
PHYSIOLOGY
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General Physiology
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lecture 20
Neuronal Reflexes :Spinal cord reflexes

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Let me save you more ways about the stabilization of a pool, what stabilization in a sense means, if you somehow excited a neuronal area or neuronal pool or certain neurons in one area, and due to the presence of different types of circuits wether it’s afterdischarge or riverbating circuits we have other types of circuits that are designed to stop this kind of activity, and that’s what we mean by stabilization of a pool, when you excite some neurons, you must find a way to terminate the excitability, and one of the things that happen that terminate the excitability, we have:

-Feedback inhibition, particularly neuronal feedback inhibition through basket cells through the cerebral cortex or in renshaw cells in the spinal cord, we have some pathways which are specifically designed to inhibit overactivity of a certain pathway that for example involves movement of the stabasal ganglia (STN basal ganglia حسب قوقل) which suppress overactivity in the motor system, and we have of course the synaptic fatigue were we have prolonged excitation and prolonged release of an excitatory neurons, the neurotransmitters become depleted

-which plays a role in long term stabilization of a neuronal excitability or so to speak basically the change of number of receptors, namely downward-down regulation or upward-up regulation of a receptor, if you have a prolonged release of a neurotransmitter, the number of receptors in the post synaptic cells which respond to this particular neurotransmitter tend to decline

Lecture objectives

- Define the reflex.
- Recognize the components of the neuronal reflex arc and the neuronal circuits of spinal cord reflexes (Stretch Reflex , Golgi tendon reflex and withdrawal reflex)
- Identify the types of reflexes (simple and acquired or conditioned reflexes).
- Differentiate between somatic reflexes and autonomic reflexes and give examples
- Learn the clinical significance of reflexes (spinal cord reflexes as an example).

Physiological anatomy of the spinal cord

- The spinal cord extends from the foramen magnum where it is continuous with the medulla to the level of the first or second lumbar vertebrae.
- It is a vital link between the brain and the body, and from the body to the brain.
- The spinal cord is 40 to 50 cm long and 1 cm to 1.5 cm in diameter. Two consecutive rows of nerve roots emerge on each of its sides.
- These nerve roots join distally to form 31 pairs of **spinal nerves**.
- The spinal cord is a cylindrical structure of nervous tissue composed of white and gray matter, is uniformly organized and is divided into four regions: cervical (C), thoracic (T), lumbar (L) and sacral (S),each of which is comprised of several segments.

The spinal cord is the part of the nervous system, and the NS (nervous system) is divided into 2 parts, the brain and the spinal cord, the brain is composed of the cerebral cortex, the diencephalon, thalamus, hypothalamus, the brainstem that is composed of the midbrain, the pons and the medulla, and the extension of the medulla that leaves a foramen in the skull known as foramen magnum, it's basically what constitutes or what forms the spinal cord, the spinal cord runs through the spinal canal within the vertebral column that allows the containment of the spinal cord until it reaches its final destination within the spine, also the spinal cord is the link between the body parts and the CNS (central nervous system)

it's 45cm in length, 1.5cm in diameter, it's divided into multiple parts, some in the cervical some in the thoracic section and some in the lumbar area and the sacrum region, and the spinal cord is divided into segments, cervical C1-C7, Thoracic T1-T12, lumbar L1-L5……, and of course from these segments of the spinal cord we will find spinal nerves, that exit through specific structures in the vertebral column, we have 31 spinal nerves, they are made of afferent neurons and sensory neurons that carry the signal from the PNS (peripheral nervous system) to the spinal cord and we have efferent neurons that leave the spinal cord and go back to the peripheral, particularly the muscles and glands

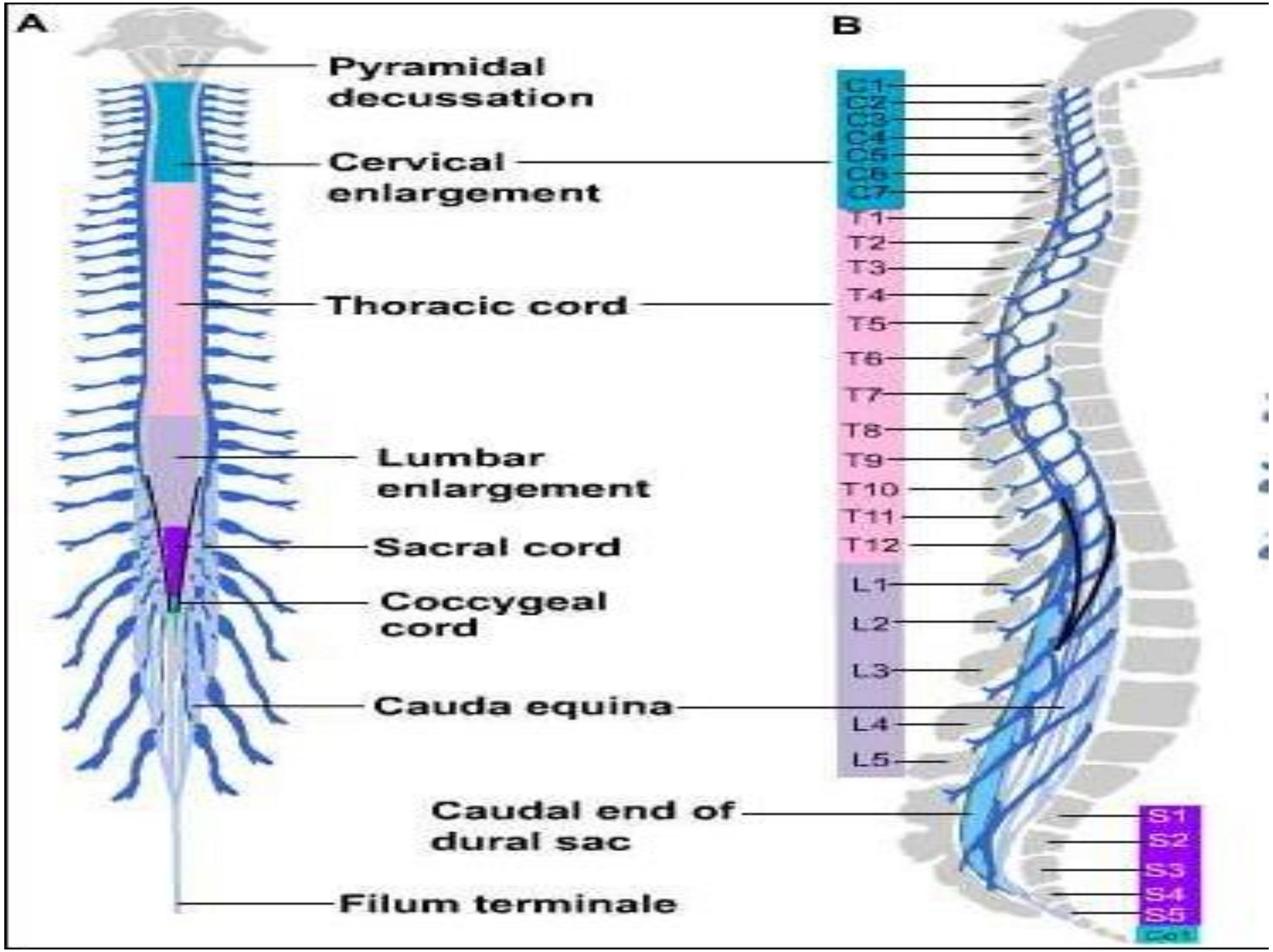
Functions of spinal cord

- **Send sensory signals to the brain.** The nerves also carry signals from different parts of your body to your brain.
- **Regulate body movements**
- Motor neurons in the ventral horn project their axons into the periphery to innervate skeletal and smooth muscles
- Final common pathway which carries motor commands of higher brain centers to skeletal muscles .
- **Control your reflexes.** The nerves in the spinal cord also control some reflex actions without involving your brain
- It contains neurons which mediates autonomic control for most of the visceral functions. For example Micturition reflex

