CNS
MOTOR DIVISION

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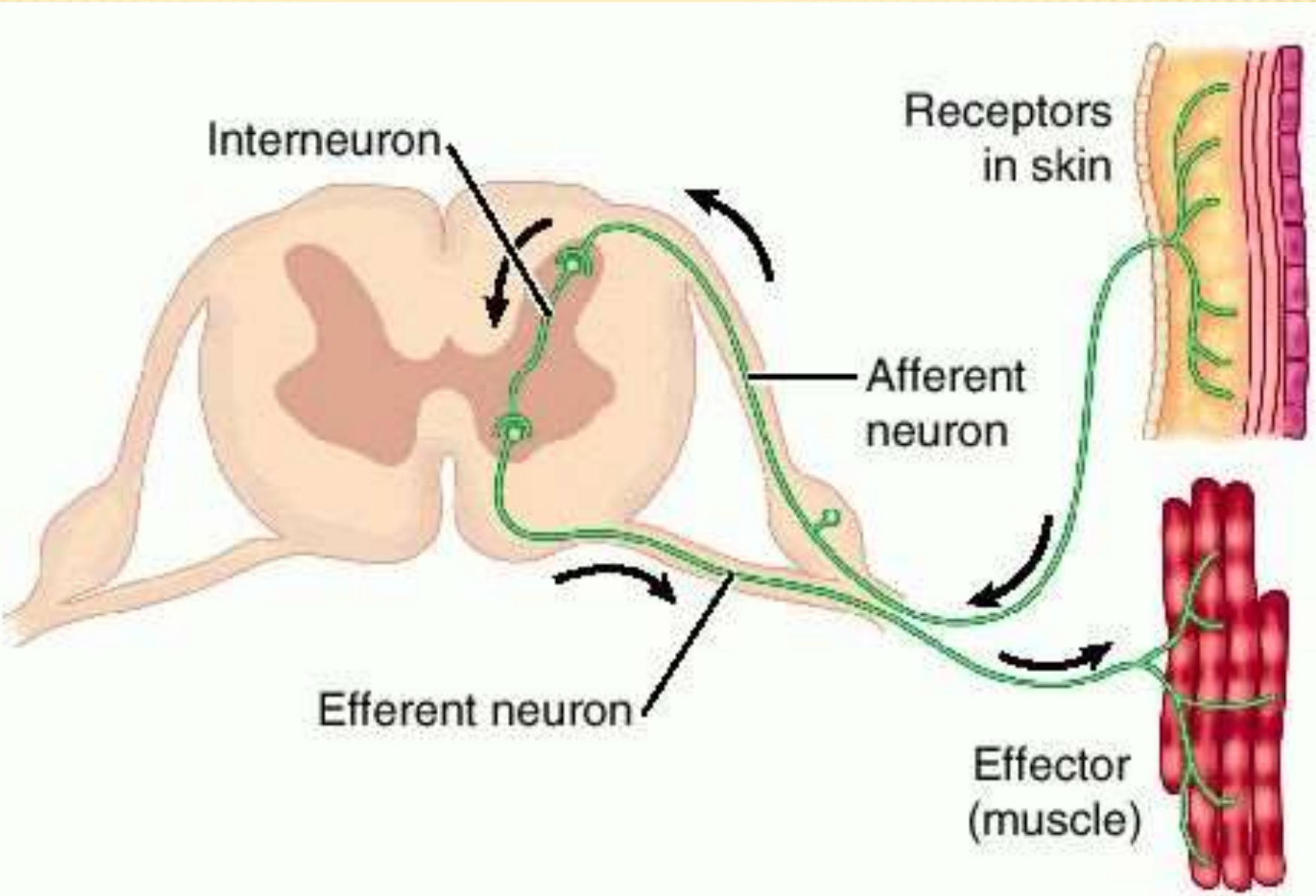
THE REFLEX ACTION

The reflex action is the physiological (functional) unit of the nervous system

The **nervous pathway** of the reflex action is called the **Reflex arc** which consists of:

- -Receptors
- -Afferent neuron
- Center
- -Efferent neuron
- -Effector organs.

REFLEX ARC


Interneuron
Receptors in skin
Afferent neuron
Efferent neuron
Effector (muscle)

TYPES OF REFLEXES

- -According to the number of synapses the reflex arcs are classified into:

