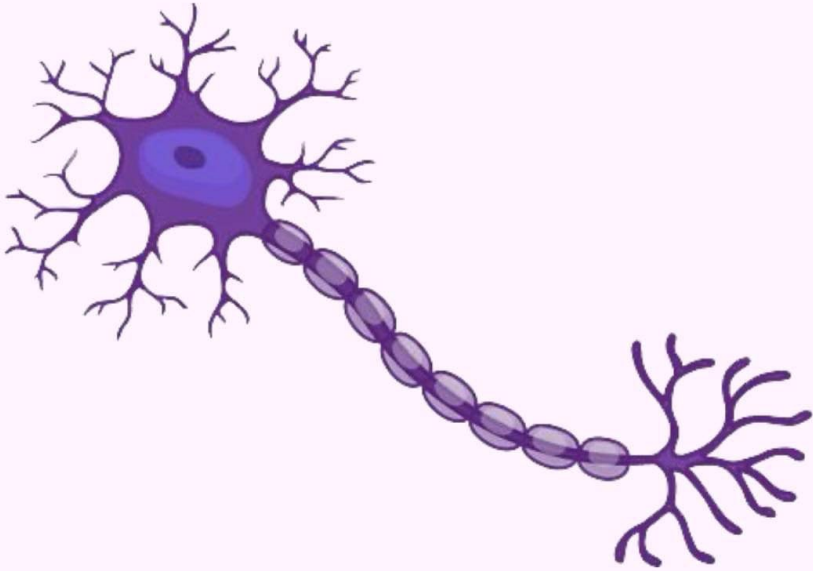




PHYSIOLOGY



LEC NO. : 5

DONE BY : Asia Al-wedyan.

وَقُلْ رَبِّ زِدْنِي عِلْمًا

Autonomic Nervous System

النظام العصبي

The nervous system is the **major** control system in the body which regulates **many body functions** necessary for life.

هو واحد من اهم الاجهزة التي تقوم بتنظيم عمل الجسم

Nerve Cell (Neuron) الوحدة البنائية التي تكون الجهاز العصبي.

- It is **the structural unit** of nervous system.

الجهاز الثاني الي يعمل Regulation for the body endocrine system هو ال

Structure:

It is formed of:

الفرق بين ال nervous system و endocrine system ، ان الجهاز العصبي يشتغل بسرعة عالية جدا

- a) Cell body (soma): **controls the activity of the whole neuron.**

انقسام / خروج الطاقة

- b) Cell processes: **2 types axis and dendrites**

The axon near its termination either joins:

يقترن ال axon بقائمه
قد تكون muscle
Gland " "
Dendrites or " "
soma of another neuron

- Muscle → neuromuscular junction.
- Gland → neuroepithelial junction.
- Dendrites or soma of another neuron → neuro-neural junction.

كل اعضاء الجسم من غدد و عضلات و احشاء و غيره يتم تغذيتها عن طريق الجهاز العصبي

c) Types

a. Afferent (sensory) neuron → carries impulses **from receptors to CNS**.
الجهاز العصبي المركزي
Control nervous system

b. Efferent (motor) neuron → carries impulses **from CNS to effector organs**.
قد تكون muscle / gland و غيره

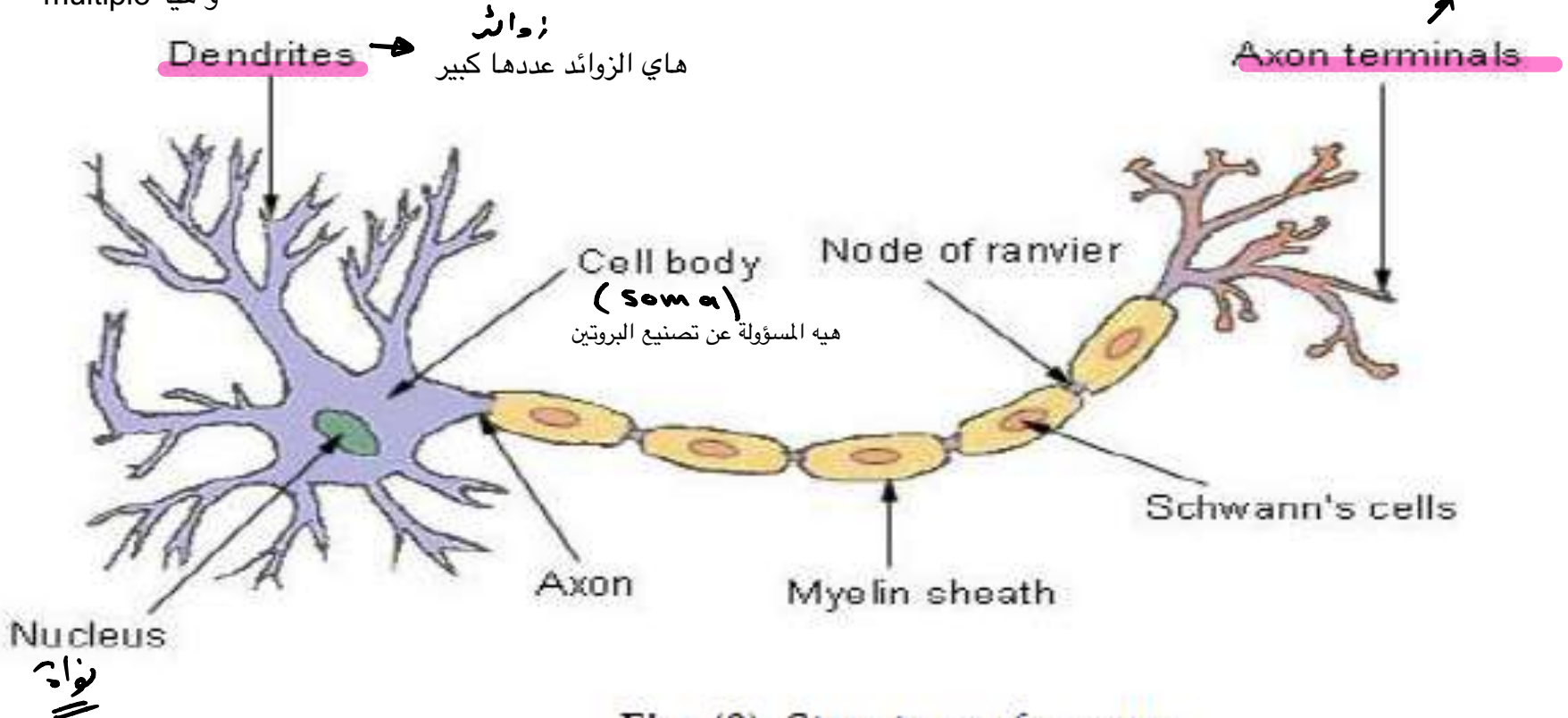
c. Interneuron (associative) → located **entirely within CNS**.

تترجم الرسالة -

الجهاز العصبي هو مسارات عصبية ، بمعنى ان الاشارة تنتقل من مكان الى اخر

The function of the dendrites : receptive
(تستقبل الاشارة من خلية عصبية بجانبها)
multiple و هيه

زوائد
بينما هون عددها واحد فقط



النواة هيه لتجديد الخلية ، الا الجهاز العصبي ما يكون في عندي تجدد للخلايا

Fig. (9): Structure of neuron

Definition

Reflex Action

Involuntary response
for a stimulus

فعل عاكس

- It is an involuntary reaction of the body to sensory stimulus

Pathway (reflex arc):

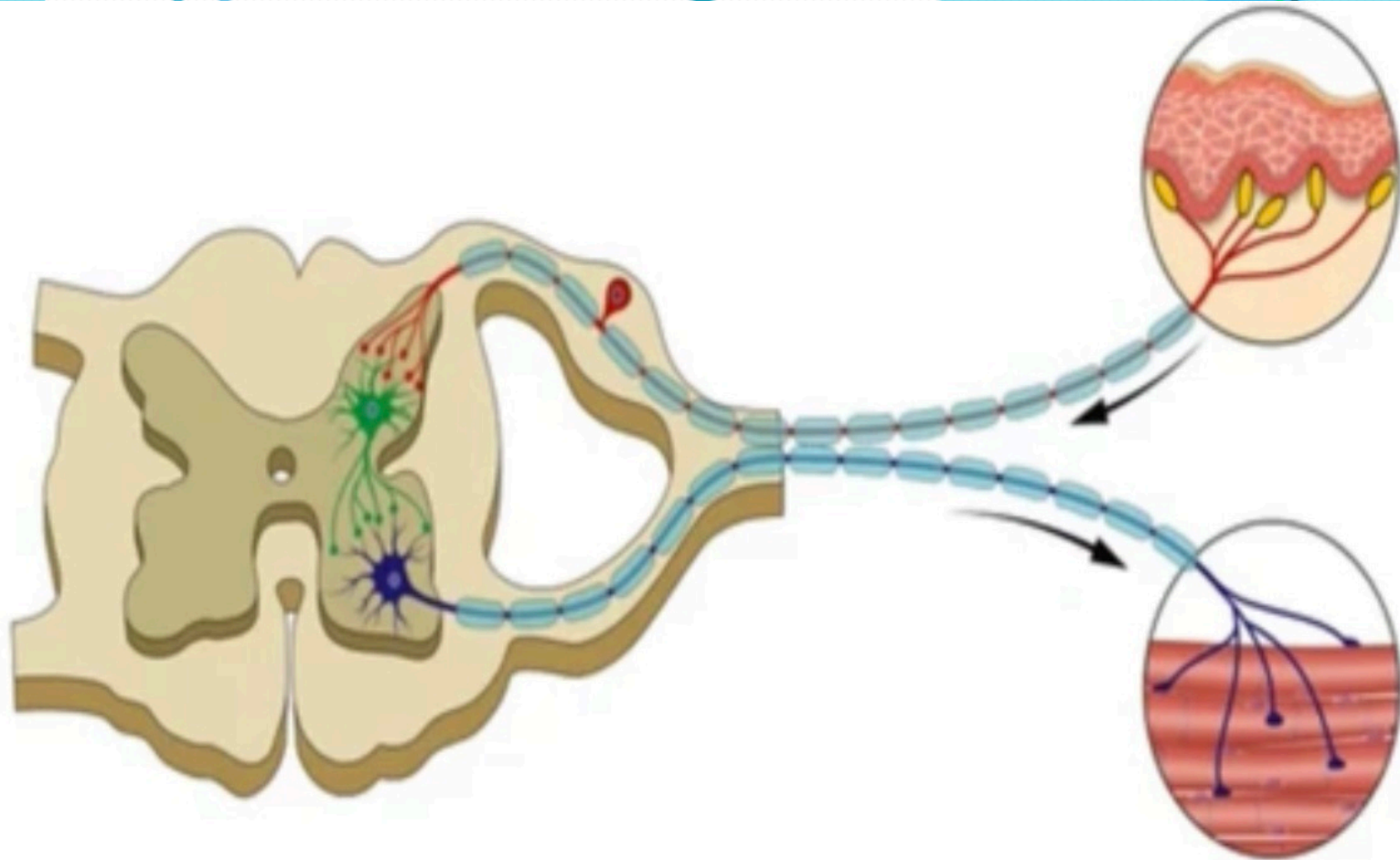
- It is carried out through pathway called reflex arc which is considered the (functional or physiological unit) of the nervous system

له الوحدة الوظيفية .

