

# INTRODUCTION TO THE HUMAN BODY

Primary Care Paramedicine

Module: 04

Section: 01



- Anatomy and physiology are branches of biology concerned with the form and functions of the body
- Anatomy:
  - The study of the shape and structure of the human body

- Gross anatomy
  - Study of the body using only the naked eye
- Microscopic anatomy
  - Study of body parts using a microscope
    - Cytology: study of cells
    - Histology: study of tissues



- Developmental anatomy
  - Study of human growth and development
- Pathological anatomy
  - Study of diseased body structures
- Systemic anatomy
  - Study of all aspects of the function of specific organ systems

- **Physiology**
  - The study of the functions of organisms; subdivisions named according to:
    - Organism involved: human or plant physiology
    - Organizational level: molecular or cellular physiology
    - Systemic function: respiratory, neurovascular or cardiovascular physiology

- Pathophysiology
  - The study of the biologic and physical manifestations of disease as they correlate with abnormalities and physiological disturbances.
  - Pathophysiology does not deal directly with the treatment of disease. Rather, it explains the processes within the body that result in the signs and symptoms of a disease.

- Terminologia Anatomica
  - Official list of anatomical terms
  - Terms listed in Latin, English, and by number
  - Avoids use of eponyms (terms based on a person's name)
- Physiology terms do not have an official list but follow the same principles as Terminologia Anatomica

- Anatomy and Physiology are interrelated since structure and function are closely connected
- Examples:
  - Cleft palate (anatomy) repaired so food will enter (physiology) the pharynx instead of the nasal cavity
  - Fractured bones (anatomy) are reset so they function (physiology)



- A single criterion may be adequate to describe life, as in following examples:
  - Autopoiesis: living organisms are self-organized and self-maintaining
  - Cell theory: if it is made of one or more cells, it is alive

- All living organisms have certain characteristics (life processes) to distinguish them from non-living forms



- Life processes that are considered most important in humans:
  - Responsiveness
  - Organization
  - Growth
  - Respiration
  - Digestion
  - Metabolism
  - Movement
  - Differentiation
  - Excretion
  - Reproduction

- Responsiveness
  - Detecting internal and external changes and reacting to that change
- Organization
  - Each component has its own job to perform in cooperation with others

- Growth
  - Increase of size whether through increase in number of cells or increase in the size of the cell itself
- Respiration
  - Exchange of  $O_2$  and  $CO_2$  between the cells and the environment and the transport of gases in and out of the blood

- Digestion
  - Break down of complex foods into simple molecules that can be absorbed
- Metabolism
  - Includes all chemical reactions that occur in the body

- Movement
  - The movement of molecules at the cellular level
  - Blood moving from one part of the body to another
  - Diaphragm moving with every breath
  - Muscle fibers shortening causing movement
- Differentiation
  - Simple cells form into specialized cells with specific structure and function (form tissues and organs)

- Excretion
  - Removal of waste products of digestion and metabolism
- Reproduction
  - Formation of new cells for replacement and repair



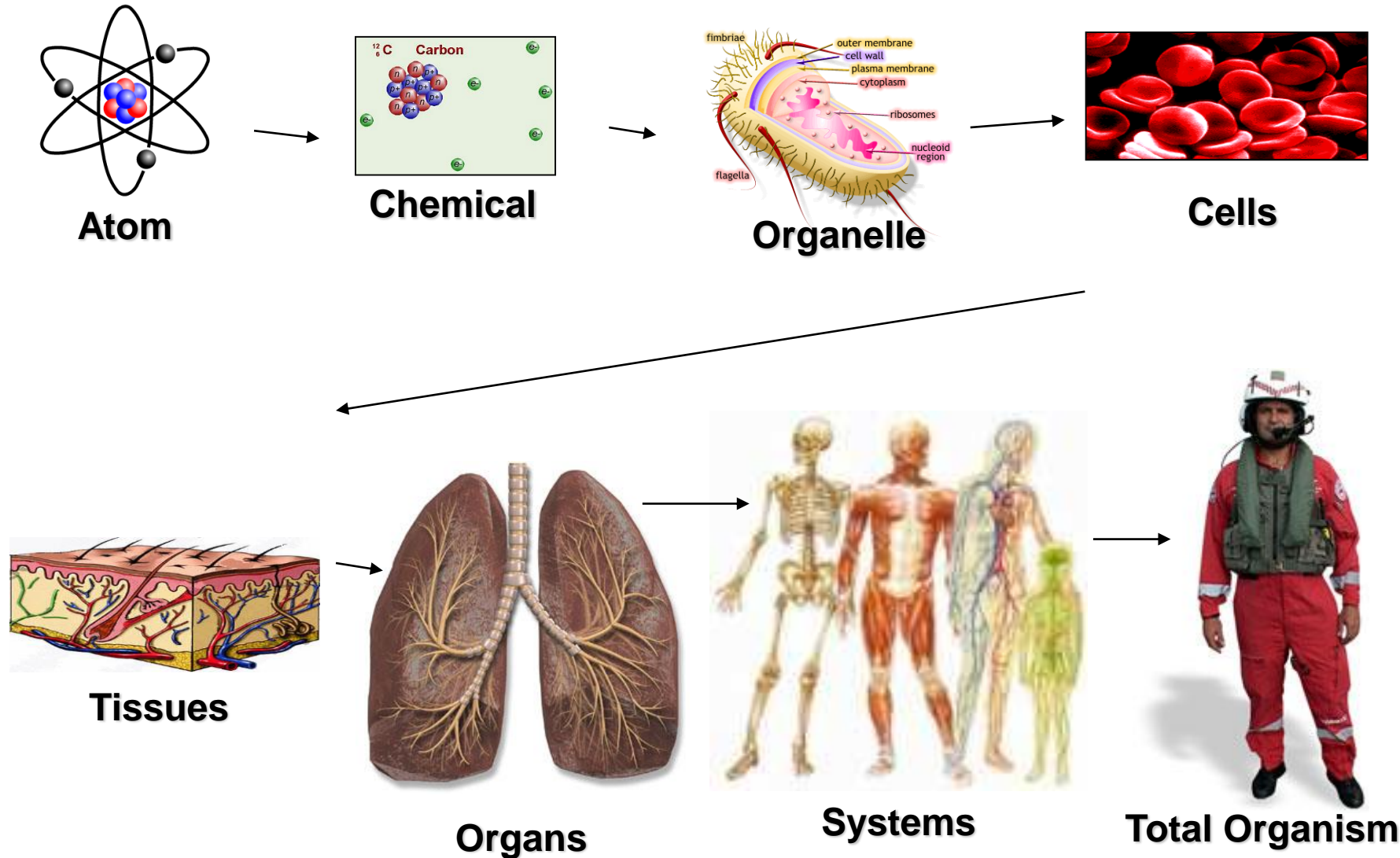
- Each characteristic is related to the sum total of all physical and chemical reactions
  - Metabolism
    - Catabolism
      - Complex substances are broken down into simpler substances creating energy
    - Anabolism
      - Simple substances combine to form complex substance (requires energy)

- The life processes are not enough for survival
- Life also depends on the following factors:
  - Water
  - Oxygen
  - Nutrients
  - Heat
  - Pressure

- Water
  - 60% of body weight
  - Transport of substances
  - Medium for chemical reaction
  - Regulates body temperature
- Oxygen
  - Needed for metabolic reactions

- Nutrients
  - Supply chemicals for energy
  - Raw material for new tissue growth, replacement and repair
- Heat
  - Needed for metabolic reactions to occur at an appropriate rate
- Pressure
  - Allows for exchange of gases and for circulation (BP)

# Levels of Organization





**Endocrine**

Regulation of body processes through hormone production



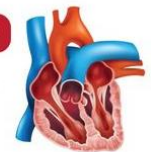
**Nervous**

Processing center for sensory input, using the input to elicit appropriate responses



**Respiratory**

Gas exchange between the internal and external environment



**Cardiovascular**

Circulation of blood, which transports gases, nutrients, hormones, and wastes



**Digestive**

Physical and chemical breakdown of food to allow absorption of nutrients



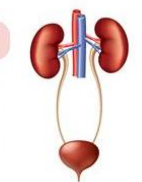
**Lymphatic**

Circulation of lymph, which maintains fluid balance and helps fight infection



**Reproductive**

Production of reproductive cells that will generate offspring



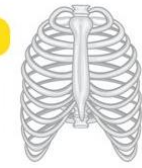
**Urinary**

Filtration of blood and excretion of wastes from the body



**Integumentary**

Protection against the external environment and regulation of temperature



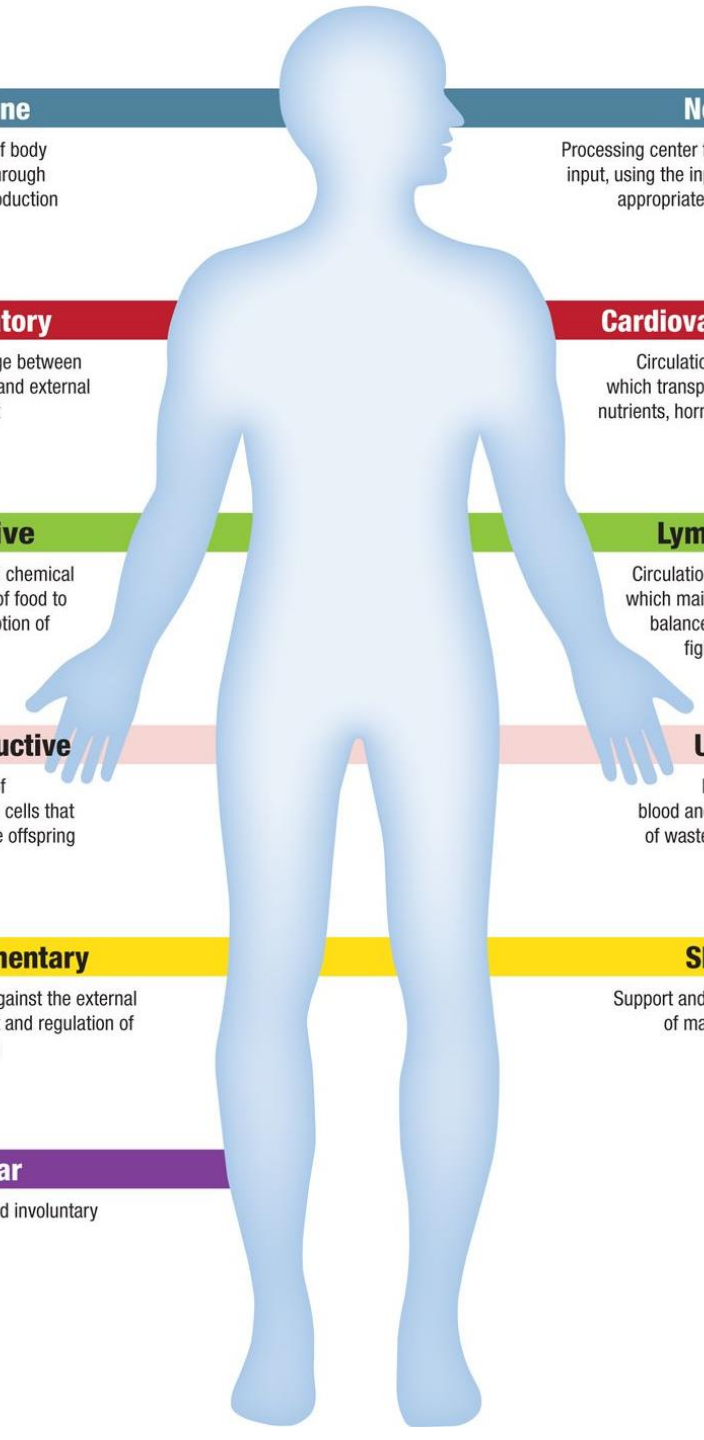
**Skeletal**

Support and protection of many internal organs



**Muscular**

Voluntary and involuntary movement



# Interaction of Structure and Function

- A relationship of structure and function is an important and unifying concept in the study of anatomy and physiology
- Anatomical structures often seem “designed” to perform specific functions because of their unique size, shape, form, or body location
- Understanding the interaction of structure and function assists in integration of otherwise isolated factual information

- Structure and function of body undergo changes over the early years (developmental processes) and late years (aging processes)
- Body functions are less efficient during infancy (development) and old age (decline)



- Young adulthood is period of greatest homeostatic efficiency
- Atrophy: term to describe the wasting effects of advancing age

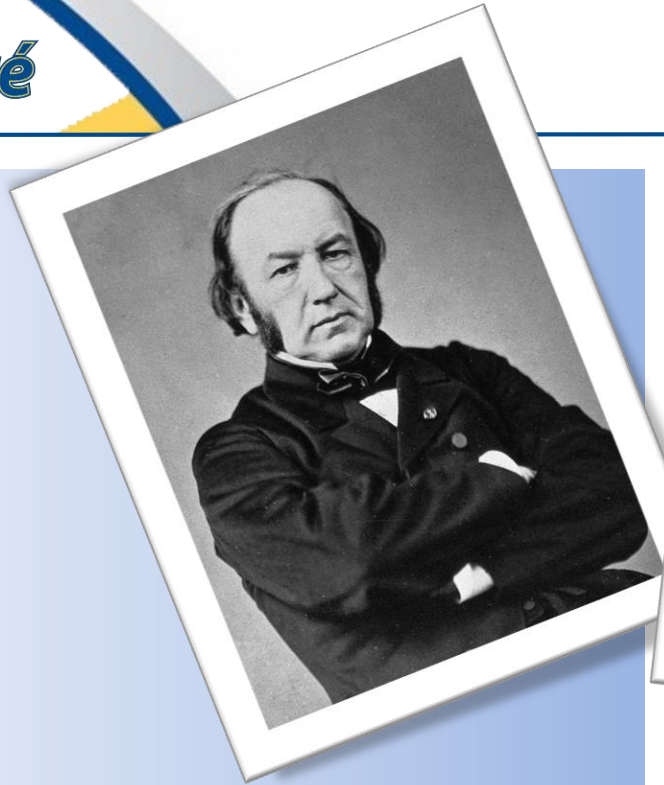
Introduction to the Human Body

# HOMEOSTASIS

- What is it?
- Why do we have it?
- What makes it happen?