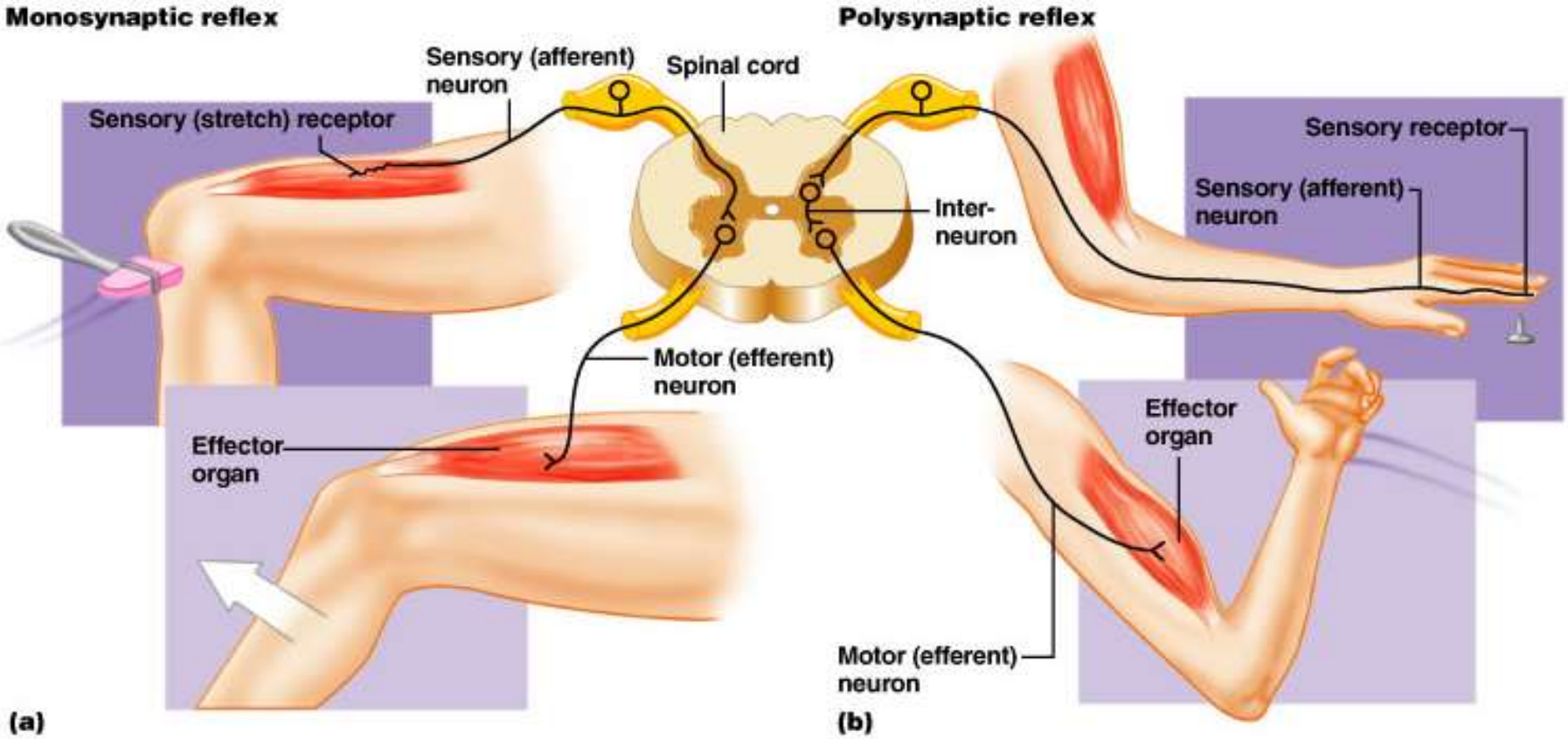
1- Monosynaptic reflex arc:

- The afferent neuron synapses with the efferent neuron without interneuron in between. e.g., stretch reflex

2- Polysynaptic reflex arc:

- In which interneurons are present between the afferent and efferent neurons.

