# REFLEX ACTIVITY

# INTRODUCTION

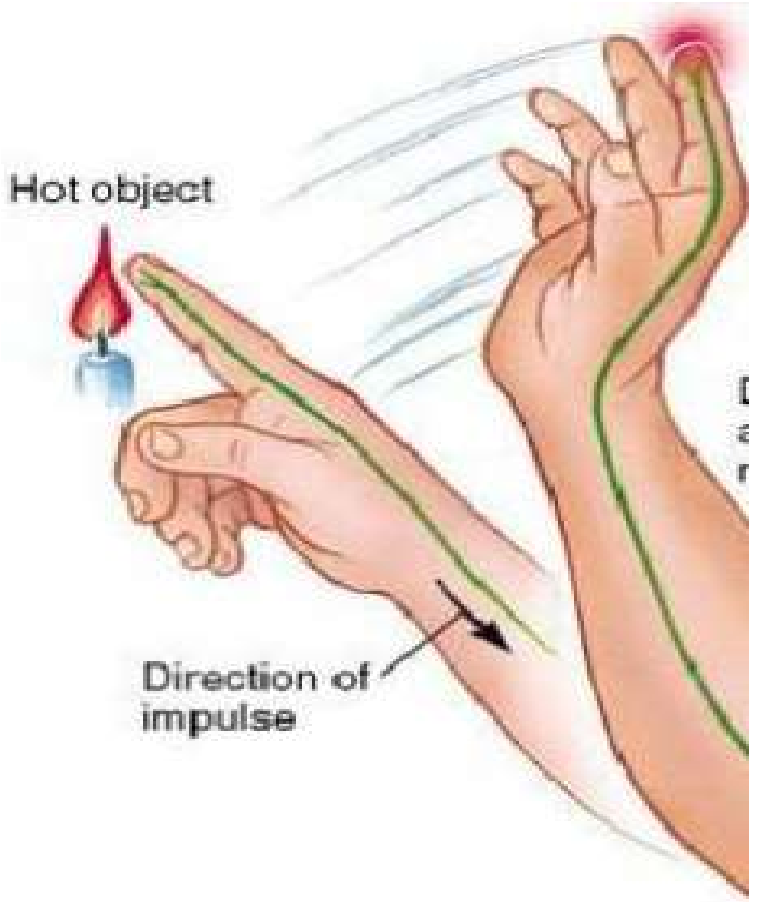
**Learning Objective-1**

- A Reflex is an Involuntary Response to a Peripheral Nervous Stimulation
- It’s a Mechanism by which Sensory Impulse is automatically converted into a Motor effect through the involvement of CNS but without the awareness/conscious will of the Individual

Purpose of Reflex:-

It’s a type of Protective Mechanism which tries to protect the body from irreparable damage.

For example:-Hand is immediately withdrawn reflexly when it touches a hot object.Its protected from getting burnt



