BACK TO BASICS: *FUNCTIONAL KINESIOLOGY REVIEW*

MIOTA CONFERENCE
OCTOBER 13, 2018

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Objectives:

1. Define Kinesiology.
2. Identify and understand the anatomical/structural, physiological/chemical, and psychological/emotional components of the Kinesiology Triad.
3. Understand and describe the role of biomechanics and the sensorimotor system in motor learning.
4. Apply the information learned to enhance clinical practice and understanding of how the skeletal muscle, integumentary, and neurological systems interact with one another through the practice of kinesiology in order to influence a patient's functional, behavioral, and emotional responses to occupational therapy treatment.

Kinesiology: **definition?**

Kinesiology:

The study of skeletal muscle and movement patterns?

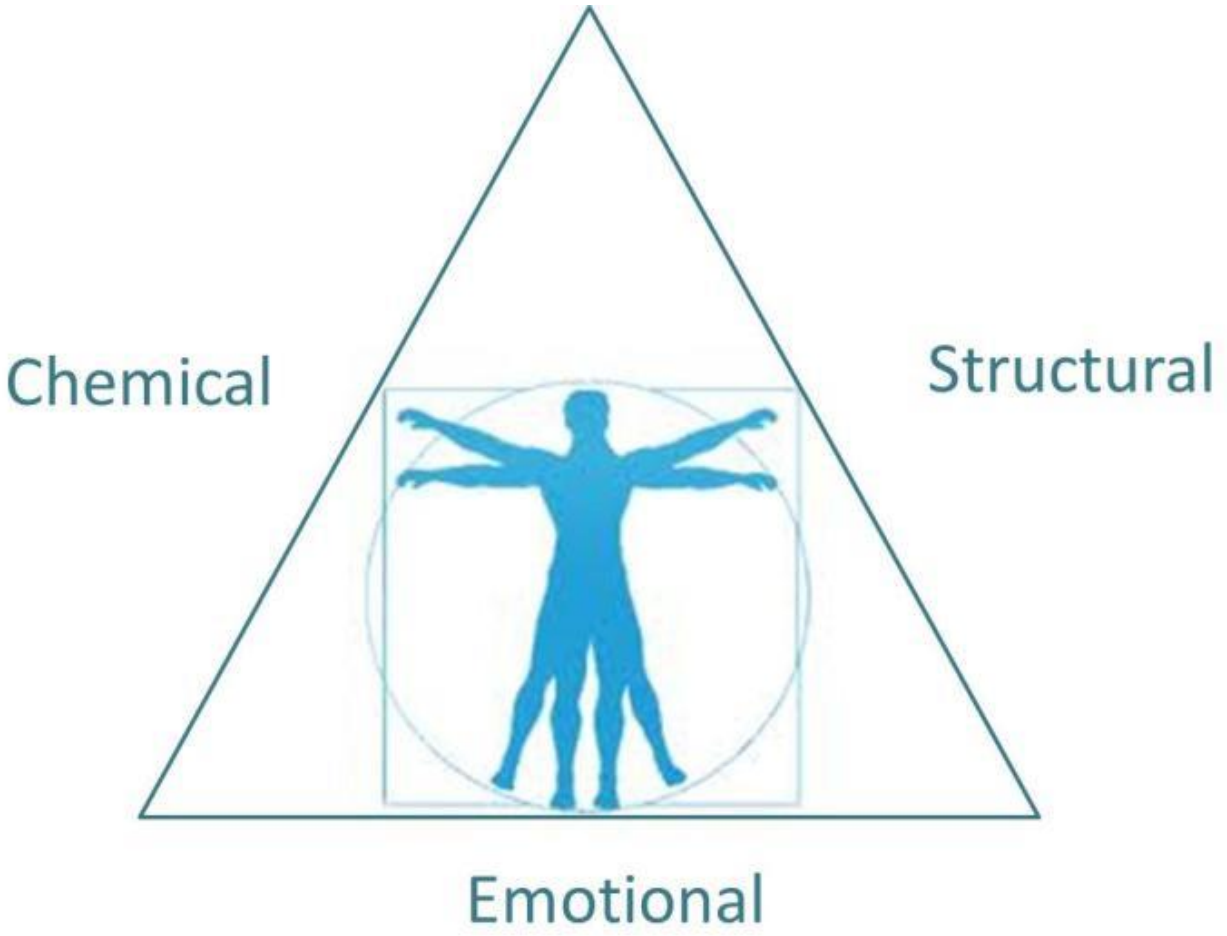
Kinesiology:

The study of skeletal muscle movement to improve postural control and athletic performance?

physioatlas.com

Kinesiology:

The study of functional movement patterns needed for normal development and daily function?



Harmony, Hitchin

Kinesiology: *the true definition…*

A complex triad of

Anatomical,

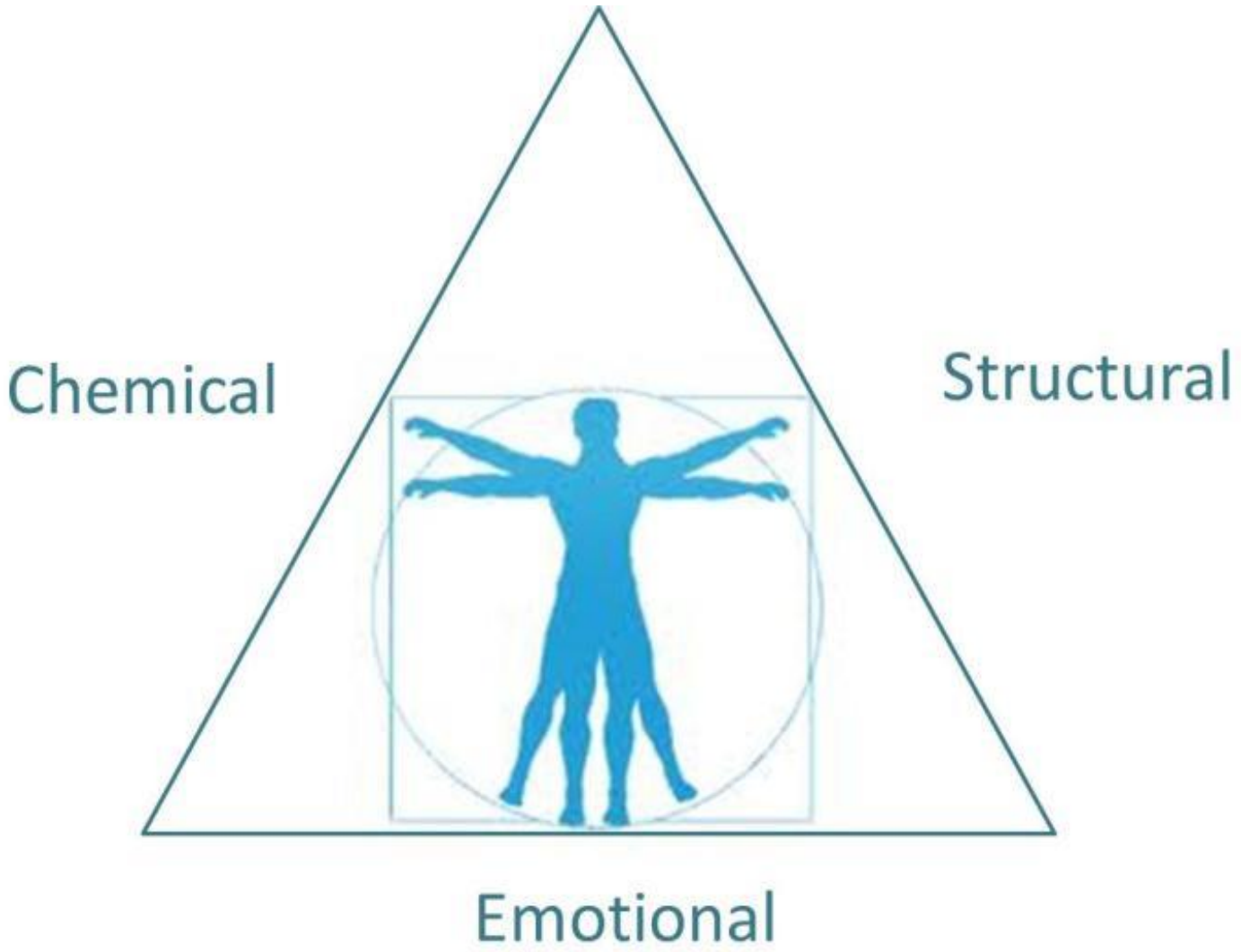
Physiological, &

Psychological

components that work together to impact functional movement

Kinesiology Triad:

ANATOMICAL / STRUCTURAL



Tissues of the body:

ANATOMICAL/STRUCTURAL COMPONENTS OF THE KINESIOLOGY TRIAD

Four Basic Tissue Categories

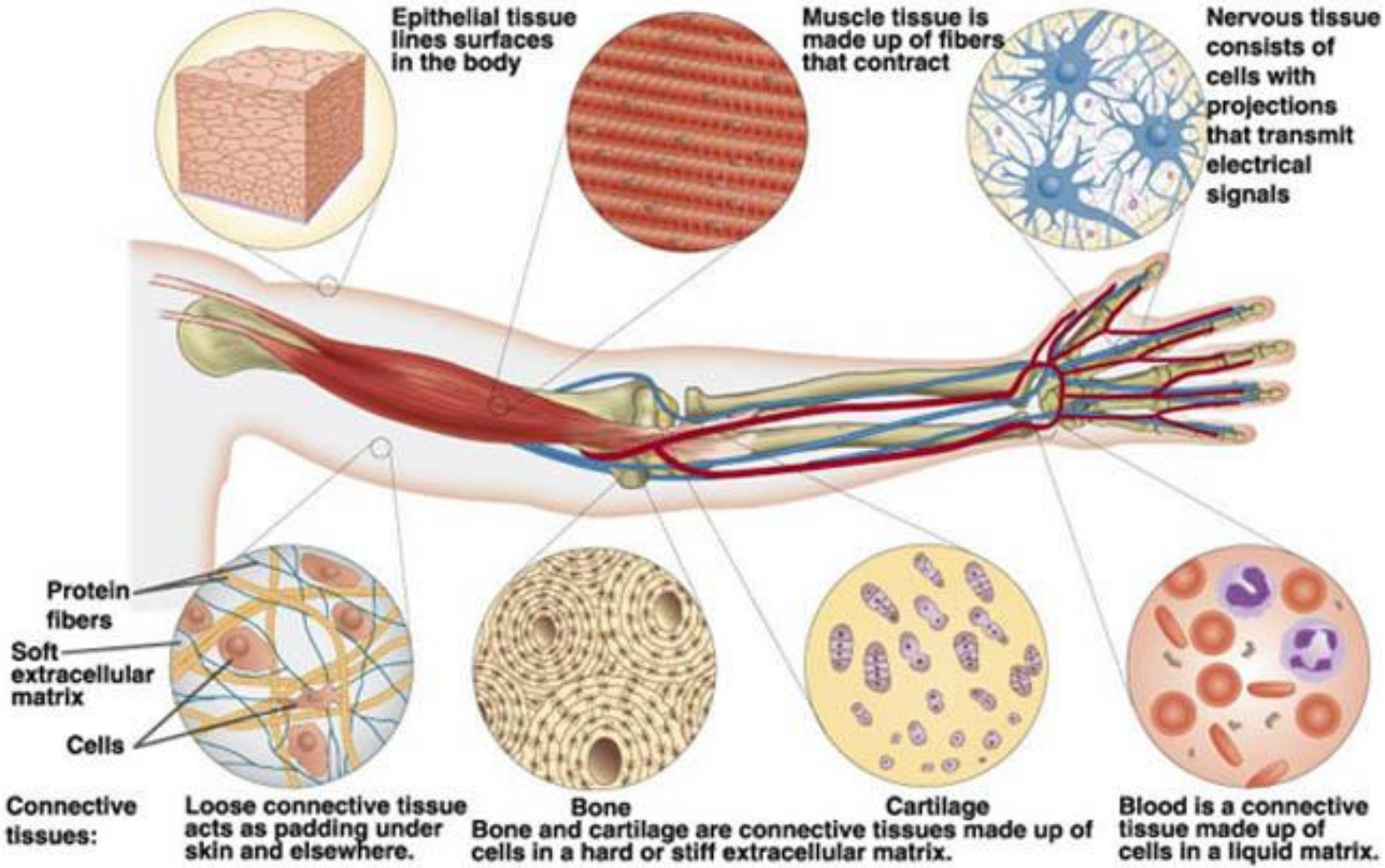
1. *Epithelial*
2. *Muscle*
3. *Nervous*
4. *Connective*

A. Loose Connective

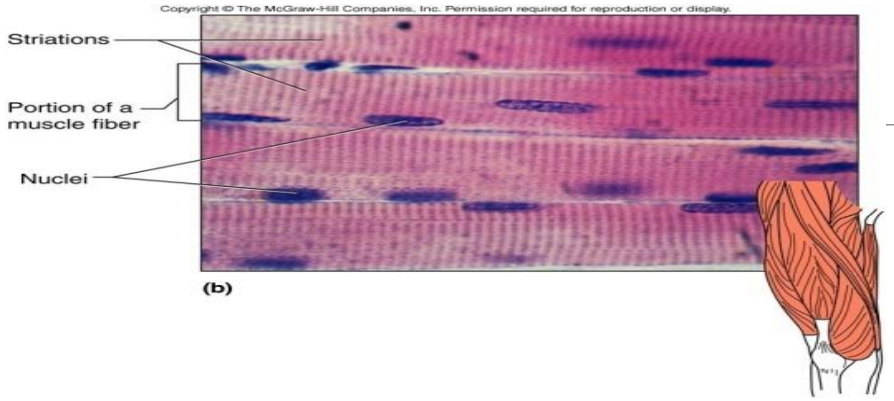
B. Bone

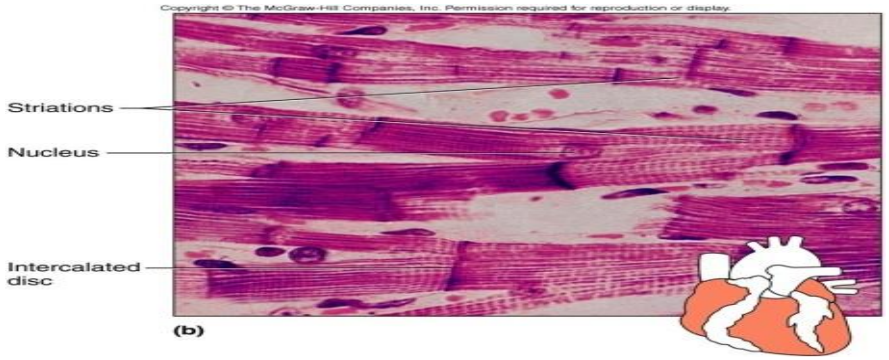
C. Cartilage

D. Blood



Muscle tissues:





Striated: Can see alternative light and dark markings from the actin and myosin fibers

Non-striated: markings are not visible

Voluntary: You CAN control by conscious effort

Involuntary: **YOU** CANNOT control

Skeletal Muscle:

ANATOMICAL/STRUCTURAL COMPONENTS OF THE KINESIOLOGY TRIAD

Tendon

Fibrous connective tissue

Attaches muscle to bone

Fascia

Continuation of the tendon

Covers and separates muscles

Fascicle

A bundle

of muscle fibers

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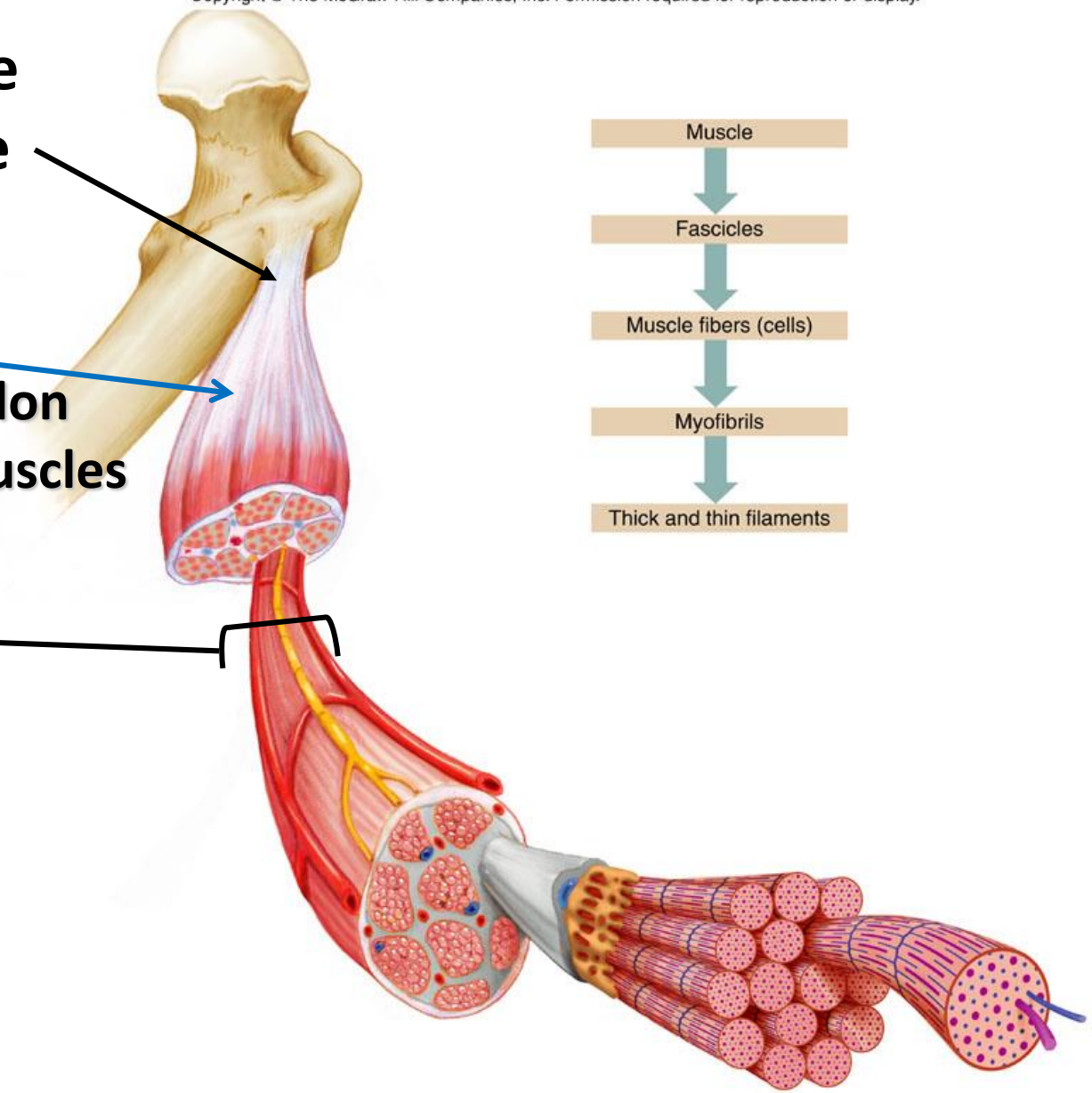

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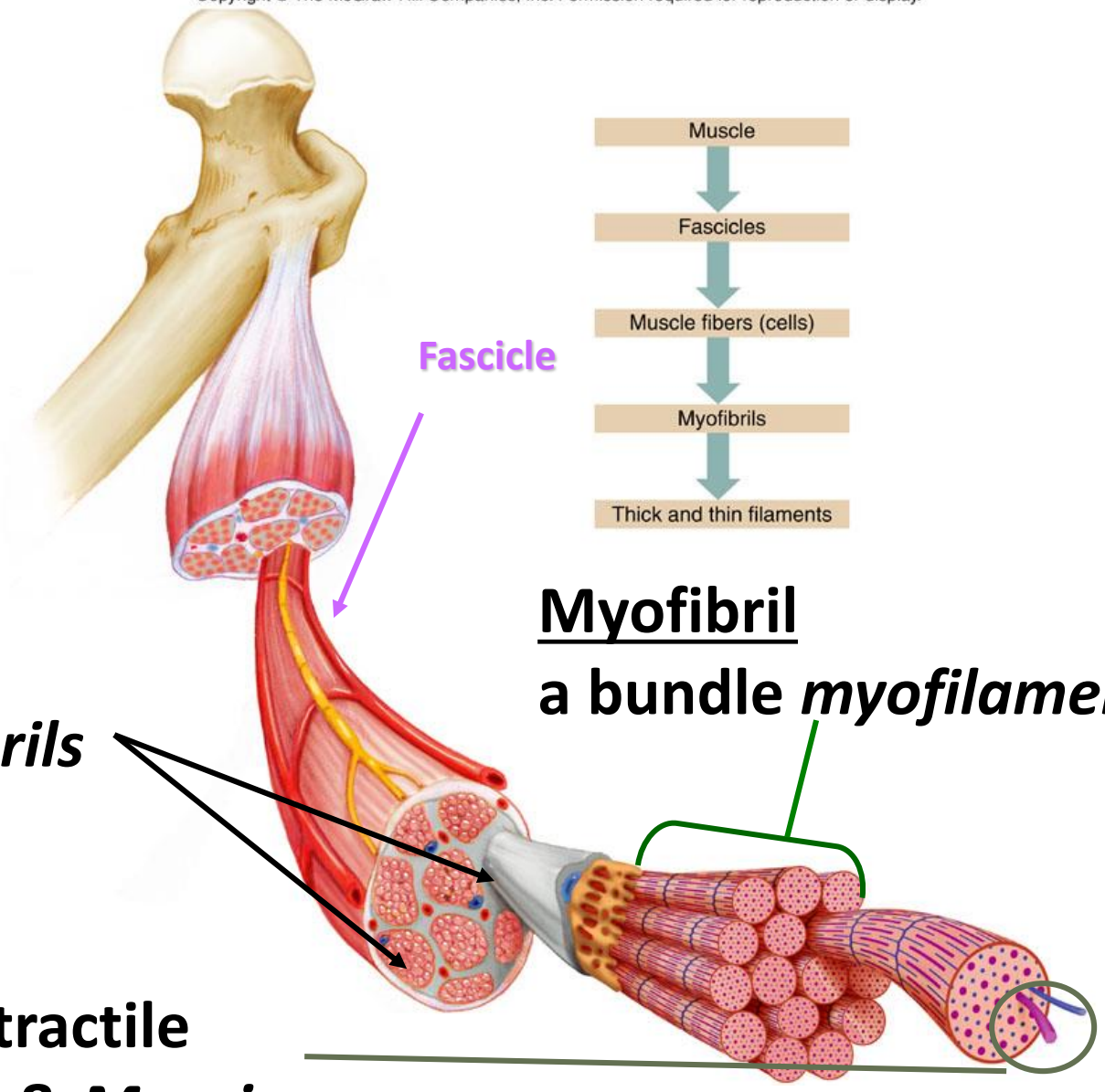


<u>Muscle fiber/cell</u>
Has many bundles *myofibrils*

<u>Myofibril</u>
a bundle *myofilaments*

<u>Myofilaments</u>
chains of contractile proteins *Actin* & *Myosin*

Function of Skeletal Muscle:

1. Movement

2. Posture

3. Heat Production

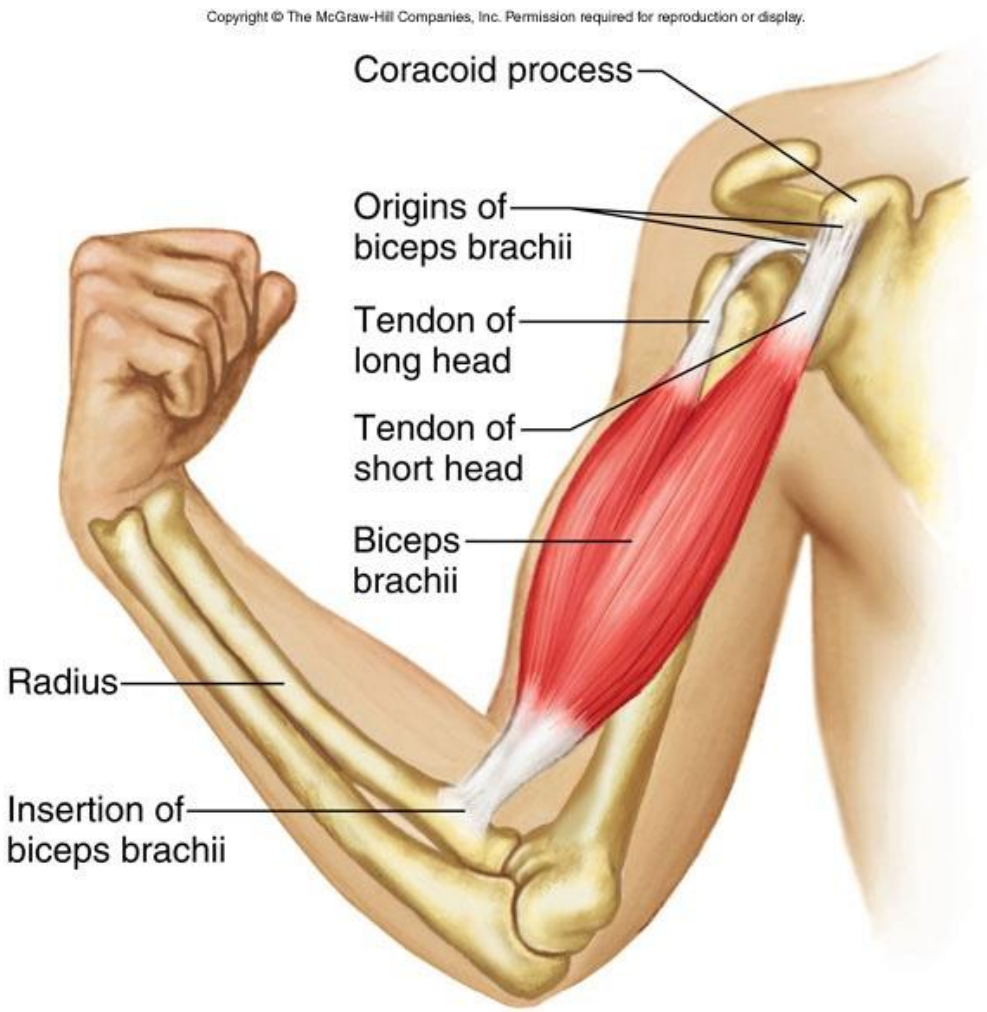
Terminology:

Origin:

fixed end of the muscle; the attachment on the bone that *does not move*.

Insertion:

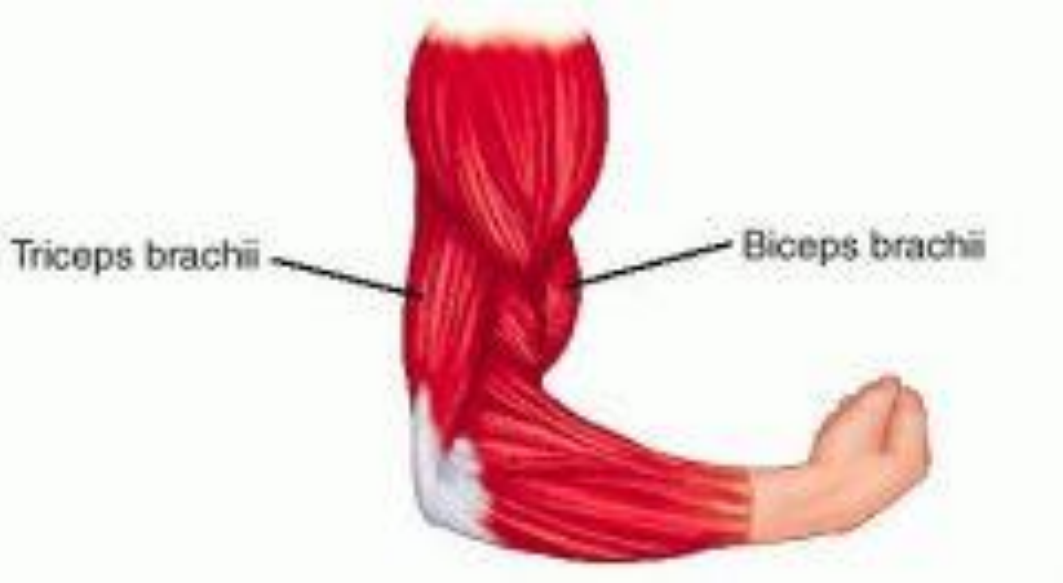
site of attachment of the muscle on the bone that *moves*.



