



Lecture:

Somatic and Autonomic Reflexes

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The Human Reflexes

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

Classification of Reflexes

A. Peripheral Reflexes or “Autonomic Reflexes”:

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

B. Central reflexes:

1. **Conditioned reflexes:** acquired “develop by learning and training and are integrated in cerebral cortex.
2. **Unconditioned reflexes:** congenital occurs since birth without learning:
 - **Hypothalamic reflexes:** regulate body temperature, water balance and others.
 - **Midbrain reflexes:** postural and visual reflexes.
 - **Medullary reflexes:** cardiovascular, respiratory and digestive reflexes.
 - **Spinal reflexes:** superficial, deep and visceral reflexes.

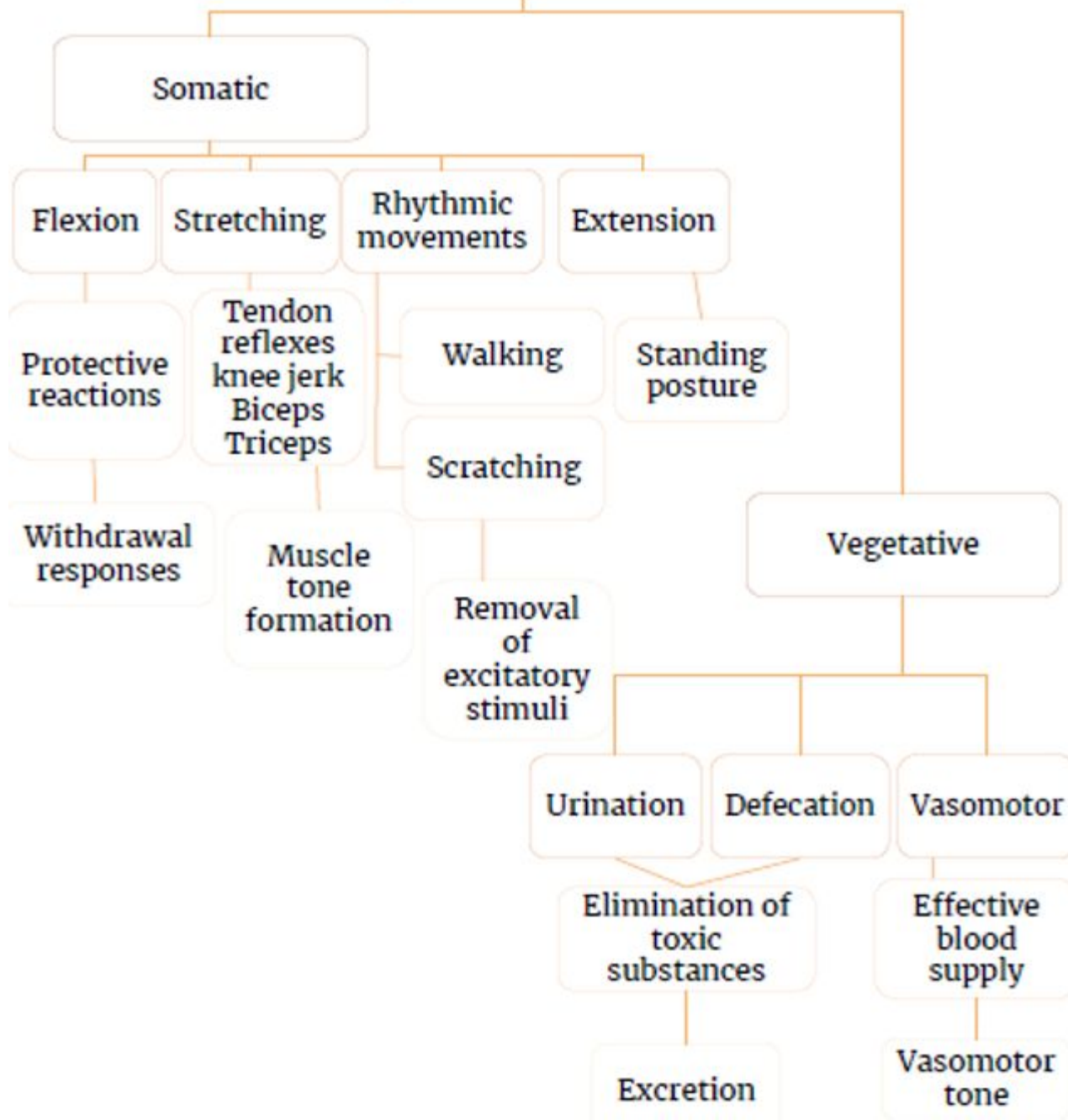
Functions of the Somatic Reflexes

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

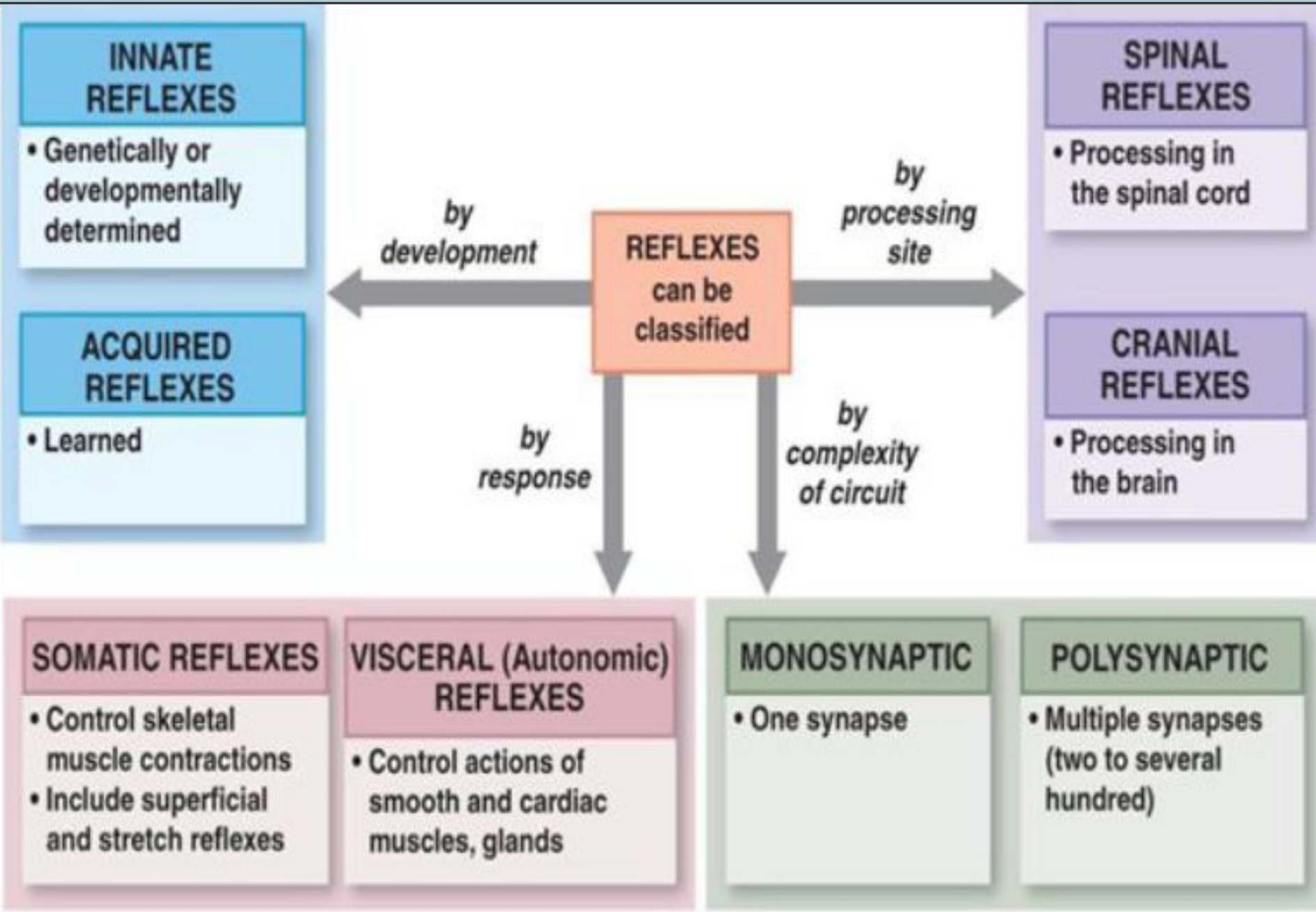
Functions of the Autonomic Reflexes

- To protect from harm.
- To maintain homeostasis (BP, heart rate, digestion).
- To direct focus and prepare for certain stimuli
(‘fight or flight’ & ‘rest & digest’).

SPINAL CORD REFLEXES



Classification of Reflexes