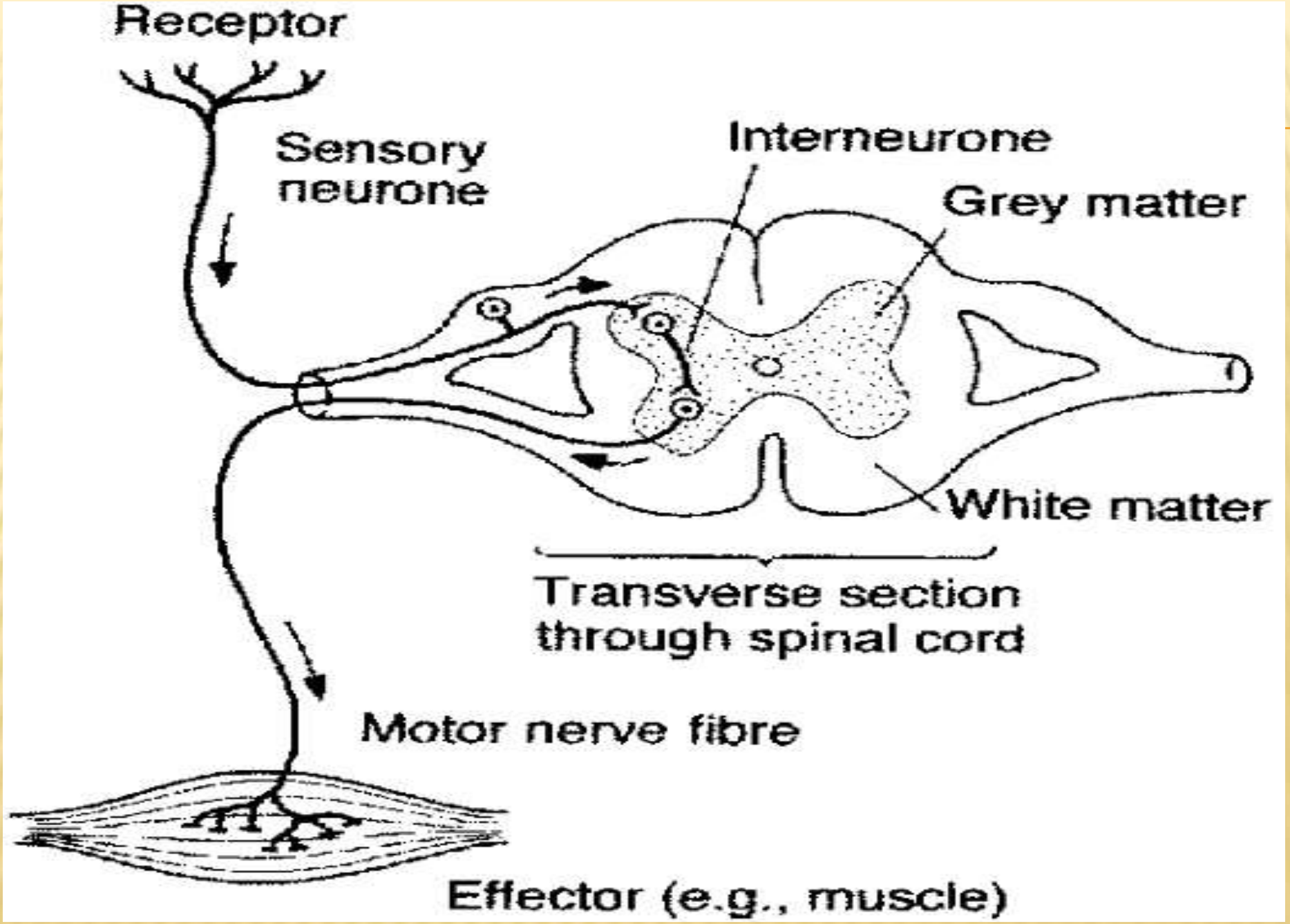
TYPES OF REFLEXES



*PROPERTIES OF THE NERVOUS REFLEXES:

1-UNIDIRECTIONAL:

- The nerve impulse runs from the afferent to the efferent neuron and never in the opposite direction due to the presence of the synapse in which transmission occurs from the pre-synaptic to the postsynaptic neuron.
- This is called **"the law of forward direction"**


Receptor
Sensory neurone
Interneurone
Grey matter
White matter
Transverse section through spinal cord
Motor nerve fibre
Effector (e.g., muscle)

2-LOCALIZATION (SPECIFICITY):

- A specific stimulus at a certain receptor leads to specific response of the effector organs included in the reflex arc. For example
- a) A pin prick on the outer, surface of the arm produces reflex flexion and adduction of the arm.
- b) If the stimulus is applied to the inner surface of the arm extension and abduction of the arm occur.

3- TOTAL REFLEX TIME:

- It varies from one reflex to another according to the number of synapses as it is very short in the stretch reflex, but it is long in the light reflex
  It includes:
- a) Time taken in the conduction in afferent nerve.
- b) Central delay (time taken to cross C.N.S.).
- c) Time taken to be conducted in the efferent nerve.
- d) Latent period of the muscle.

CENTRAL DELAY

- Transmission through a synapse takes 0.5 ms.
- If the central delay within this range, the reflex is monosynaptic, while if more than this (polysynaptic).
- The central delay = total reflex time - time taken in the afferent and in the efferent and the latent period of the muscle.