# Homeostasis

Claude Bernard  
(1813 – 1878)



- **Milieu interieur** (the internal environment)
- Believed 3 relative constants of fluid environment were required to maintain healthy cells
  - Temperature
  - Pressure
  - Chemical composition



Walter B Cannon  
(1871 - 1945)

## Homeostasis

Greek meaning 'homoios' (the same) and 'stasis' (always or staying)

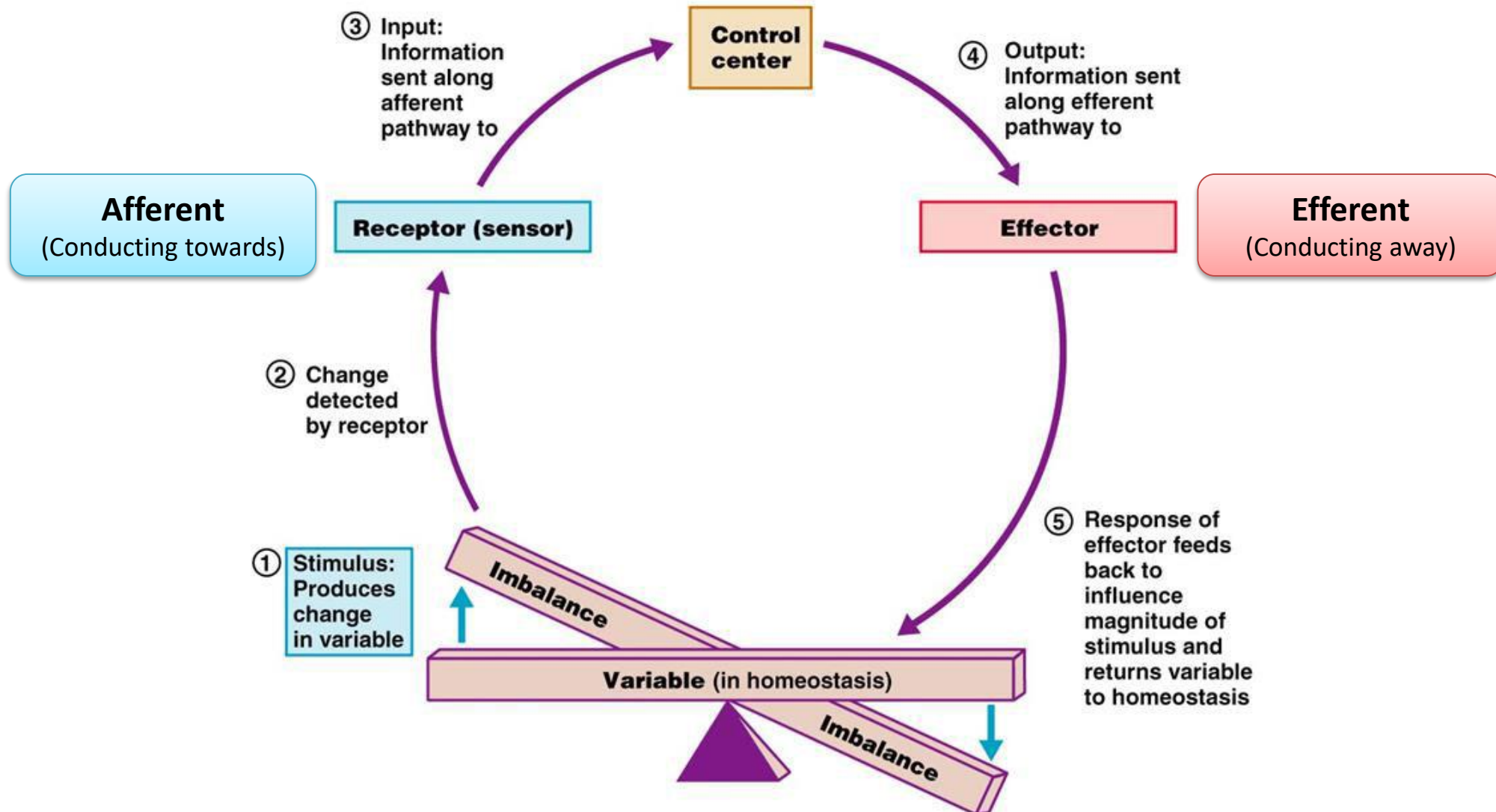
- Suggested that every regulatory mechanism of the body exists to maintain homeostasis
- Qualified that these factors did not remain fixed and immobile but rather relatively constant
- Examples:
  - Temperature, blood glucose, BP, electrolyte balances and blood gas levels

- The body's constant internal environment that must be maintained.
  - Internal environment must remain constant regardless of the external environment
  - If conditions in the cell change, mechanisms respond to try to restore conditions to normal
  - If unsuccessful, cells die leading to illness and eventually death

- Mechanisms or Processes for maintaining homeostasis
  - May involve all of the internal organs and systems
- Any condition that disrupts homeostasis is a “stressor”
- Feedback Control Loops
  - Help accomplish this self regulation

- Devices for maintaining or restoring homeostasis by self-regulation through feedback control loops
- Basic components of control mechanisms
  - Sensor mechanism
  - Integrating, or control, center
  - Effector mechanism
  - Feedback

# Homeostatic Control Mechanisms

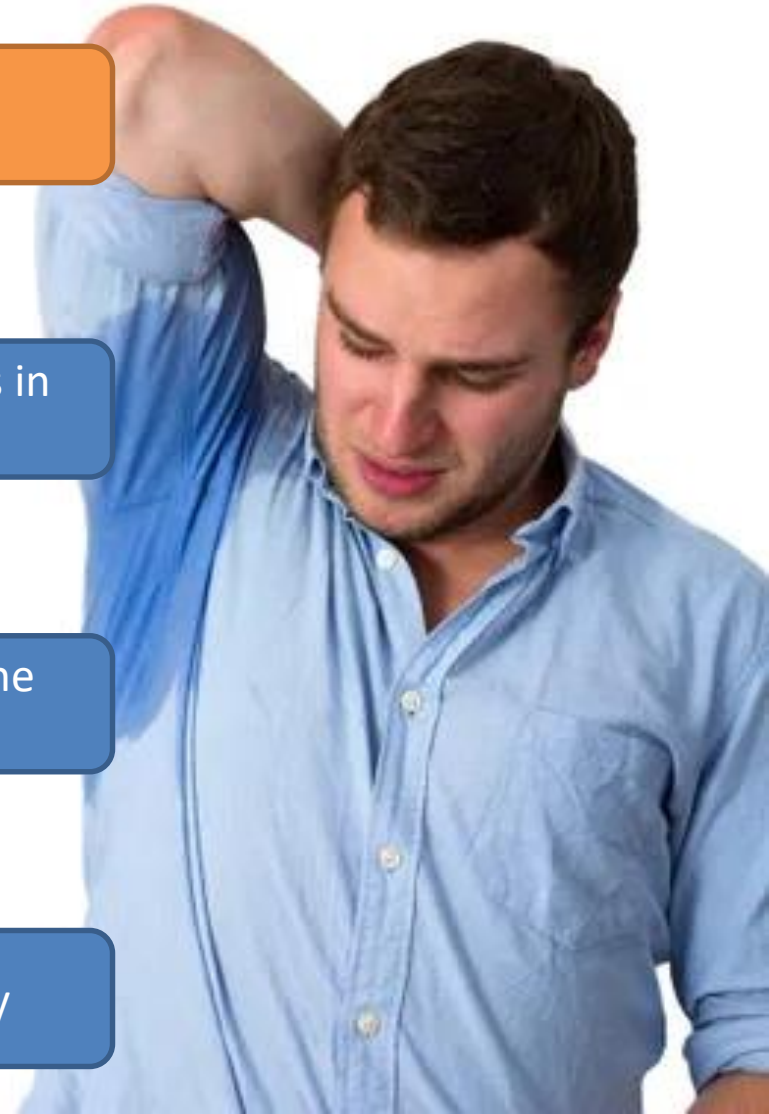
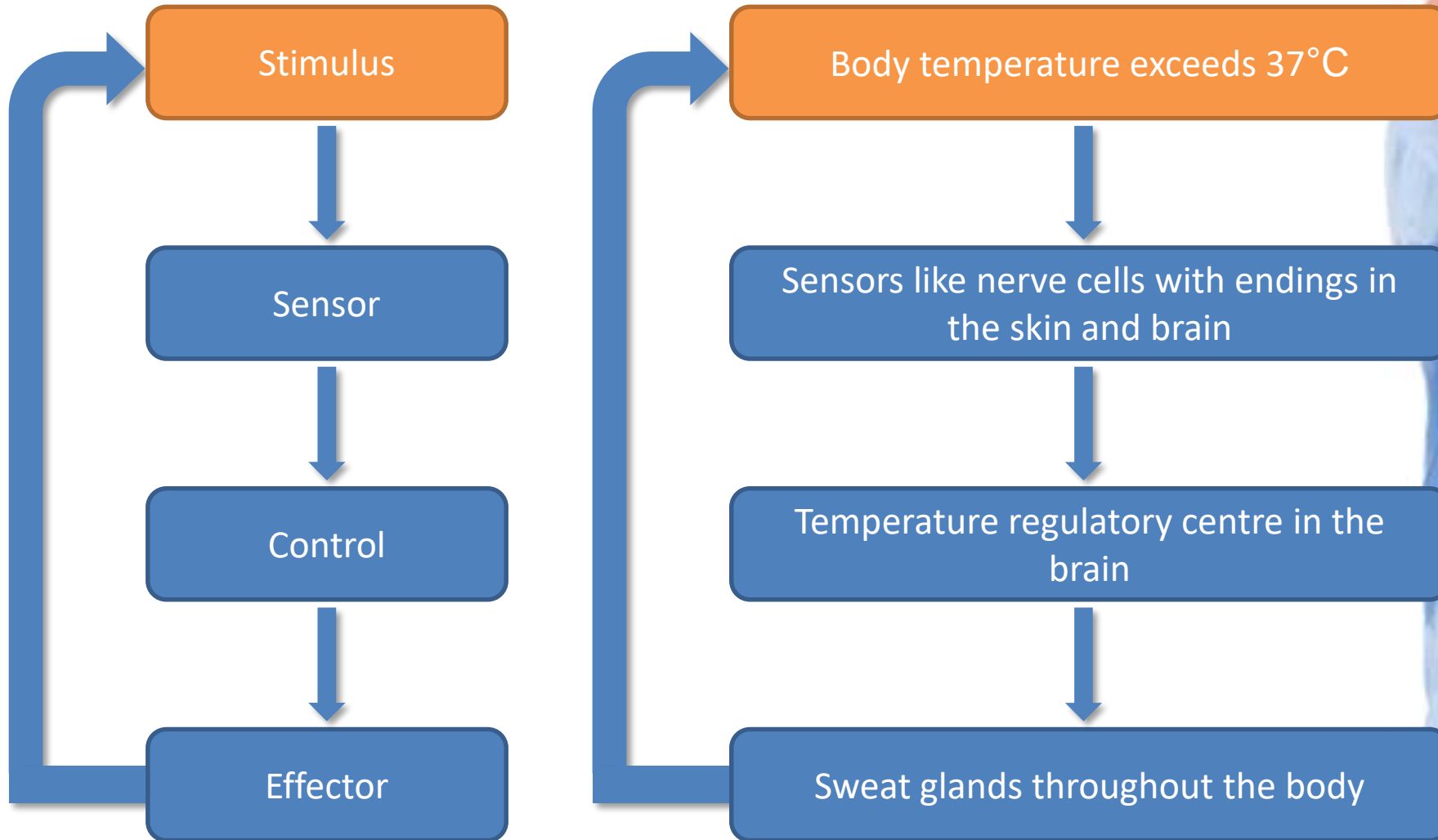