# ANATOMICAL ASPECTS

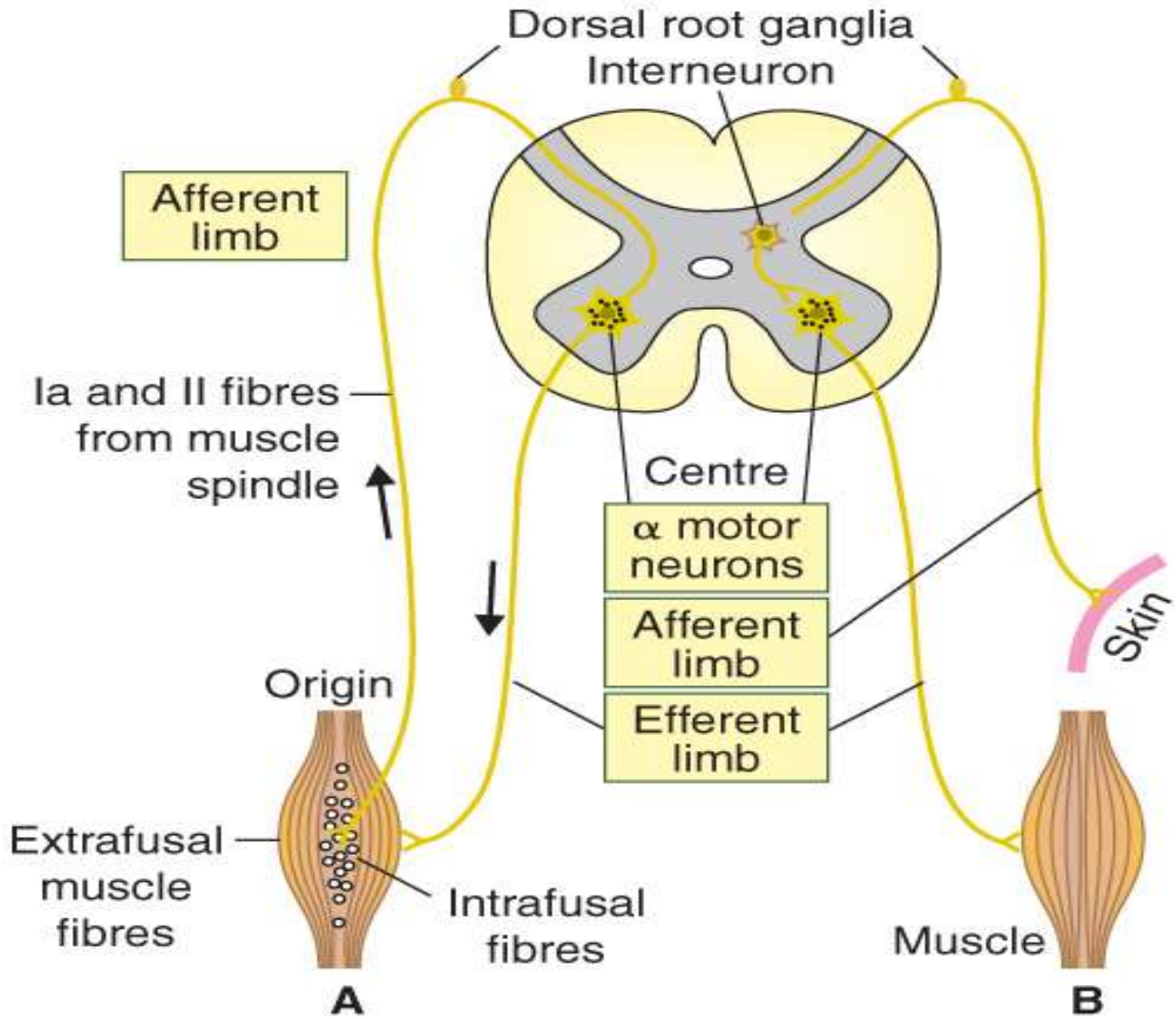
**Learning Objective-2**

# Reflex Arc:-

- The Pathway for a reflex activity is called “Reflex Arc”

- It forms the functional unit of Nervous System for a reflex.

- It consists of:-
  - Afferent Limb
  - Centre
  - Efferent Limb


Dorsal root ganglia
Interneuron
Afferent limb
Ia and II fibres from muscle spindle
Centre
α motor neurons
Afferent limb
Efferent limb
Skin
Origin
Extrafusal muscle fibres
Intrafusal fibres
Muscle
A
B

## (I) Afferent Limb:-

Consist of

### 1.Receptor:-

- It’s a modified nerve ending which receives the stimulus
- After getting stimulated or depolarized by the given stimulus sends nerve impulses or action potentials to the CNS via the Afferent Neurons

## 2.Afferent Neuron :-

Carries sensory input from the Receptor to the Centre

Afferent neurons enter the CNS via the Dorsal roots or Cranial Nerves

Their Cell bodies lie in the Dorsal root Ganglia or in the Homologous Ganglia on the Cranial Nerves

## (II) Centre

- Part of CNS (Spinal Cord or Brain) where Afferent Limb ends
- The Centre may synapse directly with the Efferent Motor Neuron or establish their contact with them via Interneurons
- Thus, the Number of Synapses may vary from at least 1 to many
- Exception is Axon Reflex which doesnot involve any Integrating Center & has no Synapse (Asynaptic Reflex)

## (III) Efferent Limb:-

Consists of:-

**1.Efferent Nerve-**

- Transmits motor impulses from the Centre to the Effector Organs
- As the CNS is usually the connecting link between the Afferent & Efferent Neurons, hence reflex activity is modified by numerous CNS inputs converging on the Efferent Neurons

## 2.Effector Organ :-

- Effector organs are Muscles or Glands which show the response to the Stimulus

# CLASSIFICATION

**Learning Objective-3**

## I. Depending Upon the Number of Synapses:-

**1.Monosynaptic Reflexes** – Contain only one Synapse

-- Stretch reflexes

- Biceps jerk
- Triceps jerk
- Knee jerk

**2.Disynaptic Reflexes**– Contain 2 Synapses

-- One Interneuron between Afferent & Efferent Neuron

- Inverse Stretch Reflex

**3.Polysynaptic Reflexes** – More than 2 Synapses

--More than 1 Interneurons

- Withdrawal Reflex
- Cross Extensor Reflex

## II. Anatomical Classification:- Depending upon location of Reflex Arc Centre

**1.Cortical Reflexes** – Reflex Arc Centre in Cerebral Cortex

**2.Cerebellar Reflexes-** Reflex Arc Centre in Cerebellum

**3.Midbrain Reflexes-** Reflex Arc Centre in Midbrain

**4.Bulbar/Medullary Reflexes-** Reflex Arc Centre in Medulla Oblongata

**5.Spinal Reflexes-** Reflex Arc Centre in Spinal Cord

## III. Physiological Classification:-

### 1.Flexor Reflexes-

- These reflexes occur in response to Nociceptive Stimuli
- Characterized by Flexion of the joints
- Are also called “ Withdrawal Reflexes”
- Example:-Reflex Flexion of the Knee & Hip Joints immediately after thorn prick to the Sole

## 2.Extensor Reflexes:-

- These reflexes are the basis of Muscle tone & Posture of the Body
- They are also called “Antigravity Reflexes”
- Ex:- Stretch Reflexes

# IV. Inborn Versus Acquired Reflexes:-

## 1.Inborn/Unconditional Reflexes:-

- Present since Birth
- Donot Require any previous learning or training
- Ex:- Reflex Salivation when anything is kept in mouth

