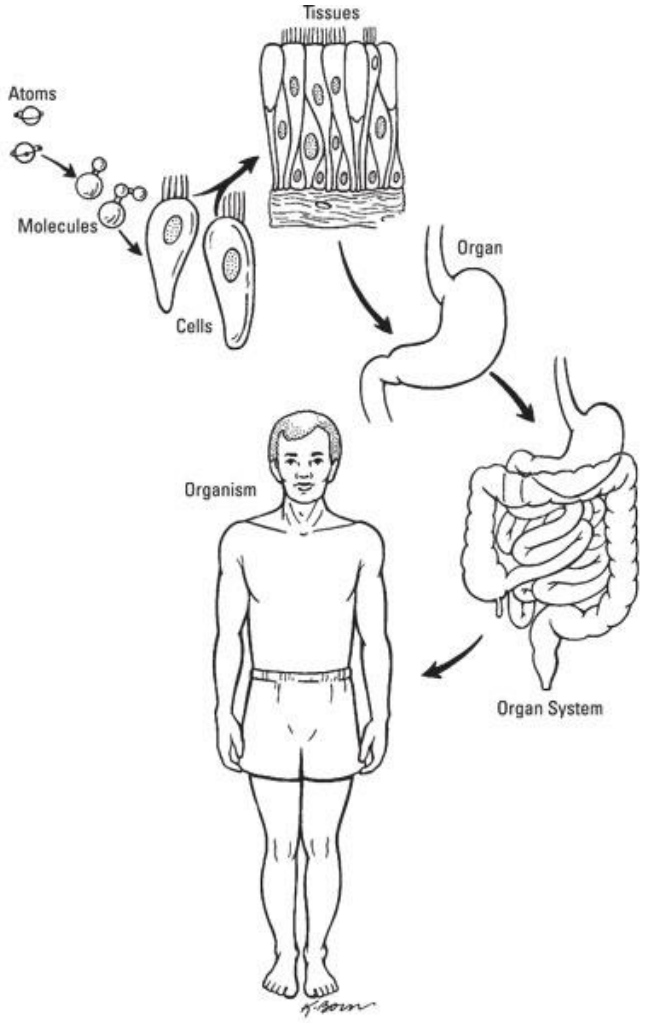
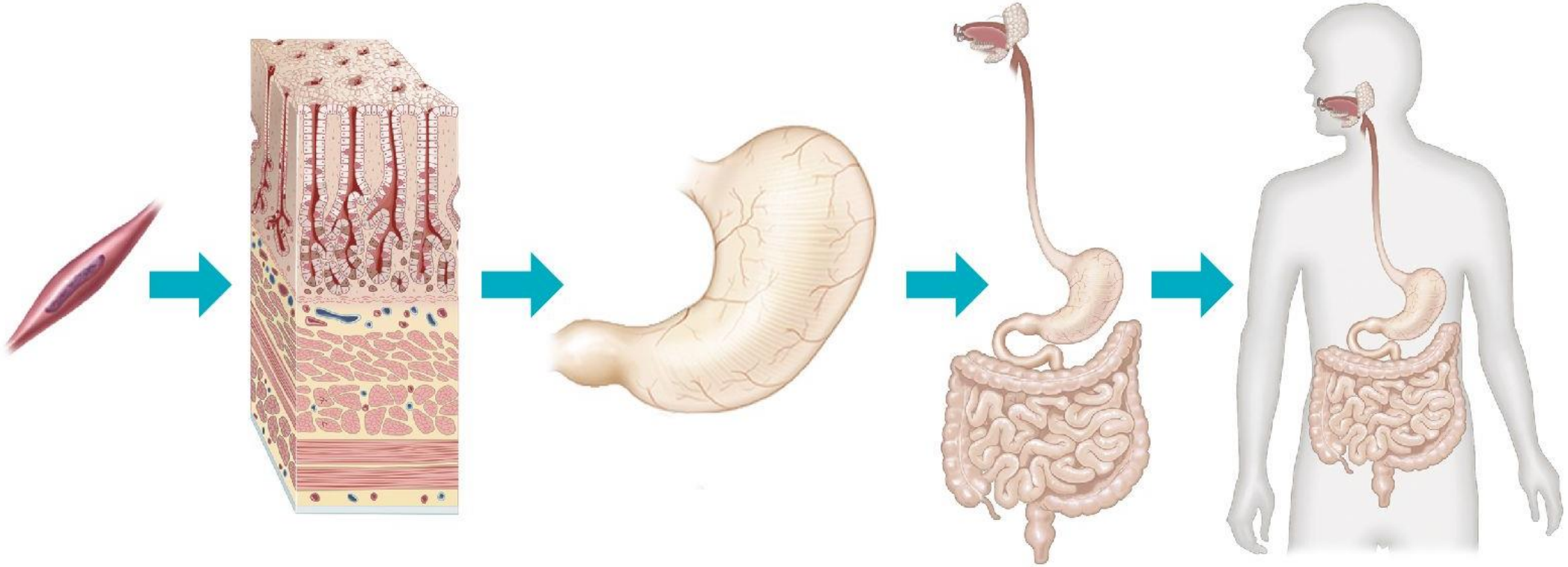
Body Structure

Levels of Organization in the Human Body

1. **Body**: The entire human organism, composed of all systems working together.
2. **Systems**: Groups of organs that perform specific functions (e.g., the circulatory system, respiratory system).
3. **Organs**: Structures made up of different types of tissues that perform specific tasks (e.g., the heart, lungs, liver).
4. **Tissues**: Groups of similar cells that work together to perform a particular function (e.g., muscle tissue, nervous tissue).
5. **Cells**: The basic unit of life; the smallest functional and structural unit of an organism (e.g., red blood cells, nerve cells).