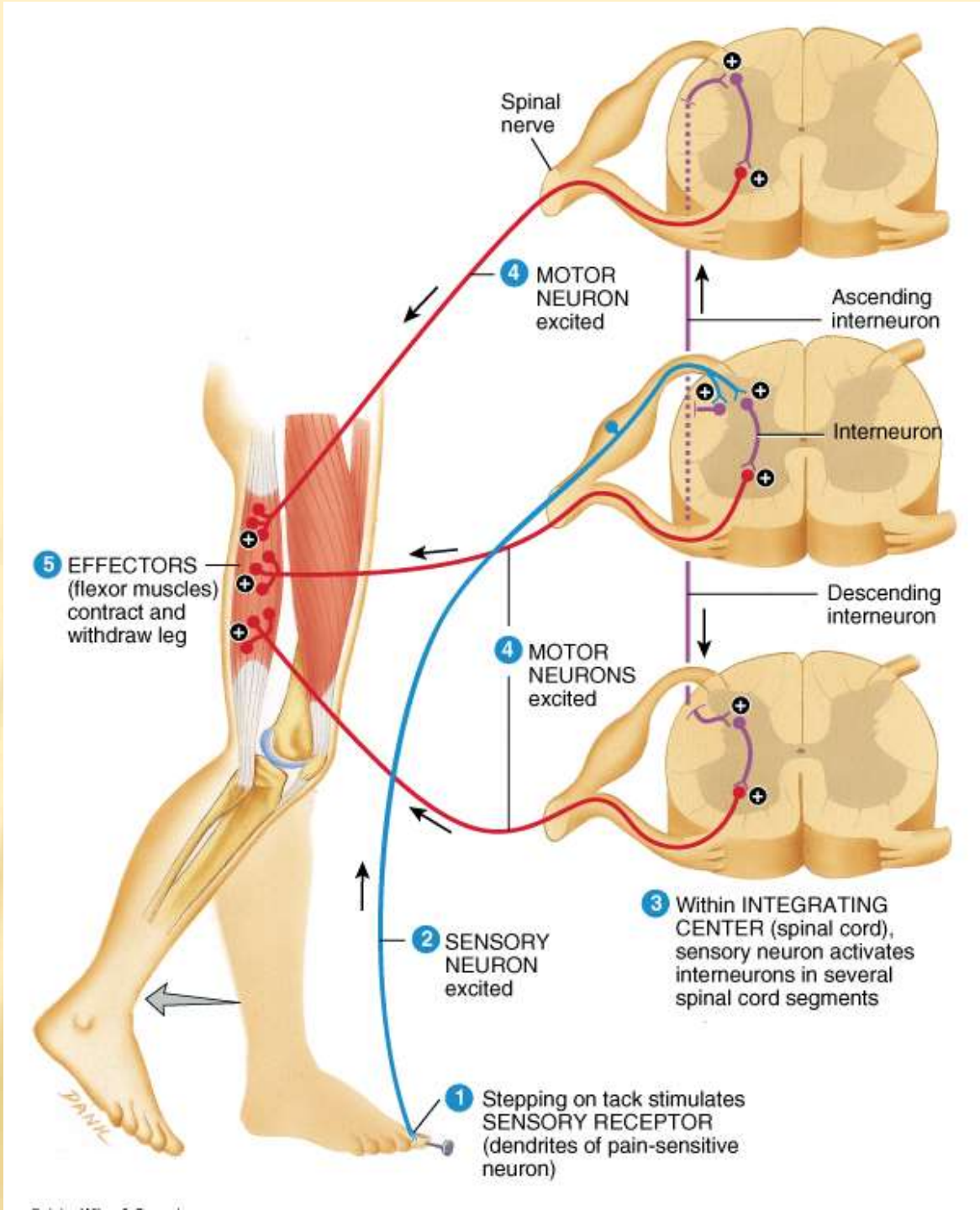
4-IRRADIATION:

- The extent of the reflex response depends on the intensity of the stimulus, thus the stronger the stimulus the more the activated neurons inside the C.N.S. and the more the extent of the response.
- **Examples:**
- a) weak painful stimulus of the sole of foot produces reflex flexion of the big toe only.

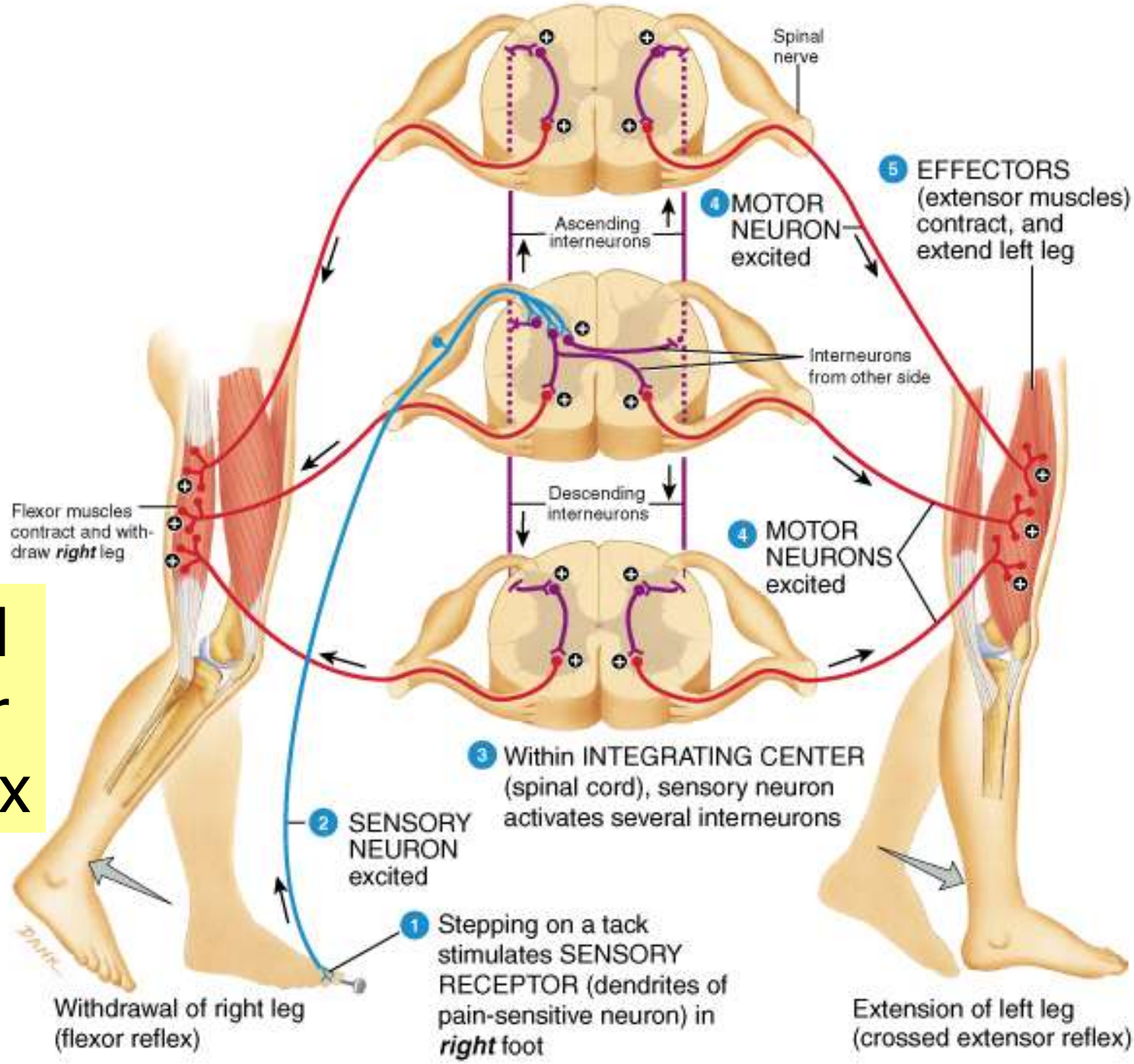
- b) Increasing the strength of the same stimulus produces reflex flexion of the ankle, knee and hip leading to withdrawal of the whole lower limb.