الوحدة التي بتشغل الجهاز العصبي هي
Reflex arc

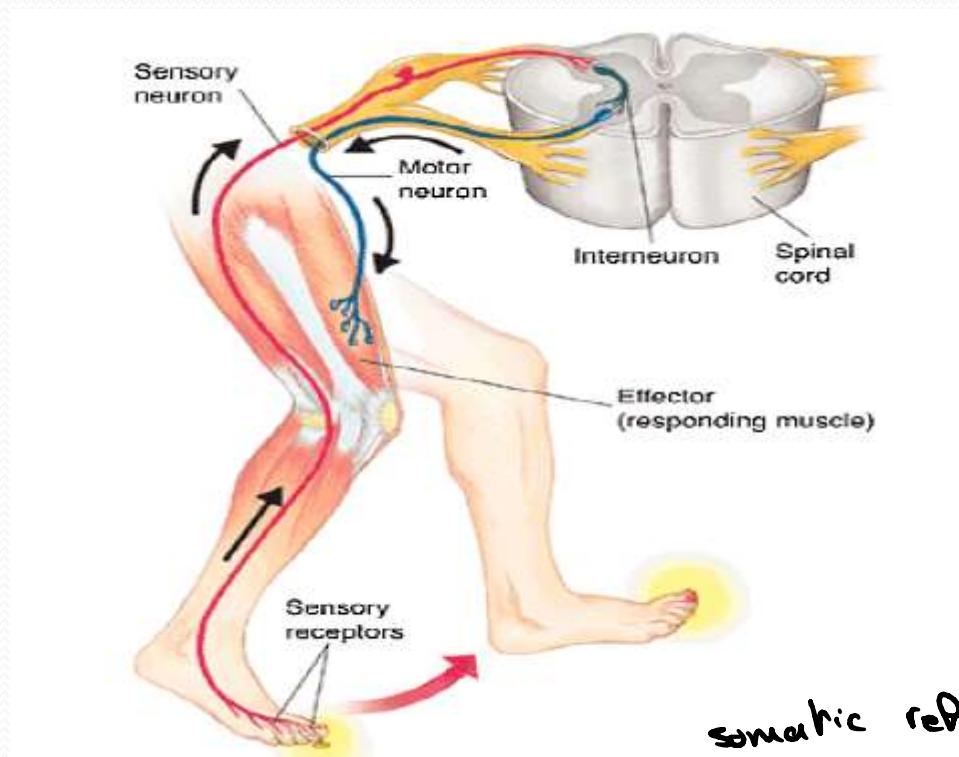
Components of reflex arc are:

- i- Receptors.
- ii- Afferent (sensory) neuron
- iii- Center (in CNS).
- iv. Efferent (motor) neuron
- v. Effectors (muscles or glands).



Types:

- i) **Somatic reflex**; e.g. flexion withdrawal reflex.
- ii) **Autonomic reflex**; e.g. micturition reflex.



Reflex arc (flexion withdrawal reflex)

Divisions of Nervous System

The nervous system is divided into:

- i) **Central nervous system (CNS).** الجهاز العصبي المركزي
- ii) **Peripheral nervous system (PNS).** الجهاز العصبي الطرفي

Central Nervous System (CNS)

It is the part of the **NS** which is **protected by bone (skull and vertebral column)**.
↳ Nervous system.

Parts:

It consists of 2 parts;

1) **Brain**

- **It is located in the skull**
- It consists of 3 parts;

The central nervous system is very precious (مهم وغالي جدا)
وهاد الاشئ بسبب ان اي تلف بالجهاز العصبي المركزي لا يمكن تعويضه

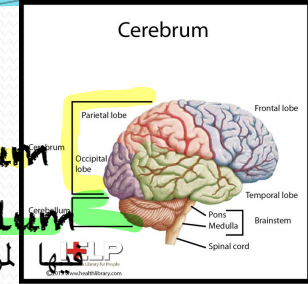
مشان هيكل ربننا حطه جوا اشئ يحميه
Brain is protect by the skull
Spinal cord is protect by the vertebra column

I. Cerebrum (2 cerebral hemispheres); consists of;

الفصين

Cerebrum

Cerebellum



- **Cerebral cortex** → العشرة الخارجة
المراكز تاعت الاحساس و الحركة سواء
كان احساس علم، او رؤية

كدة العشرة
الخارجة

• **Subcortical centers:** include

- 1- Thalamus
- 2- Hypothalamus
- 3- Basal ganglia.

اكهاد

كدة اكهاد

II. Brain stem: consists of;

1. Midbrain
2. Pons
3. Medulla oblongata.

i- Cerebellum.

له الكفينج

مسؤول عن التوازن

2) Spinal cord:

- It is located in the spine (vertebral column)

- It is subdivided into 31 segments; 8 cervical segments, 12 thoracic segments, 5 lumbar segments, 5 sacral segments and one coccygeal segment.

عند الرقبه (عنقية)

عند الصدر

في قاع الظهر (اسفله)

عند الحوض

عند العصعوص

- The spinal cord consists of 2 parts:

لونها ابيض لانو فيها حواليها myelin

(consists from lipid) ↑

1. **Outer white matter:** anterior, posterior and lateral column

لونها رمادي لانو مافي حواليها lipid layer (Myelin) الي

لونه ابيض

2. **Inner gray matter:** anterior, posterior and lateral horns

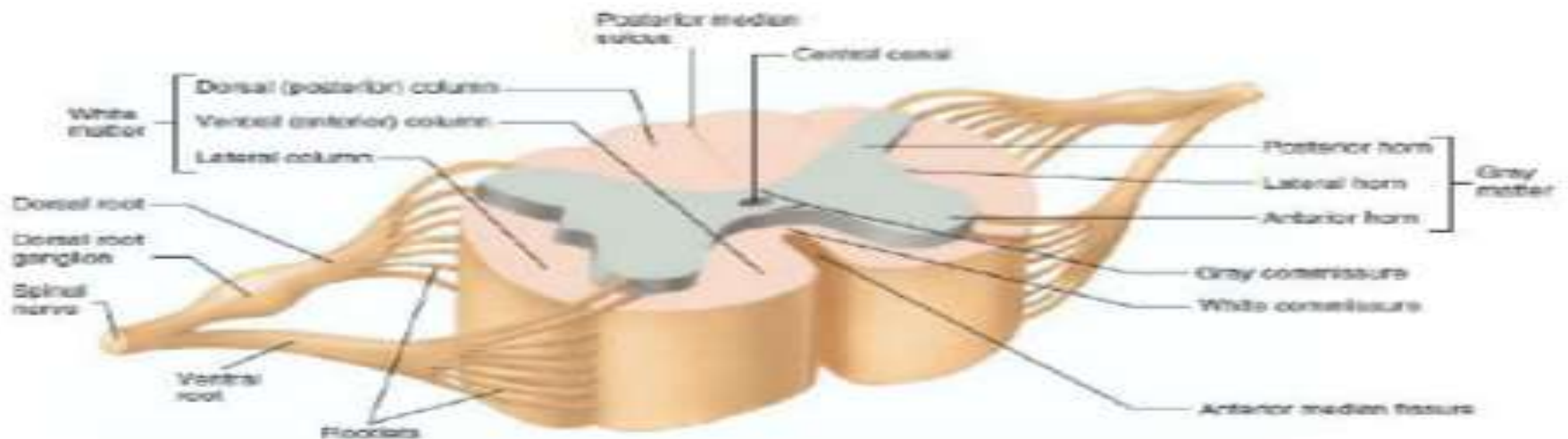
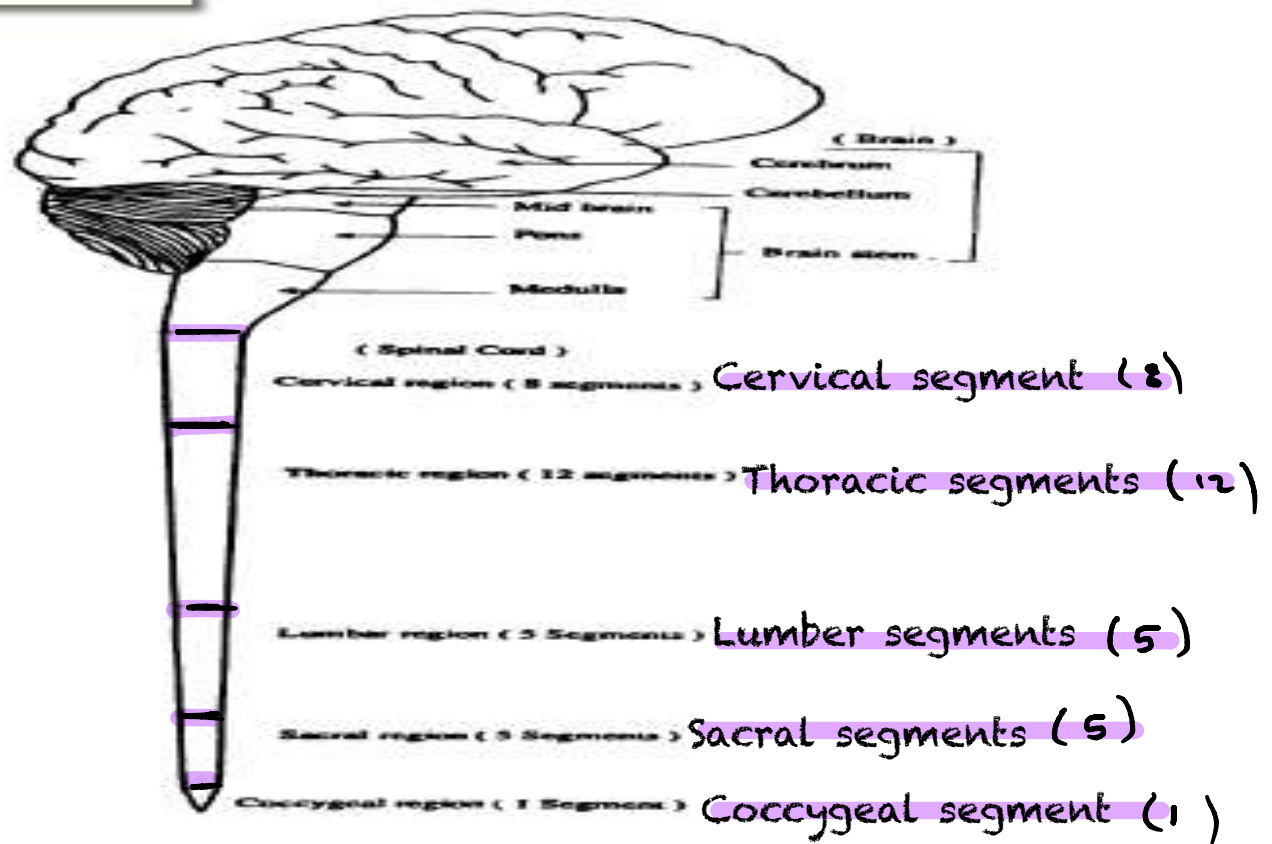
Anterior column → Anterior horn