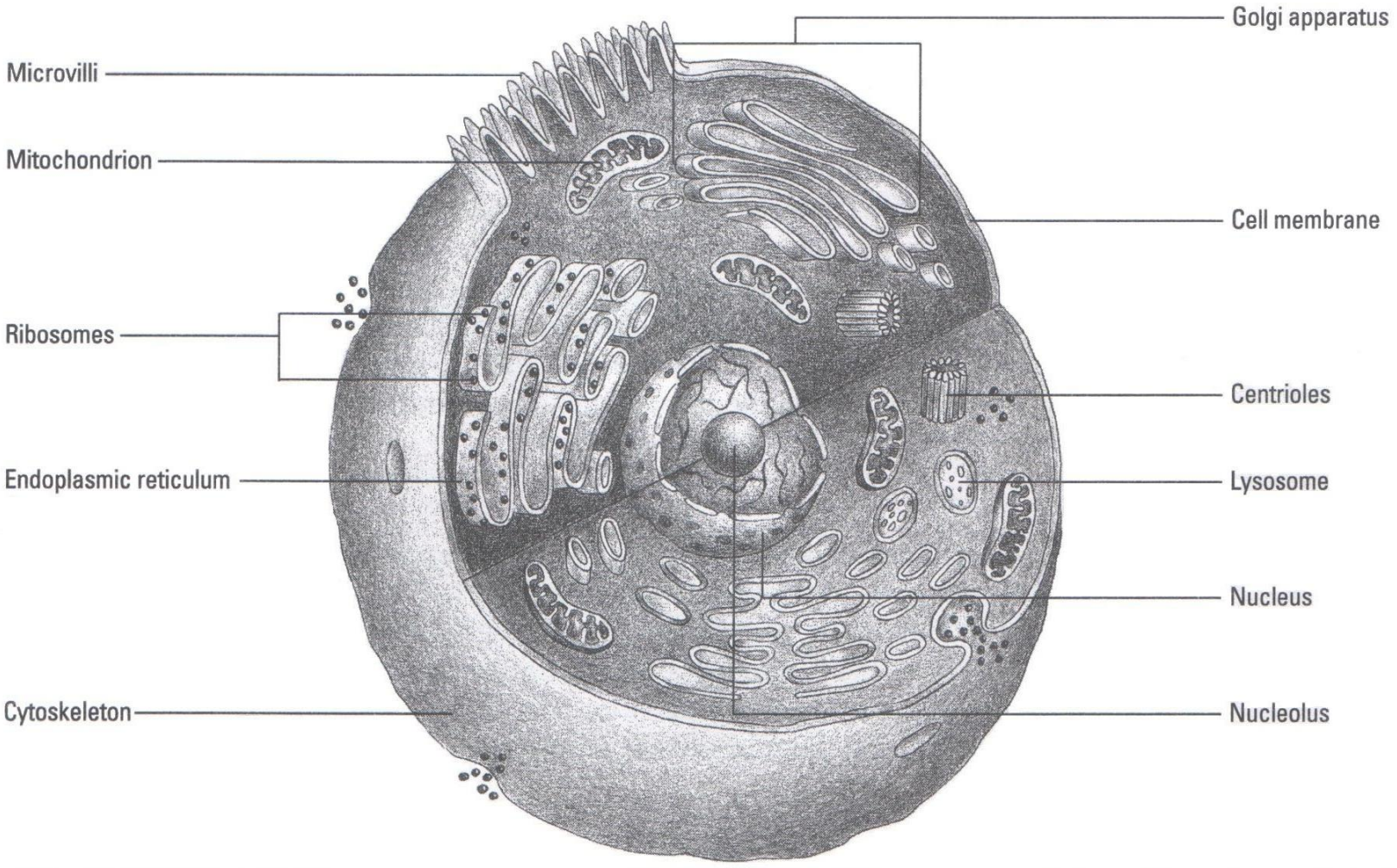
Levels of Organization in the Human Body



The cell organelles

- **Nucleus**: the name derived from Latin word (nuculeus) which means kernel (i.e. core or seed).
  - **Function**: Stores deoxyribonucleic acid (DNA), which carries the genetic materials and is responsible for cellular reproduction or division.
- **Mitochondria**: the cell's power plant
  - **Function**: Production of adenosine triphosphate (ATP), the high energy molecule that fuels cellular activity
- **Ribosomes and endoplasmic reticulum**:
  - **Function**: Synthesis of proteins and metabolism of fat within the cell
- **The Golgi apparatus**:
  - **Function**: Holds enzyme systems that assist in completing the cellular metabolic functions
- **Lysosomes**:
  - **Function**: Contain enzymes that allow cytoplasmic digestion