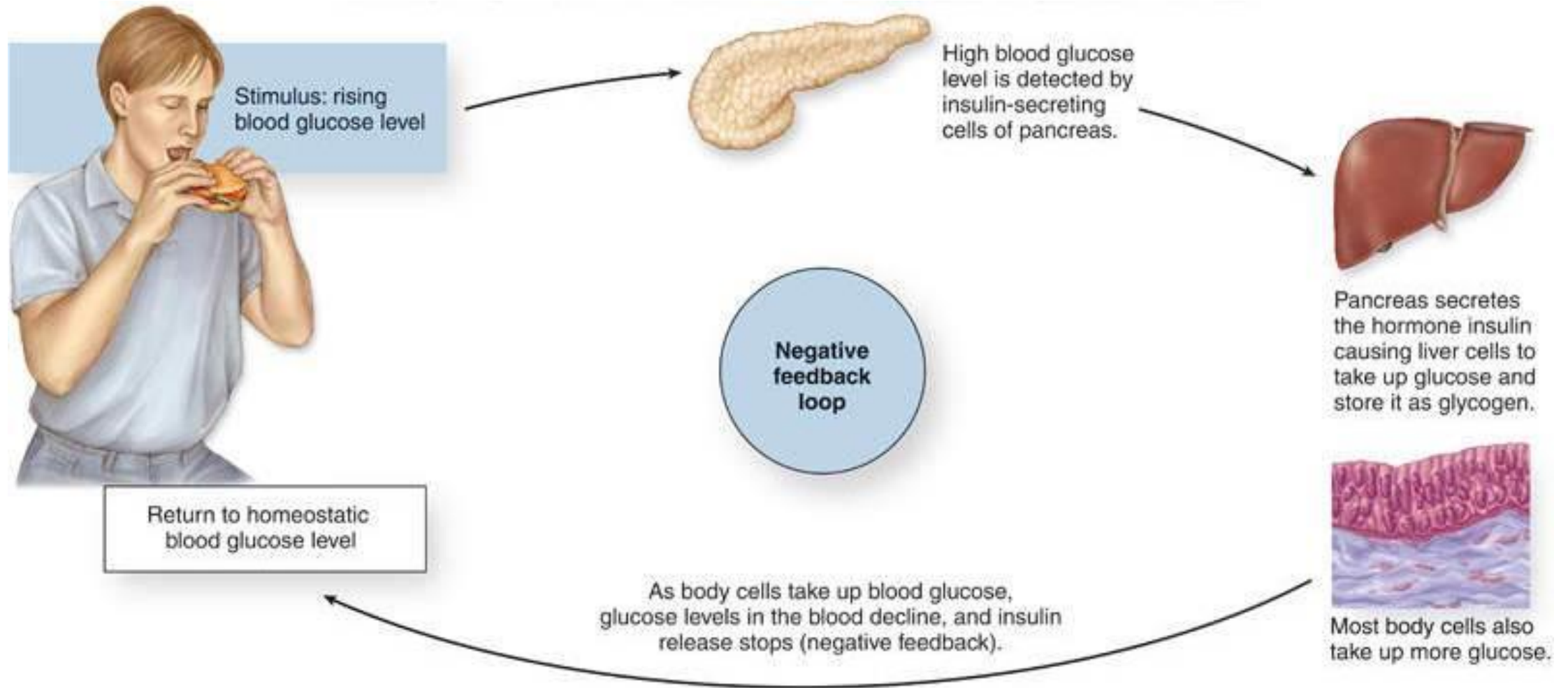
- Inhibitory
- Oppose change by creating an opposite response
- Utilizing another function to balance the internal environment
- Stabilize physiological variables
- Are much more common than positive feedback control systems

## Negative Feedback Examples

- Shivering to produce heat
- Sweating to release heat
- Maintenance of metabolism rates
- Blood sugar regulation
- RBC production



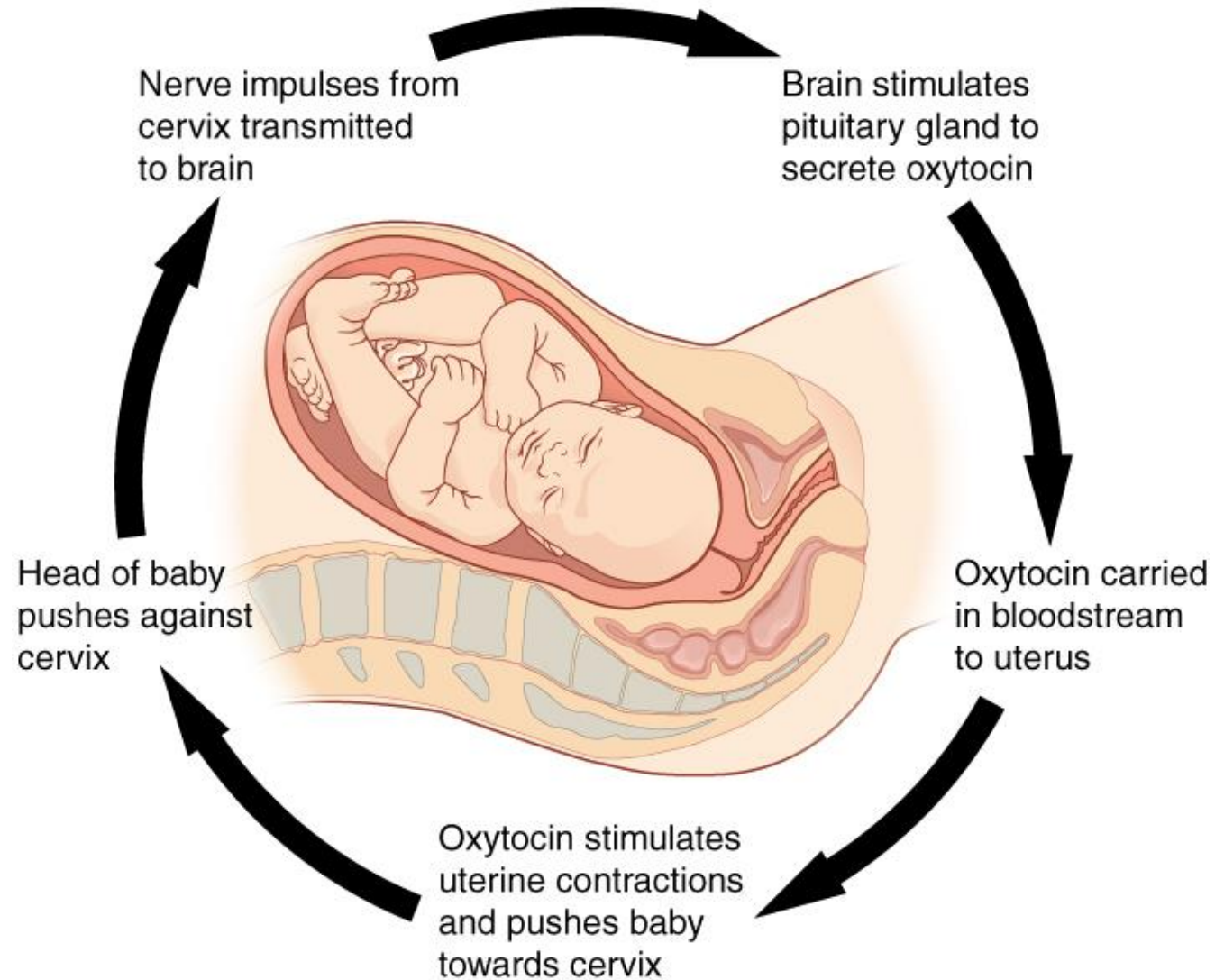
# Negative Feedback



- Stimulatory
- Destabilizing effects can be harmful and disrupt homeostasis
- Brings fast completion of specific body function
- Amplifies/accelerates or Reinforces the response

## Positive Feedback Examples

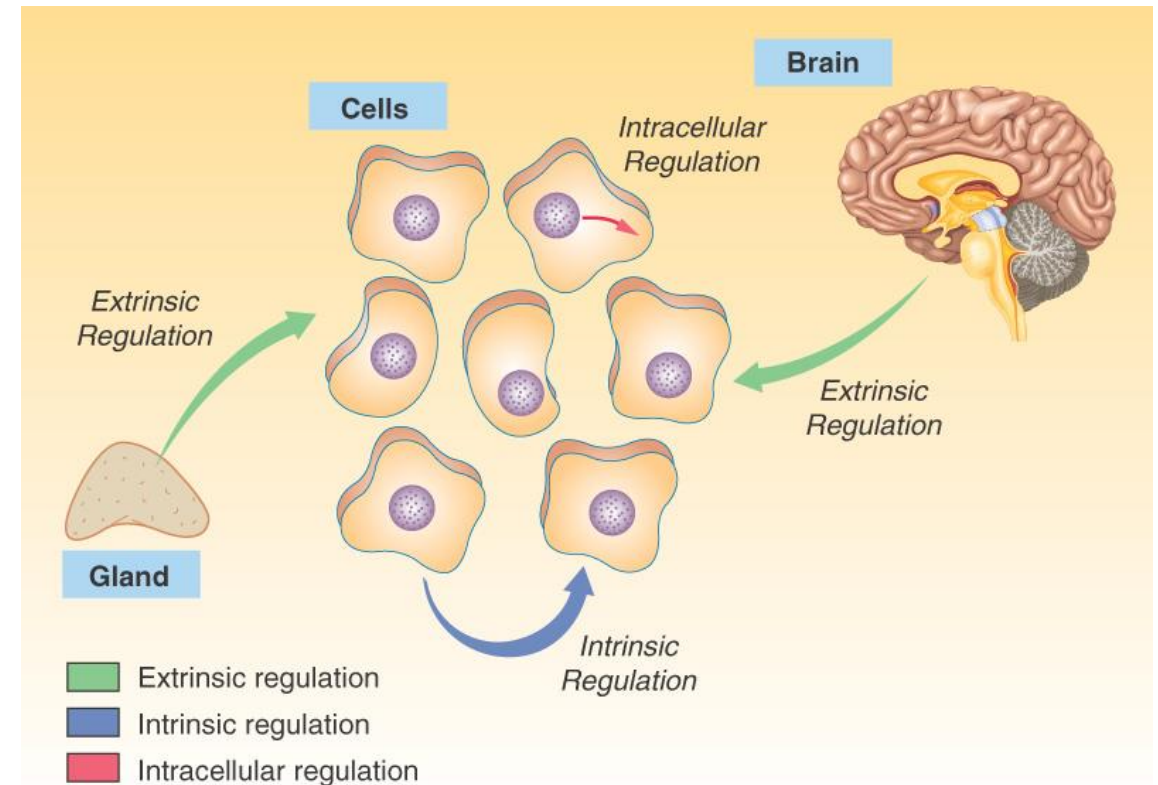
- Increasing uterine contractions by release of oxytocin
- Lactation during suckling
- Platelets release chemicals to stimulate more platelets



- Feed-forward
  - Information flows ahead to another process or feedback loop to trigger a change in anticipation of an event that will follow (food entering the stomach)

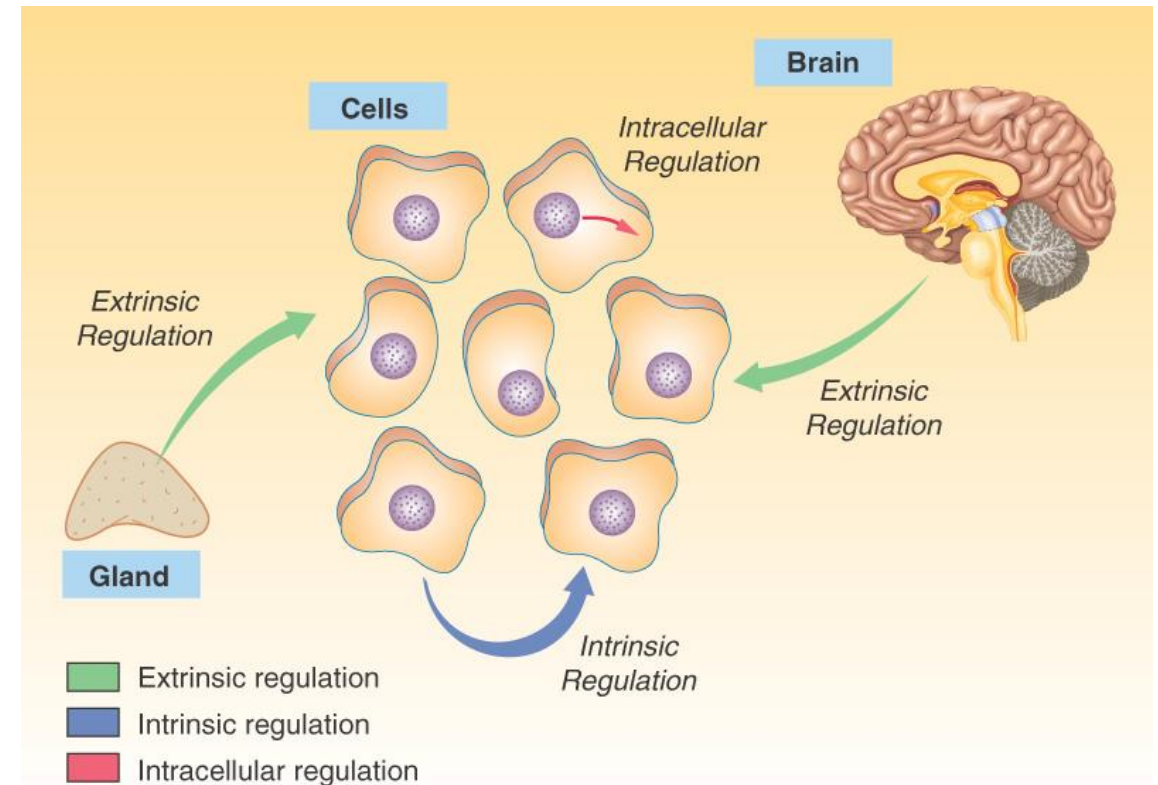
# Homeostatic Control Mechanisms

- Levels of control
  - Intracellular control
    - Regulation within cells
    - Genes or enzymes can regulate cell processes