## 2.Acquired or Conditional Reflexes:-

- Develop after Birth
- Acquired after Conditioning
- Ex:-

❑ Reflex salivation by the Sight/Smell/Thought/Hearing of a Known Edible Substance

❑ Dogs learn to salivate upon hearing the sound of Bell. The reason being the multiple times pairing of Ringing of Bell with the action of giving Food to them (Pavlov's Experiment)

## V. Clinical Classification

According to Clinical Basis, reflexes are classified into:-

**A) Physiological Reflexes**

1. Superficial Reflexes
2. Deep Tendon Reflexes
3. Visceral Reflexes

**B) Pathological Reflexes**

1. Babinski Sign
2. Mass Reflex
3. Clonus
4. Pendular Movement

# PROPERTIES OF REFLEXES

**Learning Objective - 4**

# 1.Adequate Stimulus

The Particular form of energy to which the Receptor is most Sensitive is called **“Adequate Stimulus”**

Ex:-Adequate Stimulus for Rods & Cones (Photoreceptors) = Light

## 2.Delay

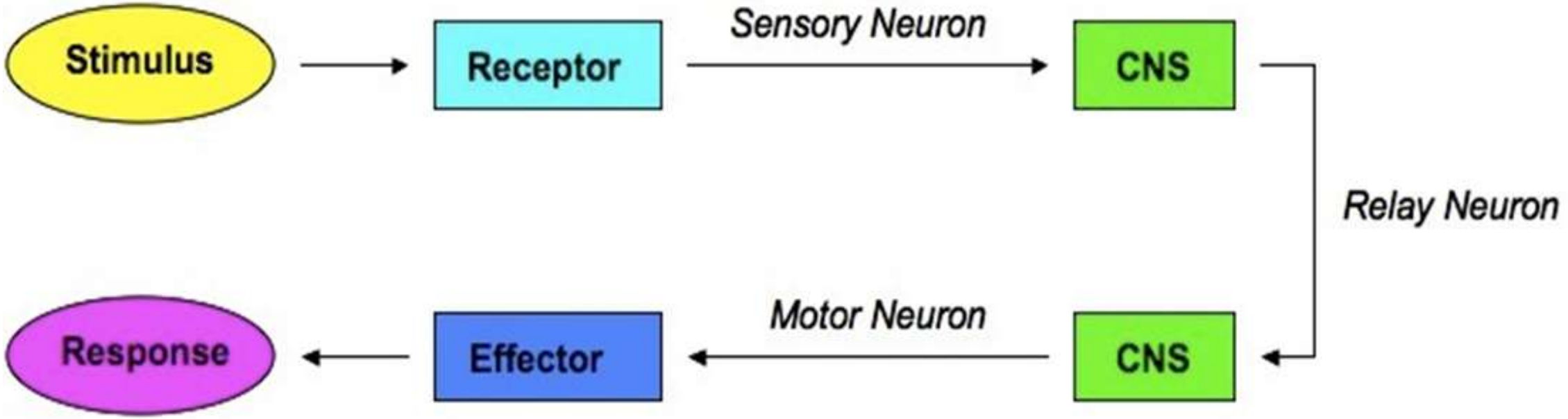
- All reflex activity is associated with Delay
- Delay refers to the Time interval between application of stimulus & starting of the response.
- The Delay is minimum in a Monosynaptic Reflex

**Peripheral Delay** — **Time taken by the Impulse transmission in Afferent & Efferent Limbs of the Reflex Arc**

**Central Delay** — **Time Spent by the Impulse in traversing the Reflex Arc Center**

# 3.One Way Conduction

As per Bell-Magendie Law,during any reflex activity,the impulses are transmitted in only one direction, through the Reflex arc,that is from the Receptors to the Centre & then from Centre to the Effector Organ



# 4.Summation

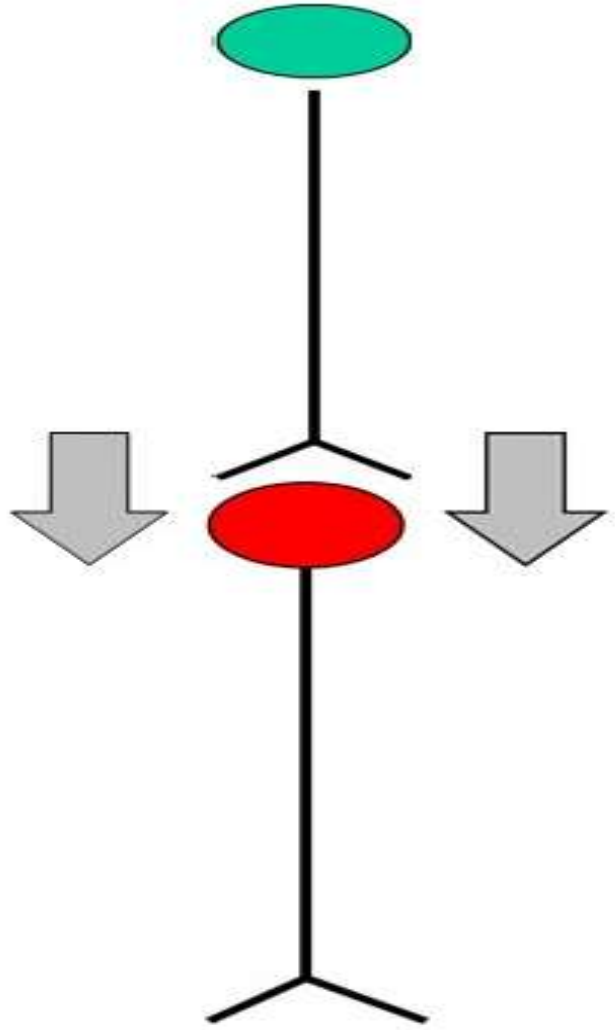
Spatial & Temporal Summation help in facilitation of reflex responses

