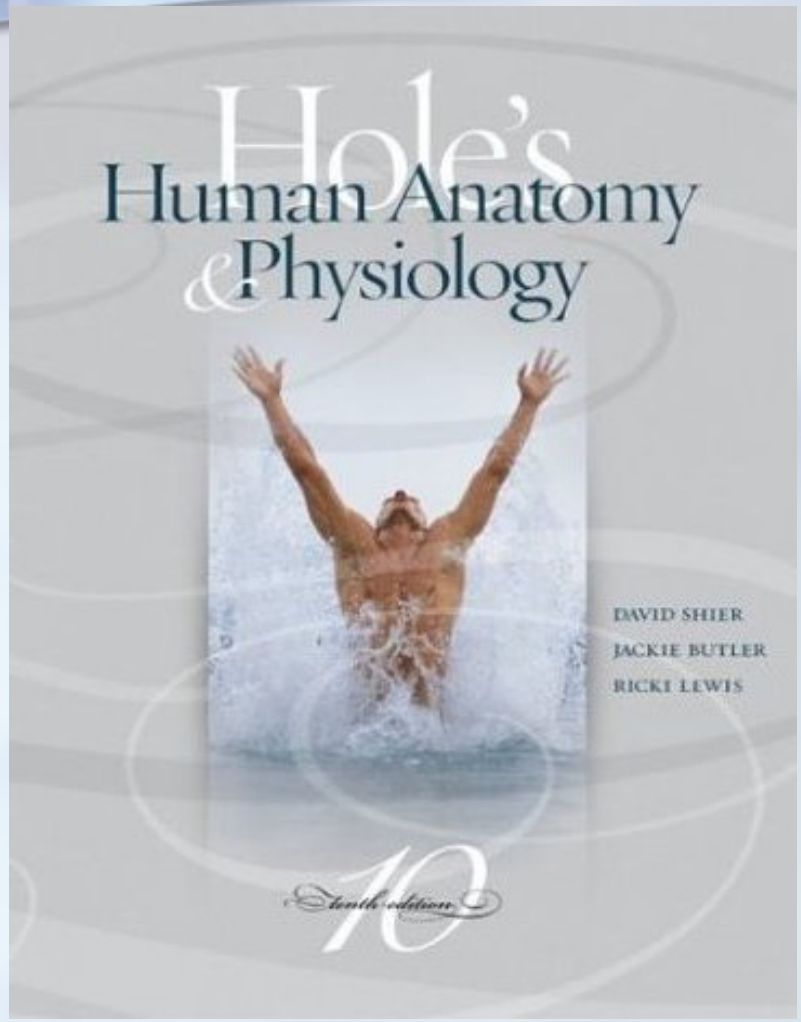
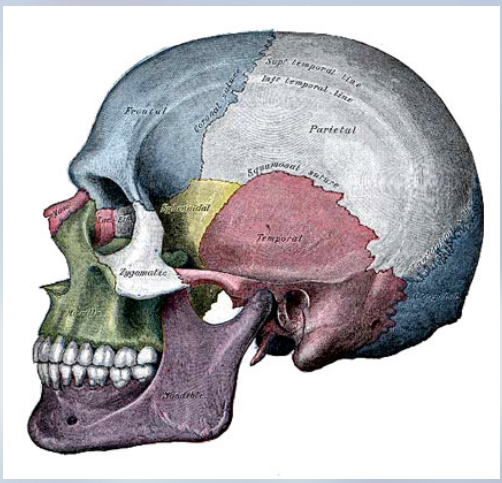
ZOOL 2003 - Human Anatomy and Physiology I



- Course Instructor: Dr. Martin Huss
- Chapter 1: Introduction to Human Anatomy and Physiology.



Overview of Human Anatomy and Physiology

- Anatomy – the study of the *structure* of the body and the relationships of the various parts of the body
  - Gross or macroscopic (visible structures)
  - Microscopic (cytology, histology)
  - Developmental – structural changes over time (embryology)
- Physiology – the study of the *functions* of the parts of the body, includes specific organ systems and molecular and cellular levels (neurophysiology, cardiovascular physiology, electrophysiology)

Levels of Structural Organization

Chemical – atoms combine to form molecules

Cellular – molecules interact to make up cells

Tissue – cells are grouped into tissue

Organ – tissues compose organs

Organ system – organs function together to form organ systems

Organism (individual) – made up of the organ systems

Levels of Structural Organization

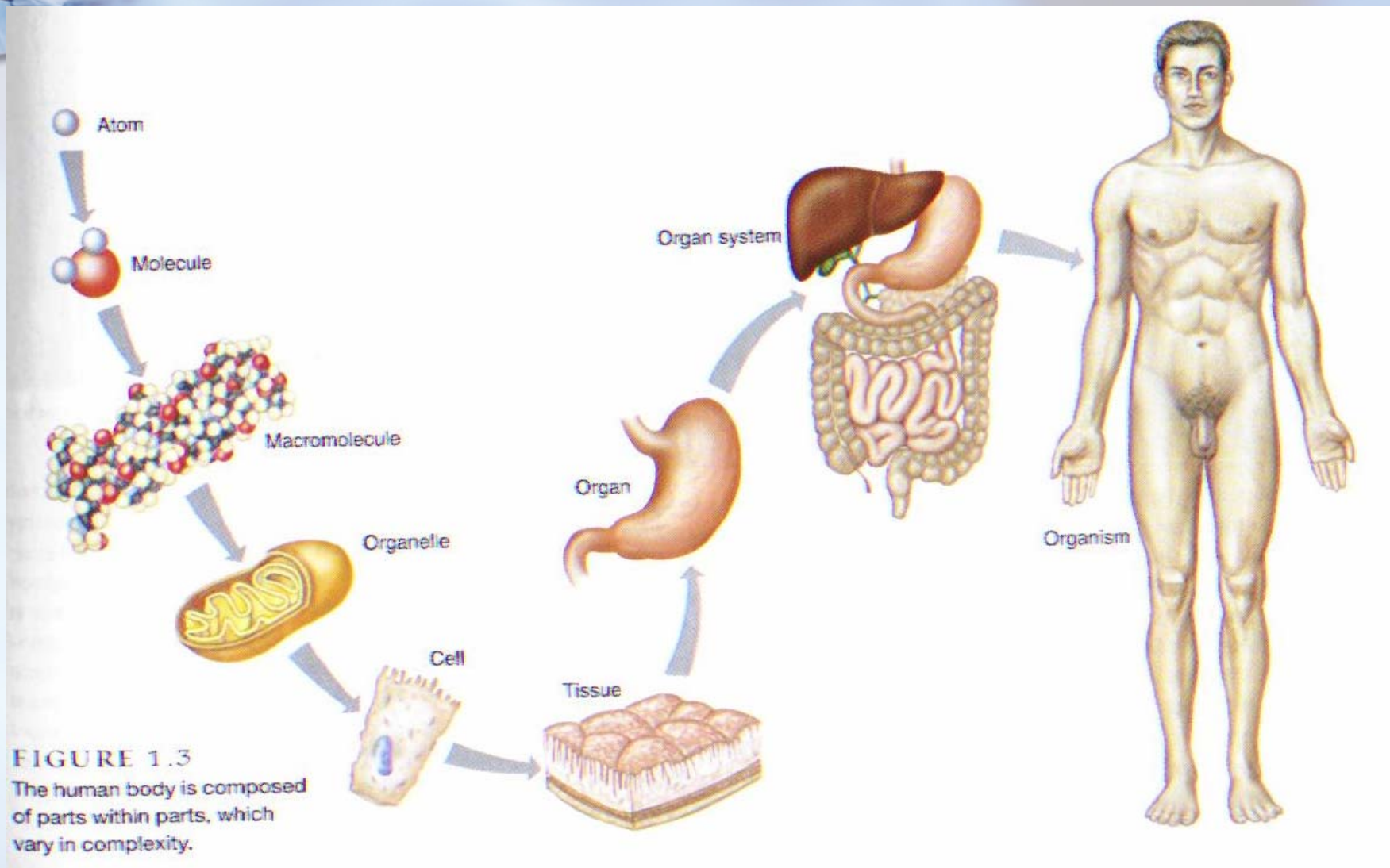


FIGURE 1.3
The human body is composed of parts within parts, which vary in complexity.

Basic Structures of the Human Body

- Tissue – A group of similar cells that performs a specific function
- Organ – A structure consisting of a group of tissues with a specialized function
- Organ System – Organs working together to allow the body to perform a function.

Organ Systems

- Integumentary system
  - Forms the external body covering
  - Composed of skin, sweat glands, oil glands, hair, and nails
  - Protects deep tissues from injury and synthesizes vitamin D

Organ Systems of the Body

- Skeletal system
  - Composed of bone, cartilage, and ligaments
  - Protects and supports body organs
  - Provides the framework for muscles
  - Site of blood cell formation
  - Stores minerals

Organ Systems of the Body

- Muscular system
  - Composed of muscles and tendons
  - Allows manipulation of the environment, locomotion, and facial expression
  - Maintains posture
  - Produces heat

Organ Systems of the Body

- Nervous system
  - Integrates and coordinates body functions
  - Composed of the brain, spinal column, and nerves
  - Is the fast-acting control system of the body
  - Responds to stimuli by activating muscles and glands

Organ Systems of the Body

- Endocrine System
  - Integrates and coordinates body functions
  - Includes all glands that secrete chemical messengers, also called hormones
  - Hormones alter the metabolism of target cells
  - Examples of organs of the ES are the pituitary, thyroid, parathyroid, adrenal glands, pancreas, ovaries, testes, pineal gland, and thymus gland

Organ Systems of the Body

- Cardiovascular system
  - Composed of the heart and blood vessels
  - The heart pumps blood
  - The blood vessels transport blood throughout the body

Organ Systems of the Body

- Lymphatic system
  - Composed of red bone marrow, thymus, spleen, lymph nodes, and lymphatic vessels
  - Picks up fluid leaked from blood vessels and returns it to blood
  - Disposes of debris in the lymphatic stream
  - Houses white blood cells involved with immunity

Organ Systems of the Body

- Respiratory system
  - Composed of the nasal cavity, pharynx, trachea, bronchi, and lungs
  - Keeps blood supplied with oxygen and removes carbon dioxide

Organ Systems of the Body

- Digestive system
  - Composed of the oral cavity, esophagus, stomach, small intestine, large intestine, rectum, anus, and liver
  - Breaks down food into absorbable units that enter the blood
  - Eliminates indigestible foodstuffs as feces

Organ Systems of the Body

- Urinary system
  - Composed of kidneys, ureters, urinary bladder, and urethra
  - Eliminates nitrogenous wastes from the body
  - Regulates water, electrolyte, and pH balance of the blood