Posterior column → Posterior horn

Lateral column → Lateral horn

Inner gray matter

* كل واحد من ال outer white matter



Structure of central nervous system and cross section of spinal cord

Peripheral Nervous System (PNS)

- It is the part of NS which communicate between the CNS and peripheral tissues.

الجهاز العصبي الطرفي يوصل الجهاز العصبي المركزي بباقي اعضاء الجسم

Divisions:

A) Anatomical divisions:

طالما الجهاز العصبي الطرفي ييوصل الجهاز العصبي المركزي بالاعصاب ، في عندي اعصاب من الدماغ و عددهم ١٢ واعصاب من الحبل الشوكي عددهم ٣١

- PNS is composed of 12 pairs of **cranial nerves** and 31 pairs of **spinal nerves** which contain:

↳ PNS

↳ PNS.

1- Afferent (sensory) nerve fibers → **conduct impulses from surface or inside of body to CNS**

2- Efferent (motor) nerve fibers → **conduct impulses from CNS to various organs of the body (effectors).**

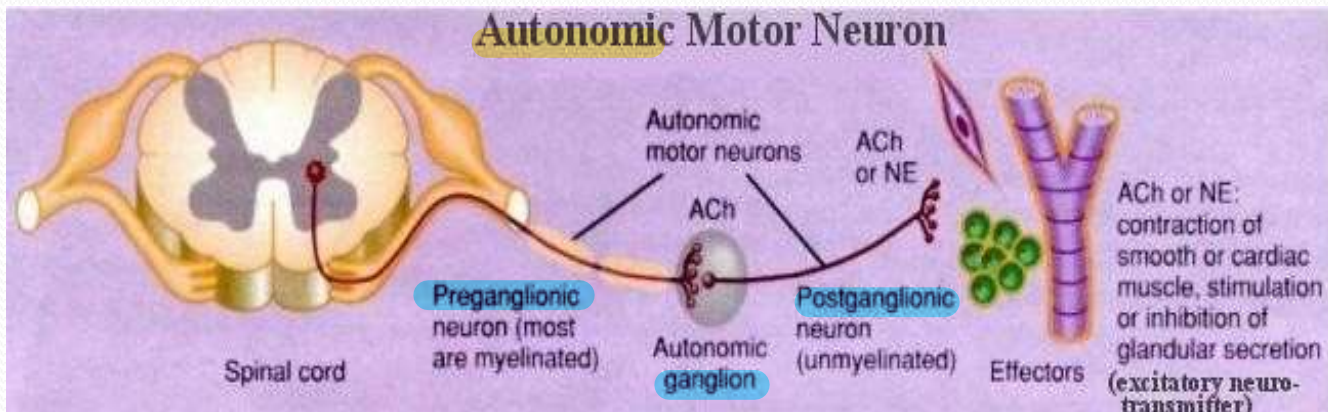
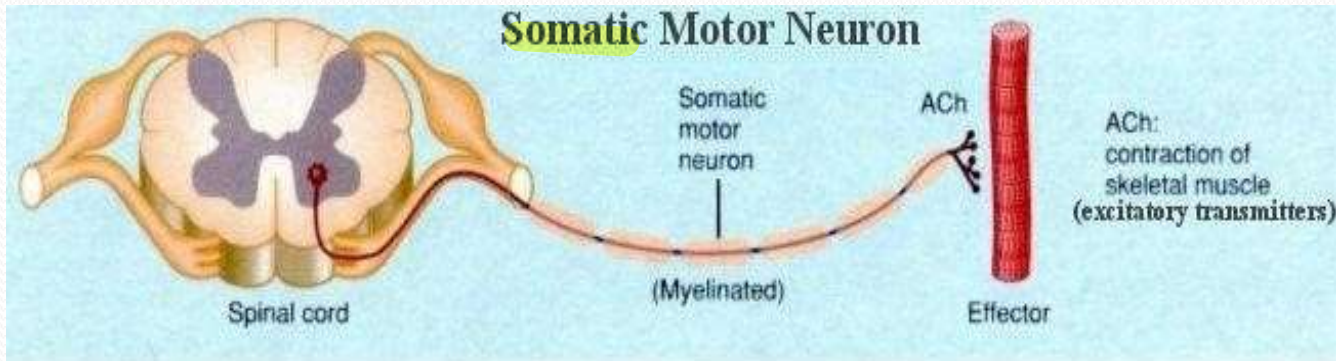
B) Physiological Divisions:

PNS is divided into;

i) **Somatic N S** → controls voluntary actions.

ii) **Autonomic N S** → controls involuntary actions

اگر کسی نے ارادتی سے عمل کیا ہے
انہیں سوماتک
جس کی وجہ سے ارادتی ہے۔



Somatic and autonomic nervous systems

Table 1: Comparison between somatic and autonomic nervous systems

	Somatic N S	Autonomic N S
Control	Voluntary functions	Involuntary functions
Connections	With <u>skin</u> , <u>skeletal</u> muscles, <u>bones</u> and joints.	عضلات ملساء موجودة في الامعاء في المعده With <u>smooth</u> <u>muscles</u> , <u>glands</u> and <u>cardiac muscle</u> .
Center	<u>Spinal cord</u> → <u>AHCs</u> ↪ Anterior horn <u>Brain stem</u> → somatic motor nuclei	<u>Spinal cord</u> → <u>LHCs</u> ↪ Lateral horn <u>Brain stem</u> → visceral motor nuclei

كل ما كان العصب سميك وكل ما كان محوط بال myeline كل ما كانت الاشارة بتمشي فيه بسرعه اكثر

	Somatic N S	Autonomic N S
<p>Efferent (motor) fibers</p> <p>Somatic : عندي عصب واحد بطلع من النخاع الشوكي للعضلة دغري</p> <p>Autonomic: عندي عصبين عصب بطلع من النخاع الشوكي اسمو (preganglionc) بتصل مع العصب الثاني الي اسمو (postganglionic) عن طريق ال (ganglion)</p>	<ul style="list-style-type: none"> - One neuron. - No ganglia i.e. not synapse outside CNS). - Thick myelinated nerve fibers (type A) - Excitatory to skeletal muscle i.e. muscle contraction 	<ul style="list-style-type: none"> - Two neurons. - Presence of ganglia (i. e. synapse outside CNS). - Preganglionic is thin myelinated nerve fibers (type B) - Postganglionic is non-myelinated nerve fibers (type C) - Either excitatory or inhibitory to effector organs.
<p>Effects of denervation</p> <p>يعني انا قطعت العصب</p>	<p>Paralysis and atrophy له ضمور في العضلة نتيجة لعدم الاستعمال</p>	<p>No paralysis (smooth muscles are myogenic). خاصية في الجدار يكون بنقبض بدون العصب و غيره (ما رح يتاثر)</p>
<p>Chemical transmitters</p>	<p>Acetylcholine</p>	<ul style="list-style-type: none"> - At preganglionic nerve endings: acetylcholine. - At postganglionic nerve endings: acetylcholine or nor epinephrine.

AHCs= anterior horn cells, LHCs= lateral horn cells.

Autonomic Nervous System

هائی اکڑتے پردھا تر جملہا
slide (۱۶-۱۸) لقدام .

Definition:

Partial nervous system

It is the part of the PNS which supplies and regulates the functions of internal organs i.e. viscera of the body.

