



Lecture:

Somatic and Autonomic Reflexes

Dr. Eyad M. Hussein

**Ph.D. of Neurology,
Consultant & Head of Neurology Department,
Nasser Hospital**

The Human Reflexes

- **Reflex:** are involuntary action performed in response to impulses (a sensory stimulus).

reflex هو partella
↳ motor response

المثير الحسي ←
sensory stimulus

.. gastric secretion, ... stimulus ← ...

Classification of Reflexes

A. **Peripheral Reflexes or “Autonomic Reflexes”:**

“sympathetic and parasympathetic” reflexes, e.g. GIT reflexes.

B. **Central reflexes:**

قبل تعلم العضل للأصغر

1. **Conditioned reflexes:** acquired “develop by learning and training” and are integrated in cerebral cortex.

2. **Unconditioned reflexes:** congenital occurs since birth without learning:

فقد يولد

- **Hypothalamic reflexes:** regulate body temperature, water balance and others.

- **Midbrain reflexes:** postural and visual reflexes. light reflex

- **Medullary reflexes:** cardiovascular, respiratory and digestive reflexes. Med

- **Spinal reflexes:** superficial, deep and visceral reflexes.

Autonomic reflex

stim. R in the tendon ex Patellar reflex

مخاطبة يترك العضل
Joint
stim. of skin or mucosa

Functions of the Somatic Reflexes

Somatic reflex ← skeletal M } deserve sensory stimuli, least
Autonomic ← smooth M }
 vascular reflex cardiac M
 gland

↳ any reflex begin by receptor [sensory] and end by target organ

- ✓ To protect from harm.
- ✓ To maintain posture/balance.
- ✓ To direct attention to stimuli.

Functions of the ^{vesciral} Autonomic Reflexes

↳ cont. cardia, smooth muscle, gland.

- To protect from harm.
- To maintain homeostasis (BP, heart rate, digestion).
- To direct focus and prepare for certain stimuli

('fight or flight' & 'rest & digest').

sympathetic.

parasympathetic.

SPINAL CORD REFLEXES

Somatic

→ skeletal muscle / عظام و عضلات

Flexion

Stretching

Rhythmic movements

Extension

Protective reactions

Tendon reflexes
knee jerk
Biceps
Triceps

Walking

Standing posture

Scratching

Withdrawal responses

Muscle tone formation
patellar.
biceps reflex
etc

Removal of excitatory stimuli

Vegetative

→ visceral or Autonomic

Urination

Defecation

Vasomotor

/ relax. of internal sphin.

Elimination of toxic substances

Effective blood supply

Excretion

Vasomotor tone

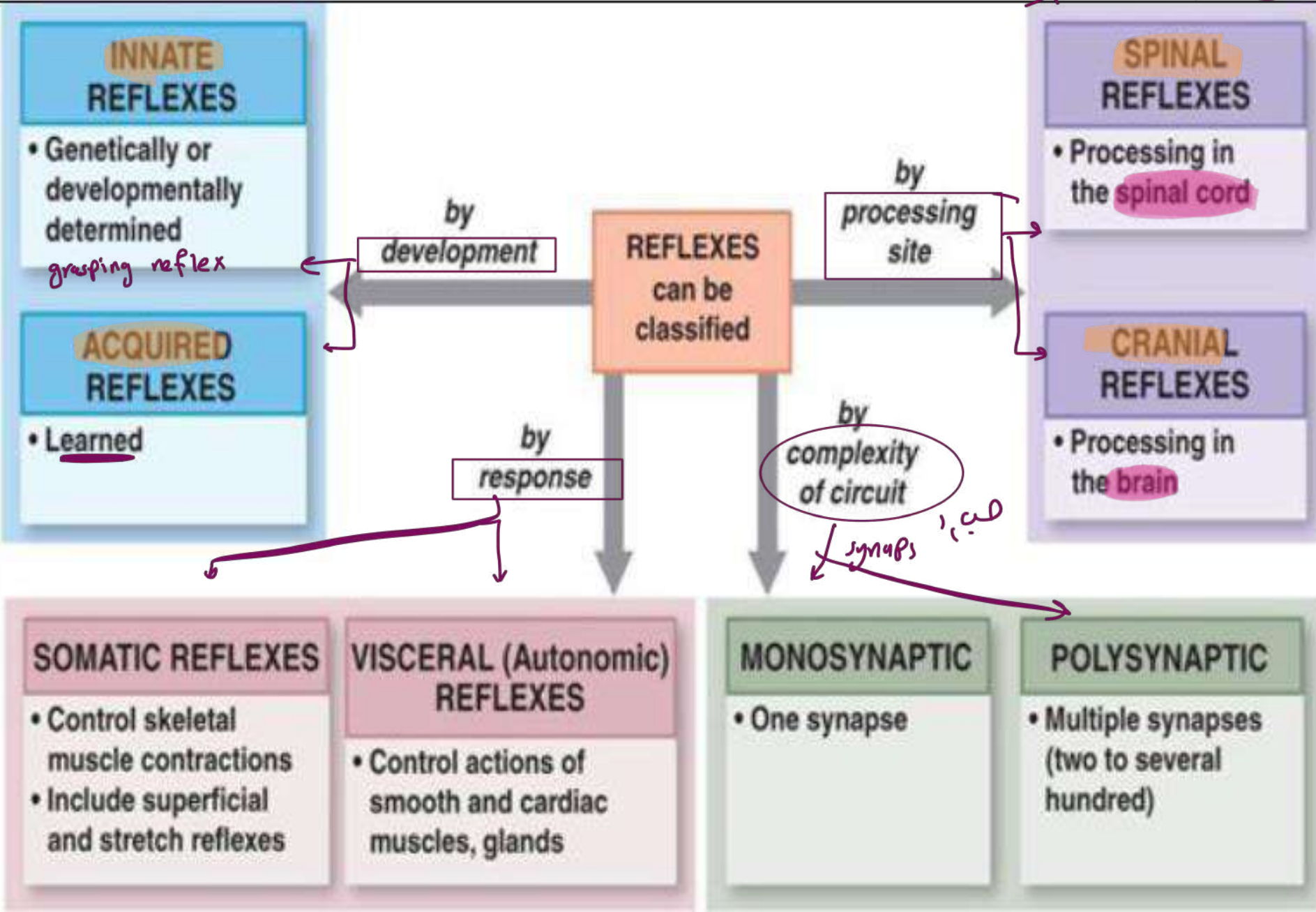
contract. the wall of bladder

* [pudendal nerve !!]

حالة من خفة اليد / خفة اليد

Classification of Reflexes

site of reflex



Classifications of Reflexes

A. According to number of neurons:

1. **Polysynaptic**: sensory axon synapse with one or more interneuron

✓ **Examples**: withdrawal, abdominal, visceral, and plantar reflexes.

2. **Monosynaptic**: sensory axon synapse with directly with anterior horn cell. *not synap with more than one inter neuron..*

✓ **Examples**: stretch reflexes.

❖ When a reflex ARC consists of only two neurons
“One sensory and one motor” it is defined as
monosynaptic.

B. According to receptor side:

1. **Deep Reflexes**: Stimulation of deep receptors in the muscles and tendons.

ا ← **a. Stretch Reflexes**: tendon jerks, they monosynaptic. The receptors is **muscle spindle**. tapping by hammer multiple stroke

✓ **Examples**: knee and patellar reflexes. tapping by hammer severe hyper reflexia and ankle in US → severely hyper.

b. Inverse Stretch Reflexes: are polysynaptic reflexes and the receptors are **Golgi Tendon Organ**. in the tendon of the muscle.

✓ **Example**: Extensor standing, posture, stepping, rhythmic walking, and scratching.

2. **Superficial Reflexes**: are polysynaptic. The receptors located in the skin or mucosa. plantar, gag reflex

✓ **Example**: abdominal, and withdrawal reflexes. skin or Autonomic.

3. **Visceral Reflexes**: are the reflexes where at least one part of the reflex arc is autonomic nerve. The receptors located in the visceral organs. internal organ.

All autonomic reflexes are polysynaptic with at least one synapse in the CNS and another in the autonomic ganglia.

✓ **Example**: Micturition, defecation, carotid sinus, and pupillary reflexes. light reflex.