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.

✓ **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 site:

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

a. **Stretch Reflexes:** tendon jerks, they monosynaptic. The receptors is **muscle spindle**.

✓ **Examples:** knee and patellar reflexes.

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

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

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

✓ **Example:** abdominal, and withdrawal reflexes.

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**.

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

Spinal Reflexes

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

A. Superficial Reflexes

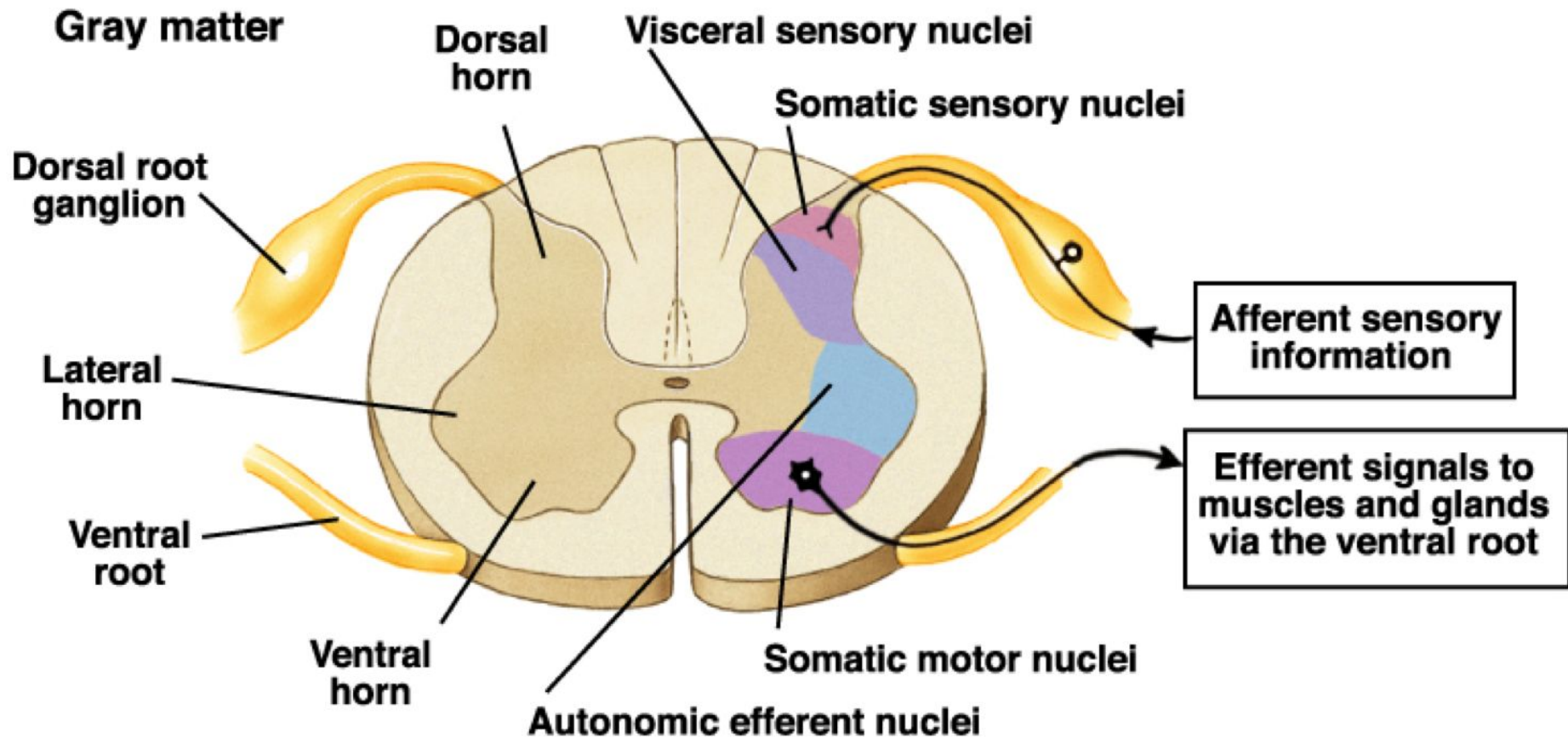
- Abdominal reflexes (upper, middle and Lower).
- Anal reflex.
- Cremasteric reflex.
- Corneal “Conjunctival” reflex “Pontine level”.
- Palatal reflex “Medullary level”.
- Gag “Pharyngeal” reflex “Medullary level”.

B. Deep “Proprioceptive or Stretch” Spinal Reflexes

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

The Human Reflex Arc

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



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.

