Module 2

MedFit Classroom

Orthopedic Fitness Specialist Course

Neuromuscular & Skeletal Structure & Function

Authors:

Dr. Irv Rubenstein & Christine Conti, M.Ed.

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Learning Objectives

- Lesson 1
    - Planes
    - Landmarks
- Lesson 2
    - Basic musculoskeletal anatomy
        - Bones
        - Joints
        - Muscles
        - Nerves

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Lesson 1: Basic Kinesiology
Planes of Motion

- **Frontal** - divides body into front and back
  - Abduction/adduction
- **Sagittal** - divides body into left and right.
  - Flexion/extension
- **Transverse/Horizontal** - divides body into upper and lower
  - Internal/external rotation
- **Diagonal** - divides body into all 3 cardinal planes

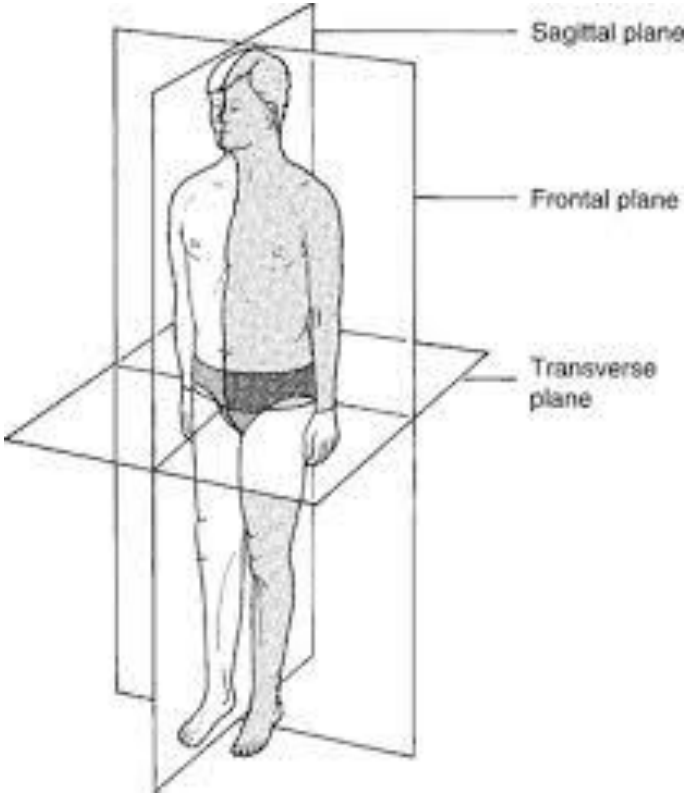

Image: musculoskeletalkey.com

An Oblique Section would be Diagonal

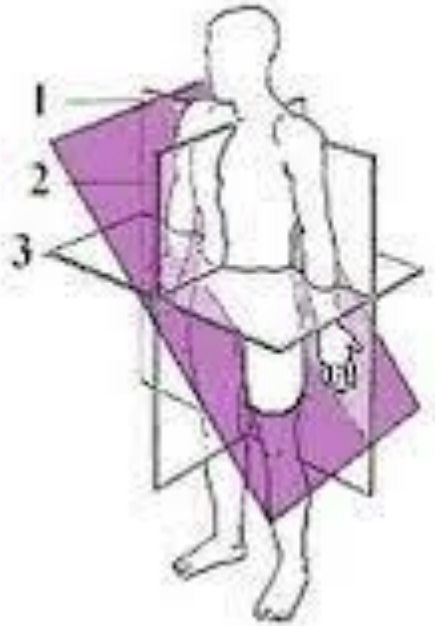

Image: scientistcindy.com

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The Anatomic vs Neutral Position

Image: purposegames.com

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Anatomical Landmarks

- Cephalic - Superior
- Caudal - Inferior
- Anterior/Posterior
- Medial/Lateral
- Proximal - closer to mid-line or center of gravity
- Distal - further from mid-line or center of gravity

Lesson 2: Basic Anatomy
Bone

- 206
- Osteo**B**lasts - Build bone, deposit calcium
- Osteo**C**lasts - Destroy bone, free calcium
  - Constant state of remodeling
- Cortical bone (compact) - hard exterior, provide strength and stability under load
- Cancellous bone (trabecular) - softer, more spaced, provide strength without mass