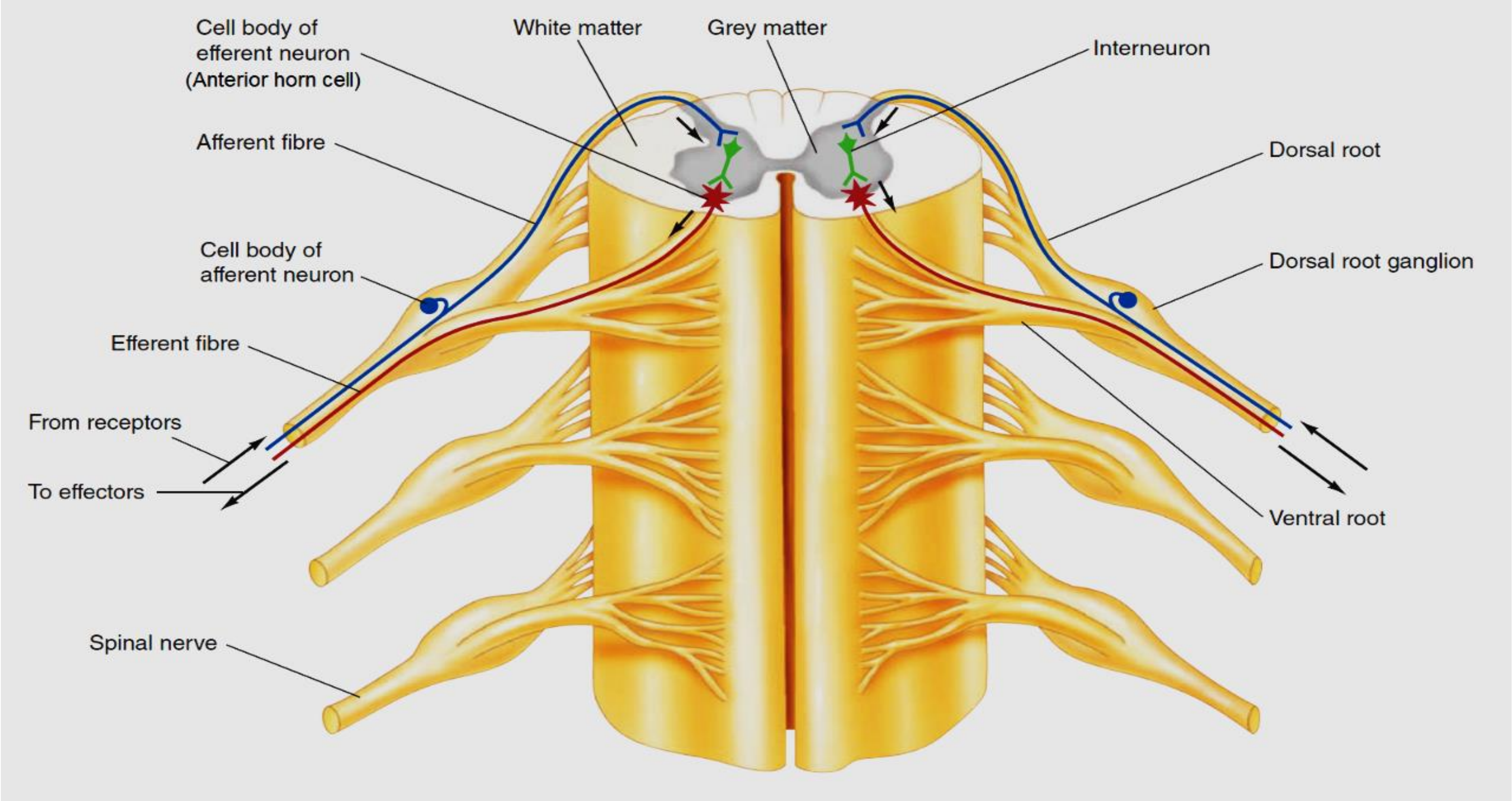
-Send sensory signals and takes it eventually to the brain, it’s enfolded in the enervation of the skeletal muscles as well as smooth muscles, so it has something to do with the movement,

-it controls certain reflexes wether they’re associated with our muscles or our autonomic functions, like emptying of the bladder or the micturition reflex, this is an autonomic reflex meaning that it’s mediated through autonomic fibers, cause the fibers have a relation with the somatic structure like the skeletal muscles, and we have the nerves that have a relation with autonomic or visceral structures like the stomach, bladder, airway etc…

Spinal cord Segments and spinal nerve



Spinal cord and spinal nerves



-White matter: the area that contains fiber tracts, wether they're ascending tracts that carry sensations to other parts of the brain thalamus and the cerebral cortex, they (fiber tracts) are the parts that take on the sensation signals to different parts of the brain, or they could contain descending motor pathways, the pathways that are responsible for movement like the cortecospinal pathway, again you will find multiple tracts located within the white matter of the spinal cord, and each tract has its specific function we will learn more in neuroscience

-grey matter: the area in which the cells are found, if you take the dorsal horn it contains a sensory fiber, if you take a ventral horn you will find the motor fibers, so the sensory fibers are initiated if you look at it here from the receptors (see the record to know the place) and their cell bodies are located in something called the dorsal root ganglia and they enter through the dorsal part of the spinal nerve or the dorsal part of the spinal cord until they reach the spinal cord and make synaptic connections with different neurons, usually the effector neurons or the motor neurons, and those guys will leave through the ventral horn right here and they will terminate and make synapses with the affector, and the spinal nerve is a mixed nerve, it contains sensory fibers or affferent or motor fibers and efferent, and this guys will carry the signal from the peripheral to the spinal cord, and this guy will carry the signal from the ventral horn of the spinal cord and to the effector, and they eventually join to make the mixed spinal nerve

What is a reflex

- A reflex is any response that occurs **automatically** without conscious effort and is part of a biological control system that links stimulus and response.
- There are two types of reflexes:
    1. Simple (basic) reflexes, which are built-in, unlearned responses, such as pulling the hand away from a burning hot object.
    2. Acquired (conditioned) reflexes, which are a result of practice and learning, such as car driving.
- Reflexes can also be classified as
    - Somatic reflexes Associated with somatic structures like Knee jerk reflex
    - Autonomic reflexes Associated with visceral structures innervated by autonomic nervous system GI reflexes, Blood pressure reflexes, Pupil reflex, Micturition reflex etc.