Organ Systems of the Body

- Male reproductive system
  - Composed of prostate gland, penis, testes, scrotum, and ductus deferens
  - Main function is the production of offspring
  - Testes produce sperm and male sex hormones
  - Ducts and glands deliver sperm to the female reproductive tract

Organ Systems of the Body

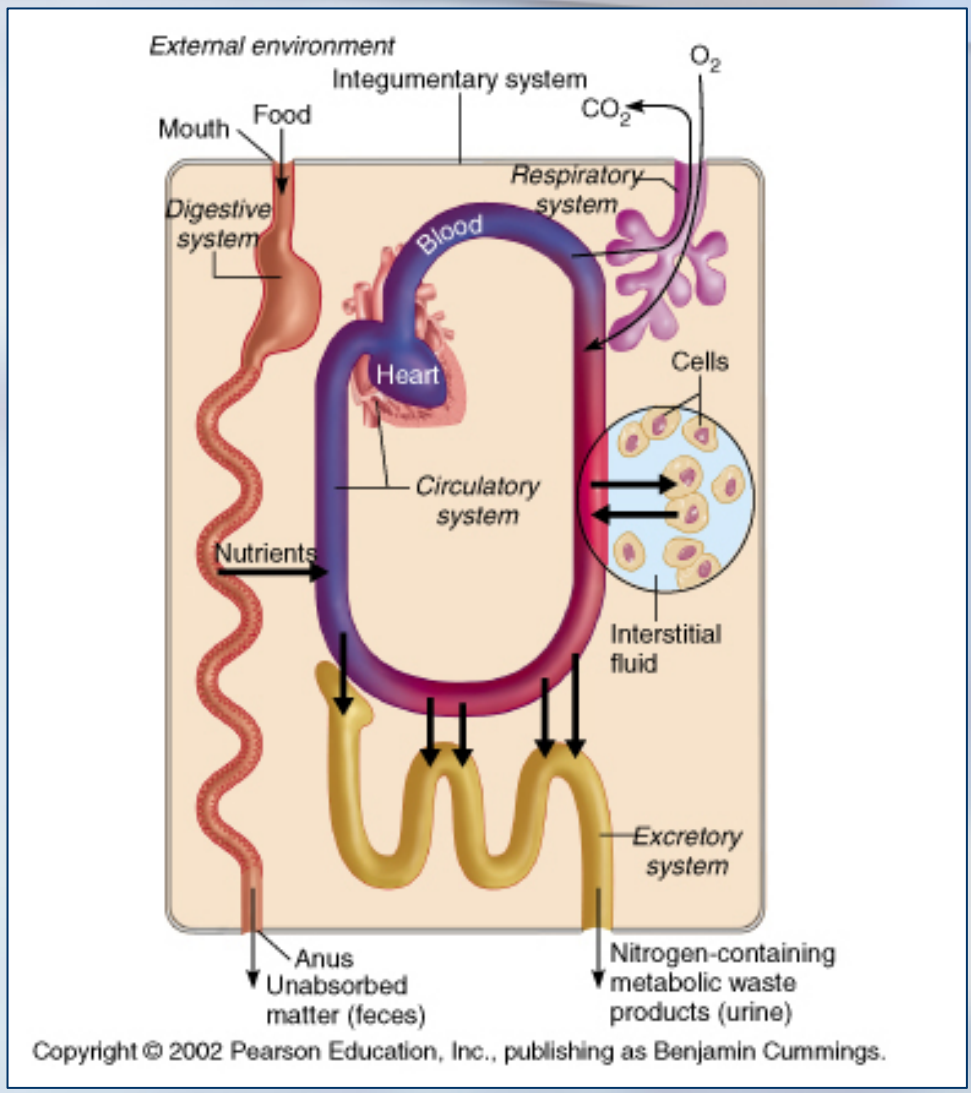
- Female reproductive system
  - Composed of mammary glands, ovaries, uterine tubes, uterus, and vagina
  - Main function is the production of offspring
  - Ovaries produce eggs and female sex hormones
  - Remaining structures serve as sites for fertilization and development of the fetus
  - Mammary glands produce milk to nourish the newborn

Organ System Interrelationships

- The integumentary system protects the body from the external environment
- Digestive and respiratory systems, in contact with the external environment, take in nutrients and oxygen

Organ System Interrelationships

- Nutrients and oxygen are distributed by the blood
- Metabolic wastes are eliminated by the urinary and respiratory systems



Necessary Life Functions I

- *Maintaining boundaries* – the internal environment remains distinct from the external
  - Cellular level – accomplished by plasma membranes
  - Organism level – accomplished by the skin
- *Movement* – locomotion, propulsion (peristalsis), and contractility
- *Responsiveness* – ability to sense changes in the environment and respond to them
- *Digestion* – breakdown of ingested food

Necessary Life Functions II

- *Metabolism* – all the chemical reactions that occur in the body
- *Excretion* – removal of wastes from the body
- *Reproduction* – cellular and organism levels
  - Cellular – an original cell divides and produces two identical daughter cells
  - Organism – sperm and egg unite (fertilization) make possible the formation of a new person
- *Growth* – increase in size of a body part or of the organism

Metabolism

- ***Metabolism:*** A broad term used for all the chemical reactions that occur within cells of the body
  - ***Catabolism*** - breaking down substances into simpler components
  - ***Anabolism*** – synthesizing more complex substances or structures from simpler substances

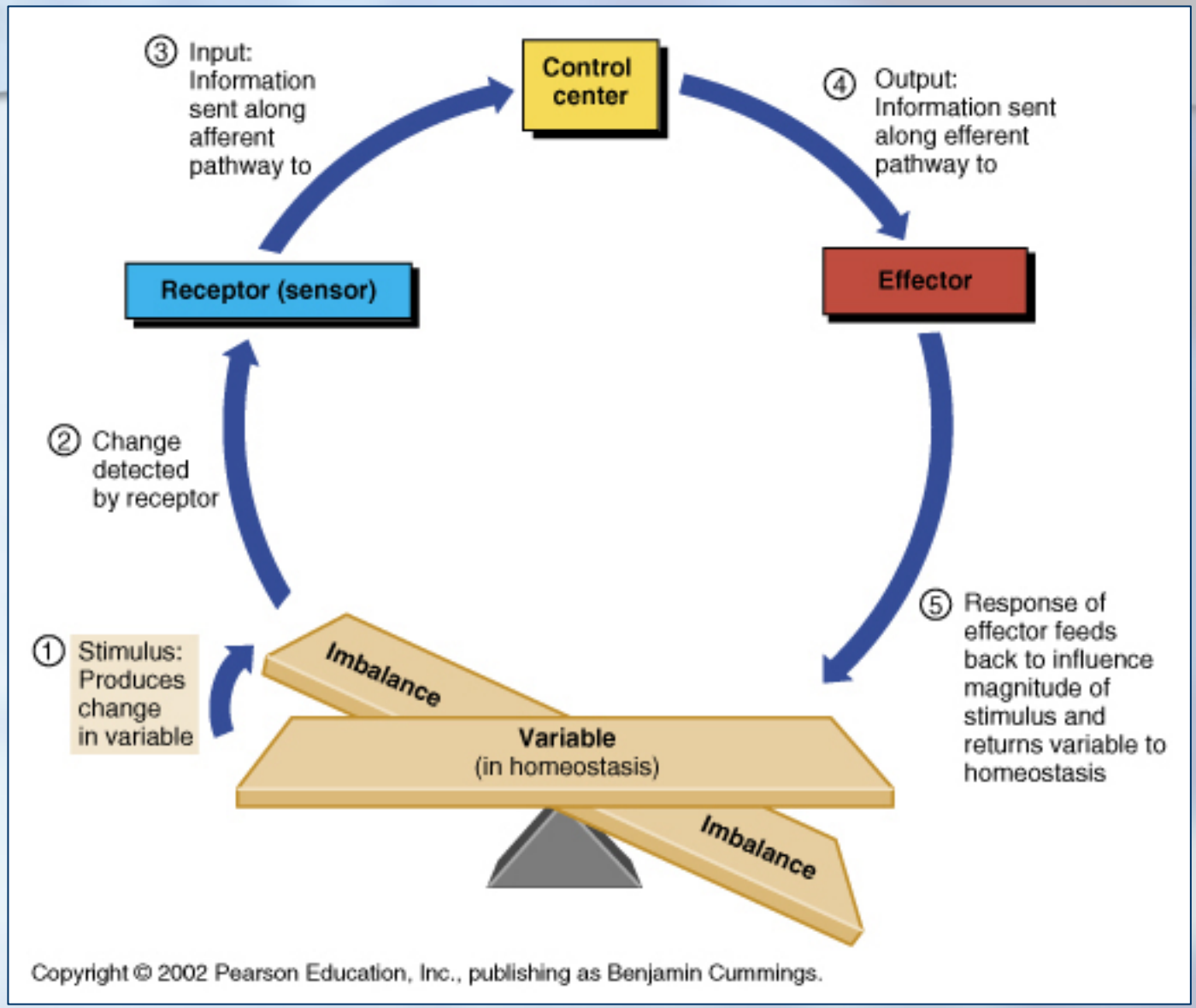
Homeostasis

- Homeostasis is the ability of the body to maintain a relatively stable internal environment
- The internal environment of the body is in a dynamic state of equilibrium (internal conditions vary, but within relatively narrow limits)
- A wide variety of chemical, thermal, and neural factors act and interact in complex ways to maintain homeostasis