Spinal Reflexes

- A. Superficial reflexes.
- B. Deep reflexes (Muscle stretch or myotatic reflexes).
- C. Visceral reflexes.

A. Superficial Reflexes

- Abdominal reflexes (upper, middle and Lower).
+ planter reflex
- Anal reflex.
- Cremasteric reflex.
- ← *pontes* Corneal “Conjunctival” reflex “Pontine level”
- ← *MO* Palatal reflex “Medullary level”.
- Gag “Pharyngeal” reflex “Medullary level”.

MO → intergatory center

cranial reflex

spinal cord

[spinal reflex]

B. Deep “Proprioceptive or Stretch” Spinal Reflexes

- Jaw reflex.
- Biceps reflex.
- Triceps reflex.
- Supinator (Brachioradialis) reflex.
- Knee “Patellar” reflex.
- Ankle (Achilles) reflex

any reflex begins in receptor

The Human Reflex Arc

impairment

superior sensory pathway / afferent or efferent (motor) or both.

1. **Sensory receptors.**

2. **Sensory Neurons:** in the spinal or cranial nerves ganglia and in the PHCs or brain stem.

cranial / post root ganglia, post. horn cell, sensory ganglia of cranial nerve
spinal root ganglia

3. **Nerve center “Interneuron” or Integrative Center:**

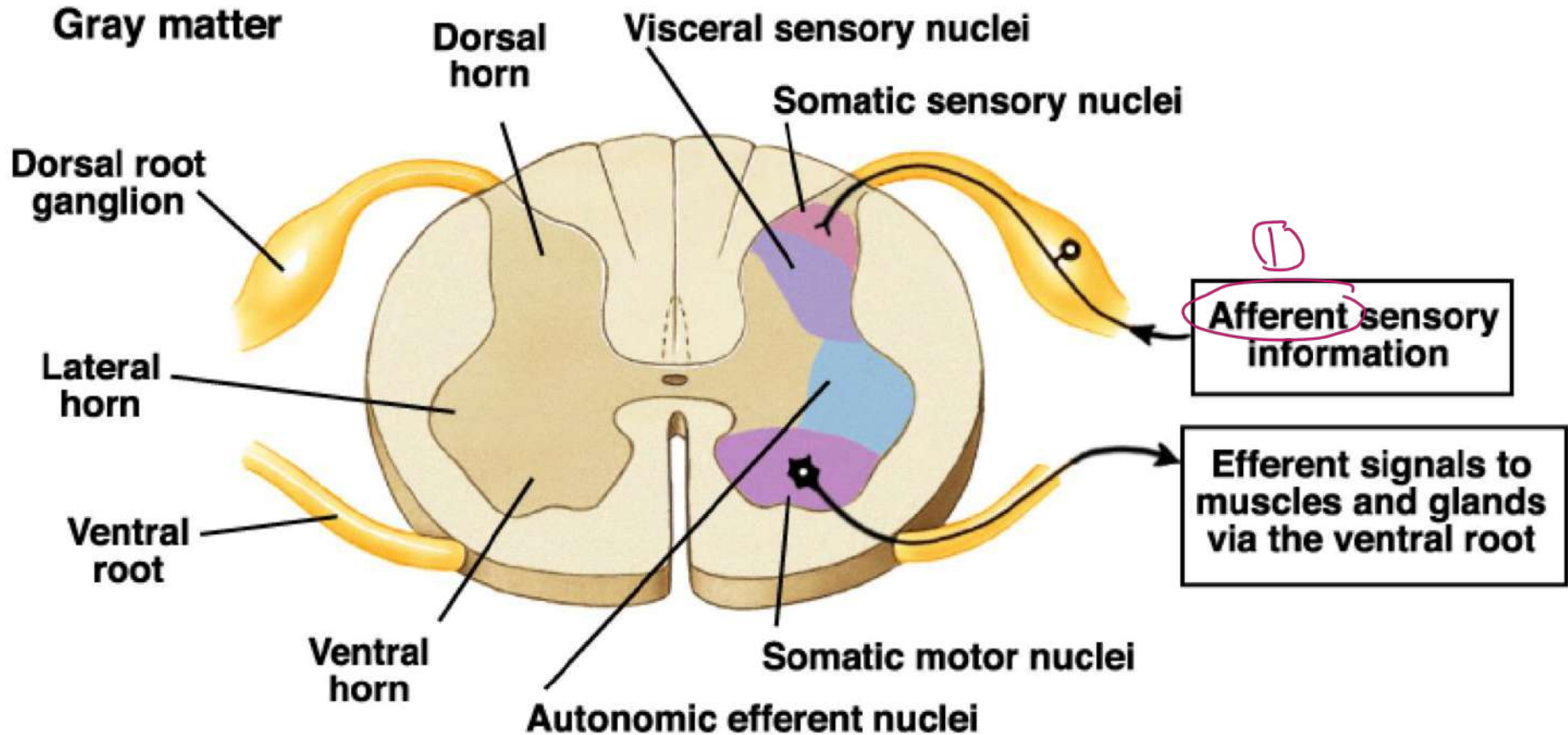
located between the AHCs and PHCs, also located in the brain stem.

4. **Efferent output “Motor Neuron”:** located in the AHCs of the spinal cord and motor nuclei of the cranial nerves.

5. **Effector:** If the effector is **skeletal muscle**, the reflex is a **somatic reflex**. If the effector is **smooth muscle, or a gland**, the reflex is an **autonomic (visceral) reflex**.

or cardiac M.

spinal reflex



Muscle Stretch Reflex Arc of Spinal Reflexes

- Stretch reflex induced by tapping the receptors of the tendon muscle → sensory fibers of the peripheral nerve → posterior root → posterior root ganglion → posterior horn cells of the spinal cord → Interneuron → anterior horn cells of the spinal cord of the same side and the same level segment → anterior root → motor fibers of the peripheral nerve → muscle contraction.
- Handwritten annotations: A circled '1' is above 'tapping'. A circled '2' is above 'sensory fibers'. A blue arrow points from 'sensory fibers' to 'SC' (spinal cord). A red arrow points from 'sensory fibers' to 'Brain stem'. The word 'effector.' is written below 'muscle'.

Knee Jerk

- **Muscle stretch reflex arc for knee jerk:**
- Stretch reflex induced by stimulation of receptors by tapping the patellar tendon of the quadriceps muscle → sensory fibers of the femoral nerve → posterior root → posterior root ganglion → posterior horn of the spinal cord “L2 – L4” segments → interneuron → anterior horn cells of the spinal cord of the same side → anterior root → motor fibers of the femoral nerve → quadriceps muscle → contraction with extension of the knee.

Spinal cord

Ventral root

Motor nerve (efferent)