Neuronal Reflexes: an event that happens without being aware of it, it happens automatically in response to stimulus and we are not aware of it, we don’t feel that something is happening, so when you stimulate a receptor it will initiate an action potential in the afferent neuron, the afferent neuron will go and make a synapse in the integrating center with the afferent neuron, the integrating center where the synapse will happen with the afferent or efferent signal depending on the reflex,
some reflexes are integrated as a spinal cord level, for example: stretch reflex, micturition reflex (bladder emptying)..…
Other reflexes where their substrate is the cranial nerves, their integrating signal is within the brain itself usually, for example: pupil constriction, when you shine a light to the pupil, it usually constricts, the link between the efferent fibers or the optic nerve which carry the light signal will make synaptic contact with specific neurons that goes to the muscles that control the size of the pupil, which are located for example in the midbrain

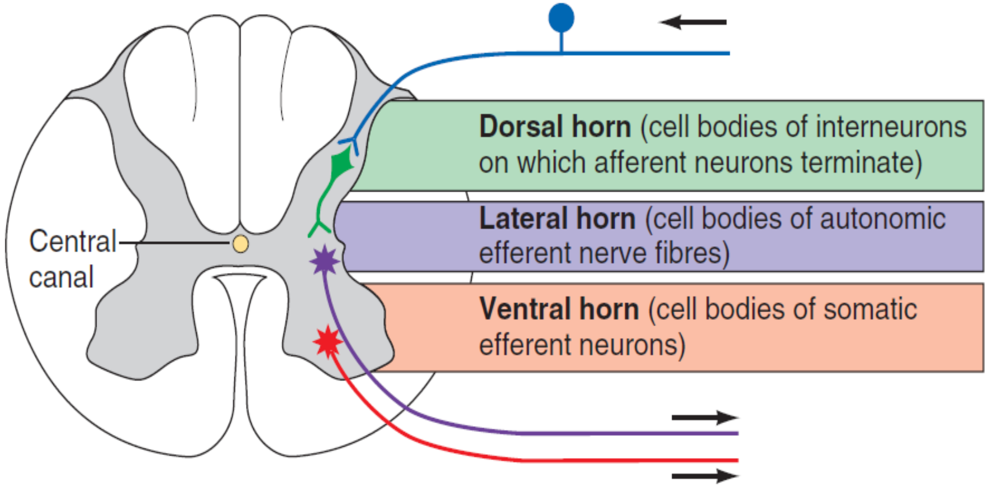
-Reflexes could be somatic, those that are related to the skeletal muscles, they occur and induce movement of the skeletal muscles, for example, the knee jerk reflex which is called the myotatic stretch reflex, particularly an example is the stretch reflex, knee jerk reflex, we will talk about it later

-Autonomic reflexes which are associated with the visceral organs, pupil reflex, micturition reflex, GI reflexes, blood pressure reflex

Sometimes we could classify the reflexes in terms of complexity
-Basic or simple reflexes: those are unlearned reflexes, for example: when someone touches a hot (صوبة) he directly removes his hands to not burn them
-Acquired or conditioned reflexes: which are learned by practice, example: there is a scientist called bablov he had a dog and he kept feeding him, and with each time he said him, he rang a bell so the dog has a response which is salivation and the want to eat, after some training whenever the scientist rang the bell, the dog would come and know that it is time for food without even telling him or showing him the food

The neuronal component of a reflex arc

- The **Reflex Arc**: The neural pathway involved in accomplishing reflex activity, which typically includes five basic components:
  1. Receptor
  2. Afferent pathway
  3. Integrating center (part of the CNS)
  4. Efferent pathway
  5. Effector (a muscle or gland)



- The reflex could be a **monosynaptic, bisynaptic,** and **polysynaptic** based on the number of neuronal synapses within the reflex arc.

What are the components of reflex, wether its an autonomic reflex or a somatic reflex,
1-we need a receptor it could be a Mechanoreceptor, a photo receptor or whatever it is depending on the receptor
2+3-the afferent neuron which carried the signal from the peripheral or the receptor to the integrating center, which is either the spinal cord or the brainstem depending on the reflex pathway
3+4-motor component of the efferent pathway: which takes back the signal from the CNS to the effector organ, which is usually a muscle (skeletal, visceral) or a gland

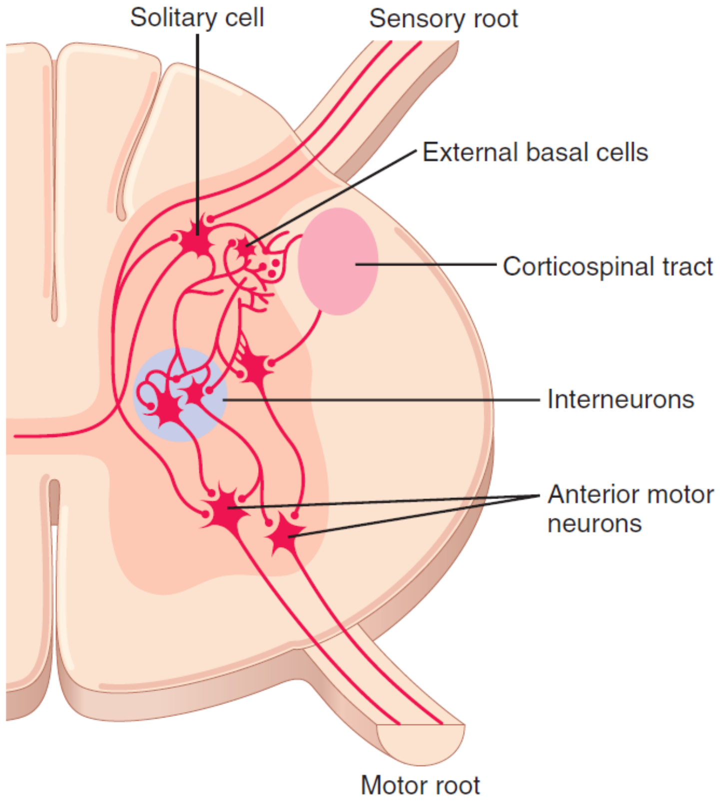
As we can see here, this is the afferent neuron here in the dorsal horn, and the cell bodies are located within the dorsal ganglia, it enters the dorsal horn of the spinal cord, and you can see here its making a synapse with an inter neuron and then the inter neuron will make a synapse with another enter neuron, or the afferent neuron could directly make a synapse with the efferent neuron that will go to the spinal cord through the ventral horn, and reach for example the somatic efferent neuron, if the somatic structure is like the skeletal muscles

So this is the input through the dorsal horn and the dorsal horn of the spinal nerve, this is the afferent neuron, it makes a synapse with the integrating center, here it's the spinal cord, and after the synaptic input is over, it will cause excitation of the efferent neuron that will carry the signal through the ventral horn and take it back to the effector or the muscle

Depending on the number of synapses between the afferent limb or the afferent pathway, which mediates the reflex, reflexes could be classified into either:
-Monosynaptic: only one (stimulus أتوقع) between the afferent and the afferent neuron, it's not shown here
-Bisynaptic: there is one synapse between the afferent and the interneuron and there is another synapse between the efferent and the motor neuron, which is located in the ventral horn
-Polysynaptic: sometimes the afferent neuron makes synapses with multiple neurons one after the other

Organization of the Spinal Cord for Motor Functions

- The cord gray matter is the integrative area for the cord reflexes.
- Sensory signals enter the spinal cord almost entirely through the sensory roots; also known as the posterior or dorsal roots.
- After entering the spinal cord, every sensory signal travels to **two** separate destinations:
  A. One branch of the sensory nerve terminates almost immediately in the **gray matter** of the cord and elicits local segmental spinal cord reflexes and other local effects.
  B. Another branch transmits signals to higher levels of the nervous system; to **higher levels** in the cord itself, to the brain stem, or even to the cerebral cortex.



