Connective tissue

Connective tissue is one of the four basic types of animal tissue, along with epithelial tissue, muscle tissue, and nervous tissue. It develops from the mesoderm. Connective tissue is found between other tissues everywhere in the body, including the nervous system. In the central nervous system, the three outer membranes (the meninges) that envelop the brain and spinal cord are composed of connective tissue. All connective tissue consists of three main
components: fibers (elastic and collagenous fibers),[1] ground substance and cells. Not all authorities include blood[2] or lymph as connective tissue because they lack the fiber component. All are immersed in the body water. The cells of connective tissue include fibroblasts, adipocytes, macrophages, mast cells and leucocytes.
Section of **epididymis**. Connective tissue (blue) is seen supporting the **epithelium** (purple).

The term "connective tissue" (in German, *Bindegewebe*) was introduced in 1830 by **Johannes Peter Müller**. The tissue was already recognized as a distinct class in the 18th century.[3][4]
Connective tissue can be broadly classified into *connective tissue proper* and *special connective tissue*. [5][6]

Connective tissue proper consists of
loose connective tissue and dense connective tissue (which is further subdivided into dense regular and dense irregular connective tissues.) Loose and dense connective tissue are distinguished by the ratio of ground substance to fibrous tissue. Loose connective tissue has much more ground substance and a relative lack of fibrous tissue, while the reverse is true of dense connective tissue. Dense regular connective tissue, found in structures such as tendons and ligaments, is characterized by collagen fibers arranged in an orderly parallel fashion, giving it tensile strength in one direction. Dense irregular connective tissue provides
strength in multiple directions by its dense bundles of fibers arranged in all directions.

Special connective tissue consists of reticular connective tissue, adipose tissue, cartilage, bone, and blood.\[^8\] Other kinds of connective tissues include fibrous, elastic, and lymphoid connective tissues.\[^9\] Fibroareolar tissue is a mix of fibrous and areolar tissue.\[^10\] Fibromuscular tissue is made up of fibrous tissue and muscular tissue. New vascularised connective tissue that forms in the process of wound healing is termed granulation tissue.\[^11\]
Type I collagen is present in many forms of connective tissue, and makes up about 25% of the total protein content of the mammalian body.\textsuperscript{[12]}

**Characteristics**

Ground substance is a clear, colorless, and viscous fluid containing **glycosaminoglycans** and **proteoglycans** to fix the collagen fibers in the intercellular spaces. Examples of non-fibrous connective tissue include adipose tissue and blood. Adipose tissue gives "mechanical cushioning" to the body, among other functions.\textsuperscript{[13][14]} Although there is no dense collagen network in
adipose tissue, groups of adipose cells are kept together by collagen fibers and collagen sheets in order to keep fat tissue under compression in place (for example, the sole of the foot). Both the ground substance and proteins (fibers) create the matrix for connective tissue.

Types of fibers:

<table>
<thead>
<tr>
<th>Tissue</th>
<th>Purpose</th>
<th>Components</th>
<th>Location</th>
</tr>
</thead>
<tbody>
<tr>
<td>Collagenous fibers</td>
<td>Bind bones and other tissues to each other</td>
<td>Alpha polypeptide chains</td>
<td>tendon, ligament, skin, cornea, cartilage, bone, blood vessels, gut, and intervertebral disc.</td>
</tr>
<tr>
<td>Elastic fibers</td>
<td>Allow organs like arteries and lungs to recoil</td>
<td>Elastic microfibril and elastin</td>
<td>extracellular matrix</td>
</tr>
<tr>
<td>Reticular fibers</td>
<td>Form a scaffolding for other cells</td>
<td>Type III collagen</td>
<td>liver, bone marrow, and lymphatic organs</td>
</tr>
</tbody>
</table>
Function
Connective tissue has a wide variety of functions that depend on the types of cells and the different classes of fibers involved. **Loose** and **dense irregular connective tissue**, formed mainly by *fibroblasts* and *collagen fibers*, have an important role in providing a medium for oxygen and nutrients to diffuse from *capillaries* to cells, and carbon dioxide and waste substances to diffuse from cells back into circulation. They also allow organs to resist stretching and tearing forces. **Dense regular connective tissue**, which forms organized structures, is a major functional component of *tendons, ligaments* and *aponeuroses*, and is also found in highly specialized
organs such as the cornea. Elastic fibers, made from elastin and fibrillin, also provide resistance to stretch forces. They are found in the walls of large blood vessels and in certain ligaments, particularly in the ligamenta flava.

In hematopoietic and lymphatic tissues, reticular fibers made by reticular cells provide the stroma—or structural support—for the parenchyma—or functional part—of the organ.

Mesenchyme is a type of connective tissue found in developing organs of embryos that is capable of differentiation into all types of mature connective
Another type of relatively undifferentiated connective tissue is the mucous connective tissue known as Wharton's jelly, found inside the umbilical cord.Various types of specialized tissues and cells are classified under the spectrum of connective tissue, and are as diverse as brown and white adipose tissue, blood, cartilage and bone. Cells of the immune system, such as macrophages, mast cells, plasma cells and eosinophils are found scattered in loose connective tissue, providing the ground for starting inflammatory and immune responses upon the detection of antigens.
The image summarizes the various categories of connective tissues found in the human body.

General features of connective tissues. The Matrix of most connective tissues is made up of ground substance and protein.
CELL CYCLE AND (CELL DIVISION)

All organisms even the largest, start their life from a single cell? single cell then goes on to form such large organisms, Growth and reproduction are characteristic of cells.

Definition of cell cycle

The cell cycle: is a cycle of stages that cells pass through to allow them to divide and produce new cells.

Why Do Cells Divide

1. Some cells die or are damaged, they must be replaced.
2. Multicellular organisms need to grow and develop, to do this requires more cells.

Frequency of cell division varies by cell type

- embryo: cell cycle < 20 minute
- skin cells: divide frequently throughout life
  12-24 hours cycle
- liver cells: retain ability to divide, but keep it in reserve M divide once every year or two metaphase anaphase prophase telophase
- mature nerve cells & muscle cells G2 C: do not divide at all after maturity permanently in G0
Phases of Cell cycle

Cell cycle has two parts:
1. growth and preparation (interphase)
2. cell division
   A. mitosis (nuclear division)
   B. cytokinesis (cytoplasm division)

The largest part of the cell cycle is called "interphase".

1-Interphase  Interphase is the time between cell divisions. It is a period of growth that consists of the G0, G1, S, and G2 phases.

G0 PHASE
- G0 is a resting phase where the cell has left the cycle and has stopped dividing.
- The word "post-mitotic" is sometimes used to refer to both quiescent and senescent cells.
- Non-proliferative (non-dividing) cells in multicellular eukaryotes generally enter the quiescent G0 state from G1 and may remain quiescent for long periods of time, possibly indefinitely (as is often the case for neurons). This is very common for cells that are fully differentiated.

Cellular senescence occurs in response to DNA damage and external stress that would make a cell's progeny nonviable; it is often a biochemical alternative to the self-destruction of such a damaged cell by apoptosis.
**G₁ Phase: Cell Growth**
In the G₁ phase, cells increase in size and synthesize new proteins and organelles.

**S Phase: DNA Replication**
In the S (or synthesis) phase, new DNA is synthesized when the chromosomes are replicated.

**G₂ Phase: Preparing for Cell Division**
In the G₂ phase, many of the organelles and molecules required for cell division are produced.

2- **Cell division**
   - A- **mitosis (nuclear division)**

   - **Prophase**
     During **prophase**, the first phase of mitosis, the duplicated chromosome condenses and becomes visible.
     The **centrioles** move to opposite sides of nucleus and help organize the spindle.
     The spindle forms and DNA strands attach at a point called their **centromere**.
     The nucleolus disappears and nuclear envelope breaks down.

   - **Metaphase**
     During metaphase, the second phase of mitosis, the centromeres of the duplicated chromosomes line up across the center of the cell.
     The spindle fibers connect the centromere of each chromosome to the two poles of the spindle.
**Anaphase**
Spindle threads shorten, causing each centromere to break, separating each sister chromatid • The separated chromatids (now called chromosomes) are pulled to opposite poles.

**Telophase**
During telophase, the fourth and final phase of mitosis, the chromosomes spread out into a tangle of chromatin. A nuclear envelope re-forms around each cluster of chromosomes. The spindle breaks apart, and a nucleolus becomes visible in each daughter nucleus.

**B- Cytokinesis**
is the final stage of cell division in
During cytokinesis, the cytoplasm splits in two and the cell divides
In animal cells, the plasma membrane of the parent cell pinches inward along the cell’s equator until two daughter cells form.
In plant cells, a cell plate forms along the equator of the parent cell. Then, a new plasma membrane and cell wall form along each side of the cell plate
Cell Cycle Stages in an Onion Root Tip

1. Interphase
2. Prophase
3. Metaphase
4. Anaphase
5. Telophase

Cytokinesis
Muscle Tissue

Muscle tissue: is made up of excitable cells that are long and fibrous. It often called muscle fibers. Contain proteins actine and myosin which allow them to contract.

Muscular Tissue: A group of cells (fibers) specialized to produce motion in response to muscle action potentials by its qualities of contractility, extensibility, elasticity and excitability.

Without these muscles, nothing in the body would move and no body movement would occur.

Muscle tissue one of four primary tissue types, divided into:

- Skeletal muscle: which is striated and voluntary
- Cardiac muscle: which is striated and involuntary
- Smooth muscle: which is non striated and involuntary

Muscle tissue has four main properties:

1. Excitability - ability to respond to stimuli.
2. Contractility - ability to contract.
3. Extensibility - ability of a muscle to be stretched without tearing.
4. Elasticity - ability to return to its normal shape.
1. **Skeletal Muscle**

Human body contains over 600 skeletal muscles, 40-50% of total body weight.

- which is striated and voluntary
- Characteristics of skeletal muscle
- Skeletal muscle cells are elongated or tubular.
- They have multiple nuclei and these nuclei are located on the periphery of the cell.
- Skeletal muscle is striated. That is, it has an alternating pattern of light and darks bands that.

**Functions of skeletal muscle**

1. Body movement (Locomotion)
2. Maintenance of posture
3. Respiration (Diaphragm and intercostal contractions)
4. Communication (Verbal and Facial)
5. Constriction of organs and vessels
   - Peristalsis of intestinal tract
   - Vasoconstriction of b.v. and other structures (pupils)
6. Production of body heat (Thermogenesis)

**Simplest level of skeletal muscle**

- Muscle fibres – multinuclear cells with large quantities of mitochondria.
- Muscle fibres consist of bundles of myofibrils, which are arranged into smaller myofilaments, which give muscle its stripy appearance.
- Sarcomere – repeating patterns of myofibrils
  - Light filaments (Actin)
  - Dark Filaments (Myosin)
2. Cardiac Muscle

Cardiac muscle cells or cardiomyocytes are the contracting cells that allow the heart to pump. Each cardiomyocyte needs to contract in coordination with its neighboring cells - known as a functional syncytium - working to efficiently pump blood from the heart, and if this coordination breaks down then – despite individual cells contracting – the heart may not pump at all, such as may occur during abnormal heart rhythms such as ventricular fibrillation.

Cardiac muscle cells are not as long as skeletal muscles cells and often are branched cells. Cardiac muscle cells may be mononucleated or binucleated. In either case the nuclei are located centrally in the cell. Cardiac muscle is also striated. In addition cardiac muscle contains intercalated discs.

**Intercalated discs:** are unique structural formations found between the myocardial cells of the heart. They play vital roles in bonding cardiac muscle cells together and in transmitting signals between cells.
3. **Cardiac Muscle**

- Branching cells
- Contain intercalated discs
- One or two nuclei per cell
- Striated
- Involuntary
- Medium speed contractions

![Cardiac muscle cells](image)

3. **Smooth Muscle**

Smooth muscle cell are described as spindle shaped. That is they are wide in the middle and narrow to almost a point at both ends. Smooth muscle cells have a single centrally located nucleus. Smooth muscle cells do not have visible striations although they do contain the same contractile proteins as skeletal and cardiac muscle, these proteins are just laid out in a different pattern.

- **Smooth Muscle**
  - Spindal cells
  - One nucleus per cell
  - Nonstriated
  - Involuntary
  - Slow, wave-like contractions

![Smooth muscle cells](image)
Nervous Tissue

Nervous tissue: is the term for groups of organized cells in the nervous system, which is the organ system that controls the body’s movements, sends and carries signals to and from the different parts of the body, and has a role in controlling bodily functions such as digestion.

Neurons: are the basic functional units of nervous tissue.

They are highly specialized to transmit nerve impulses.

Nervous Tissue Consists of two main cell types: -

A. neurons - sensory control, and regulation
B. neuroglia - support, protection, and homeostasis

A. neurons

Parts of a Neuron

1. cell body
2. dendrites
3. axon

1. Cell body:
   - contains nucleus, surrounded by granular cytoplasm contains organelles (i.e., lysosomes, mitochondria, Golgi complex, etc.)
   - Nissl bodies (chromatophilic substance)
   - arrangement of rough endoplasmic reticulum (site of protein synthesis).

2. Dendrites (neurons usually contain many):
   - highly branched processes.
• extend out from cell body and receive stimuli.
• carry a nerve impulse toward the cell body.

3. Neurons (contain only one).
• Axon long, thin, cylindrical projection
• contains mitochondria and neurofibrils
• surrounded by axolemma (lemma = sheath or husk)
• carries a nerve impulse away to other cells (nerves, muscles, glands)

B. Neuroglia
• Neuroglia constitute one-half of volume of CNS
• outnumber neurons 5-50 times
• can multiply and divide, unlike neurons
• Functions: nerve glue - supports - insulates – protects
• Types of Neuroglial Cells (astrocytes, oligodendrocytes, microglia, ependymal cells, Schwann cells, satellite cells)

➢ Neuron Classification
I. **structural classification** - based on number of processes extending from cell body
1. **Unipolar**: (pseudounipolar)
   have a single process extending from cell body, always are sensory neurons, found in embryo.
2. **Bipolar**: have one dendrite and one axon - found in retina, internal ear, and olfactory area of brain
3. **Multipolar**: several dendrites and one axon - most neurons in brain and spinal cord are of this type
II. **Functional Classification**

based on the direction in which a neuron transmits a nerve impulse

Two types of neurons in PNS: -

1. **Afferent** carry impulses (sensory information) toward CNS
   - also known as sensory neurons
2. **Efferent** carry impulses away from CNS
   - affect activity of muscles or glands
   - also known as motor neurons

Sensory → Afferent , Motor → Efferent

Nervous System:

Structural Organization Structural subdivisions of the nervous system:

1. **Central nervous system (CNS):**-
   a) Brain.
   b) Spinal cord.
2. **Peripheral nervous system (PNS)**
   a) Cranial nerves (nerves that extend from the brain).
   b) Spinal nerves (nerves that extend from the spinal cord).
   c) Ganglia (clusters of neuron cell bodies (somas) located outside the CNS).
Organisms that reproduce Sexually are made up of two different types of cells.

A. Somatic Cells are “body” cells and contain the normal number of chromosomes … called the “Diploid” number (the symbol is 2n). Examples would be … skin cells, brain cells, etc.

B. Gametes are the “sex” cells and contain only half the normal number of chromosomes…. called the “Haploid” number (the symbol is n)….. Sperm cells and ova are gametes.

**Meiosis:** The type of cell division by which gametes with half the number of chromosomes, are produced.

**Meiosis:** is a cell division process where a single (parent) cell divides twice to produce four independent (daughter) cells, each having half the chromosomes as the original cell.

- Meiosis occur in Sex cells
- Sex cells divide to produce gametes *(sperm or egg).*
- The **Male** Gamete is the **Sperm** and is produced in the male gonad the **Testes**. called spermatogenesis
- The **Female** Gamete is the **Ovum** and is produced in the female gonad the **Ovaries**. called oogenesis

Meiosis is two cell divisions

- meiosis I
- meiosis II
**Meiosis I**

- Cell division that reduces the chromosome number by one-half.

---

**Interphase I**
- Similar to mitosis interphase.
- Chromosomes replicate (S phase).
- Each duplicated chromosome consist of two identical sister chromatids attached at their centromeres. Centromeres
- Centriole pairs also replicate.
Prophase I

Longest and most complex phase (90%).

- Chromosomes condense.
- **Synapsis occurs**: homologous chromosomes come together to form a tetrad.
- **Tetrad**: is two chromosomes or four chromatids (sister and nonsister chromatids).
- **Homologous chromosome**: one of a pair of chromosomes with the same gene sequence, loci, chromosomal length, and centromere location.

**Crossing over**

- Crossing over involves the exchange of segments of DNA between homologous chromosomes during Prophase I of meiosis.
- The process of crossing over occurs as follows:
  - Homologous chromosomes become connected in a process called synapsis, forming a bivalent (or tetrad).
  - Non-sister chromatids break and recombine with their homologous partner, effectively exchanging genetic material (crossing over).
  - The non-sister chromatids remain connected in an X-shaped structure and the positions of attachment are called chiasmata.
  - Chiasma hold homologous chromosomes together as a bivalent until anaphase I.
  - As a result of crossing over, chromatids may consist of a combination of DNA derived from both homologues - these are called recombinants.
by the end of **prophase I**
the spindle has formed
the
nuclear membrane has
vesicularized
nucleoli have disintegrated
homologous chromosomes are
attached by their kinetochores to
spindle fibers from opposite poles
homologous chromosomes are
held together only at chiasmata,
the sites where crossing-over
occurred
➤ **Metaphase I**
Homologous chromosomes align along the center of the cell.
The centrioles reach the opposite poles of the cell with the spindle fibers extending from them.
The centromeres orient themselves towards the opposite poles of the cell

➤ **Anaphase I:**
Spindle fibres contract and split the bivalent, homologous chromosomes move to opposite poles of the cell

- **Telophase I:**
Chromosomes decondense, nuclear membranes may reform,
- Cytokinesis: Cell divides forming two haploid daughter cells

- Interkinesis: An optional rest period between meiosis I and meiosis II, no DNA replication occurs in this stage

**Meiosis II**

- **Prophase II:**
  Chromosomes condense, nuclear membrane dissolves (if reformed), centrioles move to opposite poles (perpendicular to previous poles)

- **Metaphase II:**
  Spindle fibres from centrioles attach to centromeres of chromosomes, chromosomes line up along the equator of the cell
➢ **Anaphase II:**
Spindle fibres contract and split the chromosome into sister chromatids, chromatids (now called chromosomes) move to opposite poles

➢ **Telophase II:**
Chromosomes decondense, nuclear membrane reforms,

- **cytokinesis**
cells divide resulting in four haploid daughter cells

- **Fertilization:** The fusion of a sperm and egg to form a zygote. **zygote**
- **A zygote** is a fertilized egg sperm
(a) Prophase I  (b) Metaphase I  (c) Anaphase I  (d) Telophase I

- Each chromosome consists of two chromatids.
- Homologous chromosomes synapse, and crossing over takes place. Nuclear envelope breaks down.
- Homologous chromosomes line up in pairs along midplane.
- Homologous chromosomes separate and move to opposite poles. Note that sister chromatids remain attached at their centromeres. One of each pair of homologous chromosomes is at each pole. Cytokinesis occurs.

(e) Prophase II  (f) Metaphase II  (g) Anaphase II  (h) Telophase II

- Chromosomes condense again.
- Chromosomes line up along midplane.
- Sister chromatids separate, and chromosomes move to opposite poles.
- Nuclei form at opposite poles. Cytokinesis occurs.
Monera kingdom—bacteria-prokaryotic-organisms, also called germs,

**Bacteria**: are microscopic organisms not visible with the naked eye. Bacteria are everywhere, both inside and outside of your body. Bacteria can live in a variety of environments, from hot water to ice. Some bacteria are good for you, while others can make you sick.

**Bacteria**: are single-celled, or simple, organisms. Though small, bacteria are powerful and complex, and they can survive in extreme conditions. Bacteria have a tough protective coating that boosts their resistance to white blood cells in the body.

**Bacteria Characteristics**

1. Bacteria are prokaryotic cells.
2. Unicellular.
3. They are 1-10 um in length (much smaller than eukaryotic cells).
4. No membrane bound organelles in cytoplasm, Except for ribosomes.
5. Lack a defined nucleus, Single circular chromosome.
6. Reproduces by binary fission (splitting in two).
7. Most have a cell wall, cell wall may be surrounded by a capsule.
Prokaryotic cells lack organelles found in eukaryotic cells such as mitochondria, endoplasmic reticular, and Golgi complexes. According to Theory, eukaryotic organelles are thought to have evolved from prokaryotic cells living in endosymbiotic relationships with one another.

1. **Capsule:** It is a polysaccharide layer that lies outside the cell envelope found in some bacterial cells, this additional outer covering protects the cell when it is engulfed by other organisms, assists in retaining moisture, and helps the cell adhere to surfaces and nutrients.

2. **Cell Wall:** The cell wall is an outer covering that protects the bacterial cell and gives it shape.

3. **Cell Membrane or Plasma Membrane:** The cell membrane surrounds the cell's cytoplasm and regulates the flow of substances in and out of the cell.

4. **Cytoplasm:** Cytoplasm is a gel-like substance composed mainly of water that also contains enzymes, salts, cell components, and various organic molecules.

5. **Ribosomes:** Ribosomes are cell structures responsible for protein production.

6. **Nucleoid Region:** Area of the cytoplasm that contains the single bacterial DNA molecule.

7. **Plasmids:** Plasmids are gene-carrying, circular DNA structures that are not involved in reproduction.
8. **Pili (Pilus singular):** Hair-like structures on the surface of the cell that attach to other bacterial cells. Shorter pili called fimbriae help bacteria attach to surfaces.

9. **Flagella:** are long, thin (about 20 nm), whip-like appendages that move the bacteria towards nutrients and other attractants. Flagella are free at one end and attached to the cell at the other end. Flagellum can never be seen directly with the light microscope but only after staining with special flagella stains that increase their diameter. Flagella can be seen easily with the electron microscope.

**Arrangement and Types**

a) **Monotrichous** (Mono means one): Single polar flagellum  
   e.g. *Vibrio cholerae*.

b) **Lophotrichous:** Tuft of flagella at one or both ends  
   e.g. *Spirilla* spp.

c) **Peritrichous** (flagella in the periphery): Flagella surrounding the bacterial cell.  
   e.g. *E. coli*.

d) **Amphitrichous:** Single flagellum at both ends  
   e.g. *Alcaligenes faecalis*.

**Spore**

Some bacteria have the ability to form highly resistant resting stage called spores, which helps them to overcome adverse environmental conditions that are unfavorable for vegetative growth of cell.
Classification of Bacteria

Bacteria can be classified into various categories based on their features and characteristics. The classification of bacteria is mainly based on the following:

1. **Mode of respiration**
   a) Anaerobic Bacteria Actinomyces
   b) Aerobic Bacteria Mycobacterium
   c)

2. **Mode of nutrition**
   a) Autotrophic Bacteria Cyanobacteria
   b) Heterotrophic Bacteria All disease-causing bacteria

3. **Composition of the cell wall (STAINING OF BACTERIA).**
   a) Peptidoglycan cell wall Gram-positive bacteria
   b) Lipopolysaccharide cell wall Gram-negative bacteria

4. **Morphology of bacteria (SHAPE)**
   a) **Cocci**

      The bacteria that are oval or spherical in shape are included called cocci bacteria. These may either remain single or attached to one another in groups.

      e.g. *Streptococcus pneumoniae*

      Cocci bacteria can be arranged either singly, in pairs, in groups of four, in chains, in clusters or cubes consisting of eight cells. These cells remain attached during cell division.

   b) **Bacilli (Rod-shaped)**

      These are rod-shaped cells that also like cocci, remain either single or attached to other cells.

      Bacilli are the bacteria which are rod-shaped and are present as single cells , e.g. *Salmonella*

      Diplobacilli : Bacilli that remain in pairs after dividing.
Streptobacilli: Bacilli that remain arranged in end-to-end chains.

c) **Spiral Bacteria**

Vibrios: Bacteria that are curved or comma-shaped. *Vibrio cholerae*

Spirilla: Bacteria that have a helical shape and fairly rigid bodies.

Spirochetes: Bacteria that have a helical shape and flexible bodies.
**Bacteria Reproduction**

Bacteria, being single-celled prokaryotic organisms, do not have a male or female version.

**Binary Fission**

Bacteria reproduce through a process called binary fission. During binary fission, the chromosome copies itself, forming two genetically identical copies. Then, the cell enlarges and divides into two new daughter cells. The two daughter cells are identical to the parent cell. Binary fission can happen very rapidly. Some species of bacteria can double their population in less than ten minutes! This process makes it possible for a tremendous bacterial colony to start from a single cell.
Gram staining: (or Gram's method): is a method of differentiating bacterial species into two large groups Gram Positive Gram Negative Gram staining differentiates bacteria by the chemical and physical properties of their cell walls.

Peptidoglycan: also known as murein, is a polymer consisting of sugars and amino acids that forms a mesh-like layer outside the cell membrane of most bacteria forming the cell wall.

Structure of Peptidoglycan
Two alternating amino sugars make up the crystal lattice structure of peptidoglycan; they are N-acetylglucosamine (shortened to NAG) and N-acetylmuramic acid (shortened to NAM). Amino sugars are sugar molecules that have an amine group (-NH2) replacing one of their hydroxyl groups. Each NAM molecule has an attached chain of four or five amino acids. Crosslinking between these amino acids gives peptidoglycan its strong structure.

The important difference between gram-positive and gram-negative bacteria in tabular form.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Gram-positive bacteria</th>
<th>Gram-negative bacteria</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cell Wall</td>
<td>A single-layered, smooth cell wall</td>
<td>A double-layered, wavy cell-wall</td>
</tr>
<tr>
<td>Cell Wall thickness</td>
<td>The thickness of the cell wall is 20 to 80 nanometres</td>
<td>The thickness of the cell wall is 8 to 10 nanometres</td>
</tr>
<tr>
<td>Peptidoglycan Layer</td>
<td>It is a thick layer/ also can be multi-layered.</td>
<td>It is a thin layer/ often single-layered.</td>
</tr>
<tr>
<td>---------------------</td>
<td>-----------------------------------------------</td>
<td>------------------------------------------</td>
</tr>
<tr>
<td>Teichoic acids</td>
<td>Teichoic acids are present.</td>
<td>Teichoic acids are not present.</td>
</tr>
<tr>
<td>Lipopolysaccharide</td>
<td>Lipopolysaccharide is not present.</td>
<td>Lipopolysaccharide is present.</td>
</tr>
<tr>
<td>Lipid content</td>
<td>The Lipid content is very low.</td>
<td>The Lipid content is 20% to 30%.</td>
</tr>
<tr>
<td>Color staining</td>
<td>They retain the color of crystal violet and stain dark blue or purple.</td>
<td>They take the color Safranin and staining red or pink</td>
</tr>
<tr>
<td>Resistance to Antibiotic</td>
<td>These are very susceptible to antibiotics.</td>
<td>These are very resistant to antibiotics.</td>
</tr>
</tbody>
</table>
REAGENTS USED IN GRAM STAIN


Principle of Gram staining
**Crystal violet (CV)** dissociates into CV+ and Cl− ions in aqueous solutions. These ions penetrate through the cell wall and cell membrane of both Gram-positive and Gram-negative cells. The CV+ ion interacts with negatively charged components of bacterial cells and stains the cells purple.

**Iodine (I)**, used as mordant interacts with CV+ and forms large complexes of crystal violet and iodine (CV−I) within the inner and outer layers of the cell.

When a **decolorizer** such as alcohol or acetone is added, it interacts with the lipids of the cell membrane. Since Gram negative organism have thin peptidoglycan layer (1-2 layers) and have additional lipopolysaccharide layer which gets dissolved due to the addition of alcohol, so gram negative organism fails to retain the complex and gets decolorized as the complex is washed away.

In contrast, a Gram-positive cell becomes dehydrated from an ethanol treatment. This closes the pores in the cell wall and prevents the stain from exiting the cell. The large CV−I complexes become trapped within the Gram-positive cell also due to the thick and multilayered (40 layers) nature of its peptidoglycan.

After decolorization, the Gram-positive cell remains purple and the Gram-negative cell loses its purple color. Counterstain, which is usually positively-charged **safranin** or basic fuchsin, is applied last to give decolorized Gram-negative bacteria a pink or red color.
Sterilization: is defined as the process by which a surface or medium is free of all living microorganisms.

Disinfection: means the destruction or removal of all pathogenic organisms or organisms capable of giving rise to infection. (Disinfection can be done by chemical)

Antisepsis: Reduction or inhibition of microbes found on living tissue like wounds.

Anticeptics: Chemical disinfectants which can be safely applied to the skin or mucous membrane and are used to prevent infection by inhibiting the growth of bacteria are called antiseptics.

Methods of Sterilization & Disinfection
A. Physical methods.
B. Chemical Methods.

A. Physical methods
1. **Heat:**

these methods divided into:

**A: Dry-heat**

1. **Red hot:**
   - Exposure of wires and forceps to the Bunsen flame until it becomes red hot, then cool down and use.
   - Used for loop, forceps, and metal rods.

2. **Flaming:**
   - Slowly passing of an object to the Bunsen flame will reduce the number of microorganisms.
   - Used for sterilization of the mouth of bottle, flasks, containers and test tubes, smear slides etc.

3. **Hot air oven:**
   - Instruments consist of heater, oven.
   - Used for sand, powder, metal, glass
A. **Moist heat:**

   moist air can be divided into 3 groups:

1. **Temperature below 100 °C:** (pasteurization of milk; holding period 63 °C for 30 minutes, or 72 °C for 15-20 minutes followed by cooling quickly to 13 °C. This process targets all non sporing pathogens)

2. **Temperature at 100 °C:** (boiling 5-10 min kills all non-spore forming bacteria).

3. **Temperature above 100 °C:** steam under pressure

   Autoclave / steam sterilizers: this means that all bacteria, viruses, fungi, and spores are inactivated by 134 °C for 3 minutes or 121 °C for 15 minutes. This happened when water boils when its vapor pressure equals the surrounding atmosphere. Thus, when pressure inside closed vessels increases, the temperature at which water boils increases too.
2. **Radiation sterilization**

Sterilization by radiation kills microbes by causing mutation to the cellular protein and disrupting cellular elements.

The main difference between different radiation types is their penetration and their effectiveness.

- **Types of radiation:**
  1. Non Ionizing
  2. Ionizing

<table>
<thead>
<tr>
<th>Non Ionizing</th>
<th>Ionizing</th>
</tr>
</thead>
<tbody>
<tr>
<td>E.g. : UV (Ultraviolet)</td>
<td>E.g.: X-rays and gamma rays</td>
</tr>
<tr>
<td>have low penetration and thus are less effective, but it is safe and can be used for small area sterilization.</td>
<td>have far more penetrating power and thus are more effective for sterilization on a large scale. But its more dangerous and thus needs special attention.</td>
</tr>
<tr>
<td>used to sterilize the interiors of biological safety cabinets between uses</td>
<td>X-rays used for sterilizing large packages of medical devices.</td>
</tr>
<tr>
<td>Operating Rooms and T.B. laboratories.</td>
<td>Gamma rays is commonly used for sterilization of most medical disposables (syringes, needles).</td>
</tr>
</tbody>
</table>

**biological safety cabinets**

**ultraviolet**
3. Filtration
Filtration is used for the removal of microbes from solutions that cannot easily be treated in other ways. Typically heat-sensitive compounds such as antibiotics and vitamins are filtered before addition to sterile cool media.

_There are three types of filters._
1. Depth filters.
2. Membrane Filters.
3. Air filters.
B. Chemical Methods.

Chemical Sterilization

Chemicals are able to inhibit and kill microbial growth.

Ex; Disinfectants are those chemicals that destroy pathogenic bacteria from specified surfaces.

- The level of disinfection achieved depends on contact time, temperature, type and concentration of the active ingredient,
- Some chemical have very narrow spectrum of activity and some have very wide.

kinds of Chemical Disinfectants:
- Alcohol
- Ethyl, isopropyl
- Aldehydes
- Formaldehyde
- Phenols
- Gases: ethylene oxide
MEIOSIS

Organisms that reproduce Sexually are made up of two different types of cells.

A. Somatic Cells are “body” cells and contain the normal number of chromosomes ….called the “Diploid” number (the symbol is 2n). Examples would be … skin cells, brain cells, etc.

B. Gametes are the “sex” cells and contain only half the normal number of chromosomes…. called the “Haploid” number (the symbol is n)….. Sperm cells and ova are gametes.

Meiosis: The type of cell division by which gametes with half the number of chromosomes, are produced.

Meiosis is a cell division process where a single (parent) cell divides twice to produce four independent (daughter) cells, each having half the chromosomes as the original cell.

- Meiosis occur in Sex cells
- Sex cells divide to produce gametes (sperm or egg).
- The Male Gamete is the Sperm and is produced in the male gonad the Testes. called spermatogenesis
- The Female Gamete is the Ovum and is produced in the female gonad the Ovaries. called oogenesis

Meiosis is two cell divisions

- meiosis I
- meiosis II
Meiosis I

- Cell division that reduces the chromosome number by one-half.

**Interphase I**
- Similar to mitosis interphase.
- Chromosomes replicate (S phase).
- Each duplicated chromosome consists of two identical sister chromatids attached at their centromeres. Centromeres
- Centriole pairs also replicate.
➢ Prophase I

Longest and most complex phase (90%).

- Chromosomes condense.
- **Synapsis occurs**: homologous chromosomes come together to form a tetrad.
- **Tetrad**: is two chromosomes or four chromatids (sister and nonsister chromatids).
- **Homologous chromosome**: one of a pair of chromosomes with the same gene sequence, loci, chromosomal length, and centromere location.

### Crossing over

- Crossing over involves the exchange of segments of DNA between homologous chromosomes during Prophase I of meiosis.
- The process of crossing over occurs as follows:
  - Homologous chromosomes become connected in a process called synapsis, forming a bivalent (or tetrad).
  - Non-sister chromatids break and recombine with their homologous partner, effectively exchanging genetic material (crossing over).
  - Non-sister chromatids remain connected in an X-shaped structure and the positions of attachment are called chiasmata.
  - Chiasma hold homologous chromosomes together as a bivalent until anaphase I.
  - As a result of crossing over, chromatids may consist of a combination of DNA derived from both homologues - these are called recombinants.
by the end of **prophase I**
the spindle has formed
the nuclear membrane has vesicularized
nucleoli have disintegrated
homologous chromosomes are attached by their kinetochores to spindle fibers from opposite poles
homologous chromosomes are held together only at chiasmata, the sites where crossing-over occurred
- **Metaphase I**: Homologous chromosomes align along the center of the cell. The centrioles reach the opposite poles of the cell with the spindle fibers extending from them. The centromeres orient themselves towards the opposite poles of the cell.

- **Anaphase I**: Spindle fibres contract and split the bivalent, homologous chromosomes move to opposite poles of the cell.

- **Telophase I**: Chromosomes decondense, nuclear membranes may reform.
- **Cytokinesis**: Cell divides forming two haploid daughter cells.

- **Interkinesis**: An optional rest period between meiosis I and meiosis II, no DNA replication occurs in this stage.

- **Meiosis II**
  - **Prophase II**: Chromosomes condense, nuclear membrane dissolves (if reformed), centrioles move to opposite poles (perpendicular to previous poles).
  - **Metaphase II**: Spindle fibres from centrioles attach to centromeres of chromosomes, chromosomes line up along the equator of the cell.
- **Anaphase II:**
  Spindle fibres contract and split the chromosome into sister chromatids, chromatids (now called chromosomes) move to opposite poles

- **Telophase II:**
  Chromosomes decondense, nuclear membrane reforms,

  - **cytokinesis**
    cells divide resulting in four haploid daughter cells

- **Fertilization:** The fusion of a sperm and egg to form a zygote.
  - **A zygote** is a fertilized egg sperm
(a) Prophase I
Each chromosome consists of two chromatids.
Homologous chromosomes synapse, and crossing over takes place. Nuclear envelope breaks down.

(b) Metaphase I
Homologous chromosomes line up in pairs along midplane.

(c) Anaphase I
Homologous chromosomes separate and move to opposite poles. Note that sister chromatids remain attached at their centromeres.

(d) Telophase I
Cell plate forms, and new nuclei are formed.

(e) Prophase II
Chromosomes condense again.

(f) Metaphase II
Chromosomes line up along midplane.

(g) Anaphase II
Sister chromatids separate, and chromosomes move to opposite poles.

(h) Telophase II
Nuclei form at opposite poles. Cytokinesis occurs.
Microscope

A *microscope* is a laboratory instrument used to examine objects that are too small to be seen by the naked eye.

or

A *microscope* is an instrument that makes an enlarged image of a small object, thus revealing details too small to be seen by the unaided eye.

**There are many types of microscopes:**

1- Optical Microscopes.

2- Compound Microscopes.

3- Confocal Laser scanning microscopes.

4- X-ray Microscopes.

5- Electron Microscopes:
   
   A- Transmission electron microscopy (TEM).
   
   B- Scanning electron microscopy (SEM).
Microscopes are generally made up of structural parts for holding and supporting the microscope and its components and the optical parts which are used for magnification and viewing of the specimen images. This description defines the parts of a microscope and the functions they perform to enable visualization.

**There are three structural parts of the microscope i.e. head, base, and arm.**

**Head** – This is also known as the body, it carries the optical parts in the upper part of the microscope.

**Base** – It acts as microscopes support. It also carries the microscopic illuminators.

**Arms** – This is the part connecting the base and to the head and the eyepiece tube to the base of the microscope. It gives support to the head of the microscope and it also used when carrying the microscope. Some high-quality microscopes have an articulated arm with more than one joint allowing more movement of the microscopic head for better viewing of specimens.

**The optical parts of the microscope are used to view, magnify, and produce an image from a specimen placed on a slide. These parts include:**

1. **Eyepiece** – also known as the ocular. This is the part used to look through the microscope. It’s found at the top of the microscope. Its standard magnification is 10x

2. **Objective lenses** – These are the major lenses used for specimen visualization. They have a magnification power of 40x-100X. There are about 1-4 objective lenses placed on one microscope, in that some are rare facing and others face forward. Each lens has its own magnification power.
3. **Nose piece** – also known as the revolving turret. It holds the objective lenses. It is movable hence it can revolve the objective lenses depending on the magnification power of the lens.

