



Motor Unit

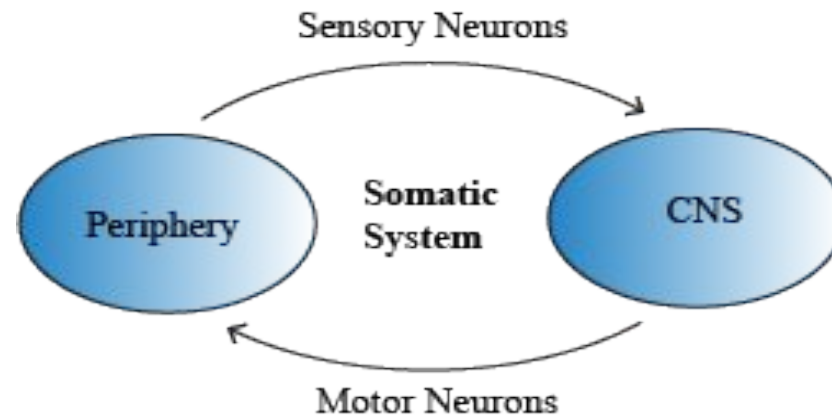
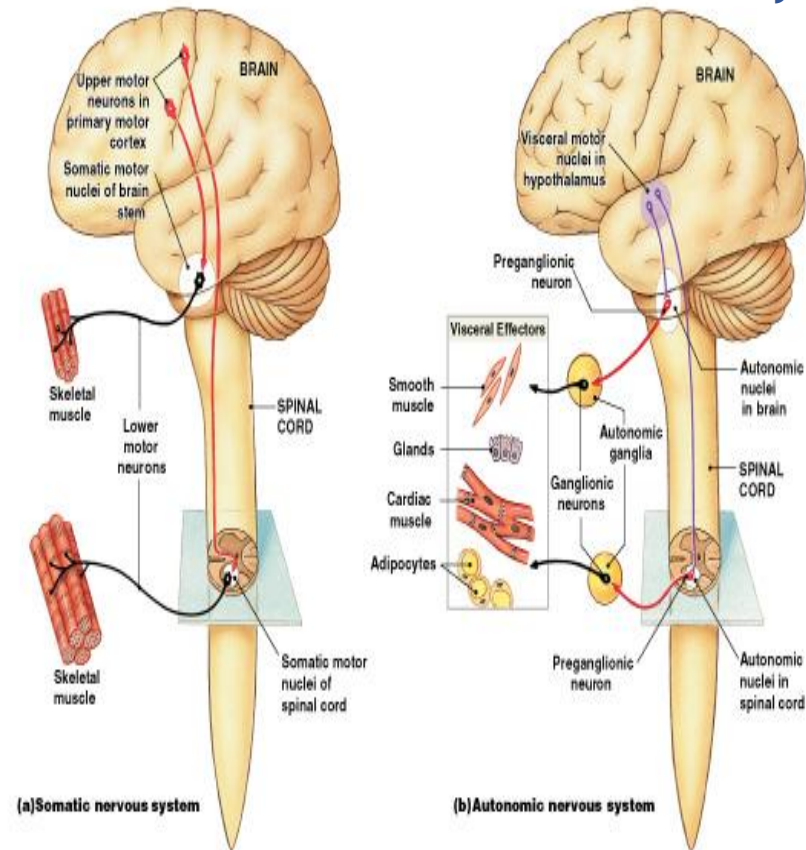
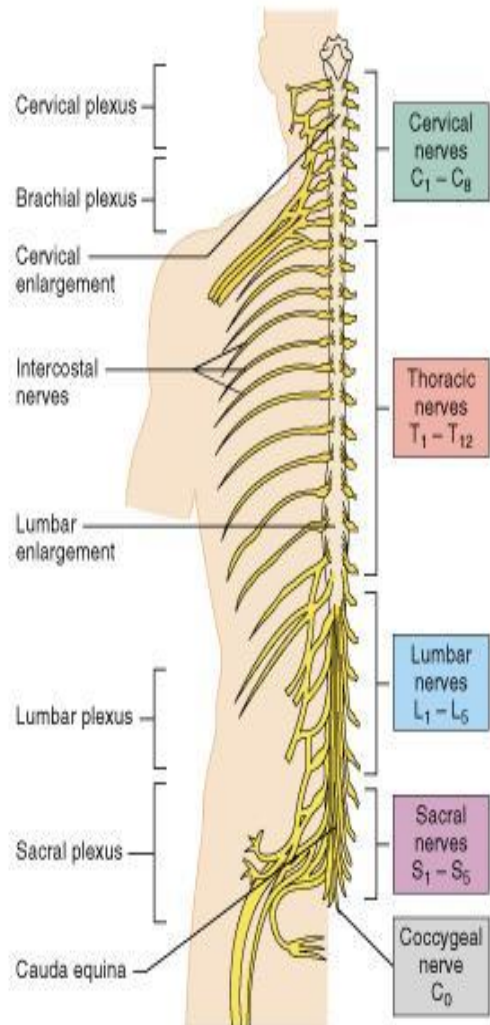


- Red : important
- Black : in male / female slides
- Pink : in female slides only
- Blue : in male slides only
- Green : notes
- Gray : extra