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

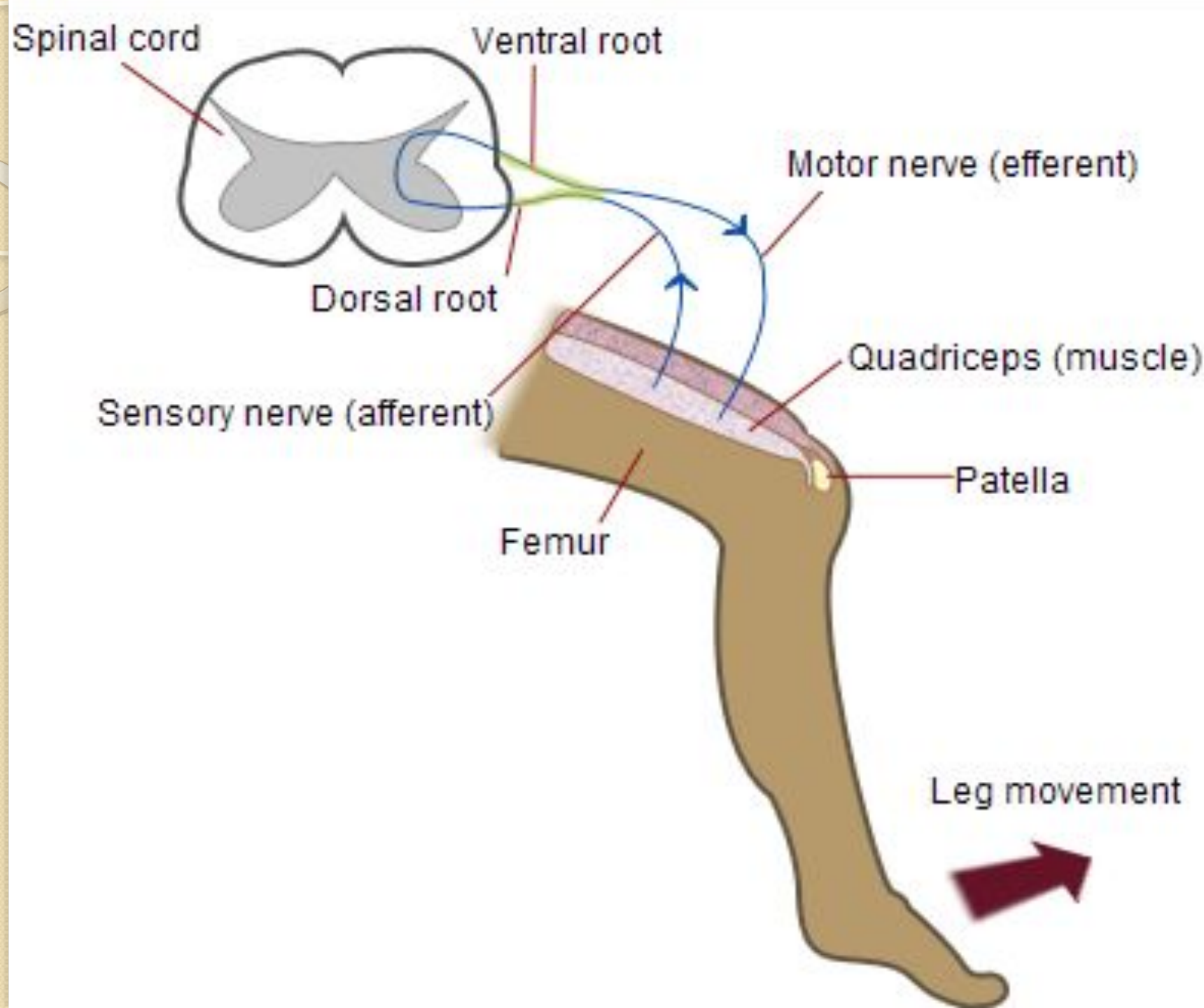
Sensory nerve (afferent)

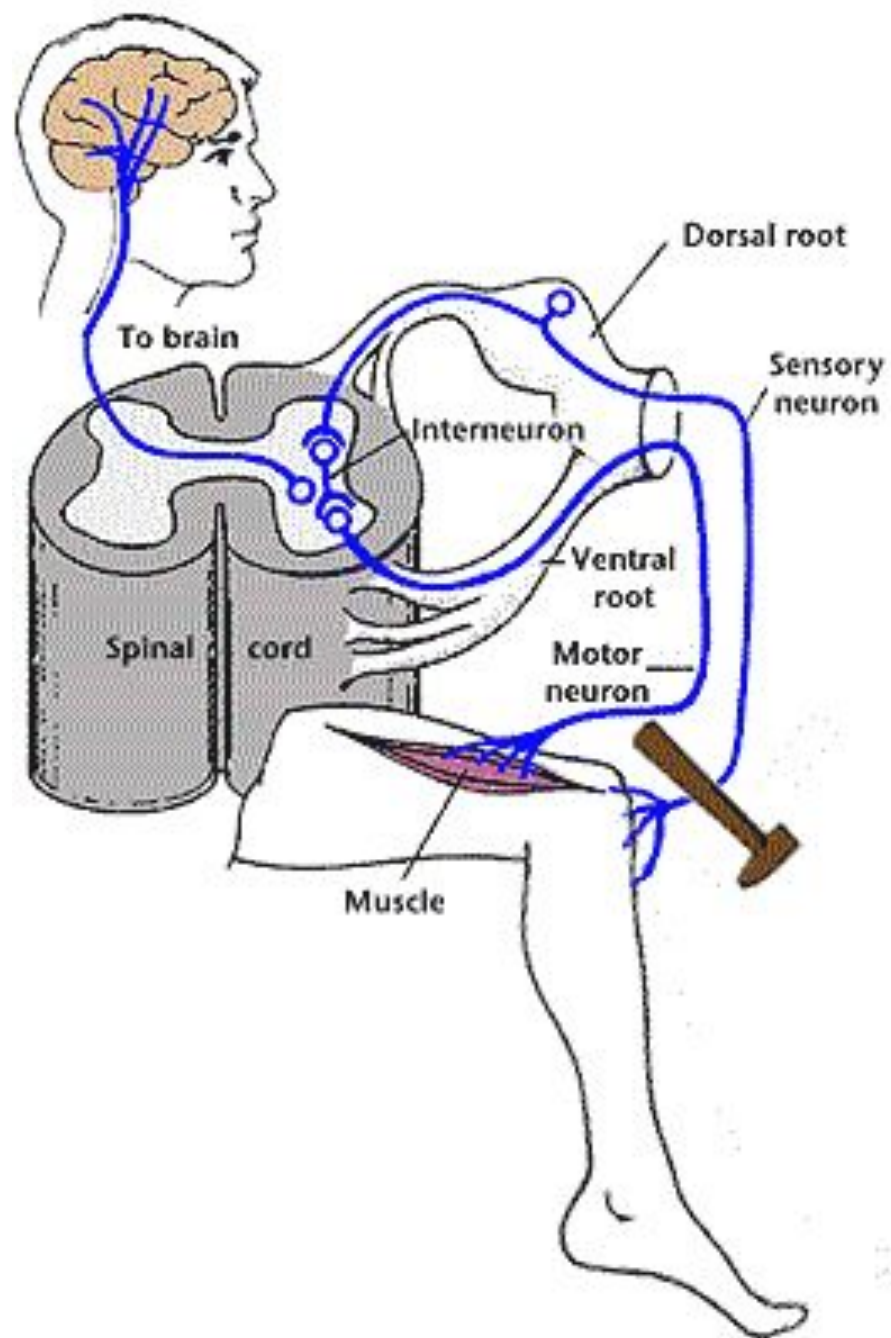
Quadriceps (muscle)