4. **The Adjustment knobs** – These are knobs that are used to focus the microscope. There are two types of adjustment knobs i.e fine adjustment knobs and the coarse adjustment knobs.
   - Coarse Adjustment: Brings the specimen into general focus.
   - Fine adjustment: Fine tunes the focus and increases the detail of the specimen

5. **Stage** – This is the section on which the specimen is placed for viewing. They have stage clips hold the specimen slides in place. The most common stage is a mechanical stage, which allows the control of the slides by moving the slides using the mechanical knobs on the stage instead of moving it manually.

6. **Aperture** – This is a hole on the microscope stage, through which the transmitted light from the source reaches the stage.

7. **Illuminator (light)** – This is the microscopes light source, located at the base. It is used instead of a mirror. It captures light from an external source of a low voltage of about 100v.

8. **Condenser** – These are lenses that are used to collect and focus light from the illuminator into the specimen. They are found under the stage next to the diaphragm of the microscope. They play a major role in ensuring clear sharp images are produced with a high magnification of 400X and above. The higher the magnification of the condenser, the more the image clarity. More sophisticated microscopes come with an Abbe condenser that has a high magnification of about 1000X.
9. **Diaphragm** – it's also known as the iris. It's found under the stage of the microscope and its primary role is to control the amount of light that reaches the specimen.

10. **Stage control**

11. **On/off switch** - This switch on the base of the microscope turns the illuminator off and on.
Magnification

Total magnification is how large the specimen appears under the microscope.

**Total magnification** = Magnification Eyepiece (ocular) × Magnification objective lens

<table>
<thead>
<tr>
<th>objective lens</th>
<th>Magnification</th>
<th>Eyepiece lens</th>
<th>Total magnification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Scanning</td>
<td>4X</td>
<td>10X</td>
<td>40X</td>
</tr>
<tr>
<td>Low power</td>
<td>10X</td>
<td>10X</td>
<td>100X</td>
</tr>
<tr>
<td>High power</td>
<td>40X</td>
<td>10X</td>
<td>400X</td>
</tr>
<tr>
<td>Oil immersion</td>
<td>100X</td>
<td>10X</td>
<td>1000X</td>
</tr>
</tbody>
</table>
THE CELL

The cell: Structural and functional unit of all living organisms.

Cells: are the basic units of living organisms.

Cytology (Cell biology): Is the branch of biology that studies the structure and function of the cell.

Cell theory

1. All living organisms are composed of one or more cells.
2. The cell is the basic unit of structure and organization in organisms.
3. Cells arise from pre-existing cells.

Modern version

The modern version of the cell theory includes the ideas that:

Energy flow occurs within cells.

Heredity information (DNA) is passed on from cell to cell.

All cells have the same basic chemical composition.
the basic structure of cell

Cells are found in different size and shapes, representing their evolution for any adaptation to different environments or to different specialized functions within a multicellular organism.

All cells are similar to each other because they all have the same basic structure inside. They all have a membrane that encloses the jelly-like cytoplasm and a nucleus that controls the cell.

Types of cells

<table>
<thead>
<tr>
<th>Prokaryotic Cells:</th>
<th>Eukaryotic Cells:</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Have no membrane covered nucleus</td>
<td>• Have a nucleus</td>
</tr>
<tr>
<td>• Have no membrane - covered organelles</td>
<td>• Have a membrane - covered organelles</td>
</tr>
<tr>
<td>• Have single circular DNA</td>
<td>• Have linear DNA</td>
</tr>
<tr>
<td>• Are bacteria</td>
<td>• Are all other cells</td>
</tr>
</tbody>
</table>

Size of Cells
Cells ranged in size from the smallest cells, bacteria, only a few length of a micrometer in diameter, to various bird eggs with dimension of centimeters.

Shapes of Cells in Human Beings

In human, shapes of cells vary from one tissue to another. Cells differ widely in shape.

Most cells are roughly cuboidal or spherical.

Following are some example of different types of shapes of cells

<table>
<thead>
<tr>
<th>1- Squamous shape</th>
<th>Flat cells, height less than the wide</th>
<th>Cells lining the blood vessels and body cavities. Function: barrier, absorption, secretion.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Have flattened nucleus</td>
<td></td>
</tr>
<tr>
<td>Shape Description</td>
<td>Cell Description</td>
<td>Example</td>
</tr>
<tr>
<td>------------------------------------------</td>
<td>------------------------------------------------------------------------------------------------------</td>
<td>--------------------------</td>
</tr>
<tr>
<td>Cuboidal shape</td>
<td>Height equal to the wide, have spherical nucleus and is found in the center of the cell.</td>
<td>Covering the ovary, thyroids</td>
</tr>
<tr>
<td>Columnar shape</td>
<td>Height more than the wide. The nucleus is oval in shape and located at The base of the cell.</td>
<td>Lining the intestine, gall bladder, uterus</td>
</tr>
<tr>
<td>Irregular shape or star like shape</td>
<td>Irregular, because the cell have dendrites extending from the body of the cell. Nucleus spherical shape</td>
<td>Nerve cells</td>
</tr>
<tr>
<td>Spherical shape cell</td>
<td>W.B.C</td>
<td>Fat cell</td>
</tr>
<tr>
<td>Spindle shape</td>
<td>Smooth muscle</td>
<td></td>
</tr>
<tr>
<td>--------------</td>
<td>--------------</td>
<td></td>
</tr>
<tr>
<td>Function: contraction</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Cylindrical shape</th>
<th>Muscle fiber</th>
</tr>
</thead>
<tbody>
<tr>
<td>Function: contraction</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Special shape</th>
<th>Cells have head, neck and tail.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Example: sperm</td>
<td></td>
</tr>
<tr>
<td>Function: reproduction</td>
<td></td>
</tr>
</tbody>
</table>
The cell Practical
Prepared by
Asst. Lec. Sarah Amer Aswed
Lab 3
Cell Organelles

*Organelles* - small structures inside a cell with specific functions.

* Plants may have lytic vacuoles, which act like lysosomes in animal cells.
** Although they're not labelled here, plant cells have microtubules and secretory vesicles, too.
*** Cell membrane and plasma membrane are just different names for the same structure.
1- Cell Membrane/Plasma Membrane

Outer membrane of cell that holds the cell together controls movement in and out of the cell.

**Function:** Regulates materials entering and exiting the cell.

**Structure:** Two layers of phospholipids, proteins
2- Cytoplasm

Gel-like mixture Surrounded by cell membrane, various organelles are found in the cytoplasm.

Structure: All cell contents that lie between the cell membrane and the nucleus. (organelles +

The main components of the cytoplasm are:

A. Cytosol— a gel-like substance (Cytosol = liquid portion/non-organelles. made up of fluid and organelles except for nucleus)

B. Organelles – the cell’s internal sub-structures, and
- **Functions**

1. Many cellular processes also occur in the cytoplasm, such as protein synthesis, the first stage of cellular respiration (known as glycolysis), mitosis, and meiosis.

2. The cytoplasm helps to move materials, such as hormones, around the cell and also dissolves cellular waste.
3- Nucleus

A membranous organelle of the eukaryotic cell that contains (Nucleolus: Contains RNA to build proteins

Chromosomes: Contains genetic material or DNA genetic material)

It is a rounded structure usually located near the center of the cell.
**Function:** Control of the genetic information, protein and enzyme synthesis, cell division and cell growth; Storage of DNA, RNA and ribosome; Regulation of the transcription of the mRNA to protein; Production of ribosomes.

**Structure:** membrane bound, contains DNA
Nuclear Envelope

**Function:** Regulates what enters or exits the nucleus.

**Structure:** Double Layer of Lipids
Nucleolus

**Function:** Produces RNA, which are used to make all proteins.

**Structure:** Inside Nucleus, separate from DNA
DNA – Deoxyribonucleic acid

**Function:** information on how to make proteins.
*Chromatin – unorganized DNA (normal state)
*Chromosomes – organized DNA (present before cell division)

**Structure:** Made up of nucleotides, locked in the nucleus
4-Mitochondria

organelles in which the biochemical processes of respiration and energy production occur.

**Function:** Produce energy for the cell – site of cellular respiration. “The Powerhouse”

**Structure:** Double membrane-bound, kidney shaped.
5-Golgi Apparatus

a complex of vesicles and folded membranes within the cytoplasm, modify and package proteins

**Function:** Packages, labels and ships proteins out of the cell.

**Structure:** Pancake-shaped layered organelle
6-Endoplasmic Reticulum

A network of membranous tubules within the cytoplasm continuous with the nuclear membrane and moves materials around in cell.

**Smooth ER**: lacks ribosomes

**Rough ER**: ribosomes embedded in surface

**Function**: Transportation route for proteins.

**Structure**: tubes and channels
7-Ribosomes

Each cell contains thousands of ribosomes that make proteins.

**Function:** Makes proteins.

**Structure:** small circular organelles
8-Lysosome

Organelles in the cytoplasm containing Digestive enzymes for proteins, fats, and carbohydrates.

**Function:** packets of enzymes that break down materials in a cell.

**Structure:** Small membrane-bound organelles
Membrane-bound sacs for storage, digestion, and waste removal

**Function:** Storage for water, nutrients or waste.

**Structure:** small membrane-bound organelle.

**Vacuoles & Vesicles**
**10-Cytoskeleton**

**Function:** Provide support and structure for the cell.

* Microfilaments
* Microtubules

**Structure:** Tubules
11-Centrioles (Animals Only)

**Function:** microtubules that help divide the cell during cell division.

**Structure:** Tubules
12. Cilia & Flagella

Function: provides movement for the cell or objects moving by the cell.

Structure:

Flagella – 1 long fiber

Cilia – many short fibers
13-Chloroplasts (Plants only)

**Function:** site of photosynthesis (converting sun and CO2 into sugar).

**Structure:** Membrane bound organelles that contain chlorophyll.

![Three-dimensional Model of Chloroplast Membranes](link)
14- Cell Wall (Plant cells only)

**Function:** Provides support for the cell and the plant.

**Structure:** Made of cellulose
Epithelial Tissue

Prepared by
Asst. Lec. Sarah Amer Aswed
Lab 4
**Introduction**

**Tissue** :- is a group of cells performing similar functions.

The body is composed of approximately 75 trillion cells.

**four** main groups of tissue are known in the body these are :

1-epithelium tissue .
2-connective tissue .
3-muscular tissue .
4-nervous tissue .
Basement membranes

• are a specialized form of extracellular matrix that surrounds epithelial, endothelial, peripheral nerve, muscle, and fat cells throughout the body.
Epithelium tissue

Is layer of cells which cover the body surface and line the internal cavity and tubes. Classified according to two criteria:

1. **Number of cell layers:**
   A. Simple epithelia
   B. Stratified epithelia

2. **Shape of the surface cells:**
   A. Squamous cells
   B. Cuboidal cells
   C. Columnar cells
Simple squamous epithelium - formed of a single layer of flat cells. Found in kidney, blood and lymph vessels.
Simple columnar epithelium

Is composed of a single layer of tall cells like hexagonal solids. Found in uterus, stomach, and intestine.

Absorptive cells
Nucleus
Brush border
Lamina propria
Lumen of gut
**Simple cuboidal epithelium**

Is composed of a single layer of cells shaped like truncated hexagonal solids. Form the covering of ovary and compose some kidney tubules.
**Pseudo stratified columnar epithelium tissue**

One layer of cells of different length, nucleus is not on the same level, so it's appear more than one layer. Can be ciliated. Found in trachea, urethra.
**Stratified Squamous epithelium**

many layers of flattened cells can be keratinized as epidermis and non keratinized as esophagus
Stratified columnar epithelium

Consist of more than one layer of cells. the superficial layer is columnar in shape.

Found in : conjunctiva of eye.
Stratified cuboidal epithelium

2 or 3 layers of cuboidal cells
Found in ducts of sweat glands

214x487

Stratified cuboidal epithelium

2 or 3 layers of cuboidal cells
Found in ducts of sweat glands

602x487
Transitional epithelium

Consist of Several layer of cells. The surface layer is large and dome-shaped. Found in urinary bladder, ureter.
1. Protection from:
   - Mechanical trauma
   - Dehydration
   - Pathogens

2. Secretion of:
   - Hormones, Enzymes, HCl, milk, Mucous.

3. Lubrication of:
   - Contents of digestive tract.

4. Filtration of wastes: (Urine)

5. Absorption of food: (Aminoacids, Glucose, Fatty acids)

6. Neuroepithelium: (Taste, Smell, Hearing)

7. Reproduction: (Germ cells)
Glandular tissue

• Glandular tissue is the type of epithelium that forms the glands from the infolding of epithelium and subsequent growth in the underlying connective tissue.

• Glands are classified

A-The glands are classified according to the number of the cells into

1-Unicellular glands: (goblet cells among absorption cells in intestinal epithelium).

2-Multicellular gland: (salivary glands).
B- glands classified into three major groups on the basis of method of distribution of their secretory products:

1. **Endocrine glands**: secrete their product into the extracellular space where it is taken up by the circulatory system. (Thyroid gland).

2. **Exocrine glands**: secrete their products into a duct that then delivers the product to the lumen of an organ (salivary glands).

3. **Mixed glands**: In this glands group of cells secrete into duct and another group of cells secrete into blood stream e.g. (pancreas, liver, ovary). Pancreas which has exocrine function in digestion of food and endocrine function in regulate blood sugar.
Connective Tissues

The tissues that connect the different parts of the body together are called connective tissues.

**Basic Functions**

1. Support and binding of other tissues
2. Defending the body against infection (Protecting).
3. Transporting substances within the body.
4. Storing nutrients as fat.

**Connective Tissues are made of three main components:**

A. Ground Substance
B. Fibers
C. Cells
A. Ground Substance [extracellular matrix] – the sieve part –

1. Fills space between cells & surrounds fibers.
2. Clear, colorless.
3. Made of Hyaluronic acid, proteoglycans and glycoproteins.

B. Fibers

There are three types of fibers prevalent in Connective tissues

1. collagen fibers – are wide and wavy in appearance and generally stain pink. 79% of the protein in the body is collagen.
2. elastic fibers – are thin flexible fibers made from the protein elastin, that generally stain black.
3. reticular fibers – are actually thin collagen fibers. They have a spider web appearance and appear black under stain.

C. The Cells

Each major type of connective tissue has its own fundamental cell type:

Type of Connective Tissue → Immature Cell → Mature Cell.

1. Connective Tissue Proper → Fibroblast → Fibrocyte.
2. Cartilage → Chondroblast → Chondrocyte.

Other Cells Present: Connective tissue is also home to many other cell types including Fat Cells, and mobile cells that migrate into the
connective tissue from the blood stream, ie. mast cells and macrophages. Plasma cell, mesenchymal cell.

**Types of Connective Tissue**

Connective tissues encompass a diverse array of tissue types that are involved in binding and supporting body structure and tissues.

• **Connective Tissue Proper:**
  A. Loose connective tissues.
  1. Areolar connective tissues.
  2. Adipose connective tissues.
  3. Reticular connective tissues.
  4. Mesenchymal connective tissues.
Connective Tissues

A. Loose connective tissues. Proper:

1. Areolar Connective Tissue Structure:

   gel like matrix with all three fiber types present. Three cell types present:


   Areolar Connective Tissue Location:

   - Found between the skin and muscle.
   - Also found between muscles
   - Packages organs
   - Surrounds Capillaries
   - Collagen Fiber
   - Elastic Fiber
   - Fibroblast

   Areolar Connective Tissue Function:

   1. Wraps and cushions organs.
   2. Macrophages phagocytize bacteria
   3. Holds and conveys tissue fluid
2. **Adipose connective tissues Structure.**

Adipocytes (fat filled cells) are shaped spherical cells filled with tryglycerides.

**Adipose Tissue Location:**

- Found around organs.
- Joints.
- surrounding the eyeball.
- within the abdomen.

**Adipose Tissue Function :**

1. Shock absorption.
2. Energy Storage.
3. Protection.
4. Insulation.

In mammals, two types of adipose tissue exist:
- white adipose tissue (WAT)
- brown adipose tissue (BAT).

3. **Reticular Tissue Structure :**

The tissue consists of reticular cells and the network of reticular fibers formed by them Most connective tissues contain reticular fibers
Reticular Tissue Location:

- Spleen
- Lymph nodes
- Liver

Reticular Tissue Function:

1. In Lymph Nodes – macrophages devour bacteria, viruses and cancer cells.
2. In Spleen – macrophages break down dying RBC’s.
3. In Liver – macrophages (Kupffer cells) devour bacteria.
4. This tissue forms a soft internal skeleton that supports other cell types.

4. Mesenchymal connective tissues.

Mesenchyme is a type of connective tissue found mostly during the embryonic development.

Mesenchyme Tissue Location:
Umbilical cord.
Connective Tissue Proper:
Dense Connective Tissue
Dense Regular Connective Tissue

**Dense Regular Connective Tissue Structure:**
Parallel collagen fibers.
Dark colored fibroblasts interspersed.

**Dense Regular Connective Tissue Location:**
- In tendons and ligaments.
- In scar tissue
- Aponeuroses
- Fascia around muscles

**Dense Regular Connective Tissue Function:**
- Provide high tensile strength in one direction.
- Attached muscles to bone, bone to bone.
**Dense Irregular Connective Tissue**

**Dense Irregular Connective Tissue Structure:**
- Primarily irregularly arranged collagen fibers.
- Some elastic fibers and fibroblasts.

**Dense Irregular Connective Tissue Function**
- Withstands tension
- Provides structural strength
- Location
- Dermis of skin
- Submucosa of digestive tract
- Fibrous capsules of joints and organs
Cartilage:

Firm, flexible tissue, Contains no blood vessels or nerves, Matrix contains up to 80% water Cell type – chondrocyte

Types:
• Hyaline
• Elastic
• Fibrocartilage

Hyaline Cartilage:

Hyaline Cartilage Structure:
The chondrocytes (cells) lie in lacunae (spaces around cells). There is a large amount of extracellular matrix which is bordered on either side by the perichondrium.

Hyaline Cartilage Location:
• Forms most of the embryonic skeleton.
• Covers the ends of long bones.
• Costal cartilage
• Nose
• Trachea
• Larynx
Hyaline Cartilage Function:
- Provides a smooth surface for joints to move over.
- Resists compression and provides flexible support.

Elastic Cartilage

Elastic Cartilage Structure - Similar to Hyaline cartilage with the exception of the elastic fibers in the matrix

Elastic Cartilage Location:
- Ears
- Epiglottis
- Larynx (voice box).

Elastic Cartilage Function:
- Maintains shape of a structure but is also extremely flexible.
Fibrocartilage

is the strongest type of cartilage and composed of hyaline and dense collagen fibers. It is inflexible, tough, and located in areas such as between vertebrae, in some joints, and in heart valves. Fibrocartilage does not have perichondrium.

**Fibrocartilage Structure:**
Thick collagen fibers predominate the matrix. Chondrocytes are interspersed among the fibers

**Fibrocartilage Location:**
- Intervertebral Discs
- Menisci of the knee
- heart valves

**Fibrocartilage Function:**
- Shock absorption
- Smooth tough support
Bone:

Of all the different types of connective tissues found in the body, bone is the most rigid, and it comes in two tissue forms called spongy bone and compact bone. As can be seen from this picture, under normal magnification spongy bone looks porous, while compact bone looks solid. Spongy Bone Compact Bone.

Compact Bone

Compact bone consists of closely packed osteons or haversian systems. The osteon consists of a central canal called the osteonic (haversian) canal, which is surrounded by concentric rings (lamellae) of matrix. Between the rings of matrix, the bone cells (osteocytes) are located in spaces called lacunae. Small channels (canaliculi) radiate from the lacunae to the osteonic (haversian) canal to provide passageways through the hard matrix. In compact bone, the haversian systems are packed tightly together to form what appears to be a solid mass. The osteonic canals contain blood vessels that are parallel to the long axis of the bone. These blood vessels interconnect, by way of perforating canals, with vessels on the surface of the bone.

Spongy (Cancellous) Bone

Spongy (cancellous) bone is lighter and less dense than compact bone. Spongy bone consists of plates (trabeculae) and bars of bone adjacent to small, irregular cavities that contain red bone marrow. The canaliculi connect to the adjacent cavities, instead of a central haversian canal, to receive their blood supply. It may appear that the trabeculae are arranged in a haphazard manner, but they are organized to provide maximum strength similar to braces that are used to support a building. The trabeculae of spongy bone follow the lines of stress and can realign if the direction of stress changes.
Bone tissue has several important functions:

- Bones (along with some cartilage) are the main support structures of the body.
- Bones protect the body’s internal organs.
- Bones provide attachment sites for tendons which hold muscles in place. This function is important in creating lever systems for body movement.
- Blood cells are produced in the red marrow of bones (the porous nature of spongy bone allows red bone marrow to be housed and protected).
- Bones function as storage facilities for inorganic salts like calcium, magnesium, and phosphorous.
Blood

**Blood**: the fluid that circulates in the principal vascular system of human beings and other vertebrates, in humans consisting of plasma in which the red blood cells, white blood cells, and platelets are suspended.

**Blood**: A liquid connective tissue composed of extracellular matrix called as blood plasma and the red blood cells, white blood cells, and platelets are suspended.

**Functions**

1. **Transport medium**
   - Oxygen, nutrients & waste material.
   - Hormones to their target glands.
   - Protective antibodies to the site of infection.
   - Electrolytes and Ions.

2. **Protection against infection**

3. **Regulation of pH**: By buffering systems found in the blood that maintain the pH between 7.35 to 7.45.

4. **Blood pressure regulation**: by increasing or decreasing blood flow to the kidneys.
5. Maintenance of body temperature.
6. Clot formation.

Physical properties:

- Denser & viscous than water and sticky
- Temperature is 38°
- Slightly alkaline pH (7.35 to 7.45)
- Color of blood varies with its oxygen content
  - When it has a high oxygen content, it is bright red
  - When it has a low oxygen content, it is dark red
- Blood volume is 5 to 6 liters in an average adult male & 4 to 5 liters in an average adult female.

Components of Blood

Blood consists of formed elements that are suspended and carried in a fluid called plasma

- **Two components of blood:**
  
  **A. Blood plasma (55%):** Watery liquid extracellular matrix contains dissolved substances (92% water, ions, plasma proteins [Albumin, globulin, Fibrinogen] Same ionic composition as interstitial fluid)
  
  **B. Formed elements (45%):** Cells
  - Red blood cells (Erythrocytes)
  - White blood cells (Leukocytes)
  - & cell fragments (platelets)
A. Plasma

Straw colored fluid made of water (~92%), other contents include:

Proteins make the bulk of the solutes: manufactured in the liver.

- **Albumins** (60%), are the most abundant type of plasma proteins, maintain the plasma volume by osmotic pressure.

- **Globulins** (35%), alpha and beta Globulins transport lipids and certain minerals through the bloodstream. Gamma Globulins are antibodies.

- **Fibrinogen** (4%) for blood clotting

**Plasma, content**

Nutrients: glucose, amino acids, lipids, cholesterol

Electrolytes: Na+, K+, Ca++, Mg++, H+, Cl-, HCO3-, PO4--, SO4--

Waste: urea, creatinine, uric acid, bilirubin

Gases: O2, CO2

Protein bound hormones

Plasma without clotting factors is called “**serum**” Formed Elements
B. Formed elements
- Platelets (Thrombocytes)
- Red blood cells (Erythrocytes)
- White blood cells (Leukocytes)
  a. Granulocytes: 75% of total WBC
  b. Agranulocytes: 25% of total WBC
     1. Lymphocytes, 2. Monocytes

Hematopoiesis
- Is a formation of blood cells from stem cells in the red bone marrow (myeloid stem cell) & lymphatic tissue (lymphoid stem cell)
- Erythropoiesis is formation of RBCs – Stimulated by erythropoietin (EPO) from kidney
- Leukopoiesis is formation of WBCs – Stimulated by variety of cytokines
- Thrombopoiesis is formation of platelets

White blood Cells (WBCs)
- Range: 5000 – 10,000/mm³ of blood
- Produced by leukopoiesis in red bone marrow, Contain nuclei
  - Functions
    – Defense against pathogens
    – Removal of toxins, wastes & damaged cells
**Neutrophil**
- 60-70% of total WBC’s
- Granules do not stain with dyes
- Diameter: 10-12 μm
- Nucleus: Usually 2-4 lobed

*Functions:*
- Neutrophils are phagocytic towards bacteria (1 neutrophil can phagocytize 5-20 bacteria)

**Eosinophil**
- 2-4 % of total WBC’s
- Granules stained by red acidic dyes
- Diameter 10-12 μm
- Nucleus: Usually 2 lobes

*Functions:*
- Involved in allergic reactions & parasitic infections.
- They destroy the antigen-antibody complexes & restrict the process of inflammation.

**Basophil**
- 0.5- 1 % of total WBC’s
- Granules stained with basic, purple blue color
- Diameter 8-10 μm
- Nucleus: Irregular and usually 2 lobes
- Granules contain heparin & histamine

*Functions:*
- At the site of infection basophils convert into mast cells
- Basophils & mast cells release histamine, bradykinin & serotonin
**Lymphocyte**
- 20-25 % of total WBC’s
- Depending upon the site of production & their actions, divided into T, B cells & Natural killer cells
- They are divided into
  - Small lymphocytes- Diameter 6-9 μm
  - Large Lymphocyte- Diameter 10-14 μm
- Nucleus: Round
- Functions:  • Plays important role in immunity.

**Monocyte**
- 3-8 % of total WBC’s
- Diameter: 12-20 μm
- Nucleus: Oval or kidney shaped
- Monocytes are converted into macrophages of the tissues
- Functions:  • Phagocytosis

**Platelets (Thrombocytes)**
- Shape & size
  - Are smallest of formed elements.
  - Lack nucleus
  - Irregularly shaped fragments of megakaryocytes, amoeboid.
- Diameter: 2-4 μm
- Life span- from 5 to 12 days
- Essential for clotting
- Number ≈250,000/ mm³
- Function
  - Involved in blood clotting mechanism
Red Blood Cells (RBCs)
- Biconcave disc shaped
- Male: 5.4 M/ mm3 of blood
- Female: 4.8 M/ mm3 of blood
- Have no nuclei
  Functional for about 120 days
- Production occurs in the red bone marrow
- Contains Hemoglobin (280 M/RBCs)
- Function: Transport of oxygen from lungs to tissues & carbon dioxide from tissues to lungs

Definition of Anemia
Deficiency in the oxygen-carrying capacity of blood due to a decrease in erythrocyte number.

May be due to:
1/ Erythrocyte loss (bleeding)
2/ Decreased Erythrocyte production
3/ low erythropoietin
4/ Decreased bone marrow response to erythropoietin
5/ Increased Erythrocyte destruction (hemolysis)

Symptoms of Anemia
- Decreased oxygenation
  1/ Exertional dyspnea
  2/ Dyspnea at rest
  3/ Fatigue
  4/ Lethargy, confusion
- Decreased volume
  1/ Fatigue
  2/ Muscle cramps
  3/ Postural dizziness
  4/ Syncope
Types of Anemia

Anemia Iron Deficiency Anemia: Inadequate absorption or excessive loss of iron

Megaloblastic Anemia: Due to deficiency of folic acid & vitamin B12

Aplastic anemia: Destruction of red bone marrow

Hemolytic anemia: Due to excessive breakdown of red blood cells

Pernicious anemia: Due to impaired absorption of vitamin B12 because of a lack of intrinsic factor in gastric secretions.

The lymphatic system

The lymphatic system: It is a network of organs, lymph nodes, lymph channels, and lymph vessels that make and carry lymph from tissues into the bloodstream. The lymphatic system is a major part of the body's immune system.

Lymph: It is a transparent liquid, its color tends to be yellowish, similar to blood except that it does not contain red blood cells, that is, it is composed of

1 / White blood cells, especially lymphocytes, which are cells that attack bacteria in the blood

2 / Fluids from the intestine called shill and contain proteins and fats

The lymphatic system includes: 1/Tonsils , 2/Adenoids , 3/Spleen , 2/Thyroid gland, 5/Lymph nodes are located in groups in different parts of the body such as: (neck, armpits, inside the center of the chest and abdomen)

Lymph nodes make immune cells that help the body fight infection. They also filter the lymph fluid and remove foreign materials such as bacteria and cancer cells. When bacteria are recognized in the lymph fluid, the lymph nodes make more infection-fighting white blood cells. This causes the nodes to swell. Swollen glands sometimes appear in the neck, under the arms, and groin.
Bone (Osseous) Tissue supportive connective
tissue Contains specialized cells Produces solid matrix of calcium salt deposits
Around collagen fibers
Bone (Osseous) Tissue
Matrix Minerals (inorganic components)
  - Two thirds of bone matrix is calcium phosphate, Ca_3(PO_4)_2 = makes bones hard
  - Matrix Proteins (organic components)
  - One third of bone matrix is protein fibers (collagen) = makes bones flexible
Bone (Osseous) Tissue
The Cells of Bone
Make up only 2% of bone mass
Bone contains four types of cells:-
1. Osteogenic cells:
   - Stem cells that divide to produce osteoblasts
   - Assist in fracture repair
2. Osteoblasts:
   - Immature bone cells that secrete matrix compounds (osteogenesis)= involved in bone growth
3. Osteocytes
   - Mature bone cells that maintain the bone matrix
   - Do not divide
   - Functions:To maintain protein and mineral content of matrix and To help repair damaged bone
4. Osteoclasts:
- Giant, multinucleate cells
- Secrete acids and protein-digesting enzymes Dissolve bone matrix and release stored minerals (osteolysis)

**Compact bone**

Solid, strong bone that is resistant to bending located along the diaphysis of long bones, provides solid structure to the skeletal frame

**Compact Bone structural**

Made of cylinder shaped units called

A. Haversian system, or osteon: the structural unit of compact bone
   1. Lamellae Column-like matrix tubes (mainly collagen).
   2. Central (Haversian) canal Contains blood vessels and nerves provide nourishment for bone.

B. Perforating (Volkmann’s) canals: Connects blood vessels and nerves of the periosteum and central canal.

C. Lacunae—small cavities that contain osteocytes.

D. Canaliculi—hairlike canals that connect lacunae to each other and the central canal.
The Structure of Spongy (cancellous) Bone:

- Does not have osteons
- The matrix forms a honeycomb network of **trabeculae**
- Trabeculae have no blood vessels
- The space between trabeculae is filled with **red bone marrow**: Which has blood vessels, forms red blood cells, and supplies nutrients to osteocytes
- **Yellow marrow**: In some bones, spongy bone holds yellow bone marrow; it is yellow because it stores fat.
Muscle Tissue

**Muscle tissue**: is made up of excitable cells that are long and fibrous. It often called muscle fibers. Contain proteins actine and myosin which allow them to contract.

**Muscular Tissue**: A group of cells (fibers) specialized to produce motion in response to muscle action potentials by its qualities of contractility, extensibility, elasticity and excitability.

Without these muscles, nothing in the body would move and no body movement would occur.

Muscle tissue one of four primary tissue types, divided into:

- **Skeletal muscle**: which is striated and voluntary
- **Cardiac muscle**: which is striated and involuntary
- **Smooth muscle**: which is non striated and involuntary

Muscle tissue has four main properties:

1. Excitability - ability to respond to stimuli.
2. Contractility - ability to contract.
3. Extensibility - ability of a muscle to be stretched without tearing.
4. Elasticity - ability to return to its normal shape.
1. **Skeletal Muscle**

Human body contains over 600 skeletal muscles, 40-50% of total body weight.

- which is striated and voluntary
- Characteristics of skeletal muscle
- Skeletal muscle cells are elongated or tubular.
- They have multiple nuclei and these nuclei are located on the periphery of the cell.
- Skeletal muscle is striated. That is, it has an alternating pattern of light and darks bands that.

**Functions of skeletal muscle**

1. Body movement (Locomotion)
2. Maintenance of posture
3. Respiration (Diaphragm and intercostal contractions)
4. Communication (Verbal and Facial)
5. Constriction of organs and vessels
   - Peristalsis of intestinal tract
   - Vasoconstriction of b.v. and other structures (pupils)
6. Production of body heat (Thermogenesis)

**Simplest level of skeletal muscle**

- Muscle fibres – multinuclear cells with large quantities of mitochondria.
- Muscle fibres consist of bundles of myofibrils, which are arranged into smaller myofilaments, which give muscle its stripy appearance.
- Sarcomere – repeating patterns of myofibrils
  - Light filaments (Actin)
  - Dark Filaments (Myosin)
2. Cardiac Muscle

Cardiac muscle cells or cardiomyocytes are the contracting cells that allow the heart to pump. Each cardiomyocyte needs to contract in coordination with its neighboring cells - known as a functional syncytium - working to efficiently pump blood from the heart, and if this coordination breaks down then – despite individual cells contracting – the heart may not pump at all, such as may occur during abnormal heart rhythms such as ventricular fibrillation.

Cardiac muscle cells are not as long as skeletal muscles cells and often are branched cells. Cardiac muscle cells may be mononucleated or binucleated. In either case the nuclei are located centrally in the cell. Cardiac muscle is also striated. In addition cardiac muscle contains intercalated discs.

**Intercalated discs:** are unique structural formations found between the myocardial cells of the heart. They play vital roles in bonding cardiac muscle cells together and in transmitting signals between cells.
Cardiac Muscle
- Branching cells
- Contain intercalated discs
- One or two nuclei per cell
- Striated
- Involuntary
- Medium speed contractions

3. Smooth Muscle
Smooth muscle Smooth muscle cell are described as spindle shaped. That is they are wide in the middle and narrow to almost a point at both ends. Smooth muscle cells have a single centrally located nucleus. Smooth muscle cells do not have visible striations although they do contain the same contractile proteins as skeletal and cardiac muscle, these proteins are just laid out in a different pattern.

Smooth Muscle
- spindle cells
- One nucleus per cell
- Nonstriated
- Involuntary
- Slow, wave-like contractions
Nervous Tissue

Nervous tissue: is the term for groups of organized cells in the nervous system, which is the organ system that controls the body’s movements, sends and carries signals to and from the different parts of the body, and has a role in controlling bodily functions such as digestion.

Neurons: are the basic functional units of nervous tissue. They are highly specialized to transmit nerve impulses.

Nervous Tissue consists of two main cell types:

A. **neurons** - sensory control, and regulation
B. **neuroglia** - support, protection, and homeostasis

A. **neurons**

Parts of a Neuron

1. cell body
2. dendrites
3. axon

1. **Cell body:**
   - contains nucleus, surrounded by granular cytoplasm contains organelles (i.e., lysosomes, mitochondria, Golgi complex, etc.).
   - Nissl bodies (chromatophilic substance).
   - arrangement of rough endoplasmic reticulum (site of protein synthesis).

2. **Dendrites** (neurons usually contain many).
   - highly branched processes.
• extend out from cell body n receive stimuli.
• carry a nerve impulse toward the cell body.

3. **Neurons** (contain only one).
   • Axon long, thin, cylindrical projection
   • contains mitochondria and neurofibrils
   • surrounded by axolemma (lemma = sheath or husk)
   • carries a nerve impulse away to other cells (nerves, muscles, glands)

B. **Neuroglia**
   • Neuroglia constitute one-half of volume of CNS
   • outnumber neurons 5-50 times
   • can multiply and divide, unlike neurons
   • Functions: - nerve glue - supports - insulates – protects
   • Types of Neuroglial Cells (astrocytes, oligodendrocytes, microglia, ependymal cells, Schwann cells, satellite cells)

➢ **Neuron Classification**

I. **structural classification** - based on number of processes extending from cell body
   1. **Unipolar**: (pseudounipolar)
      • have a single process extending from cell body, always are sensory neurons, found in embryo.
   2. **Bipolar**: have one dendrite and one axon - found in retina, internal ear, and olfactory area of brain
   3. **Multipolar**: several dendrites and one axon - most neurons in brain and spinal cord are of this type

![Neuron Diagrams](image-url)
II. Functional Classification

based on the direction in which a neuron transmits a nerve impulse

Two types of neurons in PNS: -

1. **Afferent** carry impulses(sensory information) toward CNS
   - also known as sensory neurons
2. **Efferent** carry impulses away from CNS
   - affect activity of muscles or glands
   - also known as motor neurons

Sensory → Afferent , Motor → Efferent

Nervous System:

Structural Organization Structural subdivisions of the nervous system:

1. **Central nervous system (CNS):**
   a) Brain.
   b) Spinal cord.
2. **Peripheral nervous system (PNS)**
   a) Cranial nerves (nerves that extend from the brain).
   b) Spinal nerves (nerves that extend from the spinal cord).
   c) Ganglia (clusters of neuron cell bodies (somas) located outside the CNS).
**Gram staining**: (or Gram's method): is a method of differentiating bacterial species into two large groups Gram Positive Gram Negative. Gram staining differentiates bacteria by the chemical and physical properties of their cell walls.

**Peptidoglycan**: also known as murein, is a polymer consisting of sugars and amino acids that forms a mesh-like layer outside the cell membrane of most bacteria forming the cell wall.

**Structure of Peptidoglycan**

Two alternating amino sugars make up the crystal lattice structure of peptidoglycan; they are N-acetylg glucosamine (shortened to NAG) and N-acetylmuramic acid (shortened to NAM). Amino sugars are sugar molecules that have an amine group (-NH2) replacing one of their hydroxyl groups. Each NAM molecule has an attached chain of four or five amino acids. Crosslinking between these amino acids gives peptidoglycan its strong structure.