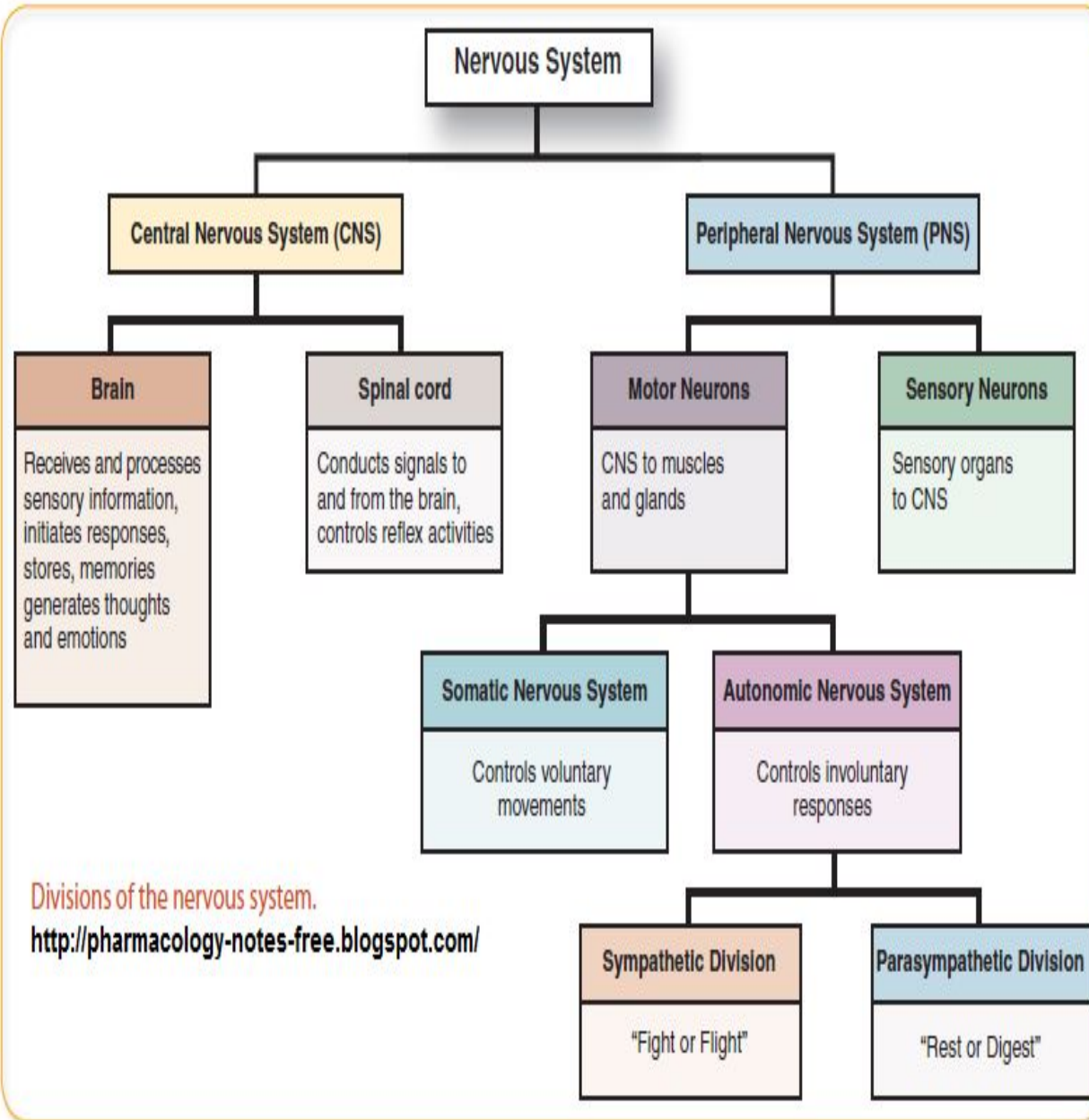
Objective

- Recognize the **organization** of the nervous system.
- Detect the **differences** between central nervous system (**CNS**) and the peripheral nervous system (**PNS**).
- Discuss the **functions and recruitment** of the motor unit.
- Interpret the effect of **motor units number** on **motor action performance**.

Organization of Nervous System



male's slides

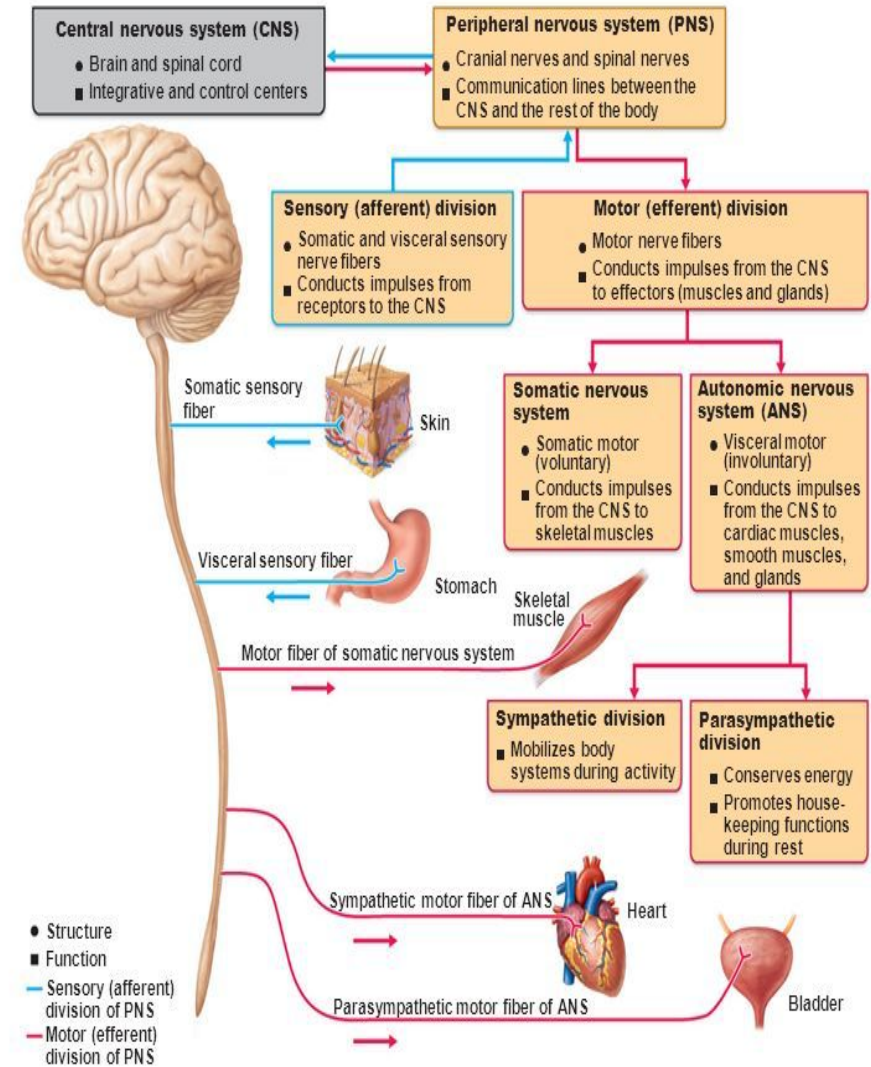


Divisions of the nervous system.

