# VISWASS SCHOOL & COLLEGE OF NURSING

## GNM 1ST YEAR

## ANATOMY AND PHYSIOLOGY

## UNIT-2

## INTRODUCTION TO THE DETAILED STRUCTURE OF THE BODY

## LONG QUESTIONS AND ANSWERS

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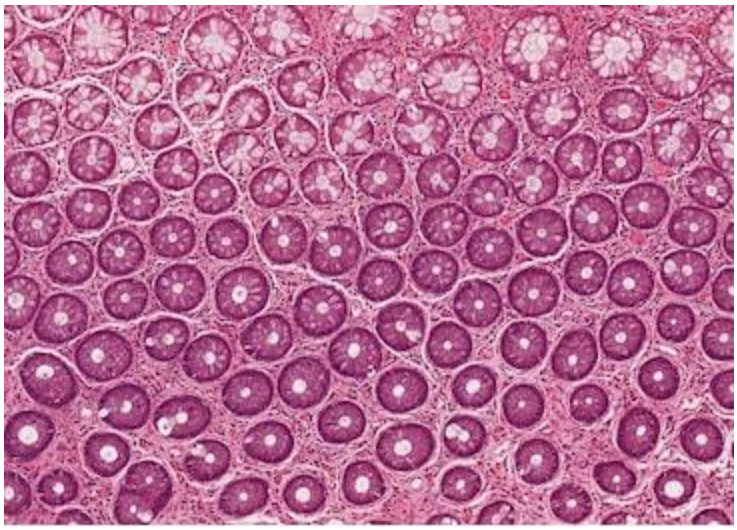
**1.a)Define Tissue.** **(2+6+7)**

**b)Classify the tissues.**

**c)Describe about epithelial tissue?**

**a)Tissue:**

- tissue is a cellular organisational level between cells and a complete organ.
- A tissue is an ensemble of similar cells and their extracellular matrix from the same origin that together carry out a specific function.
- Organs are then formed by the functional grouping together of multiple tissues.
- Tissues are groups of cells that have a similar structure and act together to perform a specific function.
- The word tissue comes from a form of an old French verb meaning “to weave”.

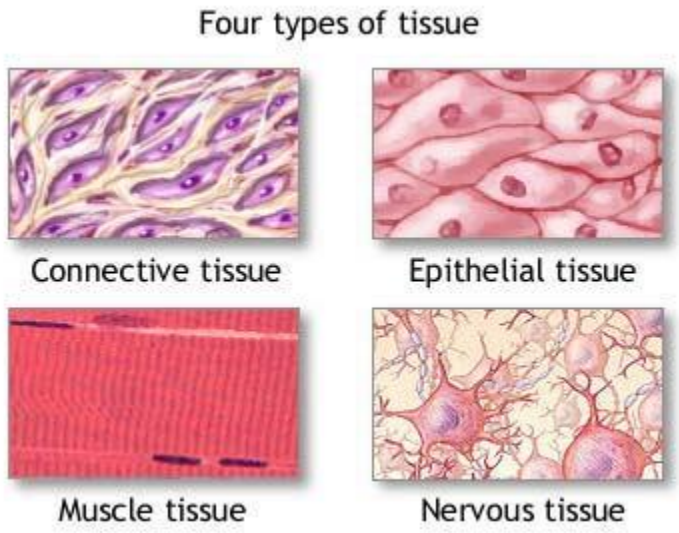


- tissues are absent from unicellular organisms. Even among the simplest multicellular species, such as sponges, tissues are lacking or are poorly differentiated.
- But multicellular animals and plants that are more advanced have specialized tissues that can organize and regulate an organism's response to its environment.

**b)classification of the tissue:**

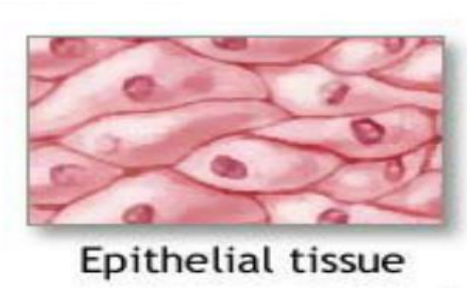
There are four main types of tissues, they are:

- Epithelial tissue or epithelium
- Connective tissue
- Muscle tissue
- Nervous tissue




Epithelial Tissue

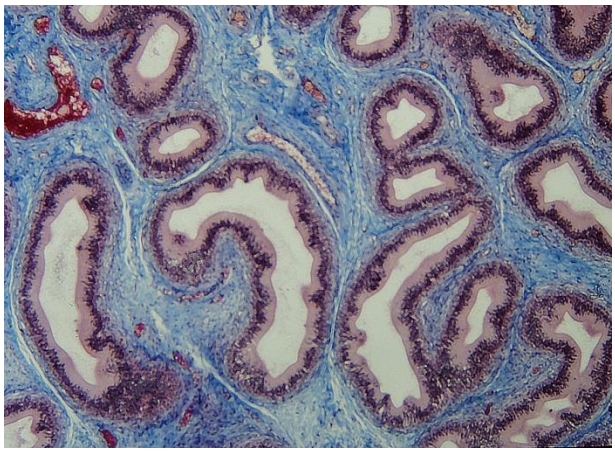
- Epithelial tissue is made up of epithelial cells, which are vastly different from the muscle cells we just talked about.
- These cells can be flat, cuboidal, or columnar.
- They are joined tightly together, making a single or stacked continuous sheet. Like a quilt that is tightly stitched, epithelium makes an excellent protective cover for the body, in the form of skin.
- Epithelial tissue can also be found lining some internal cavities and organs.




Connective Tissue

- Connective tissue makes up a connective web inside our body.

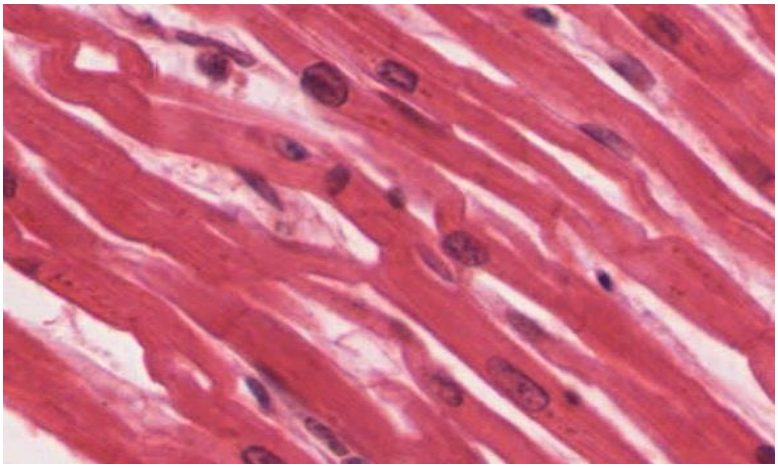
- Holding our body parts together and providing support are the main jobs of this tissue.
- We would certainly not be in good shape if all of our internal body parts were free-floating.
- Connective tissue fills in the spaces inside our body with a matrix made of fibers within a liquid, solid, or jelly-like substance.
- Think of a gelatin salad with fruit suspended inside, and you will have an idea of how certain types of connective tissue function.



Muscle Tissue

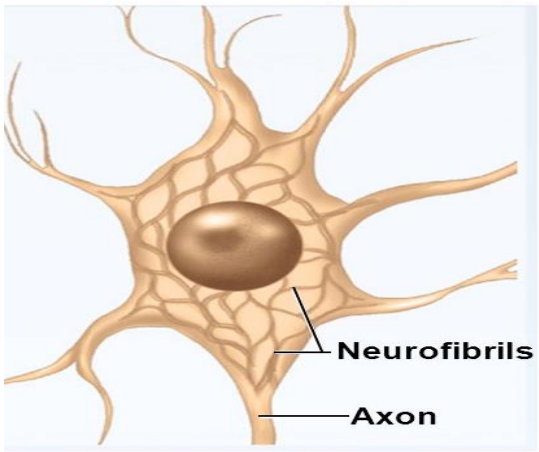
- these different types of tissue are made of particular kinds of cells that work together.

- Muscle tissue is made up of excitable cells that are long and fibrous.
- These cells are ready for contraction, or the activation of tension in our muscles, making it possible for us to move our body parts.
- They are arranged in parallel lines and are bundled, making muscle tissue very strong.
- If you take a pile of rubber bands, line them up next to each other and attempt to stretch them, you may get the idea of the nature of the muscle tissue.



Nervous Tissue

- Nervous tissue is found within the nervous system and is made up of unique specialized cells.
- Like electrical circuits, the nervous system transmits signals from nerves to the spinal cord and brain.
- Cells known as **neurons** conduct these impulses, making it possible for us to use our senses.

