

RU RMT 2
Anatomy and Physiology
Lecture 1
Cell Bio Cellular Level

Anatomy & Physiology

❑ **Anatomy** is the study of body structures and how they relate to each other

❑ **Physiology** is the study of body functions and describes processes or mechanisms operating within an organism

❑ **Pathology** describes conditions typically observed during a disease state



Subdivisions of Anatomy

- * **Surface anatomy:** study of surface landmarks via visualization and palpation
- * **Gross anatomy:** study of structures that can be examined without a microscope
- * **Regional anatomy:** study of specific body regions
- * **Systemic anatomy:** study of the structure of specific systems of the body
- * **Radiographic anatomy:** study of body structures seen with x-ray



Subdivisions of Anatomy

- * **Developmental biology:** study of the complete development of an individual from a fertilized egg to death
- * **Embryology:** study of the first 8 weeks of development following fertilization of an egg
- * **Cytology (cell biology):** study of cellular structure and functions
- * **Histology:** study of microscopic tissues
- * **Pathological anatomy:** study of structural changes associated with disease

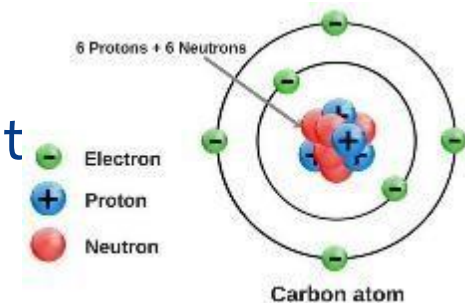


Levels of Structural Organization

The human body can be organized into 6 levels:

1. Chemical Level: made up of atoms and molecules

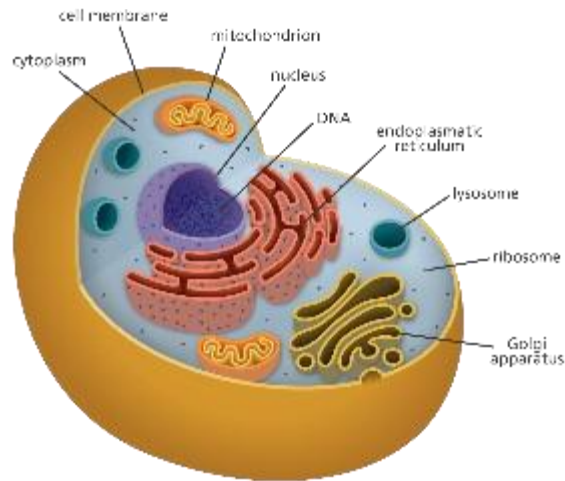
- * Atoms: they are the smallest units of matter that participate in chemical reactions (eg. The periodic table of elements: carbon, hydrogen, oxygen)
- * Molecules: they are formed two or more atoms joined together (eg. DNA)



Levels of Structural Organization

2. Cellular Level

- * Molecules combine to form cells which are the basic structural and functional units of an organism (eg. Smooth muscle cells)
- * Cells are the smallest living units in the human body



Levels of Structural Organization

3. Tissue Level

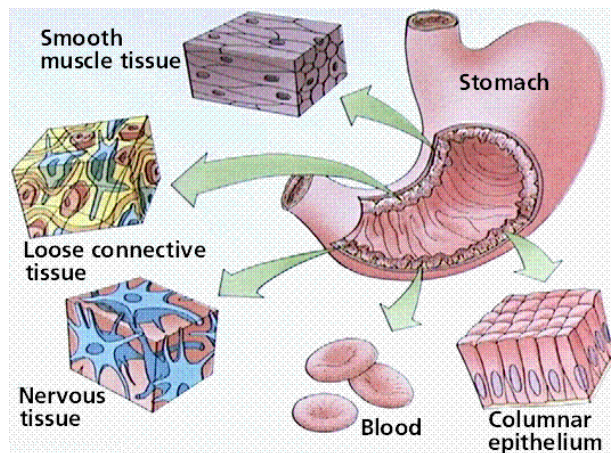
- * Tissues are groups of similar cells that work together to perform similar functions
- * There are four basic types of tissue:
 - * epithelial tissue
 - * connective tissue
 - * muscular tissue
 - * nervous tissue



Levels of Structural Organization

4. Organ Level

- * Organs are structures composed of two or more different tissue types
- * Organs have specific functions and recognizable shapes