Homeostatic Control Mechanisms

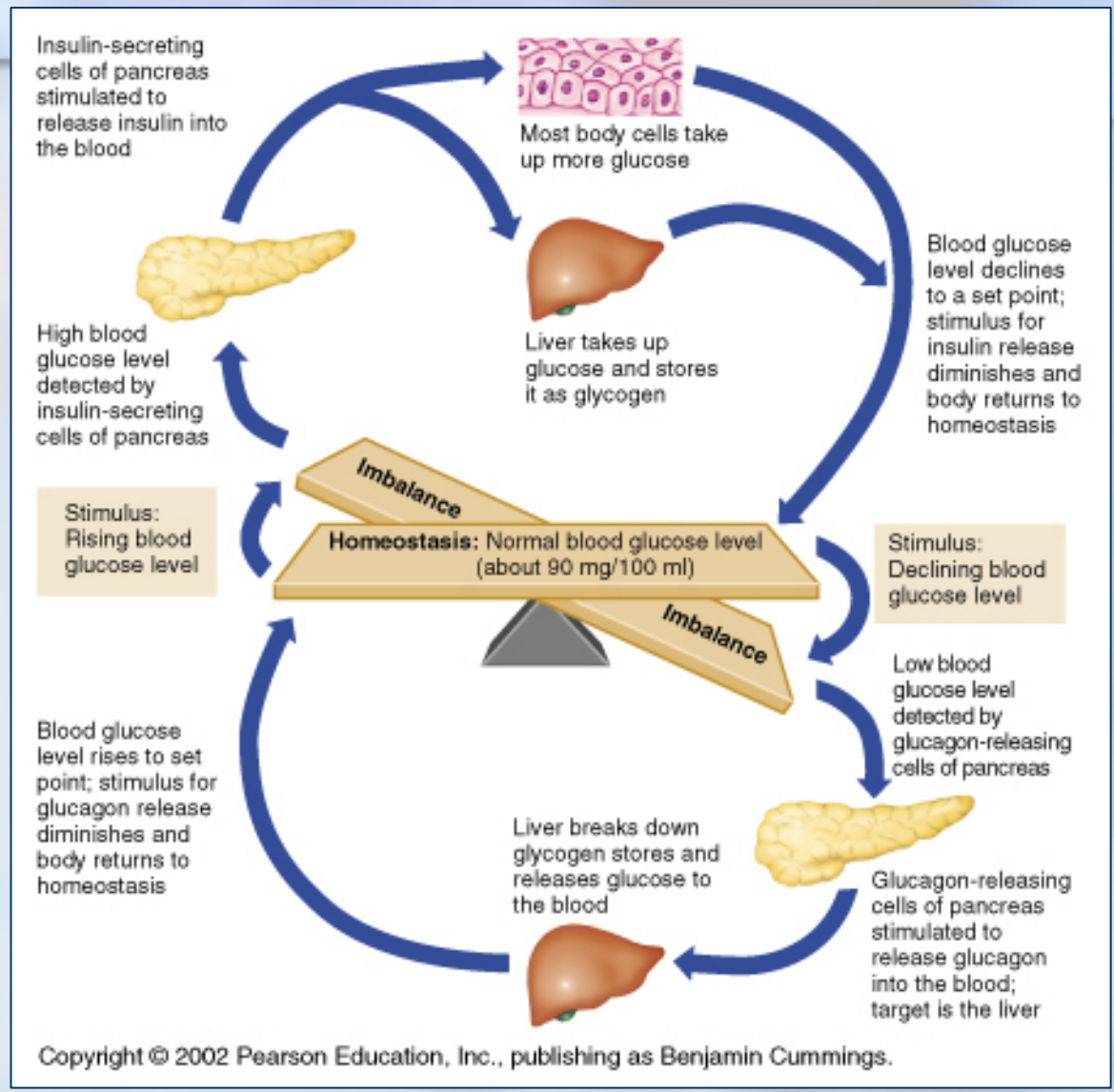
- Variable – the factor or event being regulated
- Receptor monitors the environment and responds to changes (stimuli)
- Control center determines the set point at which the variable is maintained
- Effector provides the means to respond to the stimulus

Homeostatic Control Mechanisms



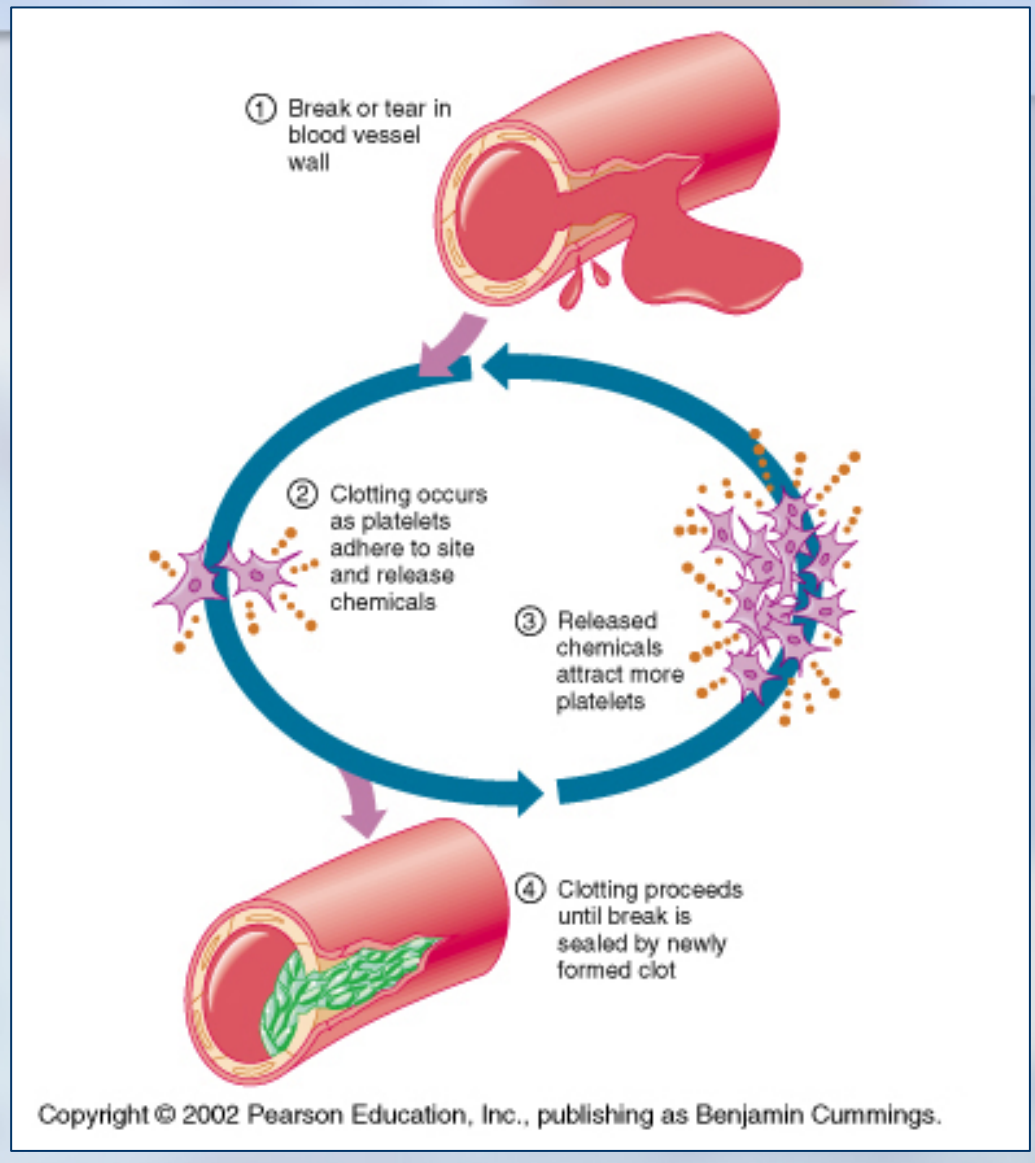
Negative Feedback

- In negative feedback systems, the output “turns down” or “shuts off” the original stimulus
- Example: Regulation of blood glucose levels



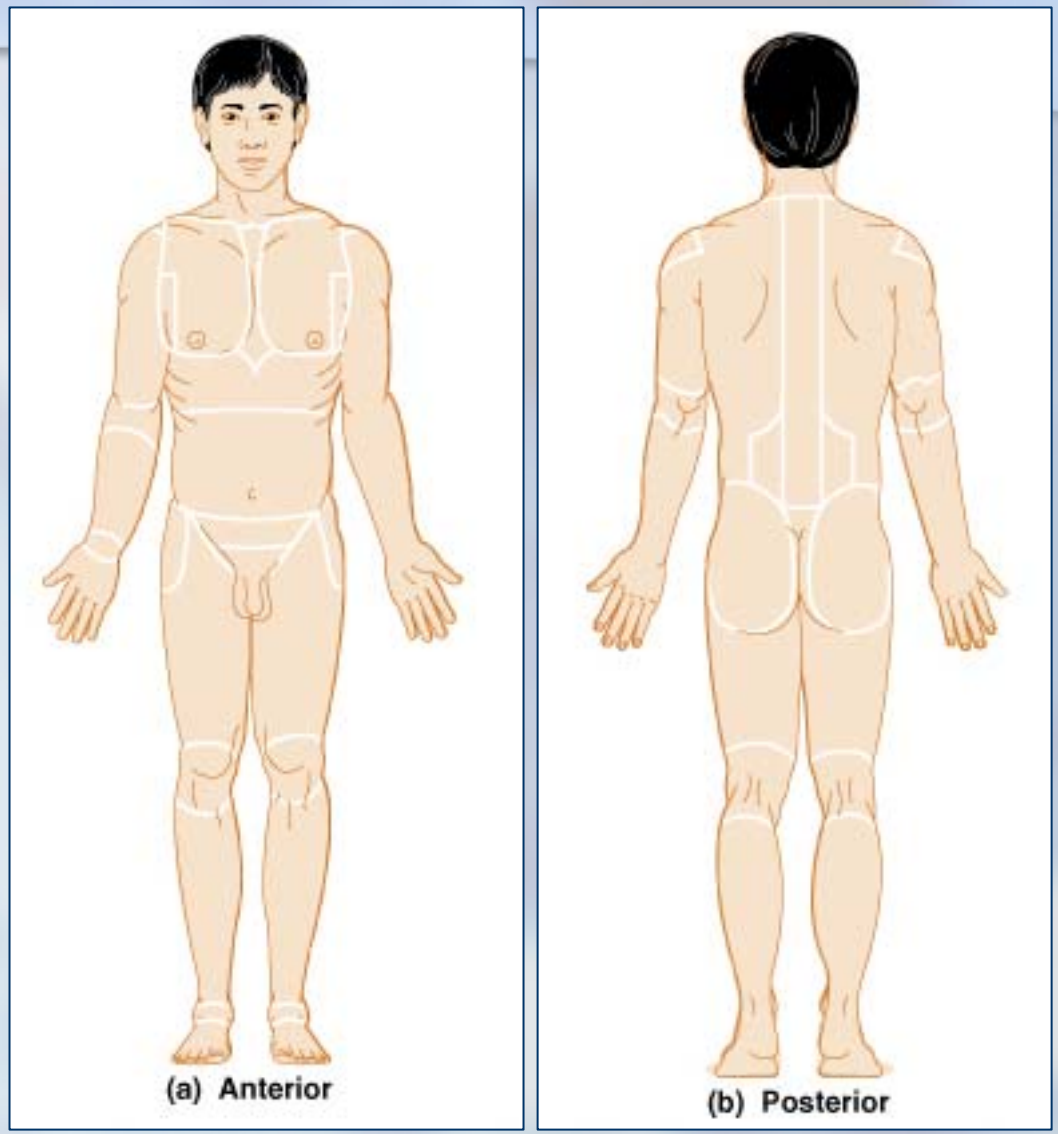
Positive Feedback

- In positive feedback systems, the output enhances or “turns up” the original stimulus
- Examples: Regulation of blood clotting, Uterine contractions during labor.