**The important difference between gram-positive and gram-negative bacteria in tabular form.**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Gram-positive bacteria</th>
<th>Gram-negative bacteria</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cell Wall</td>
<td>A single-layered, smooth cell wall</td>
<td>A double-layered, wavy cell-wall</td>
</tr>
<tr>
<td>Cell Wall thickness</td>
<td>The thickness of the cell wall is 20 to 80 nanometres</td>
<td>The thickness of the cell wall is 8 to 10 nanometres</td>
</tr>
<tr>
<td>Peptidoglycan Layer</td>
<td>It is a thick layer/ also can be multi-layered.</td>
<td>It is a thin layer/ often single-layered.</td>
</tr>
<tr>
<td>---------------------</td>
<td>-------------------------------------------------</td>
<td>-------------------------------------------</td>
</tr>
<tr>
<td>Teichoic acids</td>
<td>Teichoic acids are present.</td>
<td>Teichoic acids are not present.</td>
</tr>
<tr>
<td>Lipopolysaccharide</td>
<td>Lipopolysaccharide is not present.</td>
<td>Lipopolysaccharide is present.</td>
</tr>
<tr>
<td>Lipid content</td>
<td>The Lipid content is very low.</td>
<td>The Lipid content is 20% to 30%.</td>
</tr>
<tr>
<td>Color staining</td>
<td>They retain the color of crystal violet and stain dark blue or purple.</td>
<td>They take the color Safranin and staining red or pink</td>
</tr>
<tr>
<td>Resistance to Antibiotic</td>
<td>These are very susceptible to antibiotics.</td>
<td>These are very resistant to antibiotics.</td>
</tr>
</tbody>
</table>
REAGENTS USED IN GRAM STAIN

1. Crystal Violet
2. Iodine
3. Decolorizer (a. Methanol, b. Acetone)
4. Safranine

Principle of Gram staining
**Crystal violet (CV)** dissociates into CV+ and Cl– ions in aqueous solutions. These ions penetrate through the cell wall and cell membrane of both Gram-positive and Gram-negative cells. The CV+ ion interacts with negatively charged components of bacterial cells and stains the cells purple.

**Iodine (I)**, used as mordant interacts with CV+ and forms large complexes of crystal violet and iodine (CV–I) within the inner and outer layers of the cell.

When a **decolorizer** such as alcohol or acetone is added, it interacts with the lipids of the cell membrane. Since Gram negative organism have thin peptidoglycan layer (1-2 layers) and have additional lipopolysaccharide layer which gets dissolved due to the addition of alcohol, so gram negative organism fails to retain the complex and gets decolorized as the complex is washed away.

In contrast, a Gram-positive cell becomes dehydrated from an ethanol treatment. This closes the pores in the cell wall and prevents the stain from exiting the cell. The large CV–I complexes become trapped within the Gram-positive cell also due to the thick and multilayered (40 layers) nature of its peptidoglycan.

After decolorization, the Gram-positive cell remains purple and the Gram-negative cell loses its purple color. Counterstain, which is usually positively-charged **safranin** or basic fuchsins, is applied last to give decolorized Gram-negative bacteria a pink or red color.
Connective tissue

Connective tissue is one of the four basic types of animal tissue, along with epithelial tissue, muscle tissue, and nervous tissue. It develops from the mesoderm. Connective tissue is found in between other tissues everywhere in the body, including the nervous system. In the central nervous system, the three outer membranes (the meninges) that envelop the brain and spinal cord are composed of connective tissue. All connective tissue consists of three main
components: fibers (elastic and collagenous fibers),[1] ground substance and cells. Not all authorities include blood[2] or lymph as connective tissue because they lack the fiber component. All are immersed in the body water. The cells of connective tissue include fibroblasts, adipocytes, macrophages, mast cells and leucocytes.
Section of *epididymis*. Connective tissue (blue) is seen supporting the *epithelium* (purple).

The term "connective tissue" (in German, *Bindegewebe*) was introduced in 1830 by Johannes Peter Müller. The tissue was already recognized as a distinct class in the 18th century.\textsuperscript{[3][4]}
Connective tissue can be broadly classified into **connective tissue proper** and **special connective tissue**. [5][6]

Connective tissue proper consists of
loose connective tissue and dense connective tissue (which is further subdivided into dense regular and dense irregular connective tissues.) Loose and dense connective tissue are distinguished by the ratio of ground substance to fibrous tissue. Loose connective tissue has much more ground substance and a relative lack of fibrous tissue, while the reverse is true of dense connective tissue. Dense regular connective tissue, found in structures such as tendons and ligaments, is characterized by collagen fibers arranged in an orderly parallel fashion, giving it tensile strength in one direction. Dense irregular connective tissue provides
strength in multiple directions by its dense bundles of fibers arranged in all directions.

Special connective tissue consists of reticular connective tissue, adipose tissue, cartilage, bone, and blood.[8] Other kinds of connective tissues include fibrous, elastic, and lymphoid connective tissues.[9] Fibroareolar tissue is a mix of fibrous and areolar tissue.[10] Fibromuscular tissue is made up of fibrous tissue and muscular tissue. New vascularised connective tissue that forms in the process of wound healing is termed granulation tissue.[11]
**Type I collagen** is present in many forms of connective tissue, and makes up about 25% of the total protein content of the mammalian body.[12]

**Characteristics**

Ground substance is a clear, colorless, and viscous fluid containing **glycosaminoglycans** and **proteoglycans** to fix the collagen fibers in the intercellular spaces. Examples of non-fibrous connective tissue include adipose tissue and blood. Adipose tissue gives "mechanical cushioning" to the body, among other functions.[13][14] Although there is no dense collagen network in
adipose tissue, groups of adipose cells are kept together by collagen fibers and collagen sheets in order to keep fat tissue under compression in place (for example, the sole of the foot). Both the ground substance and proteins (fibers) create the matrix for connective tissue.

Types of fibers:

<table>
<thead>
<tr>
<th>Tissue</th>
<th>Purpose</th>
<th>Components</th>
<th>Location</th>
</tr>
</thead>
<tbody>
<tr>
<td>Collagenous fibers</td>
<td>Bind bones and other tissues to each other</td>
<td>Alpha polypeptide chains</td>
<td>tendon, ligament, skin, cornea, cartilage, bone, blood vessels, gut, and intervertebral disc.</td>
</tr>
<tr>
<td>Elastic fibers</td>
<td>Allow organs like arteries and lungs to recoil</td>
<td>Elastic microfibril and elastin</td>
<td>extracellular matrix</td>
</tr>
<tr>
<td>Reticular fibers</td>
<td>Form a scaffolding for other cells</td>
<td>Type III collagen</td>
<td>liver, bone marrow, and lymphatic organs</td>
</tr>
</tbody>
</table>
Function
Connective tissue has a wide variety of functions that depend on the types of cells and the different classes of fibers involved. **Loose and dense irregular connective tissue**, formed mainly by **fibroblasts and collagen fibers**, have an important role in providing a medium for oxygen and nutrients to diffuse from **capillaries** to cells, and carbon dioxide and waste substances to diffuse from cells back into circulation. They also allow organs to resist stretching and tearing forces. **Dense regular connective tissue**, which forms organized structures, is a major functional component of **tendons, ligaments** and **aponeuroses**, and is also found in highly specialized
organs such as the cornea.\textsuperscript{[15]:161} Elastic fibers, made from elastin and fibrilllin, also provide resistance to stretch forces.\textsuperscript{[15]:171} They are found in the walls of large blood vessels and in certain ligaments, particularly in the ligamenta flava. \textsuperscript{[15]:173}

In hematopoietic and lymphatic tissues, reticular fibers made by reticular cells provide the stroma—or structural support—for the parenchyma—or functional part—of the organ. \textsuperscript{[15]:171}

Mesenchyme is a type of connective tissue found in developing organs of embryos that is capable of differentiation into all types of mature connective
tissue. Another type of relatively undifferentiated connective tissue is the mucous connective tissue known as Wharton's jelly, found inside the umbilical cord.

Various types of specialized tissues and cells are classified under the spectrum of connective tissue, and are as diverse as brown and white adipose tissue, blood, cartilage and bone. Cells of the immune system, such as macrophages, mast cells, plasma cells and eosinophils are found scattered in loose connective tissue, providing the ground for starting inflammatory and immune responses upon the detection of antigens.
The image summarizes the various categories of connective tissues found in the human body.

General features of connective tissues. The Matrix of most connective tissues is made up of ground substance and protein.
Types of connective tissue

include:

1. Connective Tissue Proper:

   Fibroblast cells are responsible for synthesizing protein fibers for the matrix. Collagen fibers are strong, elastic fibers are flexible and reticular fibers form a supportive framework for organs and basement membranes. There are two subcategories of connective tissue proper.

A. Loose connective tissue

: Thin and soft, this tissue contains many collagen and elastic fibers in a jell-like matrix. The cells in loose connective tissue are not close together. This tissue functions in binding the skin to underlie structures. There are three types of loose connective tissue.

a. Areolar connective tissue

is a common form of loose connective tissue. It is found in the skin and mucous membranes, where it binds the skin or membrane to underlying tissues such as muscles. It is also found around blood vessels and internal organs where it links and supports them.

b. Adipose connective tissue

is commonly known as fat. This tissue contains fat cells that are specialized for lipid storage. In addition to storing energy, this tissue also cushions and protects the organs.

- consists of fat cells (adipocytes with a nucleus and stored lipids in their cytoplasm) with a little extracellular matrix. It stores fat for energy and provides insulation.

c. Reticular connective tissue

is mostly composed of reticular protein fibers which make a skeleton, known as stroma, for the lymphatic and white blood cells.
This type of tissue is found in spleen and other lymphatic system structures.

Reticular Connective Tissue
- This is a loose connective tissue made up of a network of reticular fibers that provides a supportive framework for soft organs

B. Dense connective tissue
   proper: This tissue consists of three categories, dense regular connective tissue, dense irregular connective tissue, and elastic connective tissue. These tissues differ on the arrangement and composition of the fibrous elements of the extracellular matrix.
   a. Dense regular connective tissue
      has extracellular fibers that all run in the same direction and plane. Muscle tendons are a type of dense regular connective tissue
   b. Dense irregular connective tissue
      contains collagen and elastic fibers which are found running in all different directions and planes. The dermis of the skin is composed of dense irregular connective tissue
c. **Elastic connective tissue**

Made up of freely branching elastic fibers with fibroblasts in the spaces between the fibers, this tissue allows the kind of stretch that is found in the walls of arteries.

(a) Dense regular connective tissue

consists of collagen fibers packed into parallel bundles. (b) Dense irregular connective tissue consists of collagen fibers interwoven into a mesh-like network.

2. **Cartilage**

This connective tissue is relatively solid and is a non-vascularized tissue (does not have a blood supply). The matrix is produced by cells called chondroblasts. When these cells slow down, they reside in small spaces called lacunae. These mature cells in the lacunae are called chondrocytes. There are three types of cartilage:

- hyaline cartilage, elastic cartilage, and fibrocartilage.

A. **Hyaline cartilage**
is the most common type of cartilage, contains many collagen fibers and is found in many places including the nose, between the ribs and the sternum and in the rings of the trachea.

B. **Elastic cartilage**

has many elastic fibers in the matrix and supports the shape of the ears and forms part of the larynx.

C. **Fibrocartilage** is tough and contains many collagen fibers and is responsible for cushioning the knee and for forming the disks between the vertebrae.

Cartilage is a connective tissue consisting of collagenous fibers embedded in a firm matrix of chondroitin sulfates. (a) Hyaline cartilage has chondrocytes in lacunae within a matrix. (b) Fibrocartilage has chondrocytes in lacunae within collagen fibers in a matrix. (c) Elastic cartilage has chondrocytes in lacunae within elastic fibers in a matrix.
3. **Bone**: A hard, mineralized tissue found in the skeleton. The bone matrix contains many collagen fibers as well as inorganic mineral salts, calcium carbonate, and calcium phosphate, all features that make it a very rigid structure. Bone cells, called **osteoblasts**, secrete the osteoid substance that eventually hardens around the cells to form an ossified matrix. The **osteon** forms the basic unit of compact bone. Within the osteon, the osteocytes (mature bone cells) are located in lacunae. Because the bone matrix is very dense, the osteocytes get their nutrition from the central canal via tiny canals called canaliculi.

The image shows a micrograph as well as an illustration of the cross-section of the compact bone tissue.

- The osteon (made of osteocytes, central (Haversian) canal, and canaliculi) are visible.
**Bone Cells**

There are four main subtypes of bone cells, as shown in the diagram below. Each type has a different form and function:

1. **Osteocytes** are star-shaped bone cells that make up the majority of bone tissue. They are the most common cells in mature bone and can live as long as the organism itself. They also control the function of bone cells called osteoblasts and osteoclasts.

2. **Osteoblasts** are cells with single nuclei that synthesize new bone. They function in organized groups of connected cells called osteons to form the organic and mineral matrix of bone.

3. **Osteogenic cells** are undifferentiated stem cells that differentiate to form osteoblasts in the tissue that covers the outside of the bone.

4. **Osteoclasts** are very large, multinucleated cells that are responsible for the breakdown of bones through resorption. The breakdown of bone is very important in bone health because it allows for bone remodeling.

Four sub-types of bone cells in the human skeletal system: Osteocytes (maintain bone tissues), Osteoblast (form bone matrix), Osteogenic cells (stem cell), Osteoclasts (reabsorb bone)
4. Blood

Considered a type of fluid connective tissue because the matrix of blood is not solid. The fluid matrix is called plasma, and formed elements of this tissue include white blood cells, red blood cells, and platelets.

Figure: The cells and cellular components of human blood are shown. Red blood cells deliver oxygen to the cells and remove carbon dioxide. White blood cells (including neutrophils, monocytes, lymphocytes, eosinophils, and basophils) are involved in the immune response. Platelets form clots that prevent blood loss after injury.
White Blood Cells

(also called leukocytes) are even more variable than bone cells. Five subtypes of white blood cells are shown in the figure below. All of them are immune system cells involved in defending the body, but each subtype has a different function. They also differ in the normal proportion of all leukocytes they make up.

1. Monocytes make up about 5 percent of leukocytes. They engulf and destroy (phagocytize) pathogens in tissues.

2. Eosinophils make up about 2 percent of leukocytes. They attack larger parasites and set off allergic responses.

3. Basophils make up less than 1 percent of leukocytes. They release proteins called histamines that are involved in inflammation.

4. Lymphocytes make up about 30 percent of leukocytes. They include B cells and T cells. B cells produce antibodies against non-self antigens, and T cells destroy virus-infected cells and cancer cells.

5. Neutrophils are the most numerous white blood cells, making up about 62 percent of leukocytes. They phagocytize single-celled bacteria and fungi in the blood.

White Blood Cells

Five sub-types of human white blood cells in the human immune system: monocyte, eosinophil, basophil, lymphocyte, neutrophil
Muscular tissue

Muscle cells form the active contractile tissue of the body known as muscle tissue or muscular tissue. Muscle tissue functions to produce force and cause motion, either locomotion or movement within internal organs. Muscle tissue is separated into three distinct categories: visceral or smooth muscle, found in the inner linings of organs; skeletal muscle, typically attached to bones, which generate gross movement; and cardiac muscle, found in the heart, where it contracts to pump blood throughout the organism.

Muscle tissue is made up of cells that have the unique ability to contract or become shorter. There are three major types of muscle tissue, as pictured below: skeletal, smooth, and cardiac muscle tissues.

1. **Skeletal muscles** are striated, or striped in appearance, because of their internal structure. Skeletal muscles are attached to bones, and when they pull on the bones, they enable the body to move. Skeletal muscles are under voluntary control.

2. **Smooth muscles** are nonstriated muscles. They are found in the walls of blood vessels and in the reproductive, gastrointestinal, and respiratory tracts. Smooth muscles are not under voluntary control.

3. **Cardiac muscles** are striated and found only in the heart. Their contractions cause the heart to beat. Cardiac muscles are not under voluntary control.
The body contains three types of muscle tissue:

(a) skeletal muscle

(b) smooth muscle

(c) cardiac muscle
Neural tissue (Nervous tissue)

Cells comprising the central nervous system and peripheral nervous system are classified as nervous (or neural) tissue. In the central nervous system, neural tissues form the brain and spinal cord. In the peripheral nervous system, neural tissues form the cranial nerves and spinal nerves, inclusive of the motor neurons.

Neurons transmit electrical messages and the other cells play supporting roles.

Nervous tissue makes up the central nervous system (mainly the brain and spinal cord) and peripheral nervous system (the network of nerves that runs throughout the rest of the body). There are four types of nervous tissues:

1. **Gray matter**
   is nervous tissue that is found only in the brain and spinal cord which is also called the central nervous system. Gray matter is mostly composed of the cell bodies of the neurons. Gray matter is important for information processing.

2. **White matter**
   is nervous tissue that is found in the brain and spinal cord, where it connects and facilitates communication between gray matter areas. White matter is also found in the nerves of the peripheral nervous system.

3. **Nerves** make up most of the peripheral nervous system. They are long, branching tissues that carry electrical messages between the central nervous system and the remainder of the body.

4. **Ganglia (singular, ganglion)** are also found in the peripheral nervous system. Ganglia are mostly made up of cell bodies of neurons outside of the central nervous system. They are tissues that act as relay points for messages transmitted through nerves.
An antibiotic is a type of antimicrobial substance active against bacteria.

It is the most important type of antibacterial agent for fighting bacterial infections, and antibiotic medications are widely used in the treatment and prevention of such infections. They may either kill or inhibit the growth of bacteria. A limited number of antibiotics also possess antiprotozoal activity.

Antibiotics are not effective against viruses such as the common cold or influenza; drugs which inhibit viruses are termed antiviral drugs antivirals rather than antibiotics.
Sometimes, the term antibiotic - literally "opposing life from the Greek roots ov't anti, "against" and Bios bios, "life" - is broadly used to refer to any substance used against microbes, but in the usual medical usage, antibiotics (such as penicillin) are those produced naturally (by one microorganism fighting another), whereas nonantibiotic antibacterials (such as sulfonamides and antiseptics) are fully synthetic. However, both classes have the same goal of killing or preventing the growth of microorganisms, and both "Antibacterials" are included in antimicrobial chemotherapy. "Antibacterials" include antiseptic drugs, antibacterial soaps, and chemical disinfectants, whereas antibiotics are an important class of antibacterials used more specifically in medicinals and sometimes in livestock feed.
Antibiotics have been used since ancient times. Many civilizations used topical application of moldy bread, with many references to its beneficial effects arising from ancient Egypt, Nubia, China, Serbia, Greece, and Rome. The first person to directly document the use of molds to treat infections was John Parkinson (1567-1650). Antibiotics revolutionized medicine in the 20th century. Alexander Fleming (1881-1955) discovered the modern day penicillin in 1928, the widespread use of which proved significantly beneficial during wartime. However, the effectiveness and easy access to antibiotics have also led to their overuse and some bacteria have evolved resistance to them.

The World Health Organization has classified antimicrobial resistance as a widespread "serious threat [that] is no longer a prediction for the future, it is happening right now in every region of the world and has the potential to affect anyone, of any age, in any country."
Testing the susceptibility of *Staphylococcus aureus* to antibiotics by the Kirby-Bauer disk diffusion method – antibiotics diffuse from antibiotic-containing disks and inhibit growth of *S. aureus*, resulting in a zone of inhibition.
Medical uses

Antibiotics are used to treat or prevent bacterial infections, (T12) and sometimes protozoan infections. (Metronidazole is effective against a number of parasitic diseases). When an infection is suspected of being responsible for an illness but the responsible pathogen has not been identified, an empiric therapy is adopted. \[13\] This involves the administration of a broad-spectrum antibiotic based on the signs and symptoms presented and is initiated pending laboratory results that can take several days. \[142\] \[13\] When the responsible pathogenic microorganism is already known or has been identified, definitive therapy can be started. This will usually involve the use of a narrow-spectrum antibiotic. The choice of antibiotic given will also be based on its cost. Identification is critically important as it can reduce the
OG and toxicity of the antibiotic therapy and also made the possibility of the emergence of antimicrobial name bil Towe, antibiotics may be given for non-complicated scato podiel antibiotics may be given as a preventive mere and this is only limited to at-risk populations suc in those with a weleed immine system (partienny in HIV sest peevent pneumonia), those taking surse de ce petents, and to having surgery. The men wurde procedures are to help prevent infection of indio. They are an impetant role in detal antibiotie prophecies where there may brevet bedremo consequent infective endocarditis. Antibioties stre ville used to prevent infection in cases of neutropenia partenerly cancer - moted. CD
Administration

here are many different routes of administration for antibiotic treatment. Antibiotics are usually taken by mouth.

In more severe cases, particularly deep-seated systemic infections, antibiotics can be given intravenously or by injection, where the site of is easily accessed, antibiotics may be given topically in the form of eye drops onto the conjunctiva for conjunctivitis or ear drops for ear infections and acute cases of swimmer's ear. Topical use is also one of the treatment options for some skin conditions including acne and cellulitis. [7] Advantages of topical application include achieving high and sustained concentration of antibiotic at the site of infection; Reducing the potential for systemic
absorption and toxicity, and total volumes of antibiotic required are reduced, thereby also reducing the risk of antibiotic misuse. [18] Topical antibiotics applied over certain types of surgical wounds have been reported to reduce the risk of surgical site infections. [19] However, there are certain general causes for concern with topical administration of antibiotics. Some systemic absorption of the antibiotic may occur; The quantity of antibiotic applied is difficult to accurately dose, and there is also the possibility of local hypersensitivity reactions or contact dermatitis occurring. [18] It is recommended to administer antibiotics as soon as possible, especially in life-threatening infections. Many emergency departments stock antibiotics for this purpose. [20]
antibiotic consumption are widely between countries.

The WHO report on zavole of antibiotics con published in 2015 and 2015 data from countries. As measured in defined daily desesper Log inhabitants per day.

Moglie had the lushest consumption with a rate of 64 Burundi had the lowest at 4-6 Amatllin and morcillin / comme and were the most front co
Side effects

Antibiotics are screened for any negative effects before their approval for clinical use, and are usually considered safe and well tolerated.

However, some antibiotics have been associated with a wide extent of adverse side effects ranging from mild to very severe depending on the type of antibiotic used, the microbes targeted, and the individual patient. Side effects may reflect the pharmacological or toxicological properties of the antibiotic or may involve hypersensitivity or allergic reactions. Adverse effects range from fever and nausea to major allergic reactions, including photodermatitis and anaphylaxis.
bo Commonside - effects included wilting from disruption of the species composition to the intestinal for sampling worth of pathogenic bacteria, such as Clostridium. Treatment ambel prevents associated disbeli overgrowth of yeast species of the gas candid in the who and vaginal area. Til Milton side effects can result from interaction administration of a que to the with systemic with the pool of brdon damage from the corticoster Sementiti malo do the mitochondrion, bacteria delved alle found in yol, Incoding selle Mitochondrial damage cause coidative stress in cells and has been ested as a mechanism for side effect on coquines They slow to affect cho
Choosing Wisely

5 QUESTIONS to Ask Your Doctor Before You Take Antibiotics

1. Do I really need antibiotics?

2. What are the risks?

3. Are there simpler safer options?

4. How much do they cost?

5. How do I safely take antibiotics?

Use these 5 questions to talk to your doctor about when you need antibiotics - and when you don't.

Health advocacy messages such as this one encourage patients to talk with their doctor about safety in using antibiotics.
Alcohol

Tabactions between alcohol and oral antibiotics may result in decreased efficacy of the theme players and may increase side effects and decreased efficacy of the antibiotic. While moderate alcohol consumption is unlikely to interfere with many common antibiotics, there are specific types of antibiotics, with which alcohol consumption may cause som side effects. Therefore, protection of side effects and effectiveness depend on the type of antibiotic administered. Antibiotics such as metronidazole, tine, cephadramol, tefer efedim durazodone, edifiram - live chemical con with alcohol by inhibiting its breakdown by taldede dehydrd, which you want and shorts of behan addition, the yedine and erythromycin site may be reduced by alcohol consumption. We heat of soil on antibiotic activity include altered activity of the liver nya tutmak down the blote model.
Pharmacodynamics

The successful outcome of antimicrobial therapy with antibacterial compounds depends on several factors. These include host defense mechanisms, the location of infection, and the pharmacokinetic and pharmacodynamic properties of the antibacterial. (48) The bactericidal activity of antibacterials may depend on the bacterial growth phase, and it often requires ongoing metabolic activity and division of bacterial cells. [49] These findings are based on laboratory studies, and in clinical settings have also been shown to eliminate bacterial infection. [48] [50] Since the activity of antibacterials depends frequently on its concentration, [51] in vitro characterization of antibacterial activity commonly includes the determination of the minimum inhibitory concentration and minimum bactericidal concentration of an antibacterial. [48] [52] To predict clinical outcome, the antimicrobial activity of an antibacterial is usually combined with its pharmacokinetic profile.
In important infectious diseases, including tuberculosis, combination therapy (i.e., the concurrent application of two or more antibiotics) has been used to delay or prevent the emergence of resistance. In acute bacterial infections, antibiotics as part of combination therapy are prescribed for their synergistic effects to improve treatment outcome as the combined effect of both antibiotics is better than their individual effect. [54] [55] Methicillin-resistant Staphylococcus aureus infections may be treated with a combination therapy of fusidic acid and rifampicin. [54] Antibiotics used in combination may also be antagonistic and the combined effects of the two antibiotics may be less than if one of the antibiotics was given as a monotherapy.
For example, chloramphenicol and tetracyclines are antagonists to penicillins. However, this can vary depending on the species of bacteria. In general, combinations of a bacteriostatic antibiotic and a bactericidal antibiotic are antagonistic. In addition to combining one antibiotic with another, antibiotics are sometimes co-administered with resistance-modifying agents. For example, B-lactam antibiotics may be used in combination with B-lactamase inhibitors, such as clavulanic acid or sulbactam, when a patient is infected with a B-lactamase producing strain of bacteria.
Antibiotics are commonly classified based on their mechanism of action, chemical structure, or spectrum of activity. Most target bacterial functions or growth processes. Those that target the bacterial cell wall (penicillins and cephalosporins) or the cell membrane (polymyxins), or interfere with essential bacterial enzymes (rifamycins, lipiarzycins, quinolones, and sulfonamides) have bactericidal activities.
Protein synthesis inhibitors (macrolides, lincosamides, and tetracyclines) are usually bacteriostatic (with the exception of bactericidal)

Further categorization is based on their target specificity. "Narrow-spectrum" antibiotics target specific types of bacteria, such as gram-negative or gram-positive, whereas broad-spectrum antibiotics affect a wide range of bacteria. Following a 40-year break in discovering classes of antibacterial compounds, four new classes of antibiotics were introduced to clinical use in the late 2000s and early 2010s: cyclic lipopeptides (such as daptomycin), glycylcyclines (such as tigecycline), and oxazolidinones (such as linezolid), and lipiaarmycins (such as fidaxomicin).
With advances in medicinal chemistry, most modern antibacterials are semisynthetic modifications of various natural compounds [62]. These include, for example, the beta-lactam antibiotics, which include the penicillins (produced by fungi in the genus Penicillium), the cephalosporins, and the carbapenems. Compounds that are still isolated from living organisms are the aminoglycosides, while other antibacterials -- for example, the sulfonamides, the quinolones, and the oxazolidinones -- are produced by chemical synthesis. [62] Many antibacterial compounds are relatively small molecules with a molecular weight of less than 1000 daltons.
Since the first pioneering efforts of Howard Morey and Chain in 1939, the importance of antibiotics including antibacterials, to medicine has led to intense research to produce antibacterials at large scales. Following screening of antibacterials against a wide range of bacteria, production of the active compounds is carried out using fermentation, usually in strongly aerobic conditions.
Introduction:

Many scientists contributed by their studies to develop cytology such as:

1. Antonie van Leeuwenhoek (1632-1723) who discovered the microscope, he was the first one showed the cell by his microscope. He was the first to show the cell.

2. Robert Hooke (1635-1703), was the first one who used the item cell and define it as air chamber like the cavity of honey bees wax. He was the first to use the term "cell" to describe the structure of plant cells.

3. Robert Brown (1831) discovered the nucleus of the cell.

4. Matthias Schleiden, 1838, indicated that all plants bodies consist of cells.

5. Theodor Schwann, 1839, He indicated that all animals bodies consist of cells.

Cell theory:

Cell theory, according to findings of M. Schleiden and T. Schwann, considered as:

1. All living organisms consist of cells.
2. The cells are the structural and functional units of living organisms.
3. Cells are produced from other cells by division.

The cell is the structural unit of all living organisms.

There are two types of cells according to their structure, the first one is prokaryotic cells, such as in bacteria and blue-green algae cells, which without envelope or nuclear membrane and membranous organelles, and the second are eukaryotic cells, which with nucleus surrounded by nuclear envelope and cell organelles.
Biology is a natural science concerned with the study of life and living organisms, including their structure, function, growth, evolution, distribution, and taxonomy.

How to Define Life

There are some characteristics that distinguish living and non-living things:

1. **Organization:** Being structurally composed of one or more of cells which is the basic units of life.

   Organisms are organized from atoms up to cells. The matter is structured in an ordered way. Atoms are arranged into molecules, then into macromolecules, which make up organelles, which work together to form cells. Beyond this, cells are organized in higher levels to form entire multicellular organisms.

2. **Homeostasis:** Regulation of the internal environment to maintain a constant state. Stable internal conditions of pH, temperature, water balance, etc., for example, sweating to reduce temperature.

3. **Metabolism:** Refers to the sum of the total chemical processes that occur in a cell or organism that are necessary for life.

4. **Growth and Development:** Growth means that organism increases in size and number. Development refers to all changes that occur during life.

5. **Adaptation:** The ability to change over time in response to the environment. This ability is fundamental to the process of evolution and is determined by the organism's heredity.

6. **Response to stimuli:** Organisms respond to stimuli (Temperature, Water, Food Supplies, etc.) in order to survive & reproduce.

7. **Reproduction:** The ability to produce new individual organisms, either asexually from a single parent organism, or sexually from two parent organisms.

Water is essential for life.
Water is the most abundant molecule in cells, accounting for 70% or more of total cell mass. The total amount of water in our body is found in three main locations: within our cells (two-thirds of the water), in the space between our cells and in our blood (one-third of the water).

Water is the primary building block of cells:
- It regulates our internal body temperature by sweating and respiration.
- The carbohydrates and proteins that our bodies use as food are metabolized and transported by water in the bloodstream.
- Water is used to flush waste and toxins from the body via urine.
- Forms saliva.
- Lubricates joints.

Water has a number of important properties essential for life:

- It is a molecule because of a negative charge at the oxygen end and a slightly positive charge at the hydrogen end. Water molecules can form hydrogen bonds with each other, substances are hydrophilic (water loving). Non-polar substances are hydrophobic (water hating) and are repelled by water.
- Solvent: It is a very good solvent. Molecules such as salts, sugars, amino acids dissolve readily in water (once dissolved they can be transported e.g. glucose in the blood).
- Water has a high specific heat capacity. This means that water does not change temperature easily. This minimizes fluctuations in temperature inside cells.
- Latent heat of vaporization: Water requires a lot of energy to change state from a liquid to a gas, providing a cooling mechanism (sweating). As water evaporates it extracts heats from the surrounding area, cooling the organism.
- Density: The solid state of water (ice) is less dense than the liquid.

State As the air temperature cools, bodies of water freeze from the surface, forming a layer of ice with the liquid beneath. This allows aquatic ecosystems to exist in low temperatures.
1) **Collection and adhesion:** Water molecules due to hydrogen bonds stick together, and to other biologically important polar molecules.

A stele ranging from 0 to 14 pH units, reflecting the concentration of hydrogen ions in solution.

A solution with a pH of 7.0 is neutral. Solutions with a lower pH value (< 7.0) are increasingly acidic, and those with a higher pH value are increasingly alkaline.

### pH in living systems

<table>
<thead>
<tr>
<th>Compartment</th>
<th>pH Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gastrointestinal acid</td>
<td>1</td>
</tr>
<tr>
<td>Lysosome</td>
<td>4.5</td>
</tr>
<tr>
<td>Humans</td>
<td>5.5</td>
</tr>
<tr>
<td>Urine</td>
<td>6.0</td>
</tr>
<tr>
<td>Cytosol</td>
<td>7.2</td>
</tr>
<tr>
<td>Cerebrospinal fluid</td>
<td>7.34–7.43</td>
</tr>
<tr>
<td>Blood</td>
<td>7.34–7.43</td>
</tr>
<tr>
<td>Mitochondrial fluid</td>
<td>7.5</td>
</tr>
<tr>
<td>Intestinal secret</td>
<td>8.1</td>
</tr>
</tbody>
</table>

**Buffer**

A buffer is a substance that helps minimize the change in the pH of a solution when acids or bases are added. This is important because, most of the chemical processes that occur in living organisms are highly sensitive to pH, and drastic changes in pH can cause some serious trouble.

**Divisions of biology**

الخزان المؤقت هو مادة تساعد في تقليل التغيير في درجة الحموضة في المحلول عند إضافة الأحماض أو القواعد. هذا مهم لأن معظم العمليات الكيميائية التي تحدث في الكائنات الحية حساسة للغاية لدرجة الحموضة, ويمكن أن تسبب التغييرات الجذرية في الرقم الهيدروجيني بعض المشاكل الخطيرة. أقسام علم الأحياء
Biology is divided into

1- Zoology: the study of animal behavior, structure, physiology, classification, and distribution

2- Botany: the study of plants

3- Microbiology: the study of microscopic organisms (unicellular, multi-cellular)

4- Virology: the study of viruses

5- Anatomy: the study of the structure of organisms including their systems, organs, and tissues.

6- Biochemistry: concerned with the chemical processes that occur within living organisms

7- Radiobiology: the study of the action of ionizing radiation on living things

8- Physiology: it deals with the normal function of the living organisms and their parts

9- Phycology: the study of algae

10- Cell biology: the study of cell structure and function

11- Photobiology: it studies the interaction between light and living organisms

12- Parasitology: the study of parasites and their hosts and the relation between them

13- Mycology: the scientific study of fungi

14- Immunology: the study of immunity

15- Genetics: the study of genes, genetic variation, and heredity in living organisms

16- Ecology: it includes the relation of organisms to one another and to their physical surroundings

Translation: "Be with God, be with you"
Prokaryotic and Eukaryotic Cells

Cells are of two types, eukaryotic, which contain a nucleus, and prokaryotic, which do not. Prokaryotes are single-celled organisms, while eukaryotes can be either single-celled or multicellular.

The distinction between prokaryotes and eukaryotes is considered to be the most important distinction among groups of organisms. Eukaryotic cells contain membrane-bound organelles, such as the nucleus, while prokaryotic cells do not.

Similarities:
- They both have DNA as their genetic material.
- They are both membrane bound.
- They both have ribosomes.
- They have similar basic metabolism.

Differences:
1. Eukaryotes have a nucleus, while prokaryotes do not.
2. Eukaryotes have membrane-bound organelles, while prokaryotes do not.
3. Eukaryotic cells are, on average, ten times the size of prokaryotic cells.
4. The DNA of eukaryotes is much more complex and therefore much more extensive than the DNA of prokaryotes.
5. Prokaryotes have a cell wall composed of peptidoglycan, a single large polymer of amino acids, while many types of eukaryotic cells also have cell walls but none made of peptidoglycan.
6. The DNA of prokaryotes floats freely around the cell, the DNA of eukaryotes is held within its nucleus and associated with histones (proteins).
7. Eukaryotes undergo mitosis; prokaryotes divide by binary fission (simple cell division).
nucleus
Flagellum
P.Aosome
Membrane
Cell
Prokaryote
Eukaryote
Mitochondria
Nucleolus
Capsule
Cell Wall
Flagellum
<table>
<thead>
<tr>
<th>الميزات</th>
<th>بدائيات النوى</th>
<th>حقيقيات النواة</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>الكائنات الحية النموذجية</strong></td>
<td><strong>Prokaryotes</strong></td>
<td><strong>Eukaryotes</strong></td>
</tr>
<tr>
<td><strong>Typical organisms</strong></td>
<td><strong>Bacteria</strong></td>
<td><strong>Plants, animals</strong></td>
</tr>
<tr>
<td><strong>حجم النموذجي</strong></td>
<td>1 - 5 μm</td>
<td>≥ 1 μm</td>
</tr>
<tr>
<td><strong>نوع النواة</strong></td>
<td>Nucleoid region; no true nucleus</td>
<td>True nucleus with double membrane</td>
</tr>
<tr>
<td><strong>DNA</strong></td>
<td>Circular (usually)</td>
<td>Linear molecules (chromosomes) with histone and nonhistone proteins</td>
</tr>
<tr>
<td><strong>RNA/protein synthesis</strong></td>
<td>Coupled in the cytoplasm</td>
<td>RNA synthesis in the nucleus; protein synthesis in the cytoplasm</td>
</tr>
<tr>
<td><strong>هيكل السيتوبلازم</strong></td>
<td>Very few structures</td>
<td>Highly structured by endomembranes and a cytoskeleton</td>
</tr>
<tr>
<td><strong>حركة الخلايا</strong></td>
<td>Flagella made of flagellin</td>
<td>Flagella and cilia containing microtubules</td>
</tr>
</tbody>
</table>

**Notes:**
- بكتيريا (Bacteria)
- نواة حقيقية (Eukaryotes)
- البكتيريا (Bacteria)
- النواة الحقيقية (Eukaryotes)
- حقيقيات النواة (Eukaryotes)
- تركيب النوى في البكتيريا ينتمي إلى النوى غير الحقيقية (Eukaryotes)
<table>
<thead>
<tr>
<th>Organization</th>
<th>usually single cells</th>
<th>single cells, higher multicellular organisms with specialized cells</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cell division</td>
<td>binary (simple division)</td>
<td>mitosis and meiosis</td>
</tr>
<tr>
<td>Chromosome</td>
<td>single chromosome</td>
<td>more than chromosome</td>
</tr>
<tr>
<td>Mitochondria</td>
<td>none</td>
<td>One to several thousand</td>
</tr>
<tr>
<td>Chloroplasts</td>
<td>None</td>
<td>In algae and plants</td>
</tr>
</tbody>
</table>
Diagram of an animal cell

Diagram تخطيطي لخلية حيوانية
# Animal Cell Parts and Functions I Summary

<table>
<thead>
<tr>
<th>Organelle</th>
<th>Summary of Function</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Protects the cell</td>
</tr>
<tr>
<td></td>
<td>Controls the entry and exit of molecules</td>
</tr>
<tr>
<td></td>
<td>Gives the a shape</td>
</tr>
<tr>
<td></td>
<td>Adheres to cell membrane and neighboring cells to form tissue</td>
</tr>
</tbody>
</table>

- **Organelle**: membrane
- **Function**: protects the cell, controls the entry and exit of molecules, gives the a shape, adheres to cell membrane and neighboring cells to form tissue.
Helps the cell to communicate with the exterior

Structure of the cell membrane

Hydtophitic heads
Hydrophobic tails
Hydrophilic heads

The
Cytoplasm

holds water and nutrients

The cytoskeleton gives structural rigidity to cell

Cytoskeleton

helps movement of organelles and chromosomes
<table>
<thead>
<tr>
<th>Mitochondria</th>
<th>Converts 00 we eat into energy we use Assist in cell growth, cell cycle and cellular death</th>
</tr>
</thead>
<tbody>
<tr>
<td>L sosomes</td>
<td>Break down cellular waste into building blocks Destroy foreign invaders Peroxisomes break down</td>
</tr>
</tbody>
</table>
Peroxisomes

Peroxisomes are involved in the synthesis of lipids and bile acids. Peroxisomes are harmful compound.