Levels of Structural Organization

5. System Level:

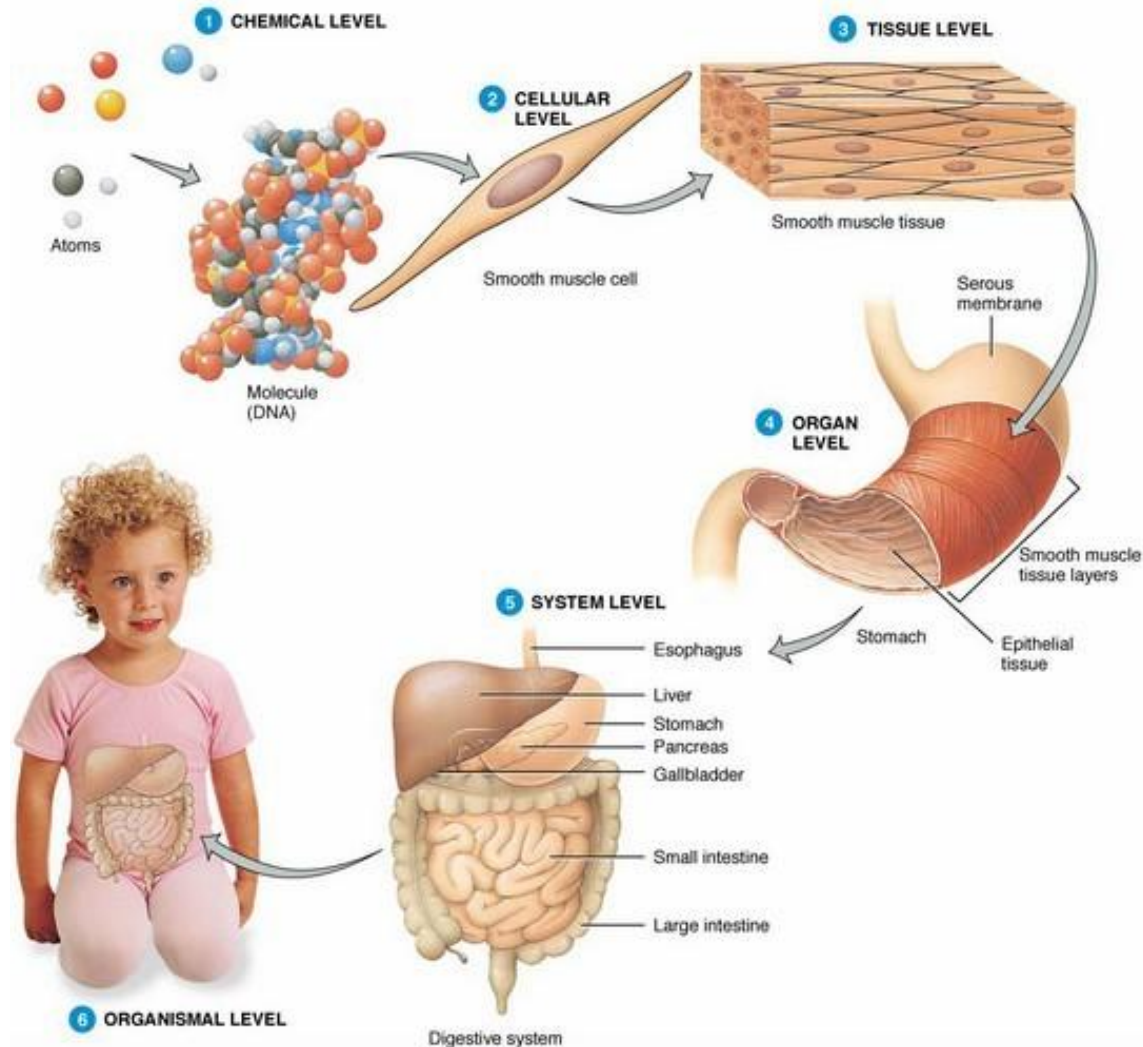
- * An organ system consists of related organs that have a common function (eg. Digestive System)

6. Organismal Level:

- * It is the collection of structurally and functionally integrated organ systems working together to constitute the organism (eg. Human being)



Levels of Structural Organization



Organ Systems

1. The Integumentary system:

- * It includes the skin, hair, nails, sweat glands, and sebaceous glands
- * It protects underlying tissues, regulates body temperature, houses sensory receptors, and synthesizes various substances (eg. Vitamin D)



Organ Systems

2. Skeletal system

- * The skeletal system is composed of bones, as well as cartilages and ligaments that bind bones together
- * It provides a protective framework, and serves as points of attachment of muscles
- * It also produces blood cells and stores inorganic salts such as calcium