Anatomical Position

Body erect,
feet slightly apart,
palms facing forward,
thumbs point away
from the body

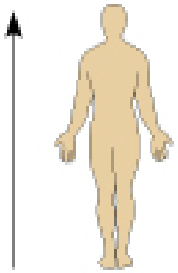
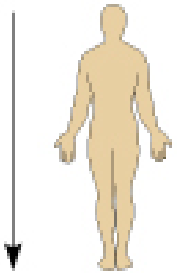
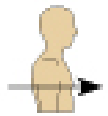


Directional Terms

- Superior (Cranial) and Inferior (Caudal) – toward and away from the head or upper part of a structure - above and below-
- Anterior (Ventral) and Posterior (Dorsal) – toward the front and back of the body
  - in front of and behind-
- Medial, Lateral, and Intermediate – toward the midline, away from the midline, and between a more medial and lateral structure

Directional Terms

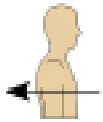
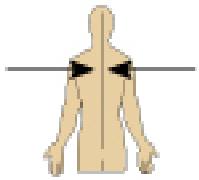
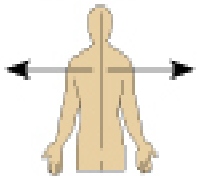
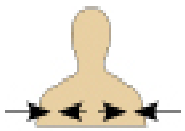
TABLE 1.1 Orientation and Directional Terms

Term	*Definition*	*Example*	
Superior (cranial)	Toward the head end or upper part of a structure or the body; above		The head is superior to the abdomen
Inferior (caudal)	Away from the head end or toward the lower part of a structure or the body; below		The navel is inferior to the chin
Anterior (ventral)*	Toward or at the front of the body; in front of		The breastbone is anterior to the spine

*Whereas the terms *ventral* and *anterior* are synonymous in humans, this is not the case in four-legged animals. *Ventral* specifically refers to the "belly" of a vertebrate animal and thus is the inferior surface of four-legged animals. Likewise, although the dorsal and posterior surfaces are the same in humans the term *dorsal* specifically refers to an animal's back. Thus, the dorsal surface of four-legged animals is their superior surface.

Directional Terms

TABLE 1.1 Orientation and Directional Terms

Term	*Definition*	*Example*	
Posterior (dorsal)*	Toward or at the back of the body; behind		The heart is posterior to the breastbone
Medial	Toward or at the midline of the body; on the inner side of		The heart is medial to the arm
Lateral	Away from the midline of the body; on the outer side of		The arms are lateral to the chest
Intermediate	Between a more medial and a more lateral structure		The collarbone is intermediate between the breastbone and shoulder

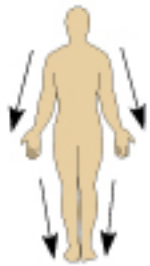
*Whereas the terms *ventral* and *anterior* are synonymous in humans, this is not the case in four-legged animals. *Ventral* specifically refers to the "belly" of a vertebrate animal and thus is the inferior surface of four-legged animals. Likewise, although the dorsal and posterior surfaces are the same in humans, the term *dorsal* specifically refers to an animal's back. Thus, the dorsal surface of four-legged animals is their superior surface.

Directional Terms

- Proximal and Distal – closer to and farther from the origin of the body part or the point of attachment of a limb
- Superficial (External) and Deep (Internal) – toward and away from the body surface

Directional Terms

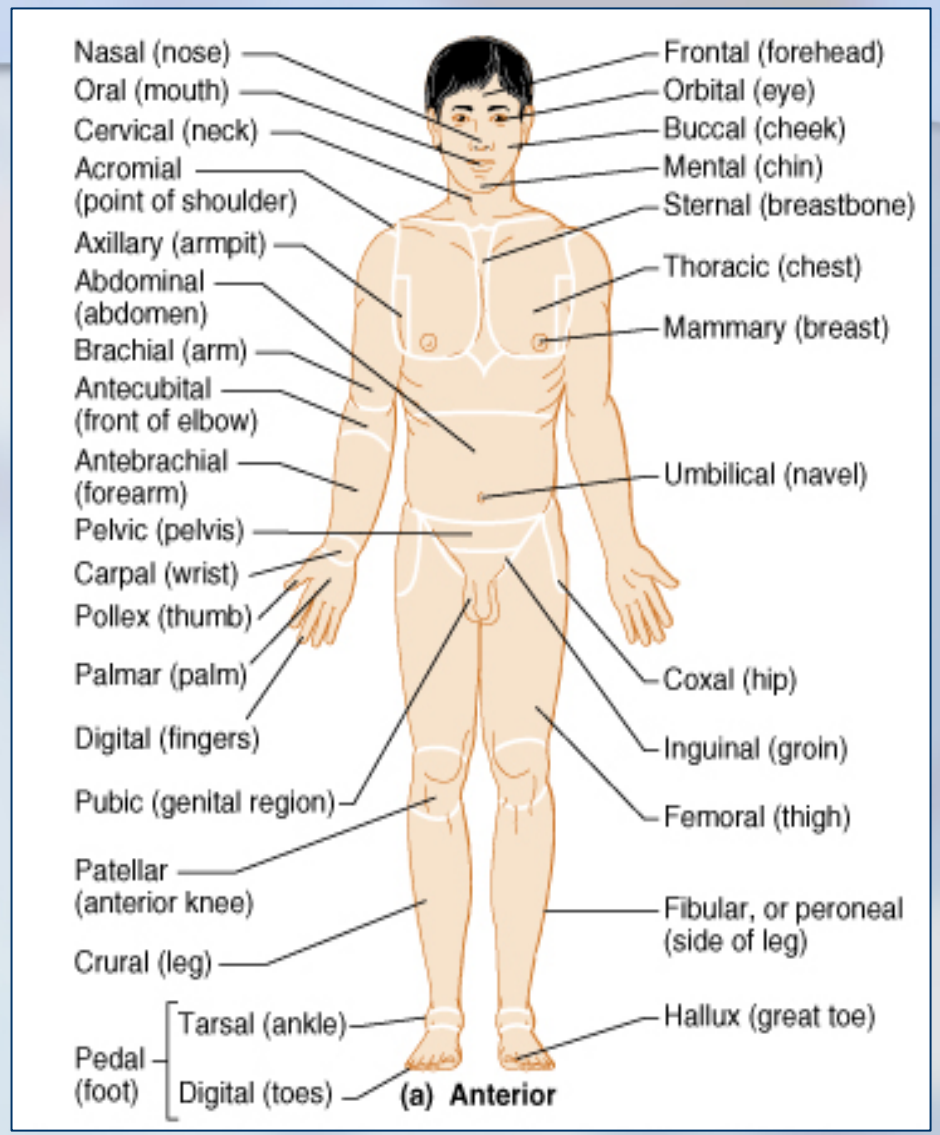
TABLE 1.1 Orientation and Directional Terms

Term	*Definition*	*Example*	
Proximal	Closer to the origin of the body part or the point of attachment of a limb to the body trunk		The elbow is proximal to the wrist
Distal	Farther from the origin of a body part or the point of attachment of a limb to the body trunk		The knee is distal to the thigh
Superficial (external)	Toward or at the body surface		The skin is superficial to the skeletal muscles
Deep (internal)	Away from the body surface; more internal		The lungs are deep to the skin

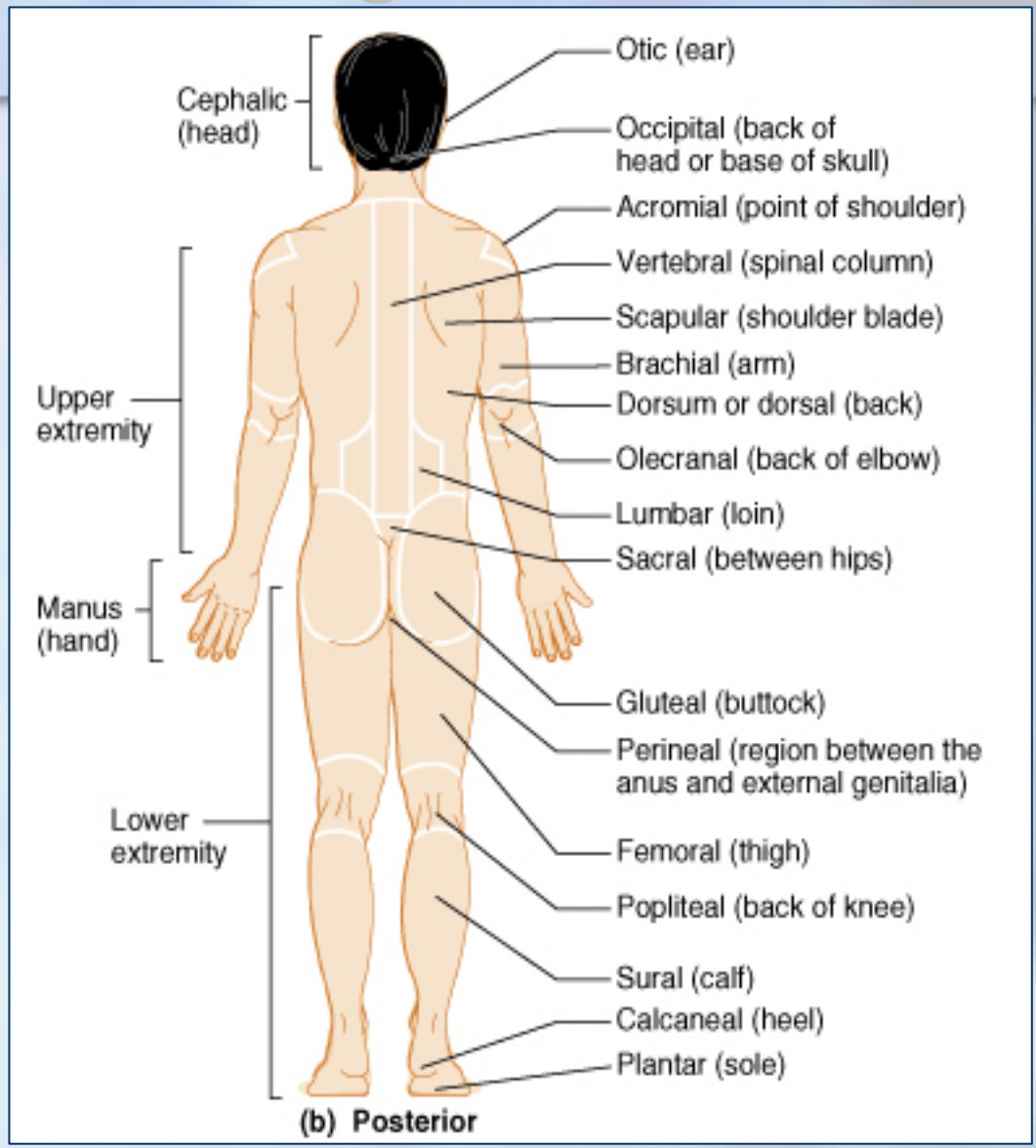
*Whereas the terms *ventral* and *anterior* are synonymous in humans, this is not the case in four-legged animals. *Ventral* specifically refers to the "belly" of a vertebrate animal and thus is the inferior surface of four-legged animals. Likewise, although the dorsal and posterior surfaces are the same in humans, the term *dorsal* specifically refers to an animal's back. Thus, the dorsal surface of four-legged animals is their superior surface.