Terminology:

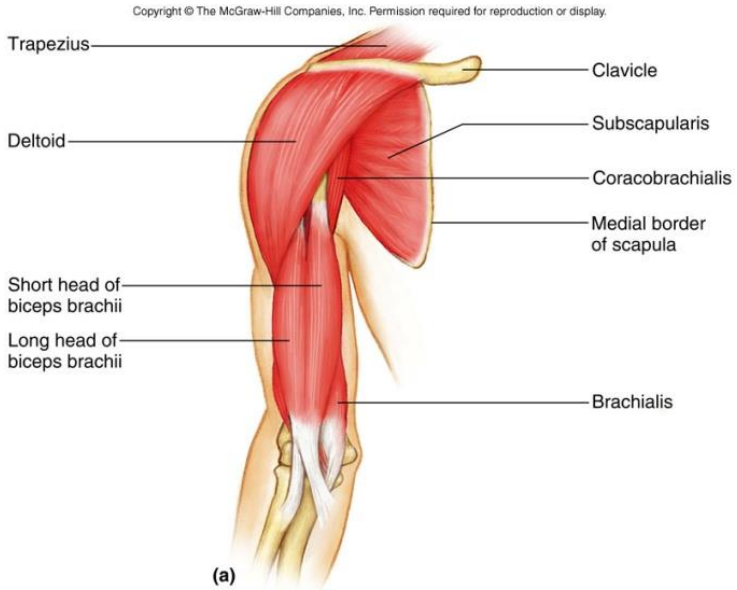
Prime mover/Agonist:

primary muscle **responsible** for a **movement**



Antagonist:

performs the **opposite action** as the prime mover; can **resist actions** of the **primary mover**



Synergist:

muscle(s) that assists or helps

Phases of Movement:

1. Preparation
2. Initiation
3. Action
4. Follow through

Skeletal Joints:

ANATOMICAL/STRUCTURAL COMPONENTS OF THE KINESIOLOGY TRIAD

Skeletal Joints: articulation

An *articulation* is a joint or juncture between bones; includes the cartilage on the bones.

This juncture **allows** bone growth and **movement**

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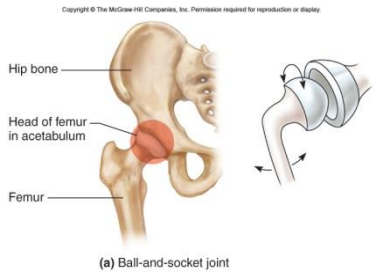
Joint CLASSIFICATIONs

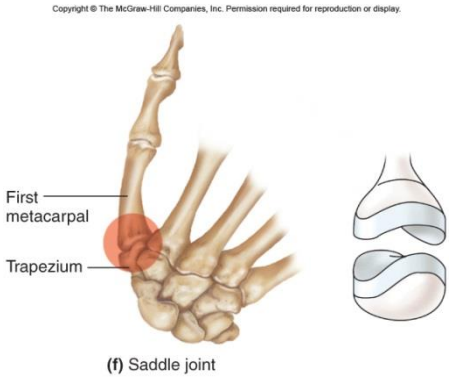
MOVEMENT	*STRUCTURE*
1. **Synarthrotic** – *NO movement*	1. **Fibrous**: i.e. Skull sutures
2. **Amphiarthrotic** – *Limited movement*	2. **Cartilaginous**: i.e. pubic symphysis
3. **Diarthrotic** – *Freely moveable*	3. **Synovial**: i.e. shoulder joint

Types of Synovial Joints

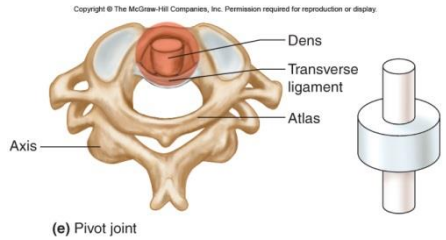
Ball & socket



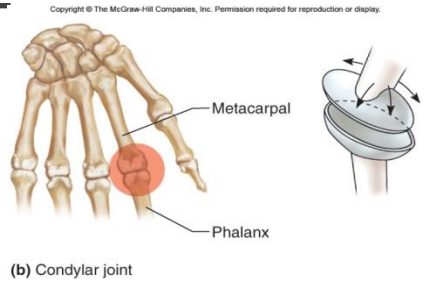
Saddle



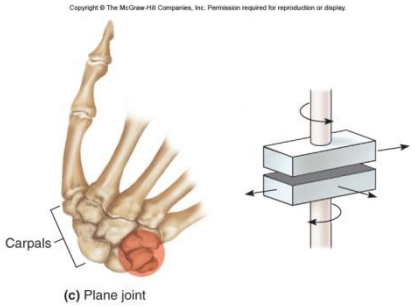
Pivot



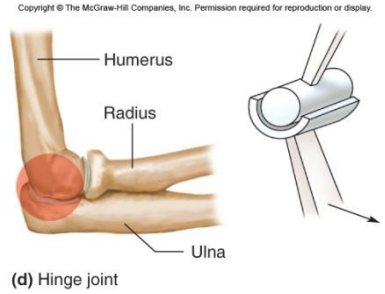
Condylar



Plane



Hinge

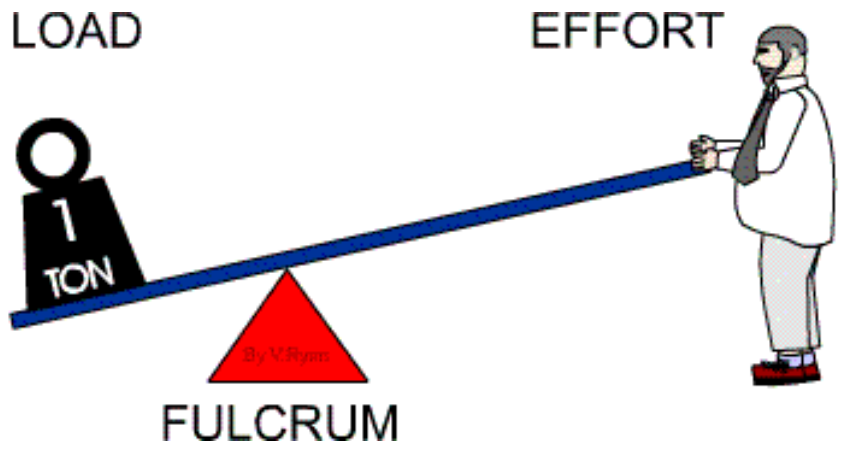


Levers:

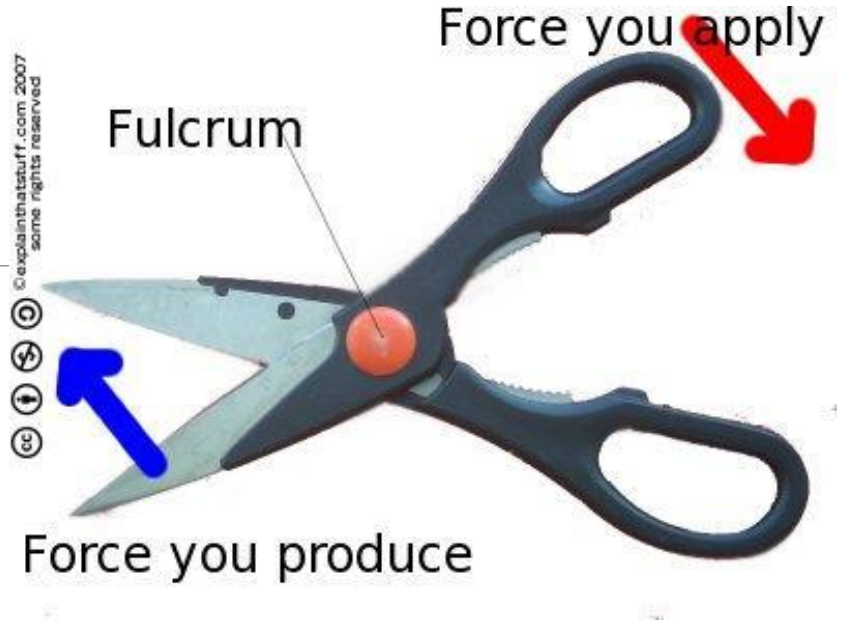
HOW CENTER OF GRAVITY IMPACTS SKELETAL MUSCLE MOVEMENT

Levers:
4 basic components

1. Rigid bar *(bone)*
2. Fulcrum / pivot point where the bar turns (joint)
3. Object moved against resistance *(muscle)*
4. Energy force to move the bar *(ATP)*



Levers: *1st Class*



Examples:

a. Scissors

b. Seesaw

c. Hemostat

Resistance>Fulcrum>Force

Levers: *2nd class*

Example:

wheelbarrow

Fulcrum>Resistance>Force

Levers: *3rd class*

Examples

a. Eyebrow tweezers

b. Forceps

Resistance>Force>Fulcrum

Body Planes:

SKELETAL MUSCLE MOVEMENT THROUGH THE X3 PLANES

BODY PLANES:

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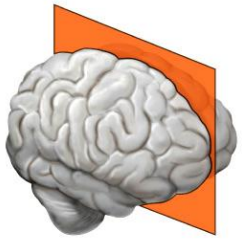

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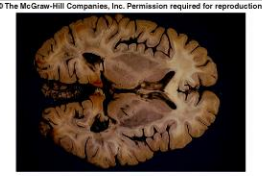

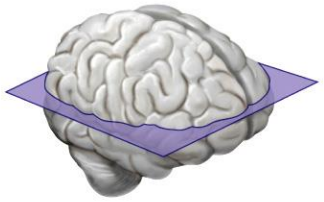

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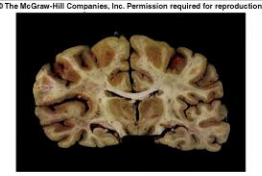
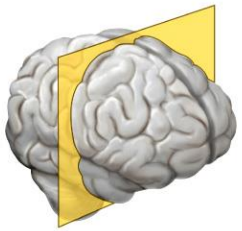
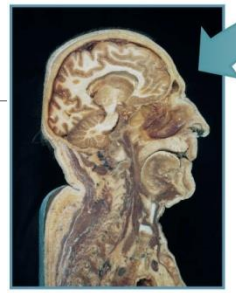




1. **Sagittal**
2. **Transverse**
3. **Frontal**
   Coronal

X3 BODY PLANES:

Sagittal : Right & left portions



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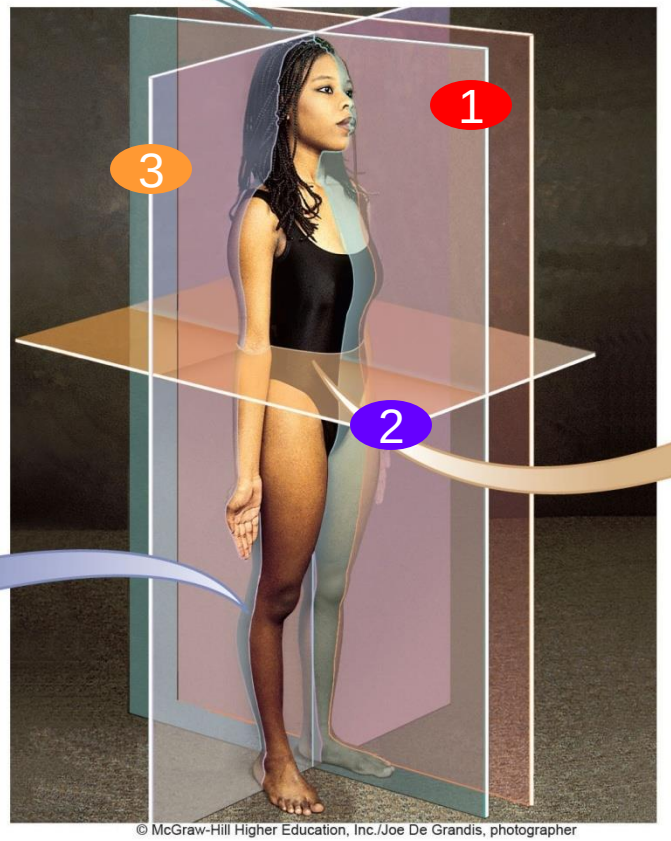

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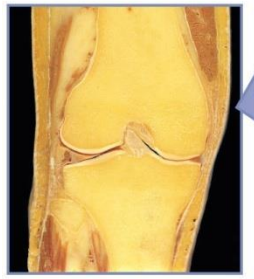
Coronal/Frontal: Anterior & Posterior



Transverse: superior & inferior

Connective Tissues:

ANATOMICAL/STRUCTURAL COMPONENTS OF THE KINESIOLOGY TRIAD

CONNECTIVE Tissues:

1. Bone
2. Blood
3. Cartilage
4. Fibrous Connective Tissue
5. Adipose

Collagen: a *fibrous protein* that gives tissues strength

FOUND IN…

DENSE REGULAR Connective Tissue

- ✓ **Ligaments**
- ✓ **Tendons**
- ✓ **Bone**

ALSO FOUND IN…

DENSE IRREGULAR Connective Tissue

- ✓ **Dermis**

Integumentary System: Dermis

ANATOMICAL/STRUCTURAL COMPONENTS OF THE KINESIOLOGY TRIAD

Epidermis is the *outermost layer* of stratified squamous epithelium

Dermis is the thick *inner layer* of fibrous connective tissue

Subcutaneous layer is layer of areolar & adipose below the dermis; also called the *hypodermis; **not part of skin***