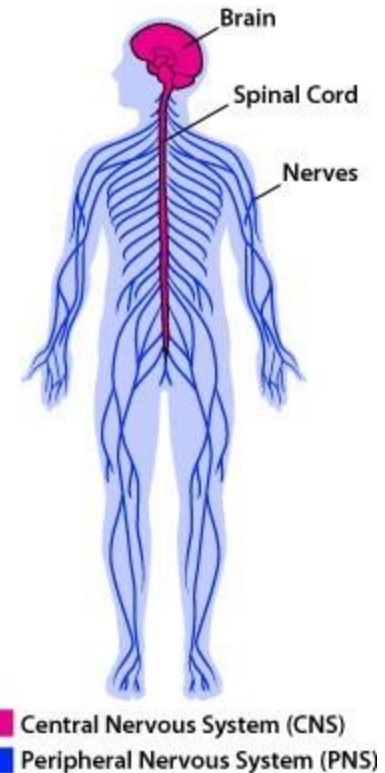
Organ Systems

3. Muscular System

- * The muscular system includes the muscles of the body
- * It moves body parts, maintains posture, and produces body heat



Organ Systems



4. Nervous System

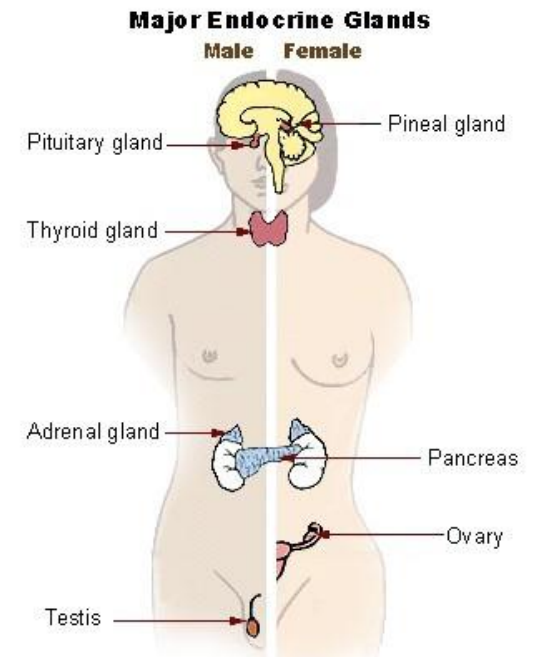
- * The nervous system consists of the brain, spinal cord, nerves, and sensory organs
- * It receives impulses from sensory parts, interprets these impulses, and acts on them by stimulating muscles or glands to respond



Organ Systems

5. Endocrine System

- * The endocrine system consists of glands that secrete hormones which help in regulating metabolism
- * This system includes the hypothalamus region of the brain and the pituitary, thyroid, parathyroid, and adrenal glands, and the pancreas, ovaries, and testes



Organ Systems

6. Cardiovascular System

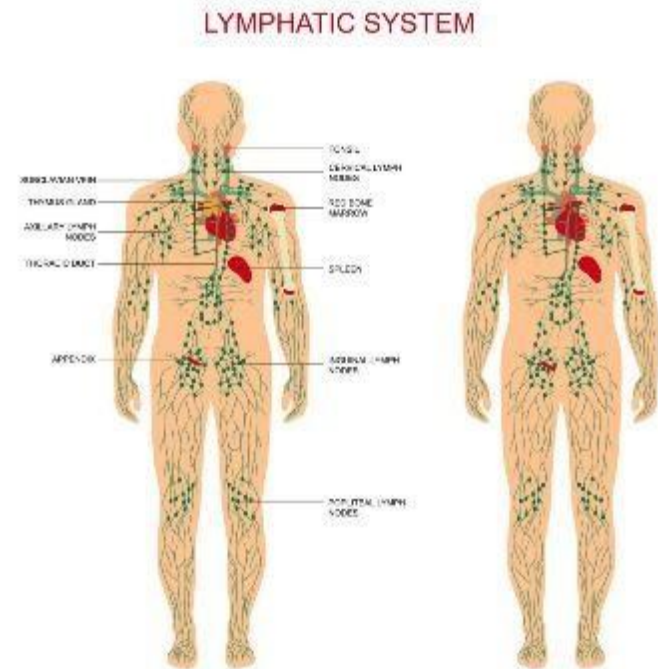
- * The cardiovascular system includes the heart, which pumps blood, and the blood vessels, which carry blood to and from body parts
- * Blood transports oxygen, nutrients, hormones, and wastes