Temporal Summation :-

Application of a Subminimal (Subthreshold) Stimulus to a Nerve fibre doesnot elicit a reflex response.

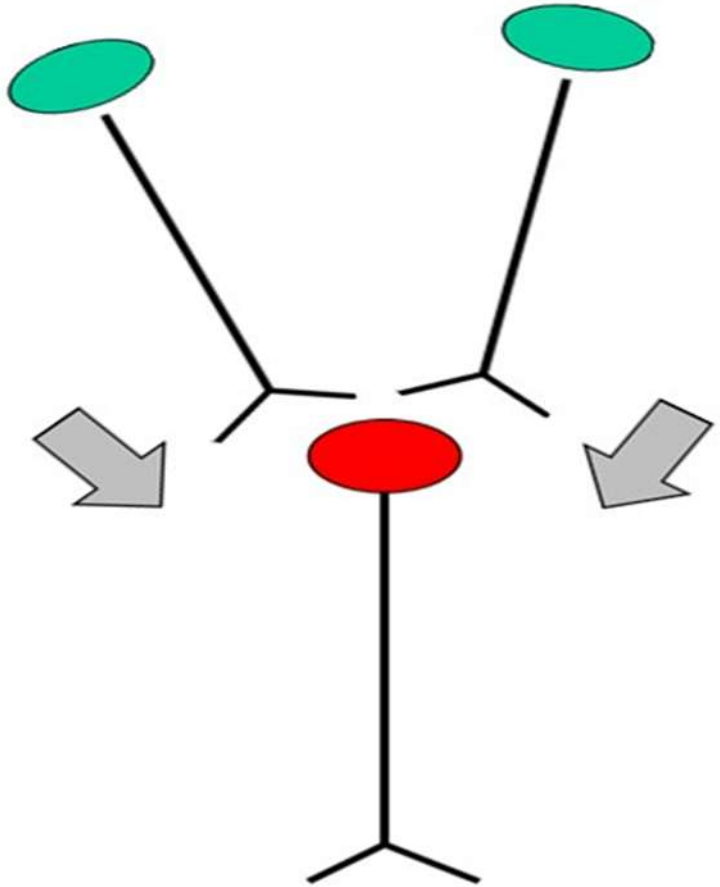
But,Repeated Stimulation of a Nerve fibre with Subthreshold stimuli in quick succession,taking care of refractory period of the Nerve,results in a response due to summation of EPSPs produced by Subthreshold stimuli.

This phenomenon is called “Temporal Summation”



Spatial Summation :-

When two or more nerve fibres supplying the same muscle are stimulated simultaneously with Subthreshold Stimuli,a reflex contraction of the muscle is obtained due to phenomenon of Spatial Summation

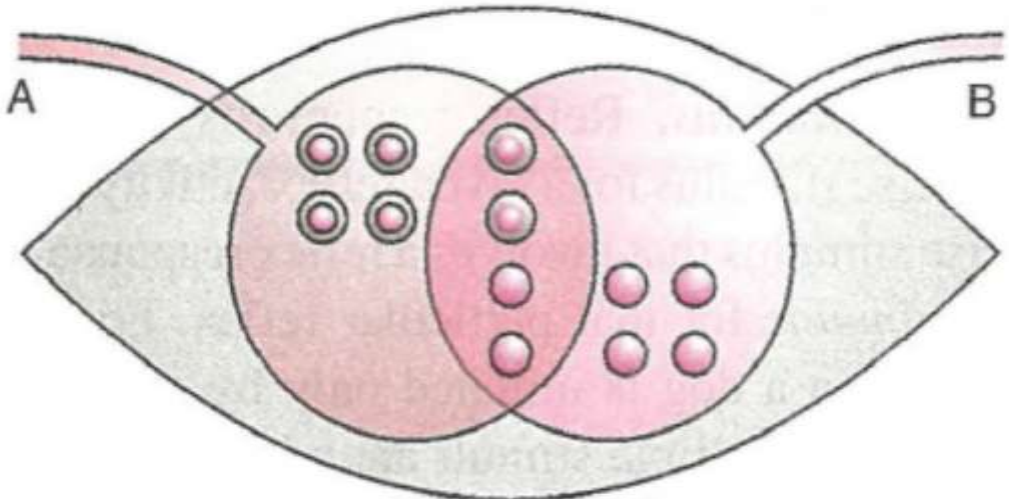


# 5.Occlusion

A phenomenon by which Stimulation of 2 neighbouring nerves (Say Nerve A & B) simultaneously evokes lesser response than sum total of the responses obtained when each nerve is separately stimulated