The cell organelles



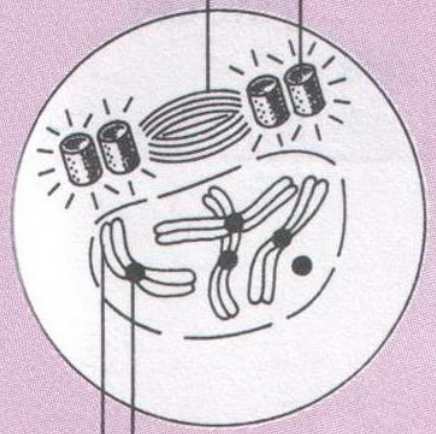
Cell division and reproduction

- Cells reproduce to replace cells that are lost by wear and tear
- Cells reproduce by splitting into two separate daughter cells by mitosis [root = mitos (Greek) means thread + suffix = -osis means action or state]
- Before getting into mitosis the cellular mass double and chromatin begins to form.
- Mitosis is composed of Four phases, they are
  - **Prophase** (chromosomes coil and shorten, nuclear membrane dissolve, chromatids and centromeres appear)
  - **Metaphase** (centromeres divide and align themselves in the middle of the spindle)
  - **Anaphase** (centromere separate and pull chromosomes toward opposite sides of the cell, 46 chromosomes are present on each side of the cell)
  - **Telophase** (spindle fibers disappear, cytoplasm divides, an new membrane forms around each set of 46 chromosomes). Telo- (Greek) means ultimate end
- **Meiosis** only occurs in gametes (ova and spermatozoa).
  - In this division, the number of chromosomes in the Four daughter cells is reduced to half (i.e. 23 chromosomes).
  - Meiosis (Greek, meaning lessening) consists of two divisions separated by a resting phase.

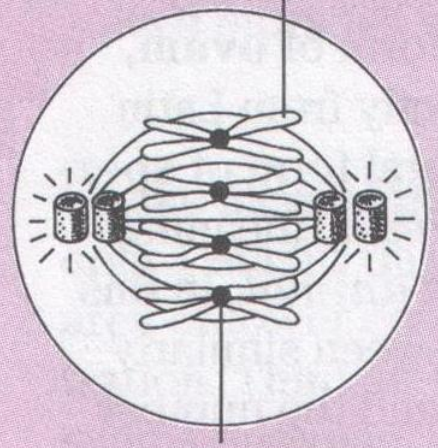
Replicate and divide

The illustrations here show the different phases of mitosis, or cell reproduction.