Dorsal root

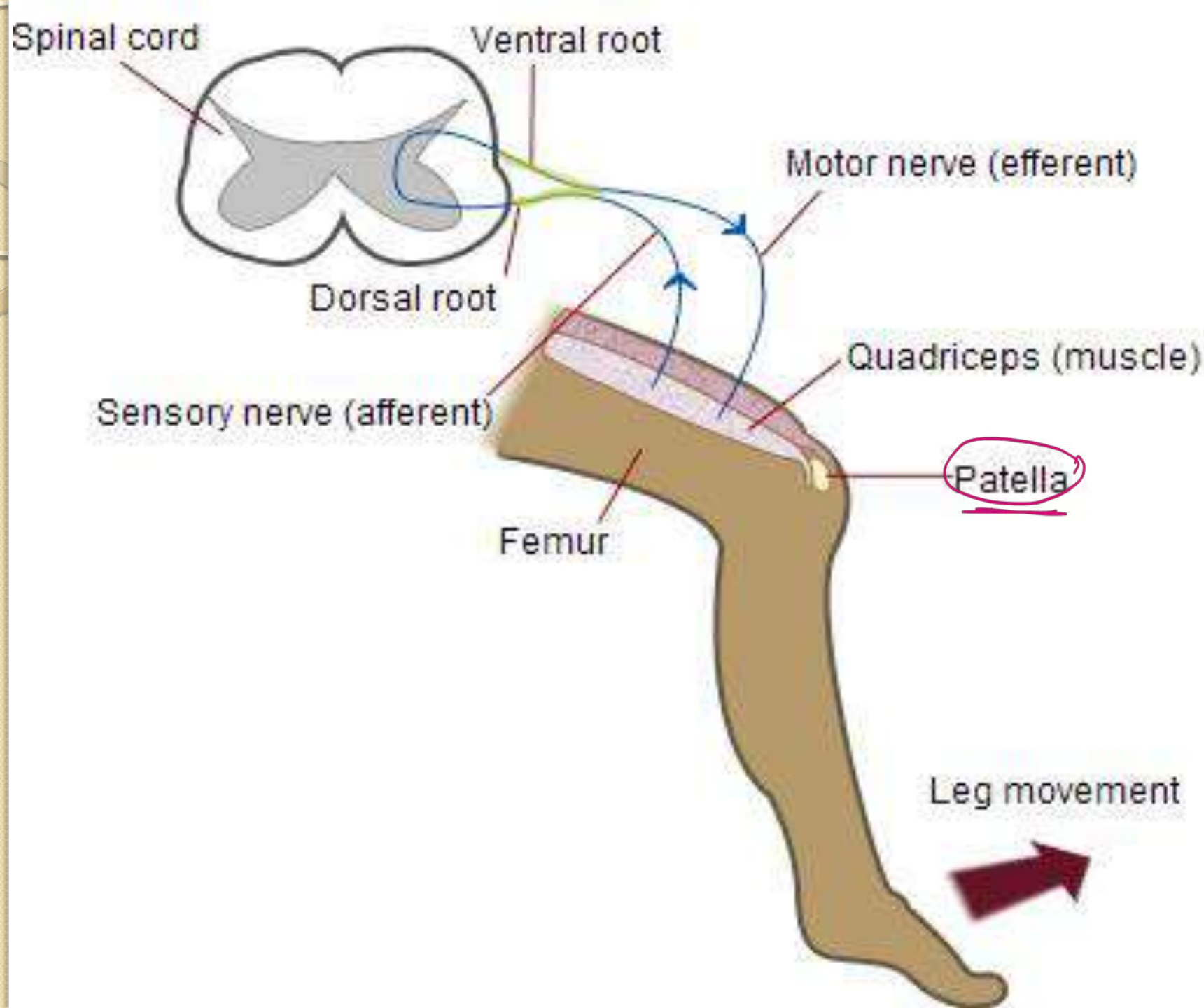
Sensory nerve (afferent)

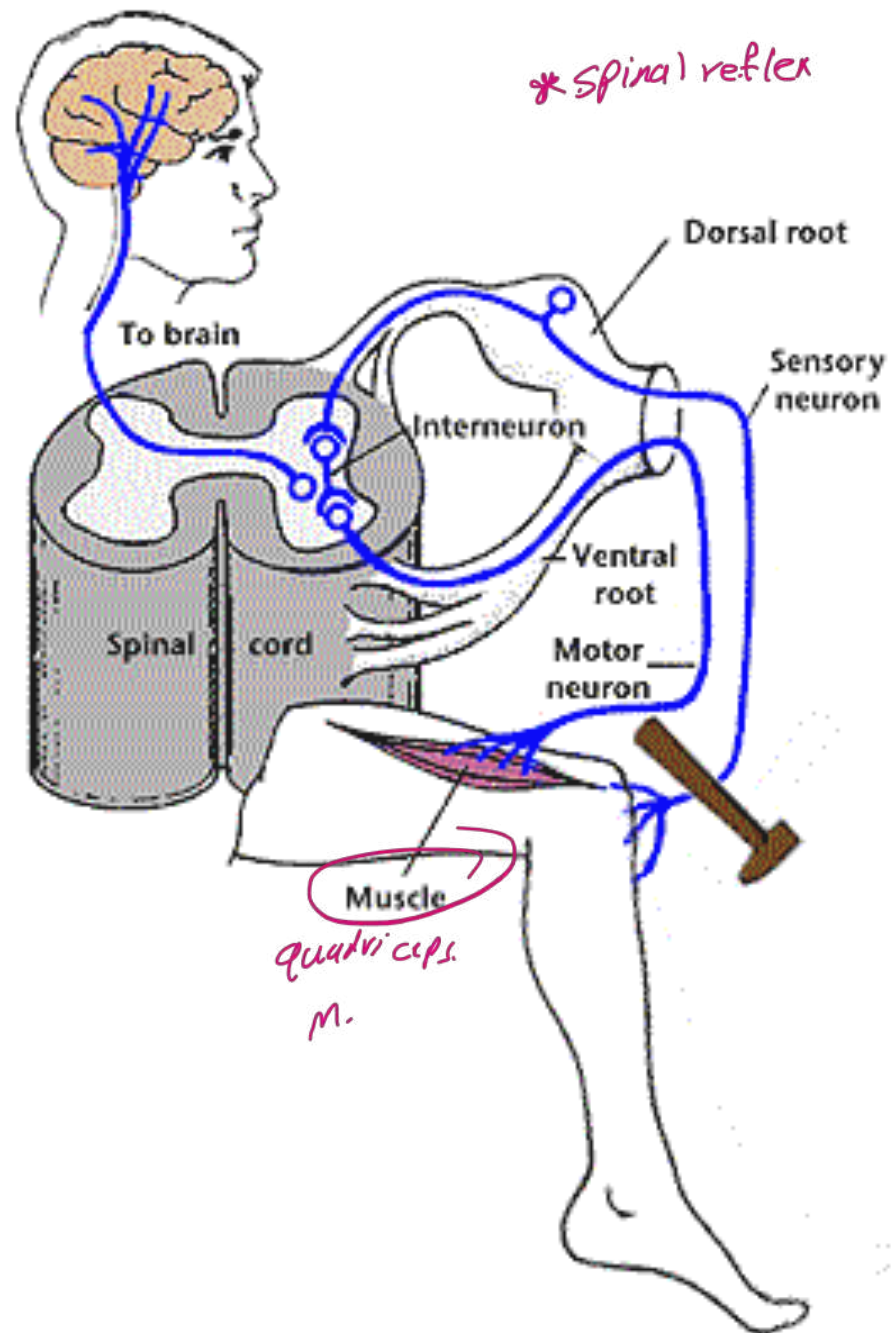
Quadriceps (muscle)

