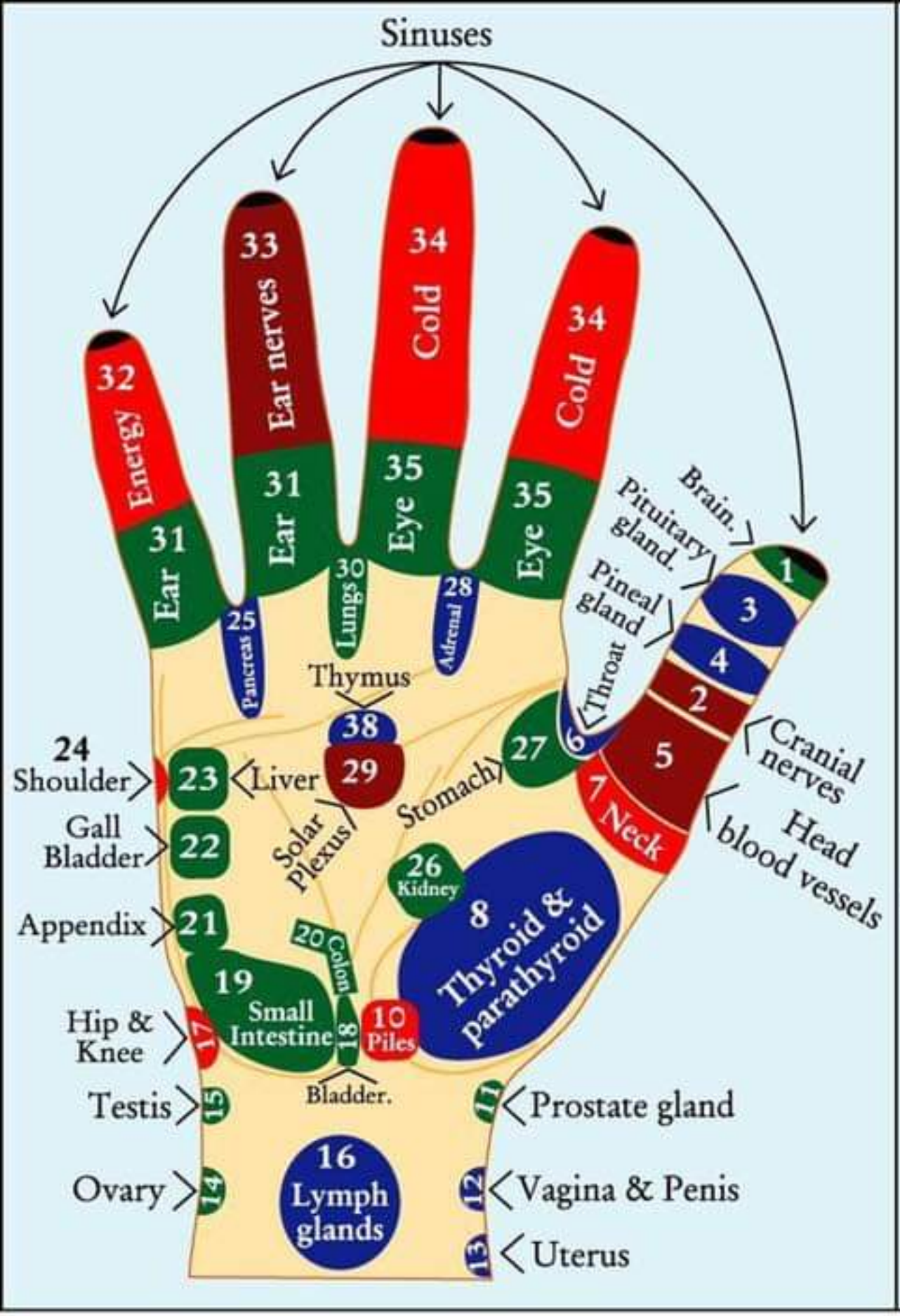
As the neural tube starts to form during early stages of human development, the tissue on either side of it starts to divide into bilateral segmented cell masses called somites. The dermatome portion of each somite is responsible for development of the dermis of the skin in each segment of the body. A layer of neural crest cells above the neural tube divides in the midline and is segmented into cell clusters near each somite. Cells from each of these clusters migrate into the somites of the same body segment and form the dorsal root ganglia. These form the sensory nerve fibers which supply the structures derived from each somite.