Regional Terms

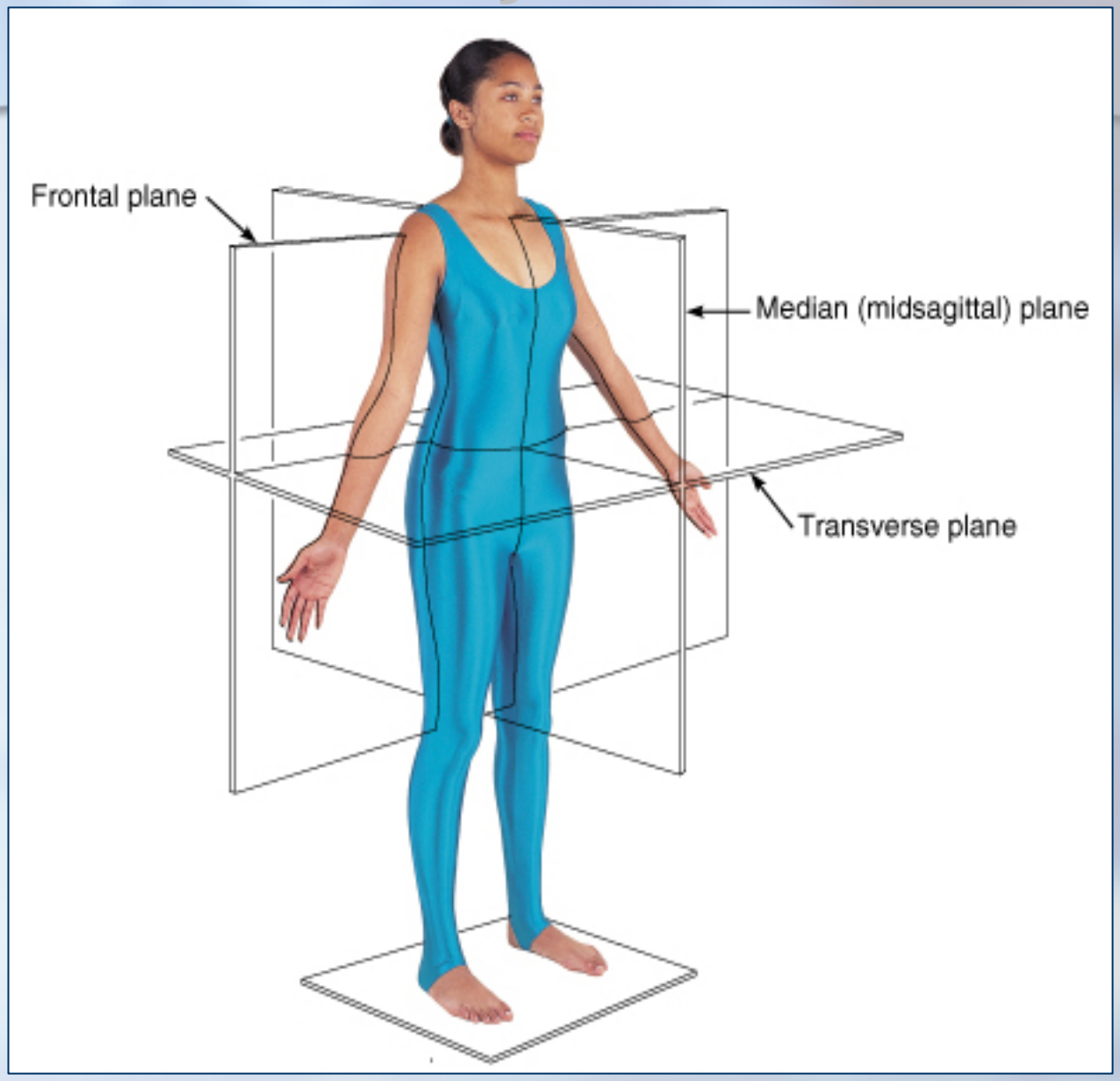
- Axial – head, neck, and trunk
- Appendicular – appendages or limbs
- Specific regional terminology



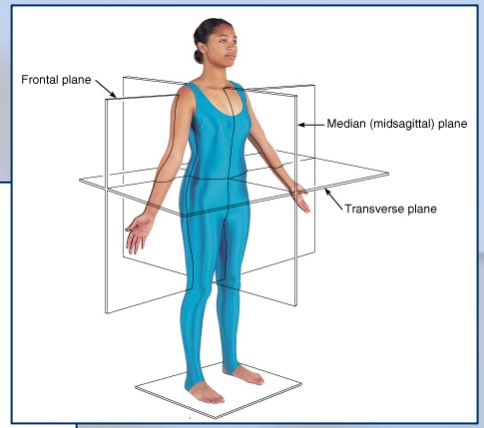
Regional Terms



Body Planes



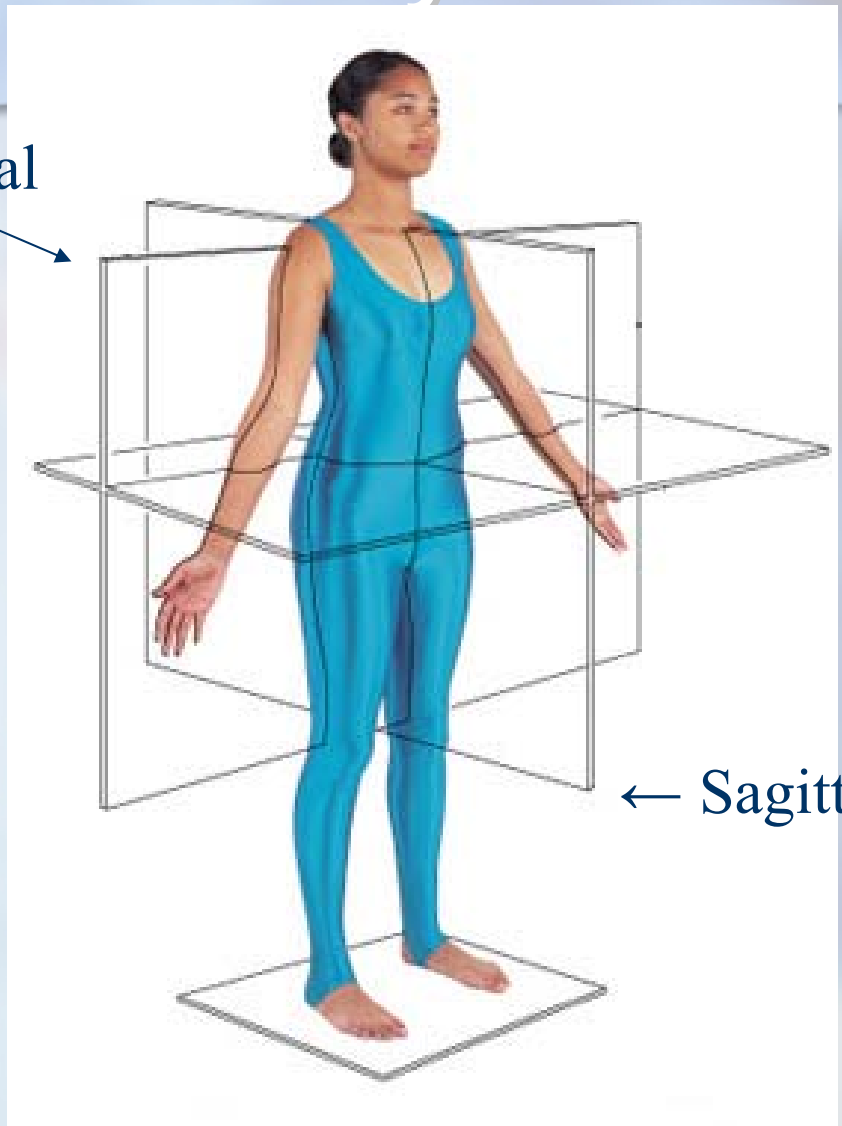
Body Planes



- Sagittal and Medial – divides the body into right and left parts
- Midsagittal – sagittal plane that lies on the midline
- Frontal or Coronal – divides the body into anterior and posterior parts
- Transverse or horizontal (cross section) – divides the body into superior and inferior parts
- Oblique section – cuts made diagonally