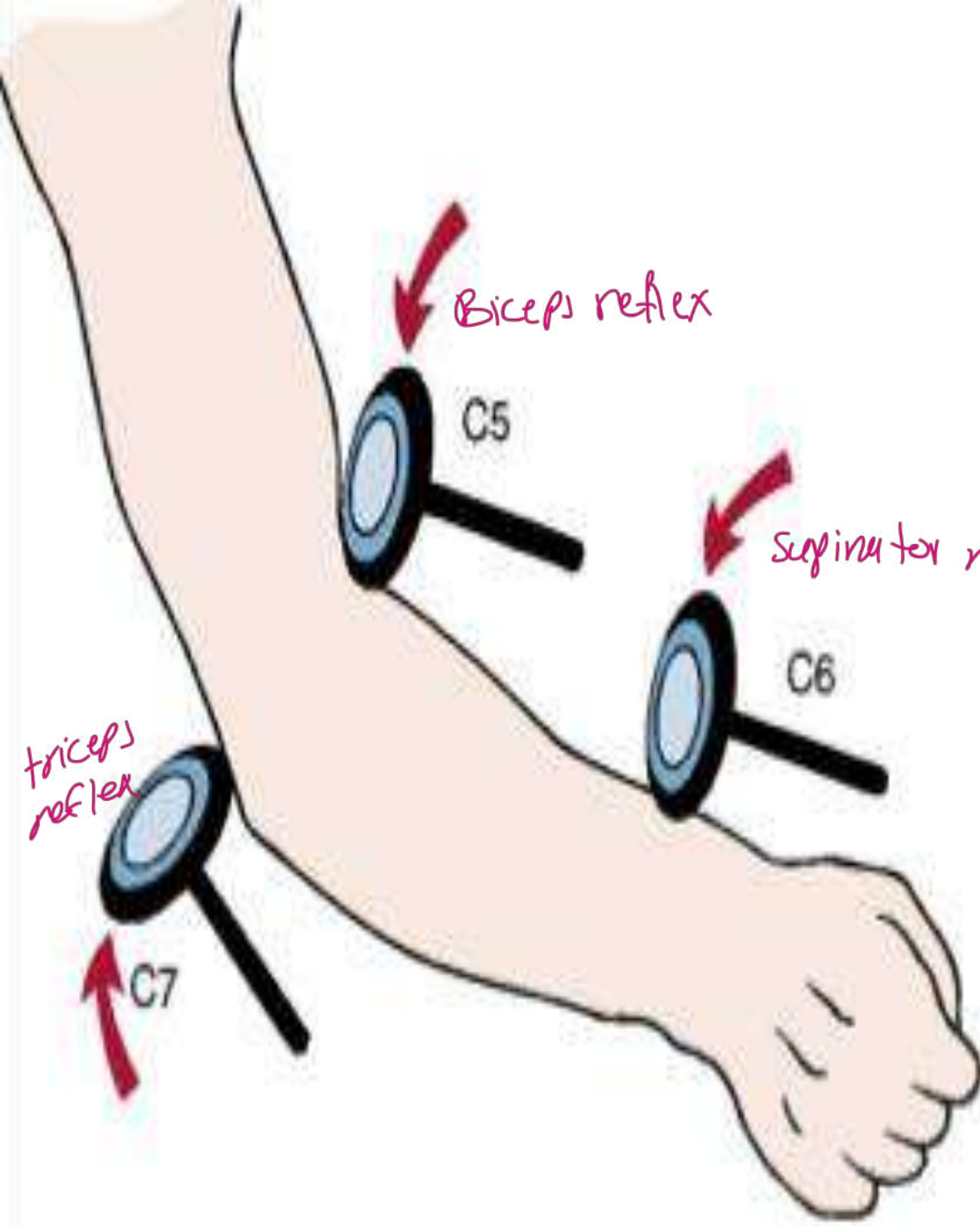
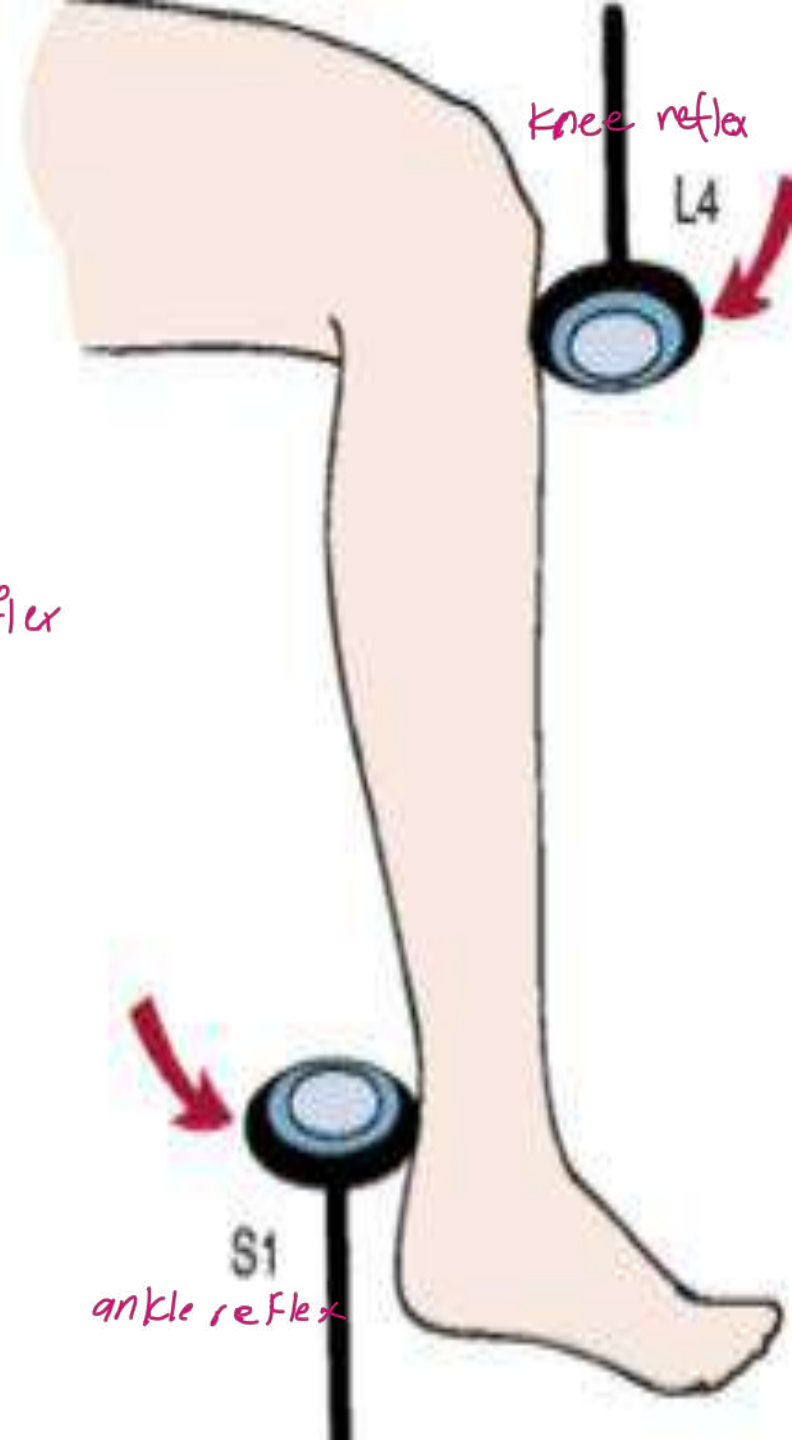
Femur

Patella

Leg movement



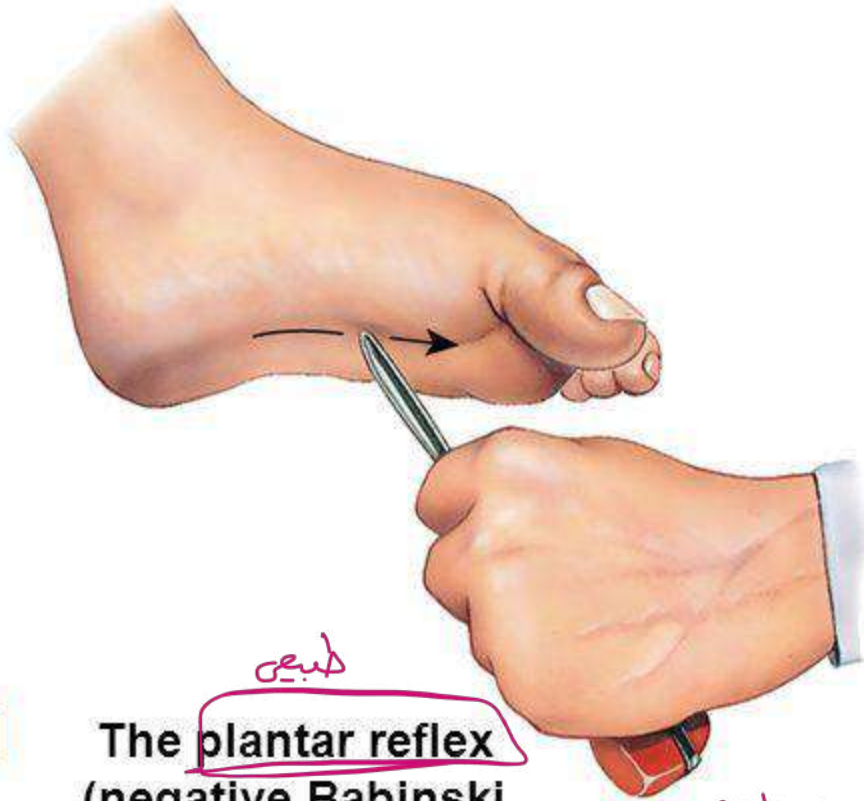




The Five Most Commonly Tested Muscle Stretch Reflexes

Muscle Stretch Reflex	Spinal Cord Segment	Nerve	Muscle
Ankle “Achilles” Jerk	S1 – S2	• Tibial	• Gastrocnemius
Knee “Patellar” Jerk	<u>L2 - L4</u>	• Femoral	• Quadriceps
Biceps Jerk	C5 – C6	• <u>Musculocutaneous</u>	• <u>Biceps</u>
Forearm “Brachioradialis or Supinator” jerk	C5 – C6	• Radial	• Brachioradialis
Triceps	C7 – C8	• Radial	• Triceps