# Homeostatic Control Mechanisms

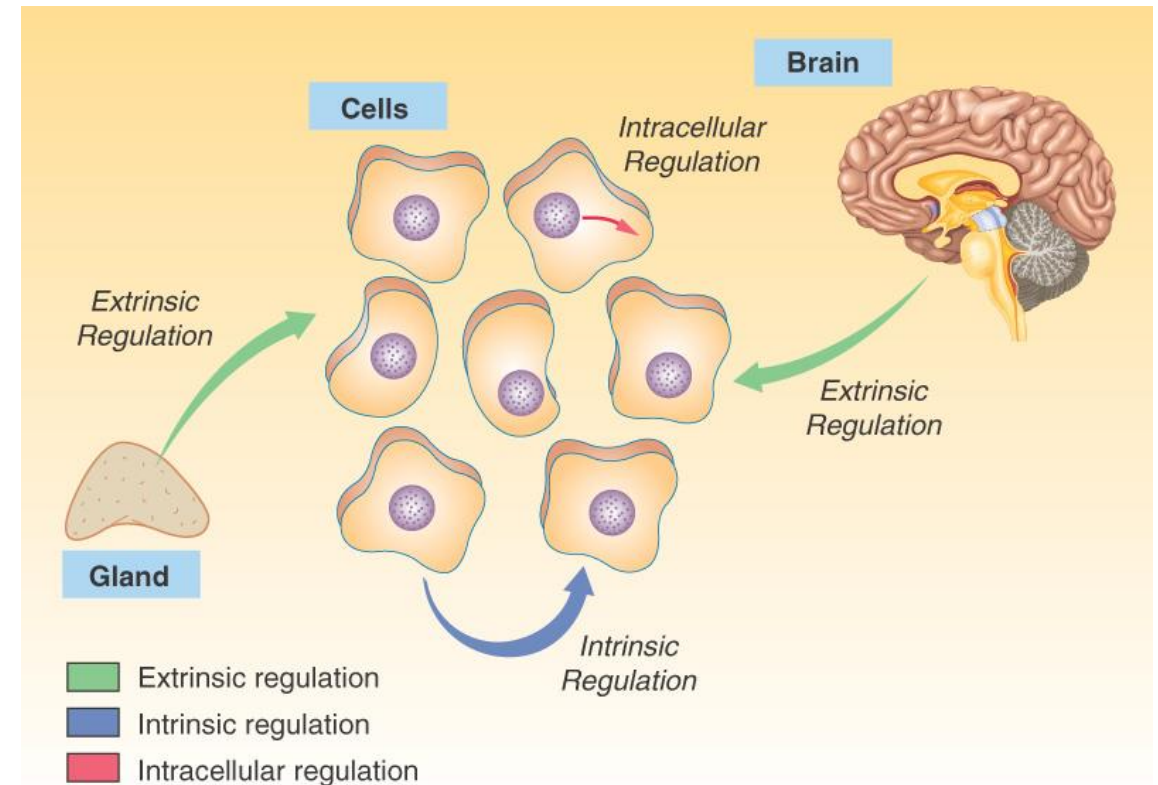
- Levels of control
  - Intrinsic control (autoregulation)
    - Regulation within tissues or organs
    - May involve chemical signals
    - May involve other “built-in” mechanisms





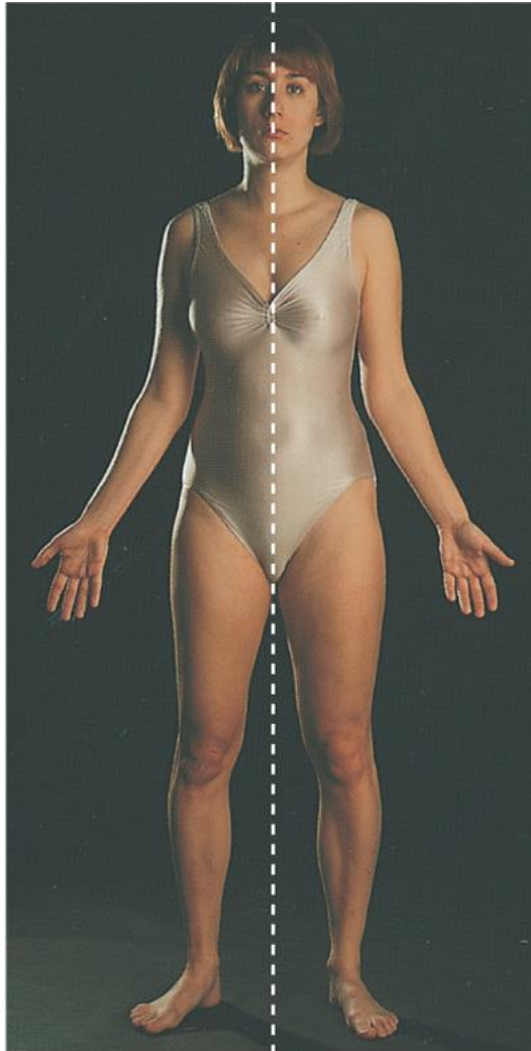
# Homeostatic Control Mechanisms

- Levels of control
  - Extrinsic control
    - Regulation from organ to organ
    - May involve nerve signals
    - May involve endocrine signals (hormones)



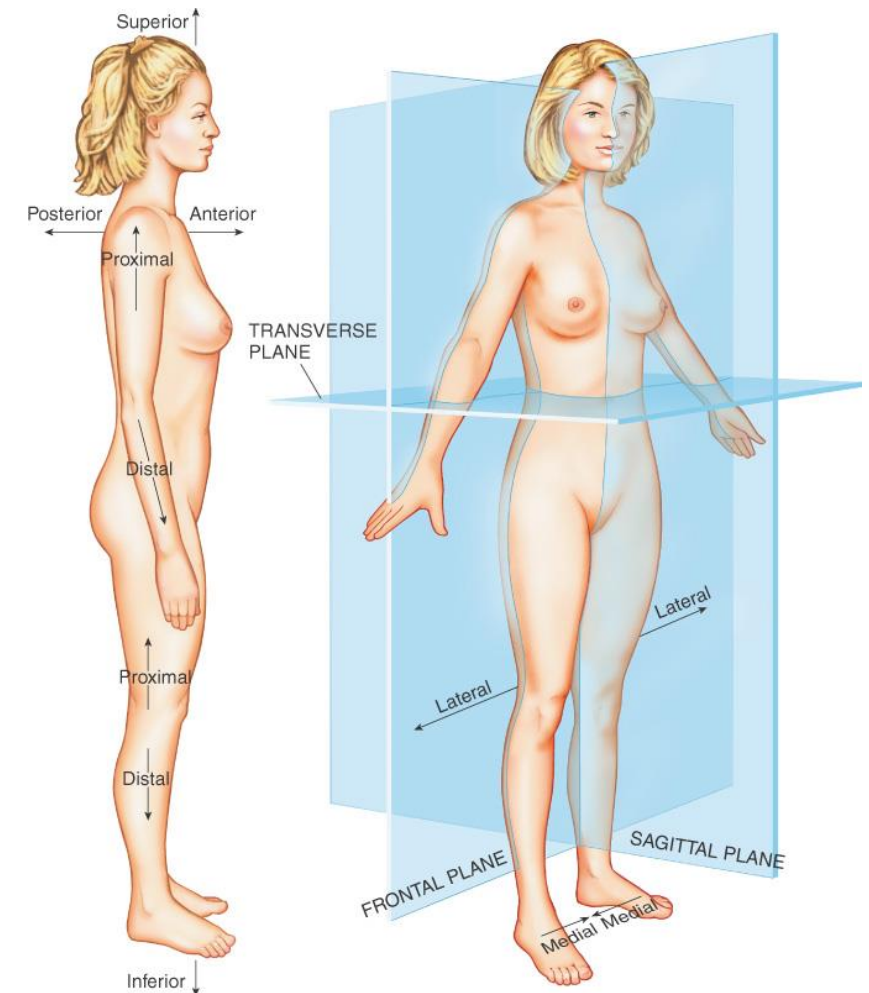
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# **ANATOMICAL TERMINOLOGY**

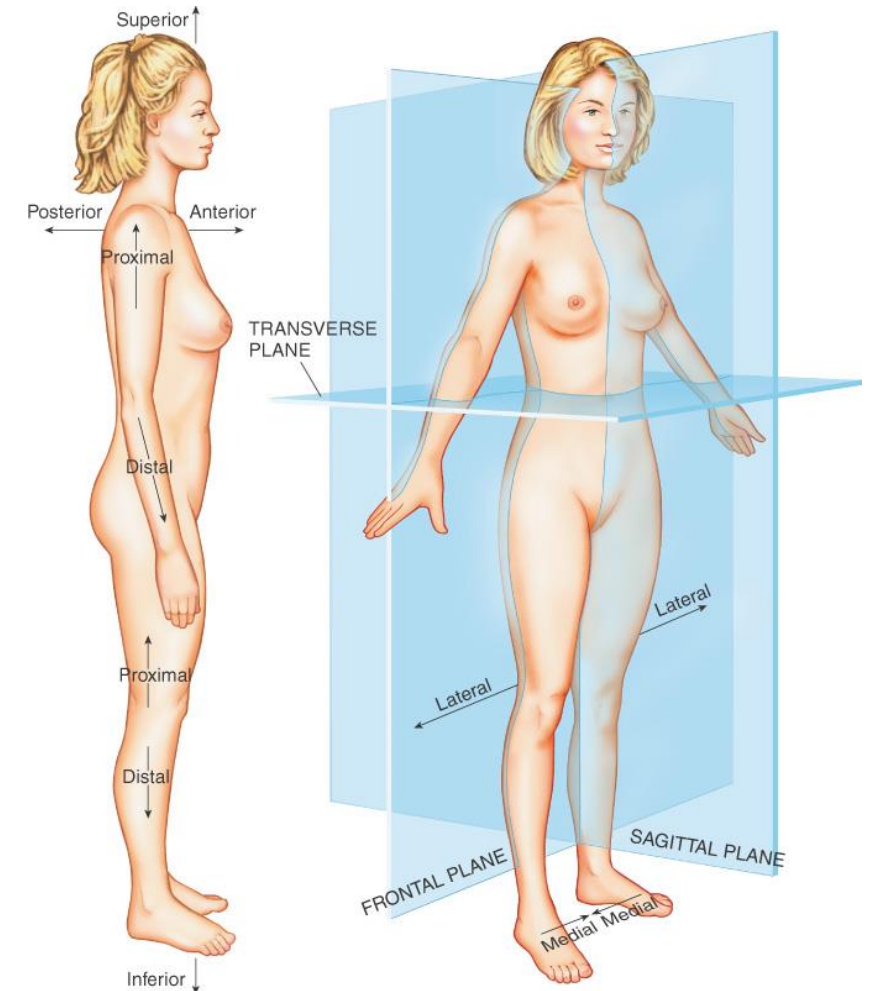


- Reference position
  - Body erect with arms at sides and palms forward
  - Head and feet pointing forward
- Bilateral symmetry
  - Confers balanced proportions
  - Ipsilateral structures are on the same side of the body in anatomical position
  - Contralateral structures are on opposite sides of the body in anatomical position

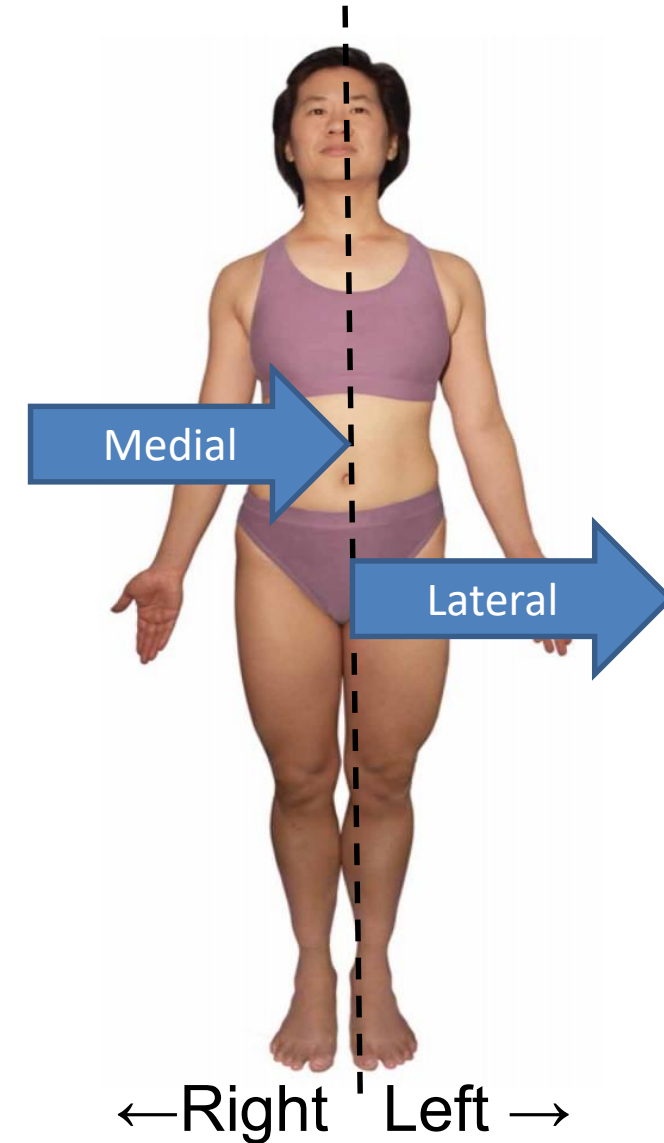
- Planes are lines of orientation along which cuts or sections can be made to divide the body, or a body part, into smaller pieces



- Sagittal plane
  - Divides the body into left and right
    - Midsagittal (Midline)
      - Equal halves
    - Parasagittal
- Transverse (horizontal plane)
  - Divides the body into top and bottom
- Frontal (coronal plane)
  - Divides the body into front and back



- Positional sides are referenced based on the patient and not the clinician (Pt's right or left)
- Medial (toward midline)
- Lateral (away from midline)

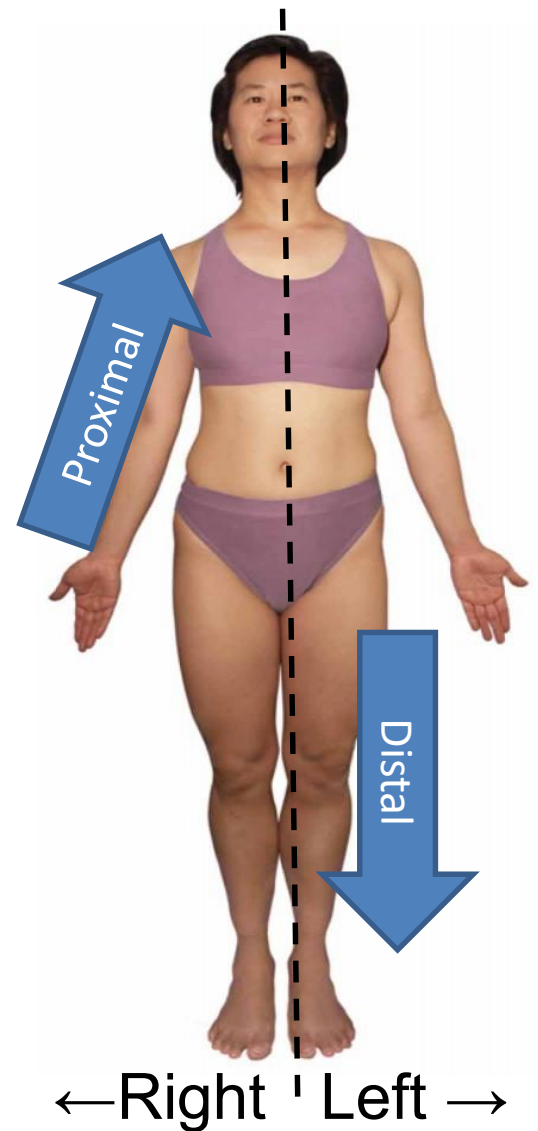


# Anatomical Directions

- Proximal
  - Closer to point of attachment
- Distal
  - Farther from point of attachment

**For example**

“Checking PMS distally to the injury.”