Vacuoles

Vacuoles contain water and
Store food,

Lung cells use cilia to move mucus out of the lungs.

A sperm cell uses its cilia.

Flagellum

Flagellum tc swirn through
Diagram of a mitochondrion

Diagram تخطيطي للميتوكوندريا
Nucleus

Center of cell

Duplicate stc information

Makes ribosomes

Sends commands

Ribosomes

Protein synthesis

Genetic
Summary of the function of the Rough ER:

Protein synthesis

Processes and packages proteins and transports

Lipids synthesis'}

Detoxification of alcohol and drugs
Golgi apparatus transports them to other parts of the cell or outside the cell.

Incoming transport vesicle
Golgi apparatus illustrating incoming and outgoing vesicles

جهاز جولجي يوضح الحويصلات الواردة والصادرة
Smooth endoplasmic reticulum
Ribosomes

Illustration of Smooth and Rough ER

Smooth and Rough ER
Nucleolus contained within the cell nucleus

ترجمة: نواة موجودة داخل نواة الخلية
Animal Cell Parts and Functions | Details

The Cell Membrane

The cell membrane like the border control of the cell, controlling what comes in and what goes out.

The cell membrane also called the plasma membrane encloses the animal cell and its contents. It separates the inside of the cell from the outside. It is a selectively permeable membrane that monitors what enters and
that monitors what enters and exits the cell.

The cell membrane is mostly made up of special proteins (membrane proteins) and lipids (phospholipids).

The phospholipids are arranged is a double layer – the Phospholipid Bilayer. The top and bottom of this double layer arrangement are hydrophilic (water-loving) while the inside of the double layer arrangement is hydrophobic (water-hating).
Mitochondria

The mitochondrion (singular) is the power house of the cell. It is responsible for converting the food that you eat into energy that your body can use. The energy that our body uses is called Adenosine Triphosphate (ATP). ATP is a super energized molecule that gives you the energy you need to function properly.

Mitochondria generate ATP from carbohydrates and fat and other fuels. They also assist in cell growth, cell cycle and cellular death.

A mitochondrion is a smooth oblong organelles with an outer smooth membrane and an inner membrane. The inner membrane has numerous infoldings called Cristae.
The Golgi Apparatus

The Golgi apparatus is the cell’s shipping department. It processes and packages proteins and sends them out to where they are needed.

The Golgi apparatus is made up of stacks of membranous layers that are referred to as Golgi bodies. Golgi bodies create hormones from proteins. They can also combine proteins with carbohydrate to make other molecules such as snot (nasal mucus).

The golgi apparatus packages its products into sacs called vesicles. These sacs have membranes made of
phospholipid just like the cell membrane. These vessicles are then shipped to other parts of the cell or out of the cell.

جهاز كولجي هو قسم الشحن بالخلية. يقوم بمعالجة وتعبئة البروتينات وارسالها إلى حيث تكون مطلوبة. يتكون جهاز كولجي من أكوام من طبقات الأغشية التي يشار إليها باسم أجسام جولجي. تخلق أجسام كولجي هرمونات من البروتينات. يمكنهم أيضًا الجمع بين البروتينات والكربوهيدرات لصنع جزيئات أخرى مثل المخاط (مخاط الأنف). يقوم جهاز كولجي بتعبئة منتجاته في أكياس تسمى أوعية. تحتوي هذه الأكياس على أغشية مصنوعة من الفوسفوليبيد تماما مثل غشاء الخلية. ثم يتم شحن هذه الأوعية إلى أجزاء أخرى من الخلية أو خارج الخلية.
Ribosomes

Ribosomes are tiny structures found floating around in the cytoplasm or attached to the ER. Ribosomes maybe small but are essential for the proper functioning of a cell. They are responsible for protein synthesis.

The Endoplasmic Reticulum (ER)

The ER is like a factory for the production of proteins and lipids. It also forms a network of tubes that carry substances around the cell. There are two types of ER; the rough ER and the smooth ER. They have slightly different structure and function.
The rough ER is called “rough” because it is studded ribosomes while the smooth ER is called “smooth” because it lacks ribosomes.

The Smooth ER contains enzymes that are involved in the creation of lipids. Other enzymes in the smooth ER help in the detoxification of drugs and alcohol.

Ribosomes attached to the Rough ER are responsible for protein synthesis. These ribosomes assemble amino acids into polypeptides. When synthesis is complete the ER packages the polypeptides in special vesicles and sends them
Lysosome & Peroxisome

Lysosomes are digestive sacs that contain enzymes to break down cellular waste or debris from outside the cell into new building material. Lysosomes break down big macro molecules into smaller molecules which can be used to nourish the cell. They also break down damaged organelles and destroy foreign invaders such as bacteria. Peroxisomes are similar to Lysosomes in structure. They break down molecules by oxidative reaction and produces hydrogen peroxide – harmful compound. Peroxisomes break down the hydrogen peroxide to produce water. Or they may use the hydrogen peroxide to break
down other molecules. Peroxisomes are also involved in the synthesis of lipid and bile acid (liver cells).

الليوزوم والبيروكسيسوم
Vacuole

Vacuoles are storage sacs filled with fluid. They store food, water and waste products.

Vacuoles in animal cells are generally smaller than that in plant cells. Animal cells can have multiple small vacuoles while plant cells usually have a single large vacuole.

Cilia and Flagellum

Some animal cells have cilia or a flagellum. Cilia (singular is cilium) are hairlike processes that extend from the cell’s surface. Flagellum is a wipe-like tail that protrudes from the cell. Both cilia and flagella are made of small protein fibers known as microtubules. Some cells have neither cilia nor a flagellum. A

تحتوي بعض الخلايا الحيوانية على أهداب أو سوط. الأهداب (المفرد هيcilium) هي عمليات تشبه الشعر تمتد من سطح الخلية. هو ذيل Flagellum يشبه المسح يبرز من الخلية. يتكون كليمن الأهداب والسوط من ألياف بروتينية صغيرة تعرف باسم الأنانيب الدقيقة. بعض الخلايا لا تحتوي على أهداب ولا سوط.
sperm cell has a flagellum. It uses its flagellum to propel itself through the female reproductive System.
The Nucleus

The nucleus is the command center of a cell. This is where most of the cell’s DNA is stored. It is enclosed in a double membrane. The double membrane has pores which allow the movement of molecules between the nucleus (Nucleoplasm) and the cytoplasm.

The Nucleolus is located inside the nucleus. The main function of the nucleolus is to make ribosomal RNA (rRNA). rRNA then combines with special proteins to form the basic units of ribosomes. Once these units are formed the nucleolus releases them out of the nuclear envelope where they will be fully assembled into ribosomes. The nucleus sends messages to the
ribosomes through messenger RNA, (mRNA). mRNA carry out orders from the nucleus to the rest of the cell.

الريبوسومات من خلال الرنا المرسل (MRNA). تقوم بتوزيع الأوامر من النواة إلى باقي الخلية.

Long strands of DNA in the nucleus combine with special protein to form long fibers called Chromatin. Chromatin is then used to make Chromosomes.

تتجمد خيوط طويلة من الحمض النووي في النواة مع البروتين الخاص لتكون ألياف طويلة تسمى الكروماتين. ثم يتم استخدام الكروماتين لصنع الكروموسومات.

The number of chromosomes present in a cell depends on the species of animal. The human sperm and egg cell both have 23 chromosomes. The number of chromosomes found in all of the other body cells is 46.

يعتمد عدد الكروموسومات الموجودة في الخلية على نوع الحيوان. يحتوي كل من الحيوان المنوي البشري وخلايا البويضة على 23 كروموسوماً. عدد الكروموسومات الموجودة في جميع خلايا الجسم الأخرى هو 46.
Cell cycle and division

Why do cell divide? Cell divide for growth, repair and reproduction. Cell division is the process by which parent cells divided into two daughter cells. Cells division usually occurs as part of large cell cycle. In Eukaryotic, there are two distinct types of cell division:

1- Mitosis or Mitotic cell division: is a type of cell division which takes place during an organism's growth where the daughter cells containing exactly the same number of chromosomes as the parents cells.

2- Meiosis or Meiotic cell division: is second type of division which the daughter cells finish up with the half of the total number of chromosomes present is the parent chromosomes. This kind of division usually takes place in the formation of gametes.

Mother cells give daughter cells by increase in number that is called cell division (Mitosis). However, genetically identical to each other. The process of mitosis is divided into stages, the stages are prophase, prometaphase, metaphase, anaphase and telophase. Mitosis occurs only in Eukaryotic cells, Prokaryotic divided by different
process called binary division. When mitosis begins the chromosomes condense and become visible. The stages are:

**Prophase**
- Chromosome condense
- Microtubules form
  The nuclear envelope break down

**Metaphase**
- Chromosomes are pulled to center of cell
- Line up along the metaphase plate

**Anaphase**
- Centromeres divide
- Spindle fibers pull one set of chromosomes to each pole
  Precise alignment is important in this phase

**Telophase**
- Nuclear envelope form around chromosomes
- Chromosomes uncoil
- Cytokinesis in animal cells pinching of plasma is occurred, this means (cytoplasm division)

Cell cycle consist of:
- Phase 1: growth and synthesis
- Phase 2: reparation for division
Phase 3. includes the overlapping Process of mitosis and cytokinesis phase 4. DNA-Synthesis phase

Prophase

Chromosome condense Microtubules form The nuclear envelope breaks

Metaphase
Chromosomes are pulled to center of Spind•cell

Line up along "metaphase plate"

اصطف على طول "لوحة الطور" كيتفاس
Anaphase
' Centromeres divide ' Spindle fibers pull set of chromosome to each pole) Precise alignment is Daughtercritical to division

Chromosomes

Telophase

Nuclear envelopeformäfocn chromosomes

Chromosomes uncoil
Cytokinesis — animals - pinching of plasma — plants - elongates and the cell future cellwall and cell membrane

الحيوانات السيتوكينية - معسر محطات البلازما - يطيل جدار الخلية وغشاء الخلية المستقبلي
Meiosis: is a specialized type of cell division that reduces the chromosome number by half, creating four haploid cells each genetically distinct from the parent cells that give rise to them. This process occurs in all sexually reproducing single cells and multicellular eukaryotes including animals, plants, and fungi.

In meiosis, DNA replication is followed by two rounds of cell division to produce four daughter cells, each with half the number of chromosomes as the original parent cells. The two meiotic divisions are known as meiosis I and meiosis II.

Before meiosis begins, durilvs phase of the cell cycle the DNA of each chromosome is replicated so that it consists of two identical sister chromatids which remain held together through sister chromatid cohesion.

In the process of meiosis, the number of chromosomes is halved during meiosis, gametes can fuse in fertilization to form diploid zygotes.

Diploid human cells contain 23 pairs of chromosomes including one pair of sex chromosomes (46 total) half of maternal origin and half of paternal origin. Meiosis produces haploid gametes (ova or sperms) that:

- Contain 23 chromosomes each
- Reflect the genetic inheritance from both parents
- Are genetically distinct from both the parent cells and each other
- Can fuse in fertilization to produce a diploid organism
A diploid cell replicates its chromosomes. The resulting zygotes contain one set of 23 chromosomes when egg and sperm fuse.

Phases of Meiosis

Meiosis I

- Only recombination
- Meiosis I and Meiosis II
- Two stages of meiosis

Meiosis II

- Only recombination
Prophase I

Chromosomes condense

Homologous chromosomes pair with each other. Each pair contains four sister chromatids - tetrad sister homologous chromatid chromosomes.

Metaphase I

Tetrads or homologous chromosomes move to the center of cell.
Anaphase I

Homologous chromosomes pulled to opposite poles

Telophase 1

° Daughter nuclei formed ° These are haploid (In)
Daughter cells undergo a second division; much like mitosis.

NO ADDITIONAL REPLICATION OCCURS

Meiosis II

Prophase II

Spindle fibers Meiosis form again Prophase I I

The chromosomes condense again. following a brief interphase in which DNA does not replicate.

Meiosis Il

Prophase Il
Sister Metaphase II

chromatids move to the center

Kinetochore of the paired chromatids line up across the equator of each cell

Anaphase II

Centromeres Anaphase II split

Individual chromosomes are pulled to poles

their becoming own right, chromosomes and are in pulled to opposite poles

Telophase II & Cytokinesis
Four haploid Te10phase ll daughter cells results from one original diploid cell. The chromosomes gather into nuclei, and the cells divide.

Review Mitosis & Meiosis
Both are forms of nuclear division
Both involve replication
Both involve disappearance of the nucleus, and nucleolus, nuclear membrane
Both involve formation of spindle fibers.

Products of meiosis of each of the four cells has a nucleus with a haploid number of chromosomes, 45 0 0 0 0. Each of the four cells has a nucleus with a haploid number of chromosomes.

 привет

الصفيحة

منتجات الانقسام الاختزال

ينتج عن الخلايا الواعدة

كلها واحدة

إلى نوى، وتقسم الخلايا

مراجعة الانقسام والانقسام الاختزال

كلاهما شكل من أشكال الانقسام النووي

كلاهما يشتمل على النسخ المتماثلة

كلاهما ينطوي على اختفاء النواة، والنواة، والغشاء النووي

كلها يتضمن تكوين ألياف المغزل

كل خلية من الخلايا الأربع لديها

خلايا ثنائية الصفيحات تجمع

الصفيحة

products of meiosis

d four cells has

nucleus with a haploid number of chromosomes,

45 0 0 0 0.

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products of meiosis

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Each of the four cells has a nucleus with a haploid number of chromosomes.
DIFFERENCES

Meiosis produces daughter cells that have 1/2 the number of chromosomes as the parent. Go from 2n to ln.

Daughter cells produced by meiosis are not genetically identical to one another.

In meiosis cell division takes place twice but replication occurs only once.

Value of Variation

Variation - differences between members of a population.
Meiosis results in random segregation of chromosomes.

Cause? dive-ise populations { haiover time can be stronger for survival

موجه؟ مجموعات الغوص { يمكن أن يكون وقت أقوى بالنسبة لـ نجاة

ترجمة: توفي،

أعزائي الطلبة أعتذر عن الترجمة ذلك بسبب الملف
Tissues:

In biology, tissue is a cellular organizational 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.

The English word "tissue" derives from the French word tissue”, meaning that something that is Woven "from the verb tissue to weave".

The term tissue is used to describe a group of cells that are similar in structure and perform a specific function. Histology is the field of study that involves the microscopic examination of tissue appearance, organization, and function.

The study of human and animal tissues is known as histology or, in connection with disease, as histopathology. For plants, the discipline is called plant anatomy. The classical tools for studying tissues are the paraffin block in which tissue is embedded and then sectioned, the histological stain, and the optical microscope. Developments in electron microscopy, immunofluorescence, and the use of frozen tissue - sections have enhanced the detail that can be observed in tissues. With these tools, the classical appearances of tissues can be examined in health and disease, enabling considerable refinement of medical diagnosis and prognosis.
Tissue types

Tissues are organized into four broad categories based on structural and functional similarities. These categories are epithelial, connective, muscle, and nervous. The primary tissue types work together to contribute to the overall health and maintenance of the human body. Thus, any disruption in the structure of a tissue can lead to injury or disease.

The Four Primary Tissue Types

Epithelial tissue refers to groups of cells that cover the exterior surfaces of the body, line internal cavities and passageways, and form certain glands. Connective tissue, as its name implies, binds the cells and organs of the body together. Muscle tissue contracts forcefully when excited, providing movement. Nervous tissue is also excitable, allowing for the generation and propagation of electrochemical signals in the form of nerve impulses that communicate between different regions of the body.

An understanding of the various primary tissue types present in the human body is essential for understanding the structure and function of organs which are composed of two or more primary tissue types. This chapter will focus on examining epithelial and connective tissues. Muscle and nervous tissue will be discussed in detail in future chapters.
The four types of tissues in the body are epithelial, connective, muscle, and nervous. Epithelial tissue is made of layers of cells that cover the surfaces of the body that come into contact with the exterior world, line internal cavities, and form glands. Connective tissue binds the cells and organs of the body together and performs many functions, especially in the protection, support, and integration of the body. Muscle tissue, which responds to stimulation and contracts to provide movement, is divided into three major types: skeletal (voluntary) muscles, smooth muscles, and the cardiac muscle in the heart. Nervous tissue allows the body to receive signals and transmit information as electric impulses from one region of the body to another.

The zygote is described as omnipotent because it ultimately gives rise to all the cells in your body including the highly specialized cells of your nervous system. Describe this transition, discussing the steps and processes that lead to these specialized cells.
The Four Primary Tissue Types: Examples of nervous tissue, epithelial tissue, muscle tissue, and connective tissue found throughout the human body. Clockwise from nervous tissue.
. Overview

There are 4 basic types of issue: connective tissue, epithelial tissue, muscle tissue, and nervous tissue. Connective tissue supports other tissues and binds them together (bone, blood, and lymph tissues). Epithelial tissue provides a covering (skin, the linings of the various passages inside the body). Muscle tissue includes strated (also called voluntary) muscles that move the skeleton, and smooth muscle, such as the muscles that surround the stomach. Nerve tissue is made up of nerve cells (neurons) and is used to carry messages to and from various parts of the body.
Epithelial tissue is made up of cells that line inner and outer body surfaces, such as the skin and the inner surface of the digestive tract.

Epithelial tissue that lines inner body surfaces and body openings is called mucous membrane.

This type of epithelial tissue produces mucus, a slimy substance that coats mucous membranes and traps pathogens, particles, and debris.

Epithelial tissue protects the body and its internal organs, secretes substances such as hormones in addition to mucus, and absorbs substances such as nutrients.

Epithelial cell Classification

Most epithelial tissues are described with two names. The first name describes the number of cell layers present and the second describes the shape of the cells. One layer of epithelial cells is called simple and more than one layer of epithelial cells is called stratified. There are three basic shapes of the epithelial cells, squamous, cuboidal, and columnar. Squamous cells are thin and flat; cuboidal cells have a shape of a cube; columnar cells have a shape of a pillar. For example, simple squamous epithelial tissue describes a single layer of cells that are flat and scale-like in shape. Types of Epithelium

- Simple squamous
- Simple cuboidal
- Simple columnar
- Stratified squamous
- Stratified cuboidal
- Pseudostratified columnar

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The epithelial tissues are formed by cells that cover the organ surfaces, such as the surface of skin, the airways, surfaces of soft organs, the reproductive tract, and the inner lining of the digestive tract. The cells comprising an epithelial layer are linked via semi-permeable, tight junctions; hence, this tissue provides a barrier between the external environment and the organ it covers. In addition to this protective function, epithelial tissue may also be specialized to function in secretion, excretion and absorption. Epithelial tissue helps to protect organs from microorganisms, injury, and fluid loss. The epithelial cells are nourished by substances diffusing from blood vessels in the underlying connective tissue. One side of the epithelial cell is oriented towards the surface of the tissue, body cavity, or external environment and the other surface is joined to a basement membrane. The basement layer is non-cellular in nature and helps to cement the epithelial tissue to the underlying structures, Types of Epithelial Tissue Epithelial tissues are identified by both the number of layers and the shape of the cells in the upper layers. There are eight basic types of epithelium: six of them are identified based on both the number of cells and their shape; two of them are named by the type of cell (squamous) found in them. Epithelial tissue is classified based on the number of cells, the shape of those cells, and the types of those cells. Simple Epithelia Simple epithelium consists of a single layer of cells. They are typically where absorption, secretion and filtration occur. The thinness of the epithelial barrier facilitates these processes. Simple epithelial tissues are generally 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.
تتكون الأنسجة الظهارية من خلايا تغطي أسطح الأعضاء، مثل سطح الجلد والمسالك الهوائية وأسطح الأعضاء الرخوة والجهاز التناسلي والبطانة الداخلية للجهاز الهضمي. وترتبط الخلايا التي تتألف من طبقة طلائية عبر وصلات ضيقة وشبه منفذة؛ وبالتالي، يوفر هذا النسيج حاجزًا بين البيئة الخارجية والعضو الذي يغطيها. بالإضافة إلى هذه الوظيفة الوقائية، قد يكون النسيج الظهاري متخصصًا أيضًا في وظيفة الإفراز والإفراز والامتصاص. يساعد النسيج الظهاري على حماية الأعضاء من الكائنات الحية الدقيقة والإصابة وفقدان السوائل. يتغذى الخلايا الظهارية بمواد منتشرة من الأوعية الدموية في النسيج الضام الأساسي. يتم توجيه جانبة واحد من الخلية الظهارية نحو سطح النسيج أو تجويف الجسم أو البيئة الخارجية والسطح الآخر متصل بالغشاء القاعدي. الطبقة القاعدية غير خالية بطبيعتها وتساعد على تثبيت النسيج الظهاري في الهياكل الأساسية، ويتطلب تحديد أنواع الأنسجة الظهارية من خلال عدد الطبقات وشكل الخلايا في الطبقات العليا. هناك ثمانية أنواع أساسية من الظهارة: ستة منها يتم تحديدها بناءً على عدد الخلايا وشكلها؛ تم تسمية اثنين منهم بنوع الخلية (الحرشفية) الموجودة فيهما. يُصنف النسيج الظهاري بناءً على عدد الخلايا وشكل تلك الخلايا وأنواع تلك الخلايا. ظهارة بسيطة تتكون ظهارة بسيطة من طبقة واحدة من الخلايا. هم عادة حيث يحدث الامتصاص والإفراز والترشيح. تسهل رقة الحاجز الظهاري هذه العمليات. تصنف الأنسجة الظهارية البسيطة بشكل عام حسب شكل خلاياها. الفئات الأربع الرئيسية للظهارة البسيطة هي: (1) الحرشفية البسيطة. (2) مكعبة بسيطة: عمودي بسيط؛ و (4) مصدق كاذب.
Simple Squamous

Simple squamous epithelium cells are flat in shape and arranged in a single layer. This single layer is thin enough to form a membrane that compounds can move through via passive diffusion. This epithelial type is found in the walls capillaries, linings of the pericardium, and the linings of the alveoli of the lungs.

Simple Cuboidal

Simple cuboidal epithelium consists of a single layer cells that are as tall as they are wide. The important functions of the simple cuboidal epithelium are secretion and absorption. This epithelial type is found in the small collecting ducts of the kidneys, pancreas, and salivary glands.

Simple Columnar

Simple columnar epithelium is a single row of tall, closely packed cells, aligned in a row. These cells are found in areas with high secretory function (such as the wall of the stomach), or absorptive areas (as in small intestine). They possess cellular extensions (e.g., microvilli in the small intestine, or the cilia found almost exclusively in the female reproductive tract).

Pseudostratified

These are simple columnar epithelial cells whose nuclei appear at different heights, giving the misleading (hence pseudo) impression that the epithelium is stratified when the cells are viewed in cross section. Pseudostratified epithelium can also possess fine hair-like extensions of their apical (luminal) membrane called cilia.
This case, the epithelium is described as ciliated pseudostratified epithelium.

Ciliated epithelium is found in the airways (nose, bronchi), but is also found in the uterus and fallopian tubes of females, where the cilia propel the ovum to the...
Functions of the Epithelium

Epithelia tissue forms boundaries between different environments, and nearly all substances must pass through the epithelium. In its role as an interface tissue, epithelium accomplishes many functions, including:

1. Protection for the underlying tissues from radiation, desiccation, toxins, and physical trauma.
2. Absorption of substances in the digestive tract lining with distinct modifications.
3. Regulation and excretion of chemicals between the underlying tissues and the body cavity.
4. The secretion of hormones into the blood vascular system. The secretion of sweat, mucus, enzymes, and other products that are delivered by ducts come from the glandular epithelium.
5. The detection of sensation.

The principle function of epithelial tissues are covering and lining of free surface. The cells of the body’s surface form the outer layer of skin.

Inside the body, epithelial cells form the lining of the mouth and alimentary canal and protect these organs.

Epithelial tissues help in the elimination of waste. Epithelial tissues secrete enzymes and / or hormones in the form of glands.

There are many kinds of epithelium, and nomenclature is somewhat variable. Most classification schemes combine a description of the cell - shape in the upper layer of the epithelium with a word denoting the number of layers.
<table>
<thead>
<tr>
<th>Types of epithelial tissues</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Cells</strong></td>
</tr>
<tr>
<td>Simple squamous epithelium</td>
</tr>
<tr>
<td>Simple cuboidal epithelium</td>
</tr>
<tr>
<td>Simple columnar epithelium</td>
</tr>
<tr>
<td>Pseudostratified columnar epithelium</td>
</tr>
<tr>
<td>Stratified squamous epithelium</td>
</tr>
<tr>
<td>Stratified cuboidal epithelium</td>
</tr>
<tr>
<td>Stratified columnar epithelium</td>
</tr>
<tr>
<td>Transitional epithelium</td>
</tr>
</tbody>
</table>

57
Connective tissue is one of the four basic types of animal tissue, along with epithelial tissue, muscle tissue, and nervous tissue. It develops from the mesoderm. Connective tissue is found between other tissues everywhere in the body, including the nervous system. In the central nervous system, the three outer membranes (the meninges) that envelop the brain and spinal cord are composed of connective tissue. All connective tissue consists of three main
النسيج الضام

هو أحد الأنواع الأربعة الأساسية للأنسجة الحيوانية، إلى جانب النسيج الظهاري، يتطور من الأديم المتوسط تم العثور على النسيج الضام بين الأنسجة الأخرى في كل مكان في الجسم، بما في ذلك الجهاز العصبي. في الجهاز العصبي المركزي، تتكون الأغشية الخارجية الثلاثة (السحايا) التي تغلف الدماغ والحبل الشوكي من نسيج ضام. يتكون النسيج الضام من ثلاثة مكونات رئيسية:
components: fibers (elastic and collagenous fibers), ground substance and cells. Not all authorities include blood or lymph as connective tissue because they lack the fiber component. All are immersed in the body water. The cells of connective tissue include fibroblasts, adipocytes, macrophages, mast cells and leucocytes.
النسيج الضام

Section of epididymis. Connective tissue (blue) is seen supporting the epithelium (purple).

The term "connective tissue" (in German, Bindegewebe) was introduced in 1830 by Johannes Peter Müller. The tissue was already recognized as a distinct class in the 18th century.[3][4]

مصطلح "النسيج الضام" (في الألمانية bindegewebe) تم تقديمته في عام 1830 من قبل يوهانس بيتر مولر. تم التعرف على الأنسجة بالفعل كفئة متميزة في القرن الثامن عشر.
Connective tissue can be broadly classified into **connective tissue proper** and **special connective tissue**.[5][6]

Connective tissue proper consists of...
loose connective tissue and dense connective tissue (which is further subdivided into dense regular and dense irregular connective tissues.) Loose and dense connective tissue are distinguished by the ratio of ground substance to fibrous tissue. Loose connective tissue has much more ground substance and a relative lack of fibrous tissue, while the reverse is true of dense connective tissue. Dense regular connective tissue, found in structures such as tendons and ligaments, is characterized by collagen fibers arranged in an orderly parallel fashion, giving it tensile strength in one direction. Dense irregular connective tissue provides
النسيج الضام الرخو والنسيج الضام الكثيف (والذي ينقسم أيضًا إلى نسيج ضام كثيف منتظم ونسيج ضام كثيف غير منتظم) يتميز النسيج الضام الرخو والكثيف بنسبة المادة البيئية إلى النسيج الليفي.

يحتوي النسيج الضام الرخو على مادة بيئية أكثر وقprocessableًا نسبيًا في الأنسجة الليفية، في حين أن العكس هو الصحيح بالنسبة للنسيج الضام الكثيف، ويتميز النسيج الضام المنتظم الكثيف الموجود في الهياكل مثل الأوتار والأربطة، بالياف الكولاجين المرتبة بطريقة موازية منتظمة، مما يعطيها قوة شد في اتجاه واحد. يوفر النسيج الضام غير المنتظم كثيفة
strength in multiple directions by its dense bundles of fibers arranged in all directions.

Special connective tissue consists of reticular connective tissue, adipose tissue, cartilage, bone, and blood.\textsuperscript{8} Other kinds of connective tissues include fibrous, elastic, and lymphoid connective tissues.\textsuperscript{9} Fibroareolar tissue is a mix of fibrous and areolar tissue.\textsuperscript{10} Fibromuscular tissue is made up of fibrous tissue and muscular tissue. New vascularised connective tissue that forms in the process of wound healing is termed granulation tissue.\textsuperscript{11}
قوته في اتجاهات متعددة من خلال حزمه الكثيفة من الألياف المرتبة في جميع الاتجاهات.

يتكون النسيج الضام الخاص من النسيج الضام الشبكي والأنسجة الدهنية والغضاريف والعظام والدم. تشمل الأنواع الأخرى من الأنسجة الضامة النسيج الضام الليفي والمرن والليمفاوي. الأنسجة الليفية. يتكون النسيج العضلي الليفي من نسيج ليفي وأنسجة عضلية. يُطلق على النسيج الضام الوعائي الجديد الذي يتشكل في عملية التئام الجروح اسم النسيج الحبيبي.
Type I collagen is present in many forms of connective tissue, and makes up about 25% of the total protein content of the mammalian body.\textsuperscript{[12]}

المميزات

Characteristics

Ground substance is a clear, colorless, and viscous fluid containing glycosaminoglycans and proteoglycans to fix the collagen fibers in the intercellular spaces. Examples of non-fibrous connective tissue include adipose tissue and blood. Adipose tissue gives "mechanical cushioning" to the body, among other functions.\textsuperscript{[13][14]} Although there is no dense collagen network in
المادة البيئية عبارة عن سائل لزج وعديم اللون صاف يحتوي على الجليكوزامينوجليكان والبروتيجليكان لتثبيت ألياف الكولاجين في الفراغ داخل الخلايا. تشمل الأمثلة على الأنسجة الضامة غير الليفية الأنسجة الدهنية والدم. تعطي الأنسجة الدهنية "توسيدًا ميكانيكيًا" للجسم ، من بين وظائف أخرى. على الرغم من عدم وجود شبكة كولاجين كثيفة في الأنسجة الدهنية
Adipose tissue, groups of adipose cells are kept together by collagen fibers and collagen sheets in order to keep fat tissue under compression in place (for example, the sole of the foot). Both the ground substance and proteins (fibers) create the matrix for connective tissue.

**Types of fibers:**

<table>
<thead>
<tr>
<th>Tissue</th>
<th>Purpose</th>
<th>Components</th>
<th>Location</th>
</tr>
</thead>
<tbody>
<tr>
<td>Collagenous</td>
<td>Bind bones and other tissues to</td>
<td>Alpha polypeptide chains</td>
<td>Tendon, ligament, skin, cornea, cartilage, bone,</td>
</tr>
<tr>
<td>fibers</td>
<td>each other</td>
<td></td>
<td>blood vessels, gut, and intervertebral disc.</td>
</tr>
<tr>
<td>Elastic</td>
<td>Allow organs like arteries and</td>
<td>Elastic microfibril and</td>
<td>Liver, bone marrow, and lymphatic organs</td>
</tr>
<tr>
<td>fibers</td>
<td>lungs to recoil</td>
<td>elastin</td>
<td></td>
</tr>
<tr>
<td>Reticular</td>
<td>Form a scaffolding for other cells</td>
<td>Type III collagen</td>
<td></td>
</tr>
</tbody>
</table>

Types of fibers can be found in various tissues such as the skin, cartilage, tendons, ligaments, bone, blood vessels, gut, and intervertebral discs. They play a crucial role in maintaining the structure and function of connective tissue.

The preservation of the adipose tissue and collagen fibers helps maintain the integrity of the tissue. The fibers are responsible for the ability of the tissue to withstand pressure and maintain its shape. The table above provides a summary of the different types of fibers and their functions.

The Arabic text translates as follows:

"أنواع الألياف"  
Types of fibers:

<table>
<thead>
<tr>
<th>النسيج (Tissue)</th>
<th>الغرض (Purpose)</th>
<th>المكونات (Components)</th>
<th>الموقع (Location)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Collagenous</td>
<td>Bind bones and</td>
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<td>Tendon, ligament,</td>
</tr>
<tr>
<td>fibers</td>
<td>other tissues to</td>
<td>chains</td>
<td>skin, cornea,</td>
</tr>
<tr>
<td></td>
<td>each other</td>
<td></td>
<td>cartilage, bone,</td>
</tr>
<tr>
<td>Elastic</td>
<td>Allow organs</td>
<td>Elastic microfibril</td>
<td>Liver, bone</td>
</tr>
<tr>
<td>fibers</td>
<td>like arteries</td>
<td>and elastin</td>
<td>marrow, and</td>
</tr>
<tr>
<td></td>
<td>and lungs to</td>
<td></td>
<td>lymphatic organs.</td>
</tr>
<tr>
<td>Reticular</td>
<td>recoil</td>
<td>Type III collagen</td>
<td></td>
</tr>
</tbody>
</table>

The table provides a summary of the different types of fibers and their functions. The fibers are responsible for the ability of the tissue to withstand pressure and maintain its shape. The table above provides a summary of the different types of fibers and their functions.
Function
Connective tissue has a wide variety of functions that depend on the types of cells and the different classes of fibers involved. **Loose and dense irregular connective tissue**, formed mainly by fibroblasts and collagen fibers, have an important role in providing a medium for oxygen and nutrients to diffuse from capillaries to cells, and carbon dioxide and waste substances to diffuse from cells back into circulation. They also allow organs to resist stretching and tearing forces. **Dense regular connective tissue**, which forms organized structures, is a major functional component of tendons, ligaments and aponeuroses, and is also found in highly specialized
الوظيفة:

للنسيج الضام مجموعة متنوعة من الوظائف التي تعتمد على نوع الخلية والفئات المختلفة للألياف المعنية. النسيج الضام غير المنتظم الرخو والكتيف، المكون بشكل أساسي من الخلايا الليفية وألياف الكولاجين، يلعب دورًا مهمًا في توفير وسيط للأكسجين والمواد المغذية للانتشار من الشعيرات الدموية إلى الخلايا، وثاني أكسيد الكربون ومواد النفايات لتنشر من الخلايا مرة أخرى إلى الدورة الدموية. كما أنها تسمح للأعضاء بمقاومة قوة التمزق والتمزق.

النسيج الضام المنتظم الكثيف الذي يشكل هياكل منظمة، هو مكون وظيفي رئيسي للأوتار والأربطة والأورام السائدة.
organs such as the cornea.\textsuperscript{[15]:161} Elastic fibers, made from elastin and fibrillin, also provide resistance to stretch forces.\textsuperscript{[15]:171} They are found in the walls of large blood vessels and in certain ligaments, particularly in the ligamenta flava.\textsuperscript{[15]:173}

In hematopoietic and lymphatic tissues, reticular fibers made by reticular cells provide the stroma—or structural support—for the parenchyma—or functional part—of the organ.\textsuperscript{[15]:171}

Mesenchyme is a type of connective tissue found in developing organs of embryos that is capable of differentiation into all types of mature connective
أعضاء مثل القرنية. توفر الألياف المرنة المصنوعة من الإيلاستين والفيبرين أيضًا مقاومة لقوى التمدد. توجد في جدران الأوعية الدموية الكبيرة وفي بعض الأربطة، وخاصة في رباط فلافا.

في الأنسجة المكونة للدم والأنسجة اللحمية، توفر الألياف الشبكية المصنوعة من الخلايا الشبكة السدي أو الدعم الهيكلية للحمة أو الجزء الوظيفي من العضو.

اللحمة المتوسطة هي نوع من الأنسجة الضامة الموجودة في أعضاء الأجنة النامية والقادرة على التمايز في جميع أنواع الأنسجة الضامة الناضجة.
tissue. Another type of relatively undifferentiated connective tissue is the mucous connective tissue known as Wharton's jelly, found inside the umbilical cord.

Various types of specialized tissues and cells are classified under the spectrum of connective tissue, and are as diverse as brown and white adipose tissue, blood, cartilage and bone. Cells of the immune system, such as macrophages, mast cells, plasma cells and eosinophils are found scattered in loose connective tissue, providing the ground for starting inflammatory and immune responses upon the detection of antigens.
نوع آخر من النسيج الضام غير المتمايز نسبيًا هو النسيج الضام المخاطي المعروف باسم هلام وارتون، الموجود داخل الحبل السري.

يتم تصنيف أنواع مختلفة من الأنسجة والخلايا المتخصصة تحت طيف النسيج الضام، وهي متنوعة مثل الأنسجة الدهنية البني والأبيض وغضاريف الدم والعظام. تم العثور على خلايا الجهاز المناعي، مثل الضامة والخلايا البدينة وخلايا البلازما والحمضات مبعثرة في النسيج الضام الرخو، مما يوفر الأرضية لبدء الالتهاب والاستجابة المناعية عند اكتشاف المستضادات.
The image summarizes the various categories of connective tissues found in the human body.

الصورة تلخص الفئات المختلفة للأنسجة الضامة الموجودة في جسم الإنسان.

النجاح لا يحتاج إلى كثير من العلوم، ولكن يحتاج إلى الحكمة.

General features of connective tissues. The Matrix of most connective tissues is made up of ground substance and protein.