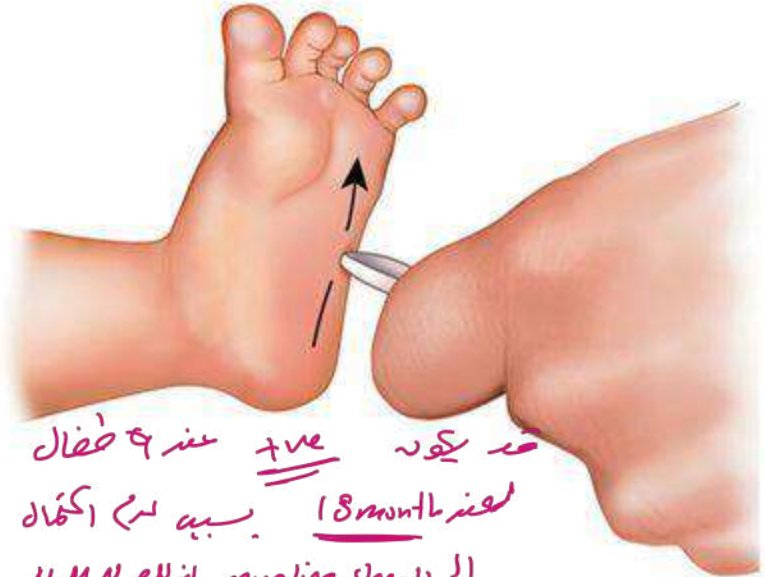
The Babinski Reflexes



a

The plantar reflex (negative Babinski reflex), a curling of the toes, is seen in healthy adults.

extension of big toe
+ flexion of finger.
↳ up normal.



b

The Babinski sign (positive Babinski reflex) occurs in the absence of descending inhibition. It is normal in infants, but pathological in adults.

من بعد سن 18 months
بجانب عدم اكتمال
myelination sheath

THE WITHDRAWAL REFLEX

REFLEX	Flexor reflex or withdrawal reflex	
CLINICAL TEST/STIMULUS	Sharp painful stimulus (stepping on nail)	
RESPONSE	Limb is rapidly withdrawn	
SENSORY RECEPTOR	Cutaneous skin and pain receptors	
SYNAPSES INVOLVED	Polysynaptic (via interneuron)	
EFFECTS ON MUSCLE	Contracts flexor muscle	
OTHER EFFECTS	Relaxes (-) extensor muscle of same limb	Reverse effect on opposite limb (crossed extensor reflex)
FUNCTION	Protective - withdrawal from painful stimulus	Cross extensor aids in maintaining posture when opposing leg is lifted

C. Visceral (Autonomic) Reflexes

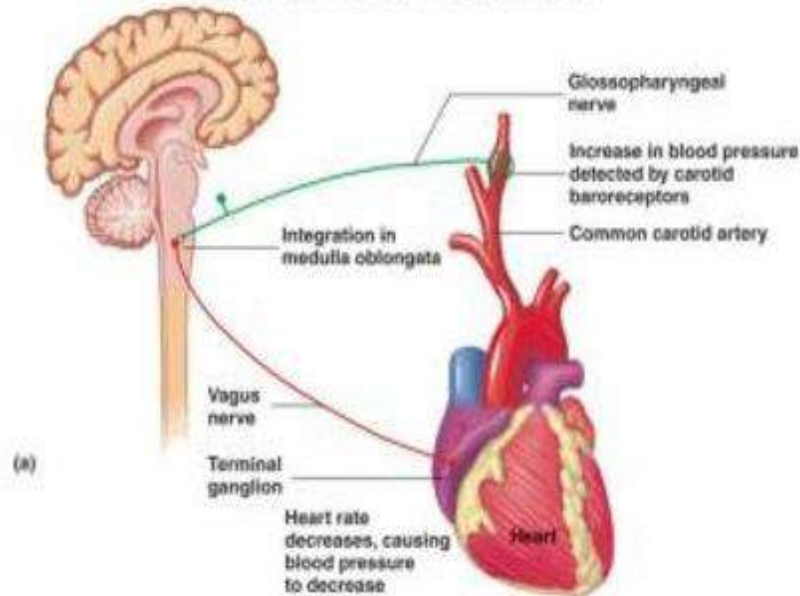
- Micturition Reflex.
- Defecation Reflex.
- Erection reflex.
- Peritoneo-intestinal reflexes that inhibit *peritonitis → inhibition the peristaltic → to ↓ the irritation of intestine.*
gastrointestinal motility in response to peritoneal irritation.

Autonomic Reflexes in the Spinal Cord

1. Changes in vascular tone resulting from changes in local skin heat.
2. Sweating, which results from localized heat on surface of the body. *يعني لو خفي ل حامي في الشبة 2 حمر
" " بارد " " زهره*
3. Reflex for motor control of intestinal.
4. Peritoneointestinal reflexes that inhibit gastrointestinal motility in response to peritoneal irritation.
5. Evacuation reflex for emptying the full bladder or the colon. *micturition,*

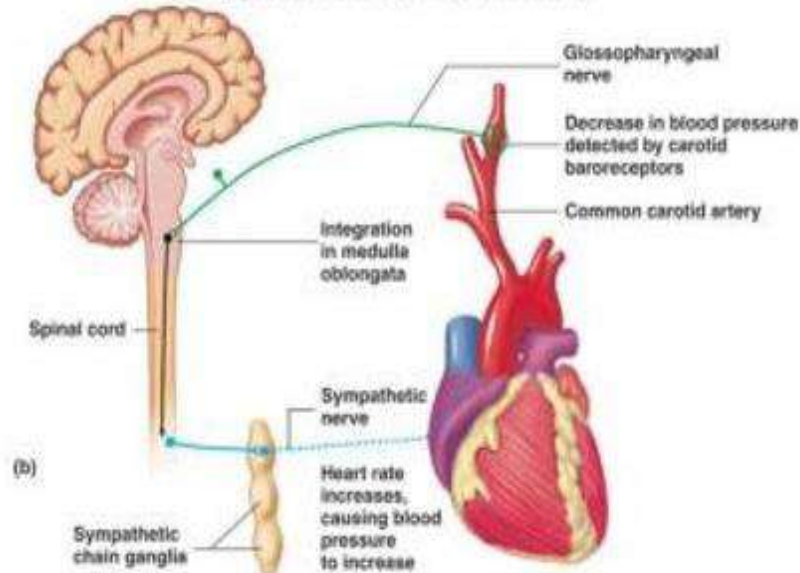
٤

The Autonomic Reflexes



a) Parasympathetic reflex via vagus lowers heart rate.