Organ Systems

7. Lymphatic System

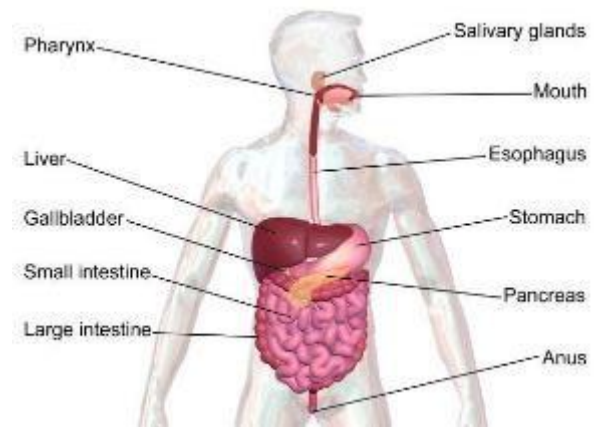
- * It is composed of lymphatic vessels, lymph fluid, lymph nodes, the thymus gland, and spleen
- * It transports lymph from tissues to the bloodstream, carries certain fatty substances away from the digestive organs, and aids in defending the body against disease causing agents (eg. Immunity)



Organ Systems

8. Digestive System

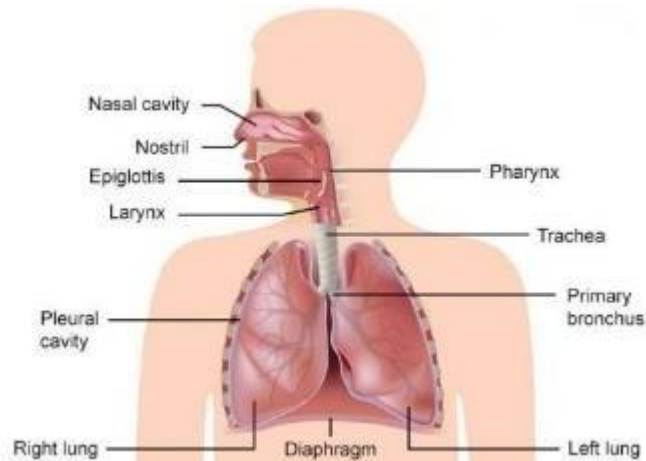
- * It breaks down food into nutrients that can easily pass through cell membranes, and be utilized by the body, and eliminates materials that are not absorbed
- * It includes the mouth, tongue, teeth, salivary glands, pharynx, esophagus, stomach, liver, gallbladder, pancreas, small intestine, and large intestine.
- * Some digestive organs also produce hormones



Organ Systems

9. Respiratory System

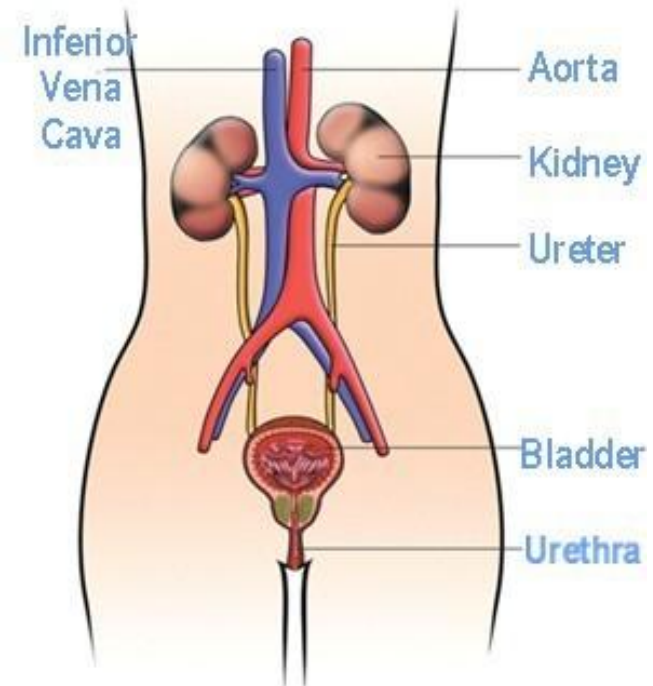
- * It takes in and sends out air and exchange carbon dioxide gases between the air and blood
- * It includes the nasal cavity, pharynx, larynx, trachea, bronchi, and lungs