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Long Bones

Examples: humerus, radius, ulna, femur, tibia, fibula, metacarpals, metatarsals

- Diaphysis - shaft
- Epiphysis - ending shaped to fit with its complement
  - Proximal and distal
- Epiphyseal plate - growth plate

https://www.verywellhealth.com/the-four-types-of-bone-4771778

Image: nrpt.co.uk

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Short Bones

- Ex: carpals, tarsals, patella (sesamoid)
- Flat, no diaphysis, allow for movements in complex joints like wrists, feet/ankles
  - Provide an “anchor point” for increased leverage at certain joints, like the knee

Image: en.wikipedia.org

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Flat Bones

- Ex. Scapula, sternum, ribs, iliac
- Provide shape/structure and insertion points for tendons and muscles

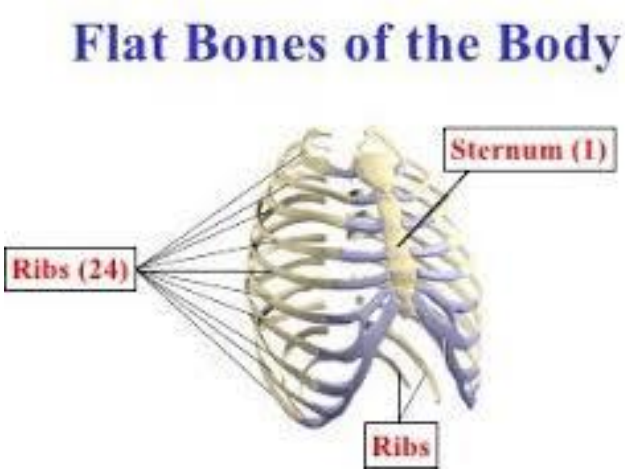

Image: slideshare.net

Irregular Bones

- All bones shaped not as long, short or flat ones with very specific functions
- Ex. Facial bones, vertebrae, irregular bones

Image: visiblebody.com

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Joints

2 Classifications

Structural	Functional
Fibrous/fixed (skull)	Pivot (neck, forearm)
Cartilaginous/partly mobile (ribs)	Hinge (elbow, knee)
Synovial/moveable	Saddle (thumb)
	Gliding (tibiotalar)
	Condyloid (fingers)
	Ball & Socket

Muscle Physiology Review

- **Slow Twitch (Type 1) - red, more myoglobin and glycogen, more oxidative, require lesser neural input by smaller nerves, endurance and posture**

- **Fast Twitch (Type IIa and IIb) - white, more ATP storage, require stronger inputs from larger nerves, designed to do powerful, faster movements**

- **Motor neuron excites multiple fibers**

  Size and firing frequency determines which fiber types fire

- **The Size Principle - Motor units recruited from smaller to larger depending on the amount of force to be applied**

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Lines of Pull

Muscles shorten from Origin to Insertion

"Origin" can switch from one end to the other depending on which end is stabilized

e.g. In a pull up, does the hand move the weight to the shoulder or does it move the shoulder to the hand?

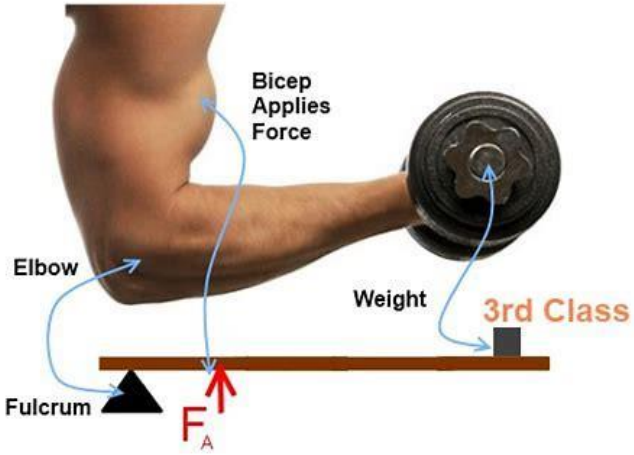
e.g. Crunch vs Reverse Crunch

Almost all muscles have 2+ movements, depending on insertion points

e.g. due to insertion of biceps brachii onto the medial radius (radial tuberosity), it supinates as it flexes the arm