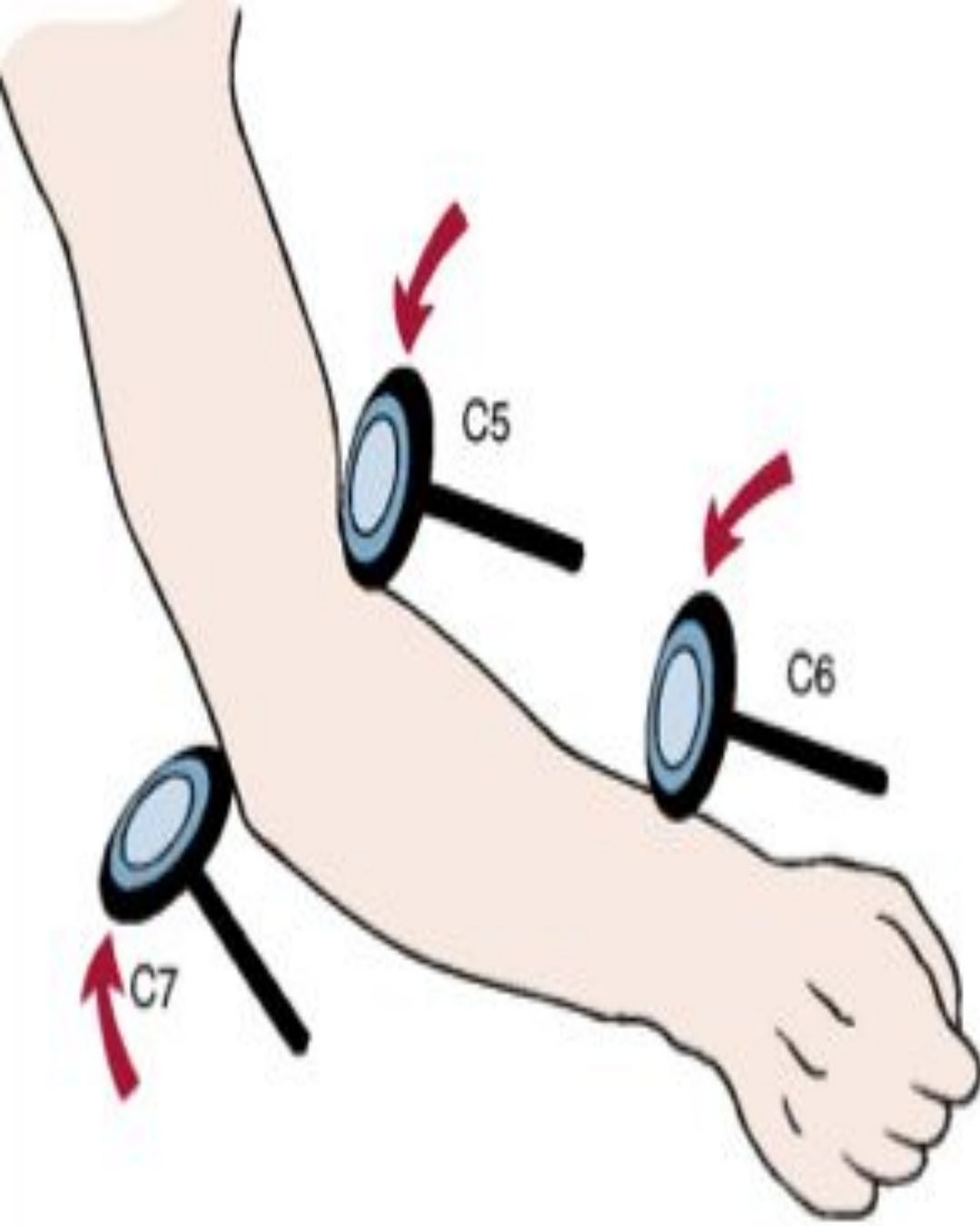
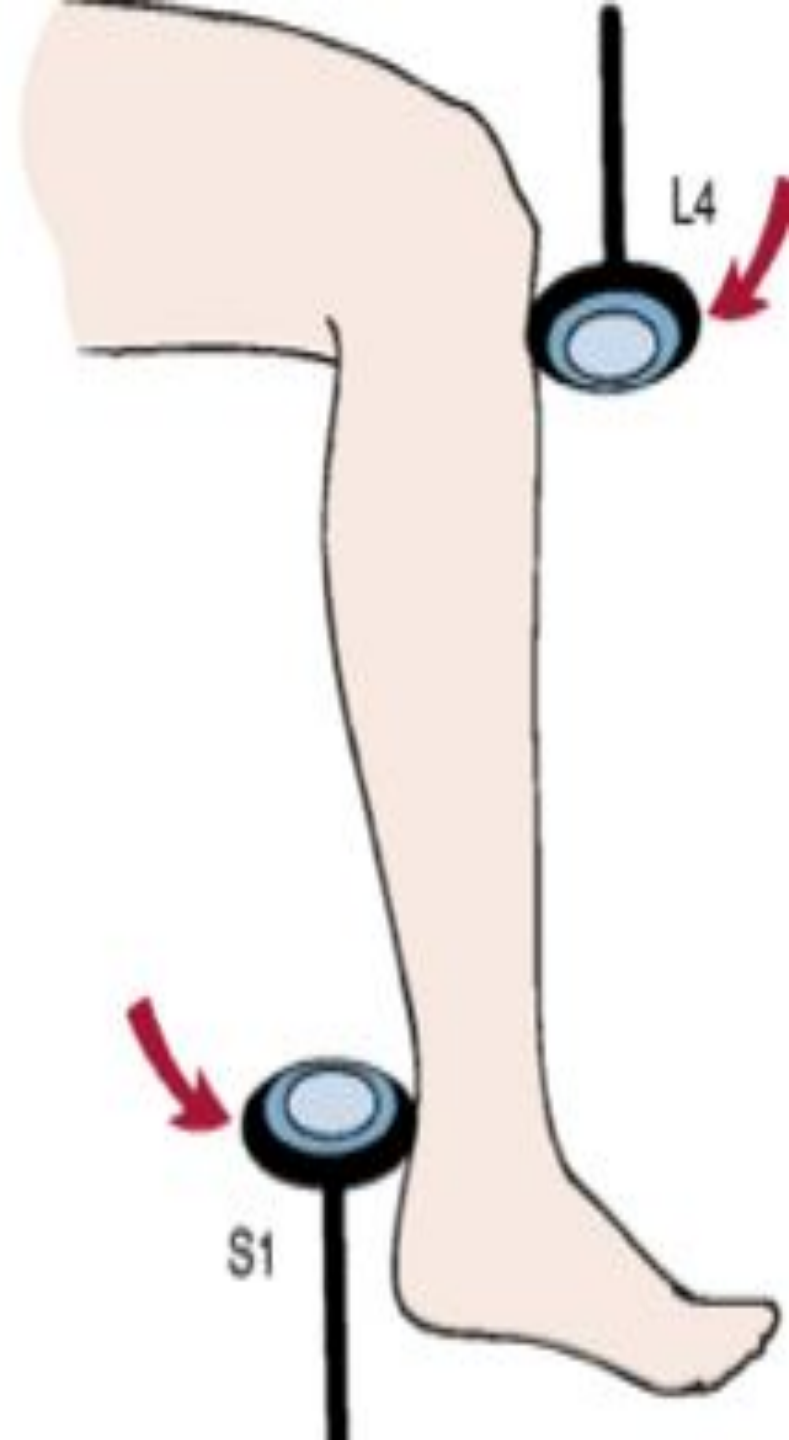
Patella