Divisions of ANS

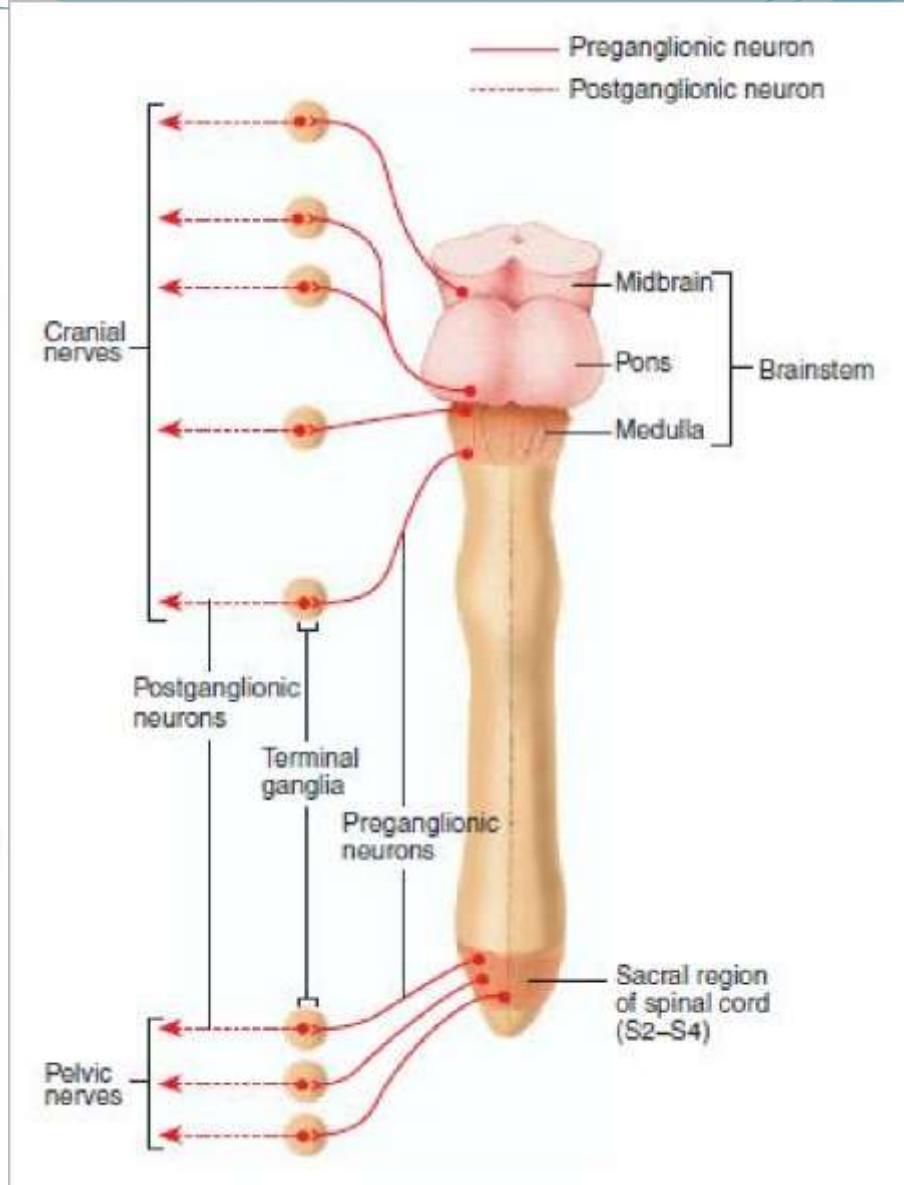
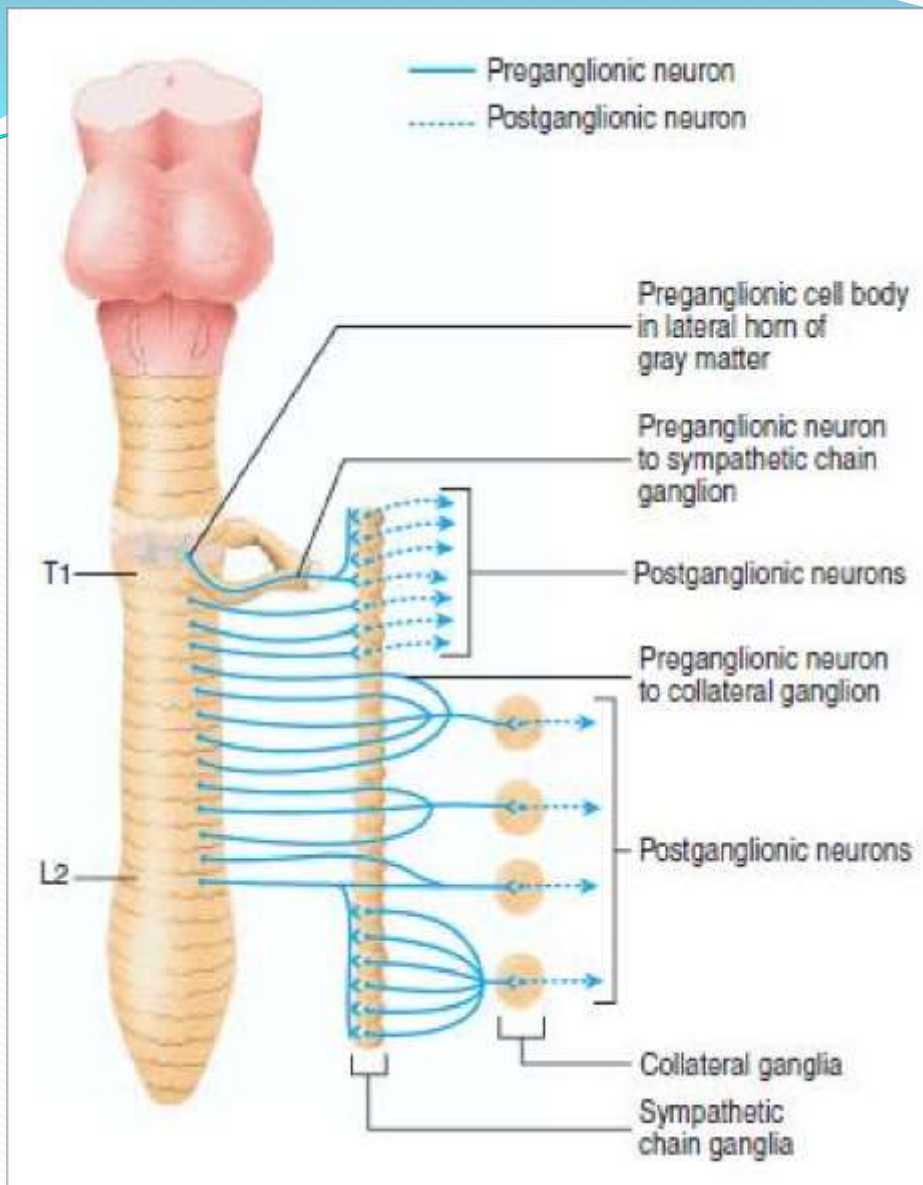
ANS is subdivided into 2 systems;

- i) Sympathetic (thoracolumbar) NS : originates from LHCs of all thoracic and upper 3 lumbar segments of the spinal cord**
- ii) Parasympathetic (craniosacral) NS: originates from 2 parts;**

A- Cranial part: arises from visceral motor of the following cranial nerves:

1. **Oculomotor nerve in midbrain.**
2. **Facial nerve in pons.**
3. **Glossopharyngeal nerve in the medulla oblongata.**
4. **Vagus nerve in the medulla oblongata.**

B-Sacral part: arises from 2nd, 3rd and 4th sacral segments of the spinal cord and forms pelvic nerve



sympathetic (a) and parasympathetic (b) division of autonomic nervous system

Autonomic Ganglia

Def,

- They are **collection of cell bodies of neurons outside the central nervous system (CNS)**. عند تجميع ال cell bodies داخل الجهاز العصبي المركزي يعطيني (nucleus)

Functions:

لكن لو تجمعت ال cell bodies خارج الجهاز العصبي المركزي يعطيني (ganglia)

- Act as a **relay station** for **autonomic preganglionic** nerve fibers

الهدف من ganglion

هو انه لو كان العصب كثير طويل عشان يوصل للجزء المطلوب قد يتعرض هاد العصب للتلف ف بتقسم لمرحلتين و بتكون ال ganglion زي محطة

تاني اشي انو ال ganglion cause

distribution

يعني ممكن يدخل عصب واحد يطلع عندي ٢٠

عصب او ٣٠ ، فھيه بتعمل توزيع



Functions of autonomic ganglia

Types:

a) Lateral (paravertebral) ganglia:

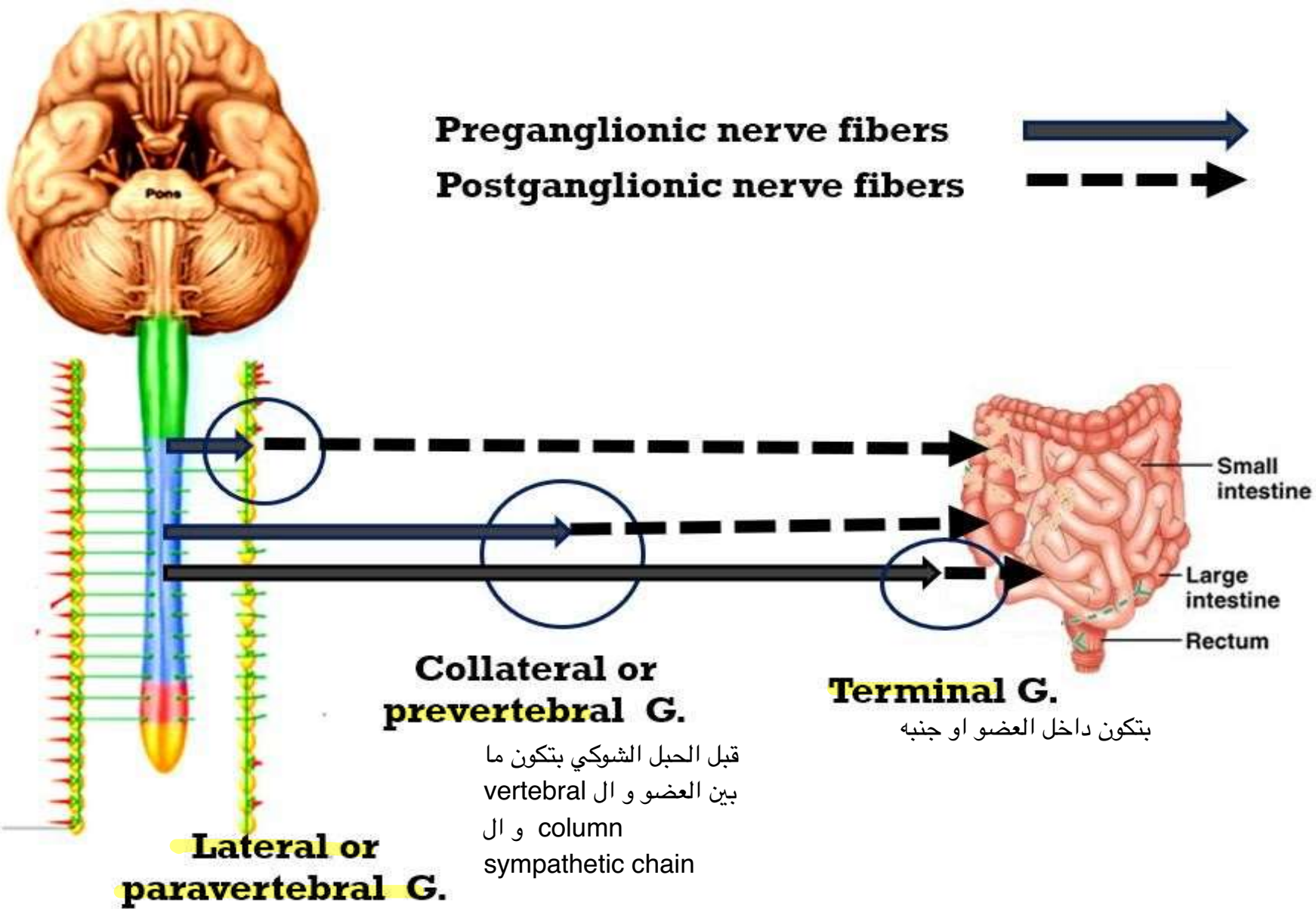
- Located **on either side of the spinal cord.**
- About 22-24 ganglia on each side.
- Form **2 rows of sympathetic chain of ganglia.**
- Act as a relay station for preganglionic sympathetic nerve fibers only.