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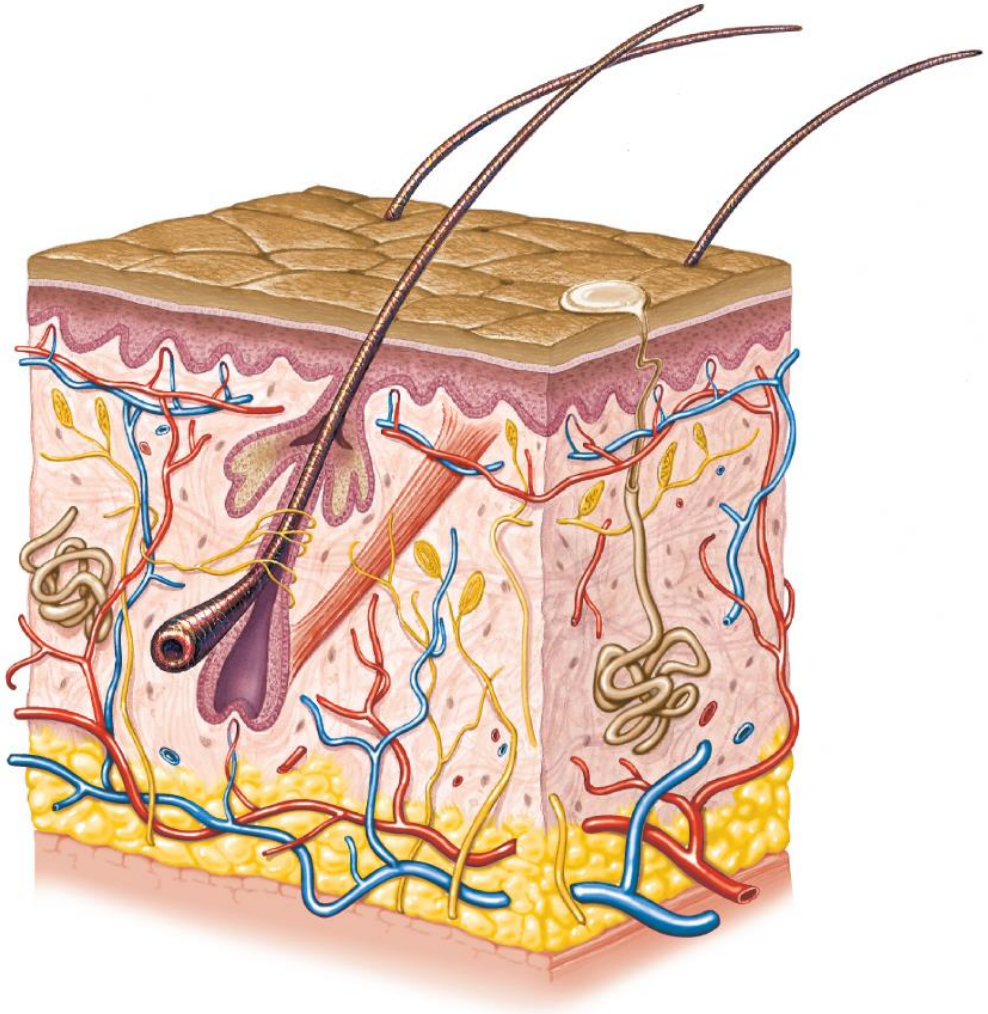


The dermis: dense irregular connective tissue with elastin and collagen. Referred to as the “True skin”.

It contains:

a. **Receptors**
b. **Nerves**
c. **Blood vessels**
d. **Muscle fibers & smooth muscle**
e. **oil and sweat Glands**
f. **Hair roots and follicles**

The dermis:

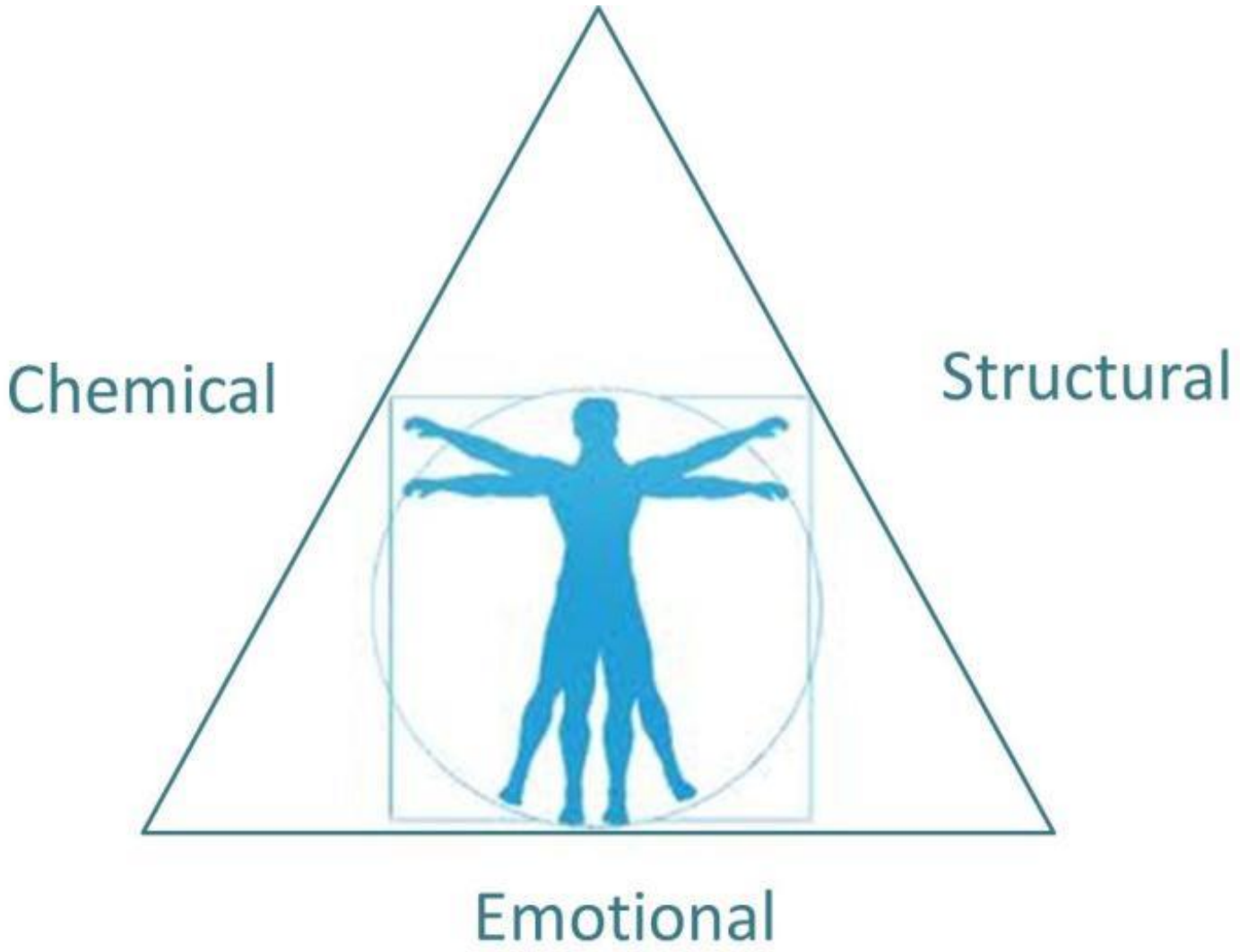
Nerves

Nerves send impulses in response to:

- **temperature changes**
- **pain**
- **pressure**
- **touch**

Kinesiology Triad:

PHYSIOLOGICAL / CHEMICAL

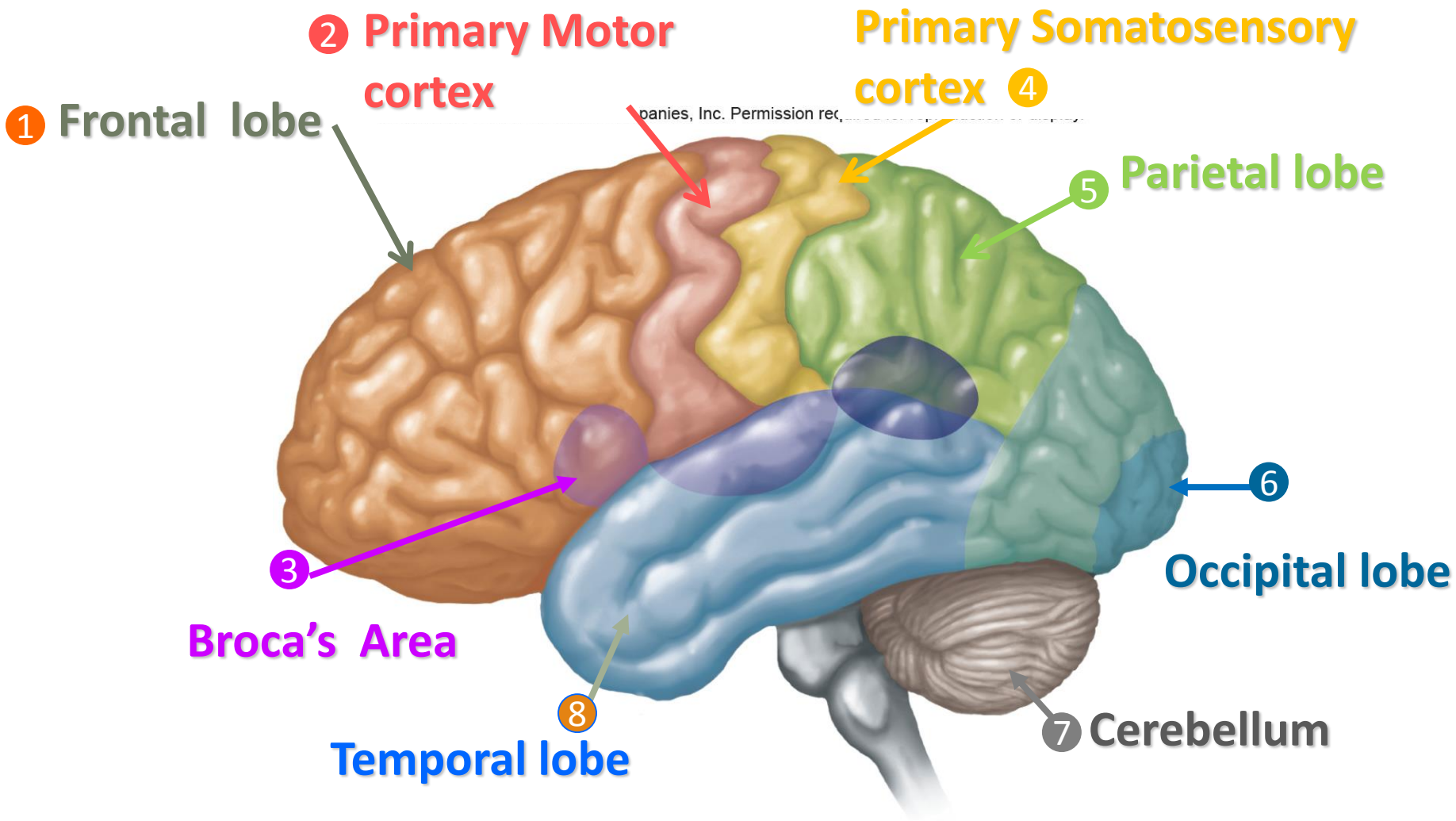


Q: Which neurotransmitter is responsible for skeletal muscle contraction?

A: ACETYLCHOLINE

Neurological Control:

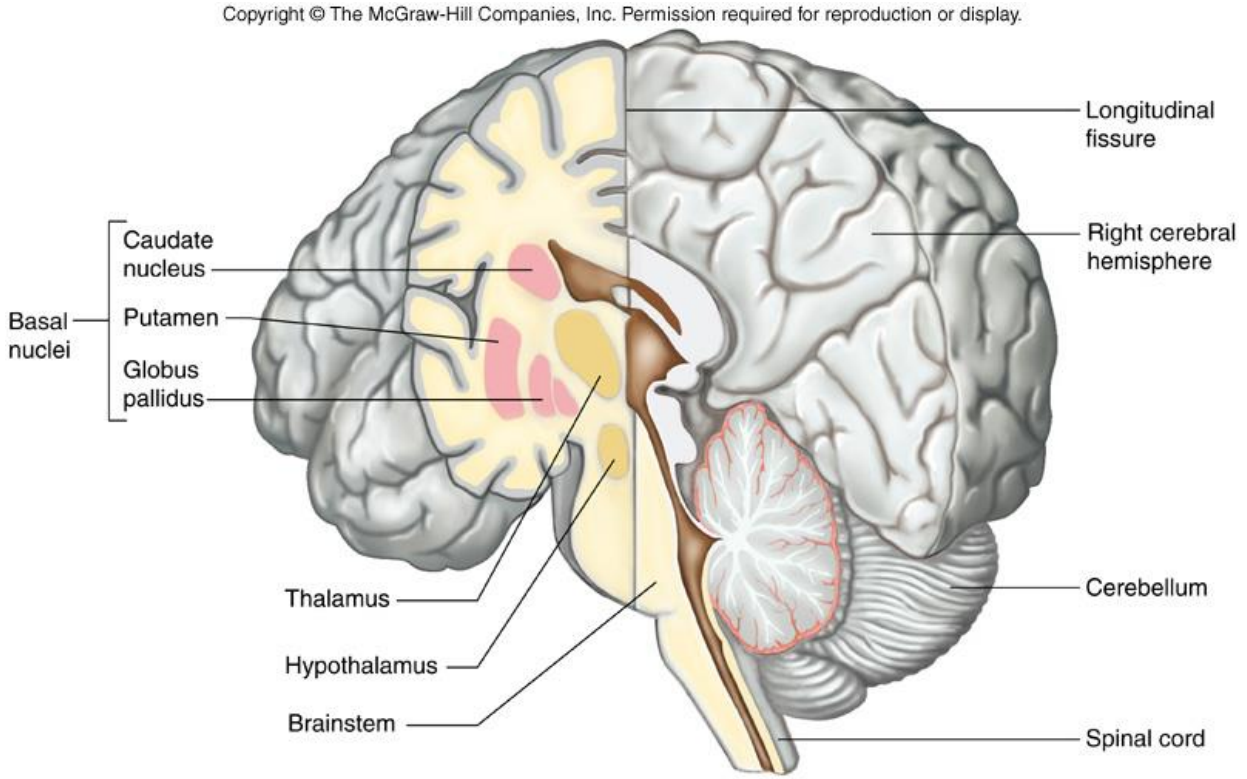
PHYSIOLOGICAL/CHEMICAL COMPONENTS OF THE KINESIOLOGY TRIAD


1 Frontal lobe
2 Primary Motor cortex
Primary Somatosensory cortex 4
5 Parietal lobe
6
Occipital lobe
3
Broca's Area
8
Temporal lobe
7 Cerebellum

Basal Ganglia (a.k.a. Basal Nuclei)

Interacts with other brain areas including the motor cortex, thalamus, and cerebellum to **facilitate voluntary movement**