Organ Systems

10. Urinary System

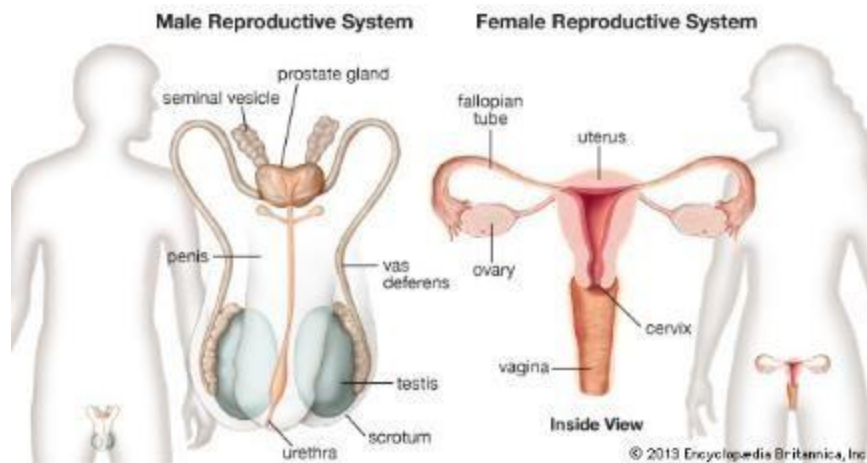
- * The urinary system includes the kidneys, ureters, urinary bladder, and urethra
- * It filters wastes from the blood and helps maintain water and electrolyte concentrations and the acidity of the internal environment of the body



Organ Systems

11. Reproductive System

- * The reproductive systems produces new organisms
- * The male reproductive system includes the scrotum, testes, prostate gland, urethra, and penis, which produce, maintain, and transport sperms
- * The female reproductive system includes the ovaries, uterine tubes, uterus, vagina, clitoris, and vulva, which produce, maintain, and transport oocytes



Characteristics of Living Human Organisms

All living organisms possess certain characteristics that distinguish them from nonliving things:

1. **Metabolism:** it is the sum of all chemical processes that occur in the body.
 - * Catabolism: the breakdown of complex substances into smaller and simpler substances
 - * Anabolism: the building up of complex substances from smaller and simpler components



Characteristics of Living Human Organisms

- 2. **Responsiveness:** it is the ability to detect and respond to changes in the external or internal environment
- 2. **Movement:** it includes motion of the whole body, individual organs and single cells
- 2. **Growth:** an increase in body size and complexity, due to an increase in the number of cells, size of cells, or both



Characteristics of Living Human Organisms

5. Differentiation: it is the development of a cell from an unspecialized state to a specialized state (eg. Stem cells)

5. Reproduction:

- * Formation of new cells for tissue growth
- * Repair, or replacement or production of a new individual following the fertilization of an ovum by a sperm cell



Body Fluids

The body fluids include:

- * **Intracellular fluid (ICF)** is the fluid that is contained within the cytoplasm of the cell
- * **Extracellular fluid (ECF)** refers to fluid situated outside the cells, and the naming and composition of ECF varies depending on its location



Extracellular Fluid

The different types of ECF include:

1. Interstitial fluid:

- * It is the extracellular fluid that is contained in the narrow spaces between cells
- * The composition of the interstitial fluid is critical for cells to function properly
- * The composition of interstitial fluid changes as substances move back and forth between it and blood



Extracellular Fluid

- 2. **Blood plasma:** the liquid portion of the blood and is contained in the blood vessels
- 2. **Lymph:** fluid contained in lymphatic vessels
- 2. **Cerebrospinal fluid:** fluid that surrounds the brain and spinal cord
- 2. **Synovial fluid:** fluid located within the joint cavity



Homeostasis

- * Homeostasis is the maintenance of relatively stable conditions within the body's internal environment
- * Its function is to maintain the internal environment of the body within normal limits (eg. Blood glucose levels)



Control of Homeostasis

- * The control of homeostatic mechanisms primarily involves the nervous system and endocrine system, working together or independently:
 - * the **nervous system** uses nerve impulses to stimulate organs and cells to make rapid changes
 - * the **endocrine system** uses hormones as chemical messengers to make changes that occur more slowly

The different regulating mechanisms of the body use feedback systems to monitor and make changes to the internal environment



Feedback Systems

- * The body regulates its internal environment through many feedback systems
- * A **feedback system** is a cycle of events in which the status of a condition is continually monitored, evaluated and changed
- * A controlled condition is a monitored variable whose value can change. For example, blood pressure, body temperature and blood glucose
- * A stimulus refers to any disruption that changes a controlled condition