Brady cardiac

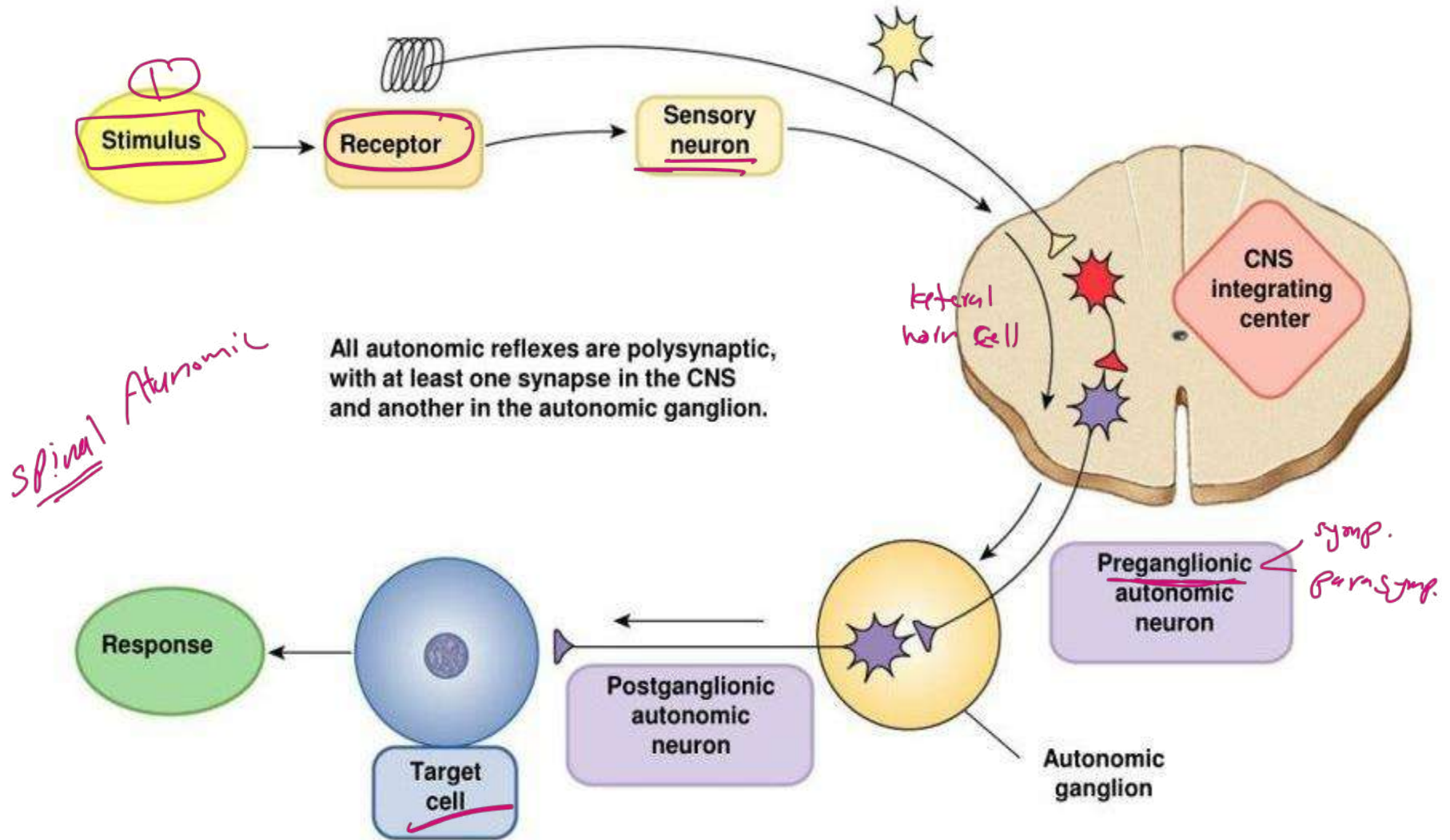


b) Sympathetic reflex via cardiac accelerator nerves (sympathetic) cause heart rate to increase.

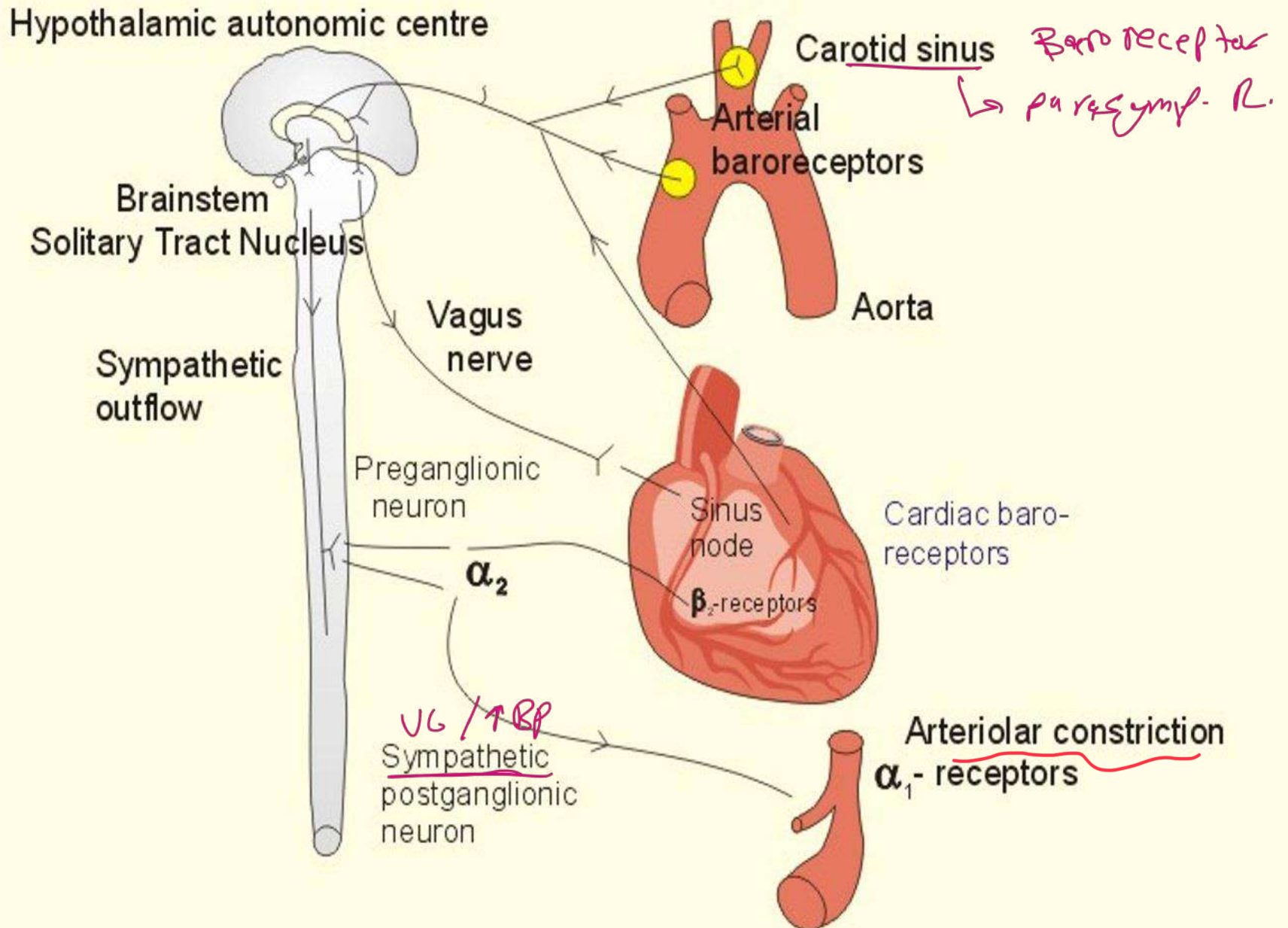
Tachy Cardia.