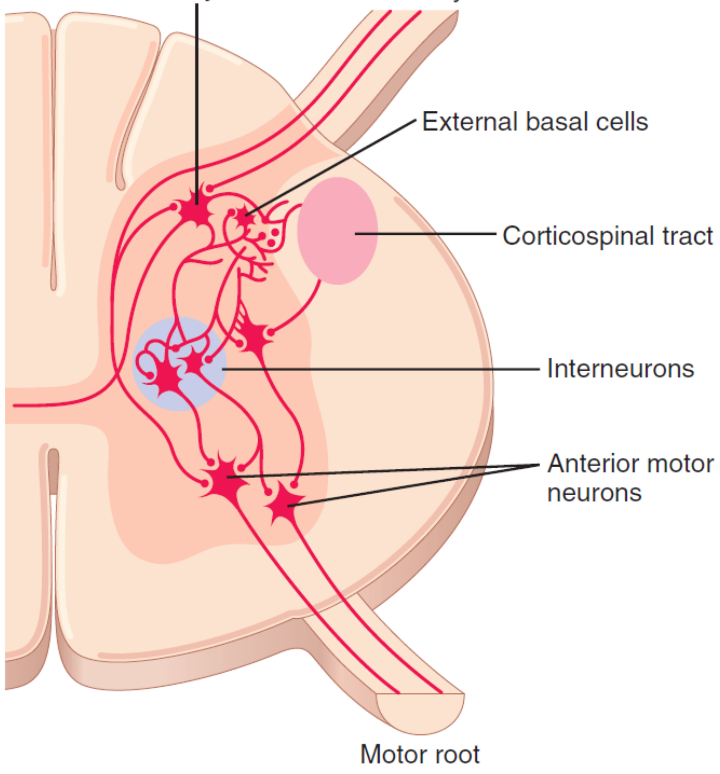
Grey matter: is the area that synapses happens between the afferent limb or the sensory signal and other neurons in the spinal cord, it could elicit (تستخرج) local segment reflexes or higher segment reflexes, we are only showing the nerves that end in the spinal cord, usually some of the fibers will go and ascend through the white matter to reach different areas of the CNS, like the brainstem, thalamus, cerebral cortex

Organization of the Spinal Cord for Motor Functions (cont.):

- Each segment of the spinal cord has several million neurons in its gray matter. these neurons are of two types:
  1. **Anterior motor neurons (large type A fibers):** that are 50-100% larger than most of the other neurons. They give rise to the nerve fibers that leave the spinal cord by way of the anterior roots and directly innervate the skeletal muscle fibers.
  2. **Interneurons:** These cells are about 30 times as numerous as the anterior motor neurons. They are small and highly excitable.

     They have many interconnections with one another, and many of them synapse directly with the anterior motor neurons. Essentially all the different types of neuronal circuits are found in the interneuron pool of cells of the spinal cord, including **diverging, converging, repetitive-discharge, and other types of circuits.**

     Almost all incoming sensory signals from the spinal nerves or motor signals from the brain are transmitted first through interneurons, where they are appropriately processed.



-Anterior horn: usually they contain the motor neuron that enervates the skeletal muscles and they’re of A-type

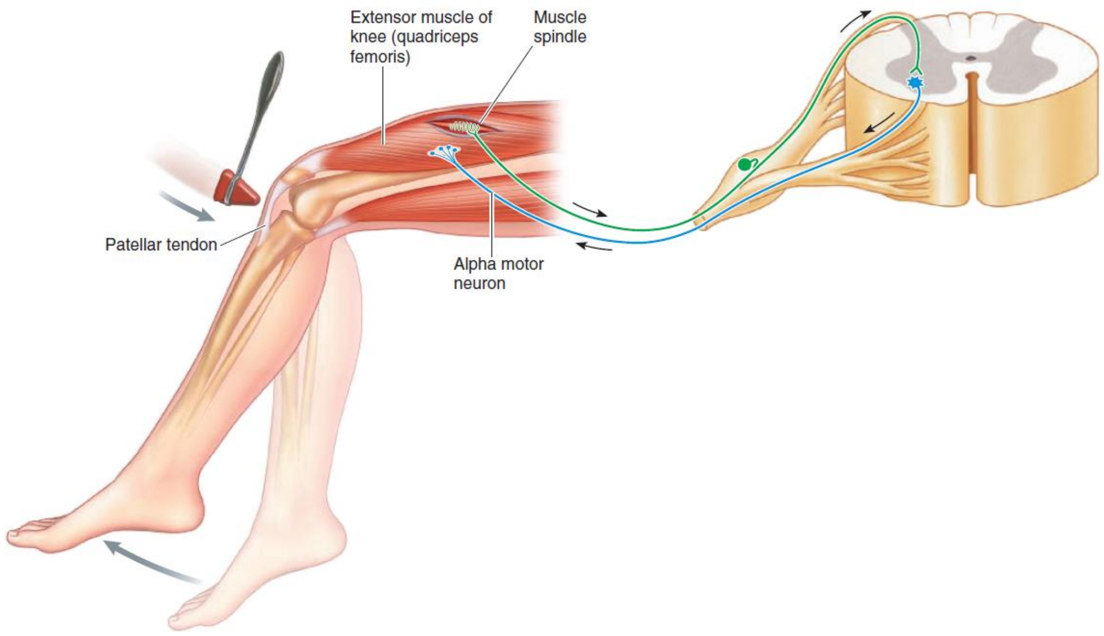
-Interneurons here (in the picture) and just to remind you the way by which synaptic contacts are made to achieve the integrating function of the neuronal pool, we have different types of circuits that are present even within the spinal cord,we have diverging, converging, repetitive-discharge, and other types of circuits, so eventually the integration between the afferent and the efferent is achieved through different types of neuron circuits, some of them are gonna be excitatory and some inhibitory, so that eventually the NS can do what it supposed to do

The Stretch Reflex or Myotatic Reflex (monosynaptic reflex)

- The afferent neuron originating at a **muscle spindle** in a skeletal muscle. This afferent neuron terminates directly on the efferent neuron supplying the same skeletal muscle.