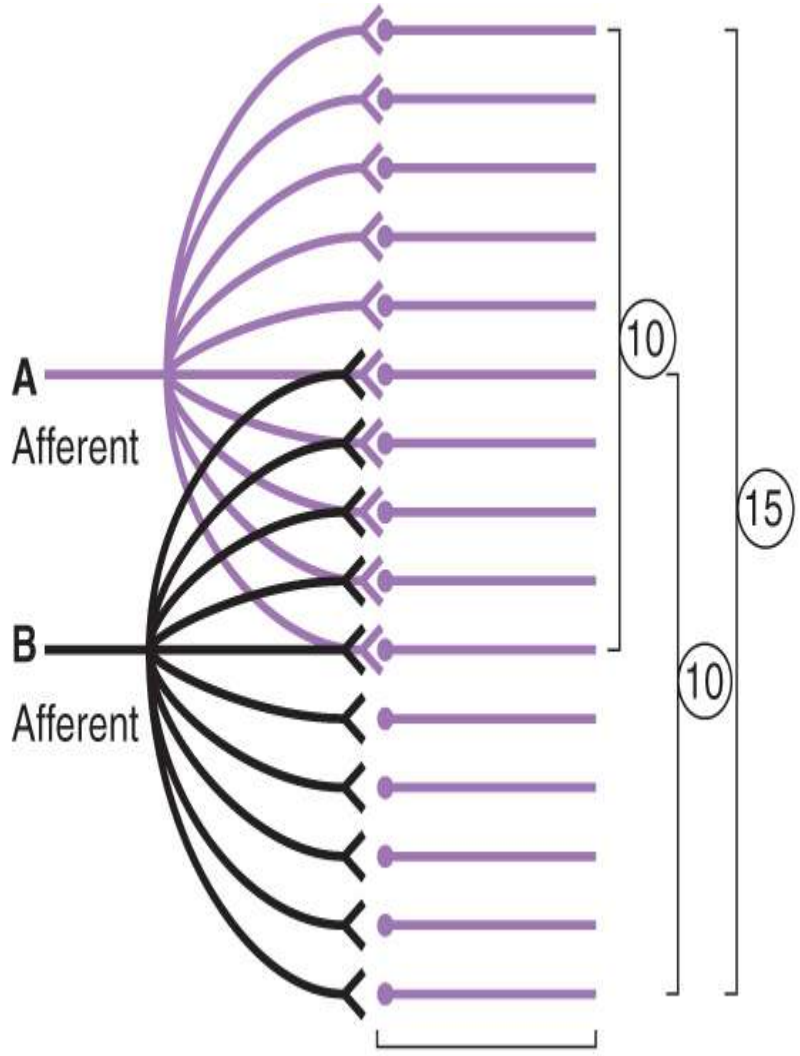
This occurs due to the fact that there is overlapping of the Nerve fibres along their distribution.

Simultaneous Stimulation (A+B) < Sum total of Separate Stimulation of Both (A & B)



Nerve A stimulated= 10 T Tension generated
Nerve B stimulated= 10 T Tension generated
Sum Total= 20 T

Simultaneous Stimulation of Both A & B =15T




Simultaneous Stimulation (A+B) < Sum total of Separate Stimulation of Both (A & B)

# 6.Subliminal Fringe

A Phenomenon by which Simultaneous Stimulation of 2 Nerves (say Nerve A & B) with weak shock evokes greater response than the Sum total of the responses when each nerve is separately stimulated with the weak shocks

Each Afferent Nerve on entering the Spinal Cord stimulates 2 groups of Neurons. One Group is stimulated adequately & Second group subminimally. Action Potential is generated in Group 1. Neurons of Group 2 are also excited but only subminimally.