The Autonomic Reflexes

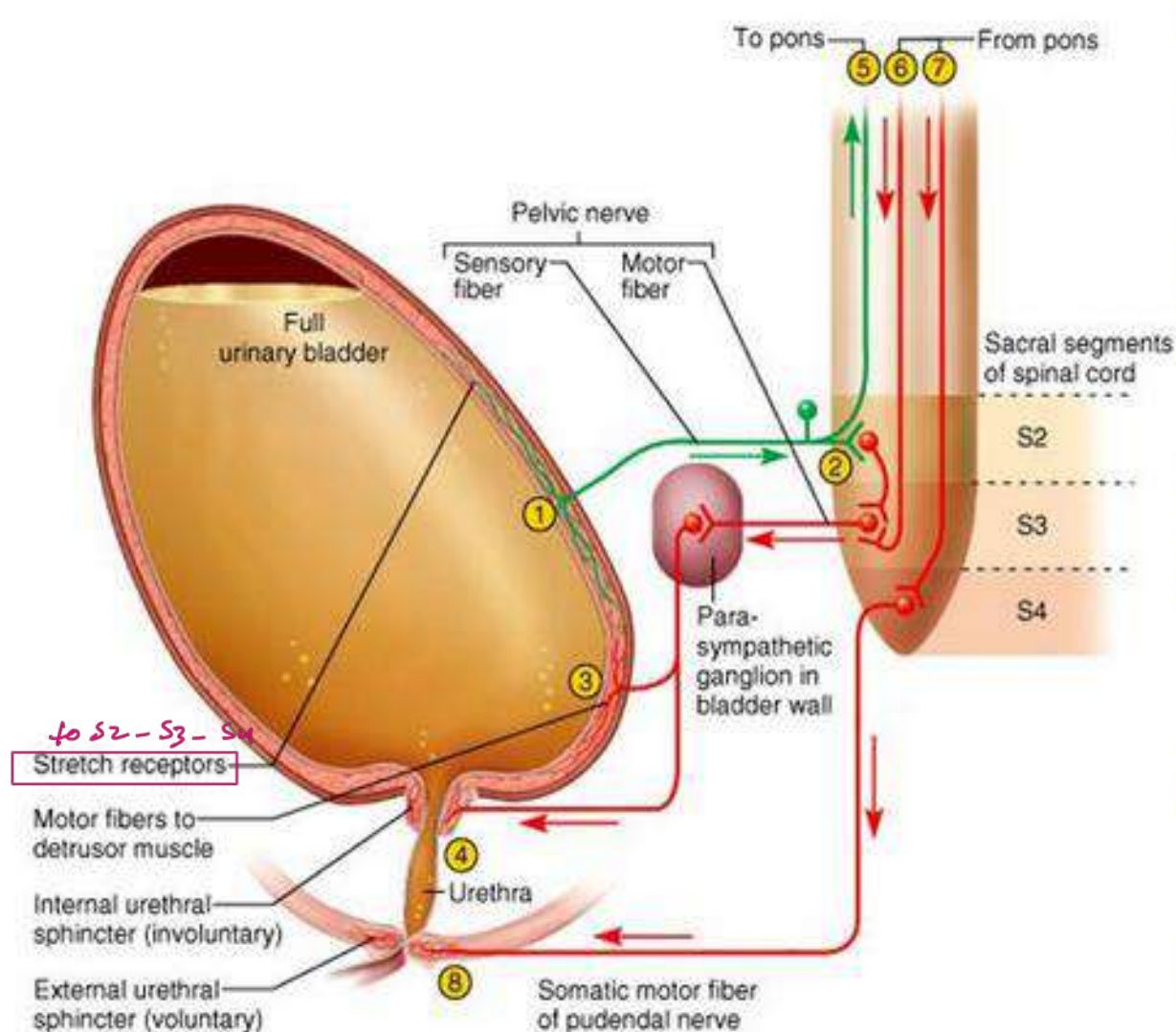
Some visceral reflexes are spinal reflexes



Autonomic Cardiovascular Control

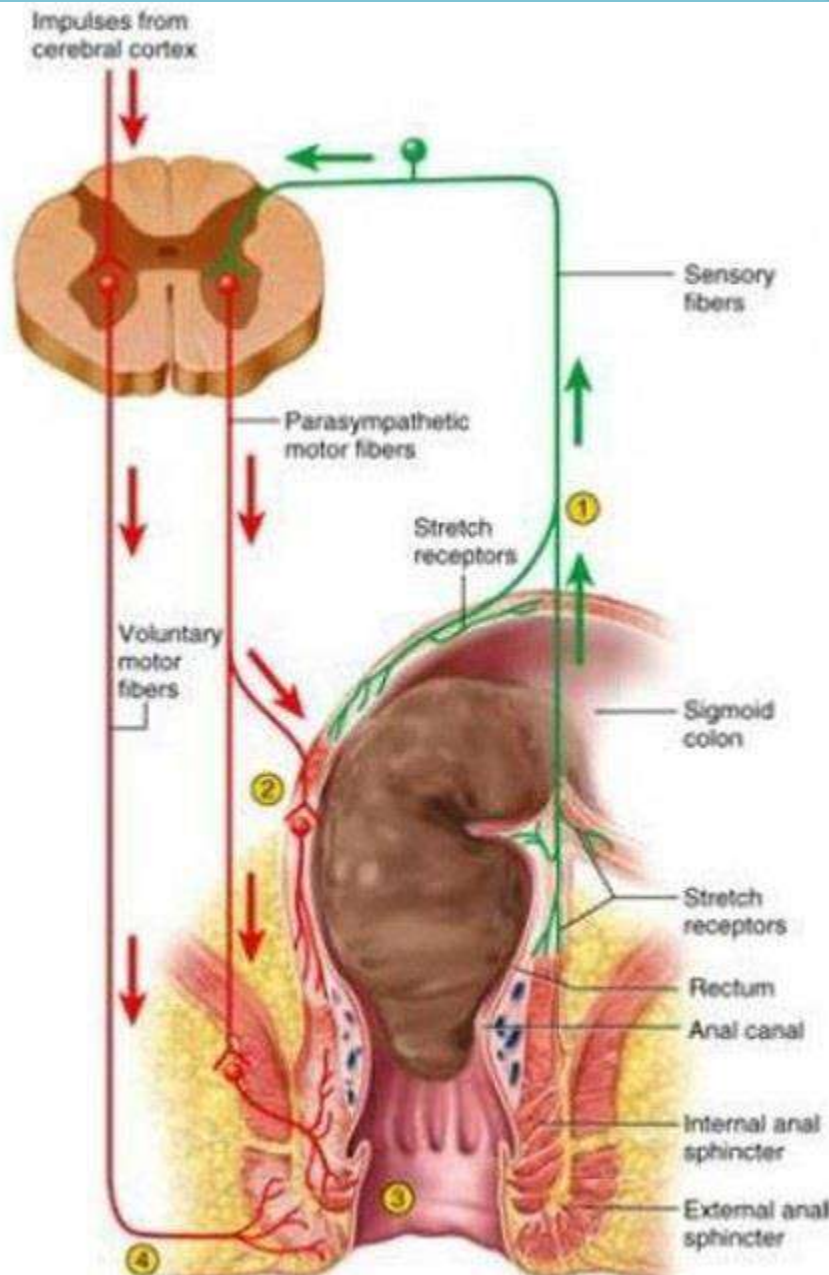


Neural Control of Micturition



- 1 Stretch receptors detect filling of bladder, transmit afferent signals to spinal cord.
- 2 Signals return to bladder from spinal cord segments S2 and S3 via parasympathetic fibers in pelvic nerve.
- 3 Efferent signals excite detrusor muscle.
- 4 Efferent signals relax internal urethral sphincter. Urine is involuntarily voided if not inhibited by brain.
- 5 For voluntary control, micturition center in pons receives signals from stretch receptors.
- 6 If it is timely to urinate, pons returns signals to spinal interneurons that excite detrusor and relax internal urethral sphincter. Urine is voided.
- 7 If it is untimely to urinate, signals from pons excite spinal interneurons that keep external urethral sphincter contracted. Urine is retained in bladder.
- 8 If it is timely to urinate, signals from pons cease and external urethral sphincter relaxes. Urine is voided.