<http://pharmacology-notes-free.blogspot.com/>

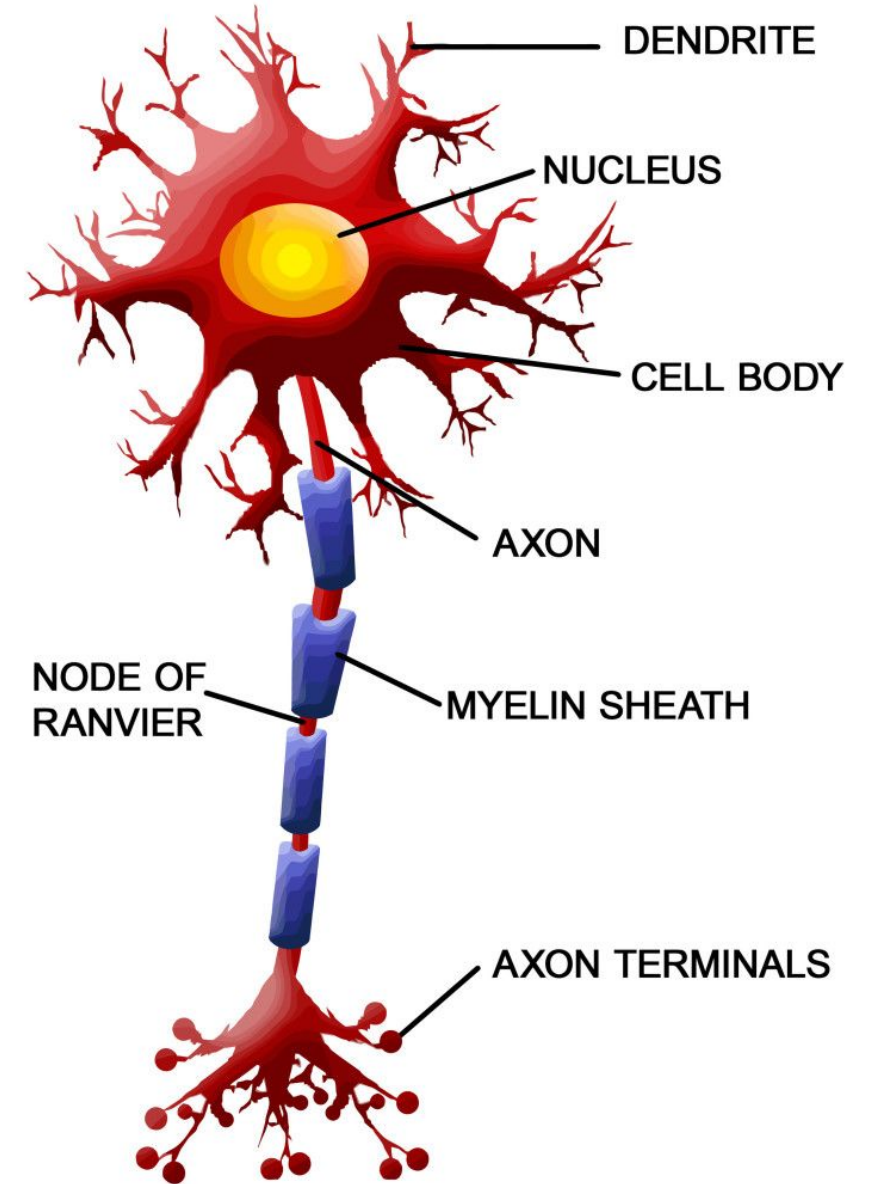
Female's slides

Figure 11.2 Schematic of levels of organization in the nervous system.



Neurons (building unit of the NS)

Components	Function/ Notes:
Cell body	Contains Nucleus
Dendrites	Synapses that receive signals
Axon	Consist of :Myelination & Nodes of Ranvier
Axon terminals	Release neurotransmitters to conduct signals
Synaptic end bulbs	<ul style="list-style-type: none">● Part of Axon terminals● Contains neurotransmitters
Neurotransmitter	Example: Acetylcholine (Ach)