السمات العامة للأنسجة الضامة. تتكون قالب معظم الأنسجة الضامة من مادة بينية وبروتين.
1. Connective Tissue Proper: Fibroblast cells are responsible for synthesizing protein fibers for the matrix. Collagen fibers are strong, elastic fibers are flexible and reticular fibers form a supportive framework for organs and basement membranes. There are two subcategories of connective tissue proper.

الخلايا الليفية هي المسؤولة عن تصنيع البروتينات. آلياف القالب. آلياف الكولاجين قوية و المرنة والألياف الشبكية تشكل إطارًا دائمًا للأعضاء والأنسجة السفلية. هناك نوعان من الفئات الفرعية للنسيج الاصلي.

A. Loose connective tissue

Thin and soft, this tissue contains many collagen and elastic fibers in a jell-like matrix. The cells in loose connective tissue are not close together. This tissue functions in binding the skin to underlying structures. There are three types of loose connective tissue.

النسيج الرخو هو رقيق وناعم ، هذا النسيج يحتوي على العديد من الكولاجين والآلياف المرنة في القالب تشبه الهلام. الخلايا في النسيج الاصلي الرخو ليست قريبة من بعضها البعض. يعمل هذا النسيج في ربط الجلد بالبنى تحتية. هناك ثلاثة أنواع من الأنسجة الاصلي الرخوة

a. Areolar connective tissue

is a common form of loose connective tissue. It is found in the skin and mucous membranes, where it binds the skin or membrane to underlying tissues such as muscles. It is also found around blood vessels and internal organs where it links and supports them,

هو شكل ملغي من النسيج الاصلي الرخوة. يوجد في الجلد والأنسجة السفلية حيث تربط الجلد أو الغشاء تحتية الأنسجة مثل العضلات. يوجد Tz أيضًا حول الأوعية الدموية والأعضاء الداخلية حيث يرتبط بها ويدعمها.

b. Adipose connective tissue

is commonly known as fat. This tissue contains fat cells that are specialized for lipid storage. In addition to storing energy, this tissue also cushions and protects the organs.

يُعرف باسم الدهون. يحتوي هذا النسيج على خلايا دهنية متخصصة لتخزين الدهون. بالإضافة إلى تخزين الطاقة، يعمل هذا النسيج أيضًا على تسهين وحماية الأعضاء.
consists of fat cells (adipocytes with a nucleus and stored lipids in their cytoplasm) with a little extracellular matrix. It stores fat for energy and provides insulation.

C. Reticular connective tissue

is mostly composed of reticular protein fibers which make a skeleton, known as stroma, for the lymphatic and white blood cells.

This type of tissue is found in spleen and other lymphatic system structures.
B. Dense connective tissue proper: This tissue consists of three categories, dense regular connective tissue, dense irregular connective tissue, and elastic connective tissue. These tissues differ on the arrangement and composition of the fibrous elements of the extracellular matrix.

The correct translation: يتكون هذا النسيج من ثلاث فئات، النسيج الضام الكثيف المنتظم، والنسيج الضام الكثيف غير المنتظم، والنسيج الضام المرن. تختلف هذه الأنسجة في ترتيب وتكوين العناصر الليفية للقائمة خارج الخلية.

a. Dense regular connective tissue has extracellular fibers that all run in the same direction and plane. Muscle tendons are a type of dense regular connective tissue.

The correct translation: يحتوي على ألياف خارج الخلية تعمل جميعها في نفس الاتجاه والمستوى. عضلة الأوتار هي نوع من الأنسجة الضامة المنتظمة الكثيفة.

b. Dense irregular connective tissue contains collagen and elastic fibers which are found running in all different directions and planes. The dermis of the skin is composed of dense irregular connective tissue.

The correct translation: يحتوي على الكولاجين والألغاف المرنة التي توجد في جميع أنواع مختلفة الاتجاهات والمستويات. يتكون هذا الجلد من نسيج ضام كثيف غير منتظم.
c. Elastic connective tissue

Made up freely branching elastic fibers with fibroblasts in the spaces between the fibers, this tissue allows the kind of stretch that is found in the walls of arteries.

نسيج الضام المرن

تتكون الألياف المرنة المتفرقة بحرية مع الأرومات الليفية في مسافات بين الألياف، يسمح هذا النسيج بنوع التمدد الموجود في جدران الشرايين

(a) Dense regular connective tissue

consists of collagen fibers packed into parallel bundles. (b) Dense irregular connective tissue consists of collagen fibers interwoven into a mesh-like network.

(ب) نسيج الضام غير المنتظم الكثيف من ألياف كولاجين متداخلة في شبكة شبكة

2. Cartilage 2. الغضارف

This connective tissue is relatively solid and is a non-vascularized tissue (does not have a blood supply). The matrix is produced by cells called chondroblasts. When these cells slow down, they reside in small spaces called lacunae. These mature cells in the lacunae are called chondrocytes. There are three types of cartilage

هو نسيج الضام صلب نسبيا وهو نسيج غير وعائي (لا يحتوي على إمداد بالدم). يتم إنتاج المصفوفة بواسطة خلايا تسمى الخلايا الغضارفية. عندما تتبطأ هذه الخلايا، فإنها تتواجد في مساحات صغيرة تسمى النفايات. تسمى هذه الخلايا الناضجة في النفايات بالخلايا الغضارفية.

هناك ثلاثة أنواع من الغضاريف
Hyaline cartilage, elastic cartilage, and fibrocartilage.

A. Hyaline cartilage is the most common type of cartilage, contains many collagen fibers and is found in many places including the nose, between the ribs and the sternum and in the rings of the trachea.

B. Elastic cartilage has many elastic fibers in the matrix and supports the shape of the ears and forms part of the larynx.

C. Fibrocartilage is tough and contains many collagen fibers and is responsible for cushioning the knee and for forming the disks between the vertebrae.
3. **Bone:** A hard, mineralized tissue found in the skeleton. The bone matrix contains many collagen fibers as well as inorganic mineral salts, calcium carbonate, and calcium phosphate, all features that make it a very rigid structure. Bone cells, called osteoblasts, secrete the osteoid substance that eventually hardens around the cells to form an ossified matrix. The osteon forms the basic unit of compact bone. Within the osteon, the osteocytes (mature bone cells) are located in lacunae. Because the bone matrix is very dense, the osteocytes get their nutrition from the central canal via tiny canals called canaliculi.

3. العظام: نسيج صلب ومعدن موجود في الهيكل العظمي. مصفوفة العظام تحتوي على العديد من ألياف الكولاجين بالإضافة إلى الأملاح المعدنية غير العضوية وكربونات الكالسيوم وفوسفات الكالسيوم، وجميع الميزات التي تجعله شديد الأهمية هيكل صلب. تفرز خلايا العظام التي تسمى بانويات العظام، المادة العظمية التي تتصلب في النهاية حول الخلايا لتتشكل مصفوفة متحجرة. يشكل العظم الوحدة الأساسية للعظم المضغوط. داخل العظم، توجد الخلايا العظمية (خلايا العظام الناضجة) في الفجوات. نظرًا لأن مصفوفة العظام كتيبة جدًا، تحصل الخلايا العظمية على غذائها من القناة المركزية عبر قنوات صغيرة تسمى القنوات.
The image shows a micrograph as well as an illustration of the cross-section of the compact bone tissue.

The osteon (made of osteocytes, central (Haversian) canal, and canaliculi) are visible.

يمكن رؤية عظم العظم (المكون من الخلايا العظمية والقناة المركزية (الهافيرسية) ومرئية
There are four main subtypes of Done cells, as shown in the diagram below. Each type has a different form and function:

1. Osteocytes are star-shaped bone cells that make up the majority of bone tissue. They are the most common cells in mature bone and can live as long as the organism itself. They also control the function of bone cells called osteoblasts and osteoclasts.

2. Osteoblasts are cells with single nuclei that synthesize new bone. They function in organized groups of connected cells called osteons to form the organic and mineral matrix of bone.

3. Osteogenic cells are undifferentiated stem cells that differentiate to form osteoblasts in the tissue that covers the outside of the bone.

4. Osteoclasts are very large, multinucleated cells that are responsible for the breakdown of bones through resorption. The breakdown of bone is very important in bone health because it allows for bone remodeling.
Four sub-types of bone cells in the human skeletal system: Osteocytes (maintain bone tissues), Osteoblast (form bone matrix), Osteogenic cells (stem cell), Osteoclasts (reabsorb bone)

أربعة أنواع فرعية من الخلايا العظمية في نظام الهيكل العظمي البشري:
الخلايا العظمية (تحافظ على أنسجة العظام)، بانيات العظم (تشكل مصفوفة العظام)، الخلايا العظمية (الخلايا الجذعية)، ناقضات العظم (إعادة امتصاص العظم)
4. Blood

Considered a cope of fluid Connective tissue because the matrix of blood is not solid. The fluid matrix is called plasma, and formed elements of this tissue include white blood cells, red blood cells, and platelets.

دم: يعتبر منظار السائل النسيجي الضام لأن قالب الدم ليست صلبة. تسمى قالب السوائل بالبلازما، وتشمل العناصر المكونة لهذا النسيج خلايا الدم البيضاء وخلايا الدم الحمراء والصفائح الدموية.

Figure The cells and cellular components of human blood are shown. Red blood cells deliver oxygen to the cells and remove carbon dioxide. White blood cells (including neutrophils, monocytes, lymphocytes, eosinophils, and basophils) are involved in the immune response. Platelets form clots that prevent blood loss after injury.

الشكل تظهر الخلايا والمكونات الخلويّة لدم الإنسان خلايا الدم الحمراء التي تنقل الأكسجين إلى الخلايا وتزيل ثاني أكسيد الكربون. دم أبيض الخلايا (بما في ذلك العدائل، وحيدات، والخلايا الليمفاوية، والحمضات، والخلايا القاعدية) يشارك في الاستجابة المناعية. تشكل الصفائح الدموية جلطات تمنع فقدان الدم بعد الإصابة
White Blood Cells

(وتسمى أيضًا الكريات البيض) أكثر تنوعًا من الخلايا العظمية. تم عرض خمسة أنواع فرعية من خلايا الدم البيضاء في الشكل أدناه. كلهم عبارة عن خلايا جهاز مناعة تشارك في الدفاع عن الجسم، ولكن كل نوع فرعي له وظيفة مختلفة. كما أنها تختلف في النسبة الطبيعية لجميع الكريات البيض التي تتكون منها

1. Monocytes make up about 5 percent of leukocytes. They engulf and destroy (phagocytize) pathogens in tissues.

2. Eosinophils make up about 2 percent of leukocytes. They attack larger parasites and set off allergic responses.

3. Basophils make up less than 1 percent of leukocytes. They release proteins called histamines that are involved in inflammation.

4. Lymphocytes make up about 30 percent of leukocytes. They include B Cells and T Cells. B cells produce antibodies against non-self antigens, and T cells destroy virus-infected cells and cancer cells.

5. Neutrophils are the most numerous white blood cells, making up about 62 percent of leukocytes. They phagocytize single-celled bacteria and fungi in the blood.

The lymphocytes are involved in several immune functions, including the release of histamines that cause inflammation and the production of antibodies against foreign substances. Neutrophils are the most numerous white blood cells and play a crucial role in defending the body from bacterial and fungal infections.
White Blood Cells

Five sub-types of human white blood cells in the human immune system: monocyte, eosinophil, basophil, lymphocyte, neutrophil.

خمسة أنواع فرعية من خلايا الدم البيضاء البشرية في جهاز المناعة البشري: الخلايا الوحيدة، الحمضات، القاعديه، الخلايا الليمفاوية، العدلة

الأنسجة العضليه

Muscular tissue

Muscle cells form the active contractile tissue of the body known as muscle tissue or muscular tissue. Muscle tissue functions to produce force and cause motion, either locomotion or movement within internal organs. Muscle tissue is separated into three distinct categories: visceral or smooth muscle, found in the inner linings of organs; skeletal muscle, typically attached to bones, which generate gross movement; and cardiac muscle, found in the heart, where it contracts to pump blood throughout an organism.

تشكل خلايا العضلات النسيج النشط المفترض في الجسم المعروف باسم الأنسجة العضلية أو الأنسجة العضليه. تعمل أنسجة العضلات على إنتاج القوة وإحداث الحركة، إما حركة أو حركة داخل الأعضاء الداخلية. يتم تقسيم أنسجة العضلات إلى ثلاث فئات مميزة: العضلات الحضوية أو العضلات الموجودة في البطانات الداخلية للأوراق، العضلات الهيكلية، وعادة ما تكون مرتبطه بالعظام، والتي تولد الحركة الإجمالية، وعضلة القلب، الموجودة في القلب، حيث تقوم بضخ الدم في جميع أنحاء الكائن الحي.

Muscle tissue is made up of cells that have the unique ability to contract or become shorter. There are three major types of muscle tissue, as pictured below: skeletal, smooth, and cardiac muscle tissues.

يتكون أنسجة العضلة من خلايا لها قدرة فريدة على الانقباض أو أن تصبح أقصر. هناك ثلاثة أنواع رئيسية من الأنسجة العضلية، كما هو واضح في الصورة أدناه: أنسجة العضلات الهيكلية، والعضلات، والقلب.

1. Skeletal muscles are striated, or striped in appearance, because of their internal structure. Skeletal muscles are attached to bones, and when they pull on the bones, they enable the body to move. Skeletal muscles are under voluntary control.

1. عضلات الهيكل العضلي مخططه، أو مخططة في المظهر، بسبب بنية الداخلية. تلتصق عضلات العظام، وعندما تسحب العظام، فإنها تمكن الجسم من الحركة. عضلات الهيكل العضلي تكون ارادييه

2. Smooth muscles are nonstriated muscles. They are found in the walls of blood vessels and in the reproductive, gastrointestinal, and respiratory tracts. Smooth muscles are not under voluntary control.

2. عضلات الملساء هي عضلات غير مخططة. توجد في جدران الأوعية الدموية والجهاز التناسلي والجهاز الهضمي والجهاز التنفسي. لا تخضع العضلات الملساء للتحكم الإرادي

3. Cardiac muscles are striated and found only in the heart. Their contractions cause the heart to beat. Cardiac muscles are not under voluntary control.

3. عضلات القلب مخططة وتوجد فقط في القلب وتؤدي انقباضاتها إلى خفقات القلب. عضلات القلب ليست ارادييه
The body contains three types of muscle tissue:

A- Skeletal muscle

b- Smooth muscle

c- Cardiac muscle
Cells comprising the **cerebrospinal fluid** and **Dendritic nervous system** are classified as nervous (or neural) tissue. In the central nervous system, neural tissues form the **brain** and **spinal cord**. In the peripheral nervous system, neural tissues form the **cranial nerves** and **spinal nerves**, inclusive of the **motor neurons**.

Nervous tissue is made up of neurons and other types of cells generally referred to as glial cells. Neurons transmit electrical messages and the other cells play supporting roles.

Nervous tissue makes up the central nervous system (mainly the brain and spinal cord) and the peripheral nervous system (the network of nerves that runs throughout the rest of the body). There are four types of nervous tissues:

1. **Gray matter**
   - Gray matter is nervous tissue that is found only in the brain and spinal cord which is also called the central nervous system. Gray matter is mostly composed of the cell bodies of the neurons. Gray matter is important for information processing. The **gray matter** is the part of the brain that contains the cell bodies of neurons. It is responsible for processing information and carrying signals to and from the brain. The gray matter is divided into different areas, each with its own specific function. Gray matter is found in the cerebral hemispheres, brainstem, and spinal cord. It is made up of several layers, each with a different function. Neurons in gray matter are large and their cell bodies are visible under a microscope. Gray matter is responsible for higher brain functions, such as conscious perception, learning, and memory. It is also responsible for the control of voluntary movement, such as when you move your arm or leg to perform a task.

2. **White matter**
   - White matter is nervous tissue that is found in the brain and spinal cord, where it connects and facilitates communication between gray matter areas. White matter is also found in the nerves of the peripheral nervous system. **White matter** is the part of the brain that contains the myelinated axons of neurons. It is the main part of the brain that carries signals between different parts of the brain. White matter is made up of fibers that are myelinated, which means they are wrapped in a fatty substance called myelin. This helps the signal to travel quickly from one part of the brain to another. White matter is found in the cerebral hemispheres, brainstem, and spinal cord. It is made up of several layers, each with a different function. Neurons in white matter are small and their axons are visible under a microscope. White matter is responsible for connecting different parts of the brain, such as when you move your arm or leg to perform a task.

3. **Nerves**
   - Nerves make up most of the peripheral nervous system. They are long, branching tissues that carry electrical messages between the central nervous system and the remainder of the body. Nerves are bundles of myelinated axons that transmit electrical impulses from the central nervous system to the periphery, and vice versa. **Nerves** are the part of the brain that contain the axons of neurons. They are responsible for carrying messages between the brain and the rest of the body. Nerves are made up of several layers, each with a different function. Neurons in nerves are small and their axons are visible under a microscope. Nerves are responsible for carrying messages between different parts of the body, such as when you move your arm or leg to perform a task or when you feel a sensation of pain or touch.
4. Ganglia (singular, ganglion) are also found in the peripheral nervous system. Ganglia are mostly made up of cell bodies of neurons outside of the central nervous system. They are tissues that act as relay points for messages transmitted through nerves.

النجاح لا يحتاج إلى كثير من العلم، ولكنه يحتاج إلى الحكمة @Hmaitham
An antibiotic is a type of antimicrobial substance active against bacteria.

It is the most important type of antibacterial agent for fighting bacterial infections, and antibiotic medications are widely used in the treatment and prevention of such infections. They may either kill or inhibit the growth of bacteria. A limited number of antibiotics also possess antiprotozoal activity.

Antibiotics are not effective against viruses such as the common cold or influenza; (5l drugs which inhibit viruses are termed antiviral drugs antivirals rather than antibiotics.
Sometimes, the term antibiotic - literally "opposing life from the Greek roots anti", "against" and Bios bios, is broadly used to refer to any substance used against microbes, but in the usual medical usage, antibiotics (such as penicillin) are those produced naturally (by one microorganism fighting another), whereas nonantibiotic antibacterials (such as sulfonamides and antiseptics) are fully synthetic. However, both classes have the same goal of killing or preventing the growth of microorganisms, and both "Antibacterials" are included in antimicrobial chemotherapy. "Antibacterials" include antiseptic drugs, antibacterial soaps, and chemical disinfectants, whereas antibiotics are an important class of antibacterials used more specifically in medicinals and sometimes in livestock feed.
Antibiotics have been used since ancient times. Many civilizations used topical application of moldy bread, with many references to its beneficial effects arising from ancient Egypt, Nubia, China, Serbia, Greece, and Rome. The first person to directly document the use of molds to treat infections was John Parkinson (1567-1650). Antibiotics revolutionized medicine in the 20th century. Alexander Fleming (1881-1955) discovered the modern day penicillin in 1928, the widespread use of which proved significantly beneficial during wartime. However, the effectiveness and easy access to antibiotics have also led to their overusell and some bacteria have evolved resistance to them. [8][9][10] The World Health Organization has classified antimicrobial resistance as a widespread "serious threat [that] is no longer a prediction for the future, it is happening right now in every region of the world and has the potential to affect anyone, of any age, in any country." [11]
Testing the susceptibility of *Staphylococcus aureus* to antibiotics by the Kirby-Bauer disk diffusion method – antibiotics diffuse from antibiotic-containing disks and inhibit growth of *S. aureus*, resulting in a zone of inhibition.
Antibiotics are used to treat or prevent bacterial infections, and sometimes protozoan infections. (Metronidazole is effective against a number of parasitic diseases). When an infection is suspected of being responsible for an illness but the responsible pathogen has not been identified, an empiric therapy is adopted. This involves the administration of a broad-spectrum antibiotic based on the signs and symptoms presented and is initiated pending laboratory results that can take several days. When the responsible pathogenic microorganism is already known or has been identified, definitive therapy can be started. This will usually involve the use of a narrow-spectrum antibiotic. The choice of antibiotic given will also be based on its cost. Identification is critically important as it can reduce the cost of treatment.

Identify the use of broad-spectrum antibiotics and the importance of identifying the pathogen.
OG and toxicity of the antibiotic therapy and also made the possibility of the emergence of antimicrobial OG اسم bil Towe، antibiotics may be given for non-complicated scato podiel antibiotics may be given as a preventive mere and this is only limited to at-risk populations suc in those with a weleed immine system (partienny in HIV sess peevent pneumonia)，those taking surse de ce petents，and to having surgery. The men wurde procedures are to help prevent infection of indio. They are an impetant role in detail antibiotic properties where there may brevet consequence infective endocarditis.

bedremo consequence infective endocarditis. Antibiotics stre ville used to prevent infection in cases of neutropenia partenerly cancer - moted. CD التهاب الشغاف المعدوي الناتج عن الغشائية في الشارع لمنع العدوى في حالات قلة العدبات السرطانية جزئيا. قرص مضخوط
Administration

There are many different routes of administration for antibiotic treatment. Antibiotics are usually taken by mouth.

In more severe cases, particularly deep-seated systemic infections, antibiotics can be given intravenously or by injection, where the site of infection is easily accessed, allowing antibiotics to be given topically in the form of eye drops onto the conjunctiva for conjunctivitis or ear drops for ear infections and acute cases of swimmer's ear. Topical use is also one of the treatment options for some skin conditions including acne and cellulitis. Advantages of topical application include achieving high and sustained concentration of antibiotics at the site of infection, reducing the potential for systemic adverse effects.
absorption and toxicity, and total volumes of antibiotic required are reduced, thereby also reducing the risk of antibiotic misuse. [18] Topical antibiotics applied over certain types of surgical wounds have been reported to reduce the risk of surgical site infections. [19] However, there are certain general causes for concern with topical administration of antibiotics. Some systemic absorption of the antibiotic may occur; The quantity of antibiotic applied is difficult to accurately dose, and there is also the possibility of local hypersensitivity reactions or contact dermatitis occurring. [18] It is recommended to administer antibiotics as soon as possible, especially in life-threatening infections. Many emergency departments stock antibiotics for this purpose. [20]
antibiotic consumption are widely between countries.

The WHO report on zavole of antibiotics consumption, published in 2015 and 2015 data from countries. As measured in defined daily desesper Log inhabitants per day.

Moglie had the lushest consumption with a rate of 64 Burundi had the lowest at 4-6 Amatllin and morcillin / comme and were the most front co
Antibiotics are screened for any negative effects before their approval for clinical use, and are usually considered safe and well tolerated.

However, some antibiotics have been associated with a wide extent of adverse side effects ranging from mild to very severe depending on the type of antibiotic used, the microbes targeted, and the individual patient. Side effects may reflect the pharmacological or toxicological properties of the antibiotic or may involve hypersensitivity or allergic reactions. Adverse effects range from fever and nausea to major allergic reactions, including photodermatitis and anaphylaxis.
bo Commonside - effects included wilting from disruption of the species composition to the intestinal for samplin worth of pathogenic bacteria, such as Clostrid treatment ambelp preventblote asociated disbeli overgrowth of yeast species of the gas candid in the who and vaginal area. Til Milton side effects can result from interaction administration of a que totle with systemic with the pool of brdon damage from the corticoster Sementttiti malo do the mitocondrion, bacteri delved alle found in yol, Incoding selle Mitochondrial damage cause cocidative stress in cells and has been ested as a mechism for side effect on coquines They slow to affect cho.
5 QUESTIONS to Ask Your Doctor Before You Take Antibiotics

1. Do I really need antibiotics?

2. What are the risks?

3. Are there simpler, safer options?

4. How much do they cost?

5. How do I safely take antibiotics?

Use these 5 questions to talk to your doctor about when you need antibiotics - and when you don't.

Health advocacy messages such as this one encourage patients to talk with their doctor about safety in using antibiotics.
Alcohol

Tabactions between alcohol and oral antibiotics may and may effects and decreased efficacy of the theme while moderate alcohol common is unlikely to interfere with many common antibiotics, there are speelfte types of antibiotics, with which oohol consumption may cause som side effects. Therefore, protetti da of side effects and effectiveness depend on the type of antibiotic ministered Atitie sich al metro, tine, cephamadol, teper efendim durazodone, edifiram - live chemical con with alcohol by inhibiting its blown by taldede dehyd, which you want and shorts of behan addition, the yedine and erythromycin site may be reduced by alcohol consumption. Wel heat of soil on antibiotic activity include altered activity of the liver nya tutmak down the blote model.
Pharmacodynamics

The successful outcome of antimicrobial therapy with antibacterial compounds depends on several factors. These include host defense mechanisms, the location of infection, and the pharmacokinetic and pharmacodynamic properties of the antibacterial. (48) The bactericidal activity of antibacterials may depend on the bacterial growth phase, and it often requires ongoing metabolic activity and division of bacterial cells. [49] These findings are based on laboratory studies, and in clinical settings have also been shown to eliminate bacterial infection [48] [50] Since the activity of antibacterials depends frequently on its concentration, [51] in vitro characterization of antibacterial activity commonly includes the determination of the minimum inhibitory concentration and minimum bactericidal concentration of an antibacterial. [48] [52] To predict clinical outcome, the antimicrobial activity of an antibacterial is usually combined with its pharmacokinetic profile.
Combination therapy

In important infectious diseases, including tuberculosis, combination therapy (i.e., the concurrent application of two or more antibiotics) has been used to delay or prevent the emergence of resistance. In acute bacterial infections, antibiotics as part of combination therapy are prescribed for their synergistic effects to improve treatment outcome as the combined effect of both antibiotics is better than their individual effect. [54] [55] Methicillin-resistant Staphylococcus aureus infections may be treated with a combination therapy of fusidic acid and rifampicin. [54]

Antibiotics used in combination may also be antagonistic and the combined effects of the two antibiotics may be less than if one of the antibiotics was given as a monotherapy.

المضادات الحيوية المستخدمة مجتمعة قد تكون أيضًا معادية وقد تكون التأثيرات المشتركة للمضادات الحيوية أقل مما لو تم إعطاء أحد المضادات الحيوية كعلاج وحيد.
For example, chloramphenicol and tetracyclines are antagonists to penicillins. However, this can vary depending on the species of bacteria.\textsuperscript{1567} In general, combinations of a bacteriostatic antibiotic and a bactericidal antibiotic are antagonistic.\textsuperscript{[54] [55]} In addition to combining one antibiotic with another, antibiotics are sometimes co-administered with resistance-modifying agents. For example, \textit{B}-lactam antibiotics may be used in combination with \textit{B}-lactamase inhibitors, such as clavulanic acid or sulbactam, when a patient is infected with a \textit{B}-lactamase producing strain of bacteria.\textsuperscript{[57]}

أو clavulanic حمض مثل حمض مثبطات اللاكتاماز ، مثل حمض sulbactam ، عندما يصاب المريض بسلالة من البكتيريا المنتجة للبلاكتاماز.\textsuperscript{[57]}
Antibiotics are commonly classified based on their mechanism of action, chemical structure, or spectrum of activity. Most target bacterial functions or growth processes. [58] Those that target the bacterial cell wall (penicillins and cephalosporins) or the cell membrane (polymyxins), or interfere with essential bacterial enzymes (rifamycins, lipiarzycins, quinolones, and sulfonamides) have bactericidal activities.
Protein synthesis inhibitors (macrolides, lincosamides, and tetracyclines) are usually bacteriostatic (with the exception of bactericidal).

Further categorization is based on their target specificity. "Narrow-spectrum" antibiotics target specific types of bacteria, such as gram-negative or gram-positive, whereas broad-spectrum antibiotics affect a wide range of bacteria. Following a 40-year break in discovering classes of antibacterial compounds, four new classes of antibiotics were introduced to clinical use in the late 2000s and early 2010s cyclic lipopeptides (such as daptomycin), glycyclcyclines (such as tigecycline), and oxazolidinones (such as linezolid), and lipiaarmycins (such as fidaxomicin).

2010s cyclic lipopeptides (such as daptomycin), glycyclcyclines (such as tigecycline), and oxazolidinones (such as linezolid), and lipiaarmycins (such as fidaxomicin).
With advances in medicinal chemistry, most modern antibacterials are semisynthetic modifications of various natural compounds [62]. These include, for example, the beta-lactam antibiotics, which include the penicillins (produced by fungi in the genus *Penicillium*), the cephalosporins, and the carbapenems. Compounds that are still isolated from living organisms are the aminoglycosides, while other antibacterials -- for example, the sulfonamides, the quinolones, and the oxazolidinones -- are produced by chemical synthesis. [62] Many antibacterial compounds are relatively small molecules with a molecular weight of less than 1000 daltons.
Since the first pioneering efforts of Howard Morey and Chain in 1939, the importance of antibiotics including antibacterials, to medicine has led to intense research to produce antibacterials at large scales. Following screening of antibacterials against a wide range of bacteria, production of the active compounds is carried out using fermentation, usually in strongly aerobic conditions.
Introduction:

Many scientists contributed by their studies to develop cytology such as:

1. Antonie van Leeuwenhoek (1632-1723) who discovered the microscope, he was the first one showed the cell by his microscope.

2. Robert Hooke (1635-1703), was the first one who used the item cell and define it as air chamber like the cavity of honey bees wax.

3. Robert Brown (1831) discovered the nucleus of the cell.

4. Mathias Schleiden, 1838, indicated that all plants bodies consist of.

5. Theodor Schwann, 1839, He indicated that all animals bodies consist of cells.

Cell theory:

Cell theory, according to findings of M. Schleiden and T. Schwann, considered as:

1. All living organisms consist of cells.
2. The cells are the structural and functional units of living organisms.
3. Cells are produced from other cells by division.

The cell is the structural unit of all living organisms.

There are two types of cells according to their structure, the first one is prokaryotic cells, such as in bacteria and blue-green algae cells, which without envelope or nuclear membrane and membranous organelles, and the second are eukaryotic cells, which with nucleus surrounded by nuclear envelope and cell organelles.
Biology

Biology is a natural science concerned with the study of life and living organisms, including their structure, function, growth, evolution, distribution, and taxonomy.

How to Define Life

There are some characteristics that distinguish living and non-living things.

1. **Organization**: Being structurally composed of one or more of cells which is the basic units of life.

   Organsms are organized from atoms up to cells. The mater is structured in an ordered way.
   
   Atoms are arranged into molecules, then into macromolecules, which make up organelles, which work together to form cells. Beyond this, cells are organized in higher levels to form entire multicellular organisms.

2. **Homeostasis**: Regulation of the internal environment to maintain a constant state. Stable internal conditions of pH, temperature, water balance, etc., for example, sweating to reduce temperature.

3. **Metabolism**: Refers to the sum of the total chemical processes that occur in a cell or organism that are necessary for life.

4. **Growth and Development**: Growth means that organism increases in size and number. Development refers to all changes that occur during life.

5. **Adaptation**: The ability to change over time in response to the environment. This ability is fundamental to the process of evolution and is determined by the organism's heredity.

6. **Response to stimuli**: Organisms respond to stimuli (Temperature, Water, Food Supplies, etc.) in order to survive & reproduce.

7. **Reproduction**: The ability to produce new individual organisms, either asexually from a single parent organism, or sexually from two parent organisms.

Water is essential for life.
Water is the most abundant molecule in cells, accounting for 70% or more of total cell mass. The total amount of water in our body is found in three main locations: within our cells (two-thirds of the water), in the space between our cells and in our blood (one-third of the water).

Water has a number of important properties essential for life:

- **Water is the primary building block of cells.** It regulates our internal body temperature by sweating and respiration.
- **The carbohydrates and proteins that our bodies use as food are metabolized and transported by water in the bloodstream.**
- **Water is used to flush waste and toxins from the body via urine.**
- **Forms saliva.**
- **Lubricates joints.**

Water has a special structure because of a negative charge at the oxygen end and a slight positive charge at the hydrogen end. Water molecules can form hydrogen bonds with each other. Substances are hydrophilic (water-loving). Non-polar substances are hydrophobic (water-hating) and are repelled by water.

Water is a very good solvent. Molecules such as salts, sugars, amino acids dissolve readily in water (once dissolved they can be transported e.g. glucose in the blood).

Water has a high specific heat capacity. This means that water does not change temperature easily. This minimizes fluctuations in temperature inside cells.

- **Latent heat of vaporization:** Water requires a lot of energy to change state from a liquid to a gas, providing a cooling mechanism (sweating). As water evaporates it extracts heats from the surrounding area, cooling the organism.
- **Density:** The solid state of water (ice) is less dense than the liquid. As the air temperature cools, bodies of water freeze from the surface, forming a layer of ice with the liquid beneath. This allows aquatic ecosystems to exist in low temperatures.
t) **Collection and adhesion**

Water molecules due to hydrogen bonds stick together, and to other biologically important polar molecules.

A stele ranges from 0 to 14 pH units, reflecting the concentration of hydrogen ions in solution.

A solution with a pH of 7.0 is neutral. Solutions with a lower pH value (<7.0) are increasingly acidic, and those with a higher pH value are increasingly alkaline.

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**pH in living systems**

<table>
<thead>
<tr>
<th>Compartment</th>
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<tbody>
<tr>
<td>Gastrointestinal</td>
<td>1</td>
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<tr>
<td>Lysosome</td>
<td>4.5</td>
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<tr>
<td>Humans</td>
<td>5.5</td>
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<tr>
<td>Urine</td>
<td>6.0</td>
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<td>72</td>
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**Bdlfferrs**

A buffer is a substance that helps minimize the change in the pH of a solution when acids or bases are added. This is important because, most of the chemical processes that occur in living organisms are highly sensitive to pH, and drastic changes in pH can cause some serious trouble.

**Divisions of biology**

The buffer is a substance that helps in maintaining the pH of a solution. This is important because most of the chemical processes that occur in living organisms are highly sensitive to pH. Drastic changes in pH can cause some serious trouble.

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الجزيئات الناتجة عن روابط الهيدروجين تلتقي ببعضها البعض بيولوجيًا. الجزيئات القطبية الهامة.

1. **Collection and adhesion**

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   A buffer is a substance that helps minimize the change in the pH of a solution when acids or bases are added. This is important because, most of the chemical processes that occur in living organisms are highly sensitive to pH, and drastic changes in pH can cause some serious trouble.

   **Divisions of biology**

   المخزن المؤقت هو مادة تساعد في تقليل التغيير في درجة الحموضة فيعال حوض عند زيادة الأحماض أو القواعد. هذا مهم لأن معظم العمليات الكيميائية التي تحدث في الكائنات الحية حساسة للغاية لدرجة الحموضة، ويمكن أن تسبب التغيرات الجذرية في الرقم الهيدروجيني بعض المشاكل الخطيرة. أقسام علم الأحياء.
Biology is divided into

1- Zoology: the study animal behavior structure, physiology, classification and distribution

2e Botany: the study of plant

3- Microbiology the study of microscopic organism
   (unicellular, multi-cellular) aw

Bacteriology: the study of bacteria

Virology: the study of viruses

4- Anatomy: the study of structure of organisms including their systems, organs and tissues.

5- Biochemistry: concerned with the chemical processes that occur within living organisms

6- Radiobiology: the study of the action of ionizing radiation on living things

7- Physiology: it deals with the normal function of the living organisms and their parts

8- Phycology: the study of algae

9- Cell biology: the study of cell structure and motion

10- Photobiology: it studies the interaction between 'fight and living organism'.

11- Parasitology: the study of parasites and their hosts and the relation between them

12- Mycology: the scientific study of fungi

13α Molecular biology is the study that deals with structure and function of proteins and nucleic acids

14- Immunology: the study of immunity

15- Genetics: the study of genes, genetic variation and heredity in living organisms

16- Ecology: it includes the relation of organisms to one another and to their physical surrounding

---

ترجمة: توفي ،

مع تمنياتي لكم بلنجاح

5
Prokaryotic and Eukaryotic Cells

Cells are of two types, eukaryotic, which contain a nucleus, and prokaryotic, which do not. Prokaryotes are single-celled organisms, while eukaryotes can be either single-celled or multicellular.

The distinction between prokaryotes and eukaryotes is considered to be the most important distinction among groups of organisms. Eukaryotic cells contain membrane-bound organelles, such as the nucleus, while prokaryotic cells do not.

Comparison between prokaryotic and eukaryotic cells.

Similarities:
- They both have DNA as their genetic material.
- They are both membrane bound.
- They both have ribosomes.
- They have similar basic metabolism.