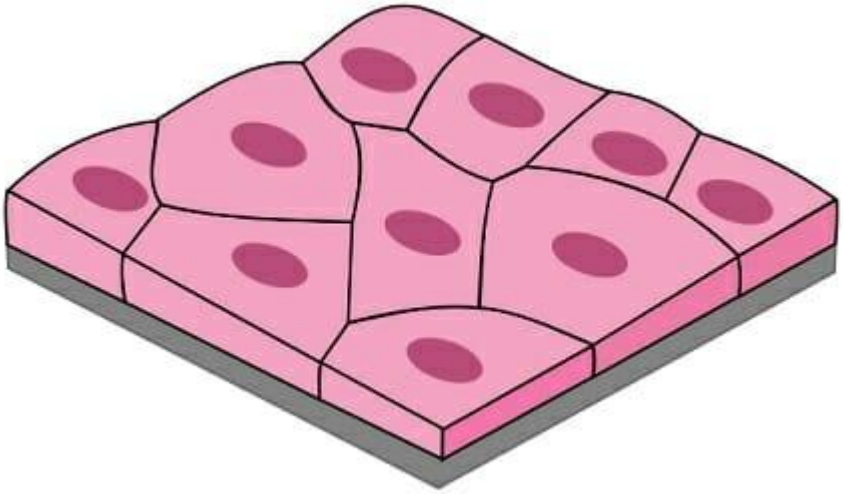



**c)describe about epithelial tissue:**

- Epithelium is one of the four basic types of tissue, along with connective tissue, muscle tissue and nervous tissue.
- Epithelial tissues line the outer surfaces of organs and blood vessels throughout the body, as well as the inner surfaces of cavities in many internal organs.
- An example is the epidermis, the outermost layer of the skin.
- There are three principal shapes of epithelial cell: squamous, columnar, and cuboidal.
- These can be arranged in a single layer of cells as simple epithelium, either squamous, columnar, or cuboidal, or in layers of two or more cells deep as stratified (layered), either squamous, columnar or cuboidal.
- In some tissues, a layer of columnar cells may appear to be stratified due to the placement of the nuclei.
- This sort of tissue is called pseudostratified.
- All glands are made up of epithelial cells. Functions of epithelial cells include secretion, selective absorption, protection, transcellular transport, and sensing.
- Epithelial layers contain no blood vessels, so they must receive nourishment via diffusion of substances from the underlying connective tissue, through the basement membrane.
- Cell junctions are well employed in epithelial tissues.

Simple epithelium

- Simple epithelium is a single layer of cells with every cell in direct contact with the basement membrane that separates it from the underlying connective tissue.
- In general, it is found where absorption and filtration occur. The thinness of the epithelial barrier facilitates these processes.
- In general, simple epithelial tissues are classified by the shape of their cells.
- The four major classes of simple epithelium are (1) simple squamous, (2) simple cuboidal, (3) simple columnar, and (4) pseudostratified.



- Simple squamous**:** Squamous epithelial cells appear scale-like, flattened, or rounded (e.g., walls of capillaries, linings of the pericardial, pleural, and peritoneal cavities, linings of the alveoli of the lungs).

Simple cuboidal**:** These cells may have secretory, absorptive, or excretory functions. Examples include small collecting ducts of the kidney, pancreas, and salivary gland.

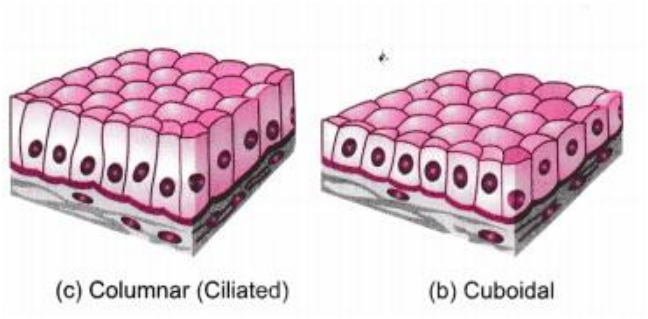
Simple columnar**:** Cells can be secretory, absorptive, or excretory.

Simple columnar epithelium can be ciliated or non-ciliated; ciliated columnar is found in the female reproductive tract and uterus.

Non-ciliated epithelium can also possess microvilli. Some tissues contain goblet cells and are referred to as simple glandular columnar epithelium.

These secrete mucus and are found in the stomach, colon, and rectum.

Pseudostratified columnar epithelium: These can be ciliated or non-ciliated. The ciliated type is also called respiratory epithelium since it is almost exclusively confined to the larger respiratory airways of the nasal cavity, trachea, and bronchi.




Stratified epithelium:

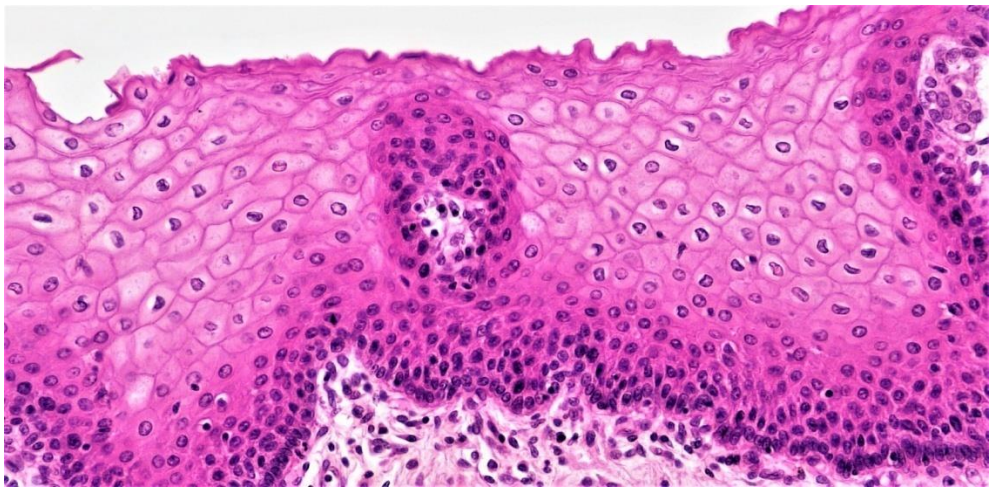
- Stratified epithelium consist of several layers of cells of various shapes.
- Continual cell division in the lower layers pushes cell above nearer and nearer to the surface, where they are shade.
- Basement membranes are usually absent.
- The main function of stratified epithelium is to protect underlying structures from mechanical wear and tear.
- There are two main types:
    - Stratified squamous
    - teransitional

stratified squamous epithelium:

it is composed of several layers of cells. In the deepest layers the cells are mainly columnar and, as they grow towards the surface, they become flattened and are then shed.

Transitional epithelium:

It is composed of several layers of pear shaped cells. It lies on several parts of the urinary tract, including the bladder, and allow for stretching as the bladder fills.



**2)a)Describe organisation of body. (8+7)**

**b)Briefly explain about the body cavity.**

**a)Organisation of body:**

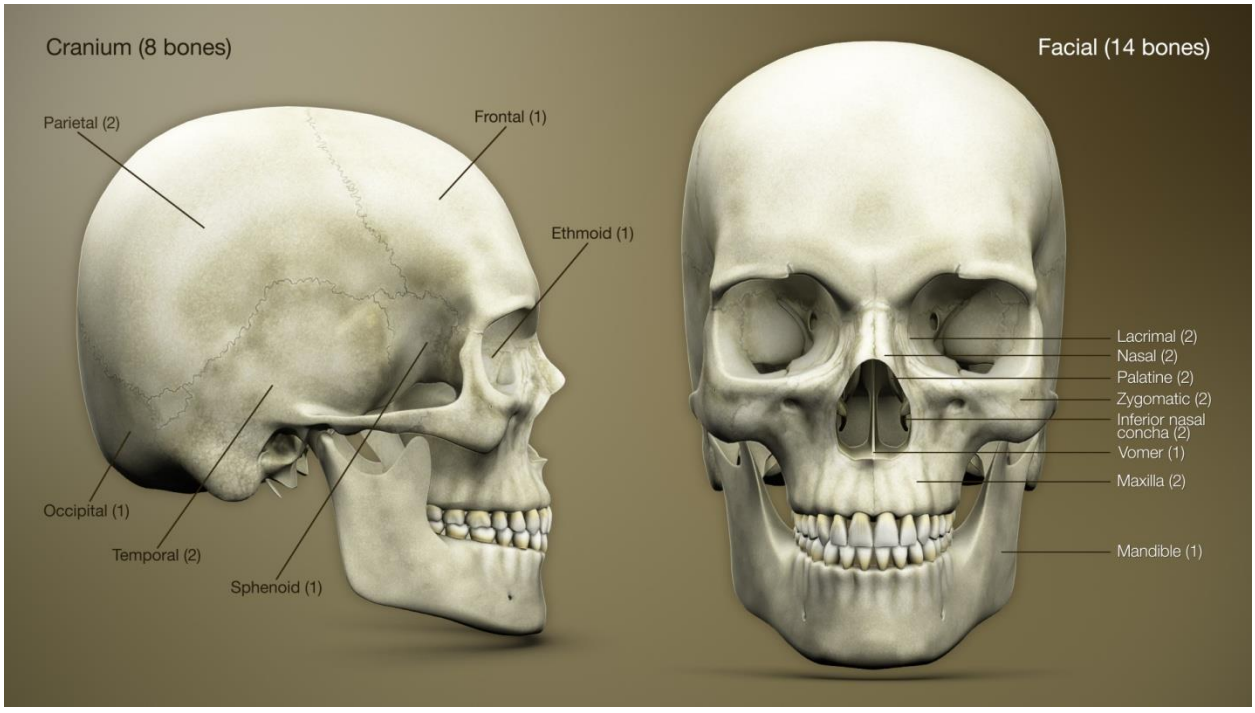
- Skeleton is the bony framework of the body.
- It forms the cavities and fossae, that protect some structuresz, forms the joints and gives attachment to muscles.
- The skeleton is described in two parts:
    - Axial skeleton
    - Appendicular skeleton

Axial skeleton

The axial skeleton consists of the skull, vertebral column, sternum and ribs.