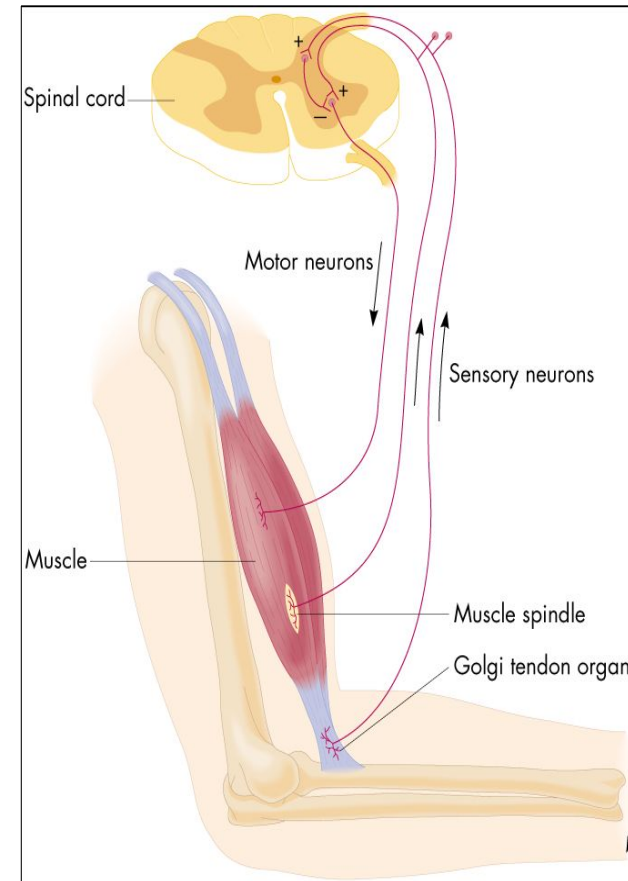
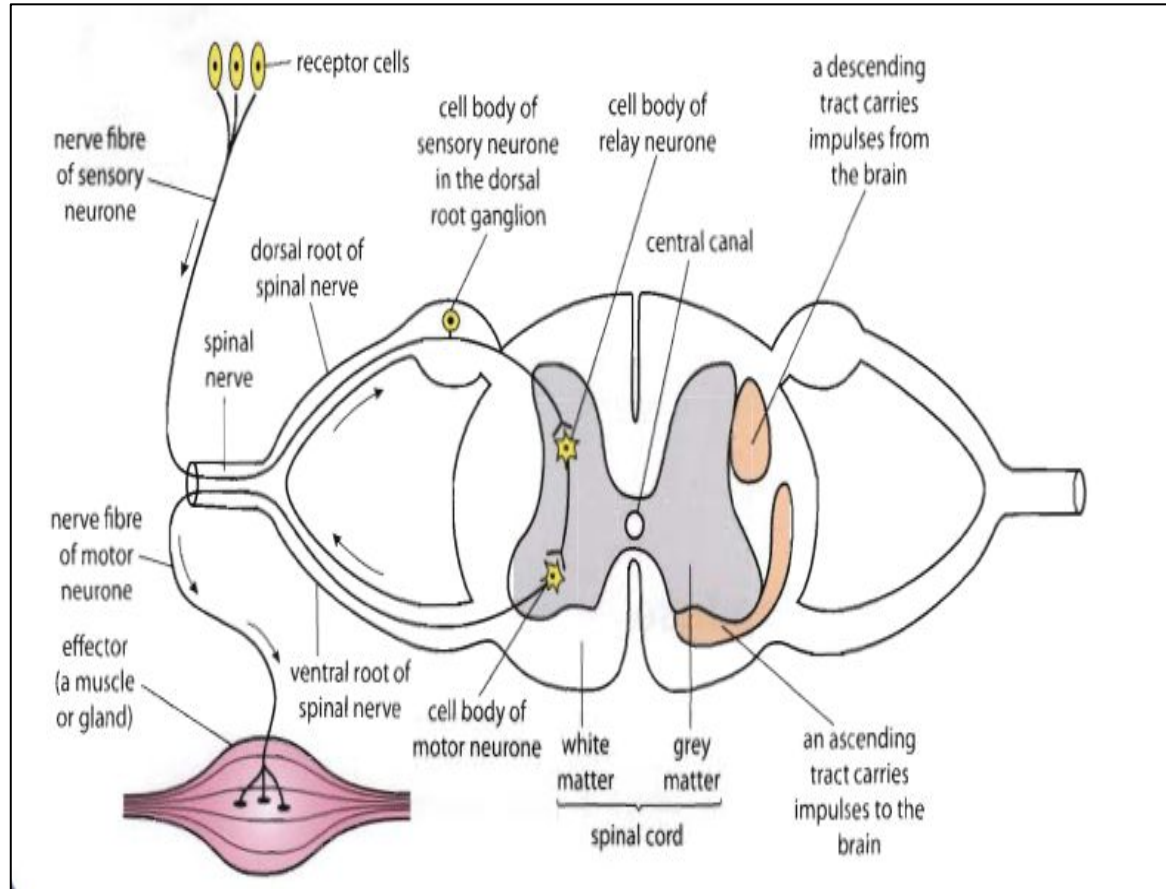
Organization of the nervous system

Central Nervous System (CNS)		Peripheral Nervous System (PNS)	
Function:	1. Integrate Information	Sensory Neurons	collects information from the various sensors located throughout the body and transmits them to the brain.
	2. Process		
	3. Send Signals		
Components:	1. Brain	Motor Neurons	conducts signals to activate muscle contraction.
	2. Spinal Cord		
Protection:	1. Brain is protected by skull		
	2. Spinal cord is protected by vertebrae		
	3. Both enclosed in meninges		

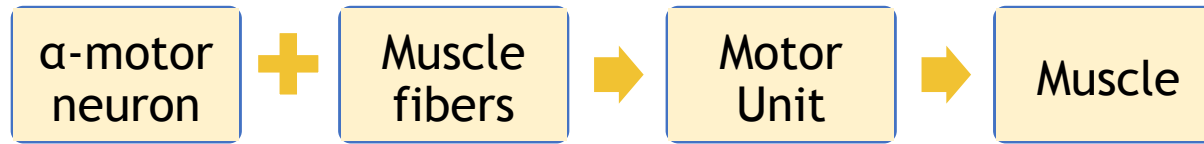
Note: Skeletal muscle activation is initiated through neural activation while Cardiac and Smooth muscles doesn't require the neural activation (initiate the contraction by themselves)