Femur

Leg movement



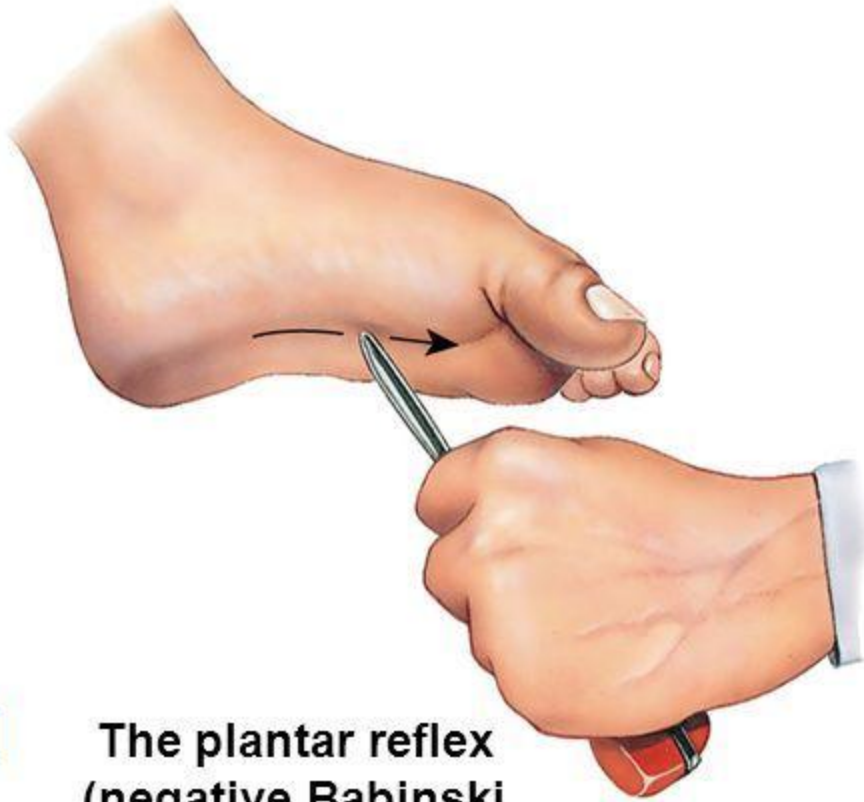




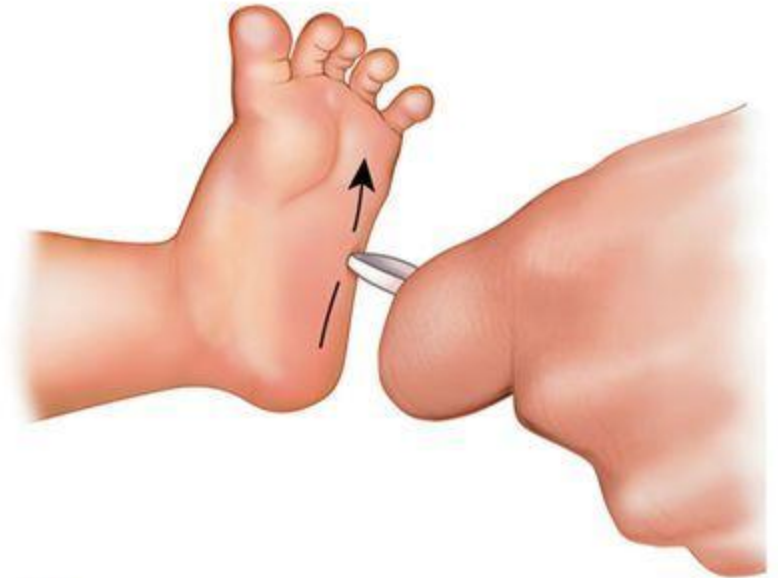
The Five Most Commonly Tested Muscle Stretch Reflexes

Muscle Stretch Reflex	Spinal Cord Segment	Nerve	Muscle
Ankle “Achilles” Jerk	S1 – S2	<ul style="list-style-type: none">• Tibial	<ul style="list-style-type: none">• Gastrocnemius
Knee “Patellar” Jerk	L2 - L4	<ul style="list-style-type: none">• Femoral	<ul style="list-style-type: none">• Quadriceps
Biceps Jerk	C5 – C6	<ul style="list-style-type: none">• Musculocutaneous	<ul style="list-style-type: none">• Biceps
Forearm “Brachioradialis or Supinator” jerk	C5 – C6	<ul style="list-style-type: none">• Radial	<ul style="list-style-type: none">• Brachioradialis
Triceps	C7 – C8	<ul style="list-style-type: none">• Radial	<ul style="list-style-type: none">• Triceps

The Babinski Reflexes



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



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

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

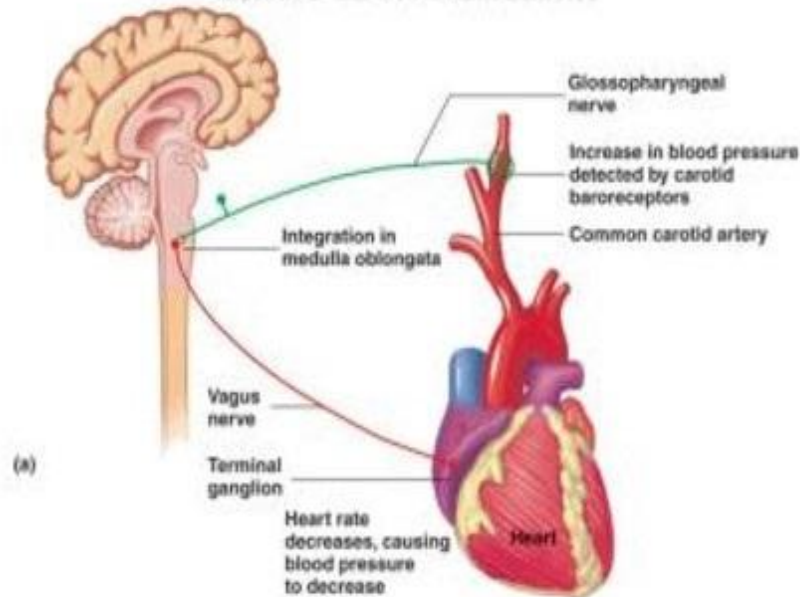
C. Visceral (Autonomic) Reflexes

- Micturition Reflex.
- Defecation Reflex.
- Erection reflex.
- Peritoneo-intestinal reflexes that inhibit gastrointestinal motility in response to peritoneal irritation.

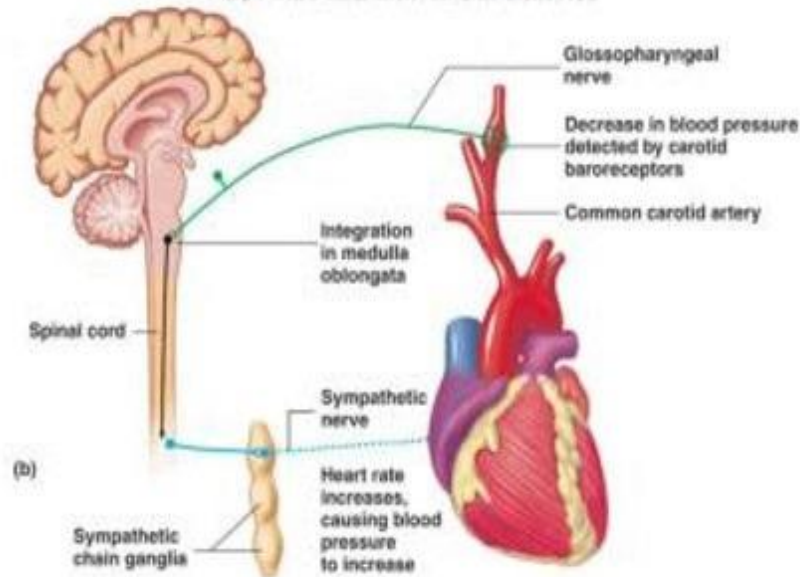
Autonomic Reflexes in the Spinal Cord

1. Changes in vascular tone resulting from changes in local skin heat.
2. Sweating, which results from localized heat on surface of the body.
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.