- The stretch reflex is a **monosynaptic reflex** (one-synapse), because the only synapse in the reflex arc is the one between the afferent neuron and the efferent neuron.

- Whenever a whole muscle is passively stretched, its muscle spindle intrafusal fibers are likewise **stretched** (activated), which increases the firing rate in the afferent nerve fibers whose sensory endings terminate on the stretched spindle fibers.



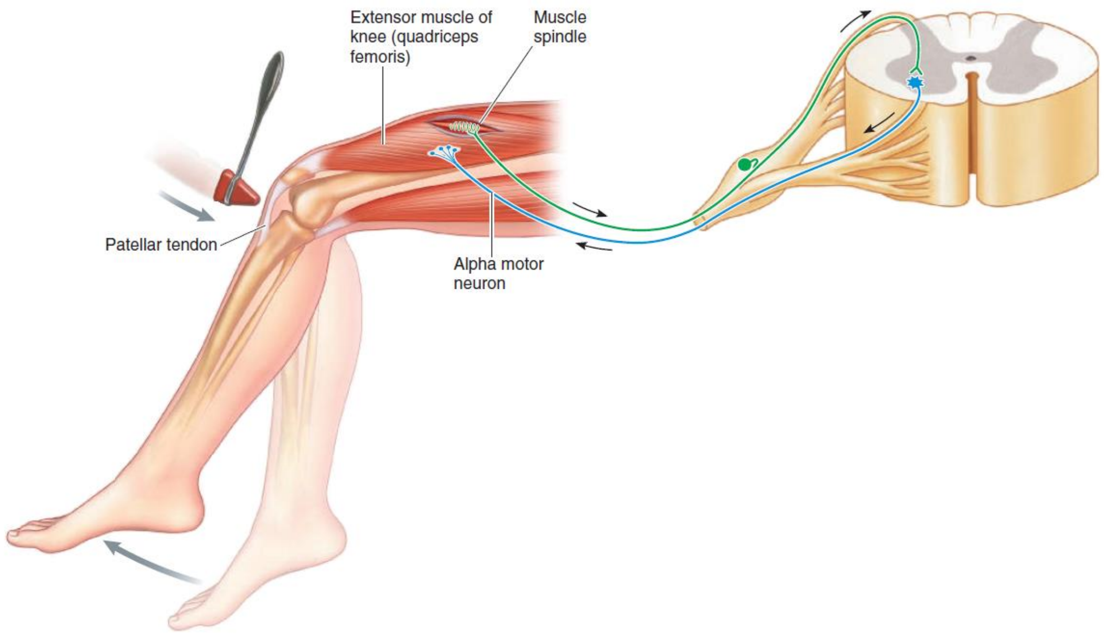
- The afferent neuron directly synapses on the **alpha motor neuron** that innervates the extrafusal fibers of the **same muscle**, resulting in **contraction** of that muscle.

Simplest form of reflexes, that is integrated in the spinal cord

Ex: if we sat down a patient, and made home cross over his legs (اجر ع اجر) and bring the hammer (made from rubber) and hit him on the tendon of the knee, evidently when you hit him with a hammer you cause stretching of a receptor there, which located within the tendon and the muscle, we call it the stretch receptor, the stretch receptor when it is activated by the tapping of the patellar tendon, here we can see the stretch receptors and there are the afferent fibers, this is the afferent side of the limb, it goes and carries the signal through the dorsal root and terminates within the spinal cord and make synapses in the ventral horn with the motor limb or the efferent limb of the reflex, that will go and excite the muscle, so this reflex is known as monosynaptic, cause there is only one synapse between the afferent and the efferent limb, (…………..), this reflex is initiated you elicit it by the stretching of the tendon, and the stretching of the tendon will excite the sensory fibers of the receptor, which is the muscle spindle, and the sensory fibers which are sometimes called 1-A fibers, they make a synapse with the motor neuron here and the motor neuron will usually cause excitation of the muscle and extension of the knee

The Stretch Reflex or Myotatic Reflex (monosynaptic reflex) cont.:

- This stretch reflex serves as a local **negative-feedback** mechanism to resist any passive changes in muscle length so that optimal resting length can be maintained.
- The classic example of the stretch reflex is the **patellar tendon (knee-jerk)** reflex.
- This test is routinely done as a preliminary assessment of nervous system function. It also indicates an appropriate balance of excitatory and inhibitory input to the motor neurons from higher brain levels.



We learn it as a tool to examine the integrity of the NS, but it has other implications, for example, it controls muscle length, so that it keeps the muscle attached, at an optimal length so that when the muscle contracts it generates sufficient tension, also it has a relation with the muscle tone, meaning that even if we don't contract our muscle, if we tried to raise the arm of the patient, you won't find it fully relaxed, it'll feel a bit passive resistance, and it is known as muscle tone, and the muscle tone changes, due to the change in the activity of the stretch reflex, for example: if someone had a stroke and had damage in the cortex, we will find that the arm is tense (مشدودة) or something called hypertonia (the muscle tone increases) it is way to teach the students how the simple neuronal circuits could do many things within the NS even at the spinal cord level, beside teaching it and telling the students the clinical importance of it, by examining these reflexes you can get an idea wether for example if the patient had a space (فراغ) in the spine;al cord or the cortex, if someone had damage in the spinal cord and he had a damage in the ventral horn or the dorsal horn, if I want to examine the knee jerk or the patellar tendon reflex, it won't be available, and we'll have no reflex,but if someone had a stroke and I examined the reflex in this patient, I'll find out that the reflex intensity is higher, not only that, but sometimes the systemic diseases are associated with the intensity of the reflexes, if we took the thyroid gland as a case, sometimes in some people the secretion of hormones is increased (hyperthyroid) for different reasons, and they'll develop hyperthyroidism, so if we examined the reflex in the hyperthyroidism we will find that the intensity of the reflex or the strength of the reflex is larger, so the people with hyperthyroidism have hyper reflexia, but if someone had hypothyroidism for one reason or the other, and we examined his reflexes, including the patellar tendon reflex, the reflex becomes weak and they'll develop hypo reflexia

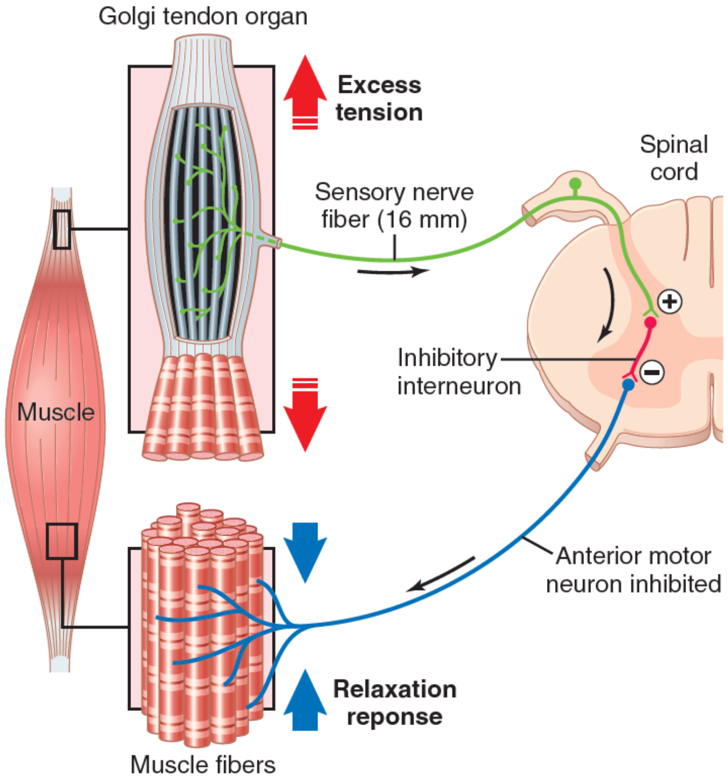
So that gives an idea besides checking the integrity of the NS, sometimes we could utilize the reflexes as a tool to give us an idea about the systemic illness, and the best example is the thyroid problems