b) Collateral (prevertebral) ganglia:

- Present mainly in the abdomen, **midway between spinal cord and viscera.**
- Act as a relay station for **sympathetic preganglionic nerve fibers.**

c) Terminal ganglia:

- Present **close to or at the wall the effector organs** especially rectum; urinary bladder reproductive organs in the pelvis.
- **Act as a relay station of:**
 - **All parasympathetic preganglionic fibers.**
 - Some sympathetic preganglionic fibers.



Types of autonomic ganglia

(I) Functions of Sympathetic NS

A) Sympathetic Supply to Head and Neck:

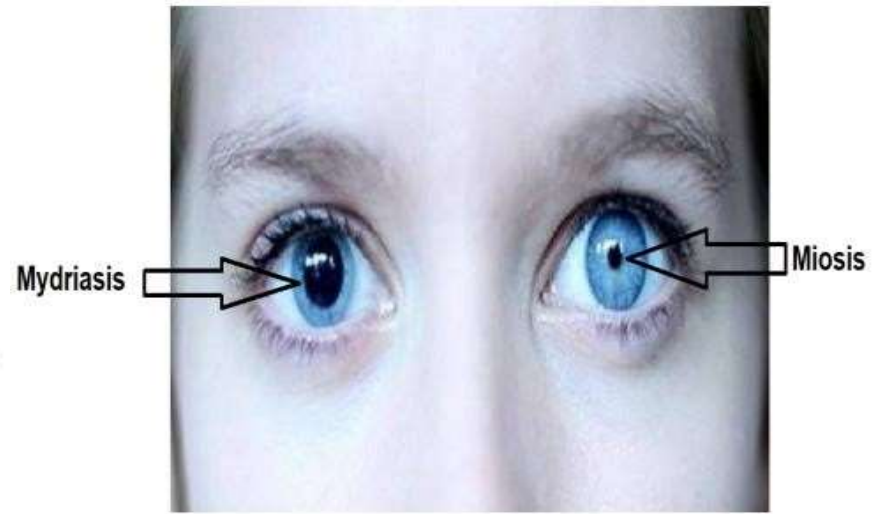
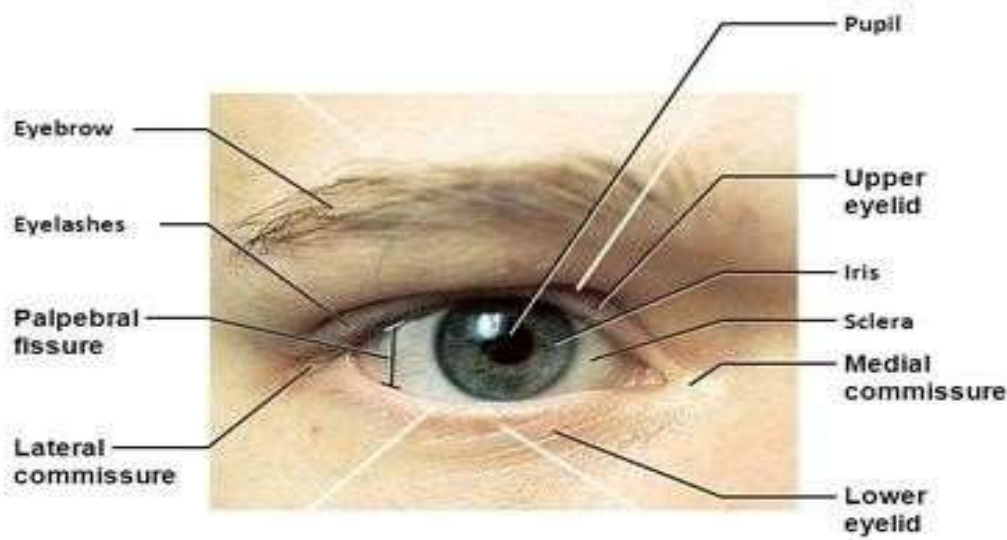
Origin:

- LHCs of **first and second thoracic segments**

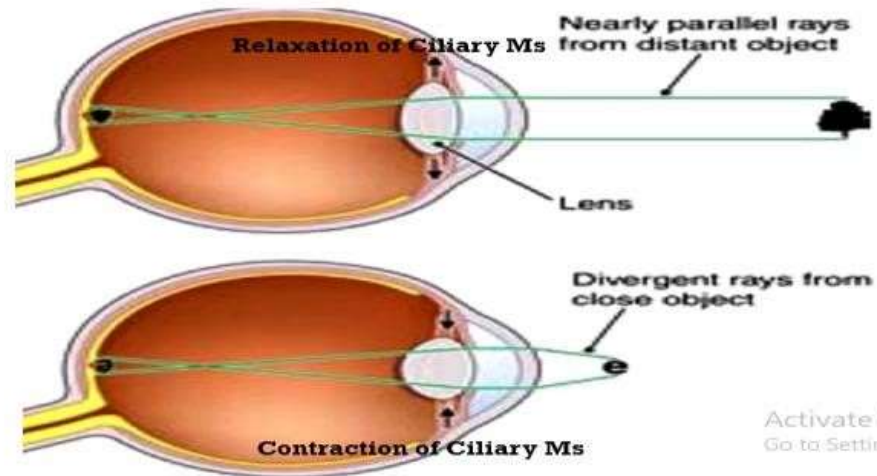
Functions:

1) Eye:

- a. Causes **dilatation of pupil (mydriasis)**
- b. Causes widening of palpebral fissure.
- c. Causes **exophthalmos.**
- d. Helps the eye to see far objects



Palpebral fissure and dilatation of pupil (mydriasis) and constriction of pupil (miosis)



Activate Windows
Go to Settings to activate Windows.

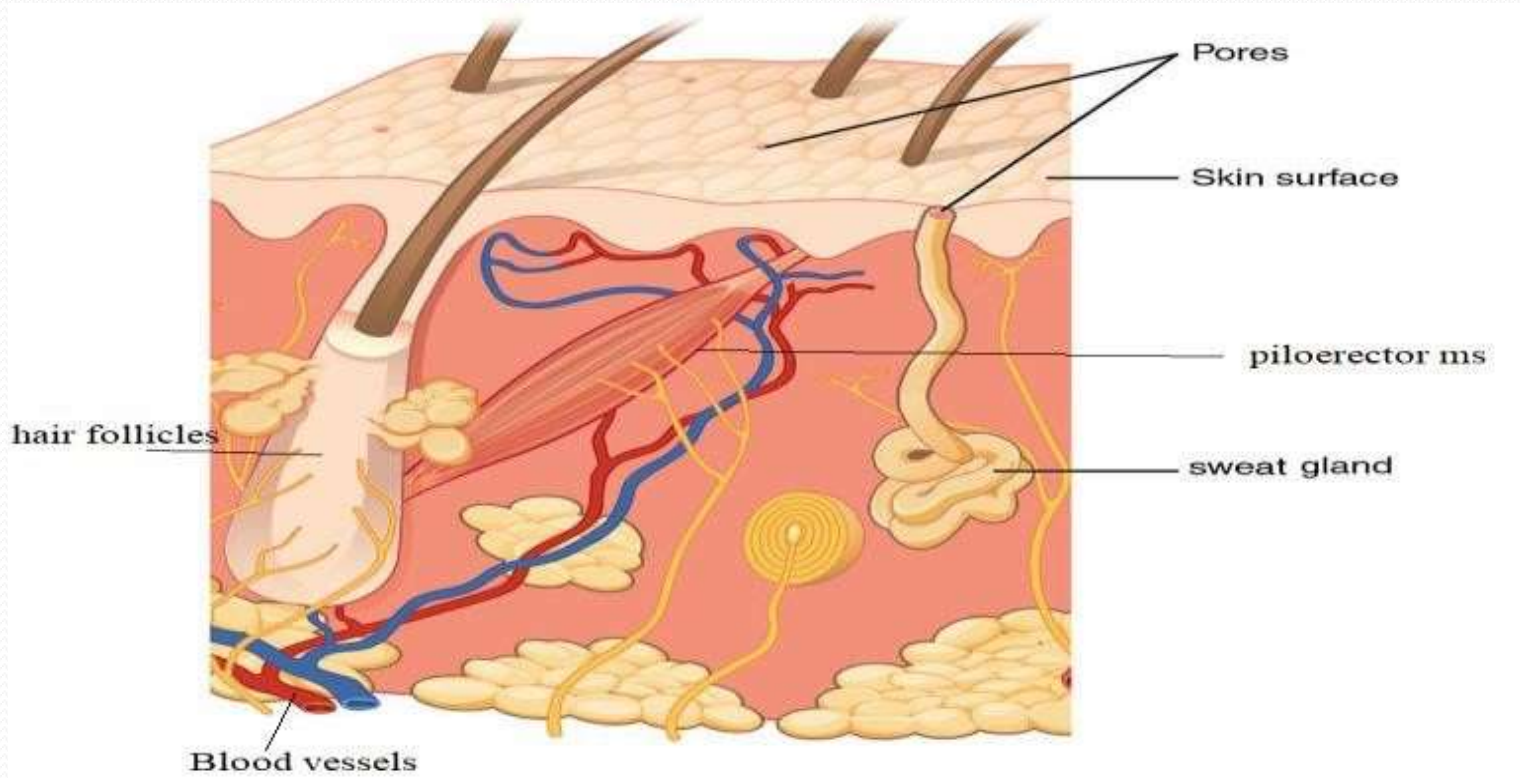
showing exophthalmos and relaxation of ciliary ms to see far objects