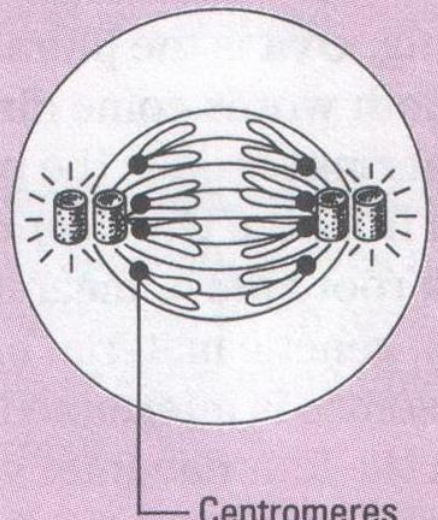
Prophase



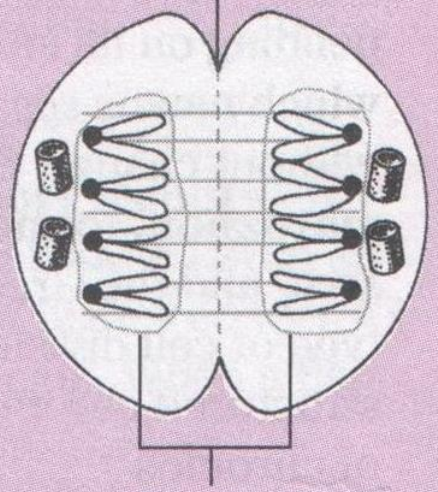
Metaphase



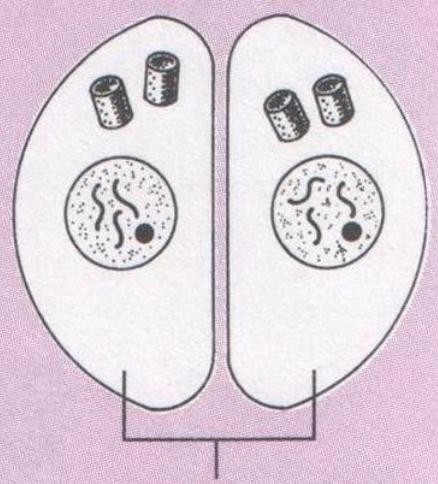
Anaphase



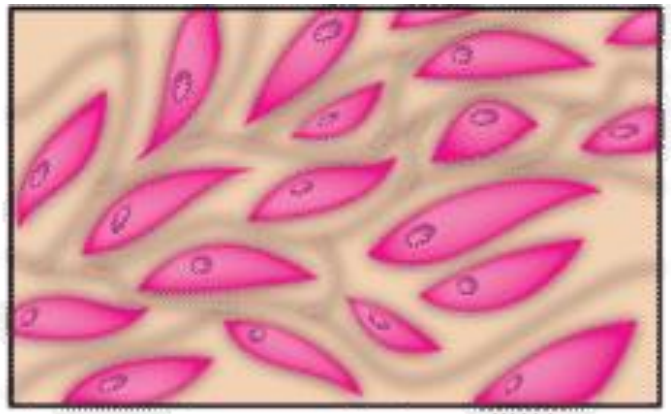
Telophase



Division complete

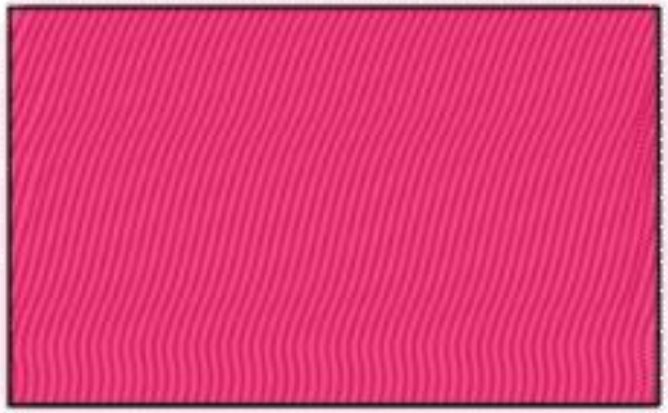


The 4 Types of Body Tissues

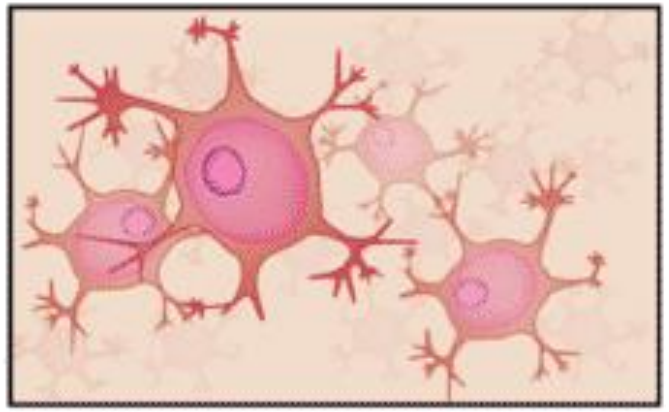


Connective tissue

Epithelial tissue



Muscle tissue



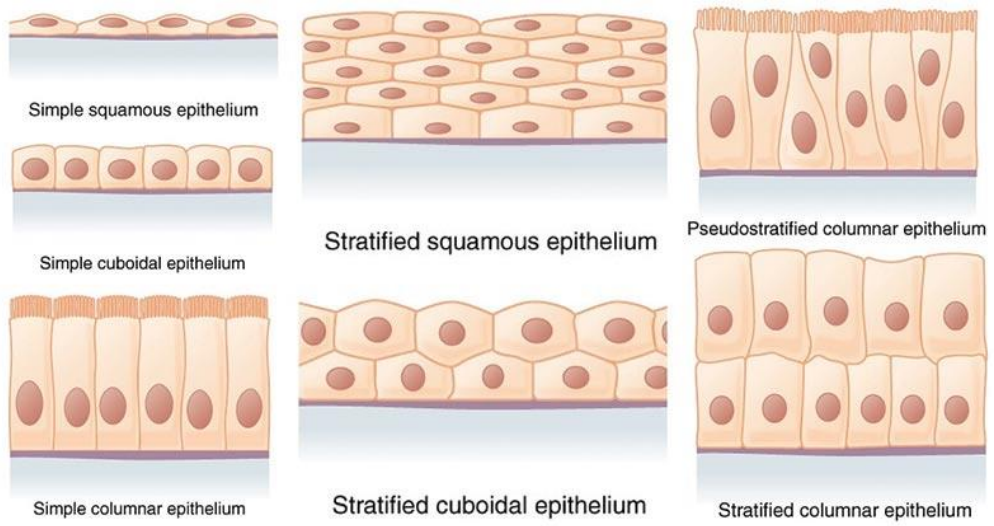
Nervous tissue

1. Epithelial tissue

- **Epithelium** is a continuous cellular sheet that covers the body's surface, lines body organs, and forms certain glands.
- **Endothelium**
  - **Definition**: The endothelium is a specialized type of epithelium that consists of a single layer of flat (squamous) cells.
  - **Location**: It lines the interior surface of blood vessels (including arteries, veins, and capillaries) and the heart.
  - **Function**: The endothelium plays a crucial role in regulating vascular functions, including the permeability of blood vessels, inflammation, and blood clotting.
- **Mesothelium**
  - **Definition**: The mesothelium is also a specialized type of epithelium, which lines the surfaces of serous membranes.
  - **Location**: It covers organs within the thoracic and abdominal cavities, including the pleura (lungs), pericardium (heart), and peritoneum (abdominal organs).
  - **Function**: The mesothelium produces serous fluid, which lubricates the surfaces of these membranes and reduces friction between organs.

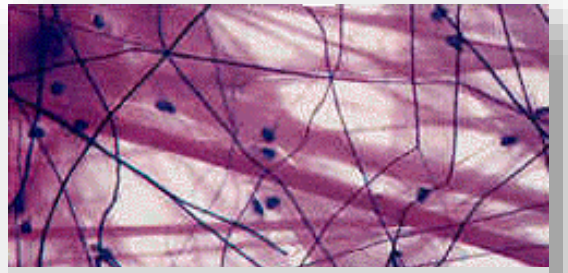
1. Epithelial tissue

Classification of the epithelial tissue according to the number of layers		Classification of the epithelial tissue according to the shape of cells	
Simple	One layer of cells	Squamous	Flat surface cell
Stratified	Three or more layers	Columnar	Tall, cylindrical, prism-shaped surface cells
Pseudostratified	One layer of cells but appears to have more	Cuboidal	Cube-shaped surface cells



2. Connective tissue

- **Includes** bone, cartilage, and adipose (fatty) tissue and blood.
- This tissue bonds together and support structure.
- **Connective tissue is classified as loose or dense**.
  - **Loose connective tissue** has large spaces that separate the fibers and cells with much intercellular fluid.
  - **Dense connective tissue** has greater fiber concentration and provides structural support.
  - Adipose tissue is a specialized type of loose connective tissue. It cushions internal organs and acts as a reserve supply of energy.