Hypoactive and hyperactive Knee jerk Reflexes Hyperreflexia and hyporeflexia

- Generally speaking lower motor neuron lesions causes a reflexia of hypo-reflexia
- Lesions in anterior horn cells or ventral root of innervation skeletal muscles causes absence of stretch reflexes
- Hypothyroidism cause diminished stretch reflexes (Hyporeflexia)
- Hyperthyroidism cause increase intensity of stretch reflexes (Hyper-refxia)
- Generally speaking Upper motor neurons lesions cause hyperreflxia

Golgi Tendon Reflex (bisynaptic reflex):

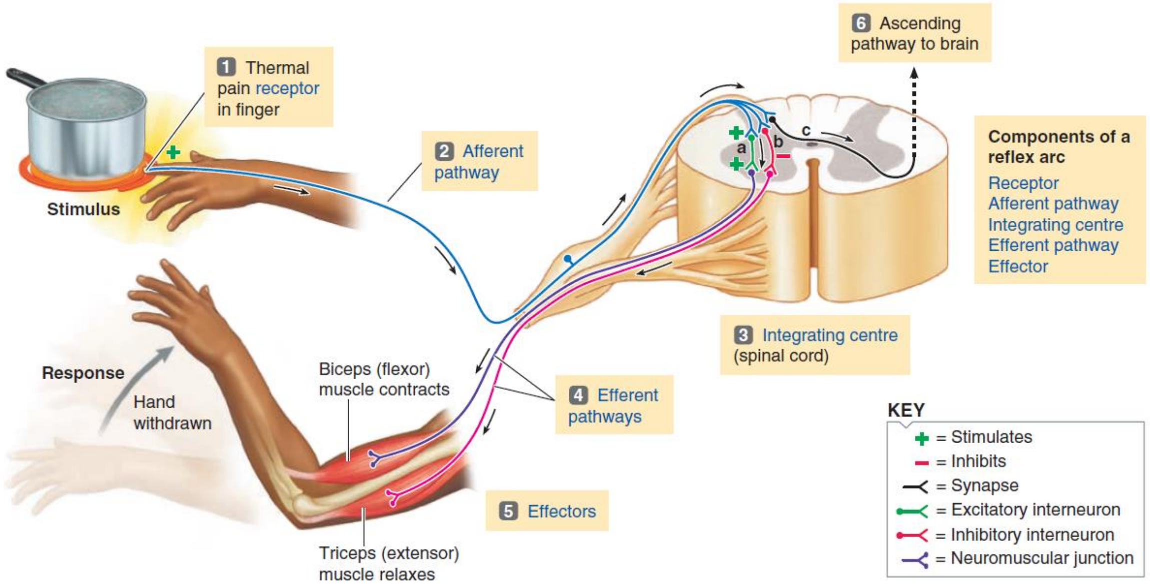
- The Golgi tendon organ is an encapsulated sensory receptor through which muscle tendon fibers pass.
- The major difference in excitation of the Golgi tendon organ versus the muscle spindle is that the spindle detects muscle length and changes in muscle length, whereas the tendon organ detects muscle **tension** as reflected by the tension in itself.
- Golgi tendon organs provide the nervous system with instantaneous information on the degree of tension in each small segment of each muscle.
- Signals from the tendon organ are transmitted through large, rapidly conducting nerve fibers that average 16 micrometers in diameter. The local spinal cord signal excites a **single inhibitory interneuron** that inhibits the anterior motor neuron. This local circuit directly inhibits the individual muscle without affecting adjacent muscles.
- This reflex is **entirely inhibitory**. Thus, this reflex provides a negative feedback mechanism that prevents the development of too much tension on the muscle.
- This effect is called the lengthening reaction; it is probably a **protective mechanism** to prevent tearing of the muscle or avulsion of the tendon from its attachments to the bone.



-Golgi tendon reflex or the inverses stretch reflex or the lengthening reflex , cause it is the opposite from the stretch reflex, in the stretch, tapping the tendon will the cause the muscle to contract and generation of tension. However, the Golgi tendon reflex (inverses stretch reflex) is related to the tension of the muscle, it detects the amount of contraction or the amount of force in the muscle, meaning when a muscle contracts, this Golgi tendon organ monitors the tension of the muscle, and if the tension of the muscle is too much, it’s gonna go and inhibit the muscle, cause we don’t extra tension on the muscle and a potential injury or tear, this is its function, so again we have receptors in the tendons of the muscles and also sensory fibers (maybe type 2 not sure), now you can see (in the picture) this the receptor and this is the afferent neuron, it goes through the dorsal root and it terminates within the spinal cord, but here you can see it doesn’t make direct contact with the motor neuron that enervates the muscle, what it’s gonna do is it will go and make with an inhibitory interneuron, in a feed-forward matter, this is a form of feed-forward inhibition, the afferent neuron will go and excite an inhibitory interneuron, and the excitation of this inhibitory interneuron will inhibit the motor neuron that’s going to that muscle, and thus it causes its relaxation, and that’s why it’s called bisynaptic, cause there are a couple (2) synapses one between the afferent limb and the motor neuron, and one synapse between efferent limb and the inhibitory interneuron, so it gives us protection from the tear of the muscle

The Withdrawal Reflex (polysynaptic reflex):

- When a painful stimulus affects a limb, a withdrawal reflex is initiated to pull the limb away from the painful stimulus.
- Once the sensory afferent neuron enters the spinal cord, it diverges to synapse with the many different **interneurons**.



1. Excitatory interneurons that in turn stimulate the efferent motor neurons supplying the flexor muscles to pull the limb away from the painful stimulus.
2. Inhibitory interneurons that in turn inhibit the efferent neurons supplying the extensor muscle to prevent it from contracting. Therefore, built into the withdrawal reflex is inhibition of the muscle that antagonizes (opposes) the desired response. Such type of neuronal connection is known as **reciprocal innervation**.
3. The afferent neuron stimulates still other interneurons that carry the signal up the spinal cord to the brain via an ascending pathway. <u>Only when the impulse reaches the sensory area of the cortex is the person aware of the pain, its location, and the type of stimulus</u>. The information can be stored as memory as well.