Differences:
1. Eukaryotes have a nucleus, while prokaryotes do not.
2. Eukaryotes have membrane-bound organelles, while prokaryotes do not.
3. Eukaryotic cells are, on average, ten times the size of prokaryotic cells.
4. The DNA of eukaryotes is much more complex and therefore much more extensive than the DNA of prokaryotes.
5. Eukaryotes have a cell wall composed of peptidoglycan, a single large polymer of amino acids and... Many types of eukaryotic cells also have cell wds, but none made of peptidoglycan.
6. The DNA of prokaryotes floats freely around the cell; the DNA of eukaryotes is held within its nucleus and associated with histones (proteins).
7. Eukaryotes undergo mitosis; prokaryotes divide by binary fission (simple cell division).
<table>
<thead>
<tr>
<th>الميزات</th>
<th>بدائيات النوى</th>
<th>حقيقيات النوى</th>
</tr>
</thead>
<tbody>
<tr>
<td>الميزات</td>
<td>Prokaryotes</td>
<td>eukaryotes</td>
</tr>
<tr>
<td>الكائنات الحية النموذجية</td>
<td>Bacteria</td>
<td>Plants, animals</td>
</tr>
<tr>
<td>الحجم النموذجي</td>
<td>1-5 μm</td>
<td>1-10 μm</td>
</tr>
<tr>
<td>نوع النواة</td>
<td>Nucleoid region; no true nucleus</td>
<td>True nucleus with double membrane</td>
</tr>
<tr>
<td>DNA</td>
<td>Circular (usually)</td>
<td>Linear molecules (chromosomes) with histone and nonhistone proteins</td>
</tr>
<tr>
<td>RNA/protein synthesis</td>
<td>Coupled in the cytoplasm</td>
<td>RNA synthesis in the nucleus, protein synthesis in the cytoplasm</td>
</tr>
<tr>
<td>هيكل السيتوبلازم</td>
<td>Very few structures</td>
<td>Highly structured by endomembranes and a cytoskeleton</td>
</tr>
<tr>
<td>حركة الخلية</td>
<td>Flagella made of flagellin</td>
<td>Flagella and cilia containing microtubules</td>
</tr>
</tbody>
</table>

Comparison of features of prokaryotic and eukaryotic cells
<table>
<thead>
<tr>
<th>Organization</th>
<th>usually single cells</th>
<th>single cells, higher multicellular organisms with specialized cells</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cell division</td>
<td>binary (simple division)</td>
<td>mitosis and meiosis</td>
</tr>
<tr>
<td>Chromosomes</td>
<td>single chromosome</td>
<td>more than chromosome</td>
</tr>
<tr>
<td>Mitochondria</td>
<td>none</td>
<td>One to several thousand</td>
</tr>
<tr>
<td>Chloroplasts</td>
<td>None</td>
<td>In algae and plants</td>
</tr>
</tbody>
</table>
Diagram of an animal cell
## Animal Cell Parts and Functions I Summary

### Table

<table>
<thead>
<tr>
<th>Organelle</th>
<th>Summary of Function</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Protects the cell</td>
</tr>
<tr>
<td></td>
<td>Controls the entry and exit of molecules</td>
</tr>
<tr>
<td></td>
<td>Gives the a shape</td>
</tr>
<tr>
<td></td>
<td>Adheres to cell membrane</td>
</tr>
<tr>
<td></td>
<td>neighboring cells to form tissue</td>
</tr>
</tbody>
</table>

ملخص الوظيفة

يحمي الخلية يتحكم في الدخول والخروج من تعطي الجزيئات الشكل الذي يلتزم به غشاء الخلايا المجاورة لتشكيل الأنسجة
Helps the cell to communicate with the exterior

Structure of the cell membrane

ܗܝܟܐ ܓܫܝܐ ܟܠܝܝܐ

The

روؤس مائي ديل مسعود ديل مسعود روؤس محبة للماء
Cytoplasm

- holds water and nutrients

Cytoskeleton

- gives structural rigidity to cell
- helps movement of organelles and chromosomes
<table>
<thead>
<tr>
<th>Mitochondria</th>
<th>Converts energy we eat into energy we use. Assist in cell growth, cell cycle and cellular death.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lysosomes</td>
<td>Break down cellular waste into building blocks. Destroy foreign invaders. Peroxisomes break down</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Peroxisomes

Peroxisomes are involved in the synthesis of lipids and bile acids.

Vacuoles

Vacuoles are involved in the synthesis of lipids and bile acids.
Lung cells use cilia to move mucus out of the lungs.

A sperm cell uses its cilia.

Flagellum

Swirl through flagellum tc.
Diagram of a mitochondrion
Nucleus

Center of cell

Duplicate store information

Makes ribosomes, sends commands to ribosomes, protein synthesis

Ribosomes

Protein synthesis

Genetic
Summary of the function of the Rough ER:

- Protein synthesis
- Processes and packages proteins and transports
- Detoxification of alcohol and drugs
- Lipids synthesis
- to for

Smooth endoplasmic reticulum (SER)

Endoplasmic Reticulum (ER)
Golgi apparatus them to other parts of theit cell or outside the cell

Incoming transport vesucte
Golgi apparatus illustrating incoming and outgoing vesicles

جهاز جولجي يوضح الحويصلات الواردة والصادرة
Smooth endoplasmic reticulum
Ribosomes

Rough endoplasmic reticulum

Illustration of Smooth and Rough ER

Smooth and رسم توضيحي لـ Rough ER
Nucleolus contained within the cell nucleus

ترجمة: نواة موجودة داخل نواة الخلية
Animal Cell Parts and Functions | Details

The Cell Membrane

The cell membrane like the border control of the cell, controlling what comes in and what goes out.

The cell membrane also called the plasma membrane encloses the animal cell and its contents. It separates the inside of the cell from the outside. It is a selectively permeable membrane that monitors what enters and
The cell membrane is mostly made up of special proteins (membrane proteins) and lipids (phospholipids).

The phospholipids are arranged is a double layer – the Phospholipid Bilayer. The top and bottom of this double layer arrangement are hydrophilic (water-loving) while the inside of the double layer arrangement is hydrophobic (water-hating).
Mitochondria

The mitochondrion (singular) is the power house of the cell. It is responsible for converting the food that you eat into energy that your body can use. The energy that our body uses is called Adenosine Triphosphate (ATP). ATP is a super energized molecule that gives you the energy you need to function properly.

Mitochondria generate ATP from carbohydrates and fat and other fuels. They also assist in cell growth, cell cycle and cellular death.

A mitochondrion is a smooth oblong organelles with an outer smooth membrane and an inner membrane. The inner membrane has numerous infoldings called Cristae.
The Golgi Apparatus

The Golgi apparatus is the cell’s shipping department. It processes and packages proteins and sends them out to where they are needed.

The Golgi apparatus is made up of stacks of membranous layers that are referred to as Golgi bodies. Golgi bodies create hormones from proteins. They can also combine proteins with carbohydrate to make other molecules such as snot (nasal mucus).

The golgi apparatus packages its products into sacs called vessicles. These sacs have membranes made of
phospholipid just like the cell membrane. These vessicles are then shipped to other parts of the cell or out of the cell.

جهاز كولجي هو قسم الشحن بالخلية. يقوم بمعالجة وتعبئة البروتينات وإرسالها إلى حيث تكون مطلوبة. يتكون جهاز كولجي من أكوام من طبقات الأغشية التي يشار إليها باسم أسماء جولجي. تخلق أجسام كولجي هرمونات من البروتينات. يمكنهم أيضًا الجمع بين البروتينات والكربوهيدرات لصنع جزيئات أخرى مثل الخلاط (مخاط الأنسجة). يقوم جهاز كولجي بتعبئة منتجاته في أكياس أوعية. تحتوي هذه الأكياس على أغشية مصنوعة من الفوسلوفيبيد تماما مثل غشاء الخلية. يتم شحن هذه الأوعية إلى أجزاء أخرى من الخلية أو خارج الخلية.
Ribosomes

Ribosomes are tiny structures found floating around in the cytoplasm or attached to the ER. Ribosomes maybe small but are essential for the proper functioning of a cell. They are responsible for protein synthesis.

The Endoplasmic Reticulum (ER)

The ER is like a factory for the production of proteins and lipids. It also forms a network of tubes that carry substances around the cell. There are two types of ER; the rough ER and the smooth ER. They have slightly different structure and function.
The rough ER is called “rough” because it is studded ribosomes while the smooth ER is called “smooth” because it lacks ribosomes.

The Smooth ER contains enzymes that are involved in the creation of lipids. Other enzymes in the smooth ER help in the detoxification of drugs and alcohol.

Ribosomes attached to the Rough ER are responsible for protein synthesis. These ribosomes assemble amino acids into polypeptides. When synthesis is complete the ER packages the polypeptides in special vesicles and sends them
Lysosomes & Peroxisome

Lysosomes are digestive sacs that contain enzymes to break down cellular waste or debris from outside the cell into new building material. Lysosomes break down big macro molecules into smaller molecules which can be used to nourish the cell. They also break down damaged organelles and destroy foreign invaders such as bacteria.

Peroxisomes are similar to Lysosomes in structure. They break down molecules by oxidative reaction and produces hydrogen peroxide – harmful compound. Peroxisomes break down the hydrogen peroxide to produce water. Or they may use the hydrogen peroxide to break
down other molecules. Peroxisomes are also involved in the synthesis of lipid and bile acid (liver cells).

الليزوزوم والبيروكسيسوم

اليوزومات عبارة عن أكياس هضمية تحتوي على إنزيمات لتفكيك النفايات الخلوية أو الحطام من خارج الخلية إلى مواد بناء جديدة. تقوم الجسيمات الحالة بتفكيك الجزيئات الكبيرة إلى جزيئات أصغر يمكن استخدامها لغذية الخلية. كما أنها تكسر العضيات التالفة وتدمر الغزاة الأجانب مثل البكتيريا. تشبه البيروكسيسومات الليزوزومات في الهيكل. يكسرون الجزيئات عن طريق تفاعل الأحماض وينتج بيروكسيد الهيدروجين - مركب ضار تحلل البيروكسيسومات بيروكسيد الهيدروجين لإنتاج الماء. وقد يستخدمون بيروكسيد الهيدروجين لتفكيك الجزيئات الأخرى. تشارك البيروكسيسومات أيضًا في تخليق الدهون وحمض الصفراء (خلايا الكبد).
Vacuole

Vacuoles are storage sacs filled with fluid. They store food, water and waste products. Vacuoles in animal cells are generally smaller than that in plant cells. Animal cells can have multiple small vacuoles while plant cells usually have a single large vacuole.

Cilia and Flagellum

Some animal cells have cilia or a flagellum. Cilia (singular is cilium) are hairlike processes that extend from the cell’s surface. Flagellum is a wipe-like tail that protrudes from the cell. Both cilia and flagella are made of small protein fibers known as microtubules. Some cells have neither cilia nor a flagellum. A
sperm cell has a flagellum. It uses its flagellum to propel itself through the female reproductive System.

تحتوي خلية الحيوانات المنوية على سوط. يستخدم جلده لدفع نفسه من خلال الجهاز التناسلي الأنثوي.
The Nucleus

The nucleus is the command center of a cell. This is where most of the cell’s DNA is stored. It is enclosed in a double membrane. The double membrane has pores which allow the movement of molecules between the nucleus (Nucleoplasm) and the cytoplasm.

The Nucleolus is located inside the nucleus. The main function of the nucleolus is to make ribosomal RNA (rRNA). rRNA then combines with special proteins to form the basic units of ribosomes. Once these units are formed the nucleolus releases them out of the nuclear envelope where they will be fully assembled into ribosomes. The nucleus sends messages to the
ribosomes through messenger RNA, (mRNA). mRNA carry out orders from the nucleus to the rest of the cell.

الرنا المبرمج (MRNA) تقوم بتلقي الأوامر من النواة إلى باقي الخلية.

Long strands of DNA in the nucleus combine with special protein to form long fibers called Chromatin. Chromatin is then used to make Chromosomes.

تشتت خيوط طويلة من الحمض النووي في النواة مع البروتين الخاص لتكون ألياف طويلة تسمى الكروماتين. ثم يتم استخدام الكروماتين لصنع الكروموسومات.

The number of chromosomes present in a cell depends on the species of animal. The human sperm and egg cell both have 23 chromosomes. The number of chromosomes found in all of the other body cells is 46.

يعتمد عدد الكروموسومات الموجودة في الخلية على نوع الحيوان. يحتوي كل من الحيوان المنوي البشري وخلية البويضة على 23 كروموسوما. عدد الكروموسومات الموجودة في جميع خلايا الجسم الأخرى هو 46.
Why do cells divide? Cells divide for growth, repair and reproduction. Cell division is the process by which parent cells divide into two daughter cells. Cells division usually occurs as part of large cell cycle. In Eukaryotic, there are two distinct types of cell division:

1. **Mitosis or Mitotic cell division**: is a type of cell division which takes place during an organism's growth where the daughter cells containing exactly the same number of chromosomes as the parents cells.

2. **Meiosis or Meiotic cell division**: is second type of division which the daughter cells finish up with the half of the total number of chromosomes present is the parent chromosomes. This kind of division generally takes place in the formation of gametes.

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**MITOSIS**

Mother cells give daughter cells by increase in number that is called cell division (Mitosis). However, genetically identical to each other. The process of mitosis is divided into stages, the stages are prophase, prometaphase, metaphase, anaphase and telophase. Mitosis occurs only in Eukaryotic cells, Prokaryotic divided by different...
process called binary division when mitosis begins the chromosomes condense and become visible. The stages are:

- **Prophase**
  - Chromosome condense
  - Microtubules form
  - The nuclear envelope break down

- **Metaphase**
  - Chromosomes are pulled to center of cell
  - Line up along the metaphase plate

- **Anaphase**
  - Centromeres divide
  - Spindle fibers pull one set of chromosomes to each pole
  - Precise alignment is important in this phase

- **Telophase**
  - Nuclear envelope form around chromosomes
  - Chromosomes uncoil
  - Cytokinesis in animal cells pinching of plasma is occurred, this means (cytoplasm division)

Cell cycle consist of:

- Phase 1: growth and synthesis
- Phase 2: preparation for division
Phase 3 includes the overlapping Process of mitosis and cytokinesis phase 4. DNA-Synthesis phase

**Prophase**

Chromosome condense Microtubles form The nuclear envelope breaks

**Metaphase**

The stage of alignment of chromosomes at the equator of the cell
Chromosomes are pulled to center of Spindle cell.

Line up along "metaphase plate"
Anaphase

' Centromeres divide ' Spindle fibers pull set of chromosome to each pole ) Precise alignment is Daughtercritical to division

Telophase

Nuclear envelopeformäfocn chromosomes Chromosomes uncoil
Cytokinesis - animals - pinching of plasma - plants - elongates and the cell future cellwall and cell membrane

الحيوانات السيتوكينية - معسر
محطات البلازما - يطيب جدار الخلية وغشاء الخلية المستقبلي
Meiosis: is a specialized type of cell division that reduces the chromosome number by half, creating four haploid cells each genetically distinct from the parent cells that give rise to them. This process occurs in all sexually reproducing single cells and multicellular eukaryotes including animals, plants, and fungi.

In meiosis, DNA replication is followed by two rounds of cell division to produce four daughter cells, each with half the number of chromosomes as the original parent cells. The two meiotic divisions are known as meiosis I and meiosis II.

Before meiosis begins, during phase of the cell cycle, the DNA of each chromosome is replicated so that it consists of two identical sister chromatids which remain held together through sister chromatid cohesion.

Because the number of chromosomes is halved during meiosis, gametes can fuse in fertilization to form diploid zygote. Diploid human cells contain 23 pairs of chromosomes including one pair of sex chromosomes (46 total), half of maternal origin and half of parental origin. Meiosis produces haploid gametes (ova or sperm) that:

- Contain 23 chromosomes each.
- Reduce the chromosome number by half.
- Ensure genetic diversity through recombination.
- Occur in all sexually reproducing organisms.
Phases of Meiosis

A diploid cell replicates its chromosomes.

Two stages of meiosis:
- Meiosis I and Meiosis II
- Only recombination

Meiosis I
- Only recombination

Meiosis II
Prophase I

Chromosomes condense

Homologous chromosomes pair with each other. Each pair contains four sister chromatids - tetrad sister homologous chromatid chromosomes.

Replication

tetrad=sister homologous chromosome

Metaphase I

Tetrads or homologous chromosomes move to the center of the cell.
Anaphase I

Homologous chromosomes pulled to opposite poles

Telophase 1

° Daughter nuclei formed ° These are haploid (In)
Daughter cells undergo a second division; much like mitosis

NO ADDITIONAL REPLICATION OCCURS

Meiosis II
Prophase II

Spindle fibers Meiosis form again Prophase I I

The chromosomes condense again, following a brief interphase in which DNA does not replicate

Metaphase II
Sister Metaphase II:
chromatids move to the center

Kinetochores of the paired chromatids line up across the equator of each cell

Anaphase II:
Centromeres Anaphase II split
Individual chromosomes are pulled to their becoming own right, chromosomes and arein pulled to opposite poles

Telophase II & Cytokinesis
Review Mitosis & Meiosis

Both involve formation of spindle fibers.
Both involve replication of the chromosomes, and nucleolus, nuclear membrane.
Both involve disappearance of the nucleus, and nucleolus.
Both are forms of nuclear division.

Results from one original diploid cell.
The chromosomes divide into nuclei, and the cells divide.
Each of the four cells has a nucleus with a haploid number of chromosomes.

Four haploid Telophase II daughter cells.

Products of meiosis.

Mitosis & Meiosis
Both are forms of nuclear division.
Both involve replication.
Both involve disappearance of the nucleus, nucleolus, nuclear membrane.
Both involve formation of spindle fibers.

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Both involve replication.
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Review Mitosis & Meiosis

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Mitosis & Meiosis
Both are forms of nuclear division.
Both involve replication.
Both involve disappearance of the nucleus, nucleolus, nuclear membrane.
Both involve formation of spindle fibers.
DIFFERENCES

Meiosis produces daughter cells that have 1/2 the number of chromosomes as the parent, Go from 2n to ln.

Daughter cells produced by meiosis are not genetically identical to one another.

In meiosis cell division takes place only twice but replication occurs only once.

Value of Variation

Variation - differences between members of a population.

قيمة الاختلاف
التباين - الاختلافات بين أفراد المجتمع
Meiosis results in random 

Causing populations to become stronger for survival

أنتج الانقسام الاختزالى عشوائيا من الكروموسومات

موجهة؟ مجموعات الغوص {يمكن أن يكون وقت أقوى بالنسبة لـ نجاة

ترجمة: توفي،

أعزائي الطلبة أعتذر عن الترجمة ذلك بسبب الملف
Tissues: In biology, tissue is a cellular organizational 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.

The English word "tissue" derives from the French word tissue", meaning that something that is Woven "from the verb tissue to weave".

The term tissue is used to describe a group of cells that are similar in structure and perform a specific function. Histology is the field of study that involves the microscopic examination of tissue appearance, organization, and function.

The study of human and animal tissues is known as histology or, in connection with disease, as histopathology. For plants, the discipline is called plant anatomy.

The classical tools for studying tissues are the paraffin block in which tissue is embedded and then sectioned, the histological stain, and the optical microscope. Developments in electron microscopy, immunofluorescence, and the use of frozen tissue - sections have enhanced the detail that can be observed in tissues. With these tools, the classical appearances of tissues can be examined in health and disease, enabling considerable refinement of medical diagnosis and prognosis.
Tissues are organized into four broad categories based on structural and functional similarities. These categories are epithelial, connective, muscle, and nervous. The primary tissue types work together to contribute to the overall health and maintenance of the human body. Thus, any disruption in the structure of a tissue can lead to injury or disease.

An understanding of the various primary tissue types present in the human body is essential for understanding the structure and function of organs which are composed of two or more primary tissue types. This chapter will focus on examining epithelial and connective tissues. Muscle and nervous tissue will be discussed in detail in future chapters.
The four types of tissues in the body are epithelial, connective, muscle, and nervous. Epithelial tissue is made of layers of cells that cover the surfaces of the body that come into contact with the exterior world, line internal cavities, and form glands. Connective tissue binds the cells and organs of the body together and performs many functions, especially in the protection, support, and integration of the body. Muscle tissue, which responds to stimulation and contracts to provide movement, is divided into three major types: skeletal (voluntary) muscles, smooth muscles, and the cardiac muscle in the heart. Nervous tissue allows the body to receive signals and transmit information as electric impulses from one region of the body to another.

The zygote is described as omnipotent because it ultimately gives rise to all the cells in your body including the highly specialized cells of your nervous system. Describe this transition, discussing the steps and processes that lead to these specialized cells.

The zygote divides into many cells. As these cells become specialized, they lose their ability to differentiate into all tissues. At first they form the three primary germ layers. Following the cells of the ectodermal germ layer, they too become more restricted in what they can form. Ultimately, some of these ectodermal cells become further restricted and differentiate in to nerve cells.

...
The Four Primary Tissue Types: Examples of nervous tissue, epithelial tissue, muscle tissue, and connective tissue found throughout the human body. Clockwise from nervous tissue.
There are 4 basic types of tissue: connective tissue, epithelial tissue, muscle tissue, and nervous tissue. Connective tissue supports other tissues and binds them together (bone, blood, and lymph tissues). Epithelial tissue provides a covering (skin, the linings of the various passages inside the body). Muscle tissue includes stratified (also called voluntary) muscles that move the skeleton, and smooth muscle, such as the muscles that surround the stomach. Nerve tissue is made up of nerve cells (neurons) and is used to carry messages to and from various parts of the body.
Epithelial tissue is made up of cells that line inner and outer body surfaces, such as the skin and the inner surface of the digestive tract.

Epithelial tissue that lines inner body surfaces and body openings is called mucous membrane. This type of epithelial tissue produces mucus, a slimy substance that coats mucous membranes and traps pathogens, particles, and debris.

Epithelial tissue protects the body and its internal organs, secretes substances such as hormones in addition to mucus, and absorbs substances such as nutrients.

Epithelial cell Classification

Most epithelial tissues are described with two names. The first name describes the number of cell layers present and the second describes the shape of the cells. One layer of epithelial cells is called simple and more than one layer of epithelial cells is called stratified. There are three basic shapes of the epithelial cells, squamous, cuboidal, and columnar. Squamous cells are thin and flat cuboidal cells have a shape of a cube; columnar cells have a shape of a pillar. For example, simple squamous epithelial tissue describes a single layer of cells that are flat and scale-like in shape.

Types of Epithelium

- Simple squamous
- Simple cuboidal
- Simple columnar
- Stratified squamous
- Stratified cuboidal
- Pseudostratified columnar

The tissue lining the digestive tract is columnar epithelium. This type of tissue is found in the respiratory tract as well, where it helps trap inhaled particles and pathogens before they enter the lungs.
The epithelial tissues are formed by cells that cover the organ surfaces, such as the surface of skin, the airways, surfaces of soft organs, the reproductive tract, and the inner lining of the digestive tract. The cells comprising an epithelial layer are linked via semi-permeable, tight junctions; hence, this tissue provides a barrier between the external environment and the organ it covers. In addition to this protective function, epithelial tissue may also be specialized to function in secretion, excretion and absorption. Epithelial tissue helps to protect organs from microorganisms, injury, and fluid loss. The epithelial cells are nourished by substances diffusing from blood vessels in the underlying connective tissue. One side of the epithelial cell is oriented towards the surface of the tissue, body cavity, or external environment and the other surface is joined to a basement membrane. The basement layer is non-cellular in nature and helps to cement the epithelial tissue to the underlying structures. Types of Epithelial Tissue Epithelial tissues are identified by both the number of layers and the shape of the cells in the upper layers. There are eight basic types of epithelium: six of them are identified based on both the number of cells and their shape; two of them are named by the type of cell (squamous) found in them. Epithelial tissue is classified based on the number of cells, the shape of those cells, and the types of those cells. Simple Epithelia Simple epithelium consists of a single layer of cells. They are typically where absorption, secretion and filtration occur. The thinness of the epithelial barrier facilitates these processes. Simple epithelial tissues are generally 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.
تتكون الأنسجة الظهارية من خلايا تغطي أسطح الأعضاء، مثل سطح الجلد والمسالك الهوائية وأسطح الأعضاء الروخة والجهاز التناسلي والبطانة الداخلية للجهاز الهضمي. وترتبط الخلايا التي تتألف من طبقة طلائية عبر وصلات ضيقة وشبه منفذة؛ وبالتالي، يوفر هذا النسيج حاجزًا بين البيئة الخارجية والعضو الذي يغطيها. بالإضافة إلى هذه الوظيفة الوقائية، فقد يكون النسيج الظهاري متخصصًا أيضًا في وظيفة الإفراز والإفراز والإمتصاص. يساعد النسيج الظهاري على حماية الأعضاء من الكائنات الحية الدقيقة والإصابة وفقدان السوائل. يتغذى الخلايا الظهارية بمواد منتشرة من الأوعية الدموية في النسيج الضام الأساسي. يتم توجيه جانب واحد من الخلية الظهارية نحو سطح النسيج أو تجويف الجسم أو البيئة الخارجية والسطح الآخر متصل بالغشاء القاعدي. الطبقة القاعدية غير خلوية بطبيعتها وتساعد على تثبيت النسيج الظهاري في الهياكل الأساسية، ويتم تحديد أنواع الأنسجة الظهارية من خلال عدد الطبقات وشكل الخلايا في الطبقات العليا.

هناك ثمانية أنواع أساسية من الظهارة: ستة منها يتم تحديدها بناءً على عدد الخلايا وشكلها، ثم تسمية اثنتين منهم بنوع الخلية (الحرشفية) الموجودة فيهما. يُصنف النسيج الظهاري بناءً على عدد الخلايا وشكل تلك الخلايا وأنواع تلك الخلايا، حيث يُصنف الأنسجة الظهارية بسيطة من طبقة واحدة من الخلايا. هم عادةً حيث يحدث الامتصاص والإفراز والتخلص. تسهل رقة الحاجز الظهاري هذه العمليات.

تصنف الأنسجة الظهارية البسيطة بشكل عام حسب شكل خلاياها. الفئات الأربعة الرئيسية للظهارة البسيطة هي: 1) الحرشفية البسيطة. 2) مكعبة بسيطة. 3) عمودي بسيط؛ و 4) مصدق كاذب.
**Simple Squamous**

Simple squamous epithelium cells are flat in shape and arranged in a single layer. This single layer is thin enough to form a membrane that compounds can move through via passive diffusion. This epithelial type is found in the walls of capillaries, linings of the pericardium, and the linings of the alveoli of the lungs.

**Simple Cuboidal**

Simple cuboidal epithelium consists of a single layer of cells that are as tall as they are wide. The important functions of the simple cuboidal epithelium are secretion and absorption. This epithelial type is found in the small collecting ducts of the kidneys, pancreas, and salivary glands.

**Simple Columnar**

Simple columnar epithelium is a single row of tall, closely packed cells, aligned in a row. These cells are found in areas with high secretory function (such as the wall of the stomach), or absorptive areas (as in small intestine). They possess cellular extensions (e.g., microvilli in the small intestine, or the cilia found almost exclusively in the female reproductive tract).

**Pseudostratified**

These are simple columnar epithelial cells whose nuclei appear at different heights, giving the misleading (hence pseudo) impression that the epithelium is stratified when the cells are viewed in cross section. Pseudostratified epithelium can also possess fine hair-like extensions of their apical (luminal) membrane called cilia.
This case, the epithelium is described as ciliated pseudostratified epithelium.

Ciliated epithelium is found in the airways (nose, bronchi), but is also found in the uterus and fallopian tubes of females, where the cilia propel the ovum to the...

Stratified Epithelium

Stratified epithelium differs from simple epithelium by being multilayered. It is therefore found where body linings have to withstand mechanical or chemical insults.

Stratified epithelia are more durable and protection is one their major functions. Since stratified epithelium consists of two or more layers, the basal cells divide and push towards the apex, and in the process flatten the apical cells. Stratified epithelia can be columnar, cuboidal, or squamous type.

However, it can also have the following specializations:

In keratinized epithelia, the most apical layers (exterior) of cells are dead and lose their nucleus and cytoplasm. They contain a tough, resistant protein called keratin. This specialization makes the epithelium waterproof, and it is abundant in mammalian skin. The lining of the esophagus is an example of a non-keratinized or moist stratified epithelium.

Transitional Epithelia

Transitional epithelia are found in tissues that stretch and it can appear to be stratified cuboidal when the tissue is not stretched, or stratified squamous when the organ is distended and the tissue stretches.
Functions of the Epithelium

Epithelia tissue forms boundaries between different environments, and nearly all substances must pass through the epithelium. In its role as an interface tissue, epithelium accomplishes many functions, including:

1. Protection for the underlying tissues from radiation, desiccation, toxins, and physical trauma.
2. Absorption of substances in the digestive tract lining with distinct modifications.
3. Regulation and excretion of chemicals between the underlying tissues and the body cavity.
4. The secretion of hormones into the blood vascular system. The secretion of substances including sweat, saliva, mucus, enzymes, and other products that are delivered by ducts come from the glandular epithelium.
5. The detection of sensation.

The principle function of epithelial tissues are covering and lining of free surface.

The cells of the body’s surface form the outer layer of skin.

Inside the body, epithelial cells form the lining of the mouth and alimentary canal and protect these organs.

Epithelial tissues help in the elimination of waste. Epithelial tissues secrete enzymes and / or hormones in the form of glands.

Some epithelial tissue perform secretory functions. They secrete a variety of substances including sweat, saliva, mucus, enzymes.

There are many kinds of epithelium, and nomenclature is somewhat variable. Most classification schemes combine a description of the cell - shape in the upper layer of the epithelium with a word denoting the number of layers.
# Types of epithelial tissues

<table>
<thead>
<tr>
<th>Cells</th>
<th>Location</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>Simple squamous epithelium</td>
<td>Lining of the mouth and the lining of the lungs, blood vessels and lymphatic vessels</td>
<td>Allows materials to pass through by diffusion and filtration, and secretes lubricating substance</td>
</tr>
<tr>
<td>Simple cuboidal epithelium</td>
<td>In ducts and secretory portions of small glands and in kidney tubules</td>
<td>Secretes and absorbs</td>
</tr>
<tr>
<td>Simple columnar epithelium</td>
<td>Ciliated tissues are in bronchi of the lung, and uterus; smooth (nonciliated) tissues are in the digestive tract and bladder</td>
<td>Absorbs; it also secretes mucus and enzymes</td>
</tr>
<tr>
<td>Pseudostratified columnar epithelium</td>
<td>Ciliated tissue lines the trachea and much of the upper respiratory tract</td>
<td>Secretes mucus; ciliated tissue moves mucus</td>
</tr>
<tr>
<td>Stratified squamous epithelium</td>
<td>Lining the esophagus, mouth, and vagina</td>
<td>Protects against abrasion</td>
</tr>
<tr>
<td>Stratified cuboidal epithelium</td>
<td>Lining the esophagus, mouth, and vagina</td>
<td>Protective tissue</td>
</tr>
<tr>
<td>Stratified columnar epithelium</td>
<td>Lining the urethra and the ducts of some glands</td>
<td>Secretes and protects</td>
</tr>
<tr>
<td>Transitional epithelium</td>
<td>Lining the bladder, urethra, and the ureters</td>
<td>Allows the urinary organs to expand and stretch</td>
</tr>
</tbody>
</table>
Microscope

A microscope is a laboratory instrument used to examine objects that are too small to be seen by the naked eye.

or

A microscope is an instrument that makes an enlarged image of a small object, thus revealing details too small to be seen by the unaided eye.

There are many types of microscopes:

1- Optical Microscopes.

2- Compound Microscopes.

3- Confocal Laser scanning microscopes.

4- X-ray Microscopes.

5- Electron Microscopes:
   
   A- Transmission electron microscopy (TEM).
   
   B- Scanning electron microscopy (SEM).
Microscopes are generally made up of structural parts for holding and supporting the microscope and its components and the optical parts which are used for magnification and viewing of the specimen images. This description defines the parts of a microscope and the functions they perform to enable visualization.

**There are three structural parts of the microscope i.e. head, base, and arm.**

**Head** – This is also known as the body, it carries the optical parts in the upper part of the microscope.

**Base** – It acts as microscopes support. It also carries the microscopic illuminators.

**Arms** – This is the part connecting the base and to the head and the eyepiece tube to the base of the microscope. It gives support to the head of the microscope and it also used when carrying the microscope. Some high-quality microscopes have an articulated arm with more than one joint allowing more movement of the microscopic head for better viewing of specimens.

**The optical parts of the microscope are used to view, magnify, and produce an image from a specimen placed on a slide. These parts include:**

1. **Eyepiece** – also known as the ocular. this is the part used to look through the microscope. Its found at the top of the microscope. Its standard magnification is 10x

2. **Objective lenses** – These are the major lenses used for specimen visualization. They have a magnification power of 40x-100X. There are about 1-4 objective lenses placed on one microscope, in that some are rare facing and others face forward. Each lens has its own magnification power.
3. **Nose piece** – also known as the revolving turret. It holds the objective lenses. It is movable hence it can revolve the objective lenses depending on the magnification power of the lens.

4. **The Adjustment knobs** – These are knobs that are used to focus the microscope. There are two types of adjustment knobs i.e fine adjustment knobs and the coarse adjustment knobs.
   - **Coarse Adjustment**: Brings the specimen into general focus.
   - **Fine adjustment**: Fine tunes the focus and increases the detail of the specimen

5. **Stage** – This is the section on which the specimen is placed for viewing. They have stage clips hold the specimen slides in place. The most common stage is a mechanical stage, which allows the control of the slides by moving the slides using the mechanical knobs on the stage instead of moving it manually.

6. **Aperture** – This is a hole on the microscope stage, through which the transmitted light from the source reaches the stage.

7. **illuminator(light)** – This is the microscopes light source, located at the base. It is used instead of a mirror. It captures light from an external source of a low voltage of about 100v.

8. **Condenser** – These are lenses that are used to collect and focus light from the illuminator into the specimen. They are found under the stage next to the diaphragm of the microscope. They play a major role in ensuring clear sharp images are produced with a high magnification of 400X and above. The higher the magnification of the condenser, the more the image clarity. More sophisticated microscopes come with an Abbe condenser that has a high magnification of about 1000X.
9. **Diaphragm** – it's also known as the iris. It's found under the stage of the microscope and its primary role is to control the amount of light that reaches the specimen.

10. **Stage control**

11. **On/off switch** - This switch on the base of the microscope turns the illuminator off and on.

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**Figure: Parts of a microscope**, Image Copyright © Sagar Aryal, www.microbenotes.com
# Magnification

**Total magnification** is how large the specimen appears under the microscope.

\[
\text{Total magnification} = \text{Magnification}_{\text{Eyepiece (ocular)}} \times \text{Magnification}_{\text{objective lens}}
\]

<table>
<thead>
<tr>
<th>objective lens</th>
<th>Magnification</th>
<th>Eyepiece lens</th>
<th>Total magnification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Scanning</td>
<td>4X</td>
<td>10X</td>
<td>40X</td>
</tr>
<tr>
<td>Low power</td>
<td>10X</td>
<td>10X</td>
<td>100X</td>
</tr>
<tr>
<td>High power</td>
<td>40X</td>
<td>10X</td>
<td>400X</td>
</tr>
<tr>
<td>Oil immersion</td>
<td>100X</td>
<td>10X</td>
<td>1000X</td>
</tr>
</tbody>
</table>
THE CELL

The cell: Structural and functional unit of all living organisms.

Cells: are the basic units of living organisms.

Cytology (Cell biology): Is the branch of biology that studies the structure and function of the cell.

Cell theory

1. All living organisms are composed of one or more cells.
2. The cell is the basic unit of structure and organization in organisms.
3. Cells arise from pre-existing cells.

Modern version

The modern version of the cell theory includes the ideas that:

Energy flow occurs within cells.
Heredity information (DNA) is passed on from cell to cell.
All cells have the same basic chemical composition.
the basic structure of cell

Cells are found in different size and shapes, representing their evolution for any adaptation to different environments or to different specialized functions within a multicellular organism.

All cells are similar to each other because they all have the same basic structure inside. They all have a membrane that encloses the jelly-like cytoplasm and a nucleus that controls the cell.

Types of cells

<table>
<thead>
<tr>
<th>Prokaryotic Cells:</th>
<th>Eukaryotic Cells:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Have no membrane covered nucleus</td>
<td>Have a nucleus</td>
</tr>
<tr>
<td>Have no membrane - covered organelles</td>
<td>Have a membrane - covered organelles</td>
</tr>
<tr>
<td>Have single circular DNA</td>
<td>Have linear DNA</td>
</tr>
<tr>
<td>Are bacteria</td>
<td>Are all other cells</td>
</tr>
</tbody>
</table>

Size of Cells
Cells ranged in size from the smallest cells, bacteria, only a few length of a micrometer in diameter, to various bird eggs with dimension of centimeters.

**Shapes of Cells in Human Beings**

In human, shapes of cells vary from one tissue to another. Cells differ widely in shape.

Most cells are roughly cuboidal or spherical.

Following are some example of different types of shapes of cells:

<table>
<thead>
<tr>
<th>1- Squamous shape</th>
<th>Flat cells, height less than the wide</th>
<th>Cells lining the blood vessels and body cavities. Function: barrier, absorption, secretion.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Have flattened nucleus</td>
<td></td>
</tr>
<tr>
<td>Cuboidal shape</td>
<td>Height equal to the wide, have spherical nucleus and is found in the center of the cell.</td>
<td>Example: Covering the ovary, thyroids. Function: protect the internal part of our body</td>
</tr>
<tr>
<td>Columnar shape</td>
<td>Height more than the wide. The nucleus is oval in shape and located at the base of the cell.</td>
<td>Example: Lining the intestine, gall bladder, uterus. Function: protection, absorption and secretion</td>
</tr>
<tr>
<td>Irregular shape or star like shape</td>
<td>Irregular, because the cell have dendrites extending from the body of the cell. Nucleus spherical shape</td>
<td>Example: Nerve cells. Function: transport signals</td>
</tr>
<tr>
<td>Spherical shape cell</td>
<td>W.B.C Function: defense</td>
<td>Fat cell Function: storage</td>
</tr>
<tr>
<td>Spindle shape</td>
<td>smooth muscle fiber</td>
<td><img src="image1.png" alt="Image" /></td>
</tr>
<tr>
<td>---------------</td>
<td>---------------------</td>
<td>---------------------</td>
</tr>
<tr>
<td>Function: contraction</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Cylindrical shape</th>
<th>muscle fiber</th>
<th><img src="image2.png" alt="Image" /></th>
</tr>
</thead>
<tbody>
<tr>
<td>Function: contraction</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Special shape</th>
<th>Cells have head, neck and tail.</th>
<th><img src="image3.png" alt="Image" /></th>
</tr>
</thead>
<tbody>
<tr>
<td>Example: sperm</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Function: reproduction</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
The cell Practical

Prepared by
Asst. Lec. Sarah Amer Aswed
Lab 3
Cell Organelles

*Organelles* - small structures inside a cell with specific functions.

* Plants may have lytic vacuoles, which act like lysosomes in animal cells.
** Although they’re not labelled here, plant cells have microtubules and secretory vesicles, too.
*** Cell membrane and plasma membrane are just different names for the same structure.
1- Cell Membrane/Plasma Membrane

Outer membrane of cell that holds the cell together controls movement in and out of the cell.

**Function:** Regulates materials entering and exiting the cell.

**Structure:** Two layers of phospholipids, proteins
2- Cytoplasm

Gel-like mixture Surrounded by cell membrane, various organelles are found in the cytoplasm.

Structure: All cell contents that lie between the cell membrane and the nucleus. (organelles +

The main components of the cytoplasm are:

A. Cytosol – a gel-like substance (Cytosol = liquid portion/non-organelles. made up of fluid and organelles except for nucleus)

B. Organelles – the cell’s internal sub-structures, and
• **Functions**

1. Many cellular processes also occur in the cytoplasm, such as protein synthesis, the first stage of cellular respiration (known as glycolysis), mitosis, and meiosis.