2) Salivary Glands:

- a. Vasoconstriction **(V.C.) of salivary gland blood vessels.**
- b. **Trophic secretions:** little, **viscous**, concentrated secretion;
poor in water and **rich in enzymes**

3) Skin:

- I. **V.C** of skin blood vessels.
- II. **Hair erection**
- III. **Sweat secretion.**



Structure of skin

B) Sympathetic Supply to Thorax:

Origin:

- **LHCs of upper 4 or 5 thoracic segments of spinal cord.**

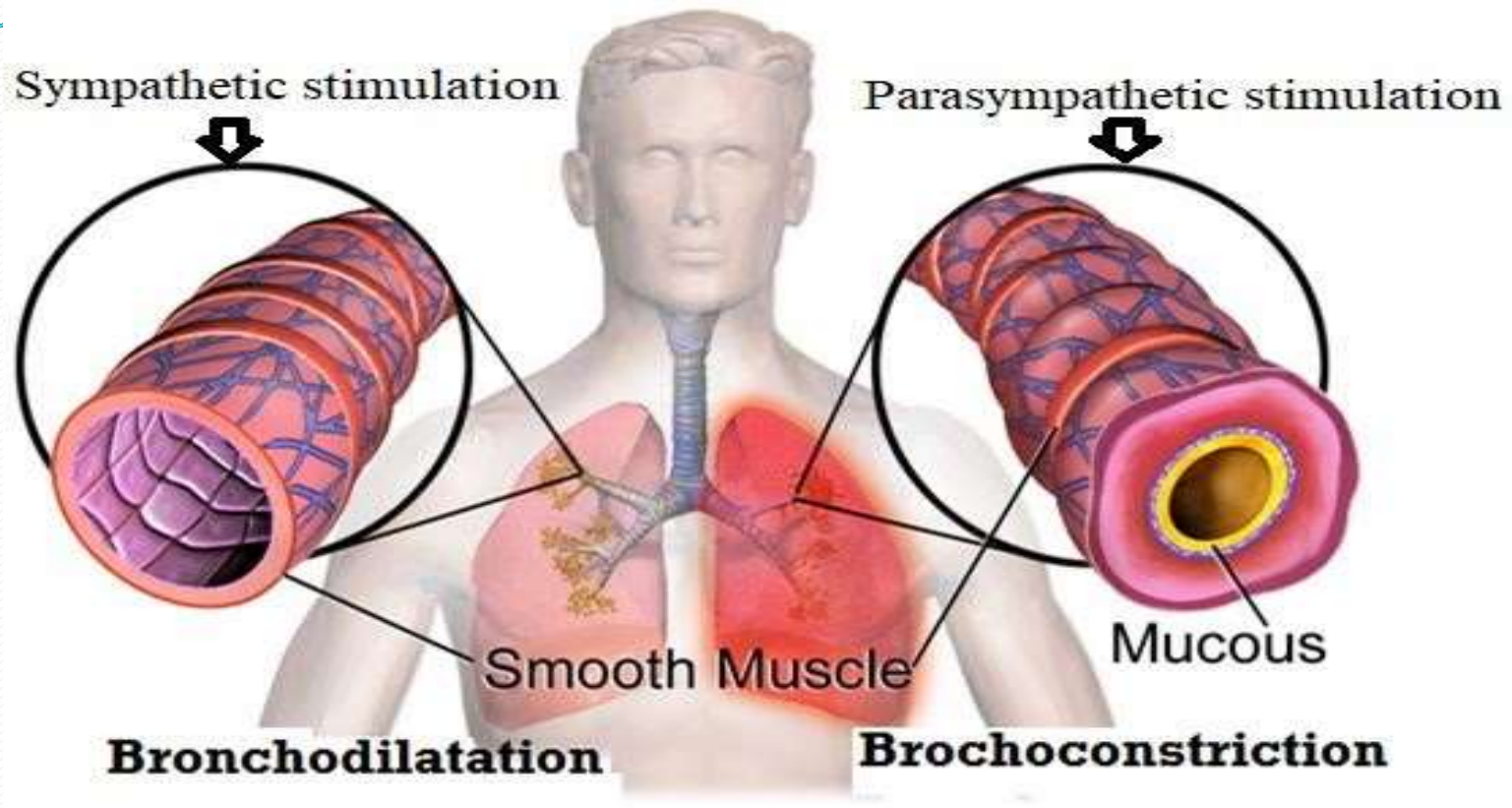
Functions:

1) Heart:

- I. It ↑es the heart rate and force of contraction**
- II. vasodilatation of coronary vessels**

2) Lungs:

- I. Bronchodilatation.**
- II. Decreases mucus secretion of air passages.**



Sympathetic stimulation to lungs and air passages

C) Sympathetic Supply to Abdomen:

Origin:

- **LHCs of T6-12 segments of spinal cord (splanchnic nerves).**

Functions:

1. GIT

Relaxation **of their walls and contraction of their sphincters**

2. Gall bladder:

Relaxation of its wall and contraction of **sphincter of Oddi** → retention of bile

3. Spleen:

Contraction of **smooth muscles in splenic capsule and trabeculae** → pouring of about 250 ml of stored blood into the general circulation.

4. Pancreas:

- It inhibits **both endocrine and exocrine pancreatic secretion.**

5. Kidneys:

- It decreases renal blood flow.
- **It decreases urine output.**

6. Suprarenal medulla

- It releases large quantities **of adrenaline (80%) and noradrenalin (20%)** into the circulating blood.
- In stress conditions, **SRM** acts together with **sympathetic nervous system (sympathoadrenal system).**

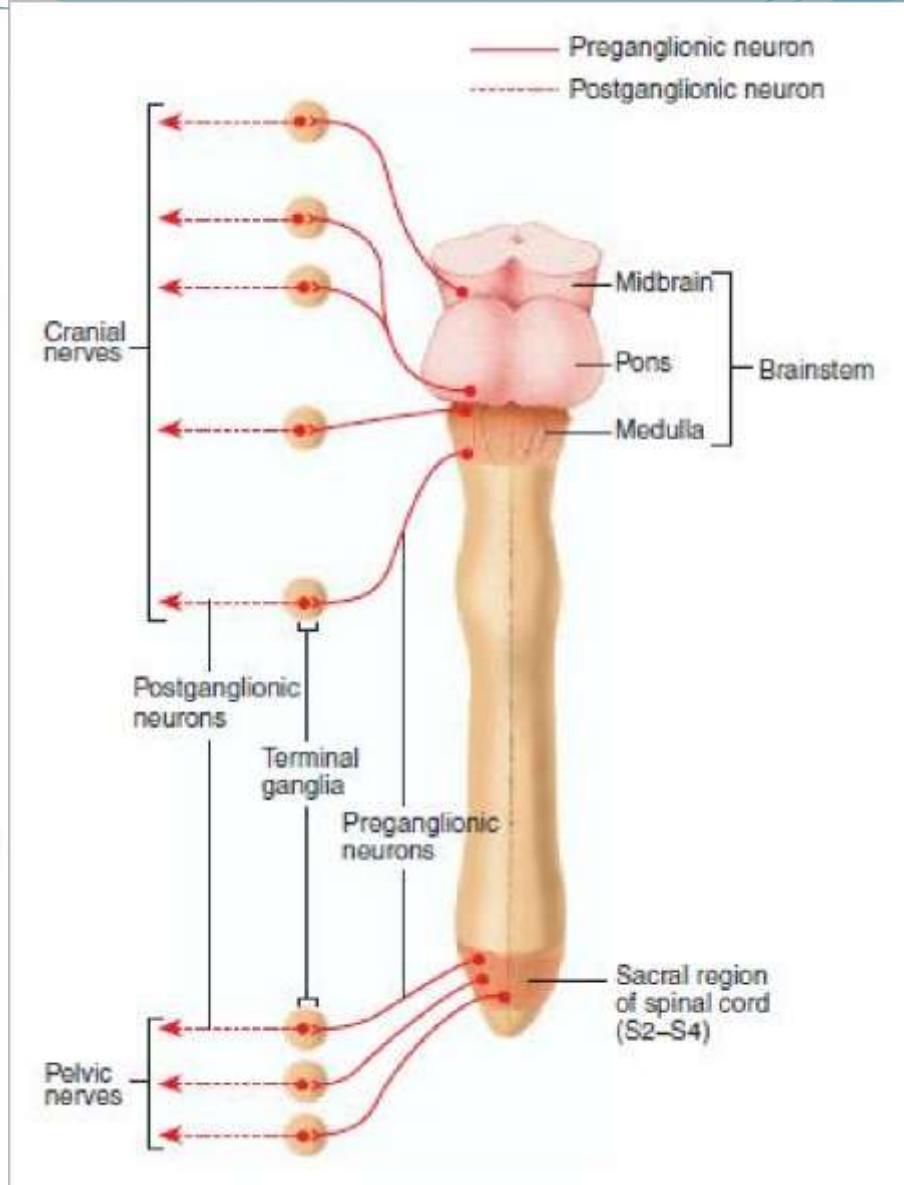
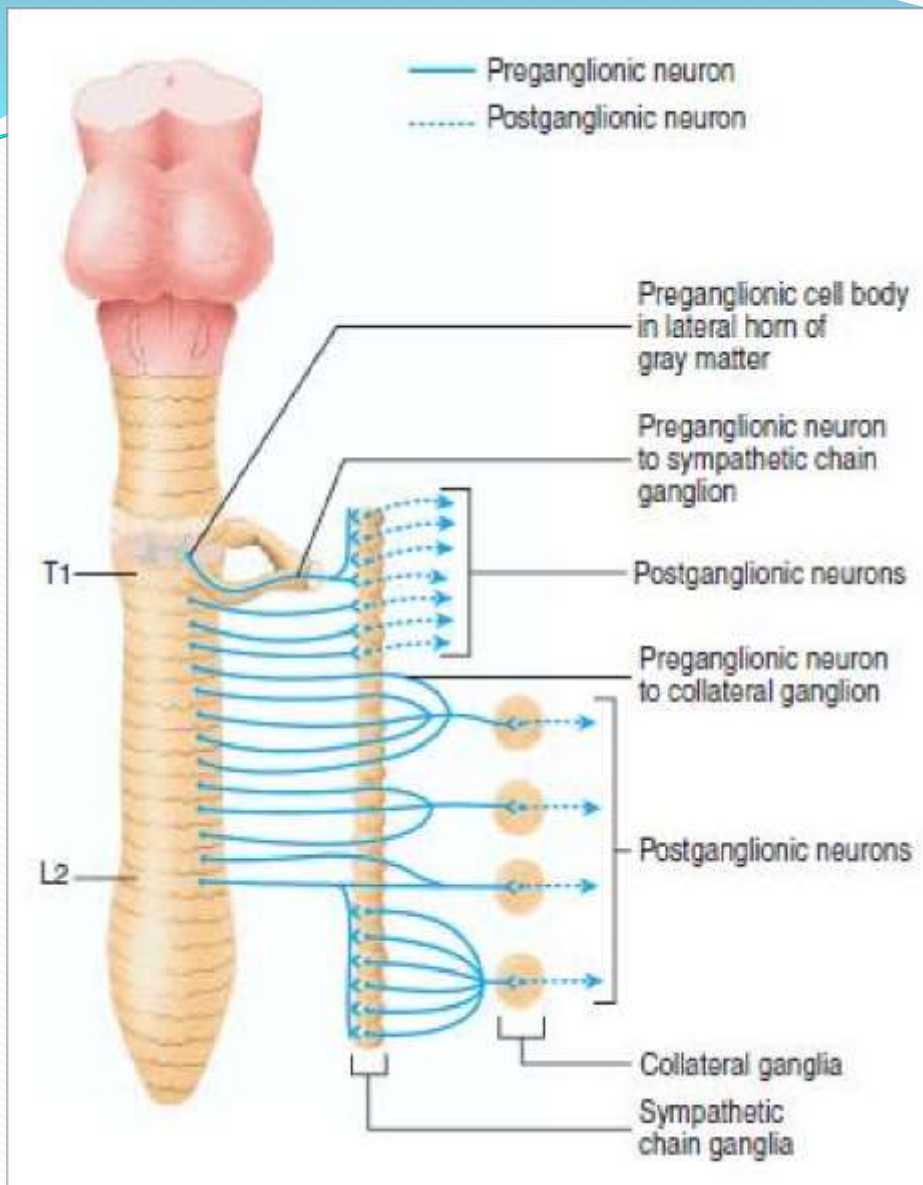
D) Sympathetic Supply to Pelvis:

Origin:

- **LHCs of L1, L2, and L3 segments of spinal cord.**

Functions:

1. **Urinary bladder:** causes relaxation of its wall and contraction of **internal** urethral sphincter → retention of urine.
2. **Rectum:** causes relaxation of its wall and contraction of internal anal sphincter → **retention of feces.**
3. **Sex organs**
 - I. It causes contraction of smooth muscle of seminal vesicle, **vas deferens and ejaculatory duct** → **ejaculation of semen.**
 - II. It causes VC of blood vessels of pelvic viscera → **shrinkage of external sex organs e.g. penis.**



sympathetic (a) and parasympathetic (b) division of autonomic nervous system

(II) Functions of Parasympathetic NS

A) Cranial part

1) Oculomotor nerve:

Origin:

- **From midbrain.**

Functions:

- a. Causes contraction of constrictor pupillae muscle → **narrowing of pupil (miosis)**
- b. Causes contraction of ciliary muscle → **helps eyes to see near objects**

2) Facial Nerve

Origin:

- From Pons

Functions:

1. **Lacrimal glands:** **i) Vasodilatation. ii) Secretion of tears.**
2. **Submandibular and sublingual salivary glands:**
 - I. Vasodilatation.
 - II. **True salivary secretion (large in volume, watery, rich in electrolyte and poor in enzymes).**

3) Glossopharyngeal Nerve:

Origin:

From medulla oblongata.

Functions:

1. Parotid salivary gland

- i) Vasodilatation.
- ii) True salivary secretion.

A) Vagus (wandering) Nerve:

Origin:

From the medulla oblongata.

Functions:

A) Thorax:

a) Heart:

- I. It decreases the heart rate, and force of contraction
- II. vasoconstriction of coronary vessels

b) Lungs:

- I. Causes **bronchoconstriction**.
- II. **Increases the mucus secretion of the air passages.**

B) Abdomen:

a) GIT

- It **causes contraction of their walls and relaxation of their sphincters.**

b) Glands

- Gastric glands → ↑es gastric juice secretion (rich in HCL).
- Pancreas: **stimulates both endocrine and exocrine components**

c) Liver:

- It **increases hepatic bile flow.**

d) Gall bladder:

- Contraction **of its wall and relaxation of sphincter of Oddi** → helps its evacuation.

e) Blood vessels:

- **Vasodilatation.**

B) Sacral part or outflow: (Pelvic Nerve)

Origin:

- Sacral segments (2nd, 3rd, 4th) of spinal cord.

Functions:

1) Urinary bladder

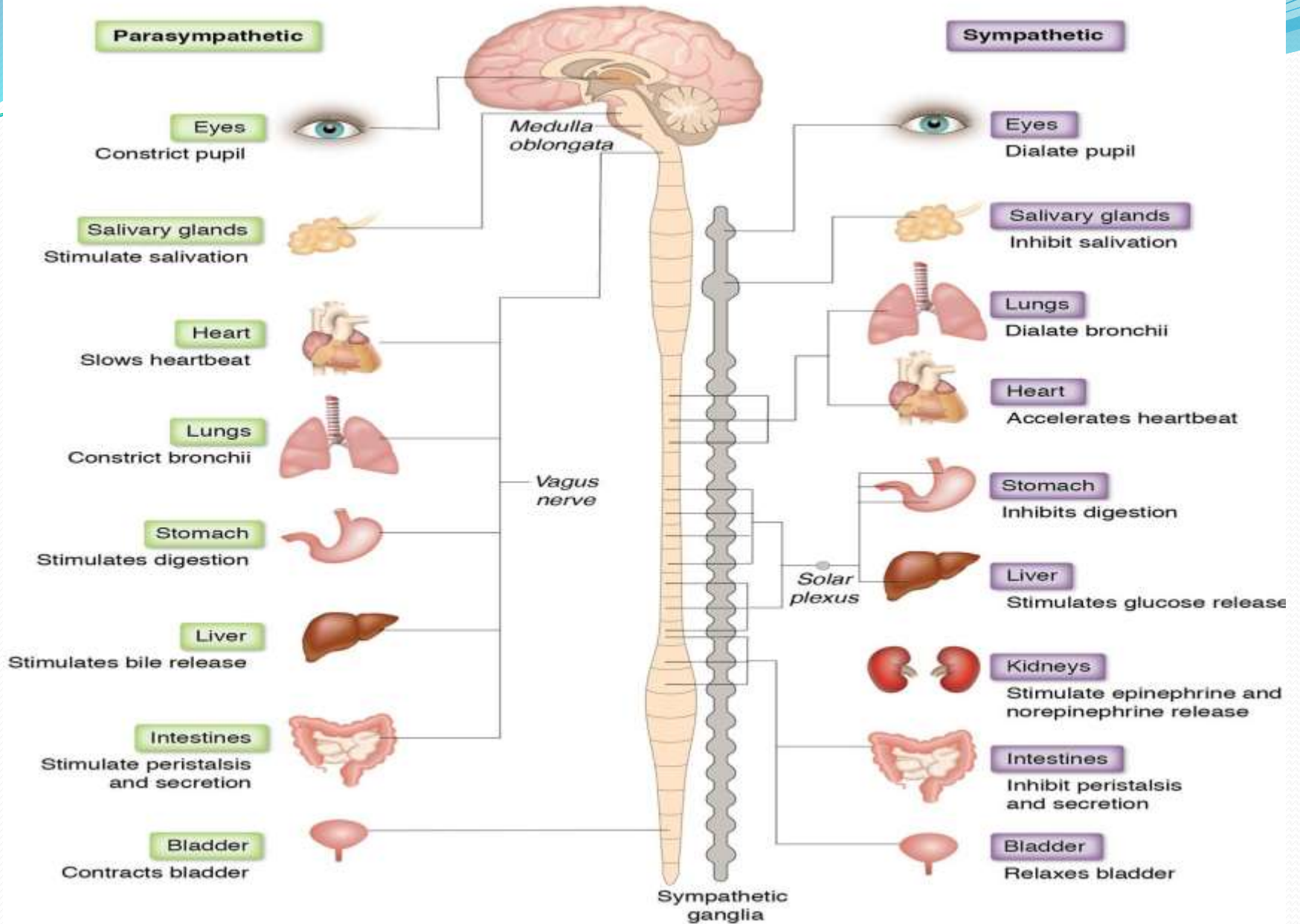
- It causes contraction of its wall and relaxation of internal urethral sphincter → micturition.

2) Rectum

- It causes contraction of its wall and relaxation of internal anal sphincter → defecation.

3) Sex organs

- It causes VC of blood vessels of pelvic viscera → erection of the external sex organs e.g. penis



Summary of the functions of sympathetic and parasympathetic N.S.