Body Planes

Frontal or Coronal Plane



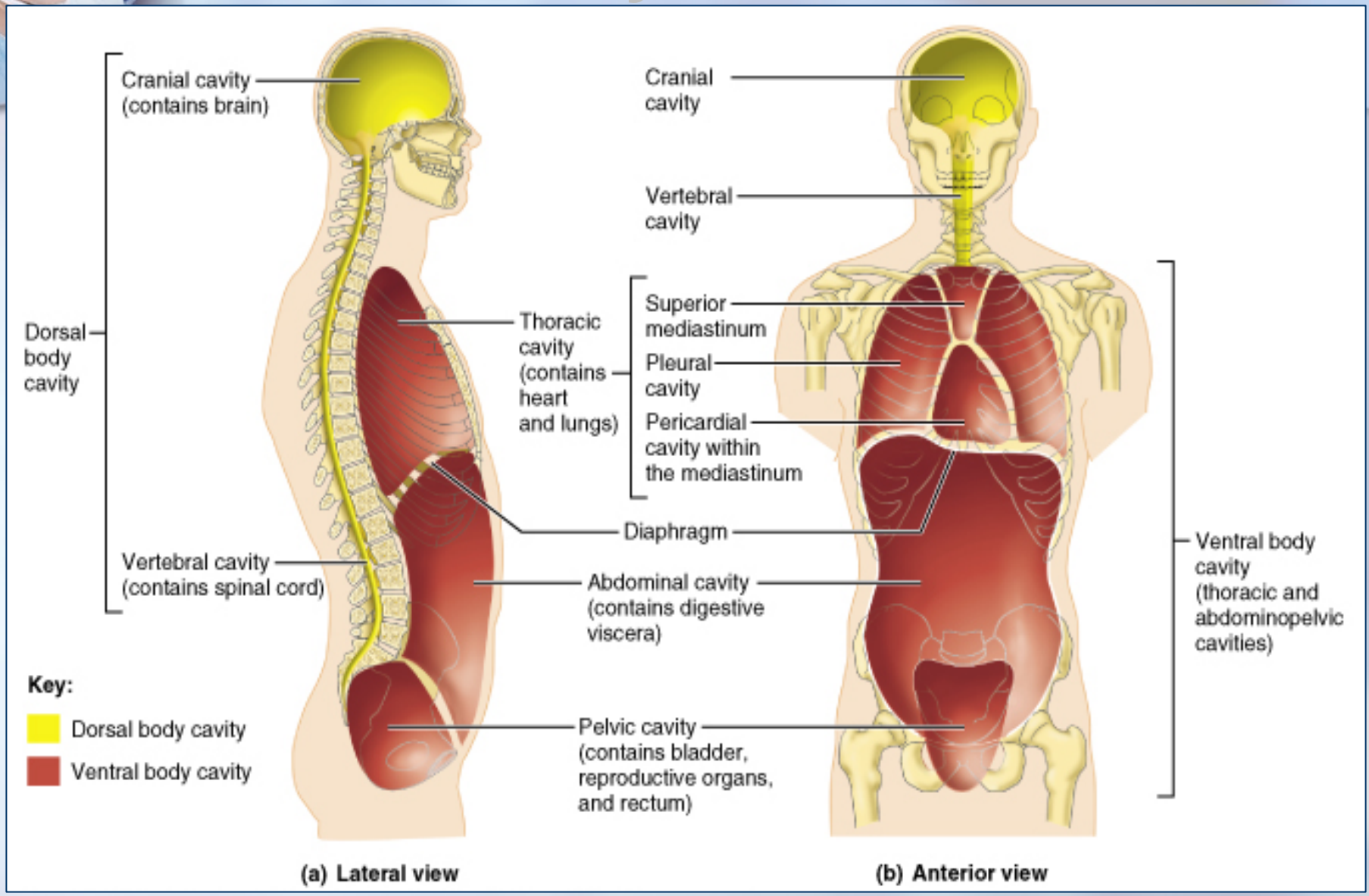
←Transverse Plane

← Sagittal Plane

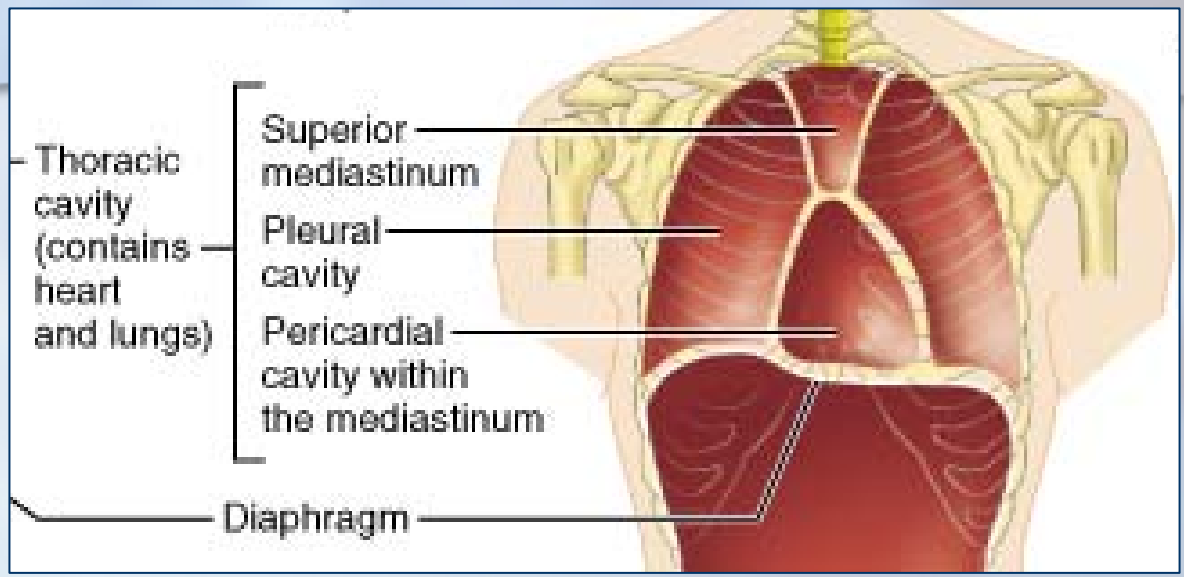
Body Cavities

- Dorsal cavity protects the nervous system, and is divided into two subdivisions
  - Cranial cavity is within the skull and encases the brain
  - Vertebral cavity runs within the vertebral column and encases the spinal cord
- Ventral cavity houses the internal organs (viscera), and is divided into two subdivisions: thoracic and abdominopelvic

Body Cavities



Body Cavities

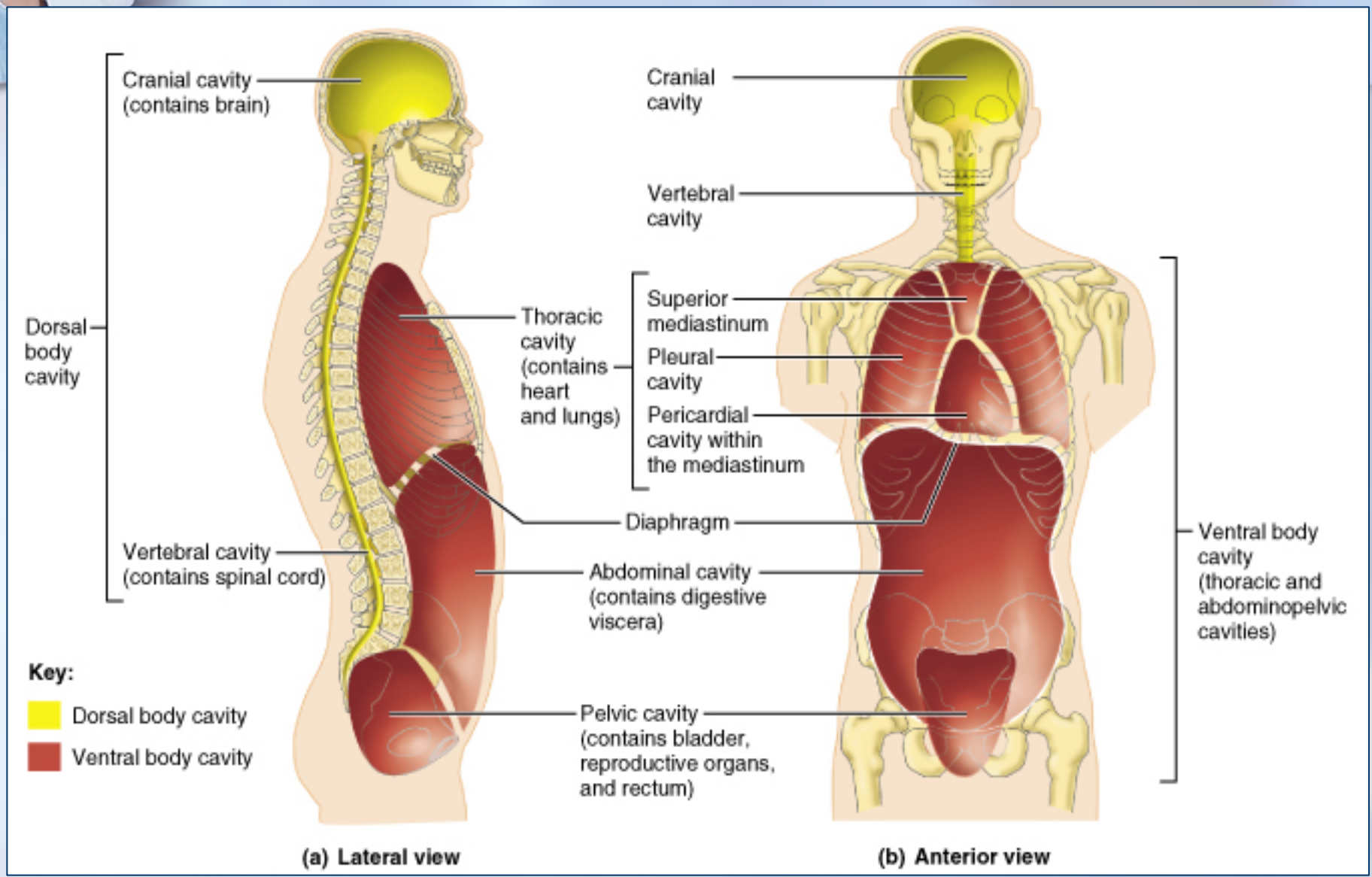


- Thoracic cavity is subdivided into pleural cavities, the mediastinum, and the pericardial cavity
  - Pleural cavities – each houses a lung
  - Mediastinum – contains the pericardial cavity, and surrounds the remaining thoracic organs
  - Pericardial – encloses the heart

Body Cavities

- The abdominopelvic cavity is separated from the superior thoracic cavity by the dome-shaped diaphragm
- It is composed of two subdivisions
  - Abdominal cavity – contains the stomach, intestines, spleen, liver, and other organs
  - Pelvic cavity – lies within the pelvis and contains the bladder, reproductive organs, and rectum

Body Cavities



Other Body Cavities

- Oral and digestive – mouth and cavities of the digestive organs
- Nasal –located within and posterior to the nose
- Orbital – house the eyes
- Middle ear – contain bones (ossicles) that transmit sound vibrations
- Synovial – joint cavities