The Autonomic Reflexes



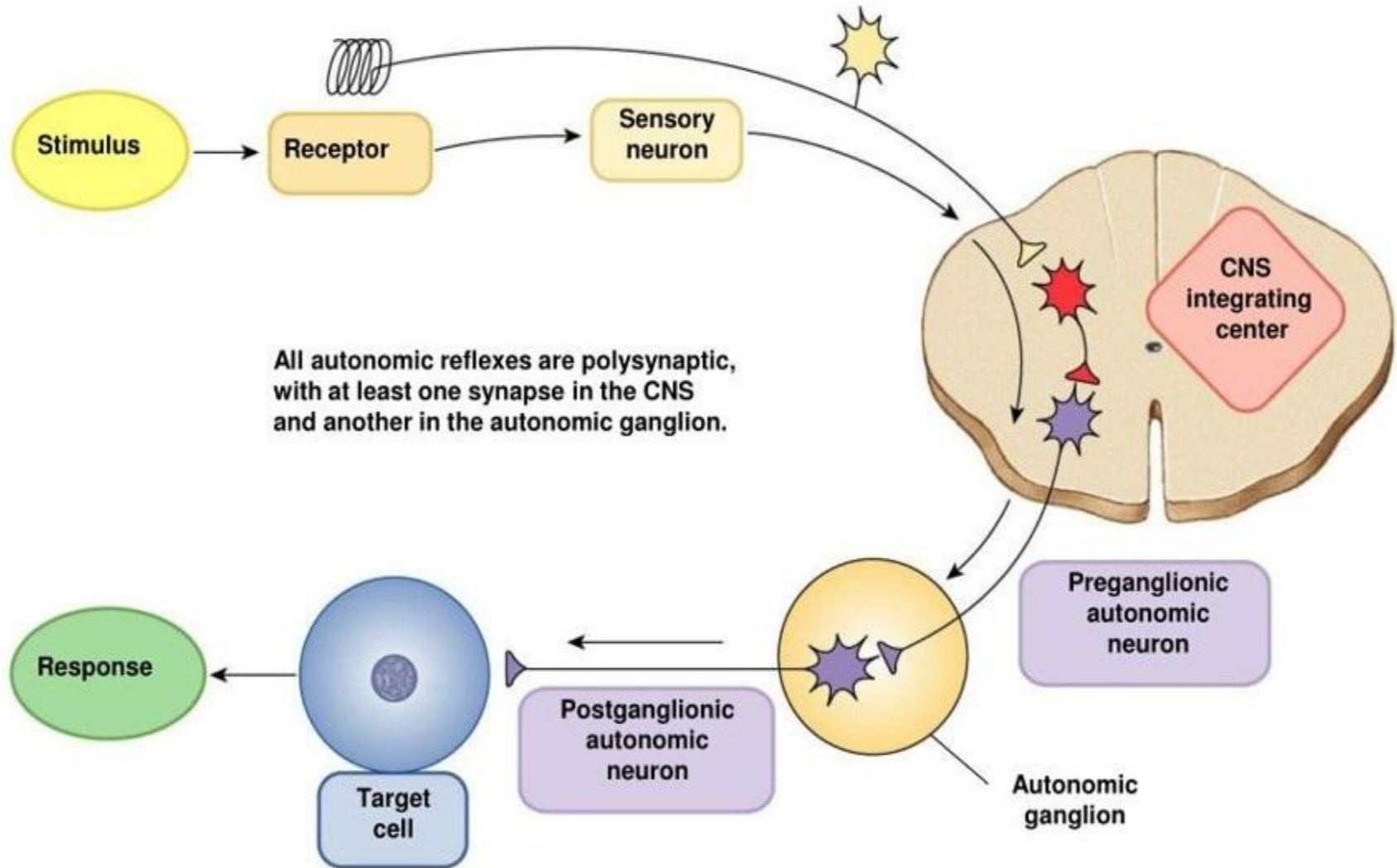
a) Parasympathetic reflex via vagus lowers heart rate.



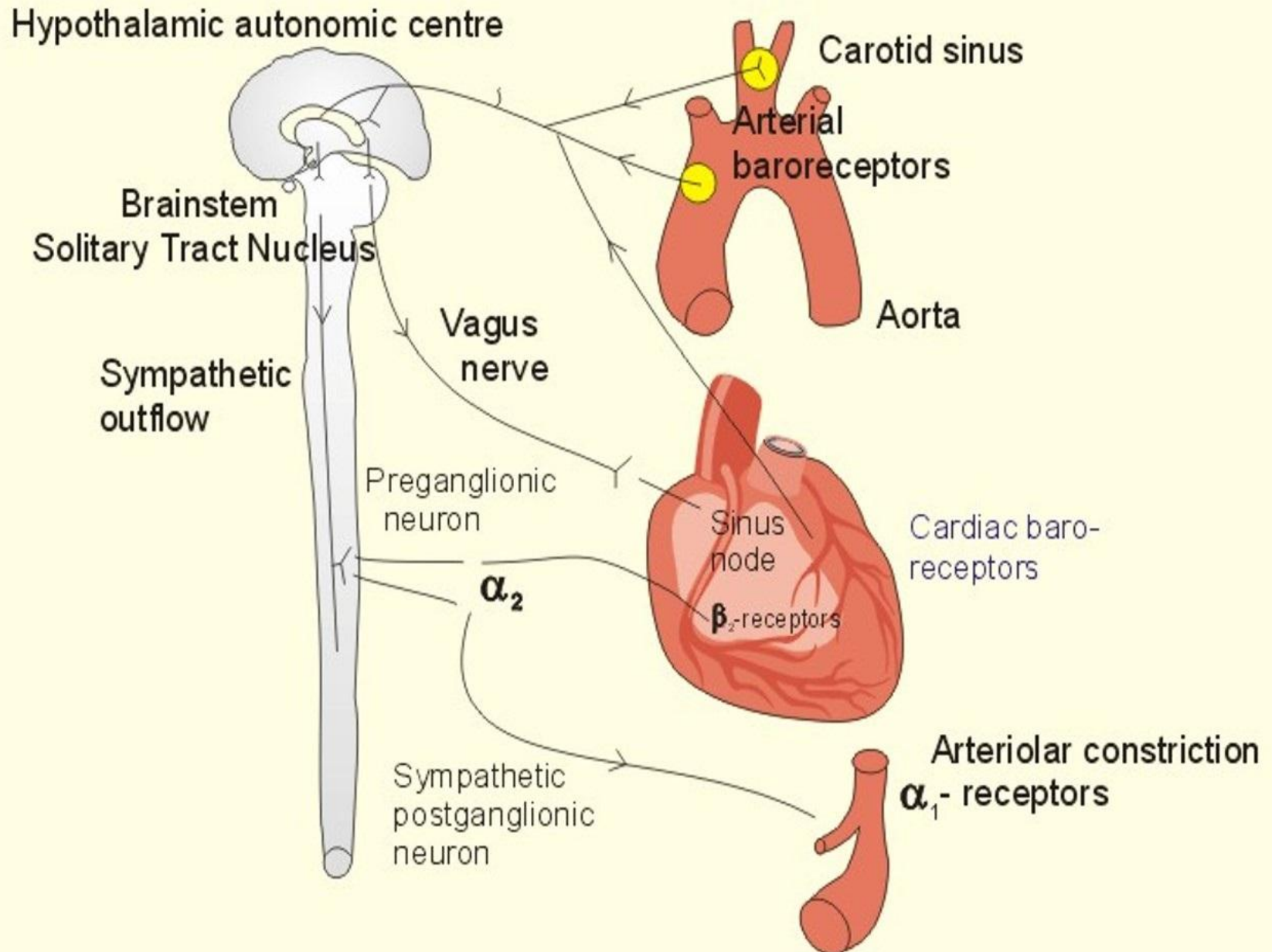
b) Sympathetic reflex via cardiac accelerator nerves (sympathetic) cause heart rate to increase.