Chemical Transmission

Definition

Synapse is **the functional connection between a neuron and second neuron**

Types of Synapses:

- Two main types of chemical transmitters released by autonomic nerve endings:
 - I. **Acetylcholine**
 - II. **Noradrenaline**

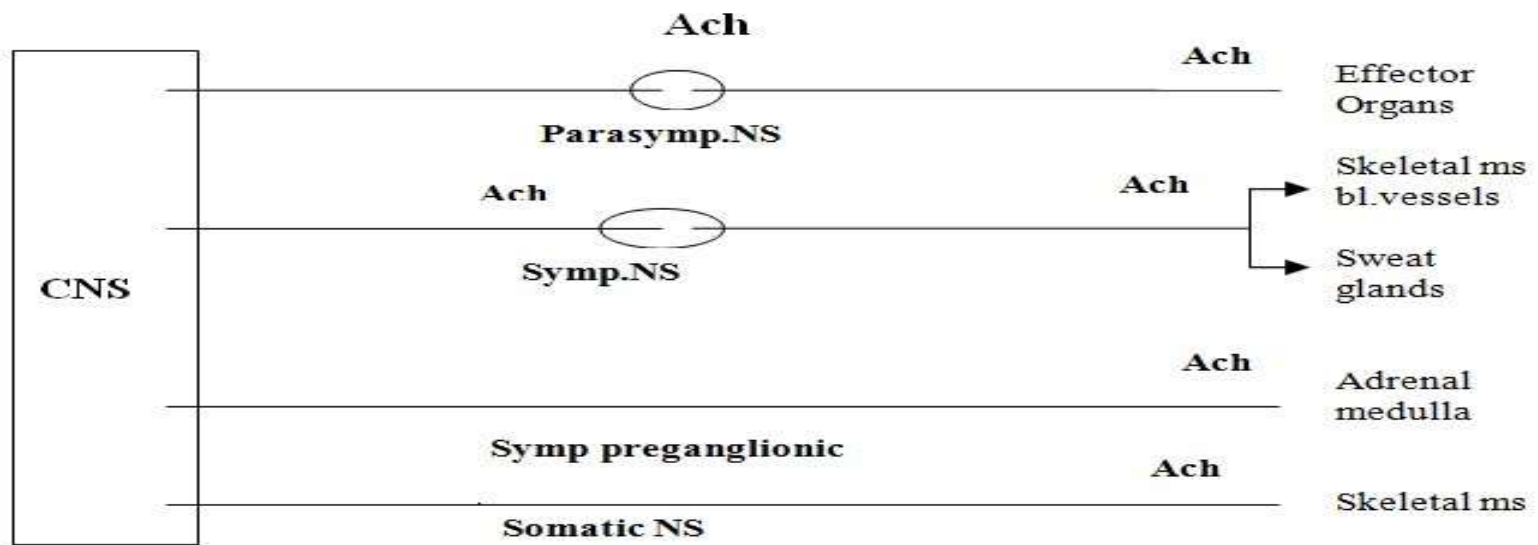
Accordingly, there are two types of autonomic nerve fibers,

1. Cholinergic nerve fibers: **secrete acetylcholine.**
2. Adrenergic nerve fibers: **secrete noradrenalin.**

Cholinergic Transmission

A) Sites of release of Acetylcholine

1. All **preganglionic** sympathetic and parasympathetic NS nerve endings.
2. Preganglionic sympathetic nerve fibers **to suprarenal medulla**.
3. All postganglionic parasympathetic nerve ending.
4. **Somatic motor nerve ending** to skeletal muscle (motor end plate).
5. Some synapses at CNS (**brain and spinal cord**).



sites of release of acetylcholine

Cholinergic Receptors

Definition

They are the receptors which respond to Ach.

Types:

Muscarinic and nicotinic receptors of acetylcholine

	i) Muscarinic receptors	ii) Nicotinic receptors
Site	Present on smooth muscles and glands	Present in autonomic ganglia and neuromuscular junction
Types	M1, M2, M3, M4 and M5	Nn (nicotinic neuronal) and Nm (nicotinic muscular)

	Muscarinic receptors (M-receptor)	Nicotinic receptors (N-receptor)
Locations	<p>smooth muscle, gland and cardiac muscle</p> <ul style="list-style-type: none"> ● M--- smooth muscle, gland ● M1-- ganglia, gland ● M2--- heart 	<p>skeletal muscle-- motor ending-plate (N2 N2), ganglia-postsynaptic membrane(N1),</p>
Effect	<p>inhibiting the cardiac muscle, exciting the smooth muscle & gland</p>	<p>N2:exciting skeletal muscle , N1 exciting the postsynaptic neuron in ganglia</p>
Antagonist	<p>Atropine</p>	<p>N1:hexamethonium N2:decamethonium</p>

Adrenergic Transmission

- **Noradrenaline and adrenaline are called catecholamines and released from**

Sites of release of catecholamines:

1. **Postganglionic sympathetic fibers**
2. Some synapses in CNS.
3. **Suprarenal medulla: adrenaline (80%) and noradrenaline (20%).**

Adrenergic Receptors

Definition: are the receptors which respond noradrenaline and adrenaline.

Types :

They are classified into 2 major types:

i) α (Alpha) adrenergic receptors (mostly excitatory)

They include many subtypes;

- **α 1 receptors**
- **α 2 receptors**

ii) β (beta) adrenergic receptors (mostly inhibitory)

They are further subdivided into:

β 1, β 2, β 3, β 4, β 5 receptors

Receptor	Major Effector Tissues	Major Functions
Alpha ₁	SM, sphincters	Contraction (constriction),
Alpha ₂	Nerve endings	↓ Transmitter release
Beta ₁	Cardiac muscle, Kidney	↑ Heart rate and force, ↑ Renin secretion
Beta ₂	SM including bronchi Liver Skeletal muscle	Relax SM ↑ Gluconeogenesis, glycogenolysis ↑ Glycogenolysis and K ⁺ uptake
Beta ₃	Adipose	↑ Lipolysis
DA ₁	SM especially renal, mesenteric and cardiac	Relax renal vascular SM (higher doses activates β ₁ and α ₁ receptors)

Which is the number of spinal cord segments?

20 (a)

~~31~~ (b)

12 (c)

40 (d)

15 (e)

Enumerate types of neurons

Answer

- a. Afferent (sensory) neuron → carries impulses from receptors to CNS.
- b. Efferent (motor) neuron → carries impulses from CNS to effector organs.
- c. Interneuron (associative) → located entirely within CNS.

Define autonomic ganglia and mention its function and types •

Answer

Def,

- They are collection of cell bodies of neurons outside the central nervous system (CNS).

Functions:

- Act as a **relay station** for **autonomic preganglionic** nerve fibers

Types of ganglia

a) Lateral (paravertebral) ganglia:

- Located on either side of the spinal cord.
- About 22-24 ganglia on each side.
- Form 2 rows of sympathetic chain of ganglia.
- Act as a relay station for preganglionic sympathetic nerve fibers only.

b) Collateral (prevertebral) ganglia:

- Present mainly in the abdomen, midway between spinal cord and viscera.

Act as a relay station for sympathetic preganglionic nerve fibers.

c) Terminal ganglia:

- Present close to or at the wall the effector organs especially rectum; urinary bladder reproductive organs in the pelvis.
- Act as a relay station of:
 - All parasympathetic preganglionic fibers.
 - Some sympathetic preganglionic fibers.

Which is a function of sympathetic nervous system to head and neck?

- Decreased sweat secretion (a)
- Vasodilatation of skin blood vessels (b)
- Watery salivary secretion (c)
- Mydriasis(dilatation of eye pupil)** (d)
- Ptosis of eye lid (e)

Which is a function of sympathetic to thorax?

- Vasoilatation of pulmonary vessels (a)
- Bronchoconstriction (b)
- Increased effectiveness of the heart as a pump (c)
- Increased bronchial secretion (d)
- Vasoconstriction of coronary vessels (e)

Which is a function of sympathetic supply to abdomen?

a-Relaxation of Gastrointestinal walls and contraction of the sphincters

b-↑es gastric juice secretion (rich in HCL).

c-stimulates both endocrine and exocrine components of pancreatic secretions .

d-It increases hepatic bile flow.

E- Contraction of wall of gall bladder and relaxation of sphincter of Oddi → helps its evacuation.

Mention function of sympathetic supply to pelvis and kidneys

To pelvis

Origin:

- LHCs of L1, L2, and L3 segments of spinal cord.

Functions:

1. **Urinary bladder:** causes relaxation of its wall and contraction of internal urethral sphincter → retention of urine.
2. **Rectum:** causes relaxation of its wall and contraction of internal anal sphincter → retention of feces.
3. **Sex organs**
 - I. It causes contraction of smooth muscle of seminal vesicle, vas deferens and ejaculatory duct → ejaculation of semen.
 - II. It causes VC of blood vessels of pelvic viscera → shrinkage of external sex organs e.g. penis.

To kidneys

- It decreases renal blood flow.
- It decreases urine output

Mention origin and parasympathetic functions of facial nerve

Answer

Facial Nerve

Origin:

- From Pons

Functions:

1. **Lacrimal glands:** i) Vasodilatation. ii) Secretion of tears.
2. **Submandibular and sublingual salivary glands:**
 - I. Vasodilatation.
 - II. True salivary secretion (large in volume, watery, rich in electrolyte and poor in enzymes).

Which is the parasympathetic nerve which (a) supply the thoracic and abdominal organs?

Glossopharyngeal (a)

Vagus (b)

Oculomotor (c)

Pelvic (d)

Sciatic (e)

Mention functions of parasympathetic nervous system to abdomen

Answer:Abdomen:

a) GIT

- It causes contraction of their walls and relaxation of their sphincters.

b) Glands

- **Gastric glands**→ ↑es gastric juice secretion (rich in HCL).

Pancreas: stimulates both endocrine and exocrine components pancreatic secretions .

c) Liver:

- It increases hepatic bile flow.

d) Gall bladder:

- **Contraction of its wall and relaxation of sphincter of Oddi** → helps its evacuation.

e) Blood vessels:

- **Vasodilatation.**

Which is the autonomic parasympathetic receptors present in smooth muscles and glands?

Adrenergic B₁ receptors (a)

Cholinergic nicotinic receptors (b)

Adrenergic alpha 1 receptors (c)

Adrenergic B₂ receptors (d)

Cholinergic muscarinic receptors (e)

Which is the autonomic receptors which its stimulation leads to increased heart rate and force?

Adrenergic B₂ (a)

Adrenergic alpha₂ (b)

Cholinergic nicotinic (c)

Adrenergic B₁ (d)

Cholinergic Alpha 1 (e)

Which is the autonomic receptors which its stimulation leads to contraction of sphincters?

- Cholinergic muscarinic (a)
- Adrenergic Alpha 1 (b)
- Adrenergic alpha2 (c)
- Cholinergic nicotinic (d)
- Adrenergic B2 (e)



Thank

You●