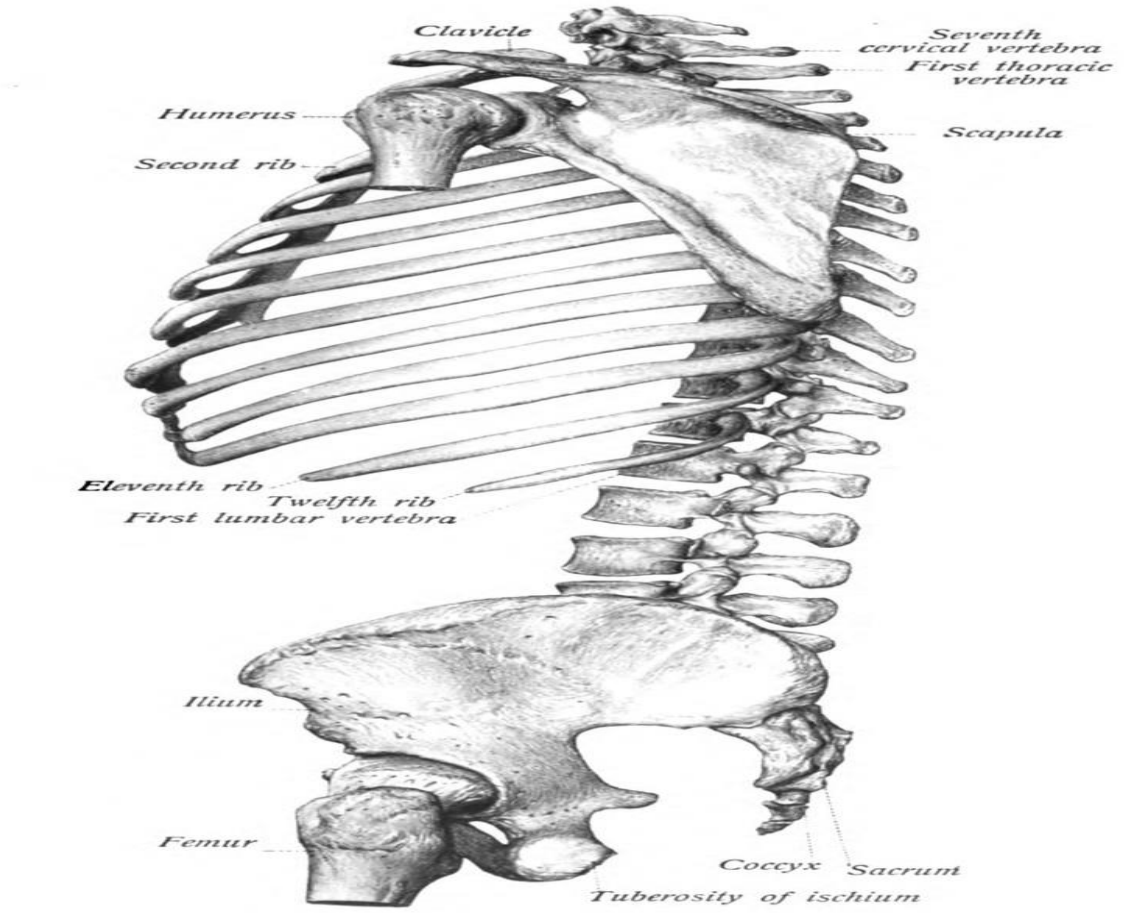
Skull:

- The human skull consists of the cranium and the facial bones.
- The cranium holds and protects the brain in a large space called the cranial vault. The cranium is formed from eight plate-shaped bones which fit together at meeting points (joints) called sutures
- there are 14 facial bones which form the lower front part of the skull. Together the 22 bones that compose the skull form additional, smaller spaces besides the cranial vault, such as the cavities for the eyes, the internal ear, the nose, and the mouth.
- The most important facial bones include the jaw or mandible, the upper jaw or maxilla, the zygomatic or cheek bone, and the nasal bone.
- Humans are born with separate plates which later fuse to allow flexibility as the skull passes through the pelvis and birth canal during birth.
- During development the eight separate plates of the immature bones fuse together into one single structure known as the Skull.
- The only bone that remains separate from the rest of the skull is the mandible.




Rib cage:

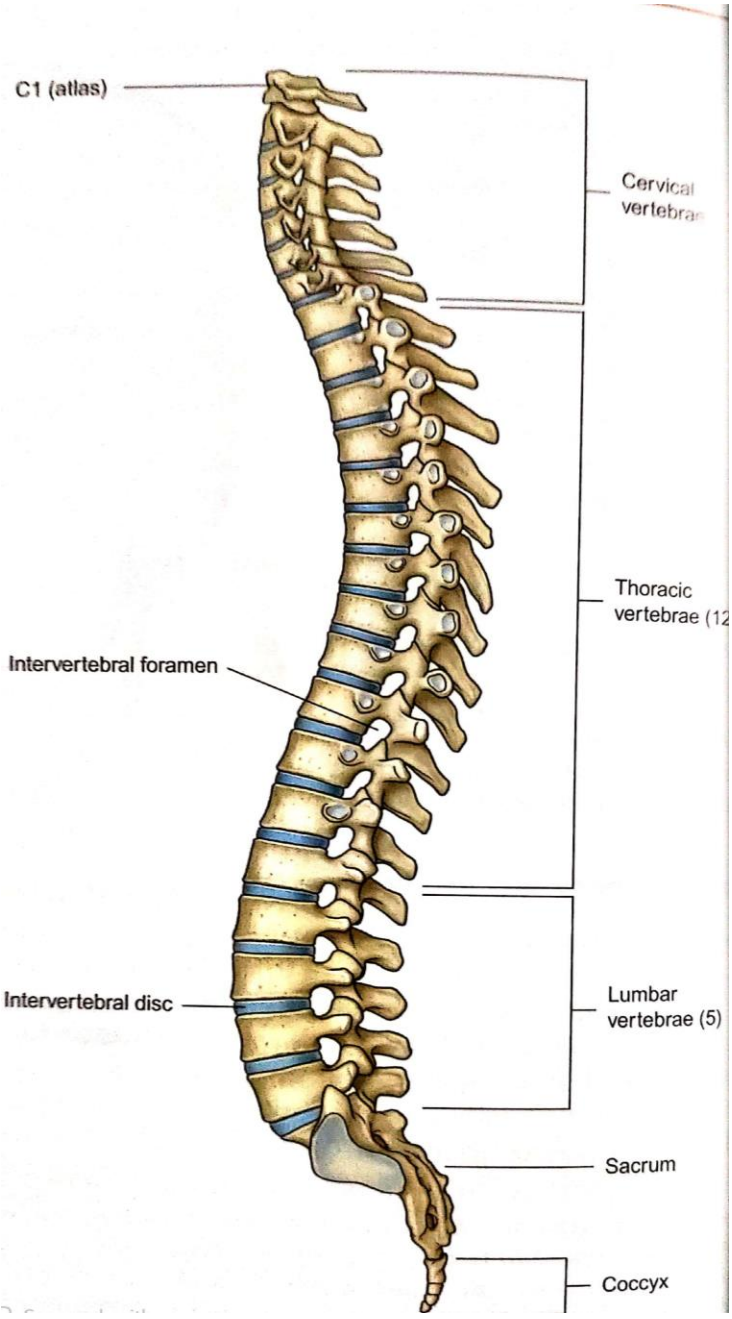
- The rib cage is composed of 12 pairs of ribs plus the sternum for a total of 25 separate bones. The rib cage functions as protection for the vital organs such as the heart and lungs.
- The ribs are shaped like crescents, with one end flattened and the other end rounded. The rounded ends are attached at joints to the thoracic vertebrae at the back and the flattened ends come together at the sternum, in the front.
- The length of each rib increases from number one to seven and then decreases until rib pair number 12. The first rib is the shortest, broadest, flattest, and most curved.




Vertebral column:

- There are 26 bones in the vertebral column.
- 24 separate vertebrae extend downwards from the occipital bone of the skull;

- Then then there is the sacrum, formed from five fused vertebrae, and lastly the coccyx, or tail, which is formed from between three and five small fused vertebrae and lastly the coccyx, or tail, which is formed from between 3-5 small fused vertebrae.
- The vertebral column is divided into different regions.
- The 1st 7 vertebrae, in the neck, form the cervical spine; the next 12 vertebrae are the thoracic spine, and the next 5 the lumber spine, the lowest vertebrae of which articulates with the sacrum.
- Each vertebrae is identified by the 1st letter of its region in the spine, followed by a number indicating its positions.