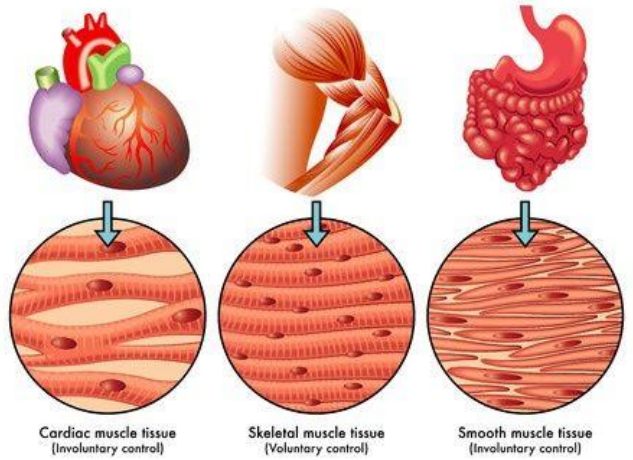


Loose connective tissue

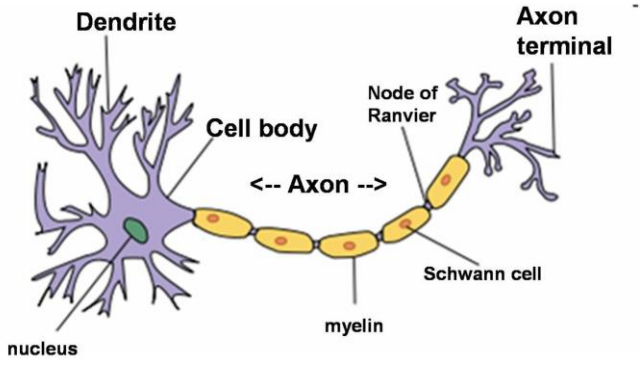
Dense connective tissue

Muscular and Nervus Tissues

3. **Muscular tissue**
   - Skeletal muscle tissue (striated and voluntary)
   - Cardiac muscle tissue (striated and involuntary)
   - Smooth muscle tissue (non-striated and involuntary)
     - Lines the wall of many internal organs and other structures such as walls of arteries and veins.



4. **Nervous tissue**
   - It's a reactive tissue.
   - Its main function is communication.
   - Nervous tissue cells may be **Neurons** or **Neuroglia**
     - **Neurons** consist of cell body, axons and dendrites
     - **Neuroglia** support neurons of nervous tissue
       - They found only in the central nervous system.
       - They insulate and protect neurons.



Body Organs And Systems

- The hemopoietic and immune system.
  - The suffix -poiesis = to make.
- The nervous system and special senses
- The genitourinary system
- The gastrointestinal system
- The cardiovascular system
- The respiratory system
- The endocrine system
- The integumentary system
  - Includes skin, hair, nails, and sweat glands.
  - It protects the body and helps regulate body temperature.
  - Integumentum in Latin means to cover.
- The musculoskeletal system

Directional Terms

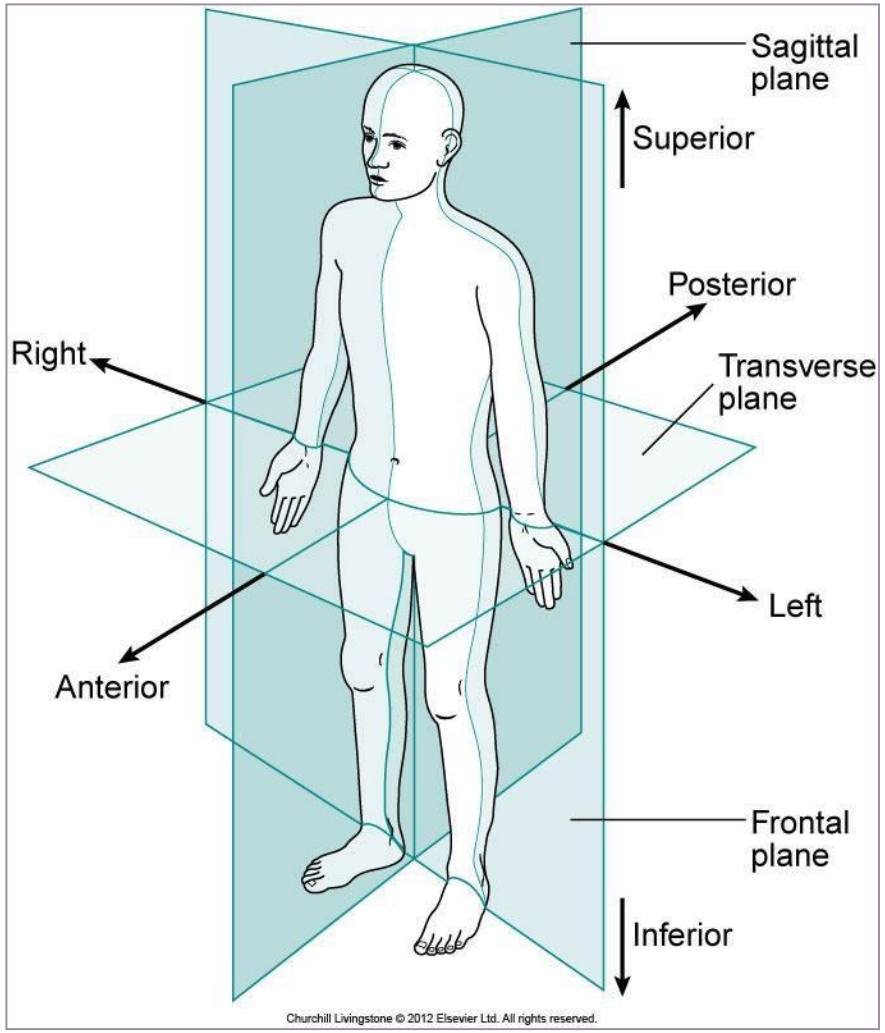
Superior	Above	Superficial	Near the surface
Inferior	Bellow	Deep	Away from the surface
Anterior	In front of	Ventral	Toward the abdomen
Posterior	In back of	Dorsal	Toward the back
Medial	Toward the midline	Eversion	Turning outward
Lateral	Away from the midline	Inversion	Turning inward or inside out
Proximal	Nearest to the point of origin	Parietal	Pertaining to the outer wall of the body cavity
Distal	Farthest to the point of origin	Visceral	Pertaining to the viscera, or internal organs, especially the abdominal organs