2. The cytoplasm helps to move materials, such as hormones, around the cell and also dissolves cellular waste.
3- Nucleus

A membranous organelle of the eukaryotic cell that contains (Nucleolus: Contains RNA to build proteins)

Chromosomes: Contains genetic material or DNA genetic material)

It is a rounded structure usually located near the center of the cell.
**Function:** Control of the genetical information, protein and enzyme synthesis, cell division and cell growth; Storage of DNA, RNA and ribosome; Regulation of the transcription of the mRNA to protein; Production of ribosomes.

**Structure:** membrane bound, contains DNA
Nuclear Envelope

**Function:** Regulates what enters or exits the nucleus.

**Structure:** Double Layer of Lipids
**Nucleolus**

**Function:** Produces RNA, which are used to make all proteins.

**Structure:** Inside Nucleus, separate from DNA.
DNA – Deoxyribonucleic acid

Function: information on how to make proteins.
*Chromatin – unorganized DNA (normal state)
*Chromosomes – organized DNA (present before cell division)

Structure: Made up of nucleotides, locked in the nucleus
4-Mitochondria

organelles in which the biochemical processes of respiration and energy production occur.

**Function:**  Produce energy for the cell – site of cellular respiration. “The Powerhouse”

**Structure:**  Double membrane-bound, kidney shaped.
5-Golgi Apparatus

a complex of vesicles and folded membranes within the cytoplasm, modify and package proteins

**Function**: Packages, labels and ships proteins out of the cell.

**Structure**: Pancake-shaped layered organelle
6-Endoplasmic Reticulum

A network of membranous tubules within the cytoplasm continuous with the nuclear membrane and moves materials around in cell.

**Smooth ER**: lacks ribosomes

**Rough ER**: ribosomes embedded in surface

**Function**: Transportation route for proteins.

**Structure**: tubes and channels
7-Ribosomes

Each cell contains thousands of ribosomes that make proteins.

**Function:** Makes proteins.

**Structure:** small circular organelles
8-Lysosome

Organelles in the cytoplasm containing Digestive enzymes for proteins, fats, and carbohydrates.

**Function:** packets of enzymes that break down materials in a cell.

**Structure:** Small membrane-bound organelles
Membrane-bound sacs for storage, digestion, and waste removal

**Function:** Storage for water, nutrients or waste.

**Structure:** Small membrane-bound organelle.

9-Vacuoles & Vesicles
10-Cytoskeleton

**Function:** Provide support and structure for the cell.

* Microfilaments
* Microtubules

**Structure:** Tubules
11-Centrioles (Animals Only)

**Function:** microtubules that help divide the cell during cell division.

**Structure:** Tubules
12-Cilia & Flagella

**Function:** provides movement for the cell or objects moving by the cell.

**Structure:**
- Flagella – 1 long fiber
- Cilia – many short fibers
13-Chloroplasts (Plants only)

**Function:** site of photosynthesis (converting sun and CO2 into sugar).

**Structure:** Membrane bound organelles that contain chlorophyll
14- Cell Wall (Plant cells only)

**Function:** Provides support for the cell and the plant.

**Structure:** Made of cellulose
Epithelial Tissue

Prepared by
Asst. Lec. Sarah Amer Aswed
Lab 4
**Tissue** :- is a group of cells performing similar functions. The body is composed of approximately 75 trillion cells.

four main groups of tissue are known in the body these are:

1- epithelium tissue.
2- connective tissue.
3- muscular tissue.
4- nervous tissue.
Basement membranes

- are a specialized form of extracellular matrix that surrounds epithelial, endothelial, peripheral nerve, muscle, and fat cells throughout the body.
Epithelium tissue

Is layer of cells which cover the body surface and line the internal cavity and tubes. Classified according to two criteria:

1. **Number of cell layers:**
   A. Simple epithelia
   B. Stratified epithelia

2. **Shape of the surface cells:**
   A. Squamous cells
   B. Cuboidal cells
   C. Columnar cells
<table>
<thead>
<tr>
<th>Simple</th>
<th>Stratified</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Squamous</strong></td>
<td></td>
</tr>
<tr>
<td>Simple squamous epithelium</td>
<td>Stratified squamous epithelium</td>
</tr>
<tr>
<td><strong>Cuboidal</strong></td>
<td></td>
</tr>
<tr>
<td>Simple cuboidal epithelium</td>
<td>Stratified cuboidal epithelium</td>
</tr>
<tr>
<td><strong>Columnar</strong></td>
<td></td>
</tr>
<tr>
<td>Simple columnar epithelium</td>
<td>Stratified columnar epithelium</td>
</tr>
</tbody>
</table>
Simple squamous epithelium
-formed of a single layer of flat cells. Found in kidney, blood and lymph vessels

Kidney Tubules
Simple columnar epithelium

Is composed of a single layer of tall cells like hexagonal solids. Found in uterus, stomach, and intestine.
Simple cuboidal epithelium

Is composed of a single layer of cells shaped like truncated hexagonal solids. Form the covering of ovary and compose some kidney tubules.
Pseudo stratified columnar epithelium tissue

One layer of cells of different length, nucleus is not on the same level, so its appear more than one layer. Can be ciliated. Found in trachea, urethra.
Stratified Squamous epithelium
many layers of flattened cells can be keratinized as epidermis and non keratinized as esophagus

Esophagus  epidermis
Stratified columnar epithelium

Consist of more than one layer of cells. the superficial layer is columnar in shape.

Found in : conjunctiva of eye.
Stratified cuboidal epithelium

2 or 3 layers of cuboidal cells Found in ducts of sweat glands.
Transitional epithelium

Consist of several layers of cells. Surface layer is large and dome-shaped. Found in urinary bladder, ureter.
Functions of Epithelia

1. Protection from:
   - Mechanical trauma
   - Dehydration
   - Pathogens

2. Secretion of:
   - Hormones, Enzymes, HCl, milk, Mucous.

3. Lubrication of:
   - Contents of digestive tract.

4. Filtration of wastes: (Urine)

5. Absorption of food: (Aminoacids, Glucose, Fatty acids)

6. Neuroepithelium: (Taste, Smell, Hearing)

7. Reproduction: (Germ cells)
Glandular tissue

• Glandular tissue is the type of epithelium that forms the glands from the infolding of epithelium and subsequent growth in the underlying connective tissue.

• Glands are classified:
  A-The glands are classified according to the number of the cells into
  1-Unicellular glands: (goblet cells among absorption cells in intestinal epithelium).
  2-Multicellular gland: (salivary glands).
B- glands classified into three major groups on the basis of method of distribution of their secretory products:

1. Endocrine glands: secrete their product into the extracellular space where it is taken up by the circulatory system. (Thyroid gland).

2. Exocrine glands: secrete their products into a duct that then delivers the product to the lumen of an organ (salivary glands).

3. Mixed glands: In this glands group of cells secrete into duct and another group of cells secrete into blood stream e.g. (pancreas, liver, ovary). Pancreas which has exocrine function in digestion of food and endocrine function in regulate blood sugar.
Connective Tissues

The tissues that connect the different parts of the body together are called connective tissues.

Basic Functions

1. Support and binding of other tissues
2. Defending the body against infection (Protecting).
3. Transporting substances within the body.
4. Storing nutrients as fat.

Connective Tissues are made of three main components:

A. Ground Substance
B. Fibers
C. Cells
A. Ground Substance [extracellular matrix]– the sieve part –

1. Fills space between cells & surrounds fibers.
2. Clear, colorless.
3. Made of Hyaluronic acid, proteoglycans and glycoproteins.

B. Fibers

There are three types of fibers prevalent in Connective tissues

1. **collagen fibers** – are wide and wavy in appearance and generally stain pink. 79% of the protein in the body is collagen.
2. **elastic fibers** – are thin flexible fibers made from the protein elastin, that generally stain black.
3. **reticular fibers** – are actually thin collagen fibers. They have a spider web appearance and appear black under stain.

![Reticular Fibers](image)

**C. The Cells**

Each major type of connective tissue has its own fundamental cell type:

<table>
<thead>
<tr>
<th>Type of Connective Tissue</th>
<th>Immature Cell</th>
<th>Mature Cell</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Connective Tissue Proper</td>
<td>Fibroblast</td>
<td>Fibrocyte</td>
</tr>
<tr>
<td>2. Cartilage</td>
<td>Chondroblast</td>
<td>Chondrocyte</td>
</tr>
<tr>
<td>3. Bone</td>
<td>Osteoblast</td>
<td>Osteocyte</td>
</tr>
<tr>
<td>4. Blood</td>
<td>Hematopoietic Stem Cell</td>
<td>Blood cell (macrophages)</td>
</tr>
</tbody>
</table>

Other Cells Present  Connective tissue is also home to many other cell types including Fat Cells, and mobile cells that migrate into the
connective tissue from the blood stream, ie. mast cells and macrophages. Plasma cell, mesenchymal cell.

**types of connective tissue**

Connective tissues encompass a diverse array of tissue types that are involved in binding and supporting body structure and tissues.

- **Connective Tissue Proper:**
  - A- Loose connective tissues.
    1. Areolar connective tissues.
    2. Adipose connective tissues.
    3. Reticular connective tissues.
    4. Mesenchymal connective tissues.
5. Mucoid connective tissues.
B-dense connective tissues.
  1. Dense regular connective tissue.
  2. Dense - Irregular Connective Tissue.

Connective Tissues

A. Loose connective tissues.e Proper:
  1. Areolar Connective Tissue Structure-

gel like matrix with all three fiber types present. Three cell types present:


Areolar Connective Tissue Location :

- Found between the skin and muscle.
- Also found between muscles
- Packages organs
- Surrounds Capillaries
- Collagen Fiber Elastic Fiber Fibroblast

Areolar Connective Tissue Function.

  1. Wraps and cushions organs.
  2. Macrophages phagocytize bacteria
  3. Holds and conveys tissue fluid
2. **Adipose connective tissues Structure.**

Adipocytes (fat filled cells) are shaped spherical cells filled with triglycerides.

**Adipose Tissue Location:**

- Found around organs.
- Joints.
- surrounding the eyeball.
- within the abdomen.

**Adipose Tissue Function:**

1. Shock absorption.
2. Energy Storage.
3. Protection.
4. Insulation.

In mammals, two types of adipose tissue exist:

- white adipose tissue (WAT)
- brown adipose tissue (BAT).

3. **Reticular Tissue Structure:**

The tissue consists of reticular cells and the network of reticular fibers formed by them Most connective tissues contain reticular fibers.
**Reticular Tissue Location:**

- Spleen
- Lymph nodes
- Liver

**Reticular Tissue Function:**

1. In Lymph Nodes – macrophages devour bacteria, viruses and cancer cells.
2. In Spleen – macrophages break down dying RBC’s.
3. In Liver – macrophages (Kupffer cells) devour bacteria.
4. This tissue forms a soft internal skeleton that supports other cell types.

4. **Mesenchymal connective tissues.**

Mesenchyme is a type of connective tissue found mostly during the embryonic development.

**Mesenchyme Tissue Location:**
Umbilical cord.
Connective Tissue Proper:

Dense Connective Tissue

Dense Regular Connective Tissue

**Dense Regular Connective Tissue Structure:**
Parallel collagen fibers.
Dark colored fibroblasts interspersed.

**Dense Regular Connective Tissue Location:**
- In tendons and ligaments.
- In scar tissue
- aponeuroses
- Fascia around muscles

**Dense Regular Connective Tissue Function:**
- Provide high tensile strength in one direction.
- Attached muscles to bone, bone to bone.
Dense Irregular Connective Tissue

Dense Irregular Connective Tissue Structure:

- Primarily irregularly arranged collagen fibers.
- Some elastic fibers and fibroblasts.

Dense Irregular Connective Tissue Function

- Withstands tension
- Provides structural strength
- Location
  - Dermis of skin
  - Submucosa of digestive tract
  - Fibrous capsules of joints and organs
Cartilage:

Firm, flexible tissue, contains no blood vessels or nerves, matrix contains up to 80% water. Cell type – chondrocyte.

Types:

• Hyaline
• Elastic
• Fibrocartilage

Hyaline Cartilage:

Hyaline Cartilage Structure:

The chondrocytes (cells) lie in lacunae (spaces around cells). There is a large amount of extracellular matrix which is bordered on either side by the perichondrium.

Hyaline Cartilage Location:

• Forms most of the embryonic skeleton.
• Covers the ends of long bones.
• Costal cartilage
• Nose
• Trachea
• Larynx
Hyaline Cartilage Function:
- Provides a smooth surface for joints to move over.
- Resists compression and provides flexible support.

Elastic Cartilage

Elastic Cartilage Structure- Similar to Hyaline cartilage with the exception of the elastic fibers in the matrix

Elastic Cartilage Location:
- Ears
- Epiglottis
- larynx (voice box).

Elastic Cartilage Function:
- Maintains shape of a structure but is also extremely flexible.
Fibrocartilage

is the strongest type of cartilage and composed of hyaline and dense collagen fibers. It is inflexible, tough, and located in areas such as between vertebrae, in some joints, and in heart valves. Fibrocartilage does not have perichondrium.

**Fibrocartilage Structure:**
Thick collagen fibers predominate the matrix. Chondrocytes are interspersed among the fibers.

**Fibrocartilage Location:**
- Intervertebral Discs
- Menisci of the knee
- Heart valves

**Fibrocartilage Function:**
- Shock absorption
- Smooth tough support
Bone:

Of all the different types of connective tissues found in the body, bone is the most rigid, and it comes in two tissue forms called spongy bone and compact bone. As can be seen from this picture, under normal magnification spongy bone looks porous, while compact bone looks solid. Spongy Bone Compact Bone.

Compact Bone

Compact bone consists of closely packed osteons or haversian systems. The osteon consists of a central canal called the osteonic (haversian) canal, which is surrounded by concentric rings (lamellae) of matrix. Between the rings of matrix, the bone cells (osteocytes) are located in spaces called lacunae. Small channels (canaliculi) radiate from the lacunae to the osteonic (haversian) canal to provide passageways through the hard matrix. In compact bone, the haversian systems are packed tightly together to form what appears to be a solid mass. The osteonic canals contain blood vessels that are parallel to the long axis of the bone. These blood vessels interconnect, by way of perforating canals, with vessels on the surface of the bone.

Spongy (Cancellous) Bone

Spongy (cancellous) bone is lighter and less dense than compact bone. Spongy bone consists of plates (trabeculae) and bars of bone adjacent to small, irregular cavities that contain red bone marrow. The canaliculi connect to the adjacent cavities, instead of a central haversian canal, to receive their blood supply. It may appear that the trabeculae are arranged in a haphazard manner, but they are organized to provide maximum strength similar to braces that are used to support a building. The trabeculae of spongy bone follow the lines of stress and can realign if the direction of stress changes.
Bone tissue has several important functions:

- Bones (along with some cartilage) are the main support structures of the body.
- Bones protect the body’s internal organs.
- Bones provide attachment sites for tendons which hold muscles in place. This function is important in creating lever systems for body movement.
- Blood cells are produced in the red marrow of bones (the porous nature of spongy bone allows red bone marrow to be housed and protected).
- Bones function as storage facilities for inorganic salts like calcium, magnesium, and phosphorous.
Blood

Blood: the fluid that circulates in the principal vascular system of human beings and other vertebrates, in humans consisting of plasma in which the red blood cells, white blood cells, and platelets are suspended.

Blood: A liquid connective tissue composed of extracellular matrix called as blood plasma and the red blood cells, white blood cells, and platelets are suspended.

Functions

1. Transport medium
   - Oxygen, nutrients & waste material.
   - Hormones to their target glands.
   - Protective antibodies to the site of infection.
   - Electrolytes and Ions.

2. Protection against infection

3. Regulation of pH: By buffering systems found in the blood that maintain the pH between 7.35 to 7.45.

4. Blood pressure regulation: by increasing or decreasing blood flow to the kidneys.
5. Maintenance of body temperature.
6. Clot formation.

Physical properties:

- Denser & viscous than water and sticky
- Temperature is 38°
- Slightly alkaline pH (7.35 to 7.45)
- Color of blood varies with its oxygen content
  - When it has a high oxygen content, it is bright red
  - When it has a low oxygen content, it is dark red
- Blood volume is 5 to 6 liters in an average adult male & 4 to 5 liters in an average adult female.

Components of Blood

Blood consists of formed elements that are suspended and carried in a fluid called plasma

- **Two components of blood:**
  - **A. Blood plasma** (55%): Watery liquid extracellular matrix contains dissolved substances (92% water, ions, plasma proteins [Albumin, globulin, Fibrinogen] Same ionic composition as interstitial fluid)
  - **B. Formed elements** (45%): Cells
    - Red blood cells (Erythrocytes)
    - White blood cells (Leukocytes) & cell fragments (platelets)
A. Plasma

Straw colored fluid made of water (~92%), other contents include:

Proteins make the bulk of the solutes: manufactured in the liver.

- **Albumins** (60%), are the most abundant type of plasma proteins, maintain the plasma volume by osmotic pressure.

- **Globulins** (35%), alpha and beta Globulins transport lipids and certain minerals through the bloodstream. Gamma Globulins are antibodies.

- **Fibrinogen** (4%) for blood clotting

**Plasma, content.**

Nutrients: glucose, amino acids, lipids, cholesterol

Electrolytes: Na+, K+, Ca++, Mg++, H+, Cl-, HCO3-, PO4--, SO4--

Waste: urea, creatinine, uric acid, bilirubin

Gases: O2, CO2

Protein bound hormones

Plasma without clotting factors is called **“serum”** Formed Elements
B. Formed elements
- Platelets (Thrombocytes)
- Red blood cells (Erythrocytes)
- White blood cells (Leukocytes)
  a. Granulocytes: 75% of total WBC
  b. Agranulocytes: 25% of total WBC
     1. Lymphocytes, 2. Monocytes

Hematopoiesis
- Is a formation of blood cells from stem cells in the red bone marrow (myeloid stem cell) & lymphatic tissue (lymphoid stem cell)
- Erythropoiesis is formation of RBCs – Stimulated by erythropoietin (EPO) from kidney
- Leukopoiesis is formation of WBCs – Stimulated by variety of cytokines
- Thrombopoiesis is formation of platelets

White blood Cells (WBCs)
- Range: 5000 – 10,000/mm3 of blood
- Produced by leukopoiesis in red bone marrow, Contain nuclei
  - Functions
    – Defense against pathogens
    – Removal of toxins, wastes & damaged cells
**Neutrophil**
- 60-70% of total WBC’s
- Granules do not stain with dyes
- Diameter: 10-12 μm
- Nucleus: Usually 2-4 lobed

**Functions:**
- Neutrophils are phagocytic towards bacteria (1 neutrophil can phagocyte 5-20 bacteria)

**Eosinophil**
- 2-4 % of total WBC’s
- Granules stained by red acidic dyes
- Diameter 10-12 μm
- Nucleus: Usually 2 lobes

**Functions:**
- Involved in allergic reactions & parasitic infections.
- They destroy the antigen-antibody complexes & restrict the process of inflammation.

**Basophil**
- 0.5- 1 % of total WBC’s
- Granules stained with basic, purple blue color
- Diameter 8-10 μm
- Nucleus: Irregular and usually 2 lobes
- Granules contain heparin & histamine

**Functions:**
- At the site of infection basophils convert into mast cells
- Basophils & mast cells release histamine, bradykinin & serotonin
**Lymphocyte**
- 20-25 % of total WBC’s
- Depending upon the site of production & their actions, divided into T, B cells & Natural killer cells
- They are divided into
- Small lymphocytes- Diameter 6-9 μm
- Large Lymphocyte- Diameter 10-14 μm
- Nucleus: Round
Functions: • Plays important role in immunity.

**Monocyte**
- 3-8 % of total WBC’s
- Diameter: 12-20 μm
- Nucleus: Oval or kidney shaped
- Monocytes are converted into macrophages of the tissues
Functions: • Phagocytosis

**Platelets (Thrombocytes)**
Shape & size
Are smallest of formed elements.
Lack nucleus
Irregularly shaped fragments of megakaryocytes, amoeboid.
Diameter: 2-4 μm
Life span- from 5 to 12 days
Essential for clotting
Number =250,000/ mm3
Function
• Involved in blood clotting mechanism
Red Blood Cells (RBCs)
- Biconcave disc shaped
- Male: 5.4 M/ mm³ of blood
- Female: 4.8 M/ mm³ of blood
- Have no nuclei
  Functional for about 120 days
- Production occurs in the red bone marrow
- Contains Hemoglobin (280 M/RBCs)
- Function: Transport of oxygen from lungs to tissues & carbon dioxide from tissues to lungs

Definition of Anemia
Deficiency in the oxygen-carrying capacity of blood due to a decrease in erythrocyte number.

May be due to:
1/ Erythrocyte loss (bleeding)
2/ Decreased Erythrocyte production
3/ low erythropoietin
4/ Decreased bone marrow response to erythropoietin
5/ Increased Erythrocyte destruction (hemolysis)

Symptoms of Anemia
- Decreased oxygenation
  1/ Exertional dyspnea
  2/ Dyspnea at rest
  3/ Fatigue
  4/ Lethargy, confusion
- Decreased volume
  1/ Fatigue
  2/ Muscle cramps
  3/ Postural dizziness
  4/ Syncope
Types of Anemia

Anemia Iron Deficiency Anemia: Inadequate absorption or excessive loss of iron

Megaloblastic Anemia: Due to deficiency of folic acid & vitamin B12

Aplastic anemia: Destruction of red bone marrow

Hemolytic anemia: Due to excessive breakdown of red blood cells

Pernicious anemia: Due to impaired absorption of vitamin B12 because of a lack of intrinsic factor in gastric secretions.

The lymphatic system

The lymphatic system: It is a network of organs, lymph nodes, lymph channels, and lymph vessels that make and carry lymph from tissues into the bloodstream. The lymphatic system is a major part of the body's immune system.

Lymph: It is a transparent liquid, its color tends to be yellowish, similar to blood except that it does not contain red blood cells, that is, it is composed of

1 / White blood cells, especially lymphocytes, which are cells that attack bacteria in the blood

2 / Fluids from the intestine called shill and contain proteins and fats

The lymphatic system includes: 1/Tonsils ,2/Adenoids , 3/Spleen ,2/Thyroid gland, 5/Lymph nodes are located in groups in different parts of the body such as: (neck, armpits, inside the center of the chest and abdomen)

Lymph nodes make immune cells that help the body fight infection. They also filter the lymph fluid and remove foreign materials such as bacteria and cancer cells. When bacteria are recognized in the lymph fluid, the lymph nodes make more infection-fighting white blood cells. This causes the nodes to swell. Swollen glands sometimes appear in the neck, under the arms, and groin.
Bone (Osseous) Tissue supportive connective
tissue Contains specialized cells Produces solid matrix of calcium salt deposits
Around collagen fibers

Bone (Osseous) Tissue

Matrix Minerals (inorganic components)
  - Two thirds of bone matrix is calcium phosphate, Ca$_3$(PO$_4$)$_2$ = makes bones hard
  - Matrix Proteins (organic components)
  - One third of bone matrix is protein fibers (collagen) = makes bones flexible

Bone (Osseous) Tissue

The Cells of Bone

Make up only 2% of bone mass

Bone contains four types of cells:-

1. Osteogenic cells:
   - Stem cells that divide to produce osteoblasts
   - Assist in fracture repair

2. Osteoblasts:
   - Immature bone cells that secrete matrix compounds (osteogenesis)= involved in bone growth

3. Osteocytes
   - Mature bone cells that maintain the bone matrix
   - Do not divide
   - Functions: To maintain protein and mineral content of matrix and To help repair damaged bone
4. **Osteoclasts:**
   - Giant, multinucleate cells
   - Secrete acids and protein-digesting enzymes Dissolve bone matrix and release stored minerals (osteolysis)

**Compact bone**

Solid, strong bone that is resistant to bending located along the diaphysis of long bones. Provides solid structure to the skeletal frame

**Compact Bone structural**

Made of cylinder shaped units called

A. Haversian system, or osteon: the structural unit of compact bone
   1. Lamellae Column-like matrix tubes (mainly collagen).
   2. Central (Haversian) canal Contains blood vessels and nerves provide nourishment for bone

B. Perforating (Volkmann’s) canals:
   Connects blood vessels and nerves of the periosteum and central canal.

C. Lacunae—small cavities that contain osteocytes.

D. Canaliculi—hairlike canals that connect lacunae to each other and the central canal.
The Structure of Spongy (cancellous) Bone:

- Does not have osteons
- The matrix forms a honeycomb network of **trabeculae**
- Trabeculae have no blood vessels
- The space between trabeculae is filled with **red bone marrow**: Which has blood vessels, forms red blood cells, and supplies nutrients to osteocytes
- **Yellow marrow**: In some bones, spongy bone holds yellow bone marrow, which is yellow because it stores fat.
CELL CYCLE AND (CELL DIVISION)

All organisms even the largest, start their life from a single cell? single cell then goes on to form such large organisms, Growth and reproduction are characteristic of cells.

Definition of cell cycle

The cell cycle: is a cycle of stages that cells pass through to allow them to divide and produce new cells.

Why Do Cells Divide

1. Some cells die or are damaged, they must be replaced.
2. Multicellular organisms need to grow and develop, to do this requires more cells.

Frequency of cell division varies by cell type

- embryo: cell cycle < 20 minute
- skin cells: divide frequently throughout life 12-24 hours cycle
- liver cells: retain ability to divide, but keep it in reserve M divide once every year or two metaphase anaphase prophase telophase
- mature nerve cells & muscle cells G2 C: do not divide at all after maturity permanently in G0
Phases of Cell cycle

Cell cycle has two parts:
1. growth and preparation (interphase)
2. cell division
   A. mitosis (nuclear division)
   B. cytokinesis (cytoplasm division)

The largest part of the cell cycle is called "interphase".

1-Interphase Interphase is the time between cell divisions. It is a period of growth that consists of the G0, G1, S, and G2 phases.

G0 PHASE
• G0 is a resting phase where the cell has left the cycle and has stopped dividing.
• The word "post-mitotic" is sometimes used to refer to both quiescent and senescent cells.
• Non-proliferative (non-dividing) cells in multicellular eukaryotes generally enter the quiescent G0 state from G1 and may remain quiescent for long periods of time, possibly indefinitely (as is often the case for neurons). This is very common for cells that are fully differentiated.

Cellular senescence occurs in response to DNA damage and external stress 
that would make a cell's progeny nonviable; it is often a biochemical alternative to the self-destruction of such a damaged cell by apoptosis.
**G₁ Phase: Cell Growth**
In the G₁ phase, cells increase in size and synthesize new proteins and organelles.

**S Phase: DNA Replication**
In the S (or synthesis) phase, new DNA is synthesized when the chromosomes are replicated.

**G₂ Phase: Preparing for Cell Division**
In the G₂ phase, many of the organelles and molecules required for cell division are produced.

**2- Cell division**

- **A- mitosis (nuclear division)**

  - **Prophase**
  During prophase, the first phase of mitosis, the duplicated chromosome condenses and becomes visible.
  The centrioles move to opposite sides of nucleus and help organize the spindle.
  The spindle forms and DNA strands attach at a point called their centromere.
  The nucleolus disappears and nuclear envelope breaks down.

  - **Metaphase**
  During metaphase, the second phase of mitosis, the centromeres of the duplicated chromosomes line up across the center of the cell.
  The spindle fibers connect the centromere of each chromosome to the two poles of the spindle.
**Anaphase**
Spindle threads shorten, causing each centromere to break, separating each sister chromatid • The separated chromatids (now called chromosomes) are pulled to opposite poles.

**Telophase**
During telophase, the fourth and final phase of mitosis, the chromosomes spread out into a tangle of chromatin. A nuclear envelope re-forms around each cluster of chromosomes. The spindle breaks apart, and a nucleolus becomes visible in each daughter nucleus.

**B- Cytokinesis**
is the final stage of cell division in
During cytokinesis, the cytoplasm splits in two and the cell divides
In animal cells, the plasma membrane of the parent cell pinches inward along the cell’s equator until two daughter cells form.
In plant cells, a cell plate forms along the equator of the parent cell. Then, a new plasma membrane and cell wall form along each side of the cell plate
Cell Cycle Stages in an Onion Root Tip

1. Interphase

2. Prophase

3. Metaphase

4. Anaphase

5. Telophase

Cytokinesis

wiseGEEK
Muscle Tissue

Muscle tissue: is made up of excitable cells that are long and fibrous. It often called muscle fibers. They contain proteins actin and myosin which allow them to contract.

Muscular Tissue: A group of cells (fibers) specialized to produce motion in response to muscle action potentials by its qualities of contractility, extensibility, elasticity and excitability.

Without these muscles, nothing in the body would move and no body movement would occur.

Muscle tissue one of four primary tissue types, divided into:

- Skeletal muscle: which is striated and voluntary
- Cardiac muscle: which is striated and involuntary
- Smooth muscle: which is non-striated and involuntary

Muscle tissue has four main properties:

1. Excitability - ability to respond to stimuli.
2. Contractibility - ability to contract.
3. Extensibility - ability of a muscle to be stretched without tearing.
4. Elasticity - ability to return to its normal shape.
1. **Skeletal Muscle**

Human body contains over 600 skeletal muscles, 40-50% of total body weight.

- which is striated and voluntary
- Characteristics of skeletal muscle
- Skeletal muscle cells are elongated or tubular.
- They have multiple nuclei and these nuclei are located on the periphery of the cell.
- Skeletal muscle is striated. That is, it has an alternating pattern of light and darks bands that.

**Functions of skeletal muscle**

1. Body movement (Locomotion)
2. Maintenance of posture
3. Respiration (Diaphragm and intercostal contractions)
4. Communication (Verbal and Facial)
5. Constriction of organs and vessels
   - Peristalsis of intestinal tract
   - Vasoconstriction of b.v. and other structures (pupils)
6. Production of body heat (Thermogenesis)

**Simplest level of skeletal muscle**

- Muscle fibres – multinuclear cells with large quantities of mitochondria.
- Muscle fibres consist of bundles of myofibrils, which are arranged into smaller myofilaments, which give muscle its stripy appearance.
- Sarcomere – repeating patterns of myofibrils
  - Light filaments (Actin)
  - Dark Filaments (Myosin)
2. Cardiac Muscle

Cardiac muscle cells or cardiomyocytes are the contracting cells that allow the heart to pump. Each cardiomyocyte needs to contract in coordination with its neighboring cells - known as a functional syncytium - working to efficiently pump blood from the heart, and if this coordination breaks down then – despite individual cells contracting – the heart may not pump at all, such as may occur during abnormal heart rhythms such as ventricular fibrillation.

Cardiac muscle cells are not as long as skeletal muscles cells and often are branched cells. Cardiac muscle cells may be mononucleated or binucleated. In either case the nuclei are located centrally in the cell. Cardiac muscle is also striated. In addition cardiac muscle contains intercalated discs.

**Intercalated discs:** are unique structural formations found between the myocardial cells of the heart. They play vital roles in bonding cardiac muscle cells together and in transmitting signals between cells.
**Cardiac Muscle**
- Branching cells
- Contain intercalated discs
- One or two nuclei per cell
- Striated
- Involuntary
- Medium speed contractions

**3. Smooth Muscle**

Smooth muscle cell are described as spindle shaped. That is they are wide in the middle and narrow to almost a point at both ends. Smooth muscle cells have a single centrally located nucleus. Smooth muscle cells do not have visible striations although they do contain the same contractile proteins as skeletal and cardiac muscle, these proteins are just laid out in a different pattern.

**Smooth Muscle**
- spindle cells
- One nucleus per cell
- Nonstriated
- Involuntary
- Slow, wave-like contractions
Nervous Tissue

Nervous tissue: is the term for groups of organized cells in the nervous system, which is the organ system that controls the body’s movements, sends and carries signals to and from the different parts of the body, and has a role in controlling bodily functions such as digestion.

Neurons: are the basic functional units of nervous tissue.

They are highly specialized to transmit nerve impulses.

Nervous Tissue consists of two main cell types: -

A. neurons - sensory control, and regulation
B. neuroglia - support, protection, and homeostasis

A. neurons

Parts of a Neuron

1. cell body
2. dendrites
3. axon

1. Cell body:
   - contains nucleus, surrounded by granular cytoplasm contains organelles (i.e., lysosomes, mitochondria, Golgi complex, etc.).
   - Nissl bodies (chromatophilic substance).
   - arrangement of rough endoplasmic reticulum (site of protein synthesis).
2. Dendrites (neurons usually contain many).
   - highly branched processes.
- extend out from cell body and receive stimuli.
- carry a nerve impulse toward the cell body.

3. **Neurons** (contain only one).
   - Axon long, thin, cylindrical projection
   - contains mitochondria and neurofibrils
   - surrounded by axolemma (lemma = sheath or husk)
   - carries a nerve impulse away to other cells (nerves, muscles, glands)

**B. Neuroglia**
- Neuroglia constitute one-half of volume of CNS
- outnumber neurons 5-50 times
- can multiply and divide, unlike neurons
- Functions: - nerve glue - supports - insulates – protects
- Types of Neuroglial Cells (astrocytes, oligodendrocytes, microglia, ependymal cells, Schwann cells, satellite cells)

- **Neuron Classification**
  I. **structural classification** - based on number of processes extending from cell body
  1. **Unipolar:** (pseudounipolar)
     - have a single process extending from cell body, always are sensory neurons, found in embryo.
  2. **Bipolar:** have one dendrite and one axon - found in retina, internal ear, and olfactory area of brain
  3. **Multipolar:** several dendrites and one axon - most neurons in brain and spinal cord are of this type
II. **Functional Classification**

based on the direction in which a neuron transmits a nerve impulse

Two types of neurons in PNS: -

1. **Afferent** carry impulses (sensory information) toward CNS
   - also known as sensory neurons
2. **Efferent** carry impulses away from CNS
   - affect activity of muscles or glands
   - also known as motor neurons

Sensory ➔ Afferent ➔ Motor ➔ Efferent

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**Nervous System:**

Structural Organization Structural subdivisions of the nervous system:

1. **Central nervous system (CNS):**-
   a) Brain.
   b) Spinal cord.
2. **Peripheral nervous system (PNS)**
   a) Cranial nerves (nerves that extend from the brain).
   b) Spinal nerves (nerves that extend from the spinal cord).
   c) Ganglia (clusters of neuron cell bodies (somas) located outside the CNS).
MEIOSIS

Organisms that reproduce sexually are made up of two different types of cells.

A. Somatic Cells are “body” cells and contain the normal number of chromosomes … called the “Diploid” number (the symbol is 2n). Examples would be … skin cells, brain cells, etc.

B. Gametes are the “sex” cells and contain only half the normal number of chromosomes …. called the “Haploid” number (the symbol is n)….. Sperm cells and ova are gametes.

Meiosis: The type of cell division by which gametes with half the number of chromosomes, are produced.

Meiosis: is a cell division process where a single (parent) cell divides twice to produce four independent (daughter) cells, each having half the chromosomes as the original cell.

- Meiosis occur in Sex cells
- Sex cells divide to produce gametes (sperm or egg).
- The Male Gamete is the Sperm and is produced in the male gonad the Testes. called spermatogenesis
- The Female Gamete is the Ovum and is produced in the female gonad the Ovaries. called oogenesis

Meiosis is two cell divisions

- meiosis I
- meiosis II
**Meiosis I**

- Cell division that reduces the chromosome number by one-half.

**Interphase I**

- Similar to mitosis interphase.
- Chromosomes replicate (S phase).
- Each duplicated chromosome consist of two identical sister chromatids attached at their centromeres. Centromeres
- Centriole pairs also replicate.
Prophase I

Longest and most complex phase (90%).

- Chromosomes condense.
- **Synapsis occurs:** homologous chromosomes come together to form a tetrad.
- **Tetrad:** is two chromosomes or four chromatids (sister and nonsister chromatids).
- **Homologous chromosome:** one of a pair of chromosomes with the same gene sequence, loci, chromosomal length, and centromere location.

Crossing over

- Crossing over involves the exchange of segments of DNA between homologous chromosomes during Prophase I of meiosis.
- The process of crossing over occurs as follows:
- Homologous chromosomes become connected in a process called synapsis, forming a bivalent (or tetrad).
- Non-sister chromatids break and recombine with their homologous partner, effectively exchanging genetic material (crossing over).
- The non-sister chromatids remain connected in an X-shaped structure and the positions of attachment are called chiasmata.
- Chiasma hold homologous chromosomes together as a bivalent until anaphase I.
- As a result of crossing over, chromatids may consist of a combination of DNA derived from both homologues - these are called recombinants.
by the end of **prophase I**
the spindle has formed
the nuclear membrane has
vesicularized
nucleoli have disintegrated
homologous chromosomes are
attached by their kinetochores to
spindle fibers from opposite poles
homologous chromosomes are
held together only at chiasmata,
the sites where crossing-over occurred
➤ **Metaphase I**
Homologous chromosomes align along the center of the cell.
The centrioles reach the opposite poles of the cell with the spindle fibers extending from them.
The centromeres orient themselves towards the opposite poles of the cell.

➤ **Anaphase I:**
Spindle fibres contract and split the bivalent, homologous chromosomes move to opposite poles of the cell.

- **Telophase I:**
Chromosomes decondense, nuclear membranes may reform,
- **cytokinesis**
  cell divides forming two haploid daughter cells

- **Interkinesis**: An optional rest period between meiosis I and meiosis II, no DNA replication occurs in this stage

---

**Meiosis II**

- **Prophase II:**
  Chromosomes condense, nuclear membrane dissolves (if reformed), centrioles move to opposite poles (perpendicular to previous poles)

- **Metaphase II:**
  Spindle fibres from centrioles attach to centromeres of chromosomes, chromosomes line up along the equator of the cell
- **Anaphase II**: Spindle fibres contract and split the chromosome into sister chromatids, chromatids (now called chromosomes) move to opposite poles.

- **Telophase II**: Chromosomes decondense, nuclear membrane reforms, cytokinesis - cells divide resulting in four haploid daughter cells.