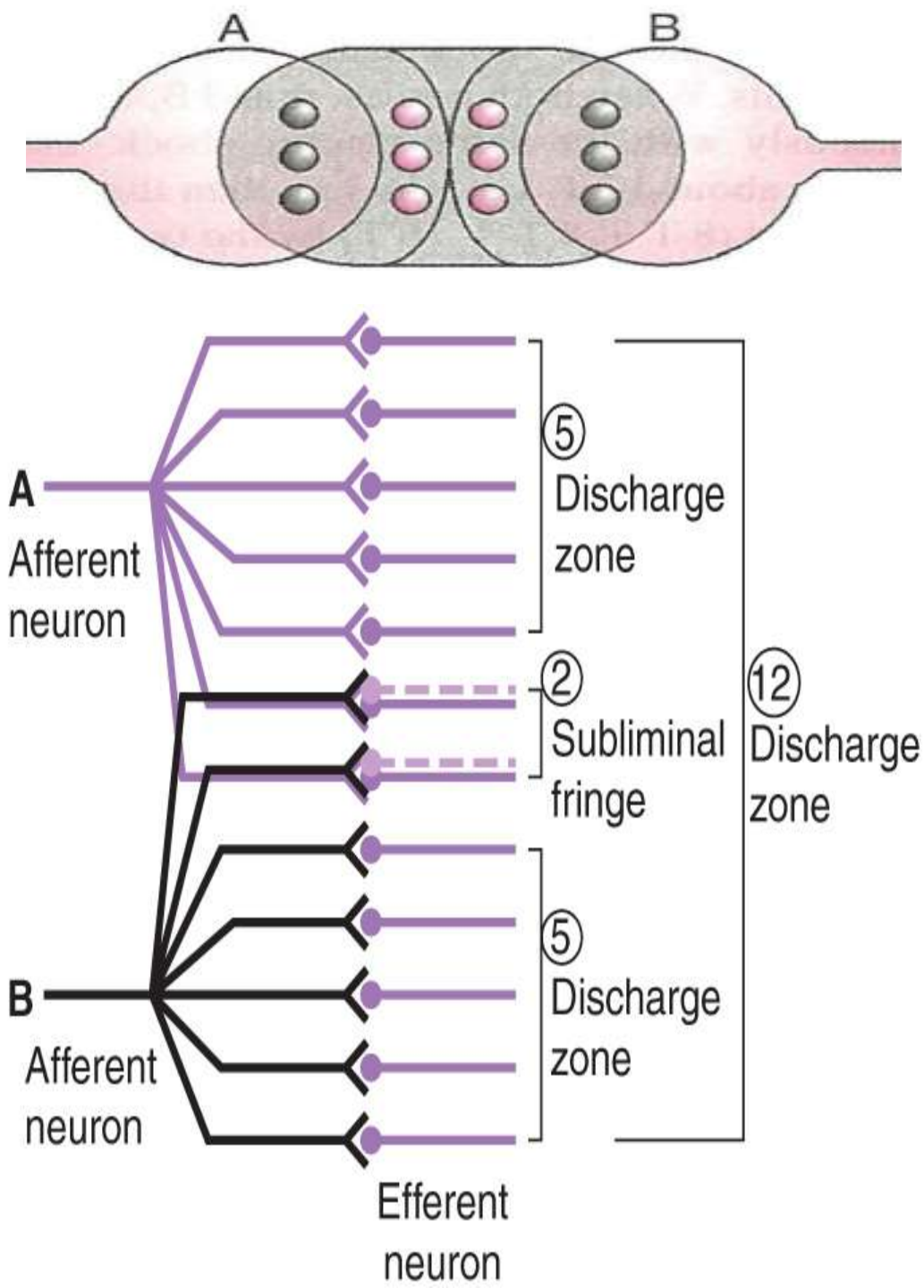
When both A & B Nerves are simultaneously stimulated,the Action Potential is generated in Group 2 also because it is now receiving Impulses from both the Nerves.Hence,Greater response is generated

Simultaneous Stimulation (A+B) > Sum total of Separate Stimulation of Both (A & B)

Nerve A stimulated= 5T Tension generated
Nerve B stimulated= 5T Tension generated
Sum Total= 10 T

Simultaneous Stimulation of Both A & B =12T

Simultaneous Stimulation (A+B) > Sum total of Separate Stimulation of Both (A & B)