Directional Terms

Superior Vs Inferior	• The Head is superior (above) to the body • The body is inferior (under) to the head
Anterior Vs Posterior	• The incisors teeth are anterior to (in front of) molars teeth • The molars teeth are posterior to (in back of) incisors teeth
Ventral Vs Dorsal	• The umbilicus is at the ventral aspect of the body • The spine is in the dorsal aspect of the body
Medial Vs Lateral	• The trunk is medial to the arms • The arms are lateral to the trunk
Proximal Vs Distal	• The arms are proximal to the hands • The hands are distal to the arms
Superficial Vs Deep	• The skin is superficial to the muscles • The muscles are deep to the skin

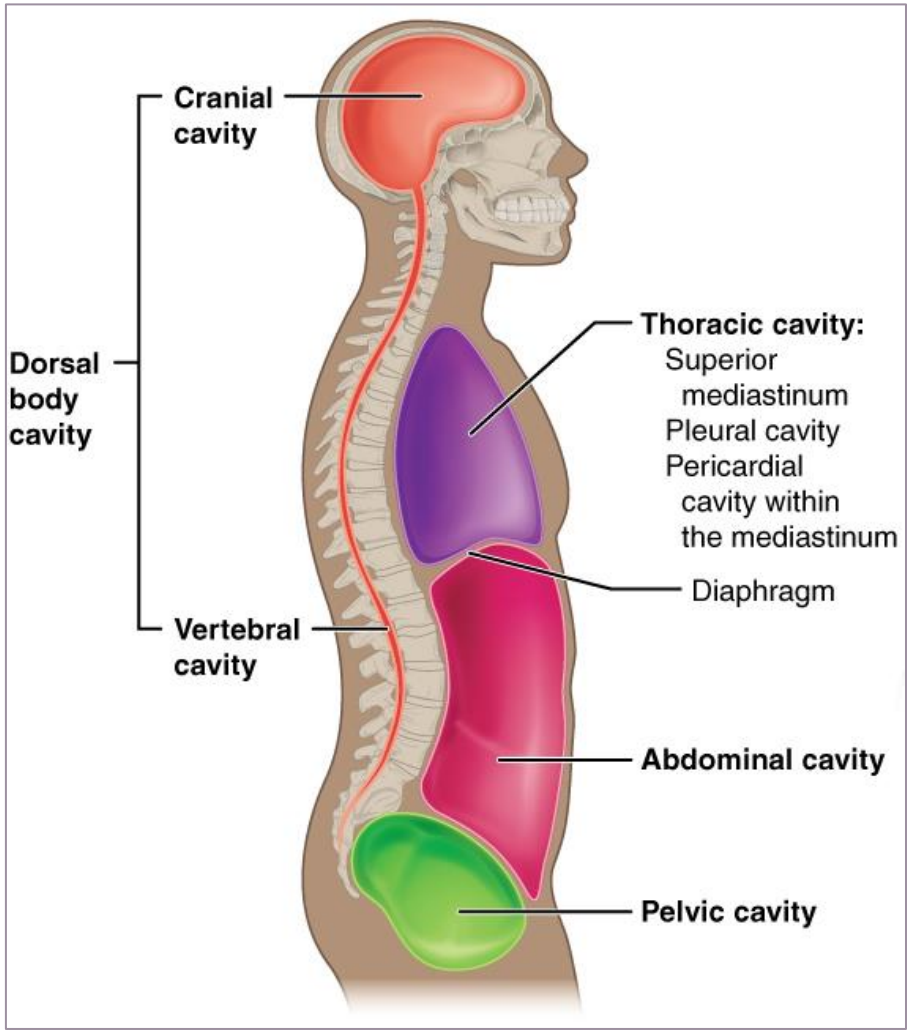
Body planes and sections

- **Sagittal plane**: runs lengthwise from front to back and divides the body into right and left sides, each containing an arm and a leg
- **Frontal plane**: runs lengthwise from side to side, dividing the body into ventral and dorsal (front and back) sections.
- **Transverse plane (horizontal plane)**: Cuts the body into upper and lower parts. These are known as the cranial (head) and the caudal (tail) portions.