Feedback Systems

- ❓ * A feedback system consists of three basic components:

1. Receptor

- * It is typically a nerve ending or other body structure that monitors changes in a controlled condition
- * It sends input (information) to the control centre, via nerve impulses or chemical signals



Feedback Systems

2. Control Center

- * The control centre sets the range within which a controlled condition should be maintained
- * It also evaluates the input it receives from receptors and generates output commands (messages) usually in the form of nerve impulses or hormones to create changes if necessary



Feedback Systems

3. Effector

- * The effector is a body structure that receives output from the control centre and produces a response or effect that changes the controlled condition



Example:

- ❓ * For example, when body temperature drops sharply, the brain (control centre) sends nerve impulses (output), to skeletal muscles (effectors), resulting in shivering which generates heat and raises body temperature



Types of Feedback Systems

1. Negative Feedback Systems

- * A negative feedback system reverses a change in a controlled condition
- * If a stimulus disrupts homeostasis by changing a controlled condition, the receptor informs the control center of this change, and the control center signals the effector to respond by altering the controlled condition and restoring homeostasis
- * Majority of the feedback systems in the body are negative feedback systems



Types of Feedback Systems

2. Positive Feedback Systems

- * A positive feedback system strengthens or reinforces a change in one of the body's controlled conditions
- * It operates similar to a negative feedback system, except for the way the response affects the controlled condition
- * If a stimulus disrupts a controlled condition, the receptor informs the control center which signals the effector to respond by enhancing the stimulus, that adds to or reinforces the initial change in the controlled condition
- * This continues until the cycle is broken
- * Examples include childbirth and blood clotting



Homeostatic Imbalances

- * Homeostasis must be maintained in order for the body to remain healthy. When controlled conditions remain within their narrow homeostatic limits, body cells function efficiently and the body stays healthy
- * If equilibrium is disturbed, and the imbalance is moderate, a disorder or disease may occur, while if the disruption is severe, death may occur.



Homeostatic Imbalances

- * A person with a disease may exhibit various signs and/ or symptoms:
 - * **Symptoms** are subjective complaints that are not visible to an observer. For example, headache, nausea, anxiety
 - * **Signs** are objective changes that a clinician can observe and measure, and can be either anatomical or physiological. For example: swelling, rash, fever, high blood pressure, paralysis



Body Cavities

- * Body cavities are spaces within the body that help protect, separate and support internal organs
- * Bones, muscles, ligaments and other structures separate the various body cavities from one another



Body Cavities

* The different body cavities include:

1. Cranial cavity:

* formed by cranial bones and contains the brain

2. Vertebral (spinal) canal:

* formed by bones of vertebral column and contains the spinal cord



Body Cavities

3. Thoracic cavity:

- * formed by the ribs, muscles of the chest, the sternum and thoracic portions of the vertebral column
- * The thoracic cavity is further subdivided into smaller cavities as follows:



Body Cavities

- * **i. Mediastinum:** the space between the lungs that extends from the sternum to the vertebral column and from the first rib to the diaphragm
- * contains all the thoracic organs such as the heart, esophagus, trachea, thymus and several large blood vessels, except the lungs themselves



Body Cavities

- * **ii. Pericardial cavity:** the fluid filled space that surrounds the heart
- * **iii. Pleural cavity:** the fluid filled space that surrounds the lungs on both sides