The Way We Move

- 3rd class lever - resistance is distal from the axis, force is proximal



- Allows for greater range of motion but requires greater force to create it

Image: cscsexamguide.com

Types of Muscle Actions

- Isometric/non-shortening
- Concentric/shortening
- Eccentric/lengthening
- Isokinetic/speed-regulated
- Isoinertial/“against a constant load where the measurement system considers acceleration and velocity”

https://en.wikipedia.org/wiki/Isoinertial

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The 2-Joint Muscle Wonder

- Biceps brachii, triceps brachii, quadriceps, hamstrings, gastrocnemius, ITB, brachioradialis, most spinal muscles
- Energy-efficient at the expense of maximal torque
  - Can’t exert as much force on one end if the other is acting forcefully
- Acts almost isometrically - does not change length during most movements

Organization of the Somatic Nervous System

- **Central Nervous System** (brain, spinal cord)
- **Peripheral Nervous System** (cranial nerves, spinal nerves)

Efferent Motor

motor nerves to skeletal muscles

Afferent Sensory

Sensory nerves from skeletal muscles, skin, specialized organs, e.g. eyes, ears, inner ears

Proprioceptors (skin, muscle, tendons, ligaments, etc.) sensitive to touch, pain, vibration, stretch, tension, pressure, temperature, etc.