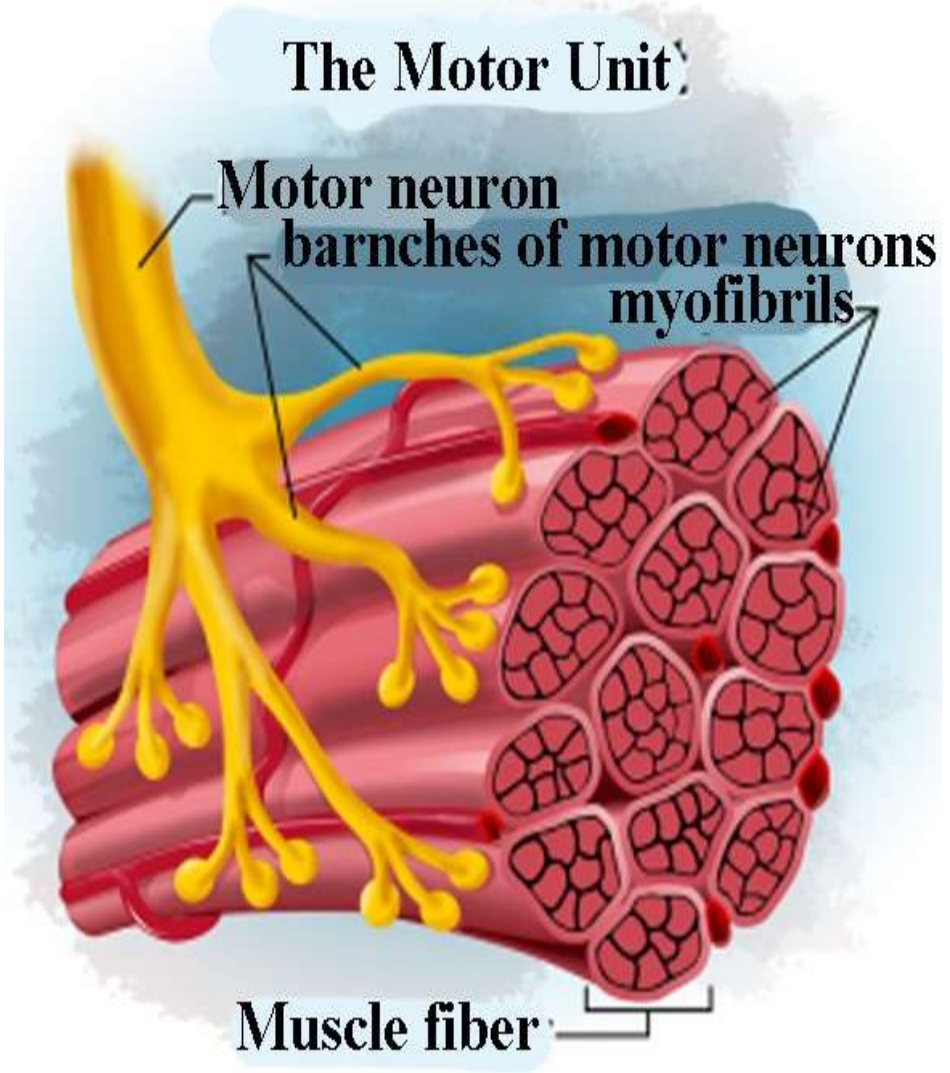


# 7.Recruitment

When an Excitatory Nerve is stimulated with a stimulus of Constant strength for a long time,there occurs a Progressive Increase in the response of Reflex activity due to progressive increase in the number of Motor Neurons activated.

This phenomenon is called “Recruitment”

But there is a limit to the number of Motor Neurons which can be recruited.So, beyond a certain limit,the prolongation of stimulation does not increase the Response & a plateau is reached



# 8.Irradiation

When the Sensory Stimulus is too strong, Impulse spreads to many neighbouring neurons in the Center & produces a Wider Response

It is due to transmission of Impulses through a Large number of Collaterals of Afferents & their Interneurons

Ex:- Mass reflex in a Paraplegic Patient
In a Paraplegic Patient, when the Skin or any portion in the Midline of Body is stimulated by gentle pinching,there occurs Evacuation of Bladder/Bowel,Flexion of Lower limb & Sweating of Skin below the Level of Lesion

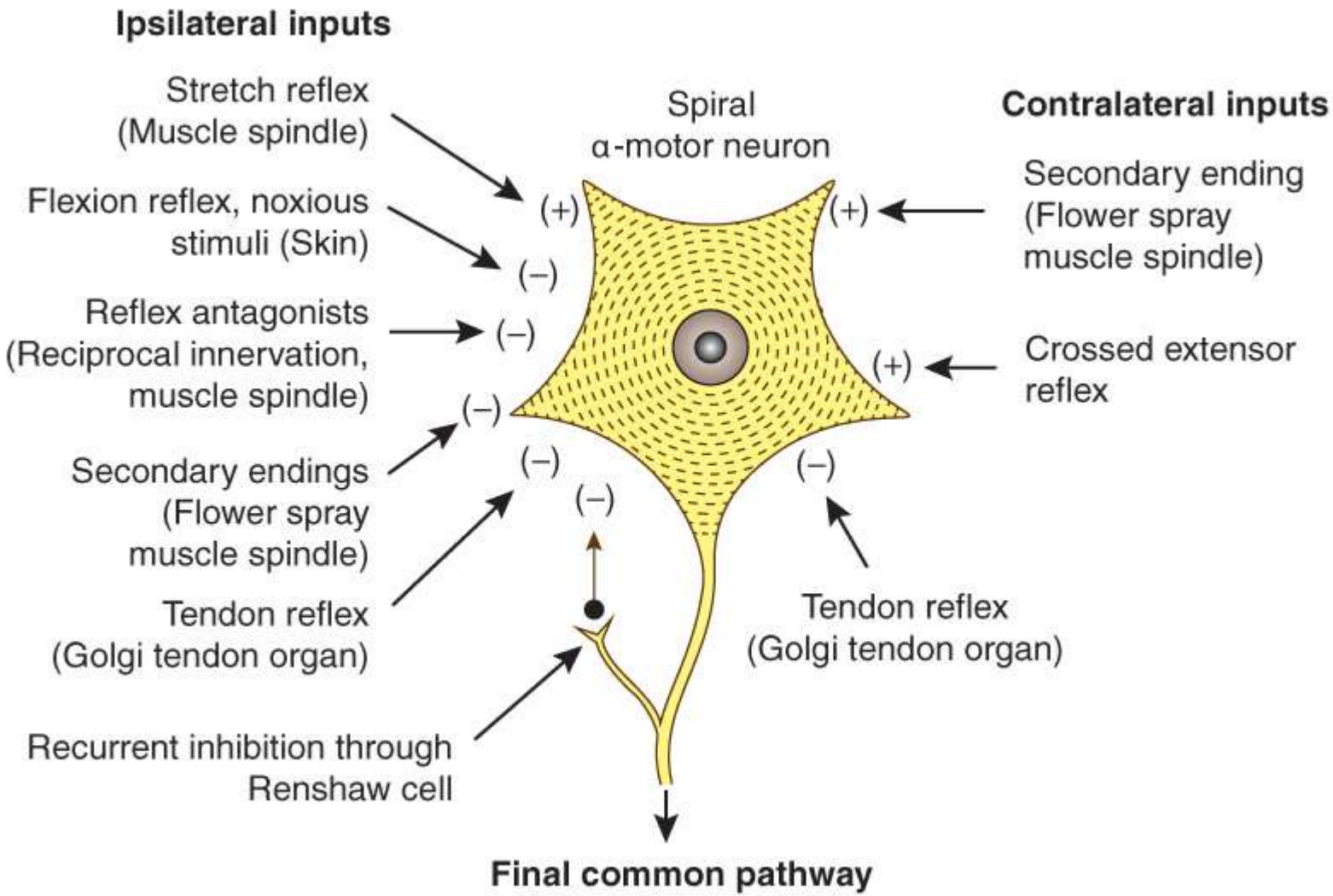
Significance :- Such patients are particularly trained to elicit mass reflex to evacuate Bowel & Bladder