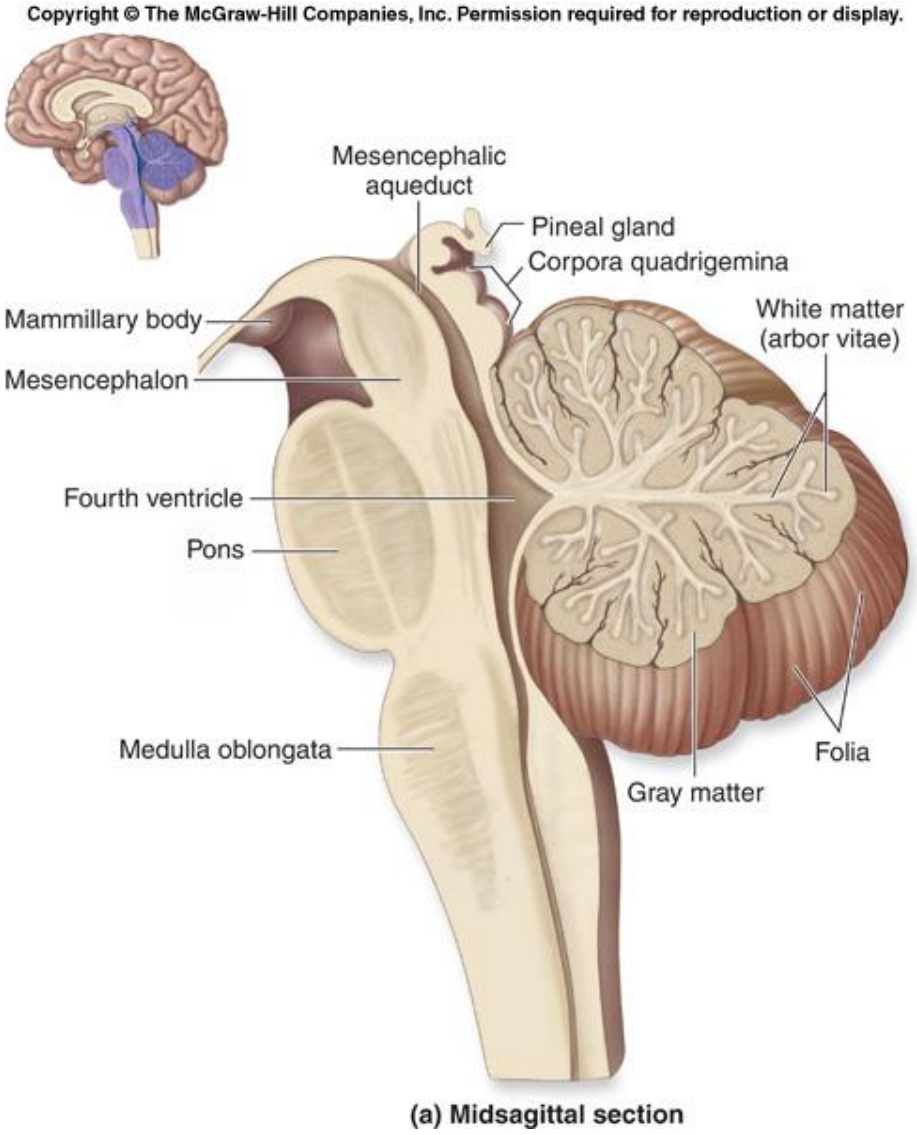
- Filters out unwanted muscle activity
- Controls repetitive movement
- Maintains posture
- Produces dopamine



Cerebellum:

Integrates sensory information about areas of muscle memory including:

- ✓ position of body parts,
- ✓ posture, and
- ✓ voluntary muscle coordination



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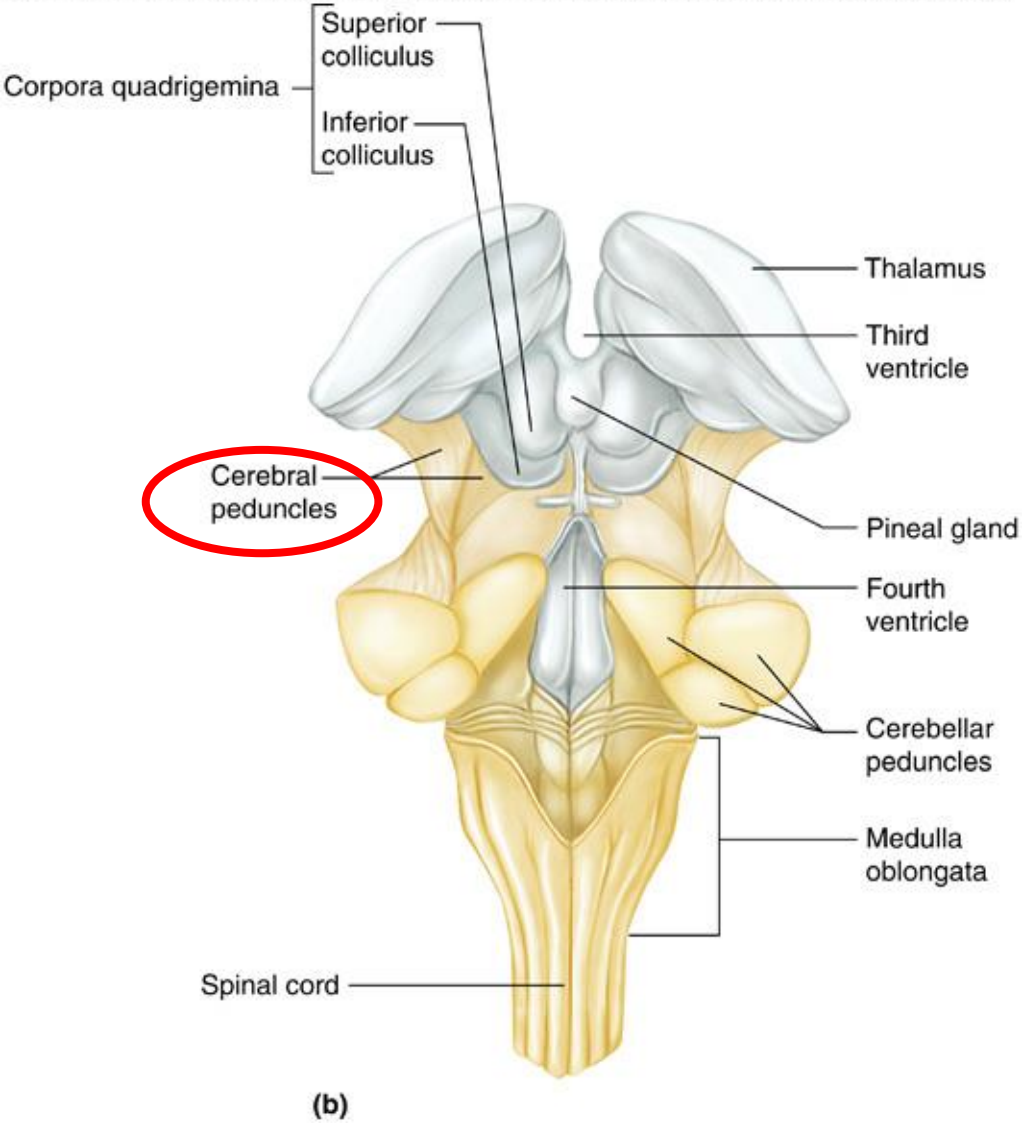

Midbrain (brainstem): Cerebral Peduncles:

x2 prominent bundles of nerve fibers on the underside of the midbrain.

They are the main motor pathways between the cerebrum and the lower parts of the nervous system.

Occipital Lobe: Visual Nerve Pathway

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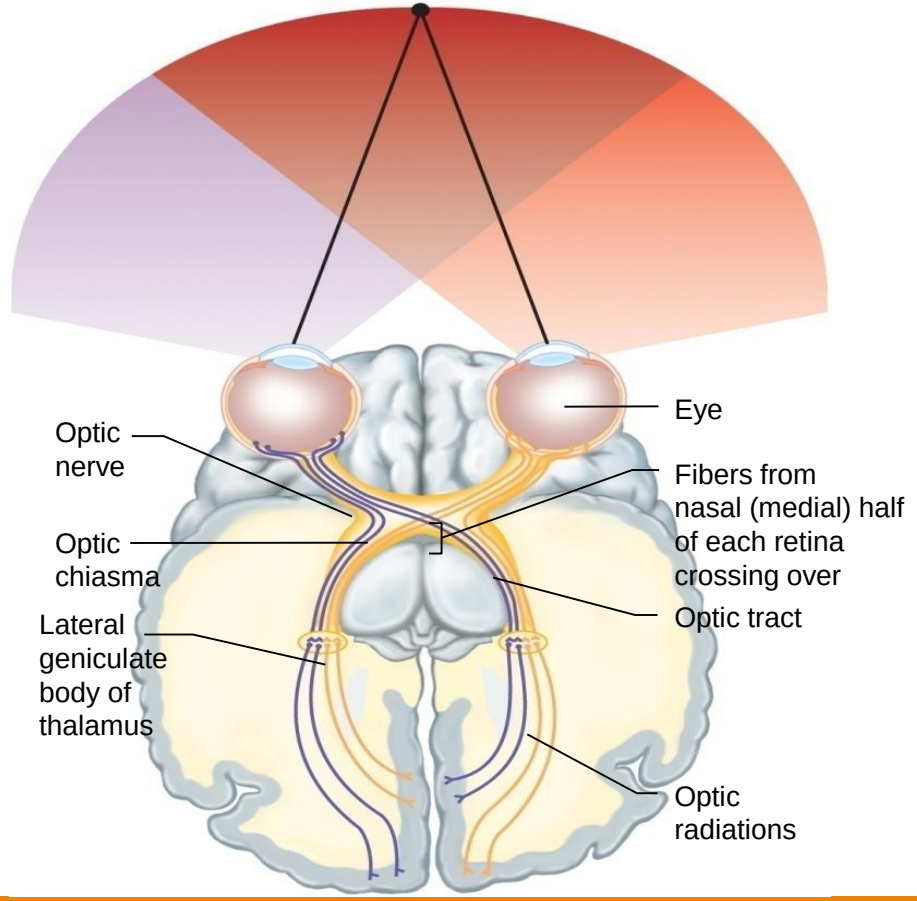

Visual cortex of occipital lobe

Stereoscopic Vision

- Provides perception of distance and depth
- Results from formation of two slightly different retinal images

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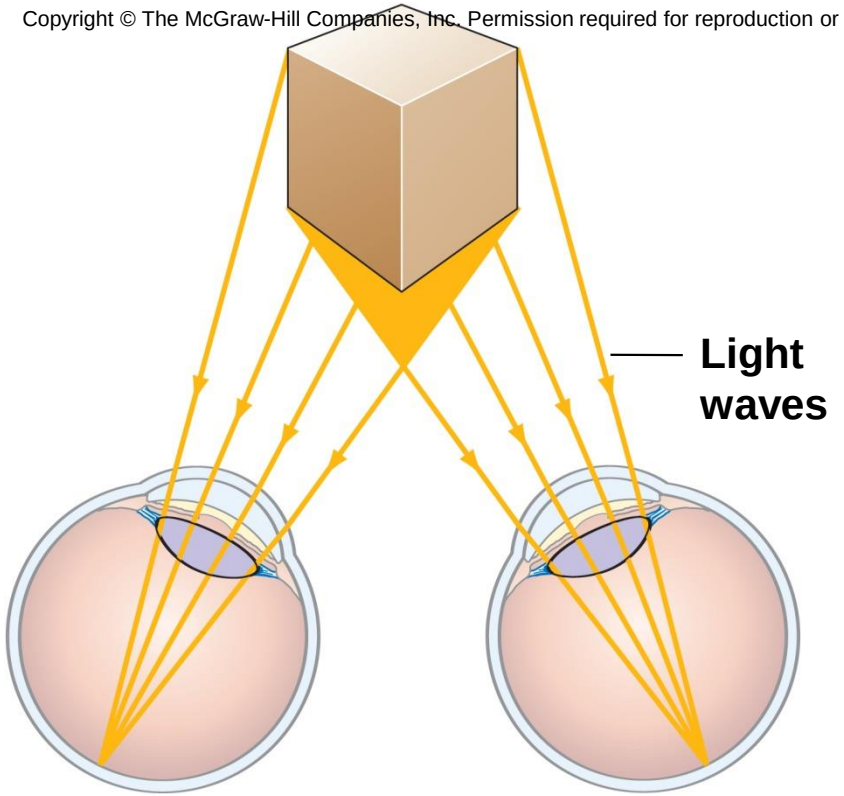


Receptors:

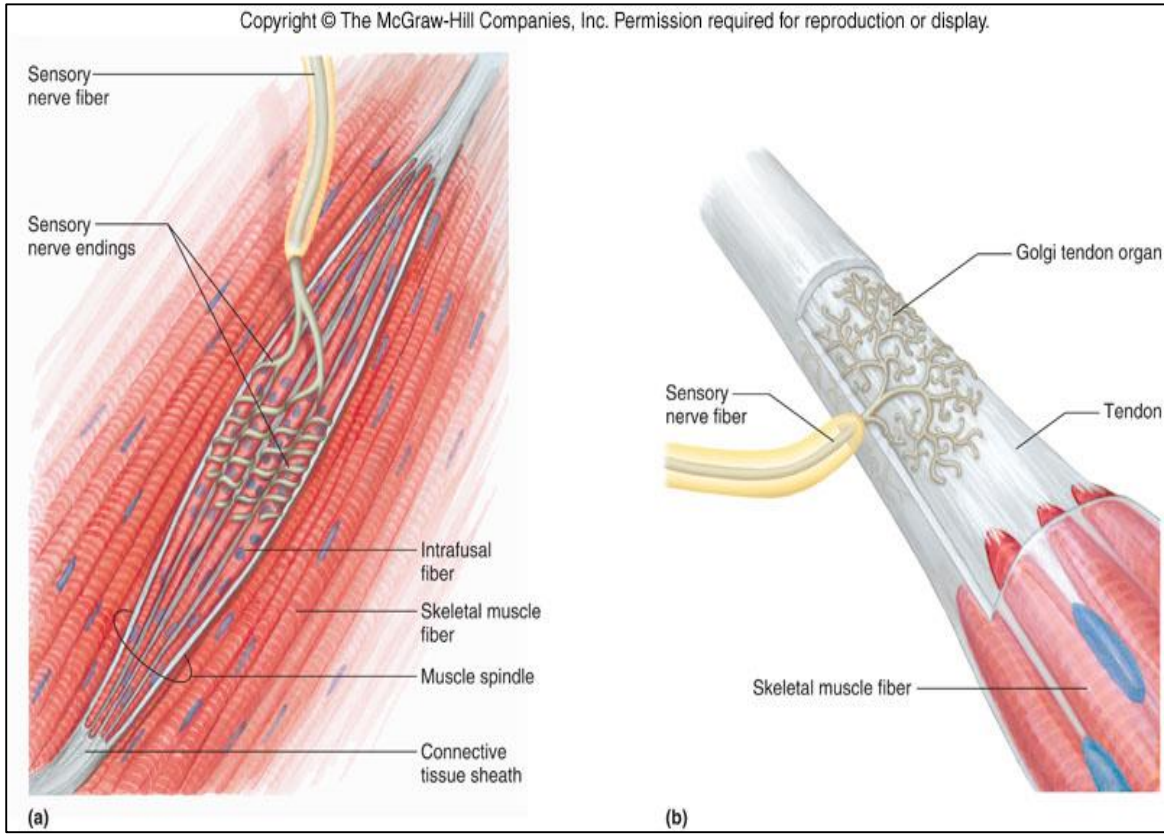
PHYSIOLOGICAL/CHEMICAL COMPONENTS OF THE KINESIOLOGY TRIAD

Mechanoreceptors

A. *Stretch receptors* in the muscles and lungs

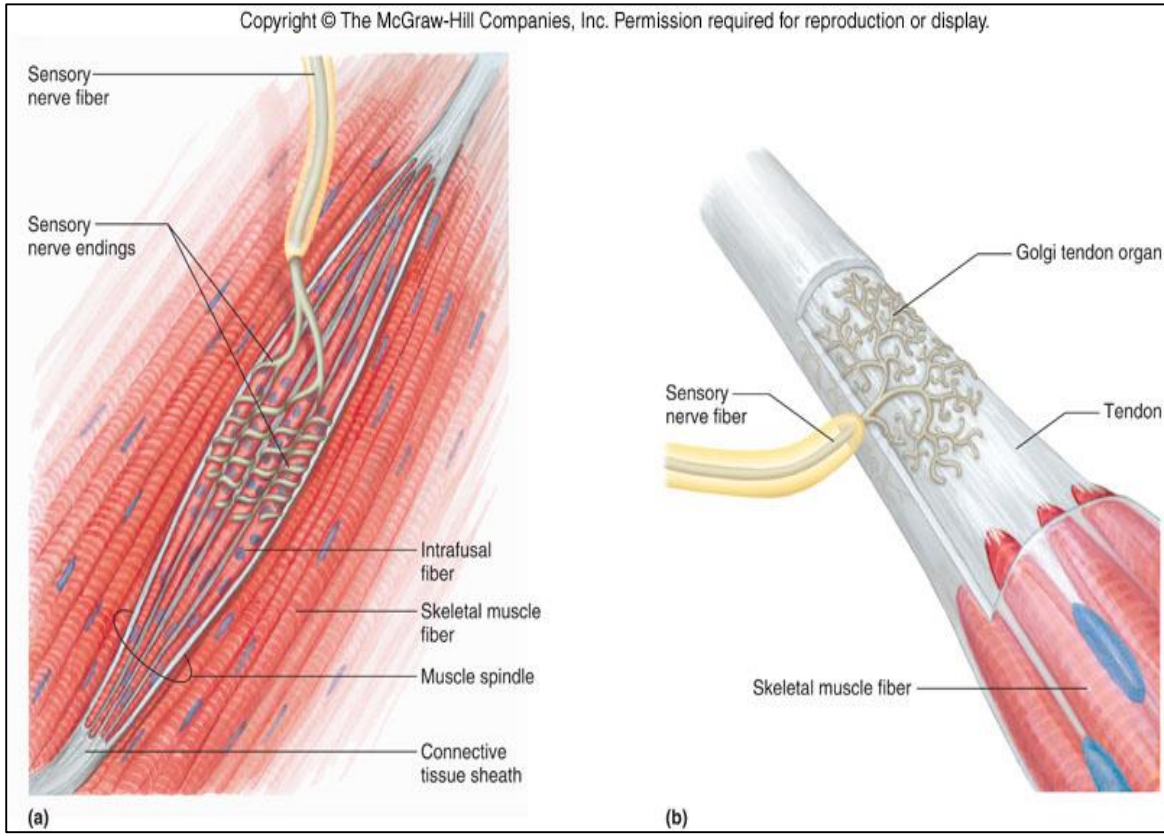
B. Baroreceptors (a.k.a. *pressoreceptors*) detect changes in blood pressure (BP)

***C. Proprioceptors* sense changes in tension in the muscles & tendons**



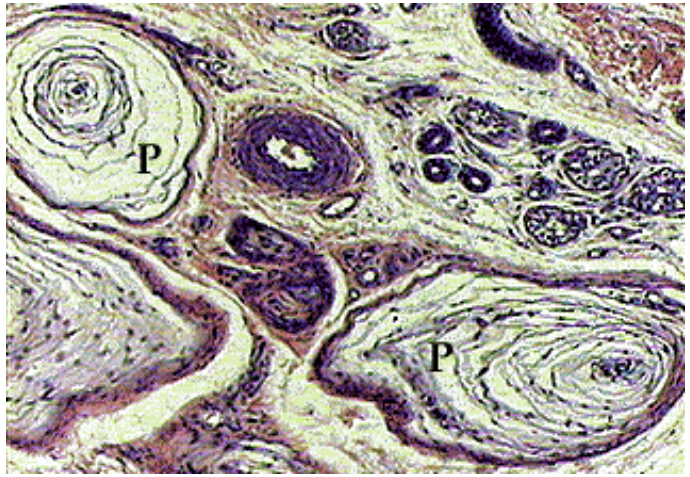
Mechanoreceptors

- Provides biofeedback after detecting a change that deforms the receptor itself
  - A. Golgi tendon organ
  - B. Muscle spindle
  - C. Pacinian corpuscles



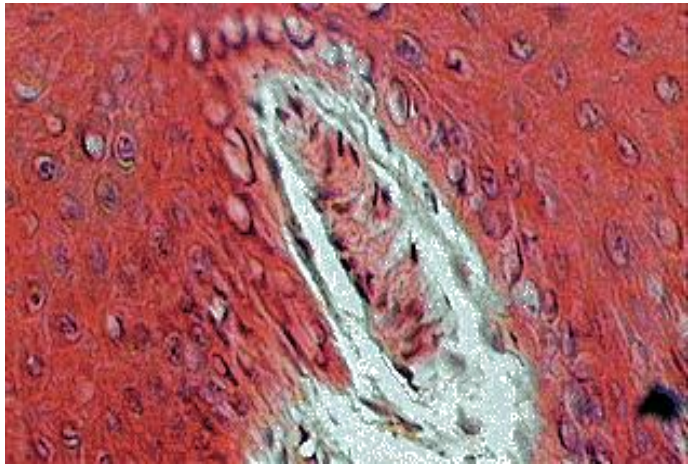
The dermis:

Mechanoreceptors



❶ **Pacinian corpuscles**

Lie deep within the dermis and detect pressure

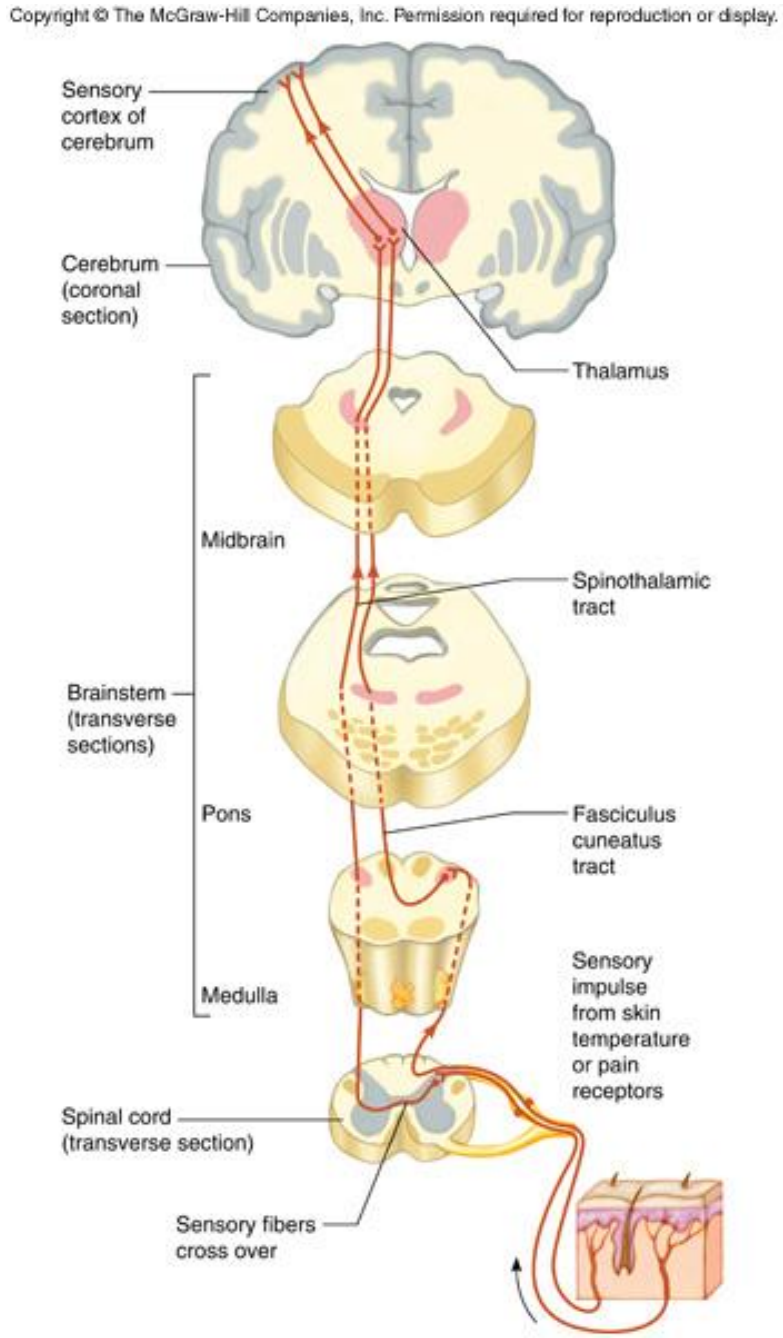


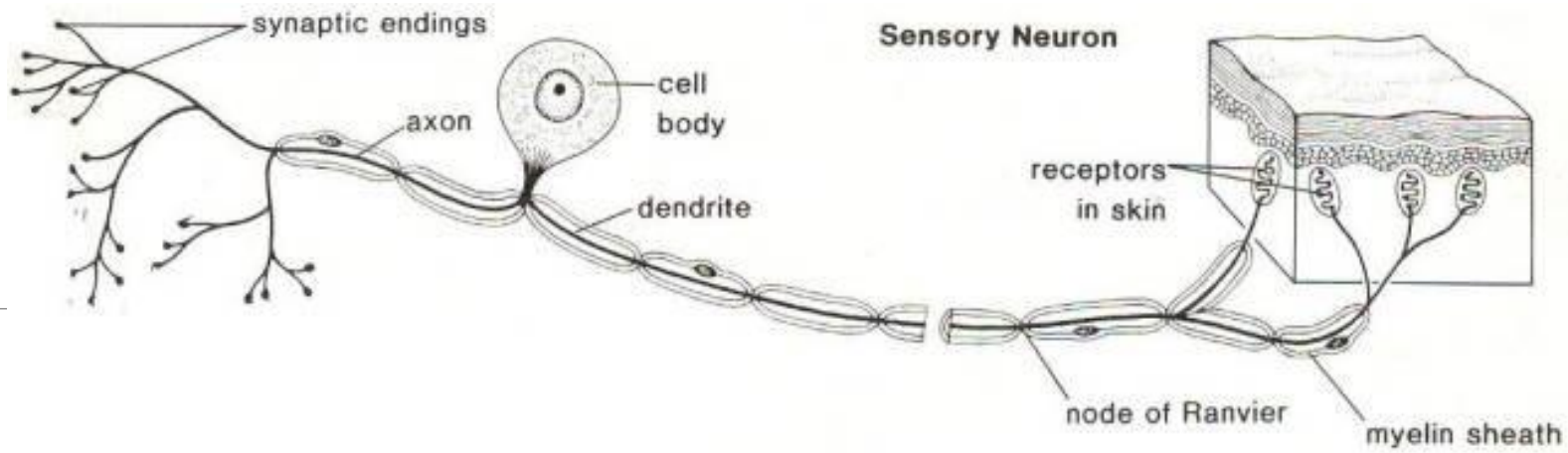
❷ **Meissner corpuscles**

lie very close to the dermal papillae and detect **light touch**

Spinal tracts:

carry information to and from the **Central Nervous System** (CNS)





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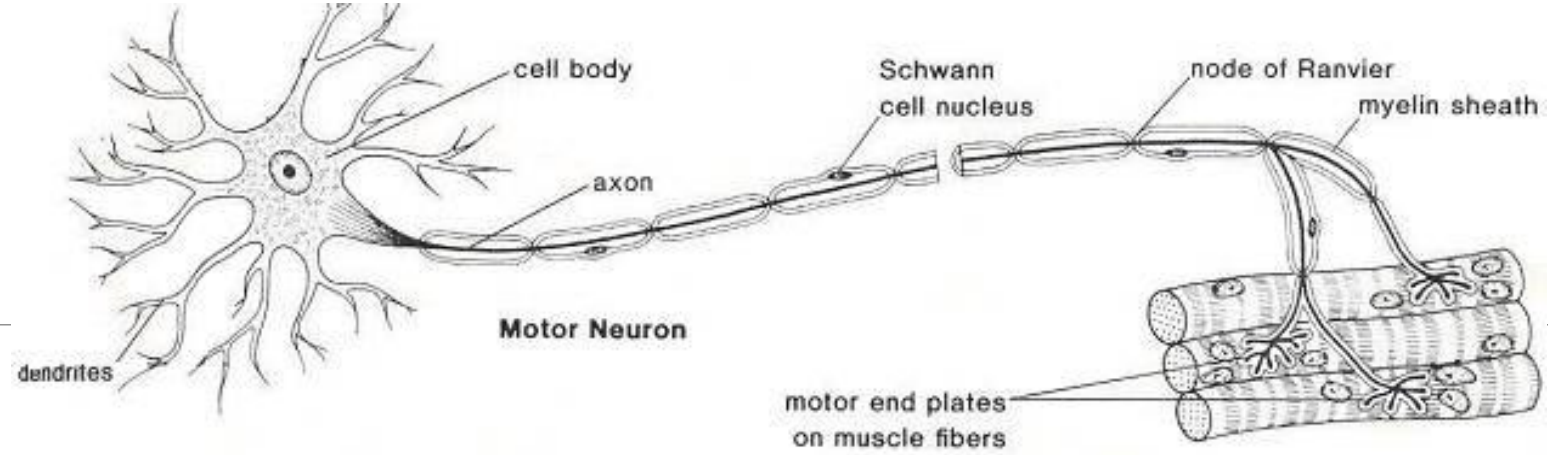
Sensory [*afferent*] neurons

1. Bring sensory impulses to the CNS
2. Dendrites or specialized structures act as sensory receptors
3. Detect changes in the environment including detecting temperature, pain, touch, pressure, vision, hearing….