α -motor neuron in the anterior horn cell

A nerve is made of a group of axons of neurons

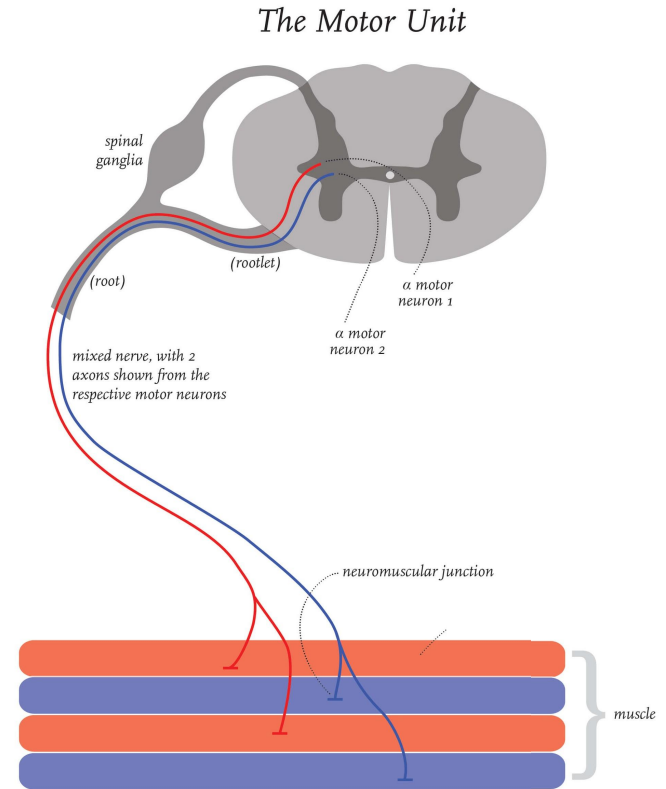


Motor Unit

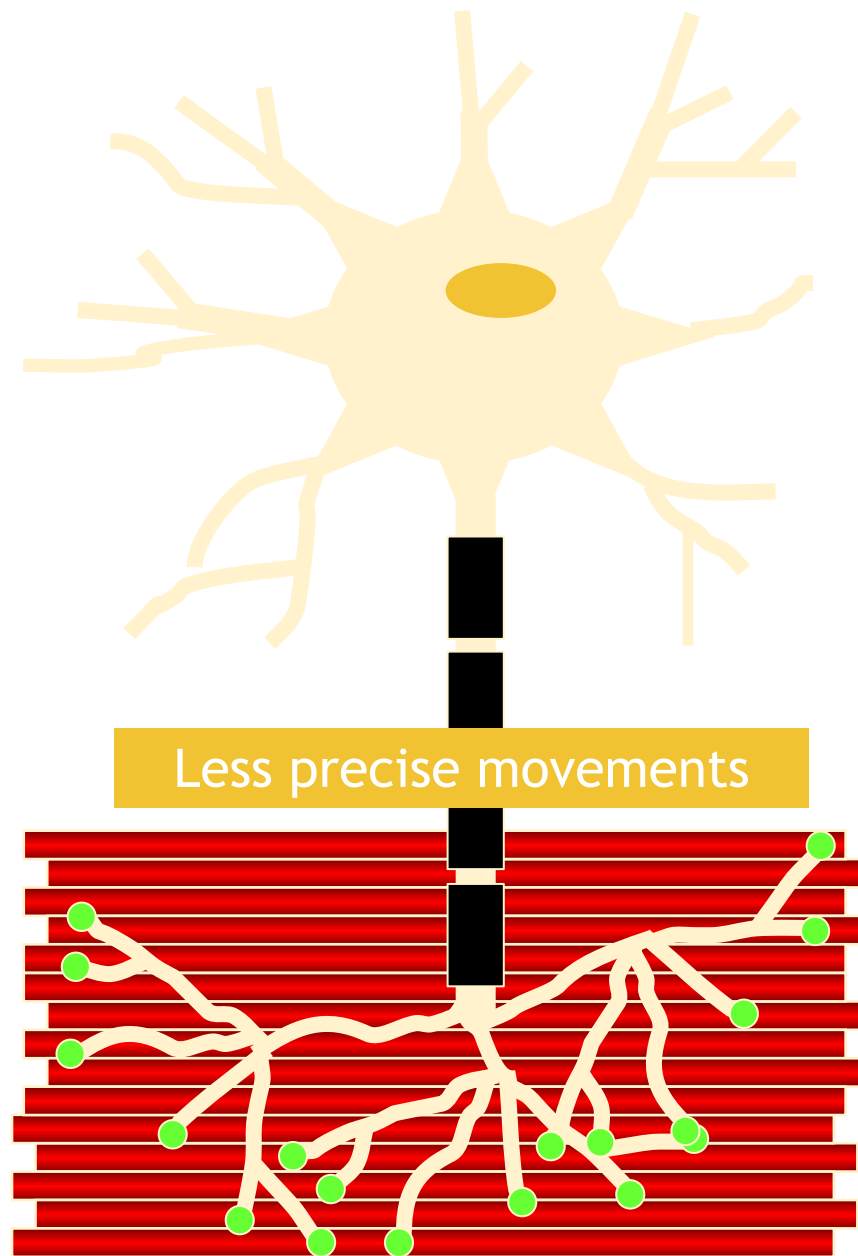
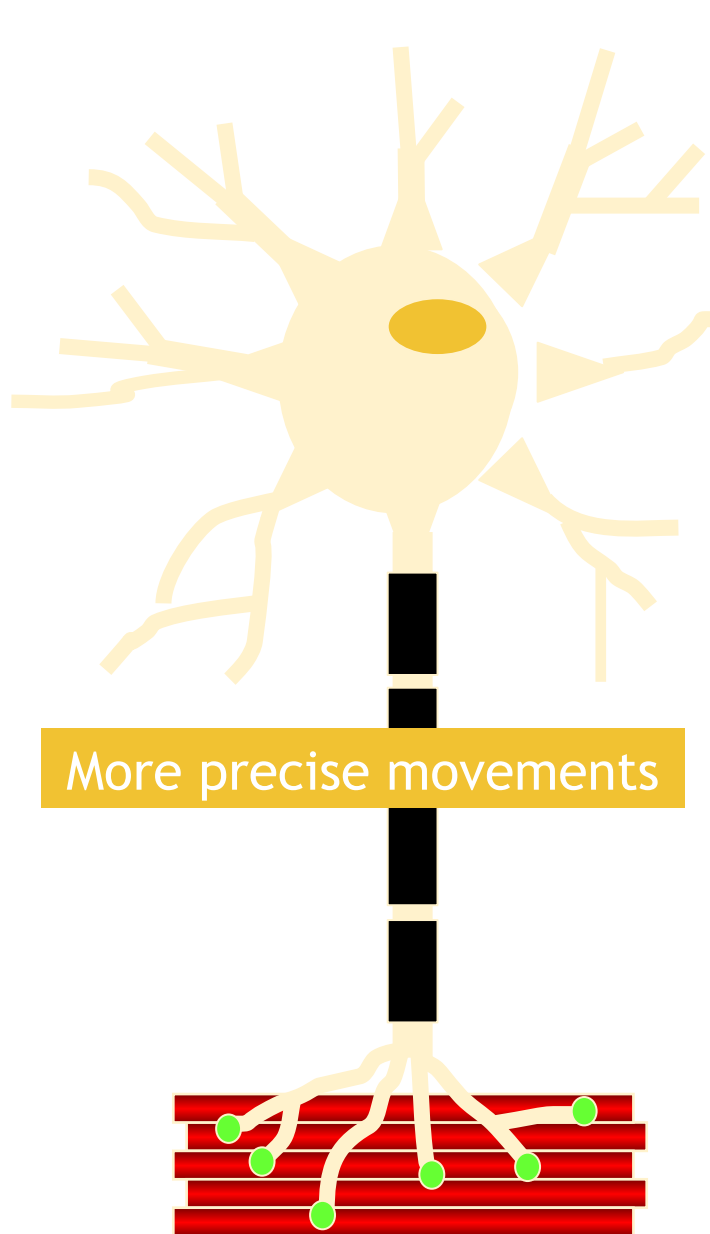