- c) Crossed extensor reflex: Very strong stimulus also to the sole of the foot leads to withdrawal reflex in the stimulated limb and the other limb extends by irradiating the impulse, to support the body weight

Flexor (Withdrawal) Reflex



Crossed Extensor Reflex



5-FATIGUE:

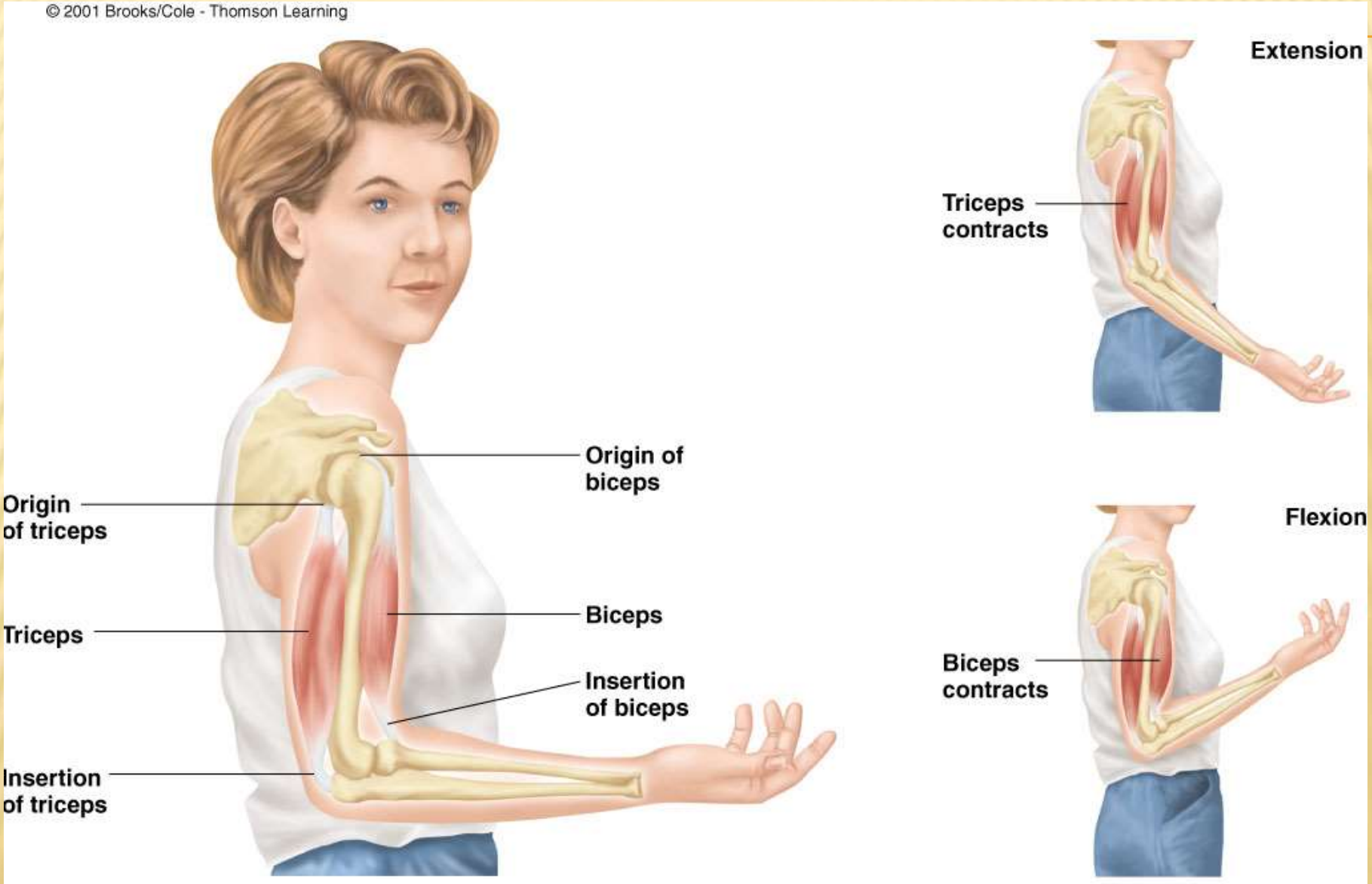
- It is defined as the decline in response after repetition of the reflex due to exhaustion of the chemical transmitter at the synapse.