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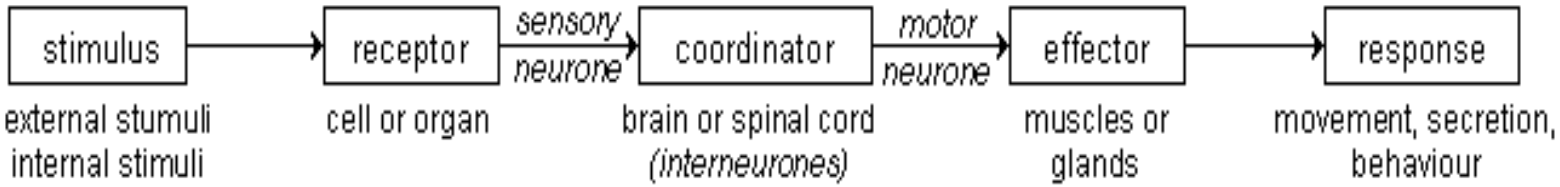
Motor *[efferent]* neurons

1. Take motor impulses from the CNS
2. Carry impulse to effectors [muscles and glands]
3. Respond to changes in the environment that are detected by sensory receptors

Reflexes:

Protective, automatic responses to change (stimuli) coming from inside or outside the body



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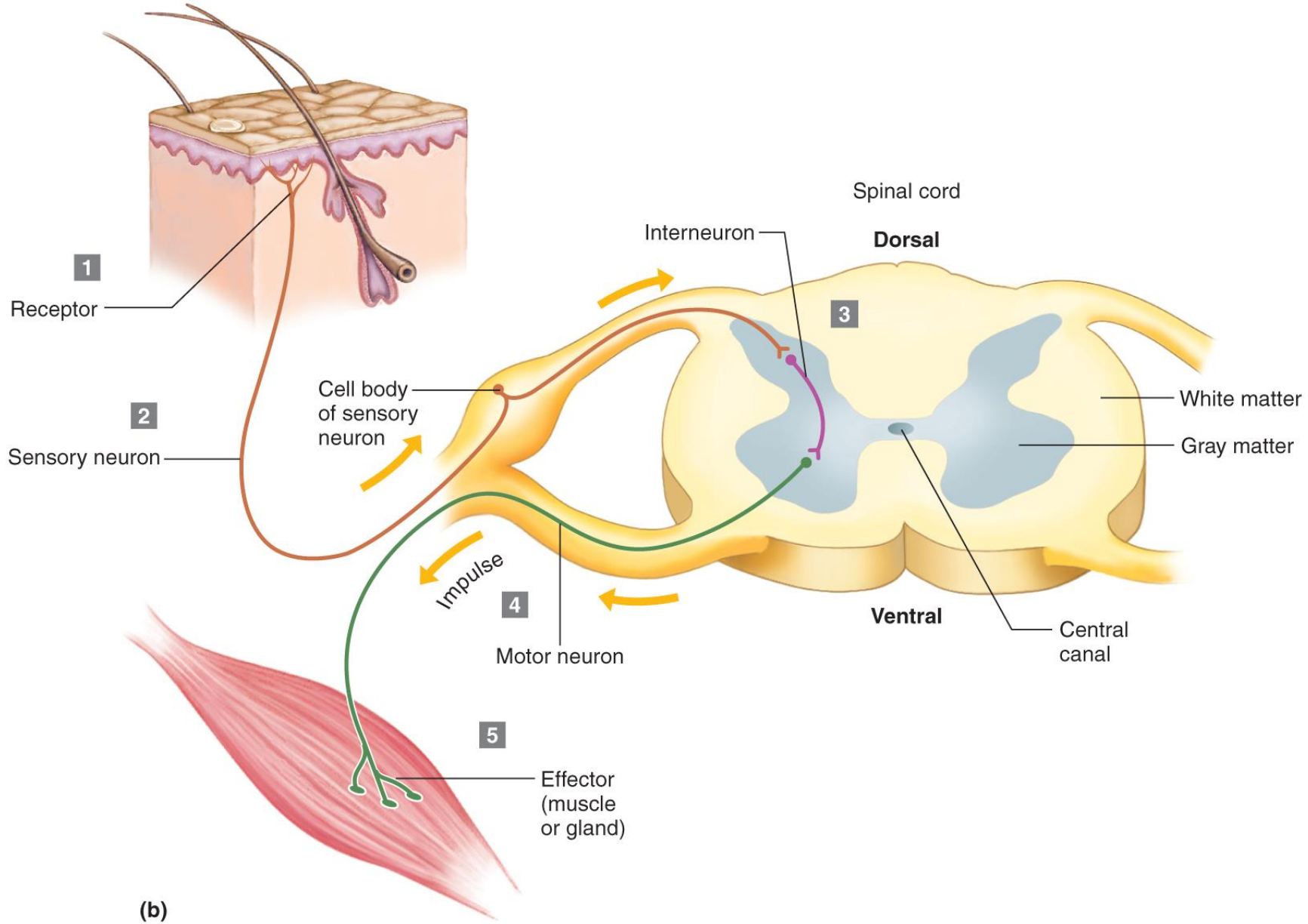
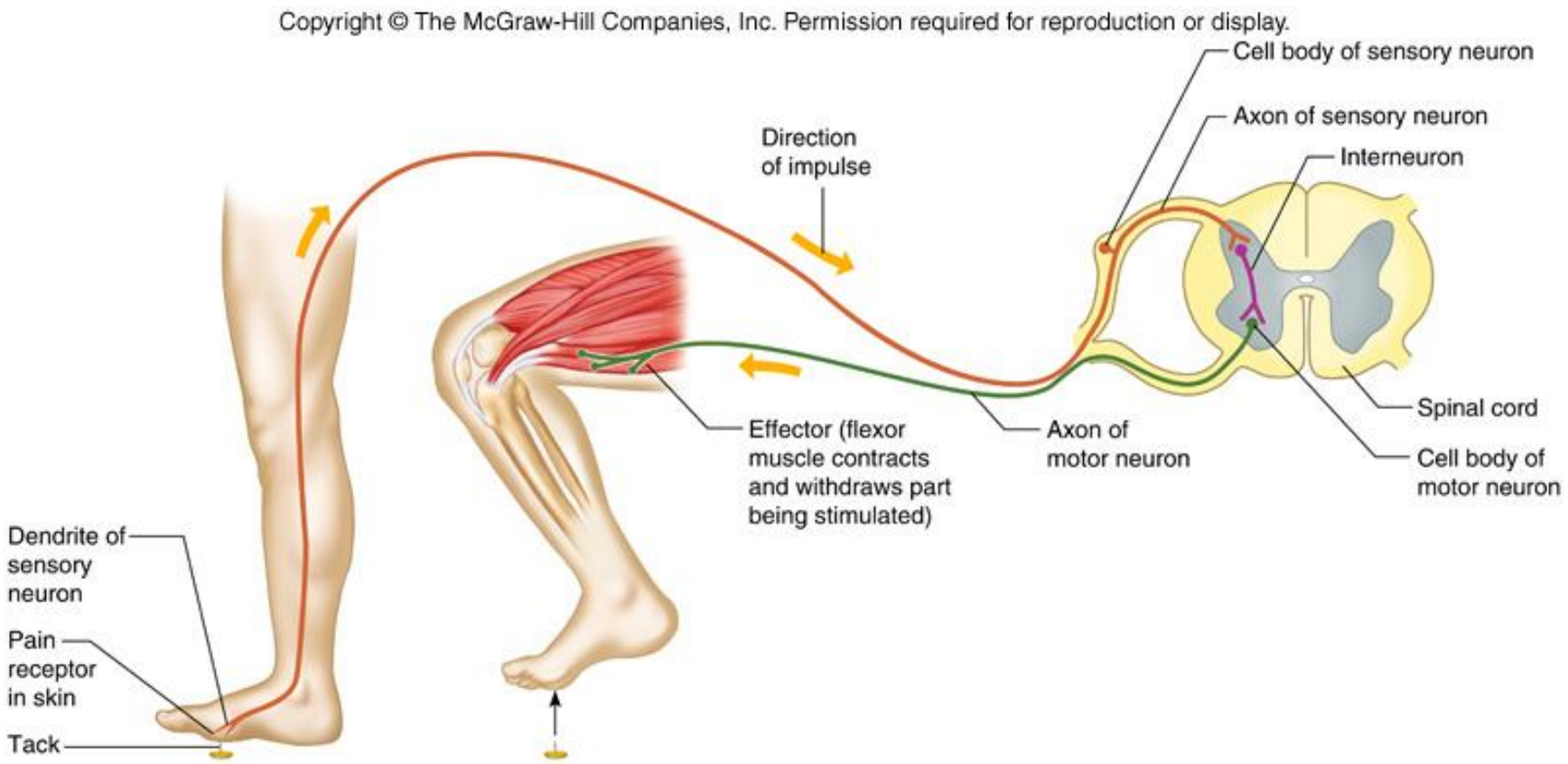
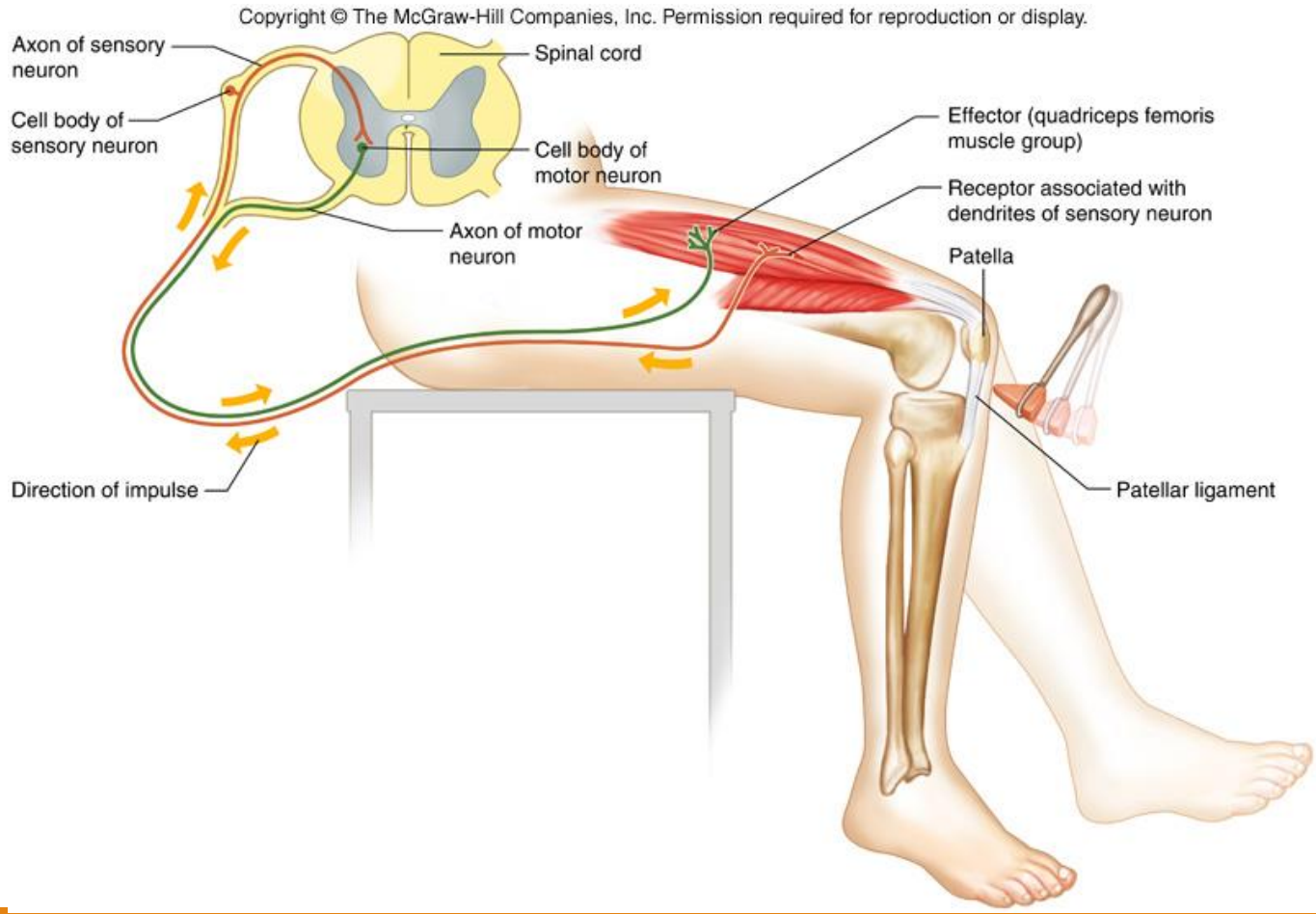