Notes:

<ul style="list-style-type: none"> • Location: in the anterior horn cell (AHC) • All muscle fibers will be of the same type (Fast/Slow twitch) 	
Each muscles consist of a number of motor units	
All muscles in a motor unit are stimulated/inhibited together when it's activated	
Number of muscle fibers in a unit varies	1. Gastrocnemius (leg muscle) - 2,000 fibers per neuron and 600 muscle fibers per motor neuron
	2. Extraocular muscles - <10 fibers per neuron
	3. Laryngeal muscles - 2 to 3 muscle fiber per motor unit
	4. The average is 80 - 100 per motor unit
Ratio of Muscle fibers to Motor Neurons	\uparrow muscle fibers + \downarrow motor units = More strength + Less precise movement Example: Leg Muscles, Trunk muscles.
	\downarrow muscle fibers + \uparrow motor units = Less strength + More precise movement Example: Eyes, Hands.



Motor Unit Pool: A group of motor units supplying a single muscle.



إذا احتاجت العضلة حركة دقيقة يكون حولها **كثير** من **motor units** وكل موتر يونت ترتبط **بعدد قليل** من **muscle fibers** بحيث تقدر الموتر يونت تتحكم بدقه بهذا العدد القليل من الألياف العصبية (437)

مثال :- عضلات العين والاصابع

الألياف العضلية اللي تغذيها الموتر يونت لابد تكون من نفس النوع

Fast Twitch muscles -
Have high force
& low endurance

Slow twitch muscles -
have low force &
high endurance

ولكن العضلة الواحدة تتكون من أكثر من نوع من الألياف العضلية

Neuron recruitment:

- **Recruitment of motor units:** the progressive activation of a muscle by successive recruitment of contractile units (motor units) to accomplish increasing degrees of contractile strength (force).

Strong muscle contraction
(more force)

- AHCs fire at fast rates
- → fast MUPs

Weak muscle contraction
(less force)

- AHCs fire at slow rates
- → slow MUPs

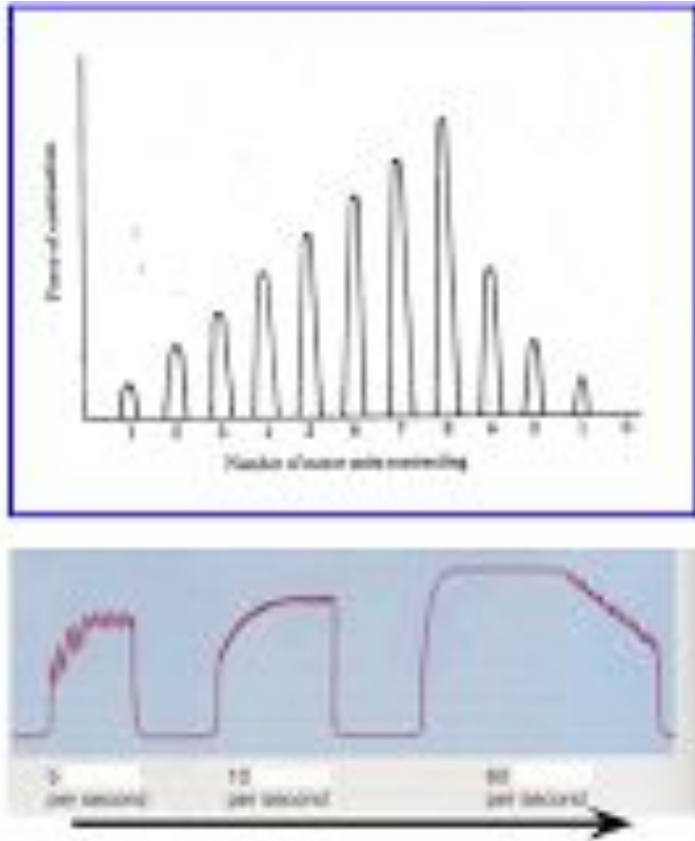
Two ways the Nervous System increases force:

1-Recruitment of new motor units	2-Increasing stimulation frequency
More Motor neurons	Rate Coding: Motor Firing Rate
More Muscle stimulation	Higher Frequency → More Tension
More contractile strength	AHC is released faster by the same number or nerves
AHC increased → Fast Motor Unit Potential (MUPs) → More Strength	Higher Muscles stimulation
Usually found in Large Muscles	Usually Found in Small muscles
Example: Deltoid	Example: 1 st Dorsal Interosseous
Force is increased by 2 to 4 times	