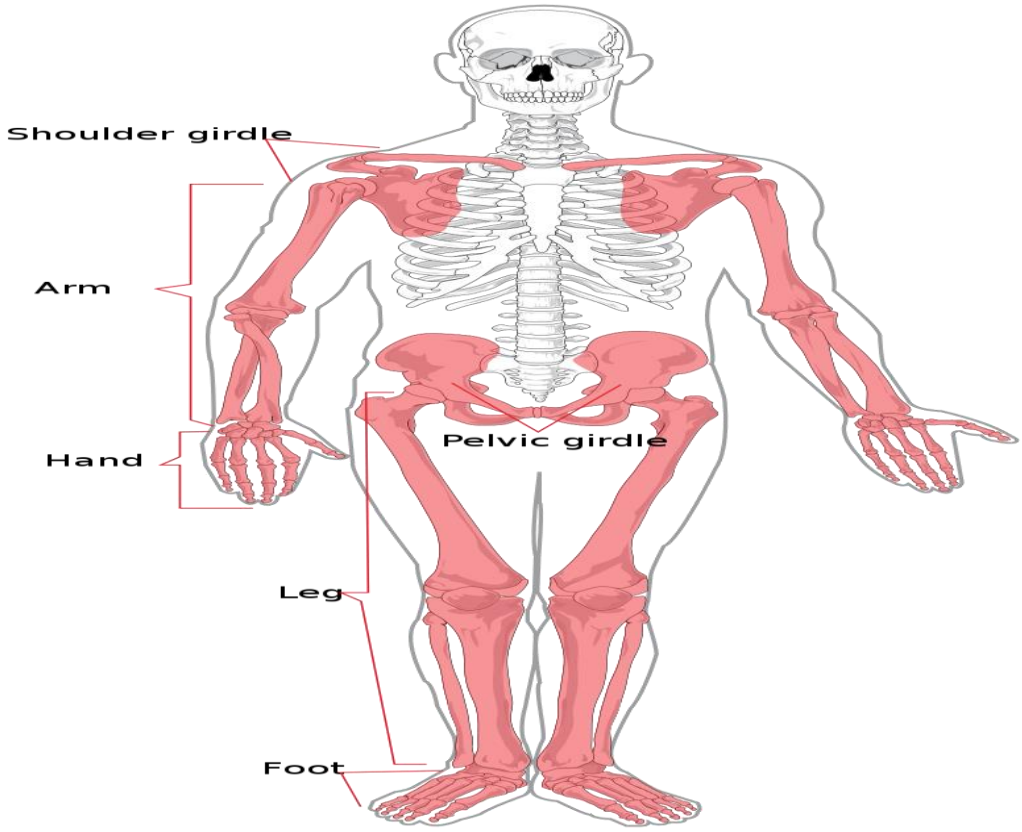



Appendicular skeleton:

- The **appendicular skeleton** is the portion of the skeleton of vertebrates consisting of the bones that support the appendages. The appendicular skeleton includes the skeletal elements within the limbs, as well as supporting shoulder girdle pectoral and pelvic girdle.

- Of the 206 bones in the human skeleton, the appendicular skeleton comprises 126. Functionally it is involved in locomotion (lower limbs) of the axial skeleton and manipulation of objects in the environment (upper limbs).
- The appendicular skeleton forms during development from cartilage, by the process of endochondral ossification.
- The appendicular skeleton is divided into six major regions:

    - Shoulder girdles (4 bones) - Left and right clavicle (2) and scapula (2).
    - Arms and forearms (6 bones) - Left and right humerus (2) (arm), ulna (2) and radius (2) (forearm).
    - Hands (54 bones) - Left and right carpals (16) (wrist), metacarpals (10), proximal phalanges (10), intermediate phalanges (8) and distal phalanges (10).
    - Pelvis (6 bones) - Ilium (2), Ischium (2) and Pubis (2).
    - Thighs and legs (8 bones) - Left and right femur (2) (thigh), patella (2) (knee), tibia (2) and fibula (2) (leg).
    - Feet and ankles (52 bones) - Left and right tarsals (14) (ankle), metatarsals (10), proximal phalanges (10), intermediate phalanges (8) and distal phalanges (10).




**b)Cavities of the body:**

- The body organs are contained and protected with in four cavities:
    - Cranial cavity
    - Thoracic cavity
    - Abdominal cavity
    - Pelvic cavity

<u>Cranial cavity:</u>

The cranial cavity contains the brain.

Its boundaries are formed by the bones of the skull.

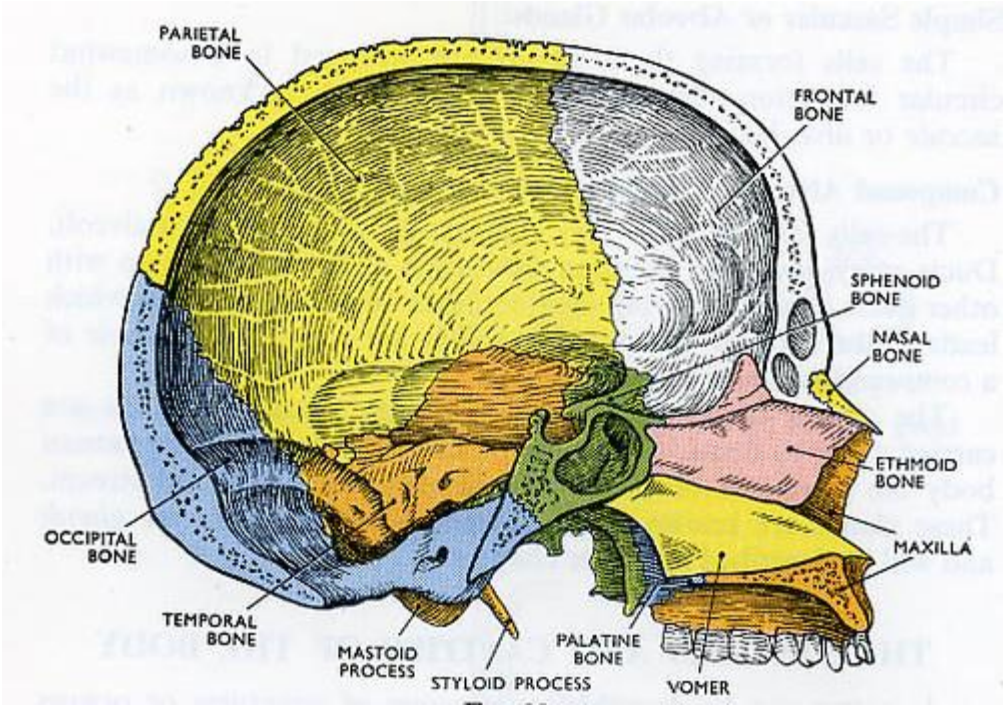
Anteriorly- 1 frontal bone

Laterally-2 temporal bones

Posteriorly-1 occipital bone

Superiorly-2 parietal bones

Inferiorly-1 sphenoid and ethmoid bone and parts of the frontal, temporal and occipital bone.




Thoracic cavity:

This cavity is situated in the upper part of the trunk.

Its boundaries are formed by the thoracic cage and supporting muscles.

Anteriorly- the sternum and costal cartilages of the ribs

Laterally-12 pair of ribs and the intercostals muscles

Posteriorly- the thoracic vertebrae

Superiorly- the structures forming the root of the neck

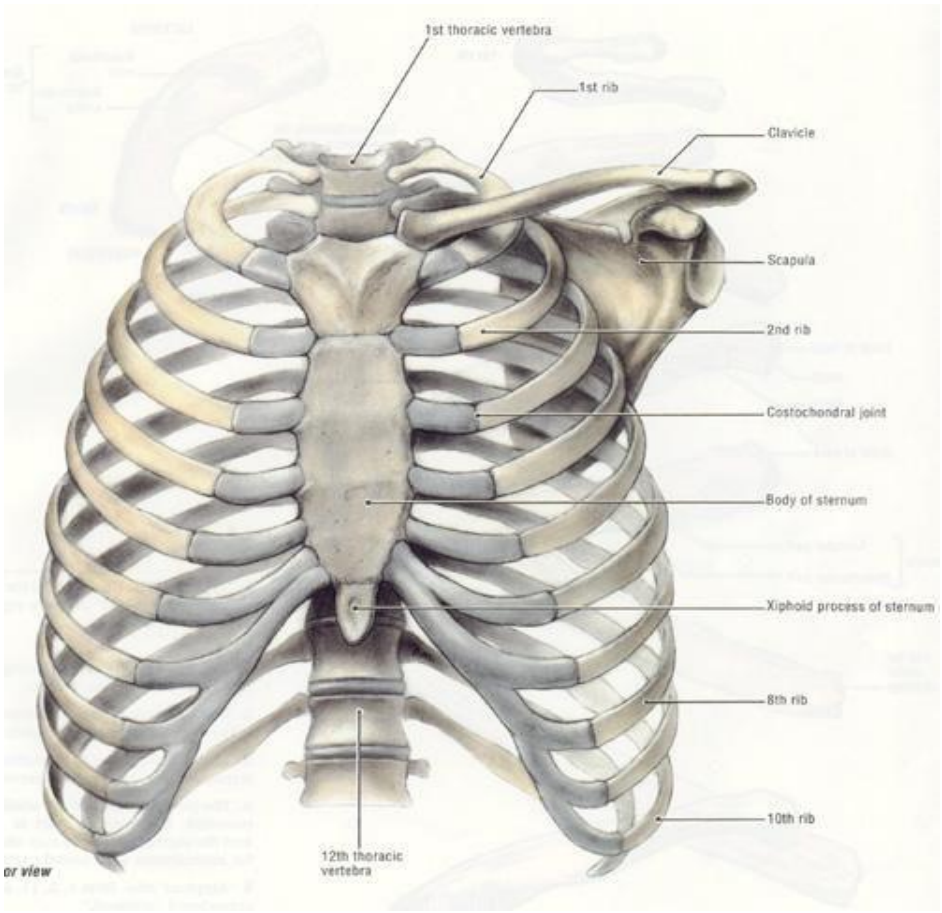
Inferiorly-the diaphragm, a dome-shaped muscle