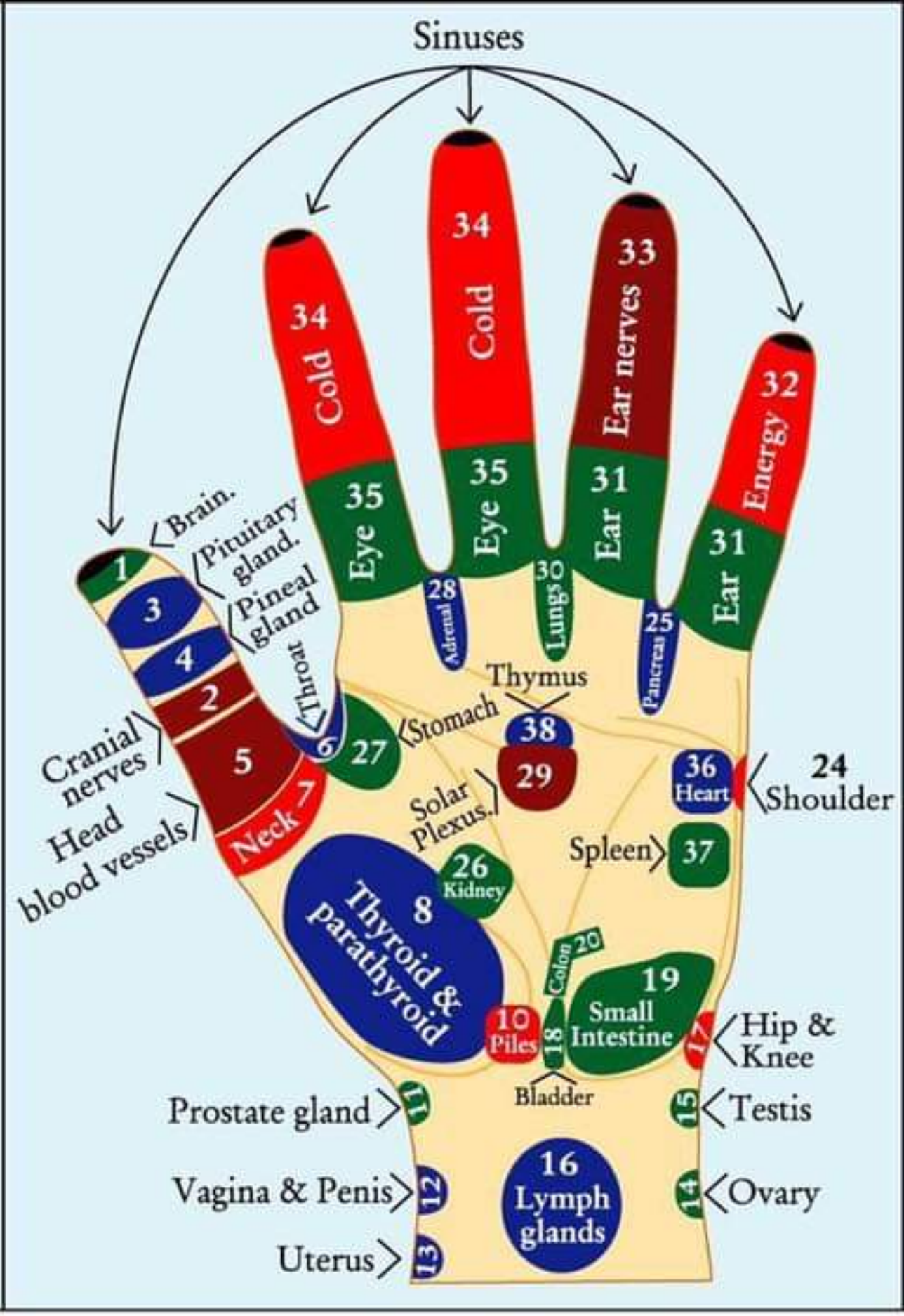
Development in the Extremities

The dermatomes on the extremities do not form patterns of consecutive bands as on the torso. Consideration of limb development in the human embryo provides a simple explanation for this. As the limb buds begin to form, somites in the area migrate out and arrange themselves parallel to the long axis of the proximal limb. As the limb forms, the consecutive somites position themselves around the axial line.