Serosa – Serous Membrane

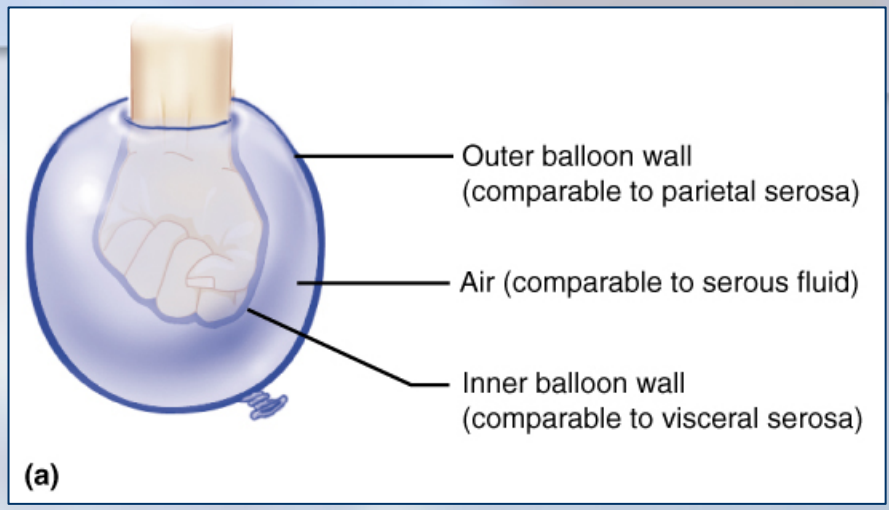
Serosa (serous membrane)- a thin membrane (mesothelium and irregular fibroelastic connective tissue) lining the closed cavities of the body; has two layers with a space between that is filled with serous fluid

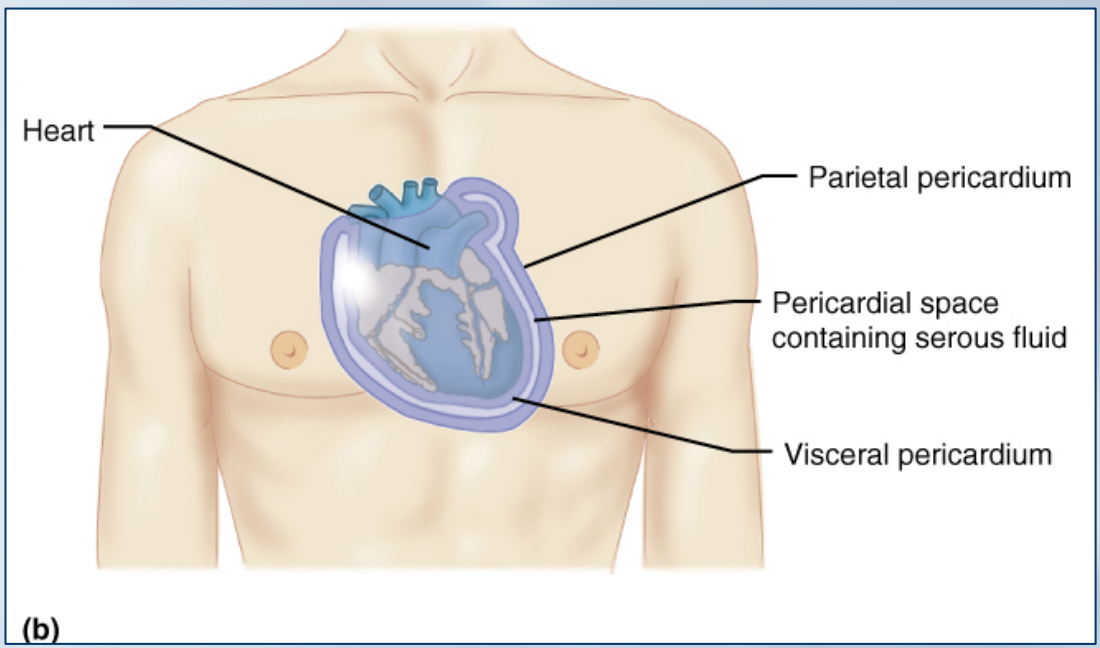
Serum – a clear, watery fluid - the fluid portion of the blood obtained after removal of the fibrin clot and blood cells

Serous - relating to, containing, or producing serum - or a substance having a watery consistency

Ventral Body Cavity Membranes

- Parietal serosa covering the body walls
- Visceral serosa covering the internal organs
- Serous fluid separates the serosae





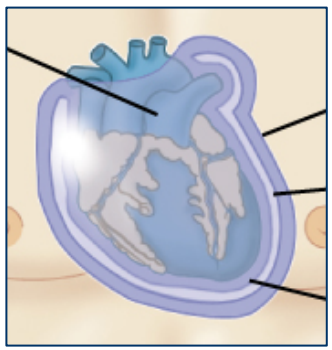
Nomenclature for Serous Membranes

Pleura - the thin serous membrane around the lungs and inner walls of the chest

Peritoneum – the serous membrane lining the abdominal cavity and covering most of the viscera

Endocardium - the membrane that lines the cavities of the heart and forms part of the heart valves

Pericardium - a double-layered serous membrane that surrounds the heart



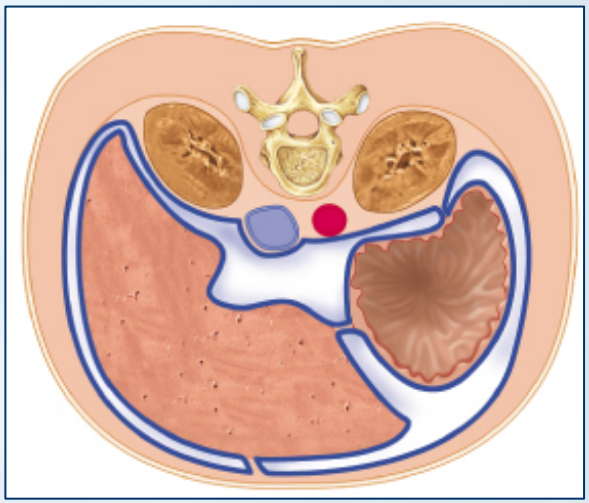
Visceral Pericardium (epicardium) - the innermost of the two layers of the pericardium

Parietal Pericardium - the tough outermost layer of the pericardium that is attached to the diaphragm and the sternum

Ventral Body Cavity Membranes

Parietal Pleura - pleura lining the inner chest walls and covering the diaphragm

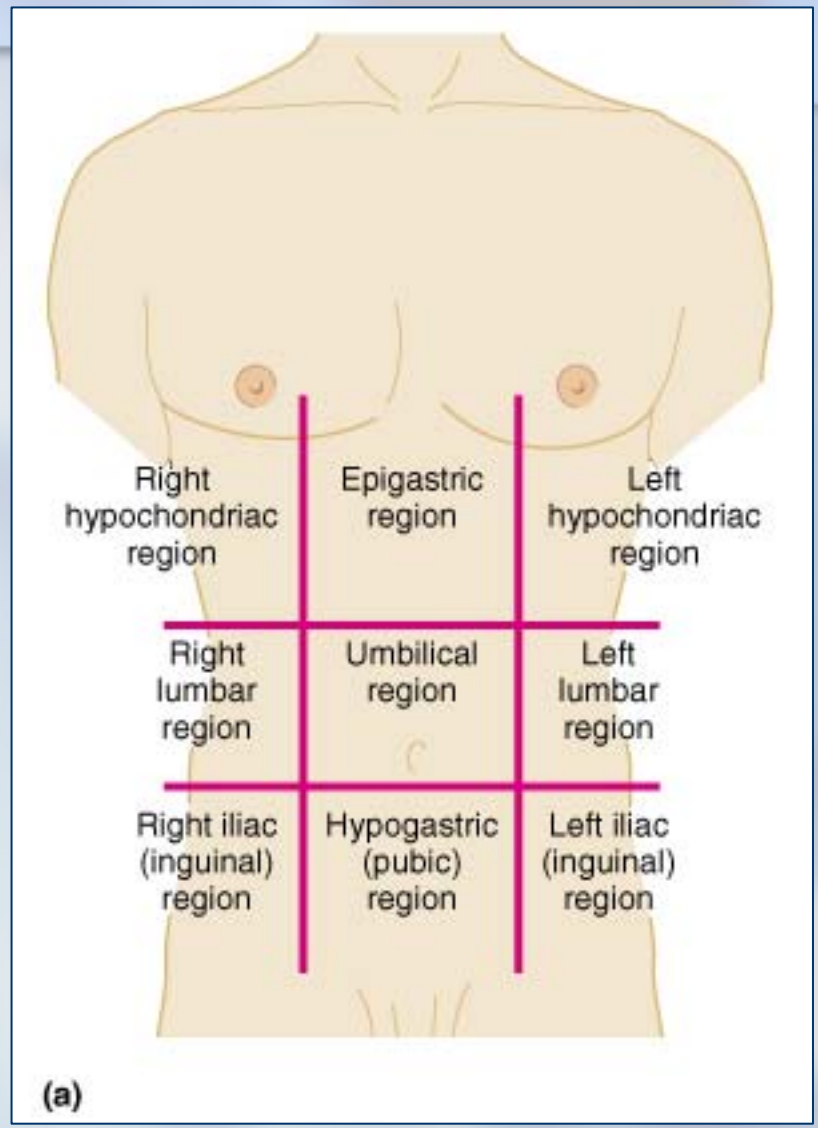
Visceral Pleura - pleura covering the lungs