The Autonomic Reflexes

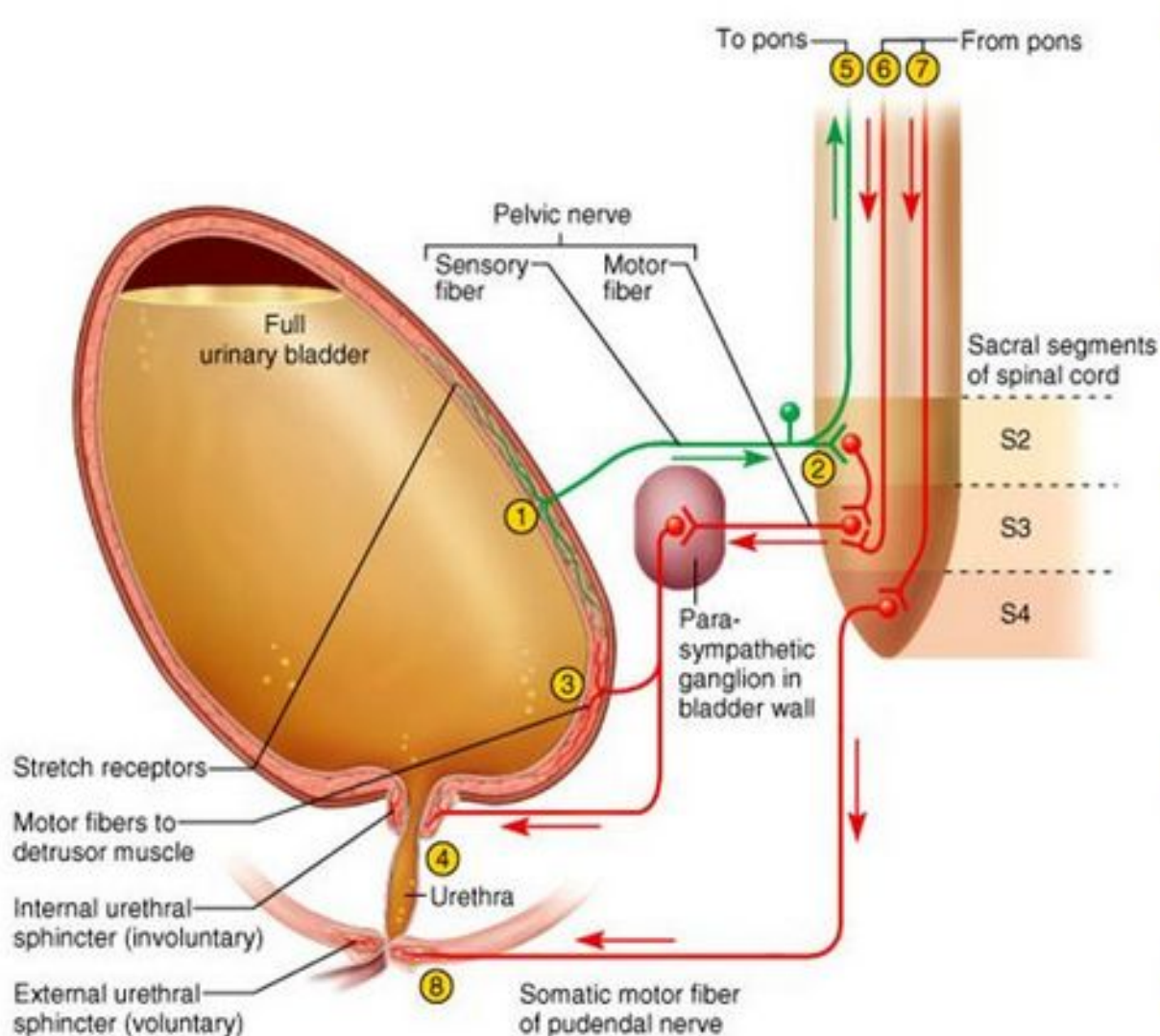
Some visceral reflexes are spinal reflexes