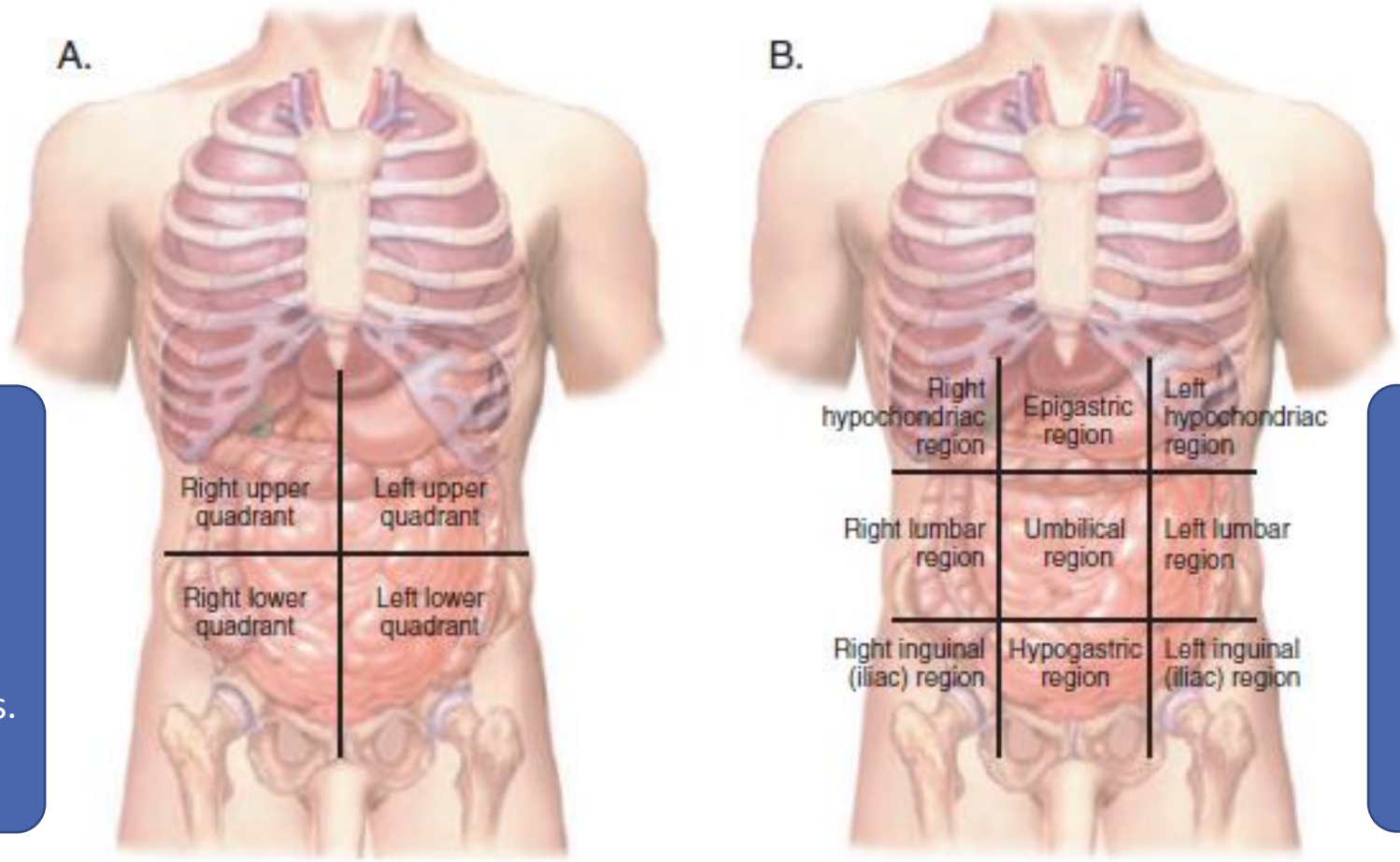
Body cavities

- **Ventral cavity**
  - Thoracic (chest) cavity.
    - It includes the mediastinum and pleural cavities
  - Abdominopelvic cavity.
- **Dorsal cavity**
  - Cranial cavity
  - Spinal cavity



What is the difference between a quadrant and region?

The quadrants of the abdomen are used primarily to identify topographical sites.



Quadrants and regions. (A) Four quadrants of the abdomen. (B) Nine regions of the abdomen