The more complicated reflex which involves many synapses between the afferent and the efferent limb, and this is called the flexor withdrawal reflex, and the best example is touching a hot pan on the stove, the receptors for initiating the stretch reflex are the thermo receptors, and if the temp is so high, this reflex would be associated with painful sensation that reaches the level of the cerebral cortex, but as a reflex and without causing pain, it is initiated by the stimulation of the warm receptors of the skin, the warm receptors will generate a receptor potential in the primary afferent neuron, it goes through the dorsal root and it terminates in the spinal cord, and now you can see here there are too many synapses, between the afferent and the efferent, and it goes to more than one motor neuron, as you can see(in the picture) one input of the afferent through interneurons through the red (in the picture) here and the other one through the blue and you can see the blue for example in this case is going to the biceps, whereas the red is going to the triceps, and those are agonist and antagonist, the contraction of the biceps causes flexion of the arm, to have a flexion I should do 2 things, from one side I should do excitation of the flexor, at the same time through inhibitory neurons I should inhibit the motor neuron that goes to the triceps, so this one would be excited the agonist, and the antagonist will be inhibited, which is known as reciprocal innervation, you excite the agonist and inhibit the antagonist, or vise versa (و العكس صحيح) so one of the muscles which act on a joint, the agonist will be inhibited and antagonist will be excited depending on the type of reflex, wether it’s flexion or extension, it’s multi synaptic

-Ex: with this receptor or stimulus a lot of times when you step on a nail while barefooted (حافي) the leg that stepped on the nail had a withdrawal reflex (flexion), however the other leg had an extension, so one leg goes up and the other will be going into the ground, so in one leg we will cause flexion and the contra-lateral leg we will cause extension, so the response of the extension of contra-lateral muscles is called crossed-extensor reflex, meaning at a side we will have withdrawal reflex (flexion) and the other crossed-extension, so the withdrawal reflex is polysynaptic initiated by build in stimuli it provides reciprocal innervation in the ipsi-lateral side causing excitation of the flexor, inhibition of the extensor, and it's also associated with something known as crossed-extensor reflex where you cause extension of the contraction-lateral limb, and for the extension of the contra-lateral limb to happen, in pathways and synapses, in this case it should excite the extensor and inhibition of the flexor, through reciprocal innervation

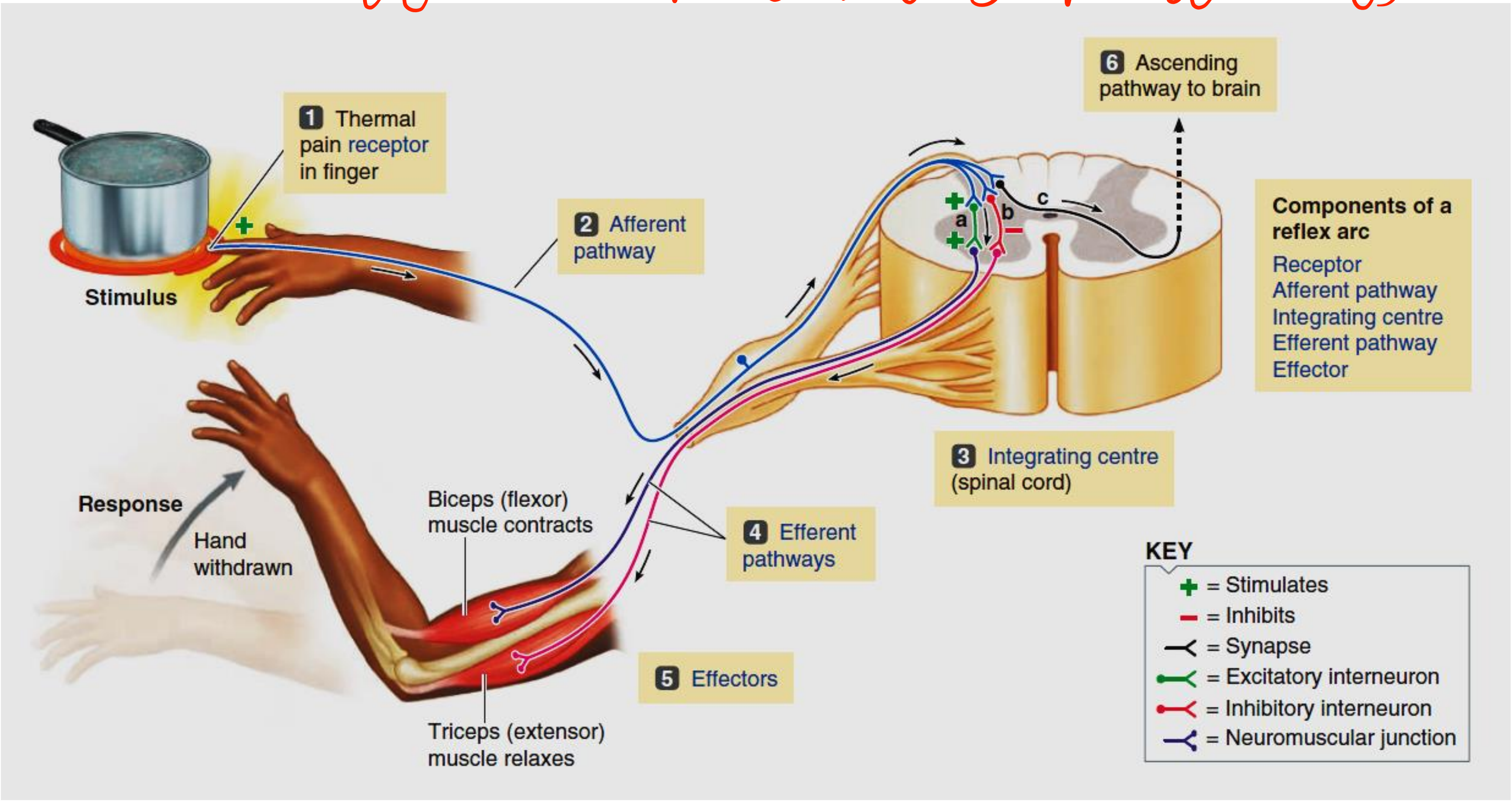
-In a lot of times if the object is very very hot that may cause excitation of the pain receptor, we won't only have the withdrawal reflex, but also the pain fibers will be excited and send pain signals through something known as the lateral spinothalamic tract (fiber tract that takes pain مش مطلوبة مننا) but the fiber tract which carries the pain sends it to the thalamus and eventually to the somatosensory cortex, and give us perception of pain (we feel it), because of that if the object is too hot, not only will he remove his hand, but also he may shout in pain, the goal of all this is to tell that something is going around and you gotta take care of it,
The pain sensation is not a reflex pathway, it's a somatosensory signal that reaches our awareness, OH BOY THIS STIMULUS WAS REALLY PAINFUL 😵