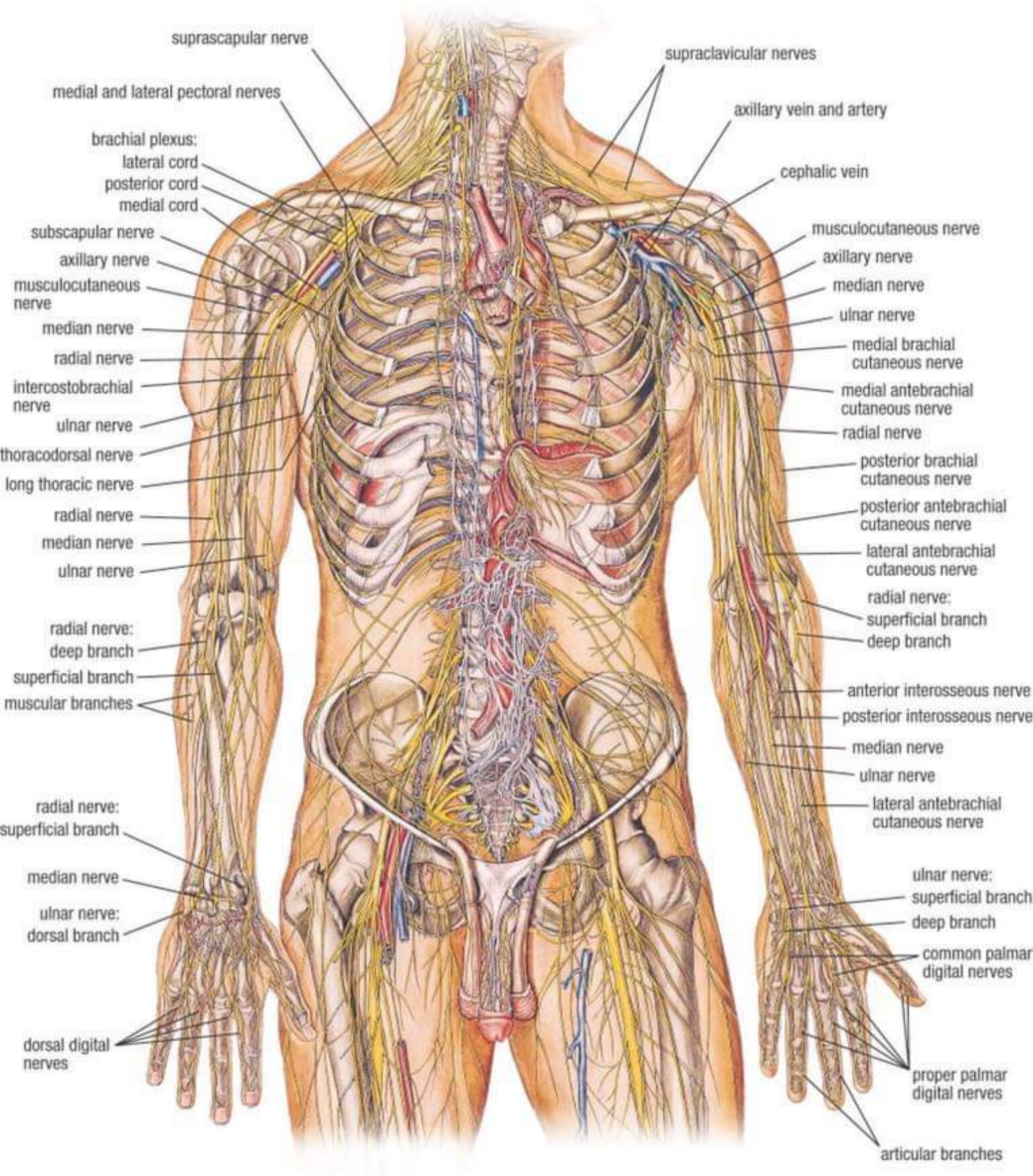


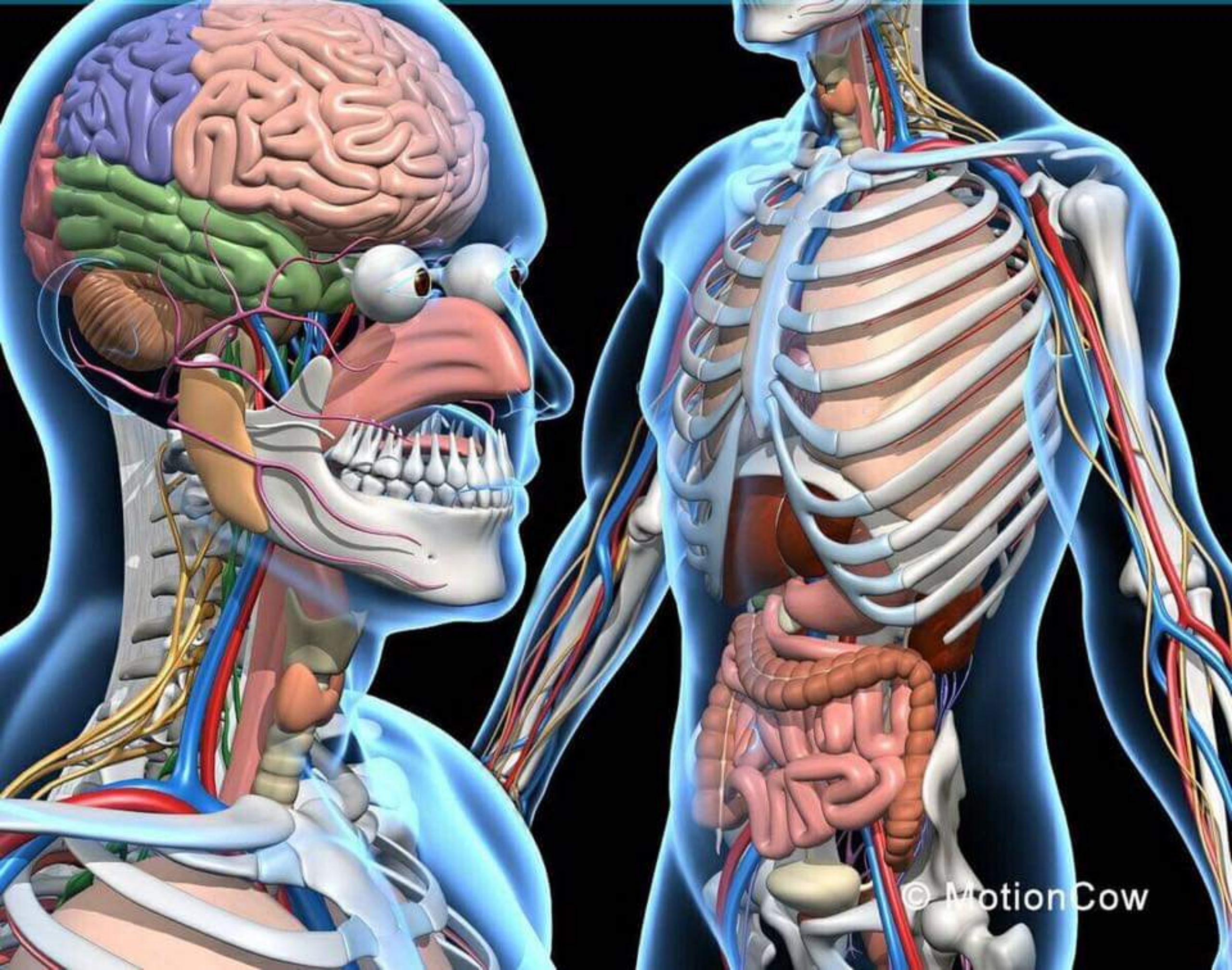
Acupressure points in right hand



Acupressure points in left hand

NERVOUS SYSTEM OF THORAX AND UPPER LIMB (ANTERIOR VIEW)