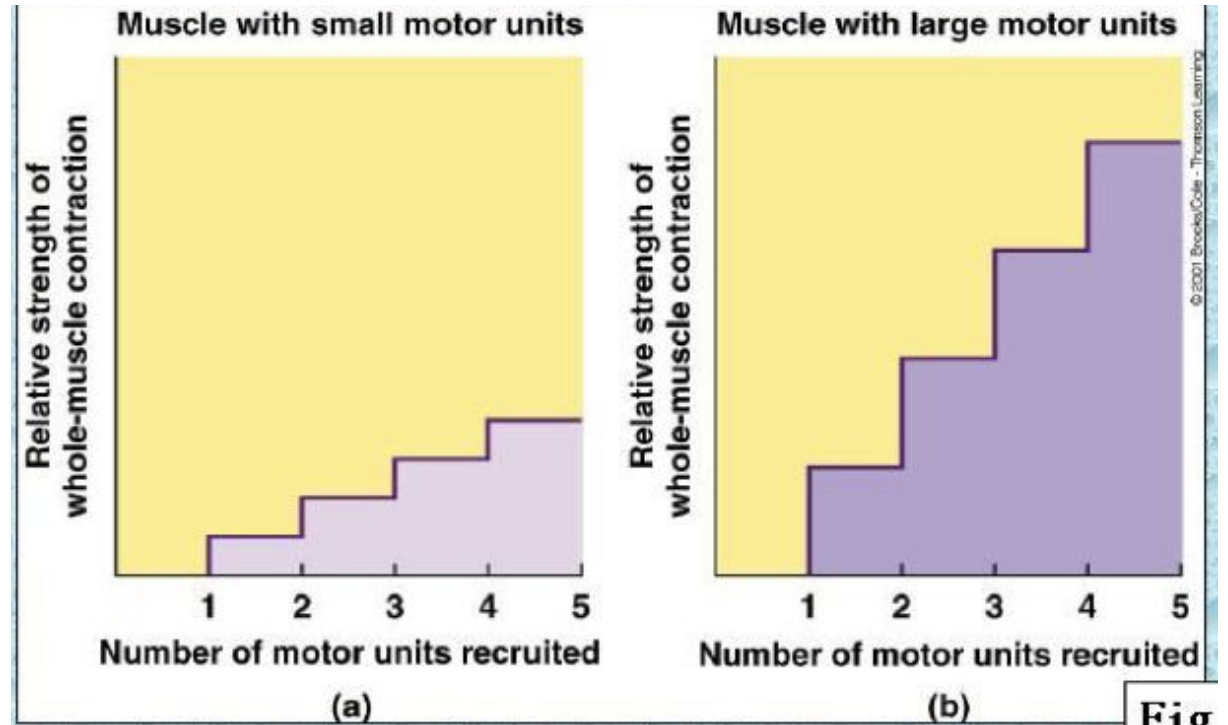
إذا الجهاز العصبي احتاج يزيد القوة لازم اول شي يسوي recruitment of new motor units اذا سواها وللحين يحتاج قوة أعلى وقتها يسوي Rate coding ما ينفع العكس لازم بالترتيب

تشبيه : مثل شركه عندها ١٠ موظفين بالعهاده كل يوم يشتغل موظفين لان الشغل قليل ، واذا فيه شغل كثير المدير يكلم الموظفين الآخرين يحضرون الين ما يصيرون ١٠ يداومون باليوم الواحد Recruitment of new motor unit طيب للحين نحتاج جهد اكثر ايش نسوي ؟ Rate coding الموظفين بالعهاده يسون ملف بالساعة ! المدير يطلب منهم يسون ملفين بالساعة

Motor Unit Recruitment | توظيف الوحدات الحركية



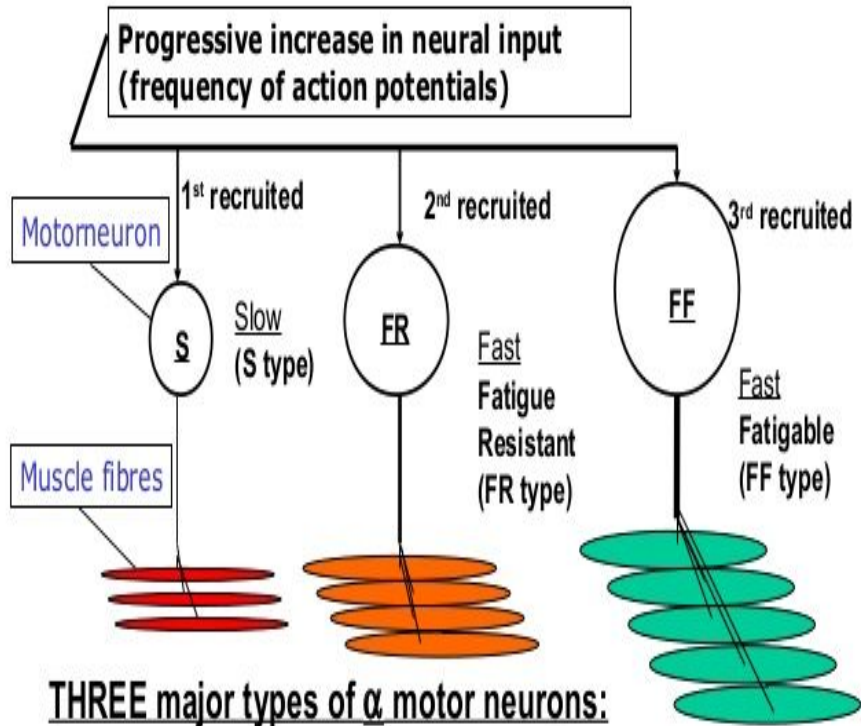
Increasing frequency of action potentials
→ resulting in stronger force of contraction



Motor Unit Recruitment
→ increases the strength of muscle contraction

Important rule:

MUs receive common neural input and are recruited according to their sizes !!! (Henneman's Size Principle)



THREE major types of α motor neurons:

- S type are small "high" excitability اوقف
- FR type are big "average" excitability امشي
- FF type are very big "low" excitability اجري

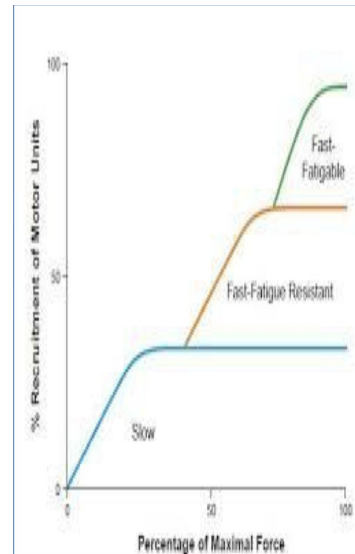
Muscle size	Small	Medium	Large
Fatigue rate	Small	Intermediate	Fast
Diameter size	Small	Intermediate	Large