- Superior (Above)
  - Cephalic
    - Towards the head
- Inferior (Below)
  - Caudal
    - Towards the tail of the spine



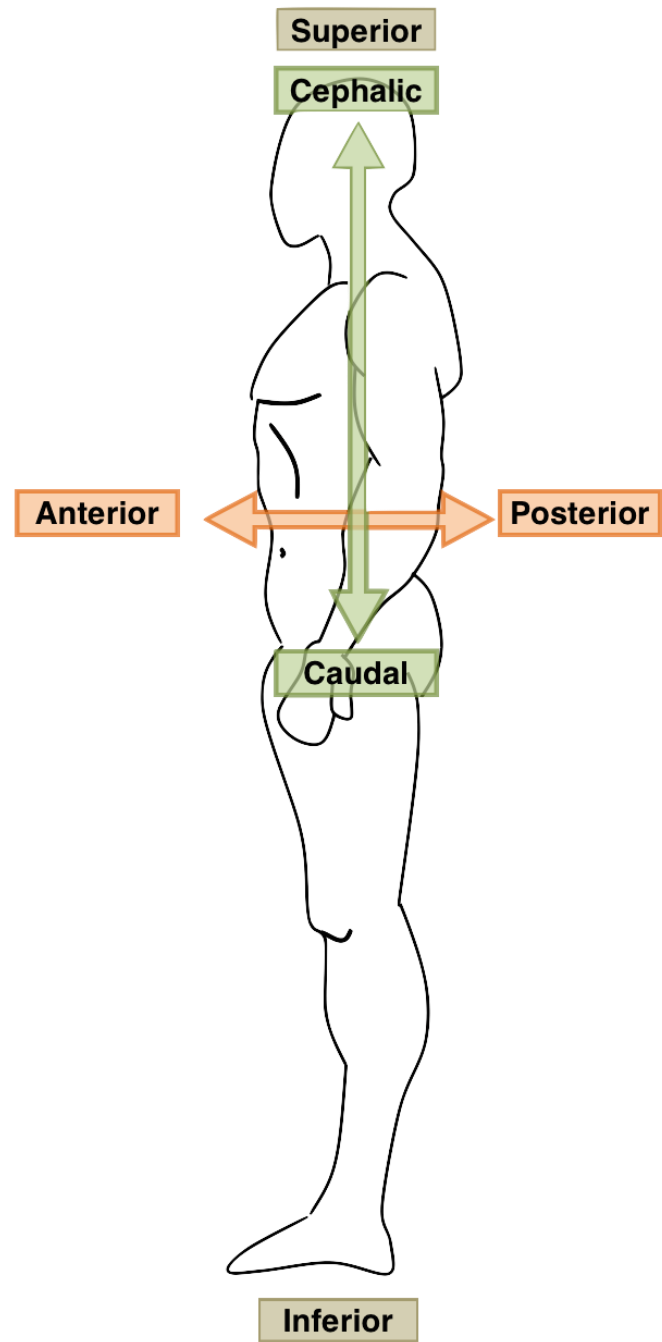
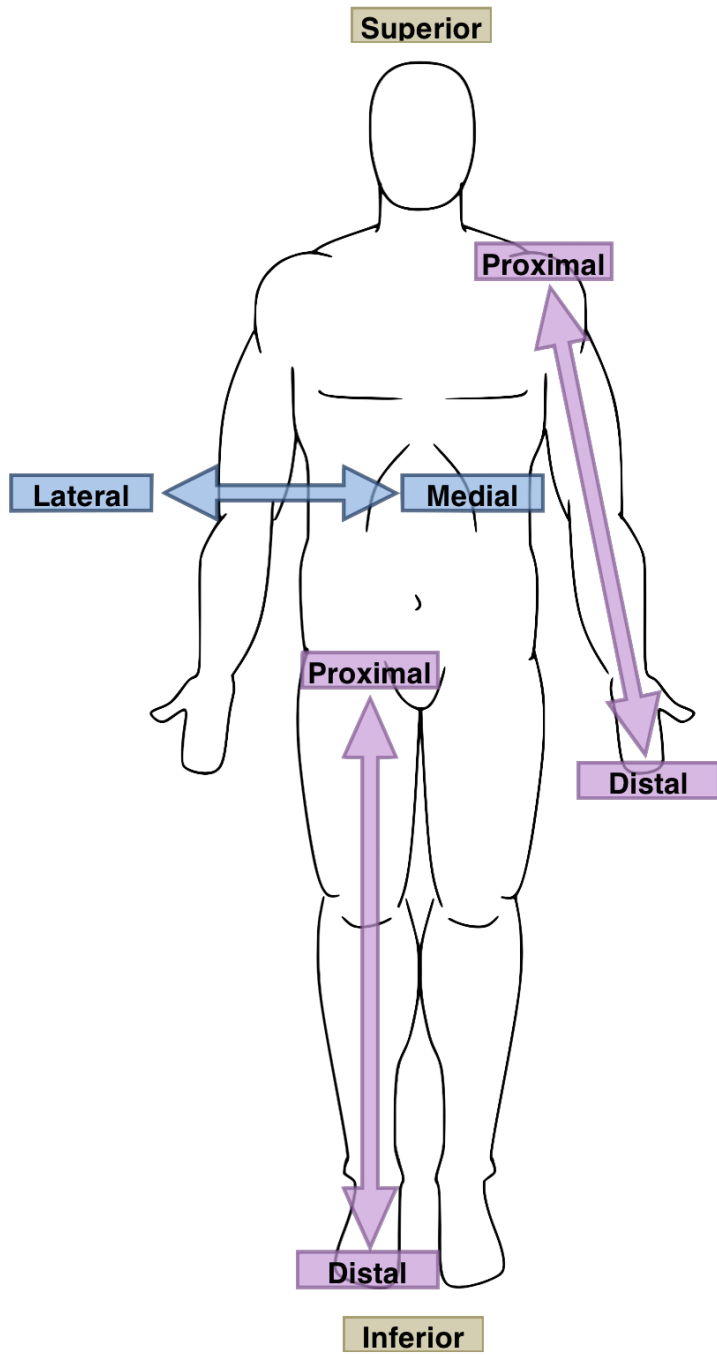
**For example**

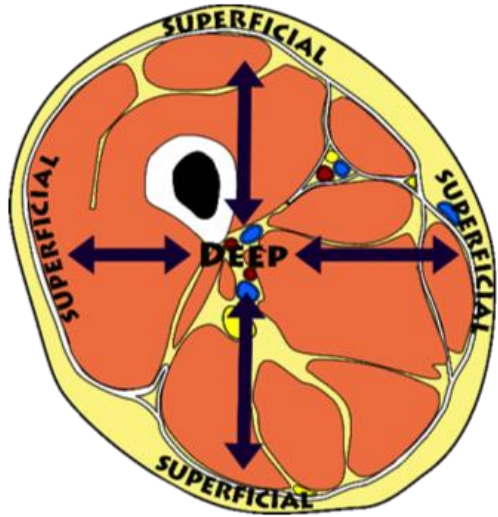
Superior vena cava  
Inferior vena cava





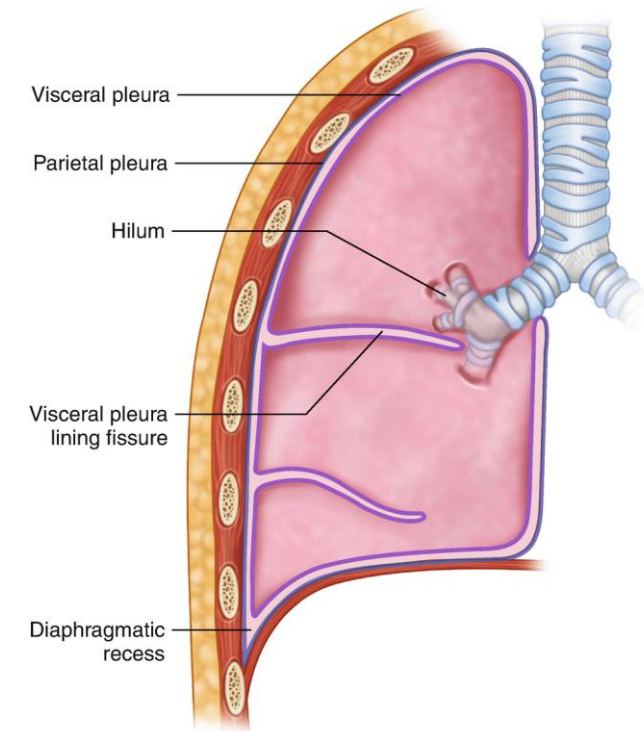
- Anterior (The front of the body)
  - Ventral
    - Pertaining to the front
- Posterior (The back of the body)
  - Dorsal
    - Pertaining to the back/top





- Superficial      Near the surface
- Deep              Into the layer

- Visceral            Inner layer (towards the viscous)
- Parietal            Outer layer (wall)