Visceral sensory and motor - generally under automatic control

Somatic Nervous System

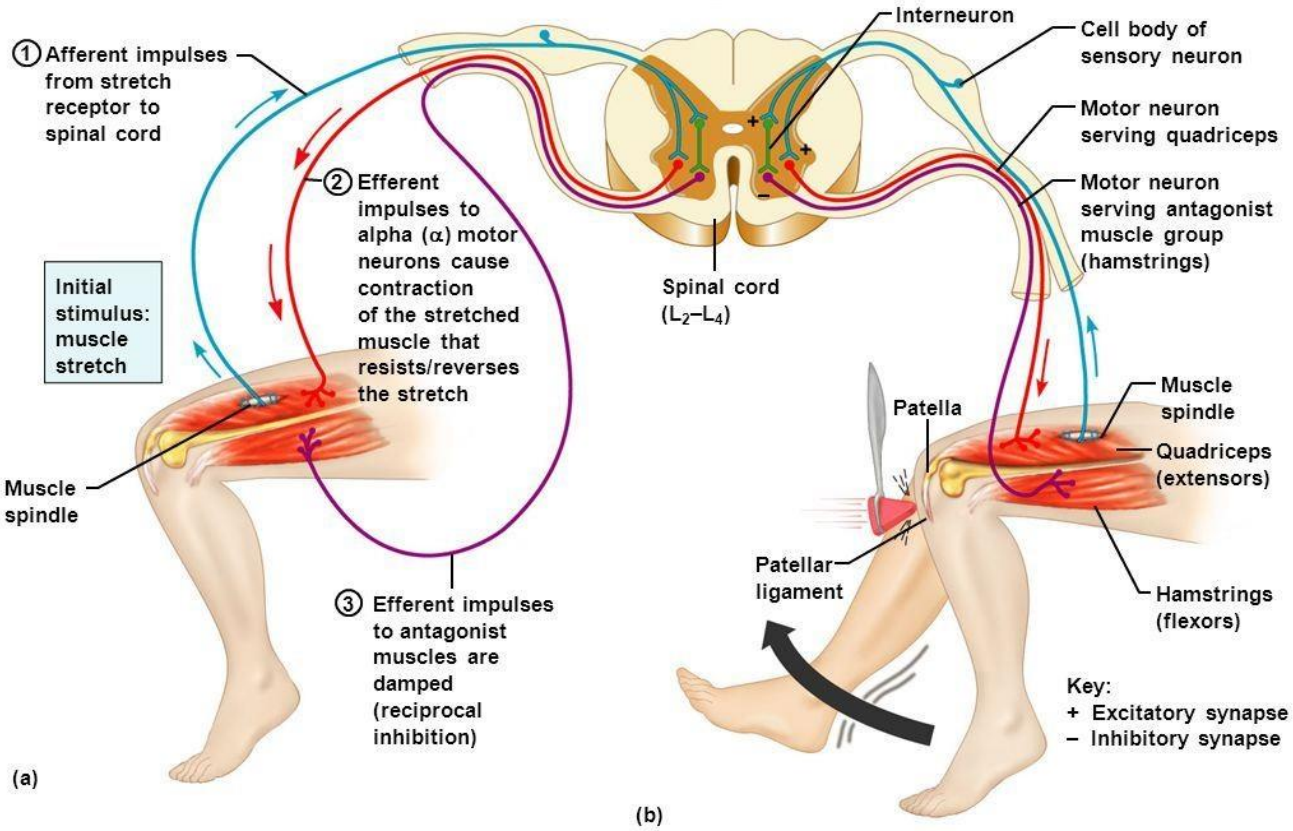

Image: https://ibiologia.com/somatic-nervous-system/

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Cross-Body Neuromuscular Connection

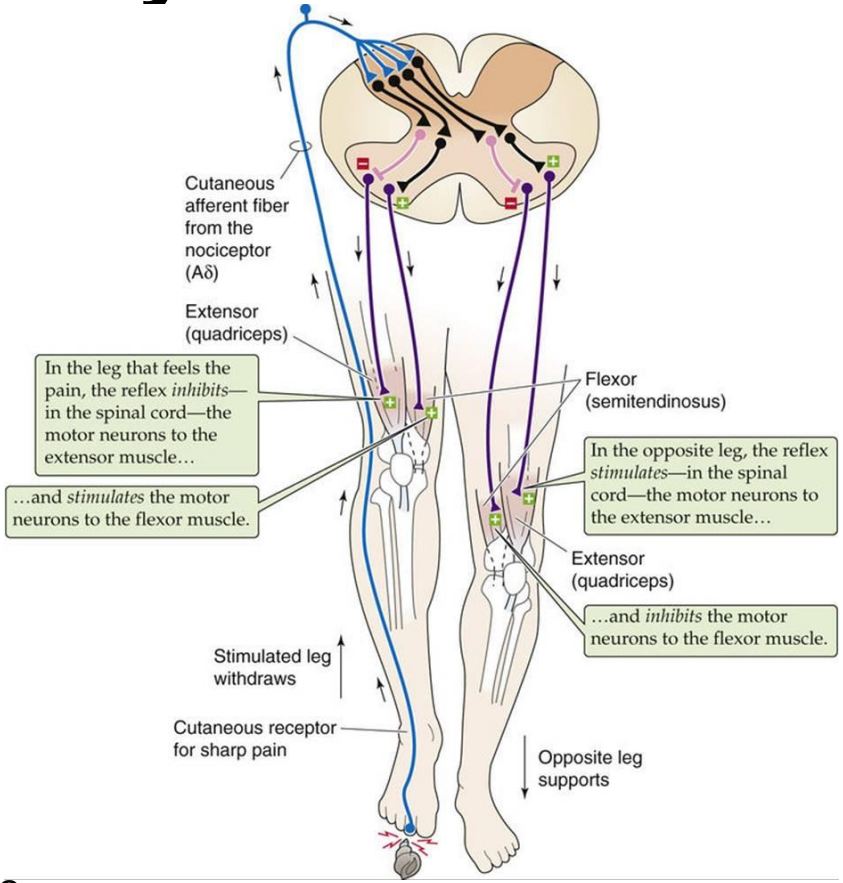

Image: doctorlib.info

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What Can Possibly Go Wrong?

- Insufficient neural input
- Insufficient muscle fiber stimuli
    - Remember - fast twitch fibers require more stimulation to contract
- Insufficient neural inhibition of antagonist muscles
- Dys-coordinated neural inputs (timing, disinhibition)

Basic Musculoskeletal Anatomy QUIZ

At this time, please complete and successfully pass the "Basic Musculoskeletal Anatomy Quiz" before continuing to the next section.

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References

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