Structure of a 3-neuron reflex arc

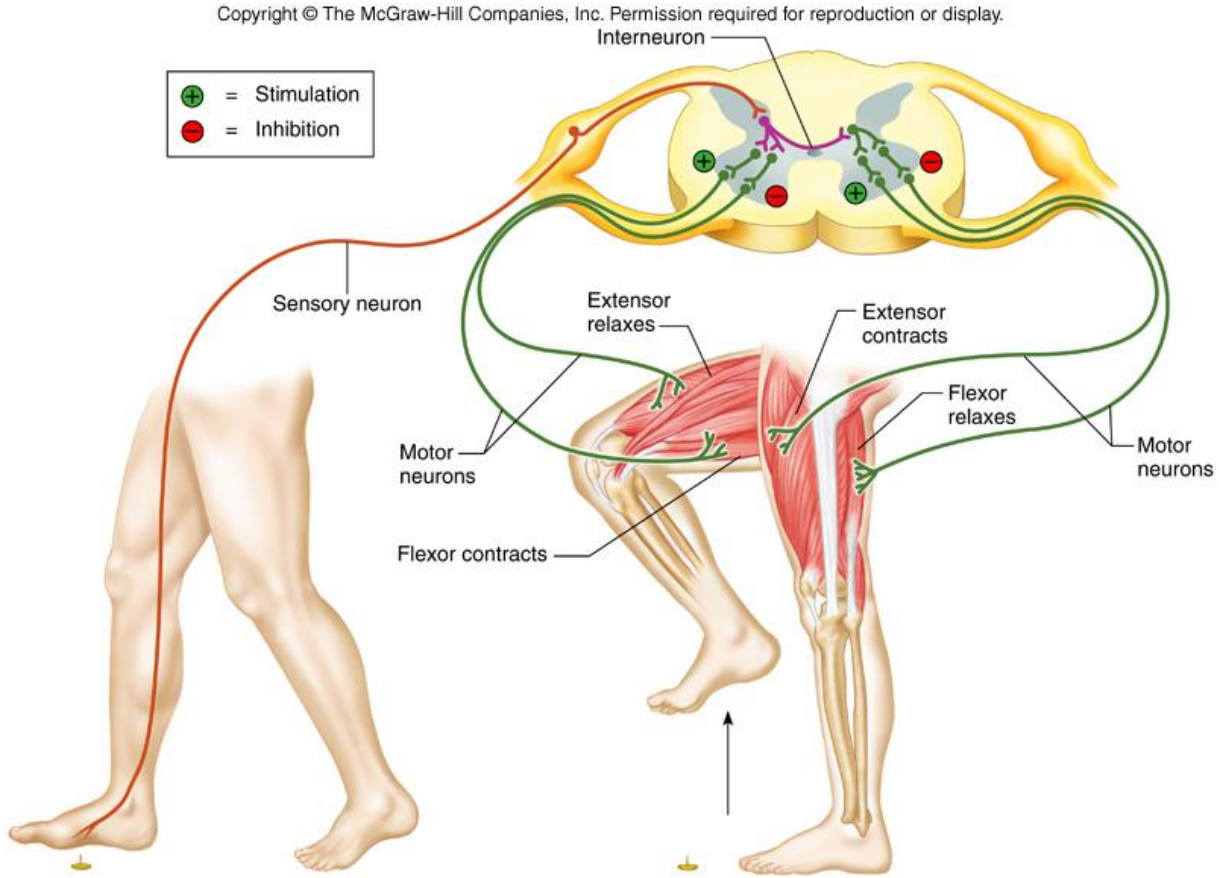
"Withdrawal Reflex"



Structure of the Simple Reflex arc: *"monosynaptic"*

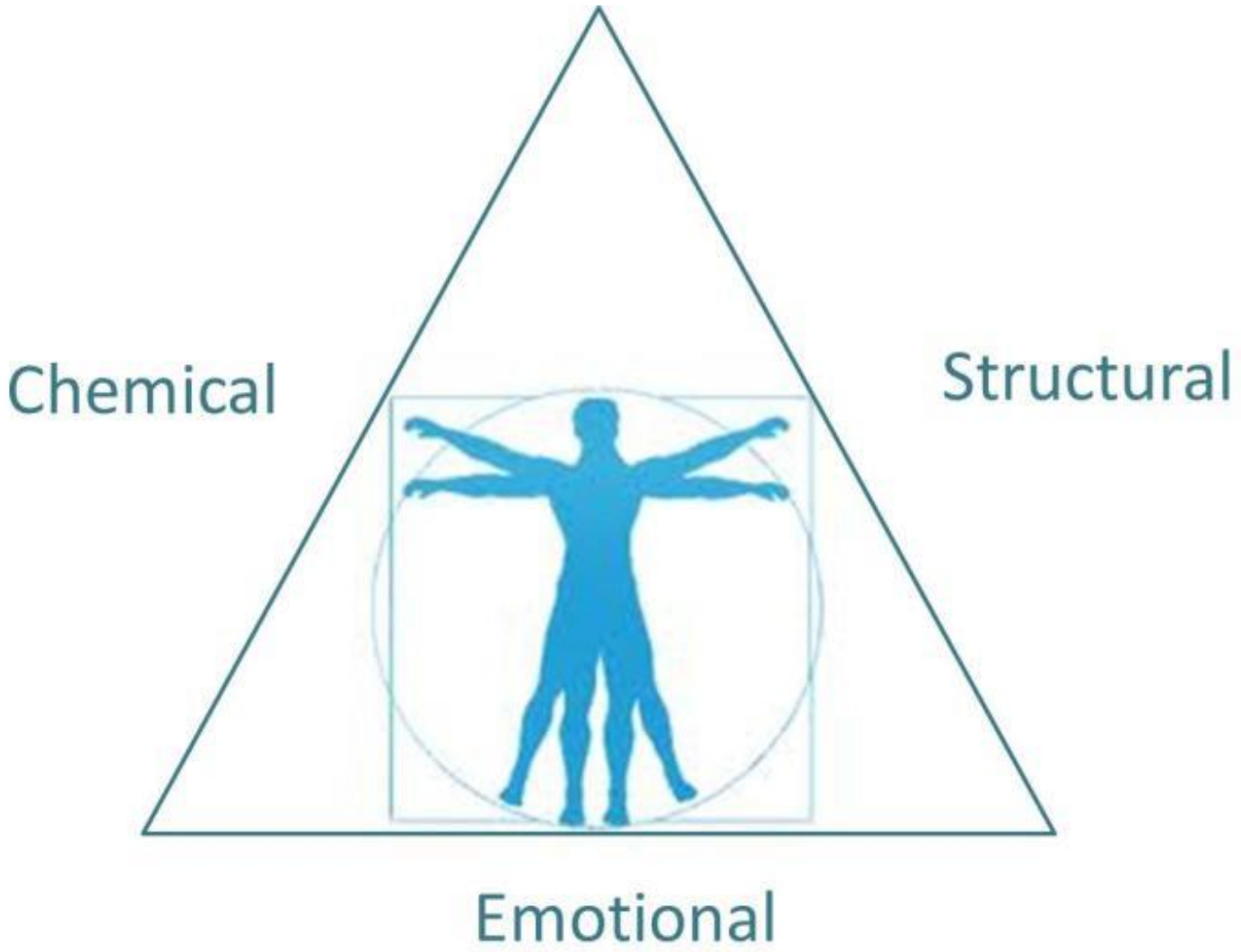


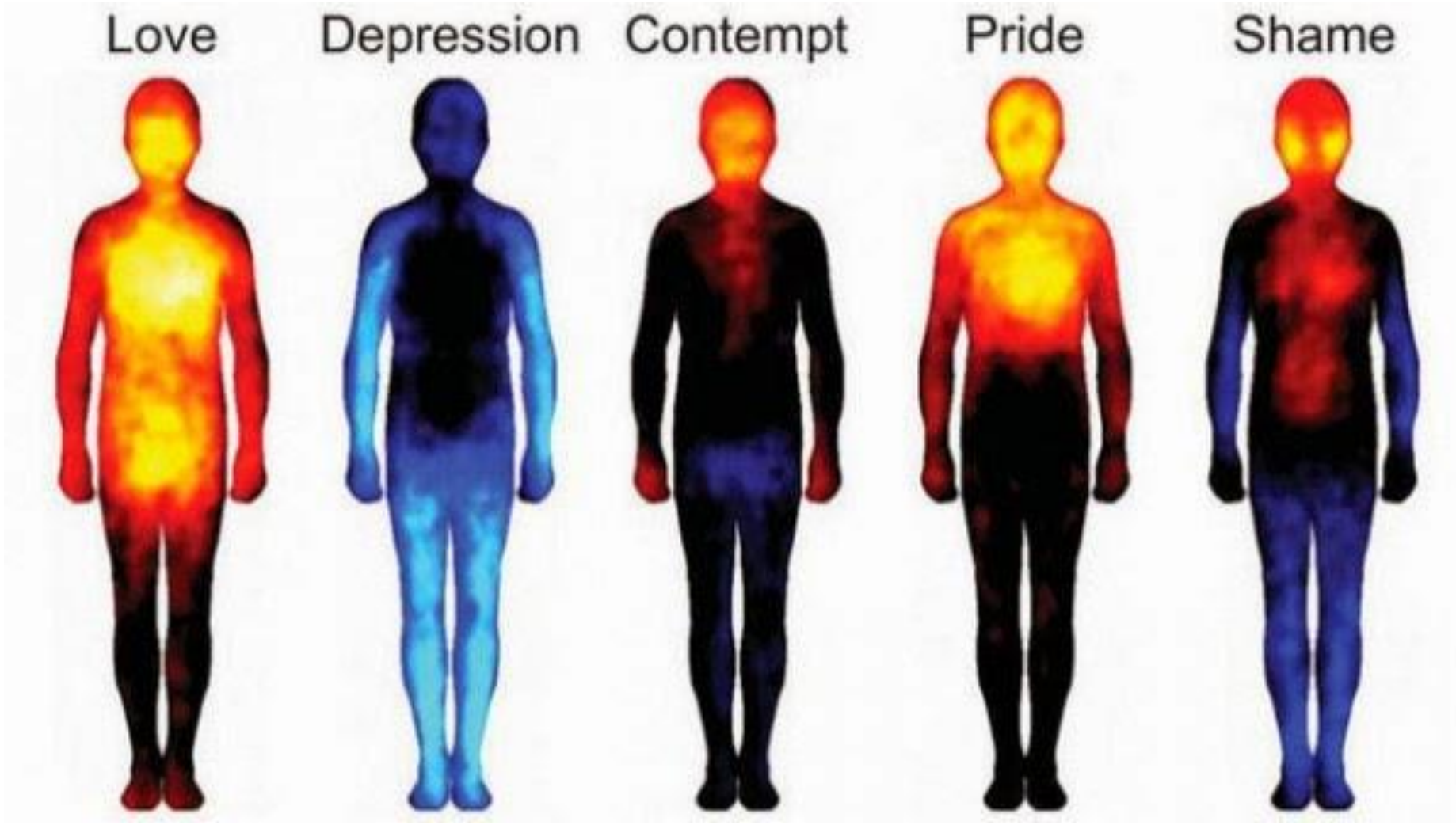
Structure of the Cross Extensor Reflex Arc: *"contralateral"*



Kinesiology Triad:

PSYCHOLOGICAL / EMOTIONAL





http://sitsshow.blogspot.com/

Age-Related Changes

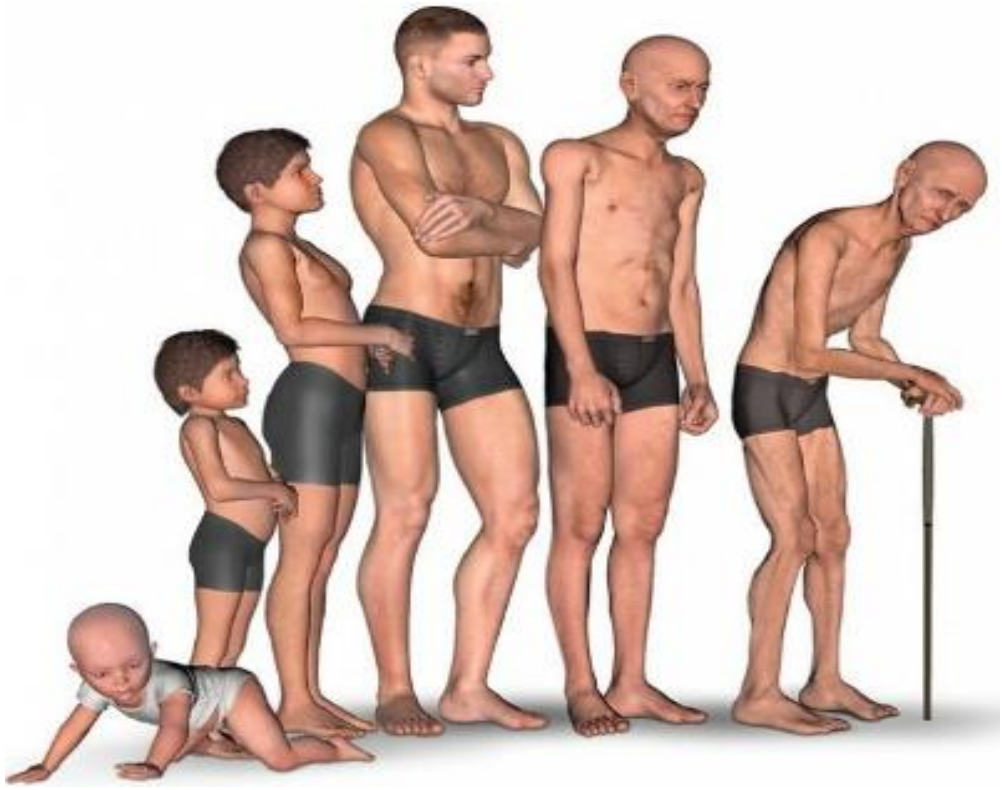
Aging muscles:

40’s

*ATP, creatine phosphate & myoglobin start to decrease

*Muscles become drier, smaller, & weaker

*Connective tissue & adipose take the place of some muscle tissue



80’s

*Nearly 50% of muscle has atrophied

*Strength is significantly decreased

*Muscle reflexes slow down significantly

Age-related changes in Joints:

- Stiff joints vs exercise
- **Fibrous joints** strengthen over time
- **Cartilaginous joints**:
  - Epiphyseal (growth) plate disappears by age 25 (when growing stops)
  - Ligaments lose elasticity > stiff muscles and joints
  - Symphysis joints in Vertebrae become dehydrated & loses movement; discs “slip” or collapse, causing elderly persons’ height to decrease, spinal stiffness, and loss of ROM
- **Synovial Joints**:
  - Slow progression of loss, beginning in 30’s
  - Fewer capillaries = slower circulation of synovial fluid… joints stiffen, which leads to falls

…the vicious cycle!!!

Activity & Exercise = prolonged use of joints

****

Lack of activity & exercise = stiff joints

Disuse decreases nutrient supply to joints, which lead to more stiffness

More stiffness leads to less desire to be active or exercise

…and so on, and so on, and so on…

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