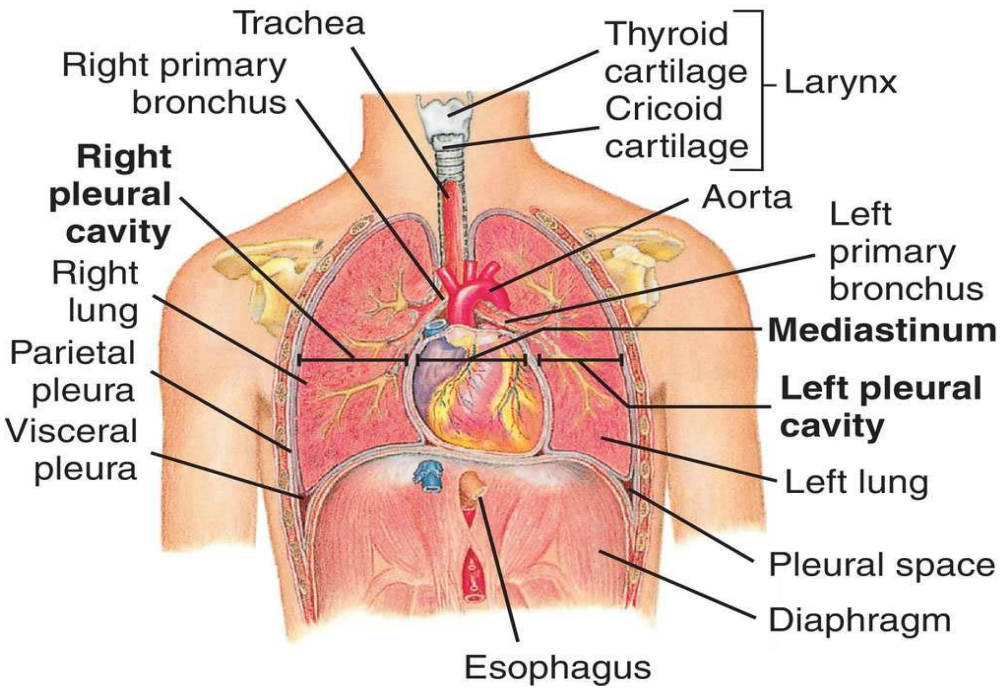
Contents:

the main organs and structures contained in the thoracic cavity includes:

- the trachea, 2 bronchi, 2 lungs
- the heart, aorta, superior and inferior vena cava, numerous other blood vessels
- the oesophagus
- lymph vessels and lymph nodes
- some important nerves

the mediasternum is the space between the lungs, including the structures found there, such as the heart, oesophagus, and blood vessels.






Abdominal cavity:

This is the largest body cavity and is oval in shape.

It occupies most of the trunk and its boundaries are:

Superiorly-the diaphragm, which separates it from the thoracic cavity.

Anteriorly-the muscles forming the anterior abdominal wall

Posteriorly- the lumber vertebrae and muscles forming the posterior abdominal wall

Laterraly-the lower rib and parts of the muscles of the abdominal wall.

Inferiorly-it is continuous with the pelvic cavity.

By convention, the abdominal cavity is divided into the nine region.

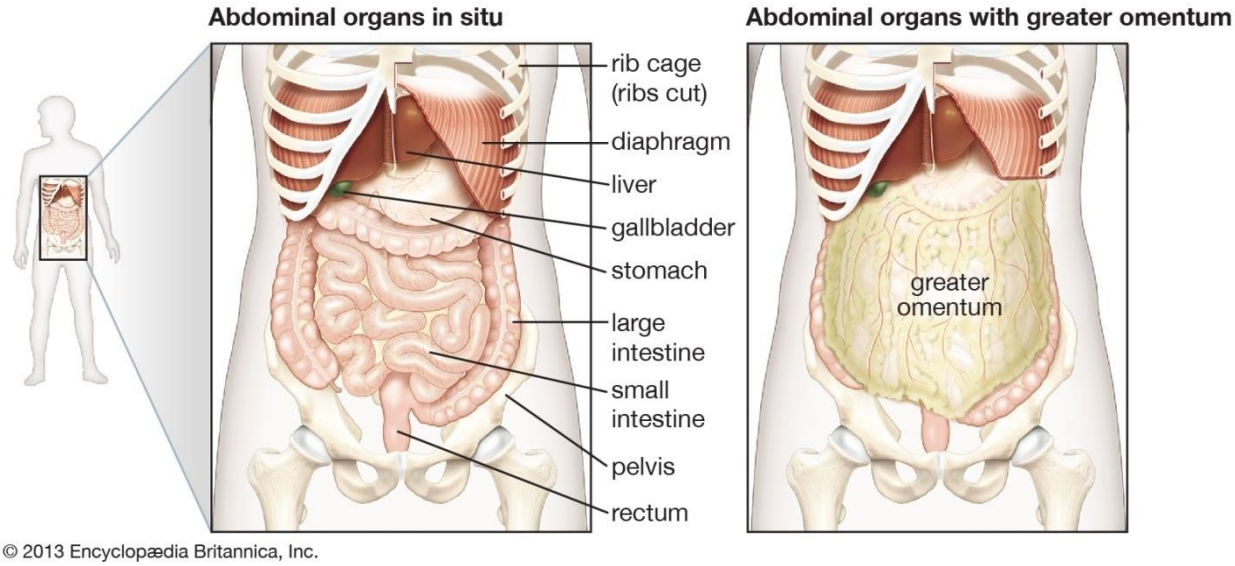
This facilitates the description of the positions of the organs and structure it contains.

Contents:

- the stomach, small intestine and most of the large intestine
- the liver, gall bladder, bile ducts and pancreas.

other structure includes:

- the spleen
- 2 kidneys and the upper part of the uterus
- 2 adrenal glands
- Numerous blood vessels, lymph vessels and nerves
- Lymph nodes




Pelvic cavity:

The pelvic cavity is roughly funnel shaped and extends from the lower end of the abdominal cavity.

Its boundaries are:

Superiorly-it is continuous with the abdominal cavity

Anteriorly-the pubic bones

Posteriorly-the sacrum and coccyx

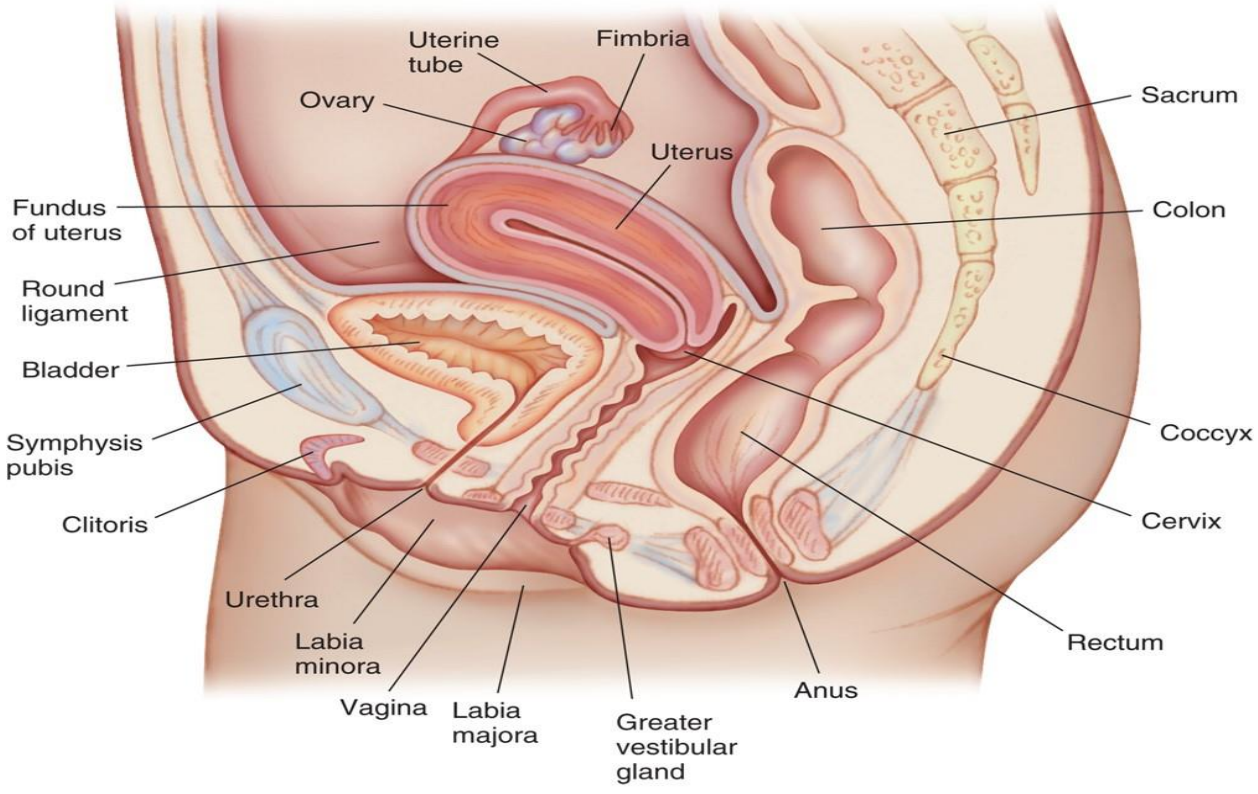
Laterally-the innominate bones

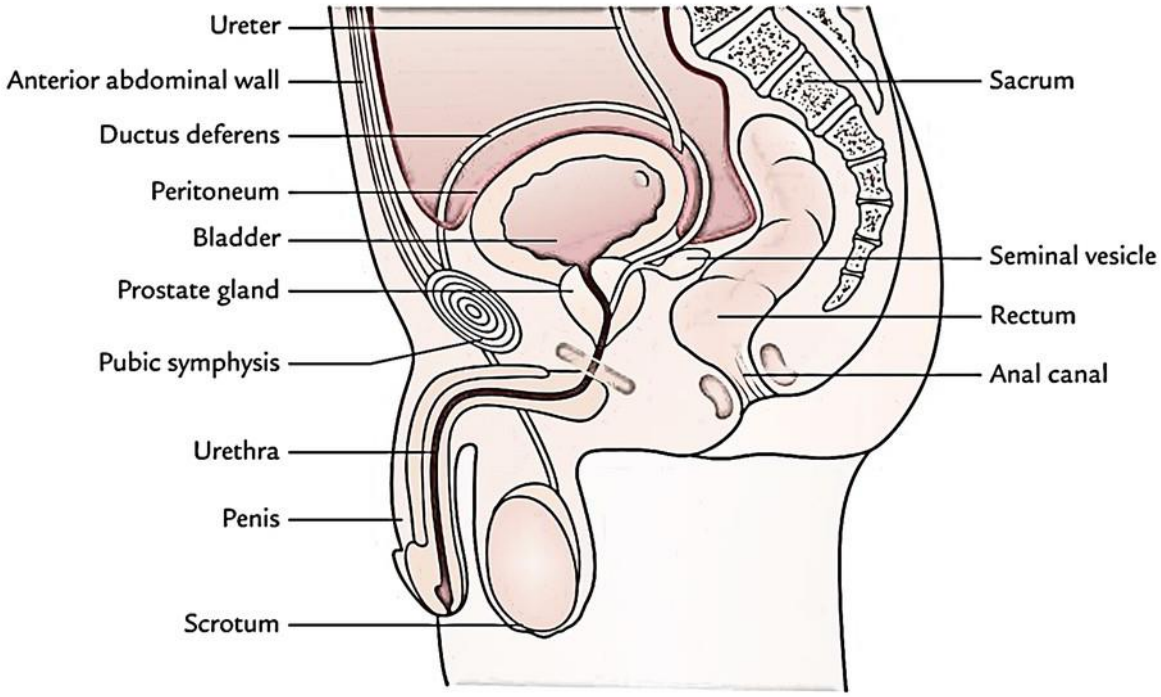
Inferiorly-the muscles of the pelvic floor

Contents:

The pelvic cavity contains the following structures:

- Sigmoid colon, rectum and anus
- Some loops of the small intestine
- Urinary bladder, lower part of the uterus and the urethra
- In the female, the organs of the reproductive systems: the uterus, uterine tubes, ovaries and vagina.
- In the male, some of the organs of the reproductive system: the prostate gland, seminal vesicles, spermatic cords, deferent ducts, ejaculatory ducts, and the urethra.






**3) a)Define cell.** **(2+5+8)**

**b)Draw the labeled diagram of cell and explain.**

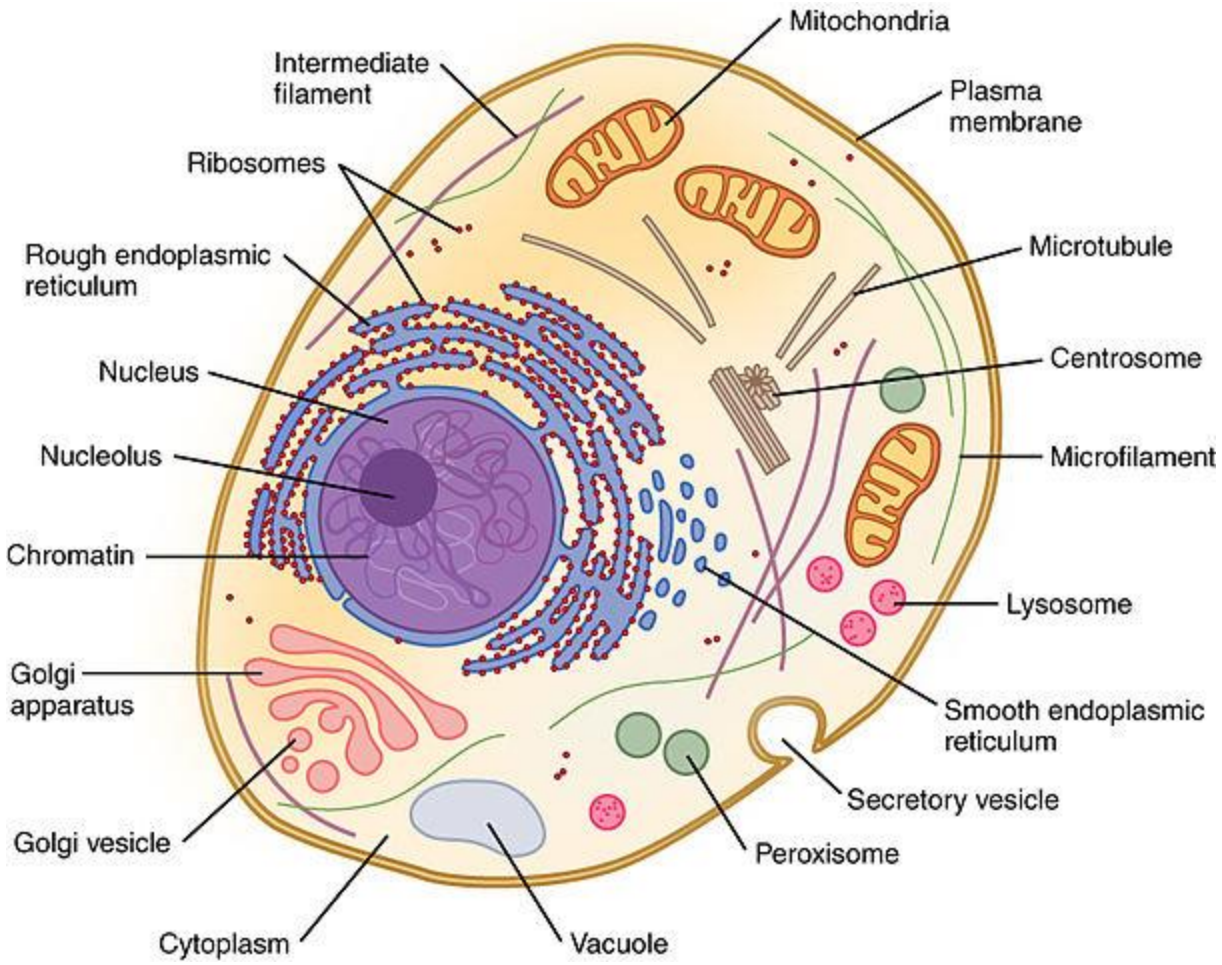
**c)Describe cell cycle.**

**a) Cell:**

- The **cell** is the basic structural, functional, and biological unit of all known organisms.
- A cell is the smallest unit of life. Cells are often called the "building blocks of life".
- Cells consist of cytoplasm enclosed within a membrane, which contains many biomolecules such as proteins and nucleic acids.
- A cell is enclosed by a plasma membrane, which forms a selective barrier that allows nutrients to enter and waste products to leave.

- The interior of the cell is organized into many specialized compartments, or organelles, each surrounded by a separate membrane. One major organelle, the nucleus, contains the genetic information necessary for cell growth and reproduction.
- Each cell contains only one nucleus, whereas other types of organelles are present in multiple copies in the cellular contents, or cytoplasm.
- Organelles include mitochondria, which are responsible for the energy transactions necessary for cell survival; lysosomes, which digest unwanted materials within the cell; and the endoplasmic reticulum and the Golgi apparatus, which play important roles in the internal organization of the cell by synthesizing selected molecules and then processing, sorting, and directing them to their proper locations.
- The cytosol contains an organized framework of fibrous molecules that constitute the cytoskeleton, which gives a cell its shape, enables organelles to move within the cell, and provides a mechanism by which the cell itself can move.
- The cytosol also contains more than 10,000 different kinds of molecules that are involved in cellular biosynthesis, the process of making large biological molecules from small ones.

**b)Labeled diagram of cell:**



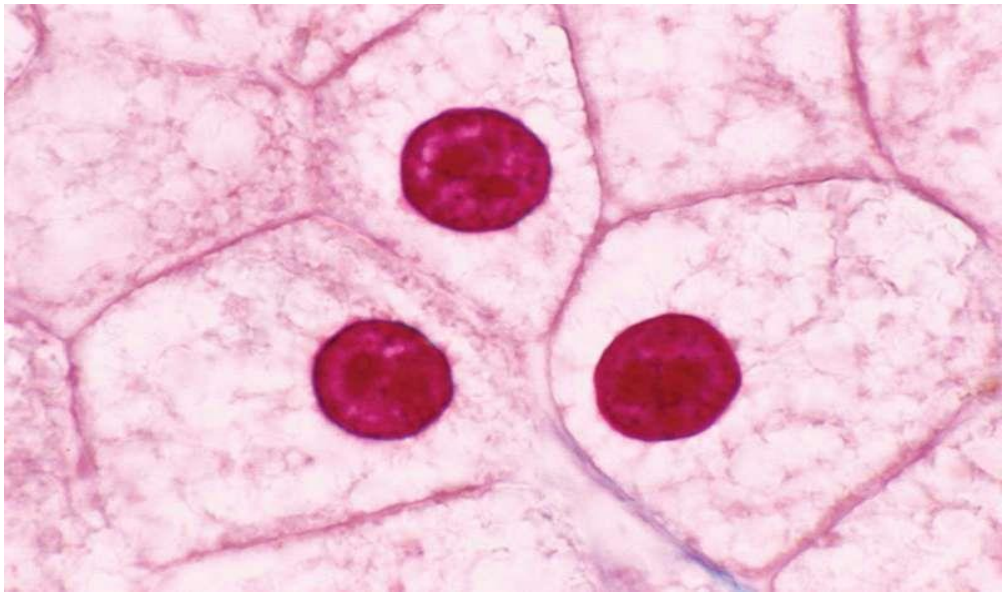

A small organ-like structure present inside the cell is called a cell organelle.