3 types of a motor neuron

Slow (S)

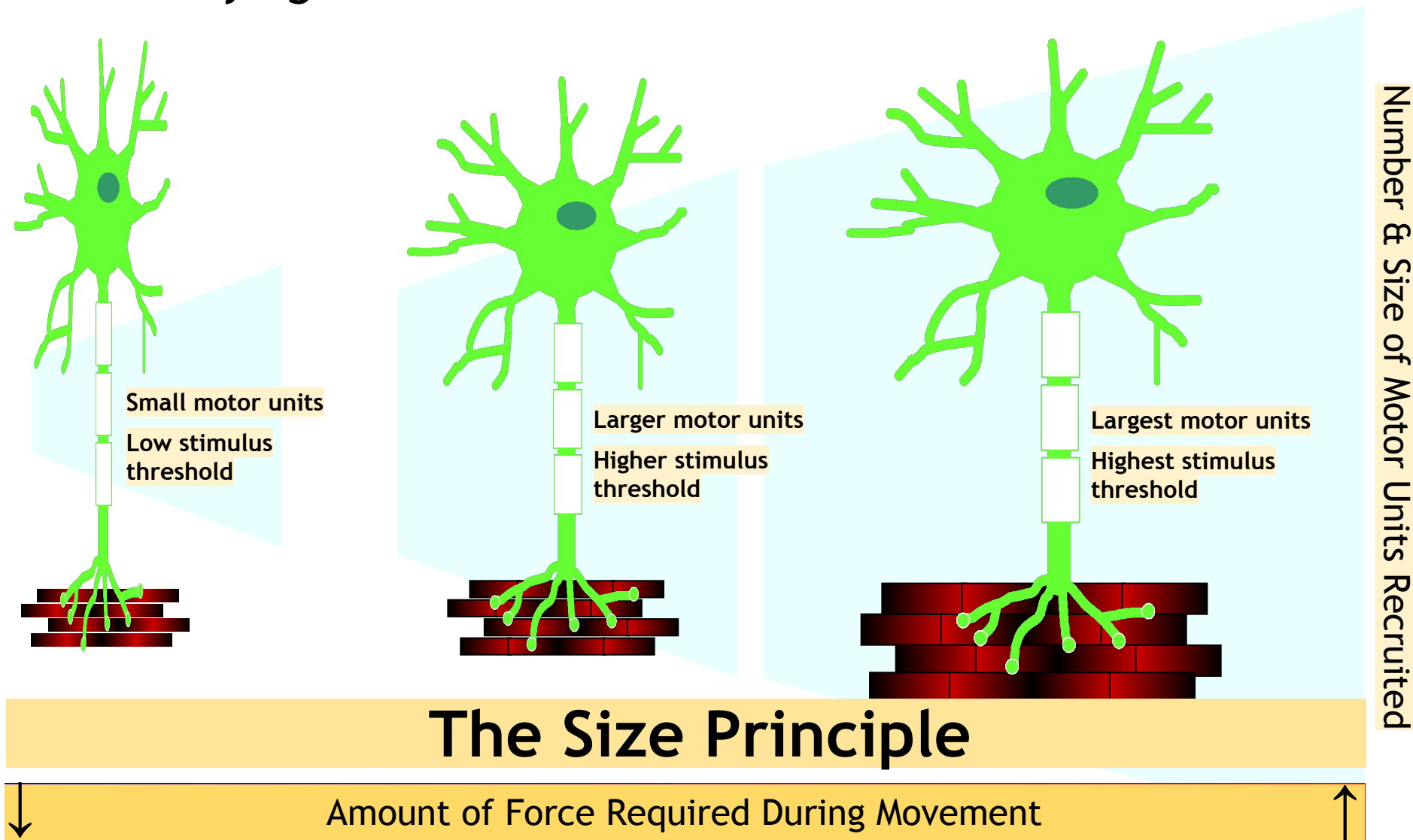
Fatigue Resistance (FR) a motor neurons

Fast Fatigue (FF) a motor neuron



Recruitment

- Varying the number of motor units activated.



All or None Role

- Motor Neuron impulse will either contract all muscle fibers or none of them.

• Myopathy and Neuropathy can be distinguished by:

→ **Electrodiagnostic testing (EMG):** for a patient with weakness

→ **Analysis of:**

motor unit action potential (MUAP)

Size

Shape

Recruitment pattern

Doctors note;

If I have a problem but I don't know if it's in the muscle or neuron what should I do ?

An **electromyography** to see the AP then compare it to the muscle (doing analysis)

Quiz

SAQ

Q1- What are the components of the motor unit?

Q2- describe the All or Not principle.

Answers

SAQ1- a-motor neuron in the anterior horn cell (AHC) and all the muscle fibers it innervates .

SAQ2- impulse from the motor neuron will cause contraction in all fibers it innervates or non .

1) Stimulation of additional motor units will increase the strength of contraction. This process is called:		2) Small muscles need to make precise movements. Where could it be?	
A.	treppe.	A.	Hands
B.	recruitment.	B.	The Trunk
C.	tetanus.	C.	The leg
D.		D.	Gastrocnemius
3) Which term applies to the combination of a motor neuron and all the skeletal muscle fibers contacted by that motor neuron?		4) In comparison to a FF motor unit, a S motor unit does not possess	
A.	Golgi tendon organ	A.	A greater innervation ratio.
B.	Motor unit	B.	More mitochondria within fibres.
C.	Propriospinal neurons	C.	More myoglobin within fibres.
D.	Skeletal muscle fibers	D.	More capillaries around each fibre.

Team leaders

Elaf Almusahel

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Thank
you



team members

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- o Meshari Alzeer
- o Aued Alanazi
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