6-RECIPROCAL INNERVATION:

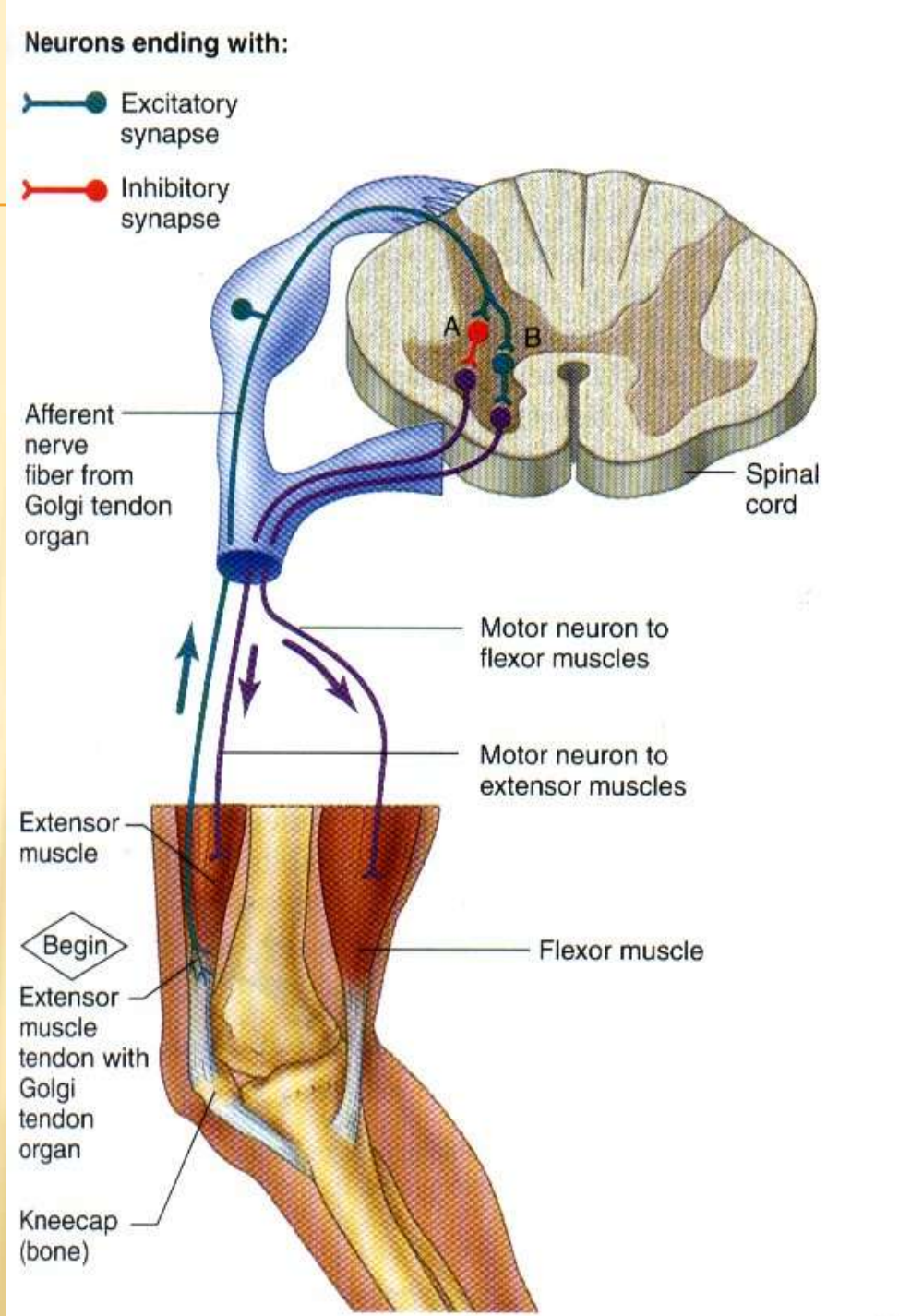
- - Reflex contraction of one group of muscles are accompanied by reflex inhibition (relaxation) of its antagonistic group of muscles to facilitate movement.