**Supine**



**Right Lateral Recumbent**

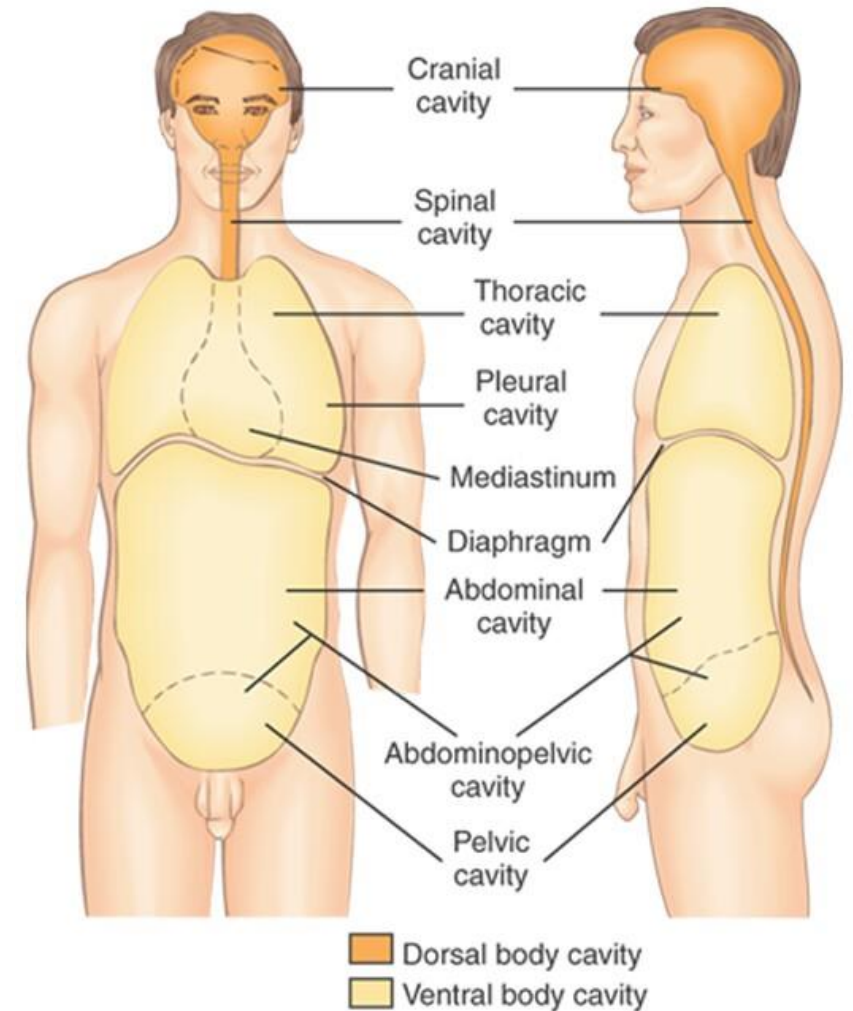


**Prone**

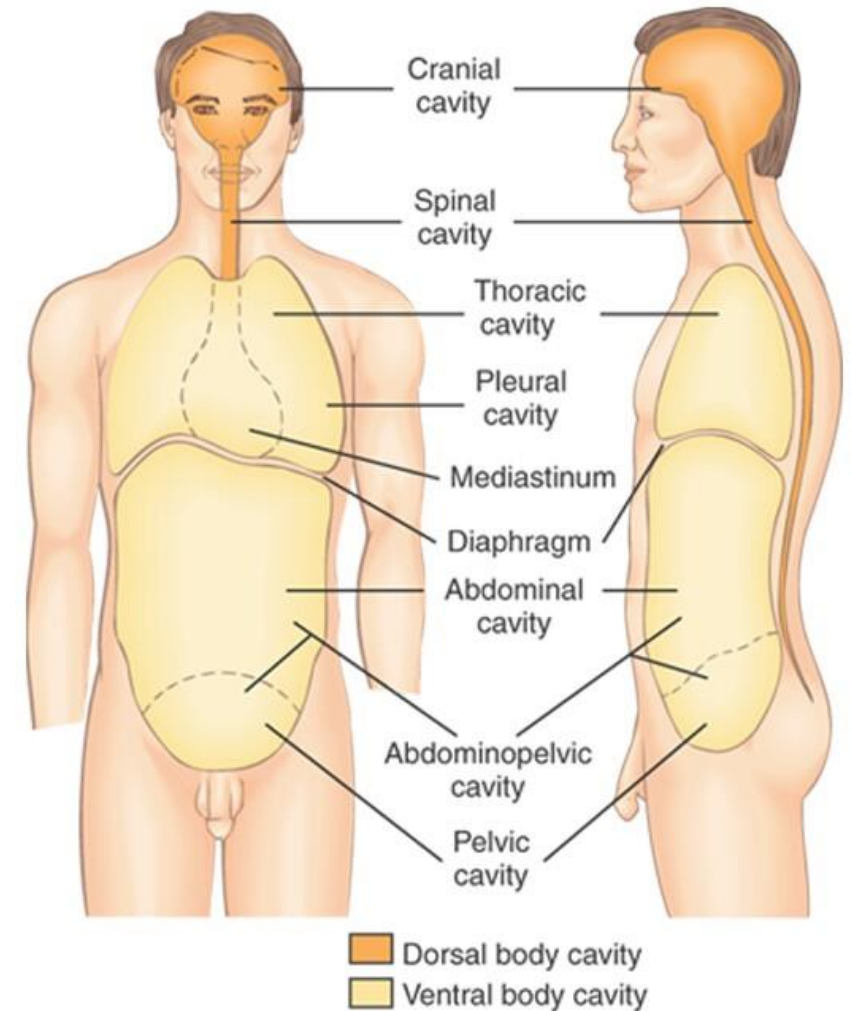


**Left Lateral Recumbent**

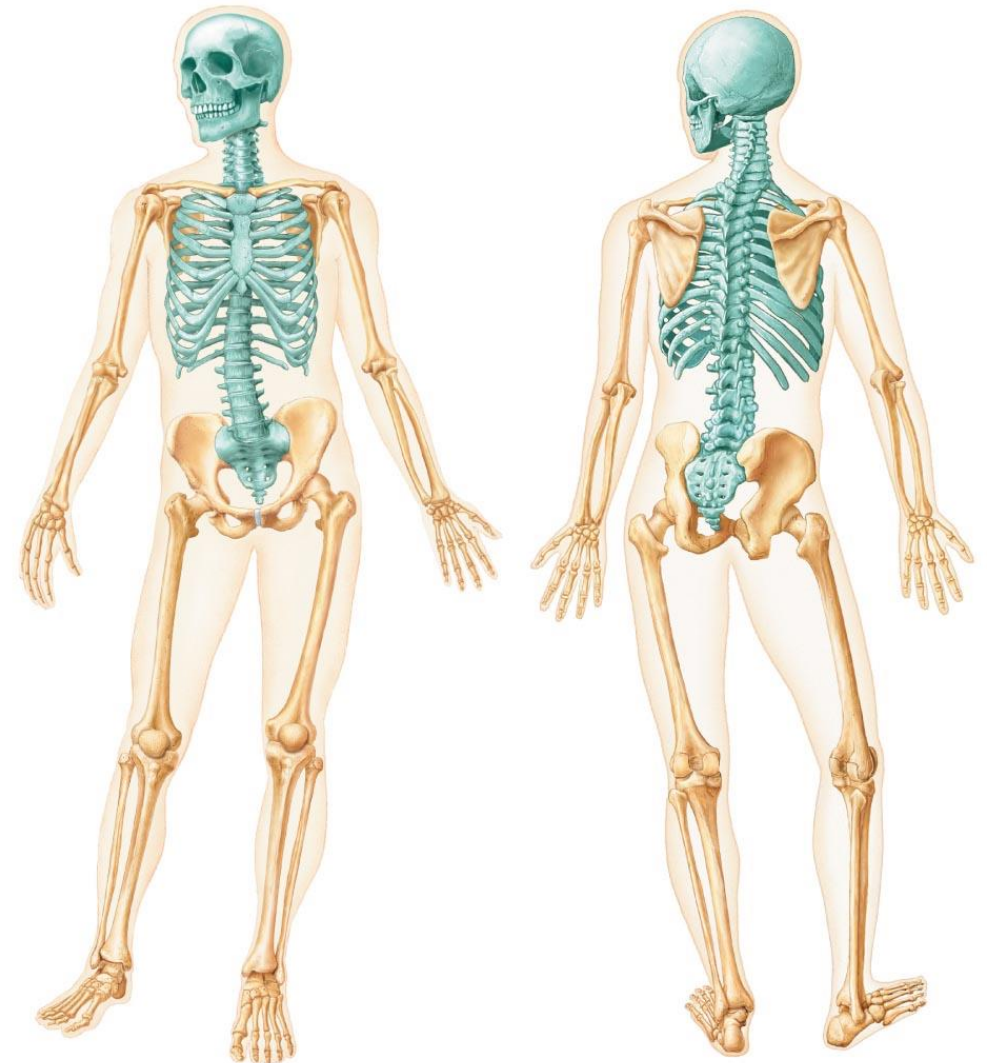
- Dorsal Cavity
  - Cranial Cavity
  - Spinal Cavity



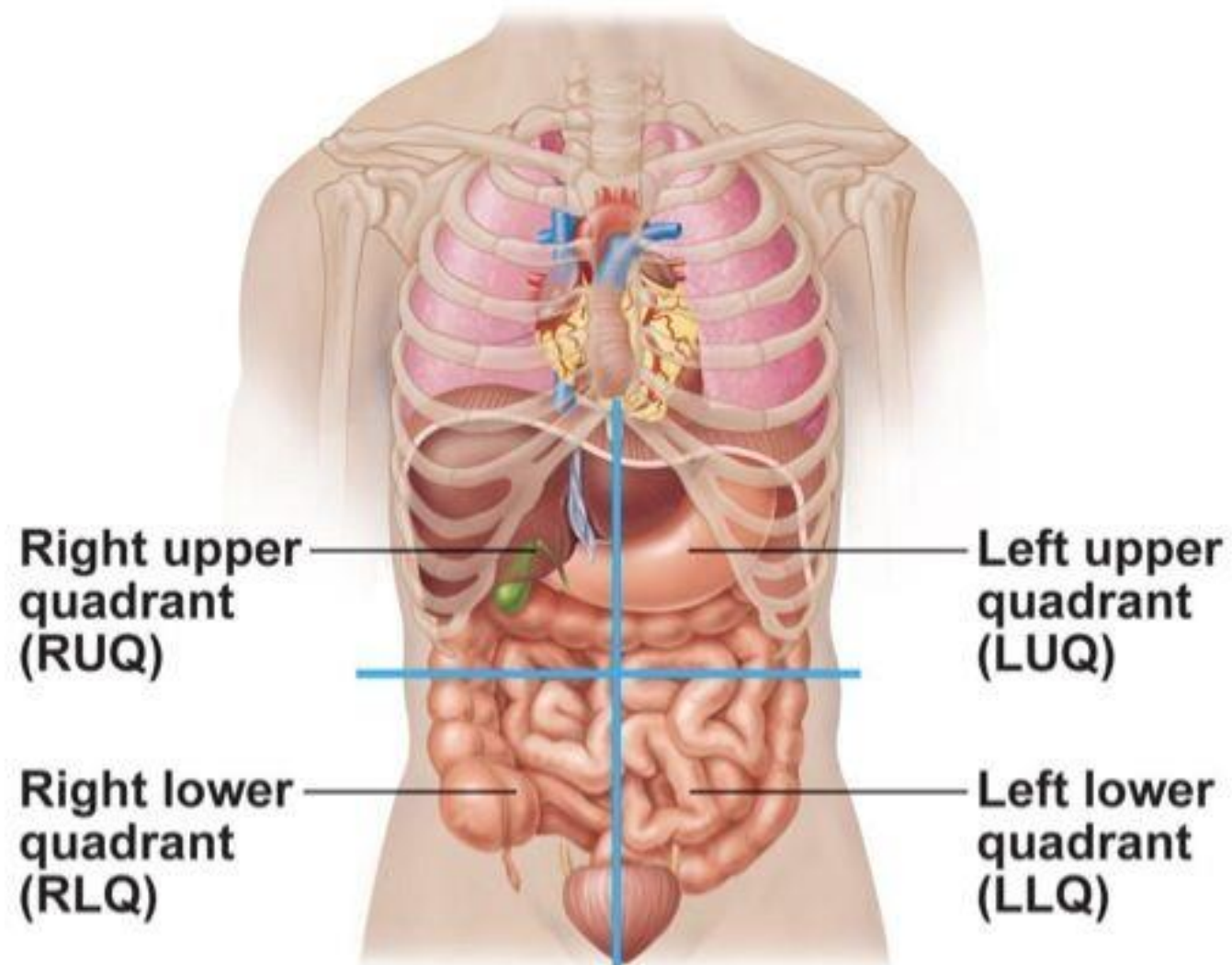
- Ventral Cavity
  - Thoracic cavity
    - Right and left pleural cavities
    - Mediastinum
  - Abdominopelvic cavity
    - Abdominal cavity
    - Pelvic cavity



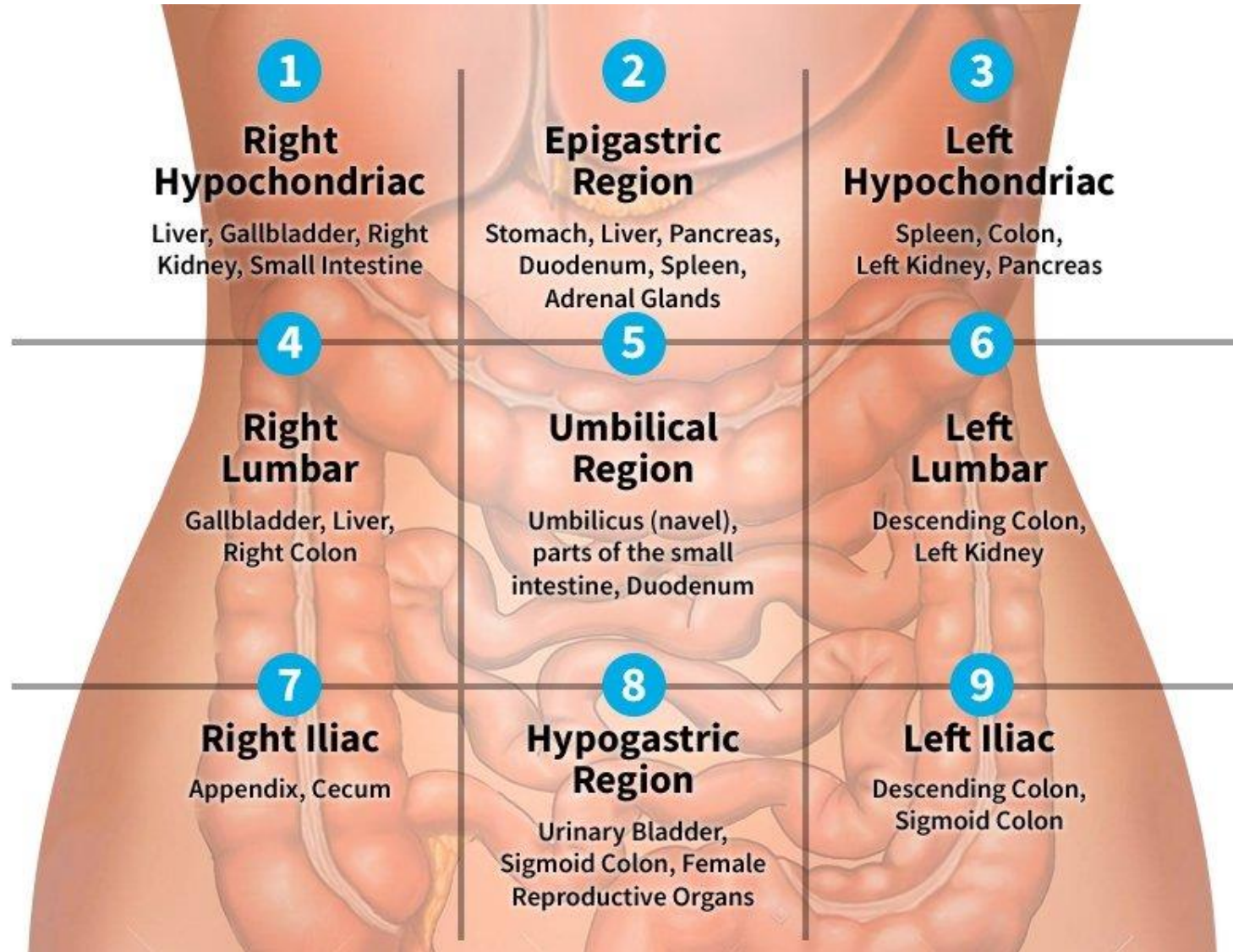
- Axial Skeleton (green)
  - Skull
  - Vertebrae
  - Sternum, ribs
  - Sacrum
- Appendicular Skeleton (tan)
  - Pectoral girdle
  - Pelvic girdle
  - Extremities