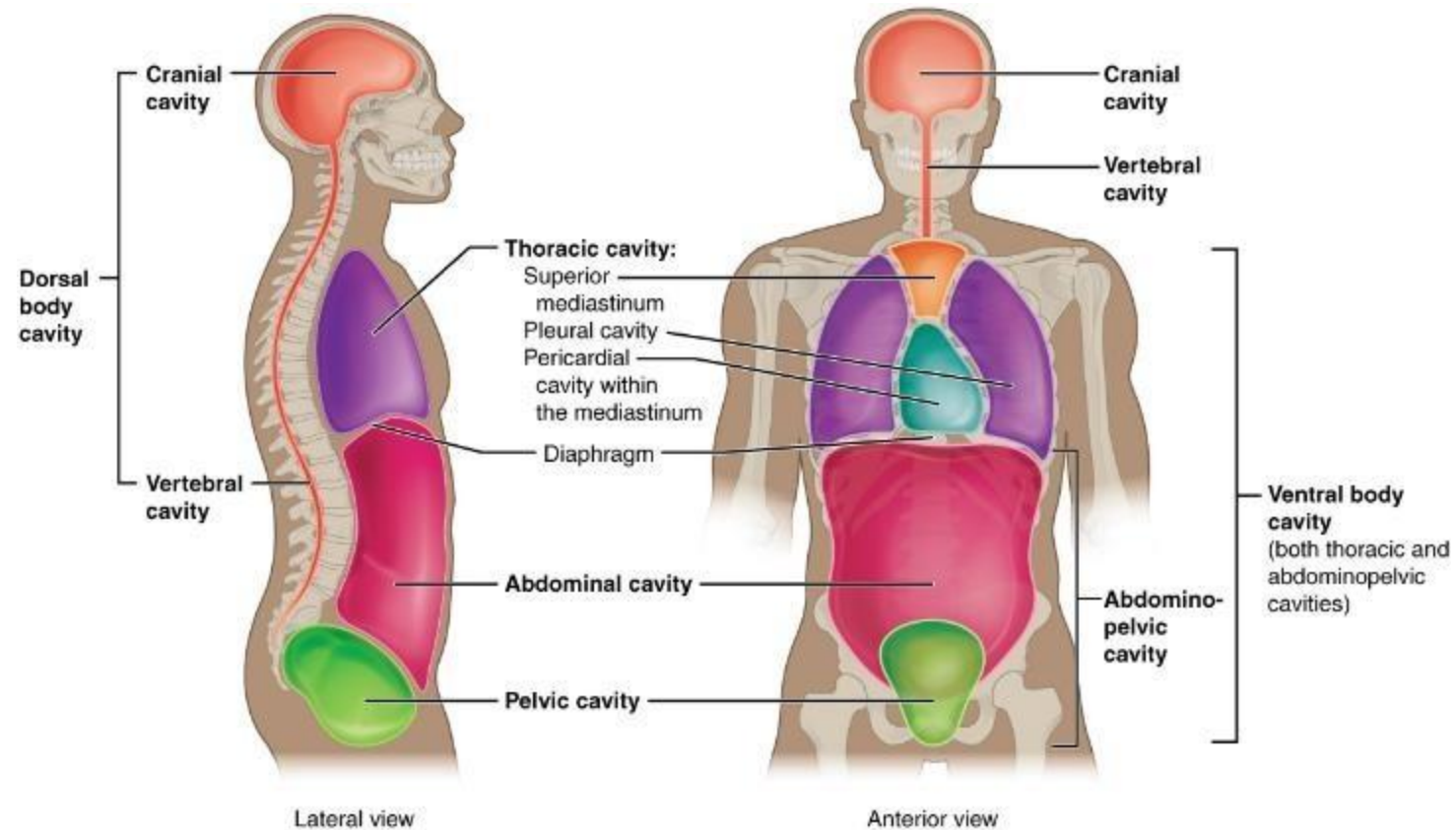
Body Cavities

4. Abdominopelvic Cavity:

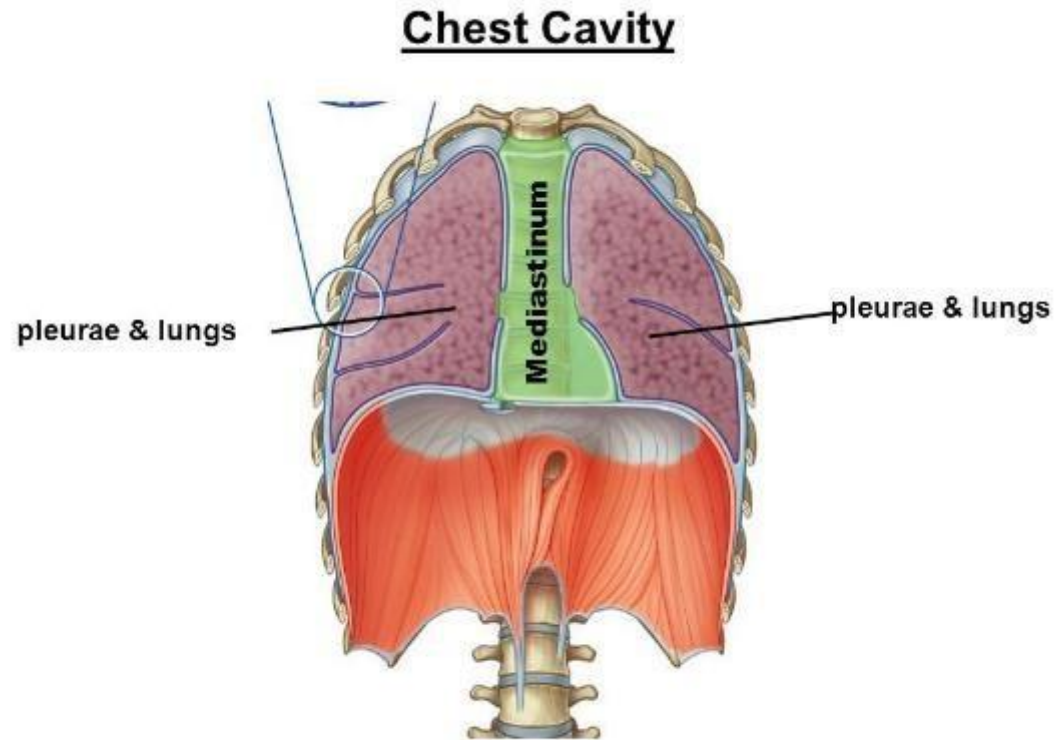
- * extends from the diaphragm to the groin and is supported by the abdominal wall and the bones and muscles of the pelvis. It is divided into two parts namely:
 - * **i. Abdominal cavity:** it is the superior part, and contains the stomach, spleen, liver, gall bladder, small intestine and most of the large intestine
 - * **ii. Pelvic cavity:** it is the inferior part and contains the urinary bladder, portions of the large intestine and internal organs of the reproductive system