It has a particular structural makeup and performs a specific function. Depending upon the presence or absence of membrane, cell organelles can be classified into three categories,

- Without membrane: Some cell organelles like ribosomes are not bounded by any membrane. They are present in prokaryotic as well as eukaryotic organisms.
- Single membrane-bound**:** Some organelles are bounded by a single membrane. For example, vacuole, lysosome, Golgi Apparatus, Endoplasmic Reticulum etc. They are present only in a eukaryotic cell.

- Double membrane-bound: Cell organelles like mitochondria and chloroplast are double membrane-bound organelles. They are present only in a eukaryotic cell.

Nucleus:



- Known as the cell's "command center," the nucleus is a large organelle that stores the cell's DNA (deoxyribonucleic acid).
- The nucleus controls all of the cell's activities, such as growth and metabolism, using the DNA's genetic information.
- Within the nucleus is a smaller structure called the nucleolus, which houses the RNA (ribonucleic acid).
- RNA helps convey the DNA's orders to the rest of the cell and serves as a template for protein synthesis.

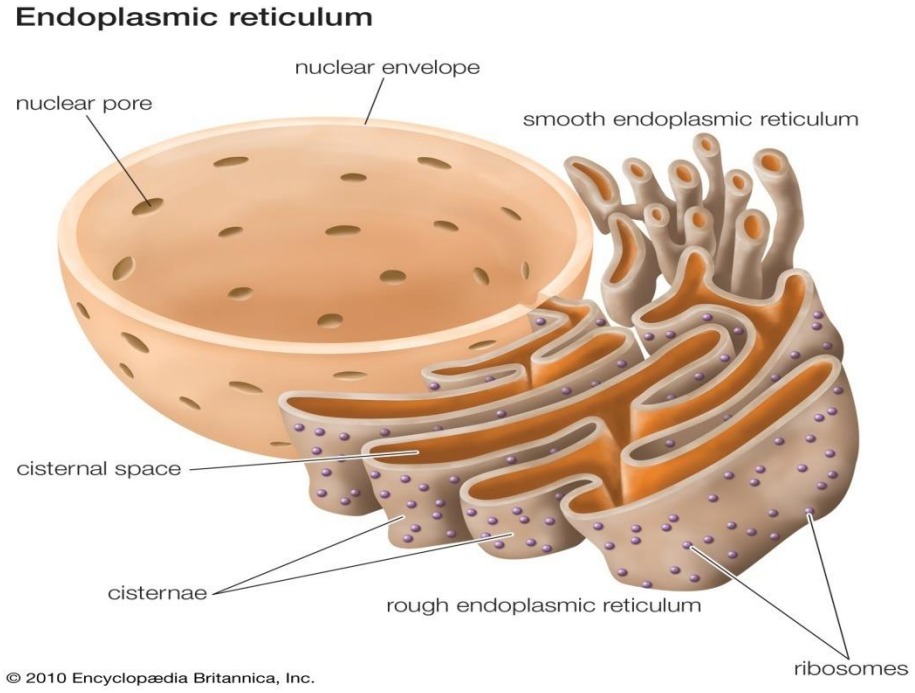
Ribosomes:

- **Ribosome**, particle that is present in large numbers in all living cells and serves as the site of protein synthesis.

- Ribosomes occur both as free particles in prokaryotic and eukaryotic cells and as particles attached to the membranes of the endoplasmic reticulum in eukaryotic cells.

Endoplasmic reticulum:

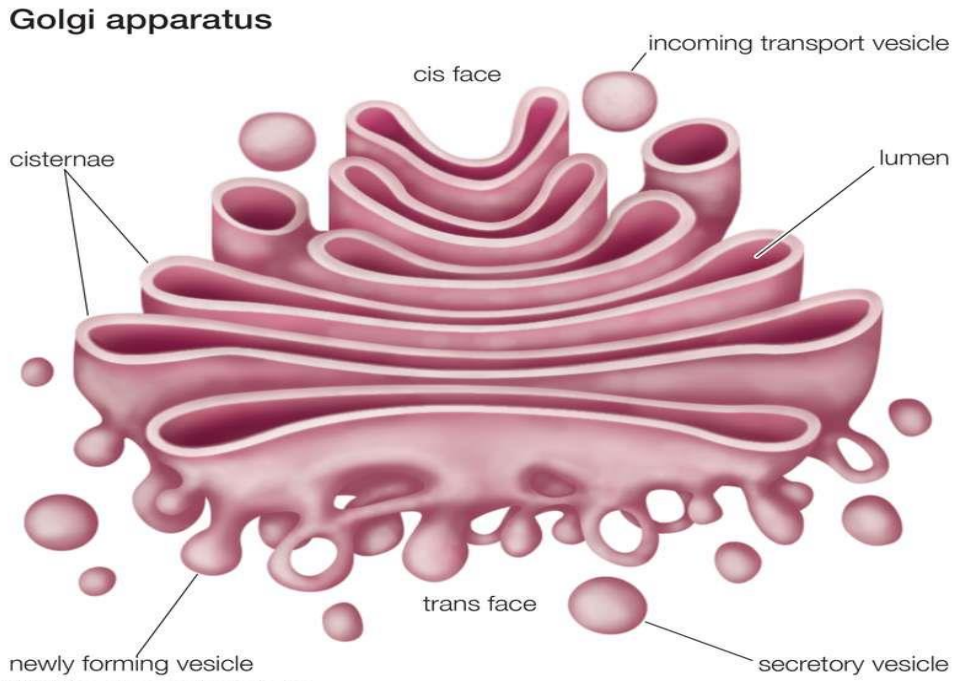
- The endoplasmic reticulum (ER) is a membranous organelle that shares part of its membrane with that of the nucleus.
- Some portions of the ER, known as the rough ER, are studded with ribosomes and are involved with protein manufacture.
- The rest of the organelle is referred to as the smooth ER and serves to produce vital lipids (fats).




Golgi Aparatus:

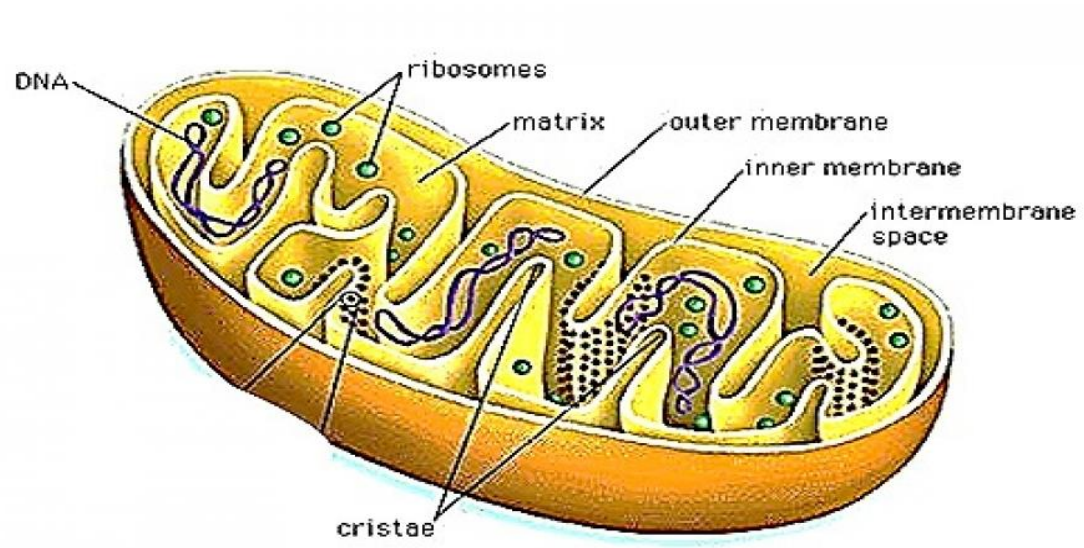
- If the proteins from the rough ER require further modification, they are transported to the Golgi apparatus (or Golgi complex).
- Like the ER, the Golgi apparatus is composed of folded membranes.
- It searches the protein's amino acid sequences for specialized "codes" and modifies them accordingly.

- These processed proteins are then stored in the Golgi or packed in vesicles to be shipped elsewhere in the cell.




Mitochondria:

- The "powerhouses" of the cell, mitochondria are oval-shaped organelles found in most eukaryotic cells.
- As the site of cellular respiration, mitochondria serve to transform molecules such as glucose into an energy molecule known as ATP (adenosine triphosphate).
- ATP fuels cellular processes by breaking its high-energy chemical bonds.
- Mitochondria are most plentiful in cells that require significant amounts of energy to function, such as liver and muscle cells.




**MITOCHONDRIA-STRUCTURE**

Lysosome:

- The lysosome is the cell's recycling center.
- These organelles are spheres full of enzymes ready to hydrolyze (chop up the chemical bonds of) whatever substance crosses the membrane, so the cell can reuse the raw material.
- These disposal enzymes only function properly in environments with a pH of 5, two orders of magnitude more acidic than the cell's internal pH of 7.
- Lysosomal proteins only being active in an acidic environment acts as safety mechanism for the rest of the cell - if the lysosome were to somehow leak or burst, the degradative enzymes would inactivate before they chopped up proteins the cell still needed.

Cytoskeleton:

- Within the cytoplasm there is network of protein fibers known as the cytoskeleton.
- This structure is responsible for both cell movement and stability.
- The major components of the cytoskeleton are microtubules, intermediate filaments, and microfilaments.

❖ Microtubules

- Microtubules are small tubes made from the protein tubulin.
- These tubules are found in cilia and flagella, structures involved in cell movement.
- They also help provide pathways for secretory vesicles to move through the cell, and are even involved in cell division as they are a part of the mitotic spindle, which pulls homologous chromosomes apart.