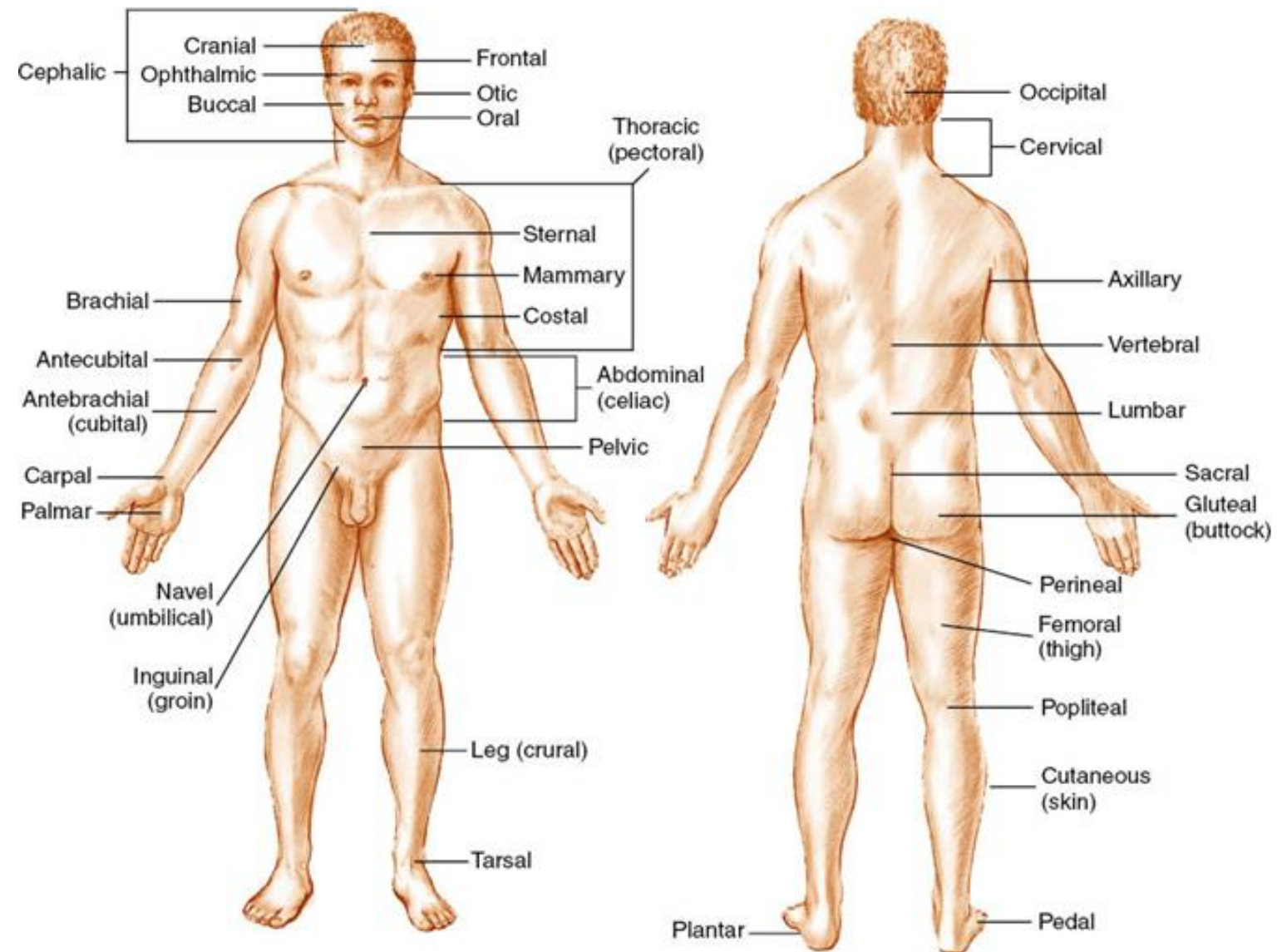
# Abdominopelvic Quadrants







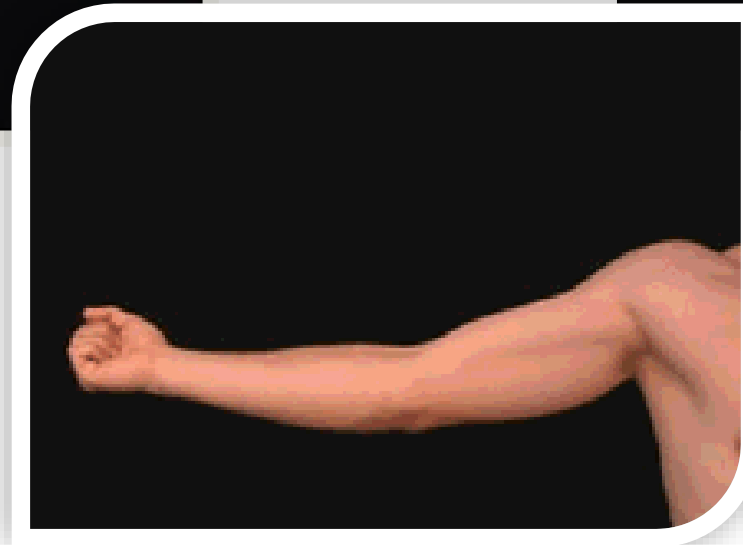
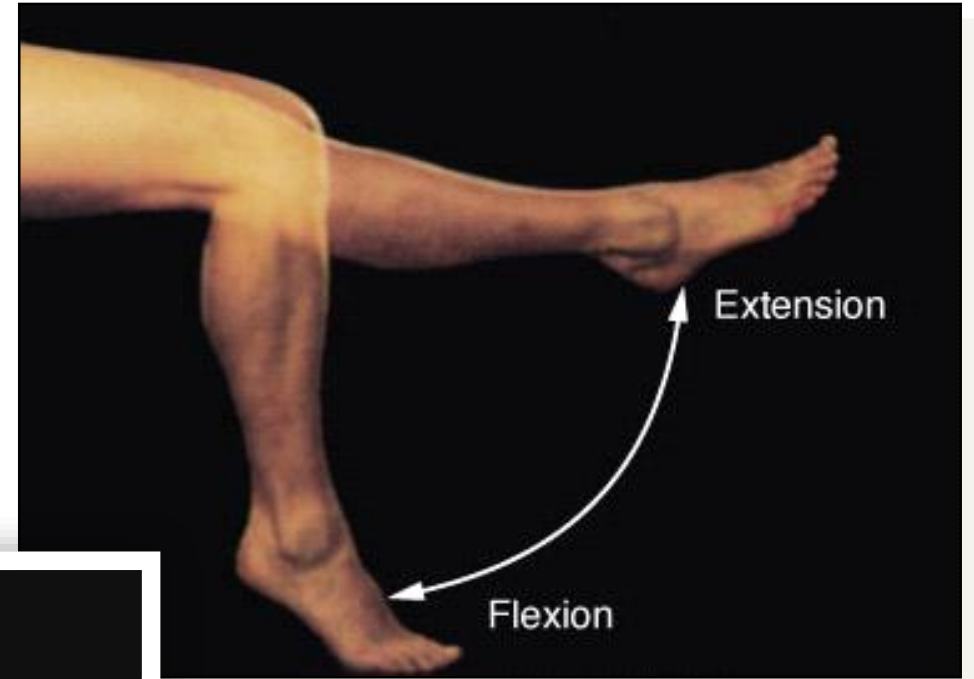
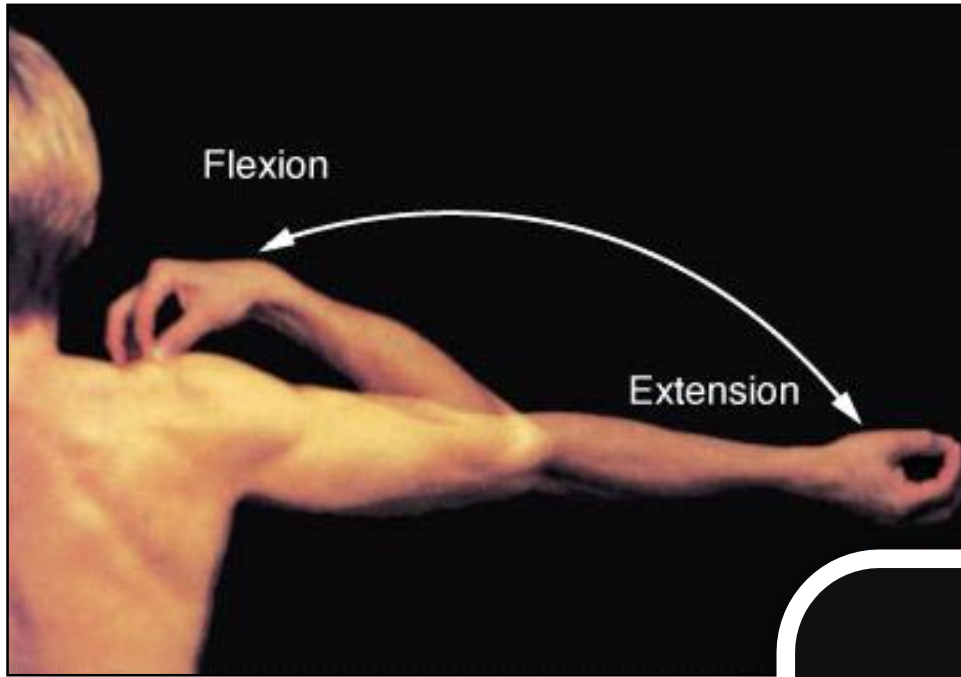
- Terms related to organs
  - Lumen (luminal)
  - Central
  - Peripheral
  - Medullary (medulla)
  - Cortical (cortex)
  - Apical (apex)
  - Basal (base)



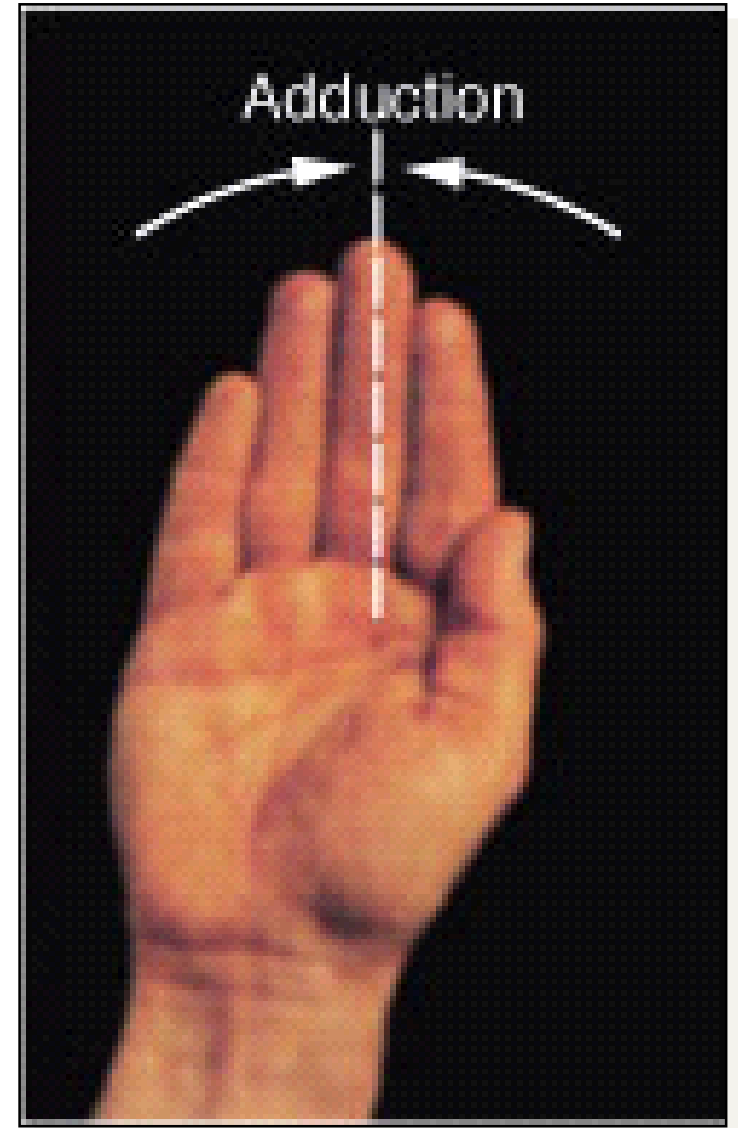
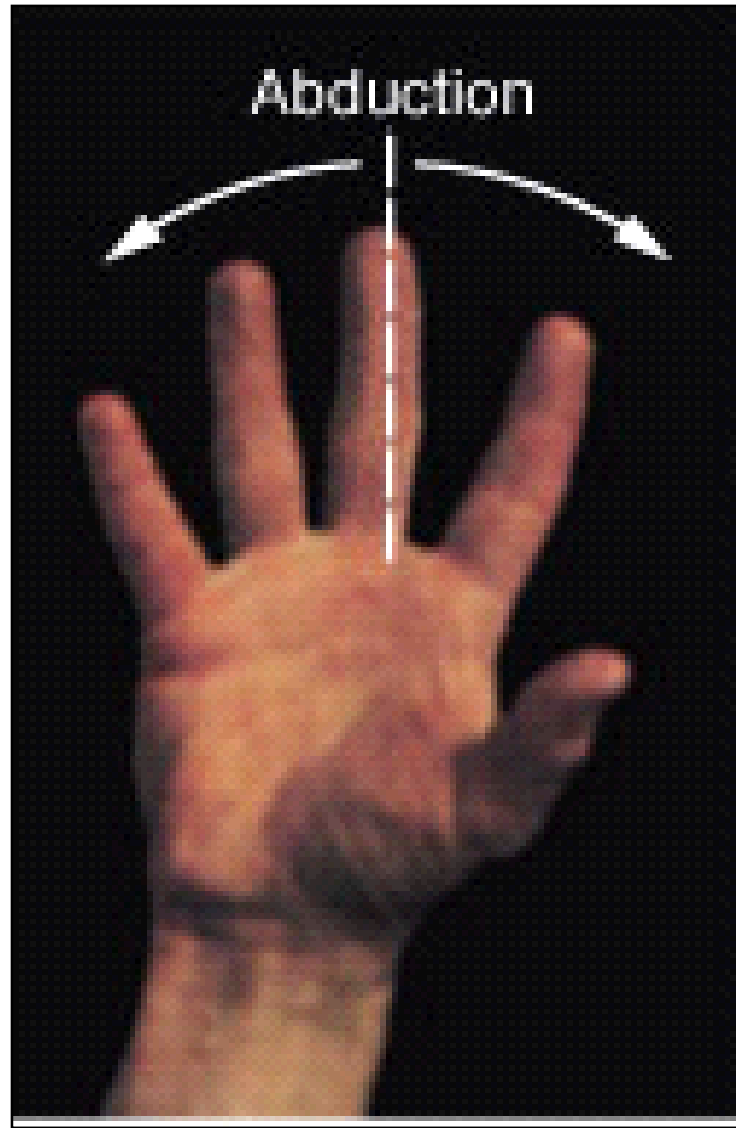
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# **TYPES OF MOVEMENT**