Parasympathetic Defecation Reflexes



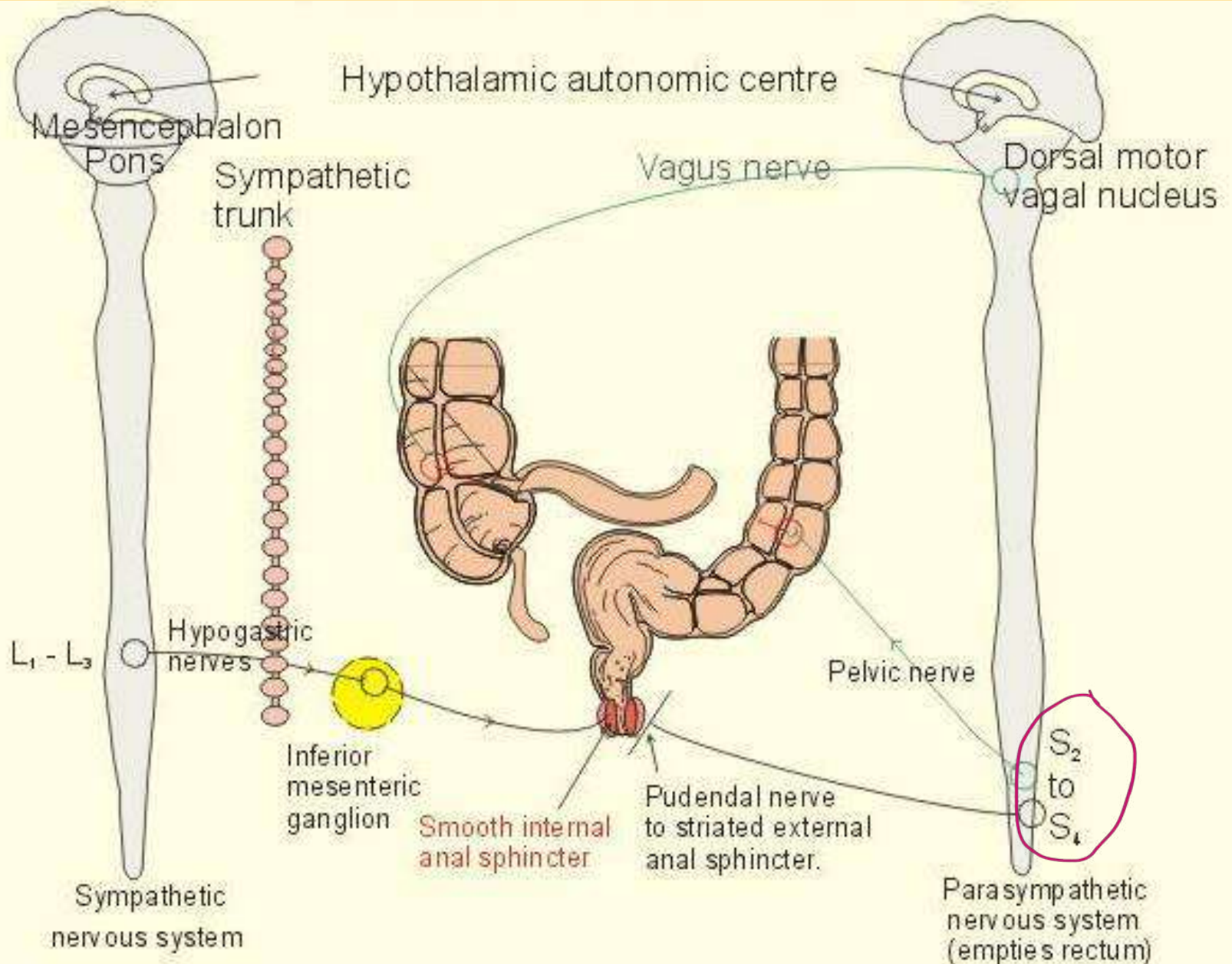
- 1 Feces stretch the rectum and stimulate stretch receptors, which transmit signals to the spinal cord.
- 2 A spinal reflex stimulates contraction of the rectum.
- 3 The spinal reflex also relaxes the internal anal sphincter.
- 4 Impulses from the brain prevent untimely defecation by keeping the external anal sphincter contracted. Defecation occurs only if this sphincter also relaxes.

creed Donia

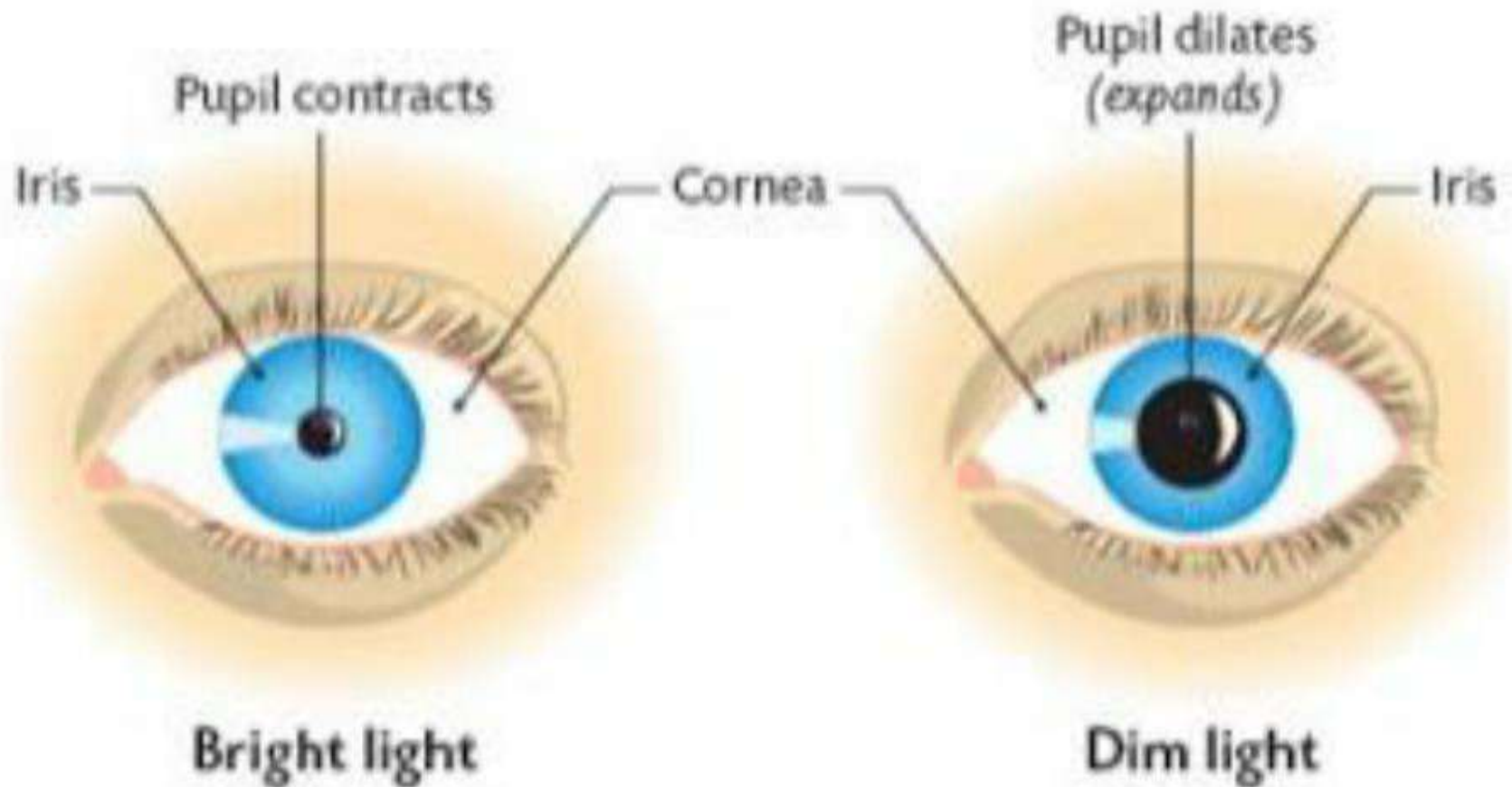
Note that this reflex opens the internal sphincter

Need voluntary relaxation of the external sphincter for defecation

Defecation Reflexes



Pupil reflex



Thank You



corneal reflex → cranial reflex

Afferent begin from eye receptor → nasociliary nerve carry signal → ophthalmic N

Efferent pathway.

← DSN at CRS in the pons ← Trigeminal N ^{afferent}
↳ integrative center.

↳ motor Nucleus of facial N. → Temporal division → temporal N
↳ efferent

.. eye closure. ← orbicularis oculi M [contract] ← zygomatic N

* the spinal reflex → integrative center in SC + Aff, Eff → SC
knee reflex

Afferent: pat. receptor → sensory fibers of femoral N → ^{issue} PRG → posterior root

interneuron ← [L2 - L4] PHCs ← Lissauer tract

Efferent:-
↳ AHCs → Ant. spinal root → motor fibers of femoral N

extension of the ← quadriceps M. [contract.]

knee

[slide 7]

[parasymp. reflex] slide 10, light reflex used & used

Afferent: sensory receptor [cones and rods of retina] → optic nerve → optic chiasm → optic tract → mid brain
.. Both E & W N ← [pretectal nuclei]

[parasymp. N.
vesical reflex
↓
supply smooth M.]

Efferent :- EWN → Oculomotor N → inferior division

8-10 ← ciliary ganglion ← N. of IOM ←
short
↳ ciliary neurons → SPM → Miosis...
↳ target organ.

[sympathetic reflex] Pupil reflex.

* Hypothalamus → hypothalamospinal tract → C8-T2 lateral horn cells → preganglionic fibers
← relay in the S.S cervical ganglion
← sympathetic plexus around ICA
↳ long ciliary N. → dilatator pup. M. → mydriasis