❖ Intermediate Filaments

- Smaller than the microtubules, but larger than the microfilaments, the intermediate filaments are made of a variety of proteins such as keratin and/or neurofilament.
- They are very stable, and help provide structure to the nuclear envelope and anchor organelles.

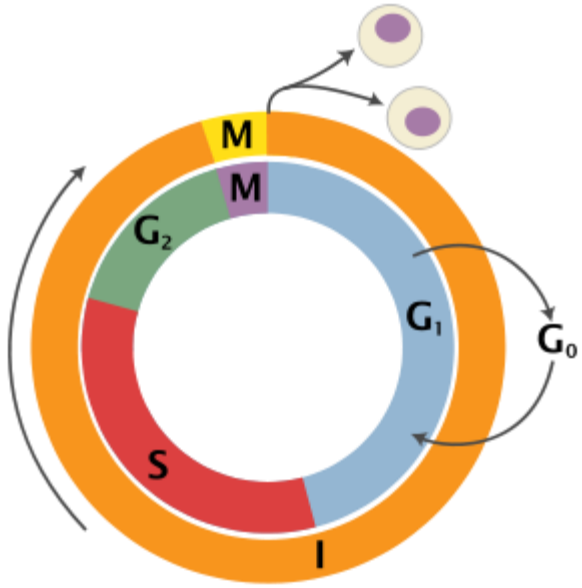
❖ Microfilaments

- Microfilaments are the thinnest part of the cytoskeleton, and are made of actin [a highly-conserved protein that is actually the most abundant protein in most eukaryotic cells].
- Actin is both flexible and strong, making it a useful protein in cell movement. In the heart, contraction is mediated through an actin-myosin system.

**c) <u>Cell cycle:</u>**

- The **cell cycle**, or **cell-division cycle**, is the series of events that take place in a <u>cell</u> that cause it to divide into two daughter cells.
- These events include the duplication of its DNA (<u>DNA replication</u>) and some of its organelles, and subsequently the partitioning of its cytoplasm and other components into two daughter cells in a process called <u>cell division</u>.
- In cells with nuclei (<u>eukaryotes</u>), (i.e., <u>animal</u>, <u>plant</u>, <u>fungal</u>, and <u>protist</u> cells), the cell cycle is divided into two main stages: <u>interphase</u> and the <u>mitotic</u> (M) phase (including <u>mitosis</u> and <u>cytokinesis</u>).

- During interphase, the cell grows, accumulating nutrients needed for mitosis, and replicates its DNA and some of its organelles.
- During the mitotic phase, the replicated chromosomes, organelles, and cytoplasm separate into two new daughter cells.
- To ensure the proper replication of cellular components and division, there are control mechanisms known as cell cycle checkpoints after each of the key steps of the cycle that determine if the cell can progress to the next phase.
- In cells without nuclei (prokaryotes), (i.e., bacteria and archaea), the cell cycle is divided into the B, C, and D periods.
- The B period extends from the end of cell division to the beginning of DNA replication.
- DNA replication occurs during the C period. The D period refers to the stage between the end of DNA replication and the splitting of the bacterial cell into two daughter cells.
- The cell-division cycle is a vital process by which a single-celled fertilized egg develops into a mature organism, as well as the process by which hair, skin, blood cells, and some internal organs are renewed.
- After cell division, each of the daughter cells begin the interphase of a new cycle.
- Although the various stages of interphase are not usually morphologically distinguishable, each phase of the cell cycle has a distinct set of specialized biochemical processes that prepare the cell for initiation of the cell division.




In eukaryotic cells, or cells with a nucleus, the stages of the cell cycle are divided into two major phases: **interphase** and the **mitotic (M) phase**.

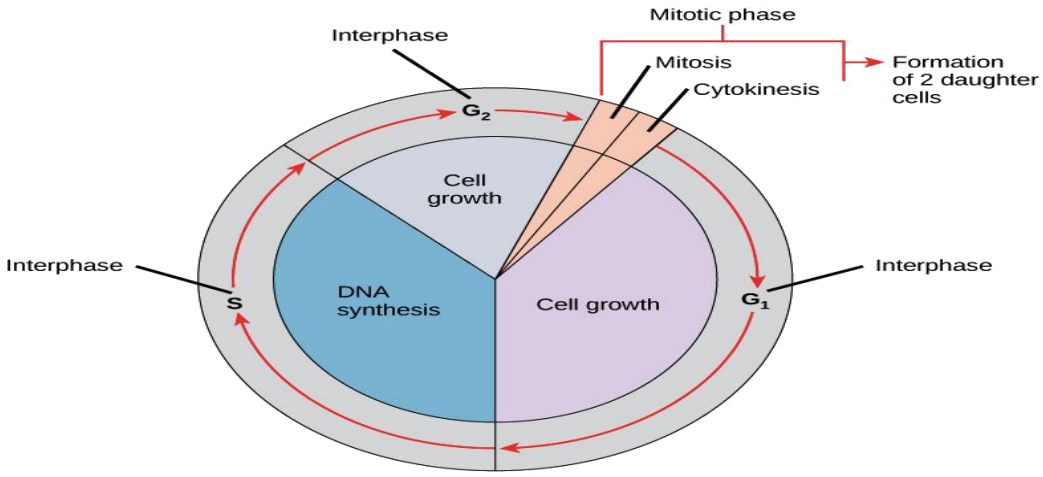
- During *interphase*, the cell grows and makes a copy of its DNA.
- During the *mitotic (M) phase*, the cell separates its DNA into two sets and divides its cytoplasm, forming two new cells.

Interphase

Let's enter the cell cycle just as a cell forms, by division of its mother cell. Preparation for division happens in three steps:

- **G**1phase, During G1 phase also called the first gap phase, the cell grows physically larger, copies organelles, and makes the molecular building blocks it will need in later steps.
- S phase**.** In S phase, the cell synthesizes a complete copy of the DNA in its nucleus. It also duplicates a microtubule-organizing structure called the centrosome. The centrosomes help separate DNA during M phase.
- G2 phase**.** During the second gap phase, or G2 phase, the cell grows more, makes proteins and organelles, and begins to reorganize its contents in preparation for mitosis. G2 phase ends when mitosis begins.

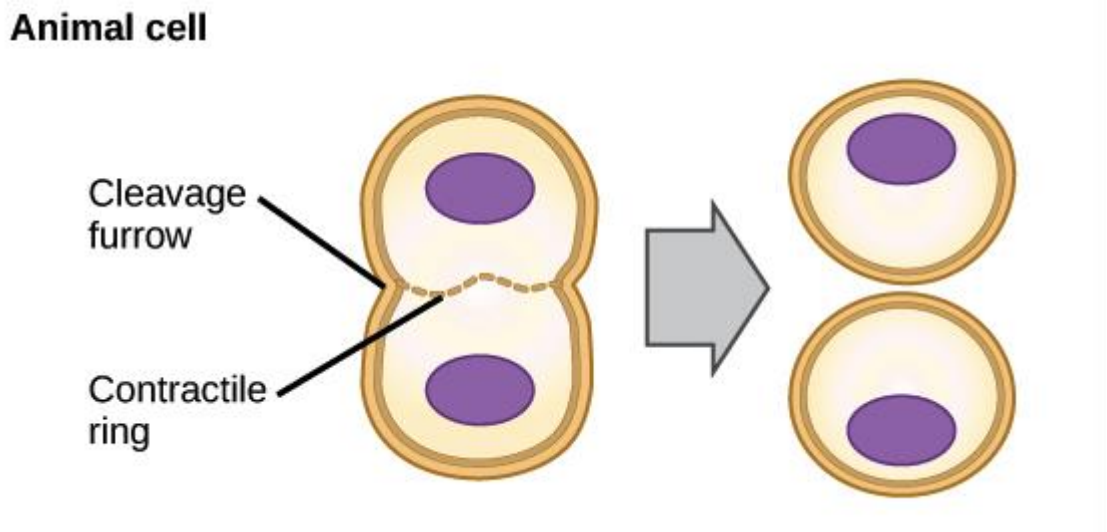
The G1,S,G2, phases together are known as **interphase**.  means between, reflecting that interphase takes place between one mitotic (M) phase and the next.




At the end of interphase comes the mitotic phase, which is made up of mitosis and cytokinesis and leads to the formation of two daughter cells. Mitosis precedes cytokinesis, though the two processes typically overlap somewhat.

<u>M phase</u>

- During the mitotic (M) phase, the cell divides its copied DNA and cytoplasm to make two new cells.
- M phase involves two distinct division-related processes: mitosis and cytokinesis.
- In **mitosis**, the nuclear DNA of the cell condenses into visible chromosomes and is pulled apart by the mitotic spindle, a specialized structure made out of microtubules.
- Mitosis takes place in four stages: prophase (sometimes divided into early prophase and prometaphase), metaphase, anaphase, and telophase.
- In **cytokinesis**, the cytoplasm of the cell is split in two, making two new cells.
- Cytokinesis usually begins just as mitosis is ending, with a little overlap.
- Importantly, cytokinesis takes place differently in animal and plant cells.




- In an animal cell, a contractile ring of cytoskeletal fibers forms at the middle of the cell and contracts inward, producing an indentation called the cleavage furrow.
- Eventually, the contractile ring pinches the mother cell in two, producing two daughter cells.
- cell division occurs when a band of cytoskeletal fibers called the **contractile ring** contracts inward and pinches the cell in two, a process called contractile cytokinesis.
- The indentation produced as the ring contracts inward is called the **cleavage furrow**. Animal cells can be pinched in two because they're relatively soft and squishy.