Autonomic Cardiovascular Control

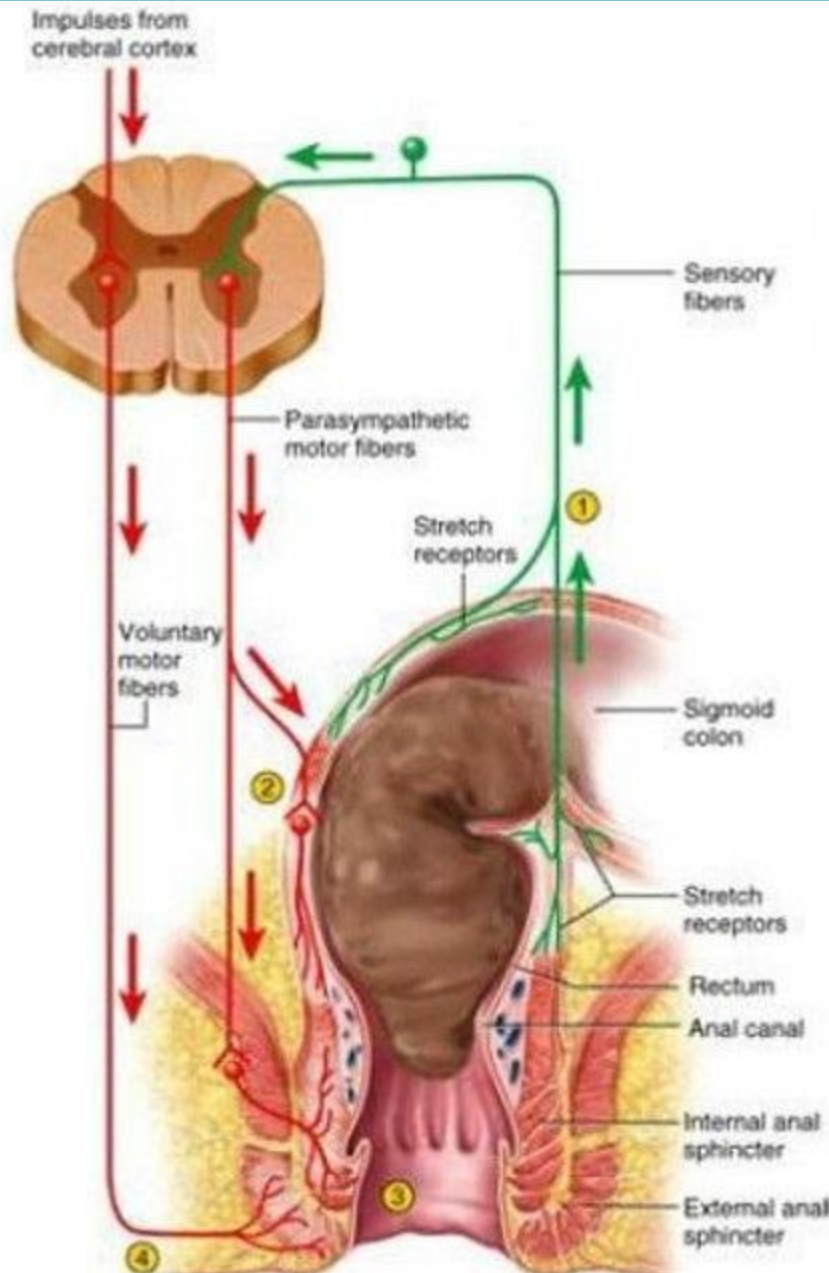


Neural Control of Micturition



- 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

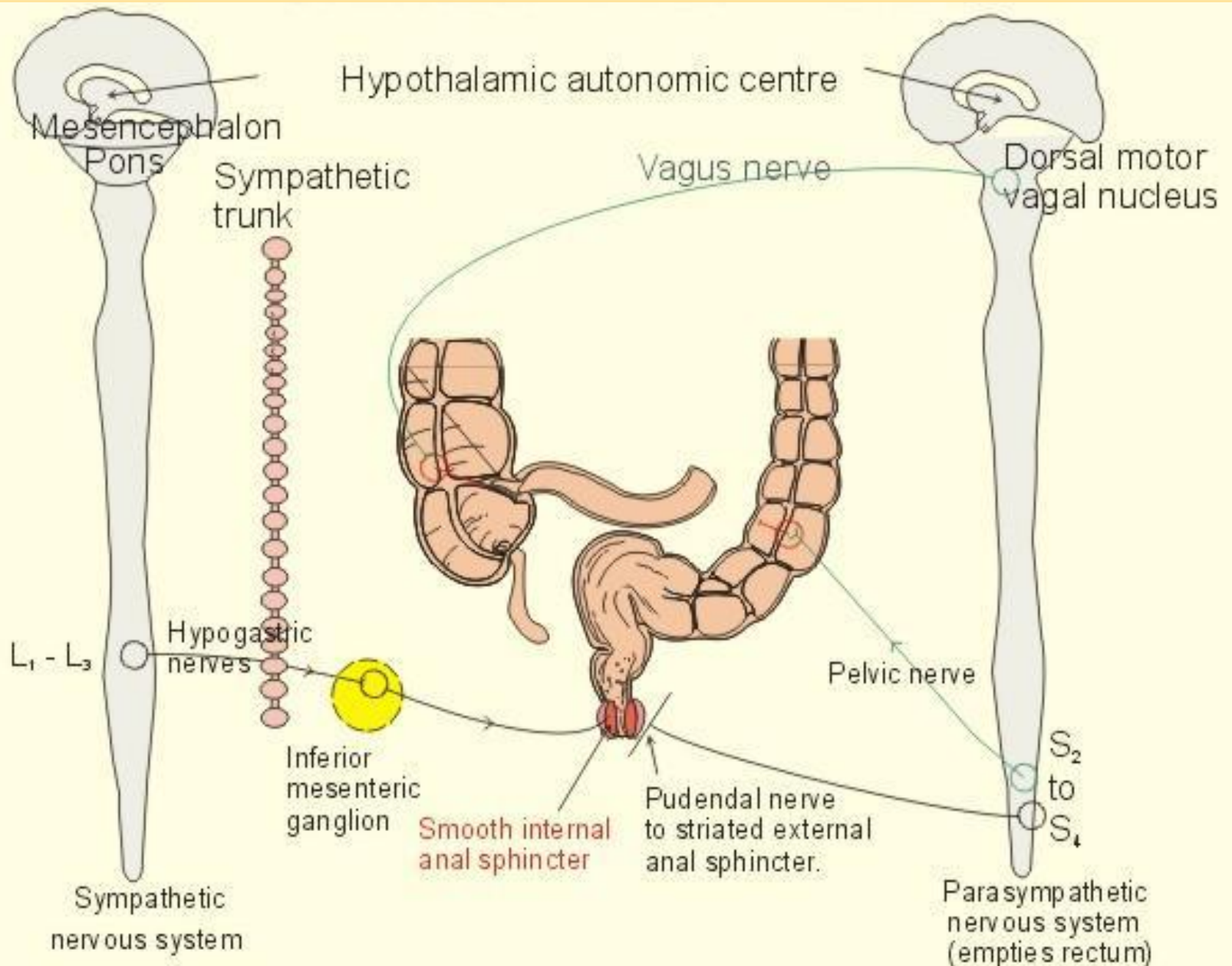


- 1 Feces stretch the rectum and stimulate stretch receptors, which transmit signals to the spinal cord.
- 2 A spinal reflex stimulates contraction of the rectum.
- 3 The spinal reflex also relaxes the internal anal sphincter.
- 4 Impulses from the brain prevent untimely defecation by keeping the external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

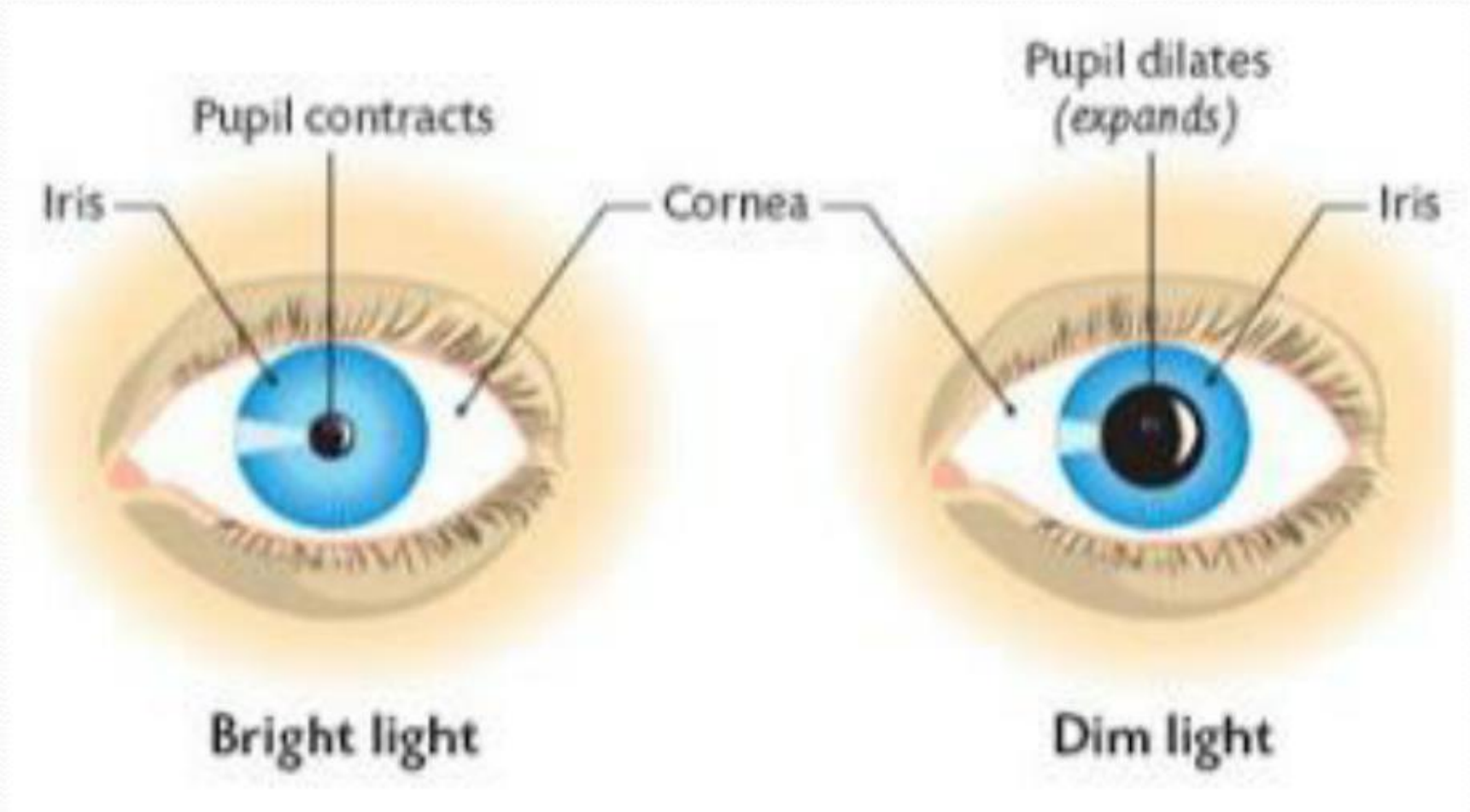
Note that this reflex opens the internal sphincter

Need voluntary relaxation of the external sphincter for defecation

Defecation Reflexes



Pupil reflex





Thank You