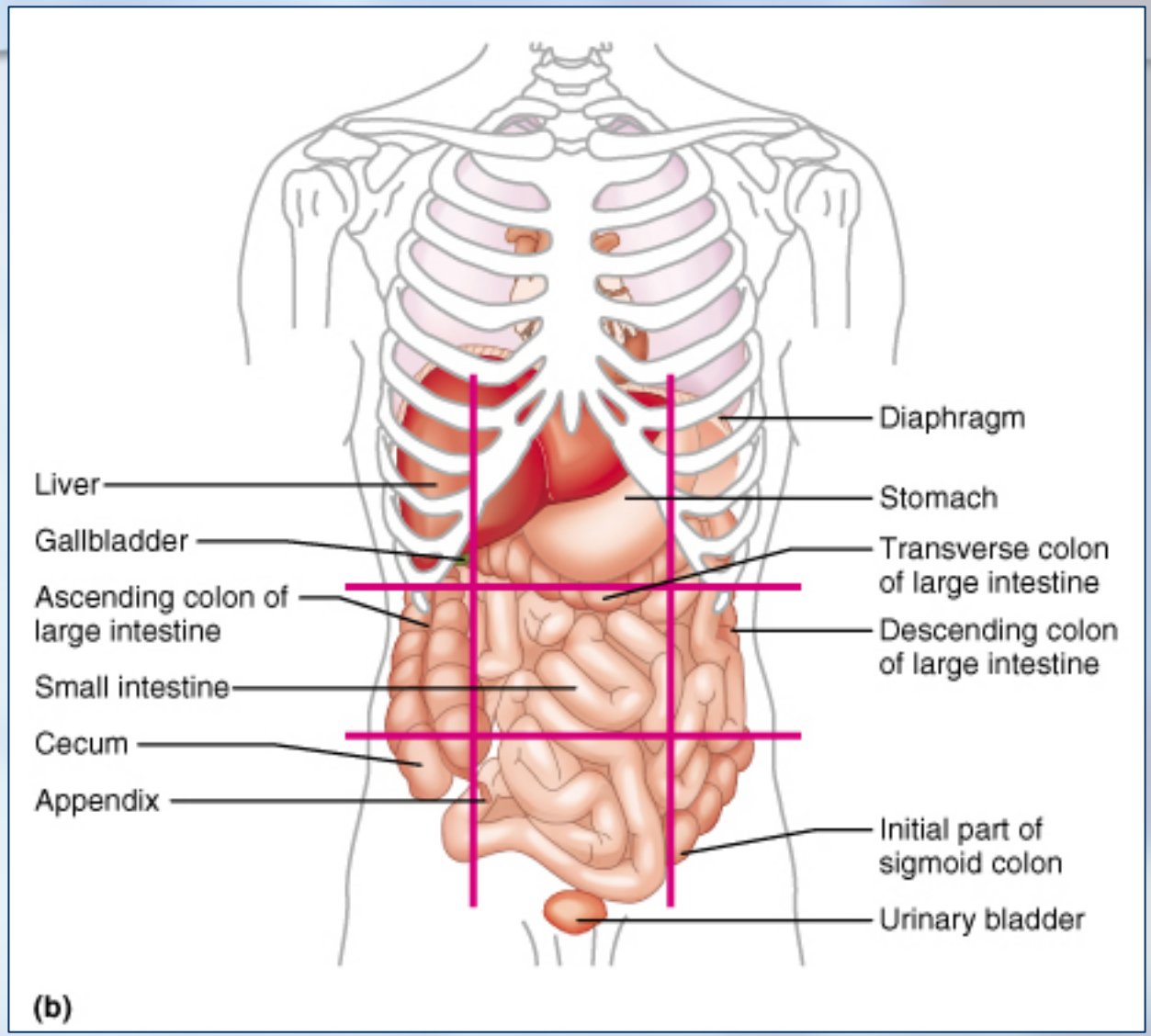
Peritoneum – the serous membrane lining the abdominal cavity and covering most of the viscera

Abdominopelvic Regions

- Umbilical
- Epigastric
- Hypogastric
- Right and left iliac or inguinal
- Right and left lumbar
- Right and left hypochondriac

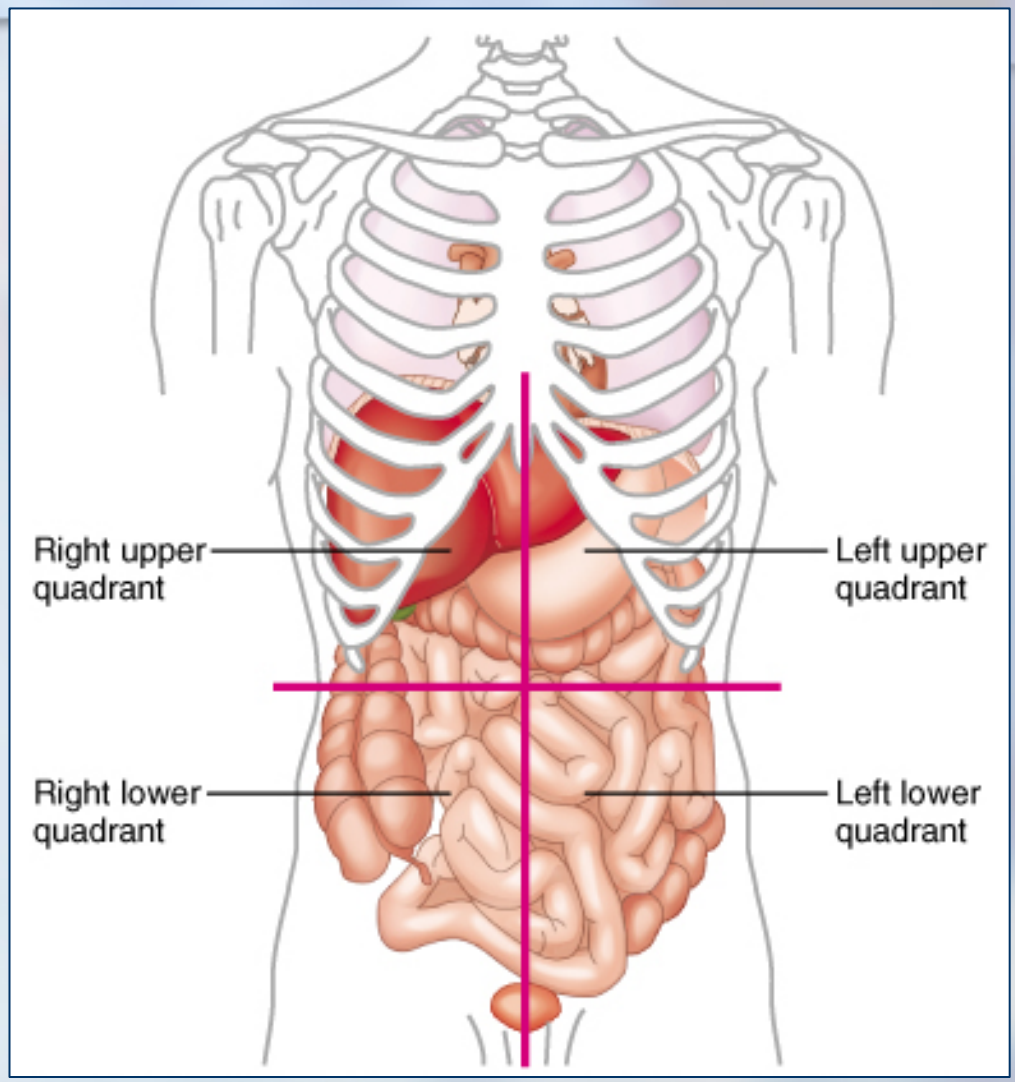


Abdominopelvic Regions



Abdominopelvic Quadrants

- Right upper
- Left upper
- Right lower
- Left lower



Life Span Changes

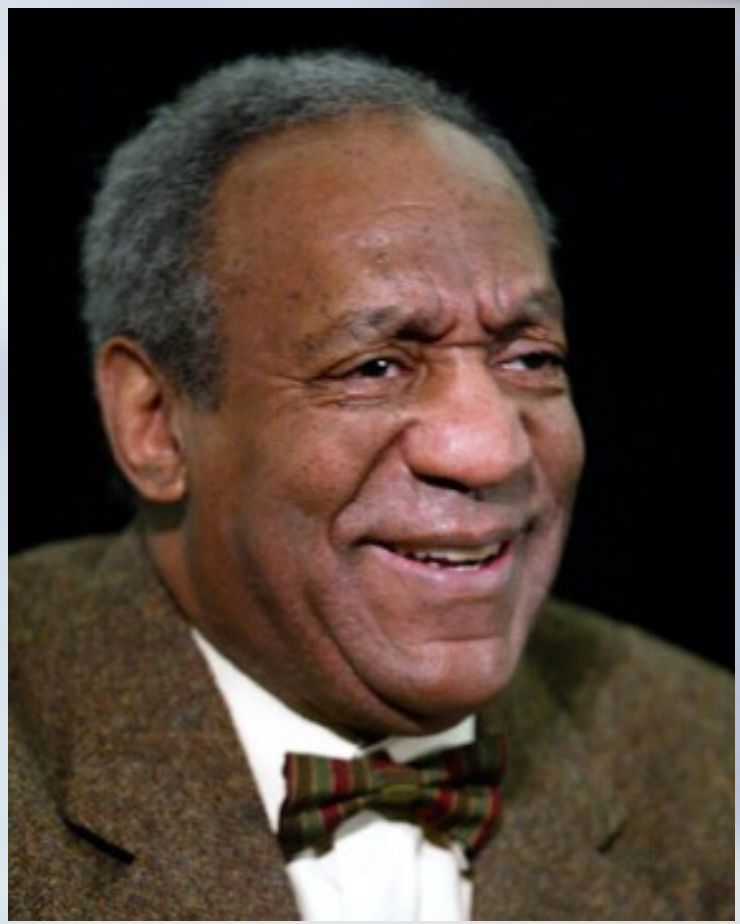
- Aging starts at conception and persists until death of the human body.
- 1st signs of aging are noticeable in one's thirties; including decline in ♀ fertility.
- In 40's & 50's, adult-onset disorders may begin
- Skin Changes due to loss of elastin, collagen, and subcutaneous fat.
- Older people may metabolize certain drugs at different rates than younger people
- Cells divide a limited number of times.
- Oxygen free-radical damage produces certain pigments. Metabolism slow, and beta amyloid protein may build up in the brain => linked to Alzheimer disease in some.

Examples of Life Span Changes: Bob Denver – Younger & Older

Examples of Life Span Changes: Russell Johnson – Younger & Older

Examples of Life Span Changes: Katherine Hepburn – Younger & Older

Examples of Life Span Changes:
Bill Cosby – Younger & Older



Examples of Life Span Changes: Lauren Bacall – Younger & Older

Examples of Life Span Changes: Mickey Rooney – Younger & Older

Medical and Applied Sciences

- Cardiology – study of the heart and vascular system
- Dermatology – study of the skin
- Endocrinology - study of hormones , hormone-secreting glands, and associated diseases.
- Epidemiology – study of the factors that contribute to determining the distribution and frequency of health-related conditions.

Medical and Applied Sciences

- Gastroenterology – study of the stomach and intestines
- Geriatrics – Branch of medicine dealing with older individuals and their medical problems
- Gynecology – study of the female reproductive system
- Hematology – study of blood and blood diseases.

Medical and Applied Sciences

- Histology – study of the structure and function of tissues (microscopic anatomy)
- Immunology – study of the body's resistance to disease
- Neonatology – study of newborns and the treatment of their disorders
- Nephrology – study of the structure and function of the kidneys

Medical and Applied Sciences

- Neurology – study of the brain and nervous system
- Obstetrics – branch of medicine dealing with pregnancy and childbirth
- Oncology – study of cancer
- Ophthalmology – study of the eye and eye disease
- Otolaryngology – study of the ear, throat, larynx, and their diseases

Medical and Applied Sciences

- Pathology – study of structural and functional changes within the body associated with disease
- Pediatrics – branch of medicine dealing with children and their diseases
- Pharmacology – study of drugs and their uses in the treatment of disease
- Podiatry – study of the care and treatment of the feet

Medical and Applied Sciences

- Psychiatry – branch of medicine dealing with the mind and its disorders
- Radiology – Study of X rays and radioactive substances
- Toxicology – study of poisonous substances and their effects on physiology
- Urology – branch of medicine dealing with the urinary and male reproductive systems and their diseases