# Flexion and Extension

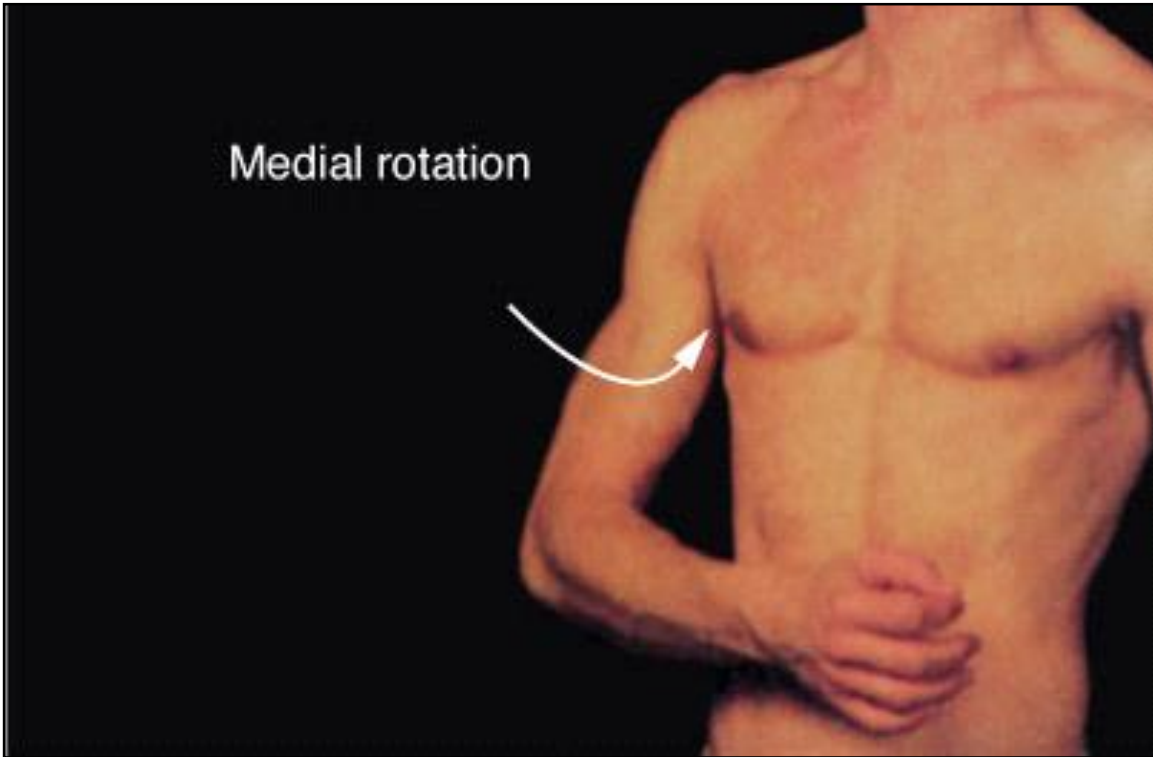


# Abduction and Adduction

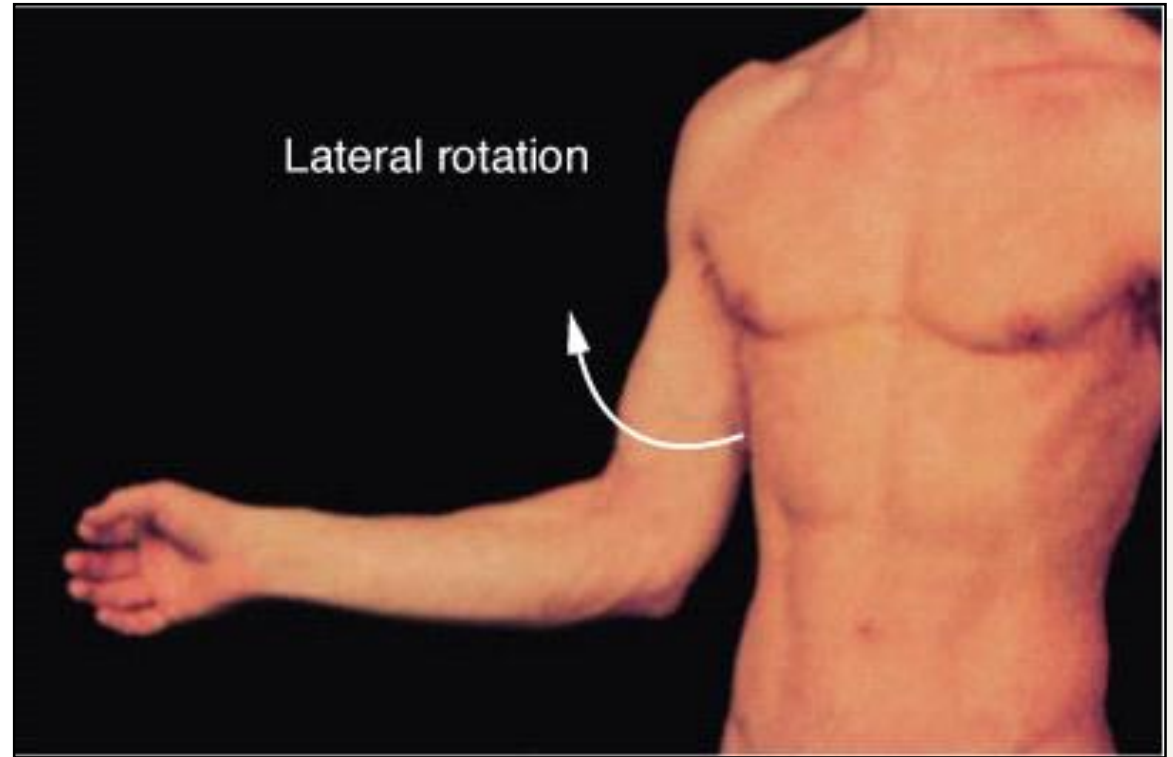


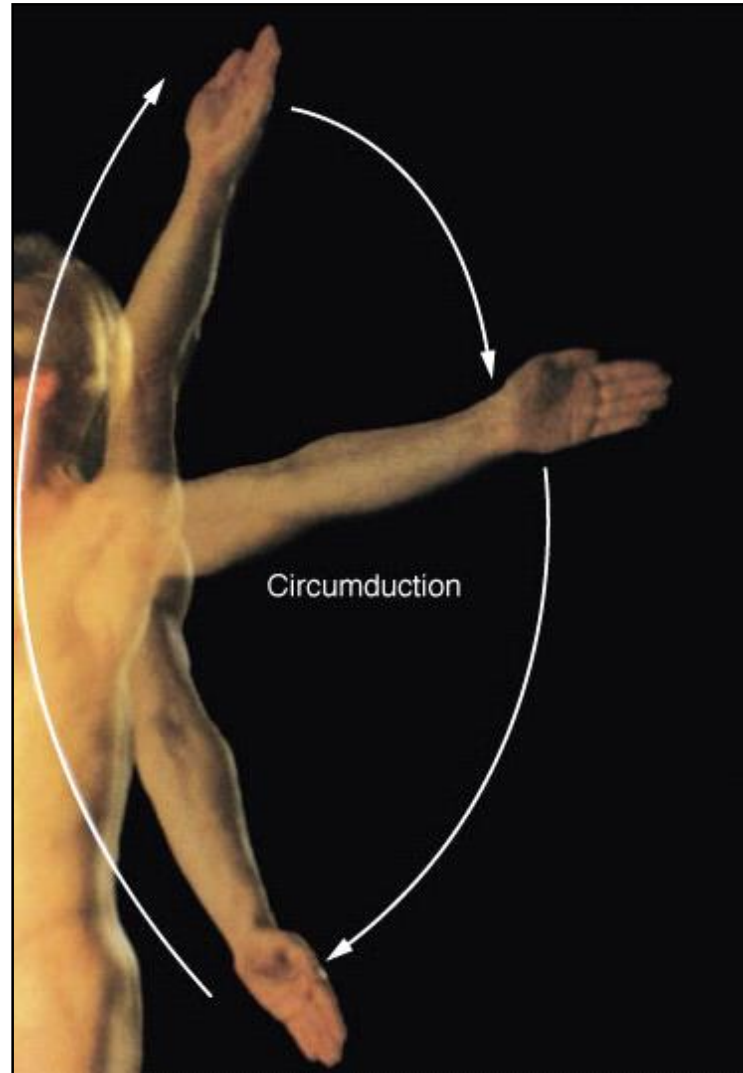
# Medial and Lateral Rotation

Medial rotation



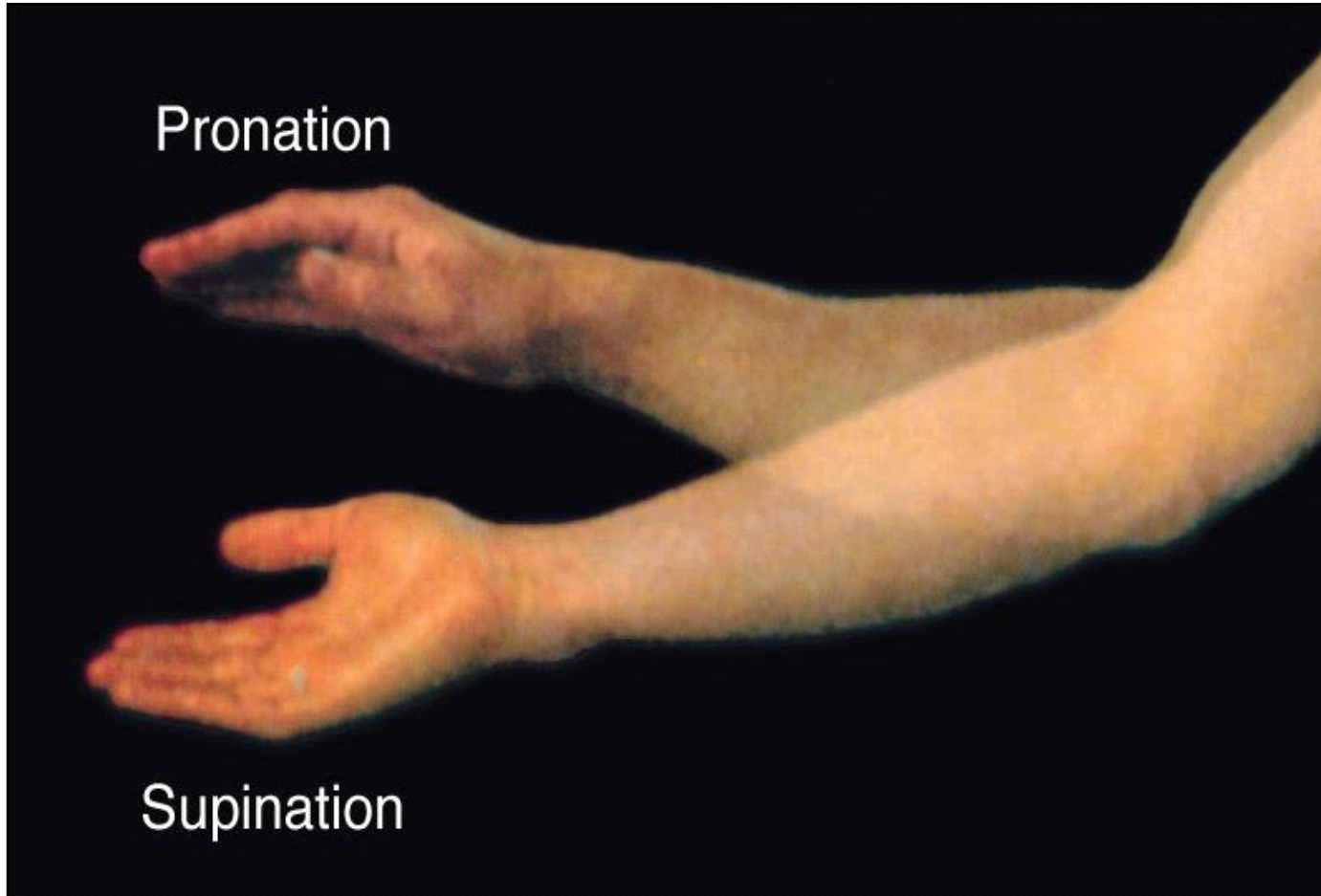
Lateral rotation







# Pronation and Supination



# Dorsiflexion and Plantar Flexion