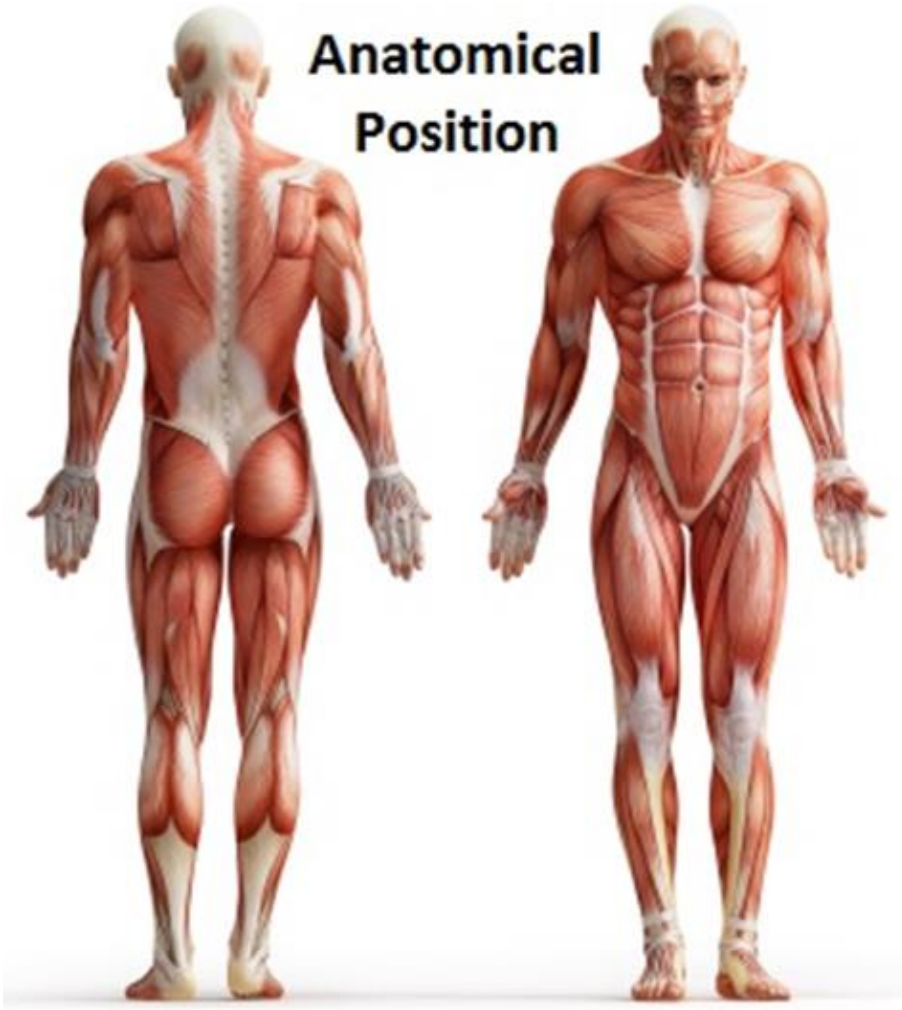
The abdominopelvic regions are used mainly to identify the location of underlying body structures and visceral organs

Abdominal regions

Right hypochondriac region	Contains the liver, right kidney, and portion of the diaphragm
Epigastric region	Contains the pancreas and portion of the stomach, liver, inferior vena cava, abdominal aorta, and duodenum
Left hypochondriac region	Contains a portion of the diaphragm, the spleen, the stomach, the left kidney, and part of the pancreas
Right lumber region	Contains portions of the large intestines and the right kidney
Umbilical region	Contains sections of the small and large intestines and a portion of the left kidney
Left lumber region	Contains portions of the small and large intestines and a portion of the left kidney
Right iliac (inguinal) region	Includes portions of the small and large intestines
Hypogastric region	Includes a portion of the sigmoid colon, the urinary bladder and ureters, and portions of the small intestine
Left iliac (inguinal) region	Contains portions of the small and large intestines

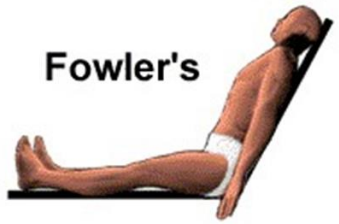
Anatomical Position

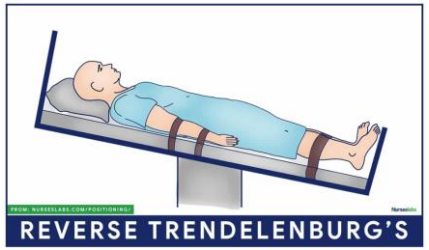
- **The anatomical position** is a body posture used to locate anatomical parts in relation to each other
- In is position, the body is erect and the eyes are looking forward. The upper limbs hang to the sides, with the palms facing forward. The lower limbs are parallel, with toes pointing straight ahead
- No matter how the body is actually positioned (standing or lying down, facing forward or backward) or how the limbs are actually placed, the positions and relationships of a structure are always described as if the body were in the anatomical position.

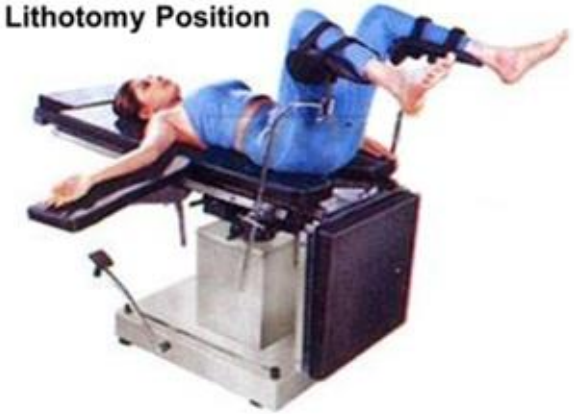


Other Positions

Fowler's position	Head of bed raised, knees slightly flexed
Trendelenburg's position	Lying flat with the head lower than the body or legs
Reverse Trendelenburg	Lying flat with the head higher than the body or legs
Lithotomy position	Lying on the back with the hips and knees flexed and the thighs abducted and externally rotated
Supine position	Lying flat on the back
Prone position	Lying face down







Supine

Prone