- - Example: Withdrawal reflex leads to contraction of the flexors and

ANTAGONISTIC MUSCLE PAIRS

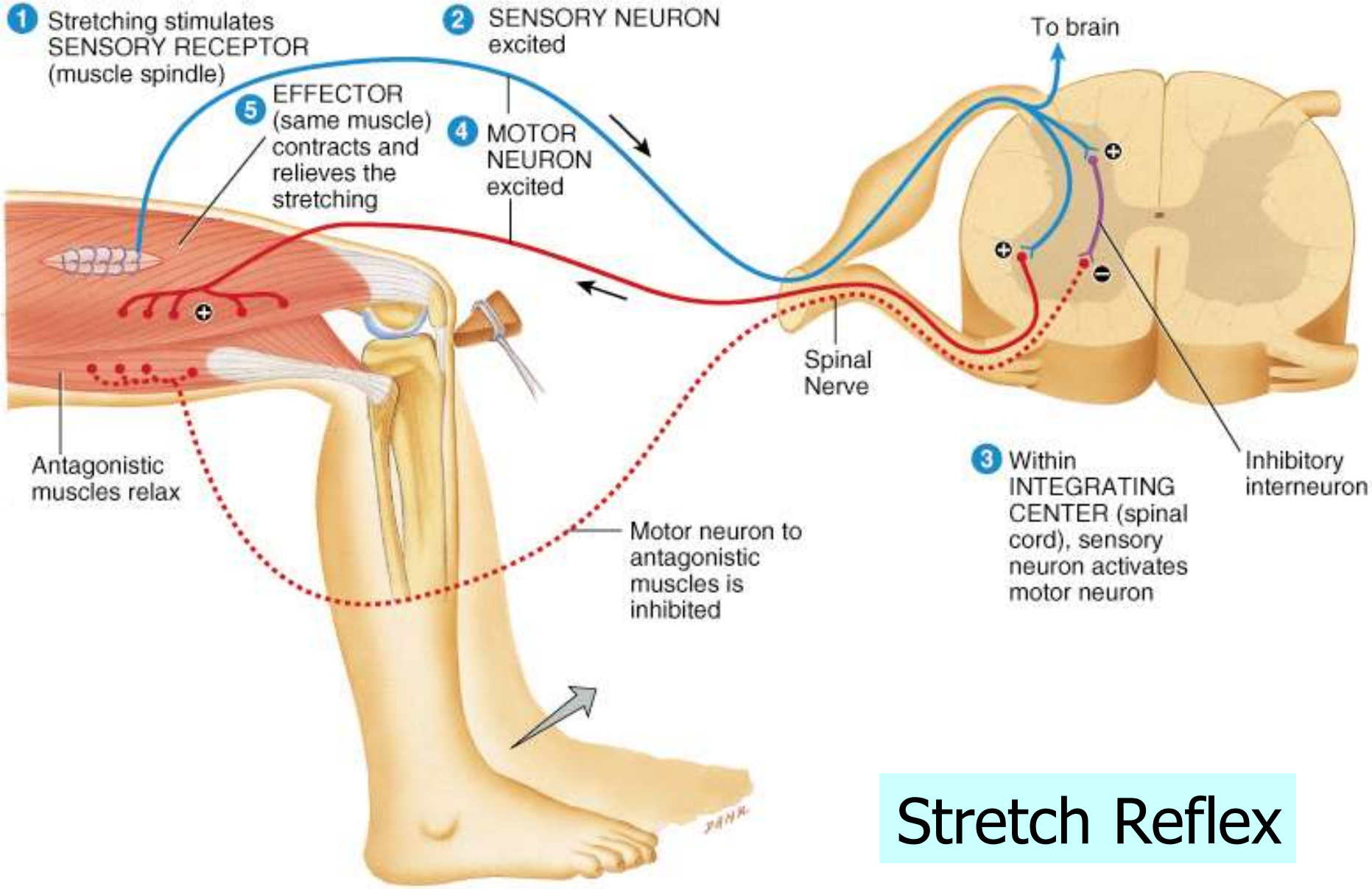


RECIPROCAL INNERVATION



- EXPLANATION:

- As the afferent neuron enters the spinal cord, it activates two sets of interneurons.
- One is excitatory to stimulate the motor neurons of the flexor muscles.
- The other is inhibitory to inhibit the motor neurons of the antagonistic extensor muscles.
- - **There is one exception**, **"the positive supporting reflex "** Pressure



Stretch Reflex

RECRUITMENT:

- It is a gradual activation of AHCs on stimulating the afferent nerve due to difference in number of interneurons

After discharge:

- It means persistent discharge from efferent neurons after stoppage of stimulation of the afferent one connected to it. Due to impulses arriving to them through interneuronal circuits.

7- RECRUITMENT AND AFTER DISCHARGE:

- This property can be studied by recording the reflex tetanus and the motor tetanus

Reflex tetanus:

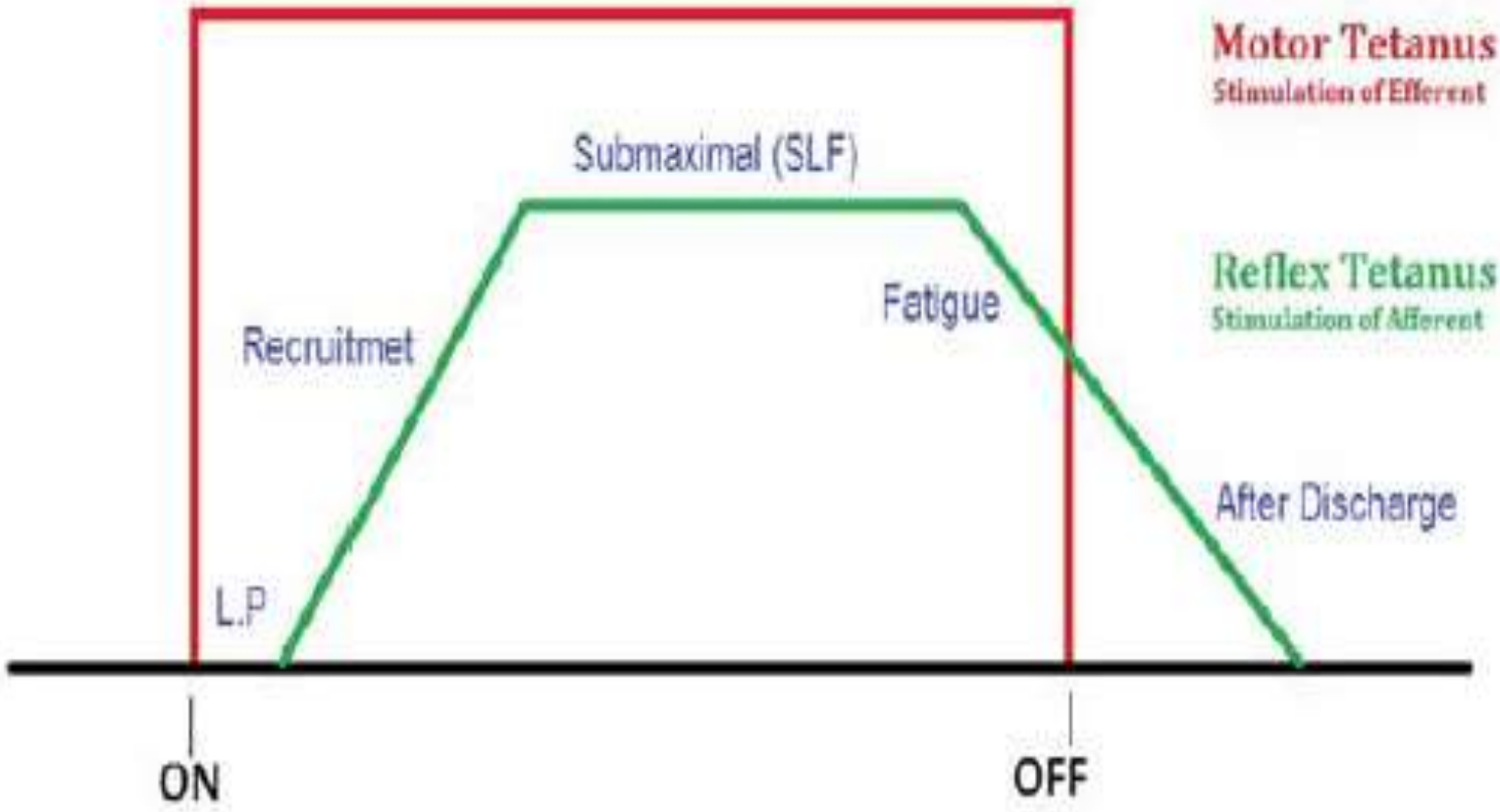
- produced by maximal repetitive stimulation of the afferent nerve

Motor tetanus:

- produced by maximal repetitive stimulation of the efferent nerve

Reflex tetanus	Motor tetanus
1-the latent period is longer, (conduction in afferent & efferent nerves and central delay).	1-the latent period is short (motor end plate delay) which resemble single synaptic delay.
2-Gradual rise of muscle contraction to maximum, due to gradual stimulation of the motor units in the	2- Rapid rise of contraction to a maximum, because all motor units of the muscle are

Reflex tetanus	Motor tetanus
3- limited power of contraction. As not all motor cells are stimulated.	3-Higher power of muscle contraction , due to stimulation of all motor fibers to the muscle.
4-After stoppage of the stimulation there is gradual relaxation (after discharge),	4- When the motor stimulation is stopped the muscle rapidly relaxes.
5-Fatigue occurs	


Motor Tetanus
Stimulation of Efferent
Submaximal (SLF)
Reflex Tetanus
Stimulation of Afferent
Fatigue
Recruitmet
After Discharge
L.P
ON
OFF

CLASSIFICATION OF HUMAN REFLEXES

A. Peripheral reflexes:

- Center outside CNS. Most of these reflexes are found in the GIT.
- 1) Local **enteric** reflex.
- 2) Local **ganglionic** reflex.
- 3) Local **axon** reflex.

- **B. Central reflexes:**

Center inside CNS. They are further subdivided into:

1-

Conditioned or Cortical reflexes
They are so called because they need: 1. Previous education or training (learning). 2. Intact cerebral Cortex (Consciousness). 3. Specific stimulus must be present.
They are not essential for life Needed for Civilization.

Unconditioned or Inborn reflexes

They are so called because:

1. Need no education.
2. Center is subcortical.
3. Present since birth (fixed stimulus).

They are essential for life.

Have vital & protective functions.

- **Inborn reflexes are classified according to the site of CENTER into:**

1) Spinal reflexes: their centers lie in the spinal cord.

2) Brain stem reflexes: their centers lie in the brain stem.

- As vomiting, deglutition, cough reflexes (centers in medulla).
- Herring - Breuer, righting reflexes (centers in pons or midbrain).

3) Hypothalamic reflexes: their centers lie in the hypothalamus.


THank you