The flexor withdrawal reflex neuronal circuit

see the record for details

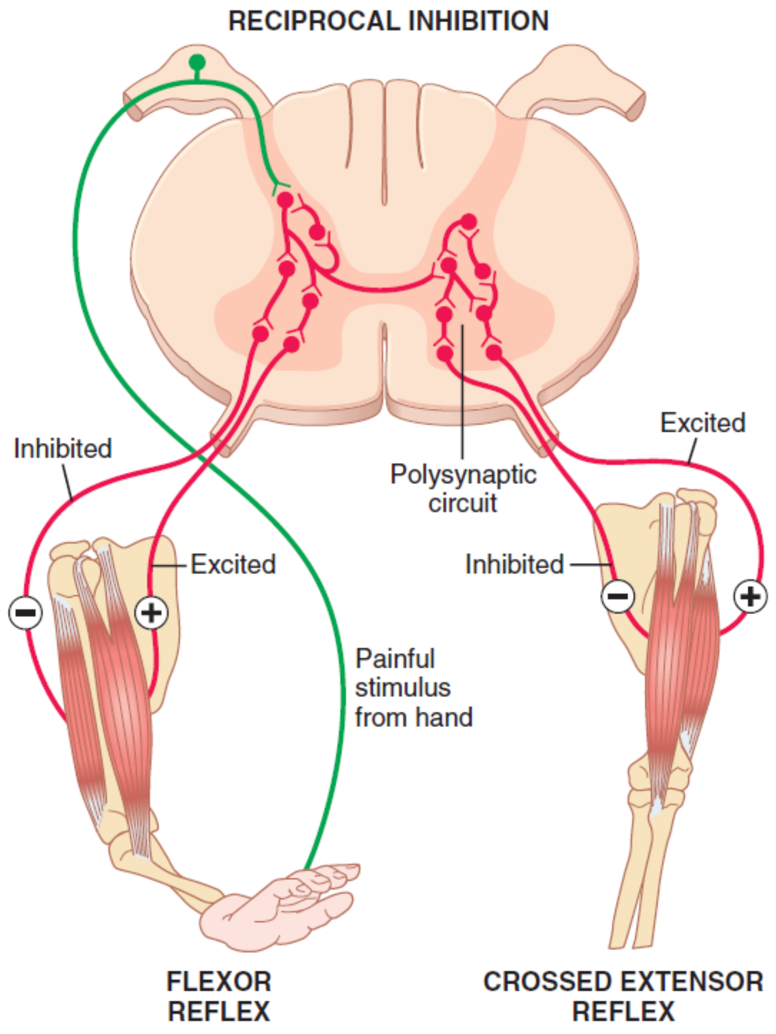
What is the neuromuscular junction?

The synapse between motor neuron and the skeletal muscles



The Withdrawal Reflex (polysynaptic reflex) cont. :

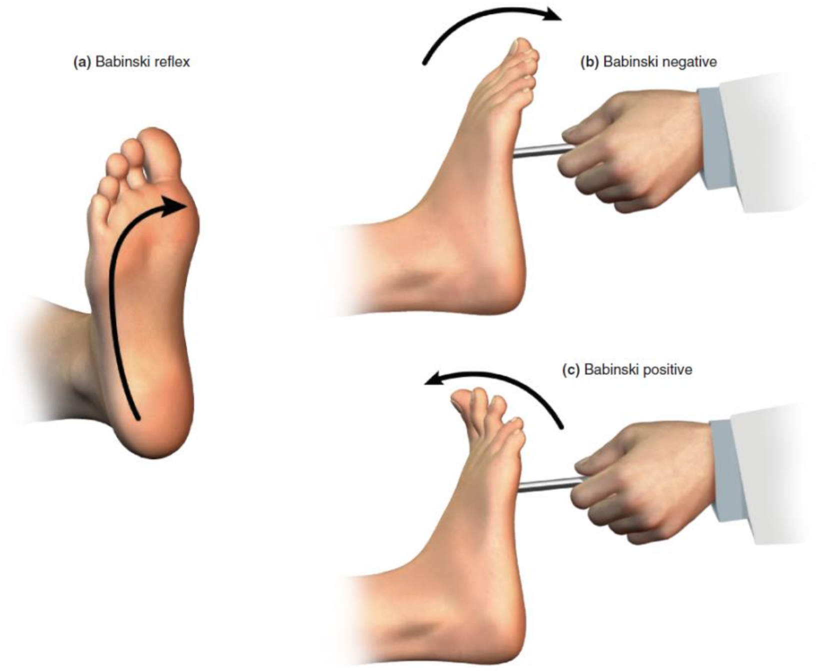
- The withdrawal reflex action is not necessarily limited to motor responses on the same side of the body to which the stimulus is applied.
- Activation of pathways that induce **crossed extensor reflex** of the opposite limb can occur to ensures that the opposite limb will be in a position to bear the weight of the body as the injured limb is withdrawn from the stimulus.
- The brain can modify and **override** the withdrawal reflex by sending IPSPs via descending pathways to the motor neurons supplying the flexors and EPSPs to those supplying the extensor muscles.



A message to take home: It is true that these reflexes are integrated within localized regions of the spinal cord, but their activity could be affected by inputs from higher brain centers, and the best example that these receptors can be affected by inputs from higher brain centers is the activity (🤖) of the reflex is increased when someone has a stroke, cause he will have excitatory inputs from higher brain center that will facilitate and then as the activity of this reflex, but remember why for example the activity (cause those aren’t isolated, the brain either high center or center

The Babinski Reflex (Plantar Reflex):

- Babinski reflex is considered positive (present) when the big toe **dorsiflexes** (straightens) and the other toes fan outward after the lateral portion of the sole of the foot has been stimulated by a sweeping pressure.
- Babinski reflex is positive in **infants**, which is normal up to two years of age. Then this reflex disappears as the child ages and the nervous system develops.
- The presence of positive Babinski reflex after age two is a sign of corticospinal tract **dysfunction**.
- A positive Babinski is commonly associated with diseases such as head injury, meningitis, multiple sclerosis, spinal cord injury, **stroke**, tuberculosis, and rabies.



If we bring a hammer, its base is made of metal, and we moved the metal on the foot while touching it, in normal circumstances the foot they extend forward all of them, the big toe and the rest of the fingers, but if someone has a problem, particularly in the corticospinal tract (for movement), those people have positive babinski
(Look at the video) this is negative babinski, meaning that the corticospinal tract is fine, if we have a positive babinski, when I do this movement or this type of movement, this rod or metal thing (they usually use a hammer), when they do the babinski they pass the metal in this direction, so if someone has damage to the corticospinal tract, you get a positive babinski sign and we have dorsiflexion of the big toe, the big toe goes back, and the rest of the fingers move away from each other (in the normal person they are close to each other and point forward), this is a babinski sign, you may observe it in a patient with stroke or meningitis, tuberculosis, but it’s very common in stroke

During development, the infants corticospinal tract is still not well developed, so if we examined the babinski reflex, we will find it positive until he reaches 2 yrs old, but after 2 yrs the nerves complete their development and fully grown, and full demylenation and the babinski sign should not be there

MCQ

Q. The Knee Jerk reflex :

A. Regulates muscle tension
B. Is attenuated in patient with stroke
C. Is a monosynaptic reflex
D. Is hyperactive in hypothyroid patients
E. Its activity is not affected affected by inputs from higher brain centers