## 9.Final Common Pathway

Efferent pathway of the reflex arc is formed by α-motor neurons that supply the Extrafusal Muscle fibres

All Neuronal influences whether Excitatory/Inhibitory affecting Muscular Contraction are ultimately funneled through the α-motor neurons

Hence,they are referred to as “Final Common Pathway”


Ipsilateral inputs
Stretch reflex (Muscle spindle)
Flexion reflex, noxious stimuli (Skin)
Reflex antagonists (Reciprocal innervation, muscle spindle)
Secondary endings (Flower spray muscle spindle)
Tendon reflex (Golgi tendon organ)
Recurrent inhibition through Renshaw cell
Spiral α-motor neuron
(+)
(–)
(–)
(–)
(–)
(–)
(+)
(+)
Contralateral inputs
Secondary ending (Flower spray muscle spindle)
Crossed extensor reflex
Tendon reflex (Golgi tendon organ)
Final common pathway

## 10.Facilitation :-

When a reflex is elicited repeatedly at proper intervals,the response becomes progressively higher for first few occasions.

It implies that each subsequent stimulus exerts a better effect than the previous one.

This is due to facilitation occurring at the Synapse

## 11.Reciprocal Inhibition :-

During a reflex activity,impulses through Sensory fibres from Protagonist muscles inhibit the action of Antagonist muscles

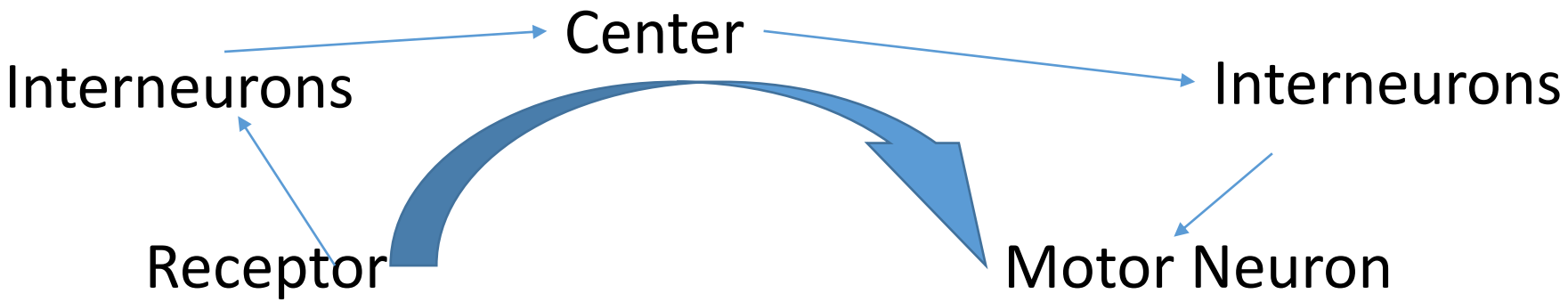
For ex :- When flexor muscles of a Joint are stimulated,Extensor muscles are inhibited.

The inhibitory activity is exerted by Interneurons

## 12.Afterdischarge :-

When a reflex action is elicited continuously for some time & then the Stimulation is stopped,the reflex response (Contraction) may continue for some time even after the cessation of stimulus.This phenomenon is called “Afterdischarge”

This is because the centre continues to discharge because of the fact that interneurons transmit impulses to the Centre even after stoppage of stimulus and also because there are many internuncial pathways stimulating the Motor Neurons & some of them take longer time to reach the Motor Neurons



## 13.Fatigue/Habituation :-

When a particular reflex is elicited repeatedly,the response is reduced progressively & then disappears all together.This phenomenon is called “Fatigue/Habituation”

The first site of Fatigue =Synapse
The Next site of Fatigue = Motor Endings (Neuromuscular Junction)
The Last Site of Fatigue =Muscles

## 14.Rebound Phenomenon :-

The Reflex activity can be inhibited for some time by some method. But,once the Inhibitory effect is over,the Reflex activity reappears & becomes more powerful

This is called “Rebound Phenomenon”

Its cause is still unknown

## 15.Fractionation :-

The force of a muscle contraction is much higher when its directly stimulated through Motor Nerve rather than when stimulated reflexly through a Sensory Nerve

## 16.Sensitization :-

When an injurious stimulus is repeatedly applied,Intensification of response occurs.

This is called “Sensitization”

It is due to Presynaptic Facilitation of an Impulse