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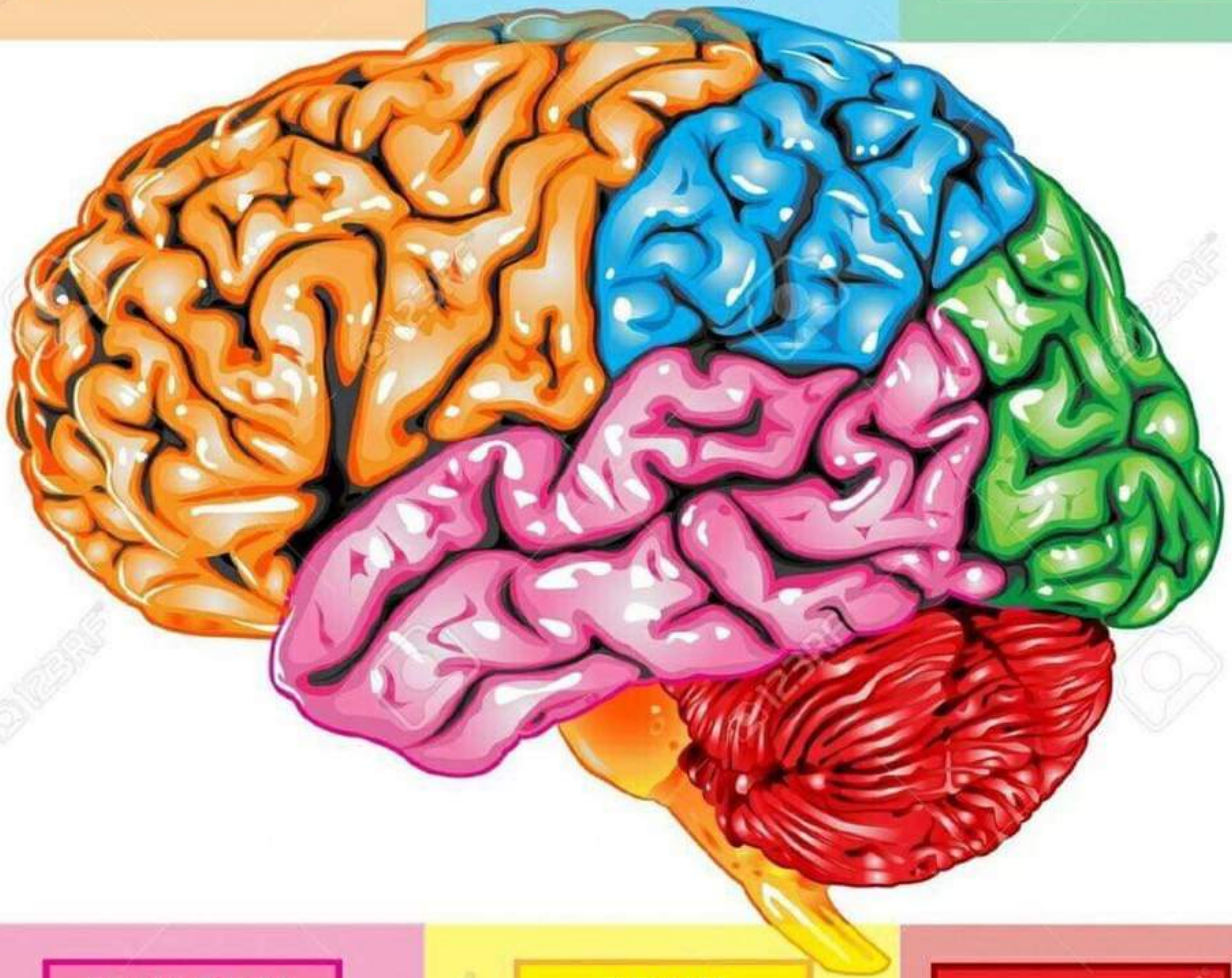
FRONTAL LOBE

PARIETAL LOBE

OCCIPITAL LOBE



TEMPORAL LOBE

BRAIN STEM

CEREBELLUM