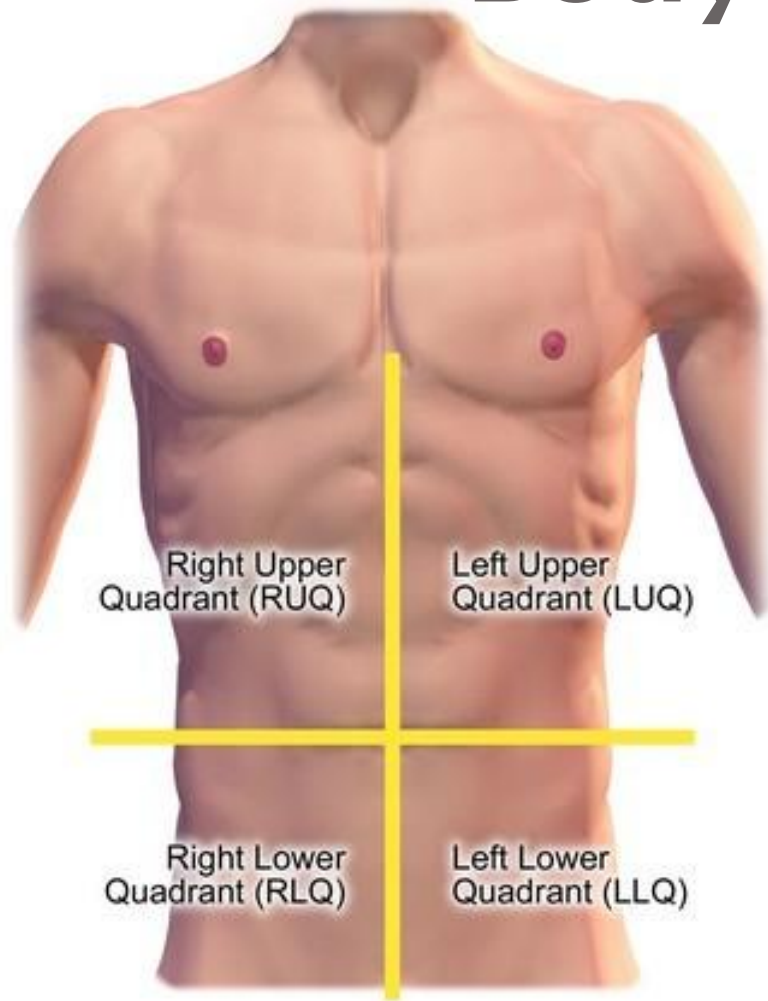
Body Cavities



Mediastinum



Body Cavities



The abdominopelvic cavity can also be divided into **four quadrants** by a vertical line and a horizontal line that pass through the umbilicus.

The four quadrants are as follows:

- * Right upper quadrant (RUQ)
- * Left upper quadrant (LUQ)
- * Right lower quadrant (RLQ)
- * Left lower quadrant (LLQ)



Nine Regions of the Abdominopelvic Cavity

The nine regions are:

- * Right hypochondriac
- * Epigastric
- * Left hypochondriac
- * Right lumbar region
- * Umbilical
- * Left lumbar
- * Right inguinal(iliac)
- * Hypogastric
- * Left inguinal (iliac)