- **Fertilization**: The fusion of a sperm and egg to form a zygote. A zygote is a fertilized egg sperm.
Prophase I:
- Each chromosome consists of two chromatids.
- Homologous chromosomes synapse, and crossing over takes place.
- Nuclear envelope breaks down.

Metaphase I:
- Homologous chromosomes line up in pairs along midplane.
- Spindle microtubules.

Anaphase I:
- Homologous chromosomes separate and move to opposite poles.
- Note that sister chromatids remain attached at their centromeres.

Telophase I:
- Cell plate.
- New nuclei.
- One of each pair of homologous chromosomes is at each pole. Cytokinesis occurs.

Prophase II:
- Chromosomes condense again.

Metaphase II:
- Chromosomes line up along midplane.
- Spindle microtubules.

Anaphase II:
- Sister chromatids separate, and chromosomes move to opposite poles.

Telophase II:
- Nuclei form at opposite poles. Cytokinesis occurs.
Monera kingdom-bacteria-prokaryotic-organisms, also called germs,

**Bacteria:** are microscopic organisms not visible with the naked eye. Bacteria are everywhere, both inside and outside of your body. Bacteria can live in a variety of environments, from hot water to ice. Some bacteria are good for you, while others can make you sick.

**Bacteria:** are single-celled, or simple, organisms. Though small, bacteria are powerful and complex, and they can survive in extreme conditions. Bacteria have a tough protective coating that boosts their resistance to white blood cells in the body.

### Bacteria Characteristics

1. Bacteria are prokaryotic cells.
2. Unicellular.
3. They are 1-10 um in length (much smaller than eukaryotic cells).
4. No membrane bound organelles in cytoplasm, Except for ribosomes.
5. Lack a defined nucleus, Single circular chromosome.
6. Reproduces by binary fission (splitting in two).
7. Most have a cell wall, cell wall may be surrounded by a capsule.
Prokaryotic cells lack organelles found in eukaryotic cells such as mitochondria, endoplasmic reticular, and Golgi complexes. According to Theory, eukaryotic organelles are thought to have evolved from prokaryotic cells living in endosymbiotic relationships with one another.

1. **Capsule**: It is a polysaccharide layer that lies outside the cell envelope found in some bacterial cells, this additional outer covering protects the cell when it is engulfed by other organisms, assists in retaining moisture, and helps the cell adhere to surfaces and nutrients.

2. **Cell Wall**: The cell wall is an outer covering that protects the bacterial cell and gives it shape.

3. **Cell Membrane or Plasma Membrane**: The cell membrane surrounds the cell's cytoplasm and regulates the flow of substances in and out of the cell.

4. **Cytoplasm**: Cytoplasm is a gel-like substance composed mainly of water that also contains enzymes, salts, cell components, and various organic molecules.

5. **Ribosomes**: Ribosomes are cell structures responsible for protein production.

6. **Nucleoid Region**: Area of the cytoplasm that contains the single bacterial DNA molecule.

7. **Plasmids**: Plasmids are gene-carrying, circular DNA structures that are not involved in reproduction.
8. **Pili (Pilus singular):** Hair-like structures on the surface of the cell that attach to other bacterial cells. Shorter pili called fimbriae help bacteria attach to surfaces.

9. **Flagella:** are long, thin (about 20 nm), whip-like appendages that move the bacteria towards nutrients and other attractants. Flagella are free at one end and attached to the cell at the other end. Flagellum can never be seen directly with the light microscope but only after staining with special flagella stains that increase their diameter. Flagella can be seen easily with the electron microscope.

**Arrangement and Types**

a) **Monotrichous (Mono means one):** Single polar flagellum  
   e.g. *Vibrio cholerae*.

b) **Lophotrichous:** Tuft of flagella at one or both ends  
   e.g. *Spirilla spp*.

c) **Peritrichous (flagella in the periphery):** Flagella surrounding the bacterial cell.  
   e.g. *E coli*.

d) **Amphitrichous:** Single flagellum at both ends  
   e.g. *Alcaligenes faecalis*.

**Spore**

Some bacteria have the ability to form highly resistant resting stage called spores, which helps them to overcome adverse environmental conditions that are unfavorable for vegetative growth of cell.
Classification of Bacteria

Bacteria can be classified into various categories based on their features and characteristics. The classification of bacteria is mainly based on the following:

1. **Mode of respiration**
   a) Anaerobic Bacteria  Actinomyces
   b) Aerobic Bacteria  Mycobacterium
   c)

2. **Mode of nutrition**
   a) Autotrophic Bacteria  Cyanobacteria
   b) Heterotrophic Bacteria  All disease-causing bacteria

3. **Composition of the cell wall (STAINING OF BACTERIA).**
   a) Peptidoglycan cell wall  Gram-positive bacteria
   b) Lipopolysaccharide cell wall  Gram-negative bacteria

4. **Morphology of bacteria (SHAPE)**
   a) **Cocci**

   The bacteria that are oval or spherical in shape are included called cocci bacteria. These may either remain single or attached to one another in groups.

   e.g.  *Streptococcus pneumoniae*

   Cocci bacteria can be arranged either singly, in pairs, in groups of four, in chains, in clusters or cubes consisting of eight cells. These cells remain attached during cell division.

   b) **Bacilli (Rod-shaped)**

   These are rod-shaped cells that also like cocci, remain either single or attached to other cells.

   Bacilli are the bacteria which are rod-shaped and are present as single cells , e.g. *Salmonella*

   Diplobacilli : Bacilli that remain in pairs after dividing.
Streptobacilli: Bacilli that remain arranged in end-to-end chains.

c) Spiral Bacteria

Vibrios: Bacteria that are curved or comma-shaped. *Vibrio cholerae*

Spirilla: Bacteria that have a helical shape and fairly rigid bodies.

Spirochetes: Bacteria that have a helical shape and flexible bodies.
**Bacteria Reproduction**

Bacteria, being single-celled prokaryotic organisms, do not have a male or female version.

**Binary Fission**

Bacteria reproduce through a process called binary fission. During binary fission, the chromosome copies itself, forming two genetically identical copies. Then, the cell enlarges and divides into two new daughter cells. The two daughter cells are identical to the parent cell. Binary fission can happen very rapidly. Some species of bacteria can double their population in less than ten minutes! This process makes it possible for a tremendous bacterial colony to start from a single cell.
**Gram staining:** (or Gram's method): is a method of differentiating bacterial species into two large groups Gram Positive Gram Negative. Gram staining differentiates bacteria by the chemical and physical properties of their cell walls.

**Peptidoglycan:** also known as murein, is a polymer consisting of sugars and amino acids that forms a mesh-like layer outside the cell membrane of most bacteria forming the cell wall.

**Structure of Peptidoglycan**

Two alternating amino sugars make up the crystal lattice structure of peptidoglycan; they are N-acetylglucosamine (shortened to NAG) and N-acetylmuramic acid (shortened to NAM). Amino sugars are sugar molecules that have an amine group (-NH2) replacing one of their hydroxyl groups. Each NAM molecule has an attached chain of four or five amino acids. Crosslinking between these amino acids gives peptidoglycan its strong structure.

**The important difference between gram-positive and gram-negative bacteria in tabular form.**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Gram-positive bacteria</th>
<th>Gram-negative bacteria</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cell Wall</td>
<td>A single-layered, smooth cell wall</td>
<td>A double-layered, wavy cell-wall</td>
</tr>
<tr>
<td>Cell Wall thickness</td>
<td>The thickness of the cell wall is 20 to 80 nanometres</td>
<td>The thickness of the cell wall is 8 to 10 nanometres</td>
</tr>
<tr>
<td>Peptidoglycan Layer</td>
<td>It is a thick layer/ also can be multi-layered.</td>
<td>It is a thin layer/ often single-layered.</td>
</tr>
<tr>
<td>---------------------</td>
<td>-----------------------------------------------</td>
<td>------------------------------------------</td>
</tr>
<tr>
<td>Teichoic acids</td>
<td>Teichoic acids are present.</td>
<td>Teichoic acids are not present.</td>
</tr>
<tr>
<td>Lipopolysaccharide</td>
<td>Lipopolysaccharide is not present.</td>
<td>Lipopolysaccharide is present.</td>
</tr>
<tr>
<td>Lipid content</td>
<td>The Lipid content is very low.</td>
<td>The Lipid content is 20% to 30%.</td>
</tr>
<tr>
<td>Color staining</td>
<td>They retain the color of crystal violet and stain dark blue or purple.</td>
<td>They take the color Safranin and staining red or pink</td>
</tr>
<tr>
<td>Resistance to Antibiotic</td>
<td>These are very susceptible to antibiotics.</td>
<td>These are very resistant to antibiotics.</td>
</tr>
</tbody>
</table>
REAGENTS USED IN GRAM STAIN


Principle of Gram staining
**Crystal violet (CV)** dissociates into CV+ and Cl– ions in aqueous solutions. These ions penetrate through the cell wall and cell membrane of both Gram-positive and Gram-negative cells. The CV+ ion interacts with negatively charged components of bacterial cells and stains the cells purple.

**Iodine (I)**, used as mordant interacts with CV+ and forms large complexes of crystal violet and iodine (CV–I) within the inner and outer layers of the cell.

When a **decolorizer** such as alcohol or acetone is added, it interacts with the lipids of the cell membrane. Since Gram negative organism have thin peptidoglycan layer (1-2 layers) and have additional lipopolysaccharide layer which gets dissolved due to the addition of alcohol, so gram negative organism fails to retain the complex and gets decolorized as the complex is washed away.

In contrast, a Gram-positive cell becomes dehydrated from an ethanol treatment. This closes the pores in the cell wall and prevents the stain from exiting the cell. The large CV–I complexes become trapped within the Gram-positive cell also due to the thick and multilayered (40 layers) nature of its peptidoglycan.

After decolorization, the Gram-positive cell remains purple and the Gram-negative cell loses its purple color. Counterstain, which is usually positively-charged **safranin** or basic fuchsin, is applied last to give decolorized Gram-negative bacteria a pink or red color.
**Sterilization & Disinfection**

**Prepared by**
Asst. Lec. Marwa bader falih

**Sterilization**: is defined as the process by which a surface or medium is free of all living microorganisms.

**Disinfection**: means the destruction or removal of all pathogenic organisms or organisms capable of giving rise to infection. (Disinfection can be done by chemica)

**Antisepsis**: Reduction or inhibition of microbes found on living tissue like wounds.

**Anticeptics**: Chemical disinfectants which can be safely applied to the skin or mucous membrane and are used to prevent infection by inhibiting the growth of bacteria are called antiseptics.

**Methods of Sterilization & Disinfection**

A. Physical methods.
B. Chemical Methods.

A. **Physical methods.**

- Heat
  - Dry heat
    - Red heat
    - Flaming
    - Incineration
    - Hot air oven
  - Moist heat
    - Temperature below 100°C
    - Temperature at 100°C
    - Temperature above 100°C
- Radiation
  - Non ionizing
  - Infrared
  - Ultraviolet
- Ionizing
  - X-rays
  - Gamma rays
1. Heat:
these methods divided in to:
A: Dry-heat
  1. Red hot:
     - Exposure of wires and forceps to the Bunsen flame until it becomes red hot, then cool down and use.
     - Used for loop, forceps, and metal rods.

2. Flaming:
   - Slowly passing of an objects to the Bunsen flame will reduce the number of microorganisms.
   - Used for sterilization of the mouth of bottle, flasks, containers and test tubes, smear slides etc.

3. Hot air oven:
   - Instruments consist of heater, oven.
   - Used for sand, powder, metal, glass
A. Moist heat: moist air can be divided into 3 groups:

1. Temperature below 100 °C: (pasteurization of milk; holding period 63 °C for 30 minutes, or 72 °C for 15-20 minutes followed by cooling quickly to 13 °C. This process targets all non-sporing pathogens)

2. Temperature at 100 °C: (boiling 5-10 min kills all non-spore-forming bacteria).

3. Temperature above 100 °C: steam under pressure
   Autoclave/steam sterilizers: this means that all bacteria, viruses, fungi, and spores are inactivated by 134 °C for 3 minutes or 121 °C for 15 minutes. This happens when water boils when its vapor pressure equals the surrounding atmosphere. Thus, when pressure inside closed vessels increases, the temperature at which water boils increases too.
2. **Radiation sterilization**

Sterilization by radiation kills microbes by causing mutation to the cellular protein and disrupting cellular elements. The main difference between different radiation types is their penetration and their effectiveness.

- **Types of radiation:**
  1. Non Ionizing
  2. Ionizing

<table>
<thead>
<tr>
<th>Non Ionizing</th>
<th>Ionizing</th>
</tr>
</thead>
<tbody>
<tr>
<td>E.g.: UV (Ultraviolet)</td>
<td>E.g.: X-rays and gamma rays</td>
</tr>
<tr>
<td>have low penetration and thus are less</td>
<td>have far more penetrating power and thus are more effective for sterilization on a large scale. But its more dangerous and thus needs special attention.</td>
</tr>
<tr>
<td>effective, but it is safe and can be used for small area sterilization.</td>
<td></td>
</tr>
<tr>
<td>used to sterilize the interiors of biological safety cabinets between uses</td>
<td>X-rays used for sterilizing large packages of medical devices.</td>
</tr>
<tr>
<td>Operating Rooms and T.B. laboratories.</td>
<td>Gamma rays is commonly used for sterilization of most medical disposables (syringes, needles).</td>
</tr>
</tbody>
</table>

**biological safety cabinets**

**ultraviolet**
3. Filtration

Filtration is used for the removal of microbes from solutions that cannot easily be treated in other ways. Typically heat-sensitive compounds such as antibiotics and vitamins are filtered before addition to sterile cool media.

There are three types of filters.
1. Depth filters.
2. Membrane Filters.
3. Air filters.
B. Chemical Methods.

Chemical Sterilization

Chemicals are able to inhibit and kill microbial growth.

Ex: Disinfectants are those chemicals that destroy pathogenic bacteria from specified surfaces.

- The level of disinfection achieved depends on contact time, temperature, type and concentration of the active ingredient,
- Some chemical have very narrow spectrum of activity and some have very wide.

Kinds of Chemical Disinfectants:

- Alcohol
- Ethyl, isopropyl
- Aldehydes
- Formaldehyde
- Phenols
- Gases: ethylene oxide
Introduction:
Many scientists contributed by their studies to develop cytology such as:

1. Antonie van. leevenhock (1632-1723) who discovered the microscope, he was the first one showed the cell by his microscope.

2. Robert Hooke (1635-1703), was the first one who used the item cell and define it as air chamber like the cavity of honey bees wax.

3. Robert brown (1831) discovered the nucleus of the cell.

4. Mathias schleidin, 1838, indicated that all plants bodies consist of cells.

5. Theodor schwann, 1839, He indicated that all animals bodies consist of cells.

Cell theory:
Cell theory, according to findings of M.Schleidin and T.Schwann, considered as:

1. All living organisms consist of cells.

2. The cells are the structural and functional units of living organisms.

3. Cells are produced from other cells by division.

The cell is the structural unit of all living organisms.
There are two types of cells according to their structure, the first one is prokaryotic cells, such as in bacteria and blue-green algae cells, which without envelope or nuclear membrane and membranous organelles, and the second are eukaryotic cells, which with nucleus surrounded by nuclear envelope and cell organelles.
Biology

Biology is a natural science concerned with the study of life and living organisms, including their structure, function, growth, evolution, distribution, and taxonomy.

How to Define Life

There are some characteristics that distinguish living and non-living things.

1. Organization: Being structurally composed of one or more of cells which is the basic units of life. Organisms are organized from atoms up to cells. The matter is structured in an ordered way. Atoms are arranged into molecules, then into macromolecules, which make up organelles, which work together to form cells. Beyond this, cells are organized in higher levels to form entire multicellular organisms.

2. Homeostasis: Regulation of the internal environment to maintain a constant state. Stable internal conditions of pH, temperature, water balance, etc. for example, sweating to reduce temperature.

3. Metabolism: Refers to the sum of the total chemical processes that occur in a cell or organism that are necessary for life.

4. These processes can be classified into anabolic and catabolic processes.

5. Growth and Development: Growth means that organism increases in size and number. Development refers to all changes that occur during life.

6. Adaptation: The ability to change over time in response to the environment. This ability is fundamental to the process of evolution and is determined by the organism's heredity.

7. Response to stimuli: Organisms respond to stimuli (Temperature, Water, Food Supplies, etc.) in order to survive & reproduce.

8. Reproduction: The ability to produce new individual organisms, either asexually from a single parent organism, or sexually from two parent organisms.
Water is essential for life:

Water is the most abundant molecule in cells, accounting for 70% or more of total cell mass. The total amount of water in our body is found in three main locations: within our cells (two-thirds of the water), in the space between our cells and in our blood (one-third of the water).

Water serves a number of essential functions in the body:

- It regulates our internal body temperature by sweating and respiration.
- The carbohydrates and proteins that our bodies use as food are metabolized and transported by water in the bloodstream.
- Water is used to flush waste and toxins from the body via urine.
- Forms saliva.
- Lubricates joints.

Water has a number of important properties essential for life.

Water (H₂O) is a polar molecule because of a slightly negative charge at the oxygen end and a slightly positive charge at the hydrogen end. Water molecules can form hydrogen bonds with each other. Polar substances are hydrophilic (water loving). Nonpolar substances are hydrophobic (water hating) and are repelled by water.

- **Solvent**: it is a very good solvent. Molecules such as salts, sugars, amino acids dissolve readily in water (once dissolved they can be transported e.g. glucose in the blood).
- **Water has a high specific heat capacity**: This means that water does not change temperature easily. This minimises fluctuations in temperature inside cells.
- **Latent heat of vaporization**: Water requires a lot of energy to change state from a liquid to a gas, providing a cooling mechanism (sweating). As water evaporates it extracts heats from the surrounding area, cooling the organism.
- **Density**: The solid state of water (ice) is less dense than the liquid state. As the air temperature cools, bodies of water freeze from the surface, forming a layer of ice with the liquid beneath. This allows aquatic ecosystem to exist in low temperatures.
Water molecules due to hydrogen bonds stick together, and to other biologically important polar molecules.

**pH scale**

A scale ranging from 0 to 14 pH units, reflecting the concentration of hydrogen ions in solution. A solution with a pH of 7.0 is neutral. Solutions with a lower pH value (<7.0) are increasingly acidic, and those with a higher pH value (>7.0) are increasingly alkaline.

<table>
<thead>
<tr>
<th><strong>pH in living systems</strong></th>
<th>pH</th>
</tr>
</thead>
<tbody>
<tr>
<td>Compartments</td>
<td>pH</td>
</tr>
<tr>
<td>Gastric acid</td>
<td>1</td>
</tr>
<tr>
<td>Lysosomes</td>
<td>4.5</td>
</tr>
<tr>
<td>Human skin</td>
<td>5.5</td>
</tr>
<tr>
<td>Urine</td>
<td>6.0</td>
</tr>
<tr>
<td>Cytosol</td>
<td>7.2</td>
</tr>
<tr>
<td>Cerebrospinal fluid</td>
<td>7.5</td>
</tr>
<tr>
<td>Blood</td>
<td>7.34–7.45</td>
</tr>
<tr>
<td>Mitochondrial matrix</td>
<td>7.5</td>
</tr>
<tr>
<td>Pancreas secret</td>
<td>8.1</td>
</tr>
</tbody>
</table>

**Buffers**

A buffer is a substance that helps minimize the change in the pH of a solution when acids or bases are added. This is important because, most of the chemical processes that occur in living organisms are highly sensitive to pH, and drastic changes in pH can cause some serious trouble.
Divisions of biology

Biology is divided into

1- Zoology: the study animal behavior, structure, physiology, classification and distribution
2- Botany: the study of plant
3- Microbiology: the study of microscopic organism (unicellular, multi-cellular)
   a- Bacteriology: the study of bacteria
   b- Virology: the study of viruses
4- Anatomy: the study of structure of organisms including their system, organs and tissues.
5- Biochemistry: concerned with the chemical processes that occur within living organisms
6- Radiobiology: the study of the action of ionizing radiation on living things
7- Physiology: it deals with the normal function of the living organisms and their parts
8- Phycology: the study of algae
9- Cell biology: the study of cell structure and function
10- Photobiology: it studies the interaction between light and living organism.
11- Parasitology: the study of parasites and their hosts and the relation between them.
12- Mycology: the scientific study of fungi.
13- Molecular biology: is the study that deals with structure and function of proteins and nucleic acids
14- Immunology: the study of immunity.
15- Genetics: the study of genes, genetic variation and heredity in living organisms.
16- Ecology: it includes the relation of organisms to one another and to their physical surrounding.
Prokaryotic and Eukaryotic Cells

Cells are of two types, eukaryotic, which contain a nucleus, and prokaryotic, which do not. Prokaryotes are single-celled organisms, while eukaryotes can be either single-celled or multicellular.

The distinction between prokaryotes and eukaryotes is considered to be the most important distinction among groups of organisms. Eukaryotic cells contain membrane-bound organelles, such as the nucleus, while prokaryotic cells do not.

Comparison between prokaryotic and eukaryotic cells.

Similarities:

- They both have DNA as their genetic material.
- They are both membrane bound.
- They both have ribosomes.
- They have similar basic metabolism.

Differences:

1. Eukaryotes have a nucleus, while prokaryotes do not.
2. Eukaryotes have membrane-bound organelles, while prokaryotes do not.
3. Eukaryotic cells are, on average, ten times the size of prokaryotic cells.
4. The DNA of eukaryotes is much more complex and therefore much more extensive than the DNA of prokaryotes.
5. Prokaryotes have a cell wall composed of peptidoglycan, a single large polymer of amino acids and sugar. Many types of eukaryotic cells also have cell walls, but none made of peptidoglycan.
6. The DNA of prokaryotes floats freely around the cell; the DNA of eukaryotes is held within its nucleus and associated with histones (proteins).
7. Eukaryotes undergo mitosis; prokaryotes divide by binary fission (simple cell division).
<table>
<thead>
<tr>
<th>Features</th>
<th>Prokaryotes</th>
<th>Eukaryotes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Typical organisms</td>
<td>Bacteria</td>
<td>Plants, animals</td>
</tr>
<tr>
<td>Typical size</td>
<td>~1-5 μm</td>
<td>~10-100 μm</td>
</tr>
<tr>
<td>Type of nucleus</td>
<td>Nucleoid region; no true nucleus</td>
<td>True nucleus with double membrane</td>
</tr>
<tr>
<td>DNA</td>
<td>Circular (usually)</td>
<td>Linear molecules (chromosomes) with histone and nonhistone proteins</td>
</tr>
<tr>
<td>RNA/protein synthesis</td>
<td>Coupled in the cytoplasm</td>
<td>RNA synthesis in the nucleus protein synthesis in the cytoplasm</td>
</tr>
<tr>
<td>Cytoplasmic structure</td>
<td>Very few structures</td>
<td>Highly structured by endomembranes and a cytoskeleton</td>
</tr>
<tr>
<td>Cell movement</td>
<td>Flagella made of flagellin</td>
<td>Flagella and cilia containing microtubules Lamellipodia and filopodia containing actin</td>
</tr>
<tr>
<td>Mitochondria</td>
<td>none</td>
<td>One to several thousand</td>
</tr>
<tr>
<td>Chloroplasts</td>
<td>None</td>
<td>In algae and plants</td>
</tr>
<tr>
<td>Organization</td>
<td>usually single cells</td>
<td>single cells, higher multicellular organisms with specialized cells</td>
</tr>
<tr>
<td>-------------------------------------</td>
<td>---------------------------------------------</td>
<td>---------------------------------------------------------------------</td>
</tr>
<tr>
<td>Cell division</td>
<td>binary fission (simple division)</td>
<td>mitosis and meiosis</td>
</tr>
<tr>
<td>Chromosomes</td>
<td>single chromosome</td>
<td>more than one chromosome</td>
</tr>
</tbody>
</table>
Diagram of an animal cell

Animal Cell Parts and Functions | Summary Table
<table>
<thead>
<tr>
<th>Organelle</th>
<th>Summary of Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cell membrane</td>
<td>• Protects the cell</td>
</tr>
<tr>
<td></td>
<td>• Controls the entry and exit of molecules</td>
</tr>
<tr>
<td></td>
<td>• Gives the cell a shape</td>
</tr>
<tr>
<td></td>
<td>• Adheres to neighboring cells to form tissue</td>
</tr>
<tr>
<td></td>
<td>• Helps the cell to communicate with the exterior</td>
</tr>
</tbody>
</table>
Structure of the cell membrane
<table>
<thead>
<tr>
<th>Cytoplasm &amp; Cytoskeleton</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>The cytoplasm holds water and nutrients</strong></td>
</tr>
<tr>
<td><strong>The cytoskeleton gives structural rigidity to cell</strong></td>
</tr>
<tr>
<td><strong>The cytoskeleton helps movement of organelles and chromosomes</strong></td>
</tr>
</tbody>
</table>
| Mitochondria | • Converts food we eat into energy we use
• Assist in cell growth, cell cycle and cellular death |

<table>
<thead>
<tr>
<th>Lysosomes</th>
<th>Peroxisomes</th>
</tr>
</thead>
</table>
| • Break down cellular waste into building blocks
• Destroy foreign invaders |
<p>| • Peroxisomes break down hydrogen peroxide – harmful |</p>
<table>
<thead>
<tr>
<th><strong>Vacuoles</strong></th>
<th><strong>Cilia</strong></th>
<th><strong>Flagellum</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>- Store food, water and waste</td>
<td>- Lung cells use cilia to move mucus out of the lungs</td>
<td>- A sperm cell uses its flagellum to swim through</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Diagram of a mitochondrion
<table>
<thead>
<tr>
<th>Nucleus</th>
<th>• Command center of the cell</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>• Duplicate and store genetic information</td>
</tr>
<tr>
<td></td>
<td>• Makes ribosomes</td>
</tr>
<tr>
<td></td>
<td>• Sends commands to ribosomes for protein synthesis</td>
</tr>
<tr>
<td>Ribosomes</td>
<td>• Protein synthesis</td>
</tr>
<tr>
<td>Smooth endoplasmic reticulum (ser)</td>
<td>Lipids synthesis</td>
</tr>
<tr>
<td>------------------------------------</td>
<td>-----------------</td>
</tr>
<tr>
<td>Rough Endoplasmic Reticulum (RER)</td>
<td>• Detoxification of alcohol and drugs</td>
</tr>
<tr>
<td></td>
<td>Summary of the function of the Rough ER:</td>
</tr>
<tr>
<td></td>
<td>• Protein synthesis</td>
</tr>
<tr>
<td></td>
<td>• Processes and packages proteins and transports them to other parts of the cell or outside the cell</td>
</tr>
</tbody>
</table>

Golgi apparatus
Golgi apparatus illustrating incoming and outgoing vesicles
Illustration of Smooth and Rough ER
Nucleolus contained within the cell nucleus
Animal Cell Parts and Functions | Details

The Cell Membrane

The cell membrane like the border control of the cell, controlling what comes in and what goes out.

The cell membrane also called the plasma membrane encloses the animal cell and its contents. It separates the inside of the cell from the outside. It is a selectively permeable membrane that monitors what enters and...
that monitors what enters and exits the cell.

The cell membrane is mostly made up of special proteins (membrane proteins) and lipids (phospholipid).

The phospholipids are arranged in a double layer – the Phospholipid Bilayer. The top and bottom of this double layer arrangement are hydrophilic (water-loving) while the inside of the double layer arrangement is hydrophobic (water-hating).
Mitochondria

The mitochondrion (singular) is the power house of the cell. It is responsible for converting the food that you eat into energy that your body can use. The energy that our body uses is called Adenosine Triphosphate (ATP). ATP is a super energized molecule that gives you the energy you need to function properly.

Mitochondria generate ATP from carbohydrates and fat and other fuels. They also assist in cell growth, cell cycle and cellular death.

A mitochondrion is a smooth oblong organelles with an outer smooth membrane and an inner membrane. The inner membrane has numerous infoldings called Cristae.
The Golgi Apparatus

The Golgi apparatus is the cell's shipping department. It processes and packages proteins and sends them out to where they are needed.

The Golgi apparatus is made up of stacks of membranous layers that are referred to as Golgi bodies. Golgi bodies create hormones from proteins. They can also combine proteins with carbohydrate to make other molecules such as snot (nasal mucus).

The golgi apparatus packages its products into sacs called vesicles. These sacs have membranes made of
phospholipid just like the cell membrane. These vesicles are then shipped to other parts of the cell or out of the cell.
Ribosomes

Ribosomes are tiny structures found floating around in the cytoplasm or attached to the ER. Ribosomes maybe small but are essential for the proper functioning of a cell. They are responsible for protein synthesis.

The Endoplasmic Reticulum (ER)

The ER is like a factory for the production of proteins and lipids. It also forms a network of tubes that carry substances around the cell. There are two types of ER; the rough ER and the smooth ER. They have slightly different structure and function.
The rough ER is called "rough" because it is studded ribosomes while the smooth ER is called "smooth" because it lacks ribosomes.

The Smooth ER contains enzymes that are involved in the creation of lipids. Other enzymes in the smooth ER help in the detoxification of drugs and alcohol.

Ribosomes attached to the Rough ER are responsible for protein synthesis. These ribosomes assemble amino acids into polypeptides. When synthesis is complete the ER packages the polypeptides in special vesicles and sends them
Lysosome & Peroxisome

Lysosomes are digestive sacs that contain enzymes to break down cellular waste or debris from outside the cell into new building material. Lysosomes break down big macro molecules into smaller molecules which can be used to nourish the cell. They also break down damaged organelles and destroy foreign invaders such as bacteria.

Peroxisomes are similar to Lysosomes in structure. They break down molecules by oxidative reaction and produces hydrogen peroxide – harmful compound. Peroxisomes break down the hydrogen peroxide to produce water. Or they may use the hydrogen peroxide to break
down other molecules. Peroxisomes are also involved in the synthesis of lipid and bile acid (liver cells).
Vacuole

Vacuoles are storage sacs filled with fluid. They store food, water and waste products. Vacuoles in animal cells are generally smaller than that in plant cells. Animal cells can have multiple small vacuoles while plant cells usually have a single large vacuole.

Cilia and Flagellum

Some animal cells have cilia or a flagellum. Cilia (singular is cilium) are hairlike processes that extend from the cell’s surface. Flagellum is a wipe-like tail that protrudes from the cell. Both cilia and flagella are made of small protein fibers known as microtubules. Some cells have neither cilia nor a flagellum. A
sperm cell has a flagellum. It uses its flagellum to propel itself through the female reproductive system.
The Nucleus

The nucleus is the command center of a cell. This is where most of the cell’s DNA is stored. It is enclosed in a double membrane. The double membrane has pores which allow the movement of molecules between the nucleus (Nucleoplasm) and the cytoplasm.

The Nucleolus is located inside the nucleus. The main function of the nucleolus is to make ribosomal RNA (rRNA). rRNA then combines with special proteins to form the basic units of ribosomes. Once these units are formed the nucleolus releases them out of the nuclear envelope where they will be fully assembled into ribosomes. The nucleus sends messages to the
ribosomes through messenger RNA, (mRNA). mRNA carry out orders from the nucleus to the rest of the cell.

Long strands of DNA in the nucleus combine with special protein to form long fibers called Chromatin. Chromatin is then used to make Chromosomes.

The number of chromosomes present in a cell depends on the species of animal. The human sperm and egg cell both have 23 chromosomes. The number of chromosomes found in all of the other body cells is 46.
Cell cycle and division

Why do cell divide? Cell divide for growth, repair and reproduction. Cell division is the process by which parent cells divided into two daughter cells. Cells division usually occurs as part of large cell cycle. In Eukaryotic, there are two distinct types of cell division:

1- Mitosis or Mitotic cell division: is a type of cell division which takes place during an organism's growth where the daughter cells containing exactly the same number of chromosomes as the parents cells.

2- Meiosis or Meiotic cell division: is second type of division which the daughter cells finish up with the half of the total number of chromosomes present is the parent chromosomes. This kind of division generally takes place in the formation of gametes.

MITOSIS

Mother cells give daughter cells by increase in number that is called cell division (Mitosis). However, genetically identical to each other. The process of mitosis is divided into stages, the stages are prophase, prometaphase, metaphase, anaphase and telophase. Mitosis occurs only in Eukaryotic cells, Prokaryotic divided by different process called binary division when mitosis begins the chromosomes condense and become visible. The stages are:
Prophase
- Chromosome condense
- Microtubules form
- The nuclear envelope break down

Metaphase
- Chromosomes are pulled to center of cell
- Line up along the metaphase plate

Anaphase
- Centromeres divide
- Spindle fibers pull one set of chromosomes to each pole
- Precise alignment is important in this phase

Telophase
- Nuclear envelope form around chromosomes
- Chromosomes uncoil
- Cytokinesis in animal cells pinching of plasma is occurred, this means ( cytoplasm division )

Cell cycle consist of:
  Phase 1, growth and synthesis
  Phase 2, Preparation for division
  Phase 3, includes the over lapping Process of mitosis and cytokinesis
  phase 4, DNA Synthesis phase
Prophase

- Chromosome condense
- Microtubules form
- The nuclear envelope breaks down

Metaphase

- Chromosomes are pulled to center of cell
- Line up along "metaphase plate"
Anaphase

- Centromeres divide
- Spindle fibers pull set of chromosome to each pole

Precise alignment is critical to division

Telophase

- Nuclear envelope forms around chromosomes
- Chromosomes uncoil
- Cytokinesis
  - animals - pinching of plasma
  - plants - elongates and the cell plate forms, future cell wall and cell membrane.
Meiosis:
is a specialized type of cell division that reduce
the chromosome number by half, creating four haploid cells
each genetically distinct from the parent cells that give rise
to them, this process occurs in all sexually reproduction
single cells and multi cellular eukaryote including animal,
plant and fungi.

In meiosis, DNA replication is followed by two round of
cell division to produce four daughter cells, each with half
the number of chromosomes as original parent cells, the
two meiosis division are known as meiosis 1 and meiosis II

Before meiosis begins, during S phase of the cell cycle the
DNA of each chromosome is replicated so that it consist
of two identical sister chromatids which remain held
together through sister chromatid cohesion.

Because the number of chromosomes is halved during
meiosis, gametes can fuse in fertilization to form diploid
zygote.

Diploid human cells contain 23 pairs of
chromosomes including I pair of sex chromosomes (46
total) half of maternal origin and half of paternal origin.
Meiosis produces haploid gametes ova or sperm that
contain one set 23 chromosomes when egg and sperm fuse
the resulting zygotes.
Phases of Meiosis

- A diploid cell replicates its chromosomes
- Two stages of meiosis
  
  Meiosis I and Meiosis II
  Only 1 replication

Meiosis I
Prophase I

- Chromosomes condense
  - Homologous chromosomes pair with other
  - Each pair contains four sister chromatids - tetrad

Metaphase I

- Tetrads or homologous chromosomes move to center of cell
### Anaphase I

- Homologous chromosomes pulled to opposite poles

### Telophase I

- Daughter nuclei formed
- These are haploid (1n)
• Daughter cells undergo a second division; much like mitosis

• **NO ADDITIONAL REPLICATION OCCURS**

---

**Meiosis II**

**Prophase II**

• Spindle fibers form again

---

The chromosomes condense again, following a brief interphase in which DNA does not replicate.
Metaphase II

- Sister chromatids move to the center

Anaphase II

- Centromeres split
- Individual chromosomes are pulled to poles
Telophase II & Cytokinesis

- Four haploid daughter cells result from one original diploid cell

Review Mitosis & Meiosis

Both are forms of nuclear division
Both involve replication
Both involve disappearance of the nucleus, and nucleolus, nuclear membrane
Both involve formation of spindle fibers
Differences

Meiosis produces daughter cells that have $1/2$ the number of chromosomes as the parent. Go from $2n$ to $1n$.

Daughter cells produced by meiosis are not genetically identical to one another.

In meiosis cell division takes place twice but replication occurs only once.

Value of Variation

- **Variation** - differences between members of a population.
- Meiosis results in *random separation* of chromosomes in gametes.
- Causes *diverse populations* that over time can be stronger for survival.
Connective tissue

Connective tissue is one of the four basic types of animal tissue, along with epithelial tissue, muscle tissue, and nervous tissue. It develops from the mesoderm. Connective tissue is found in between other tissues everywhere in the body, including the nervous system. In the central nervous system, the three outer membranes (the meninges) that envelop the brain and spinal cord are composed of connective tissue. All connective tissue consists of three main
components: fibers (elastic and collagenous fibers), ground substance and cells. Not all authorities include blood or lymph as connective tissue because they lack the fiber component. All are immersed in the body water. The cells of connective tissue include fibroblasts, adipocytes, macrophages, mast cells and leucocytes.
Section of **epididymis**. Connective tissue (blue) is seen supporting the **epithelium** (purple).

The term "connective tissue" (in German, *Bindegewebe*) was introduced in 1830 by **Johannes Peter Müller**. The tissue was already recognized as a distinct class in the 18th century.\[3\]\[4\]
Connective tissue can be broadly classified into **connective tissue proper** and **special connective tissue**. [5][6]

Connective tissue proper consists of
loose connective tissue and dense connective tissue (which is further subdivided into dense regular and dense irregular connective tissues.)[^7] Loose and dense connective tissue are distinguished by the ratio of ground substance to fibrous tissue. Loose connective tissue has much more ground substance and a relative lack of fibrous tissue, while the reverse is true of dense connective tissue. Dense regular connective tissue, found in structures such as tendons and ligaments, is characterized by collagen fibers arranged in an orderly parallel fashion, giving it tensile strength in one direction. Dense irregular connective tissue provides
strength in multiple directions by its dense bundles of fibers arranged in all directions.

Special connective tissue consists of reticular connective tissue, adipose tissue, cartilage, bone, and blood. Other kinds of connective tissues include fibrous, elastic, and lymphoid connective tissues. Fibroareolar tissue is a mix of fibrous and areolar tissue. Fibromuscular tissue is made up of fibrous tissue and muscular tissue. New vascularised connective tissue that forms in the process of wound healing is termed granulation tissue.
Type I collagen is present in many forms of connective tissue, and makes up about 25% of the total protein content of the mammalian body.\cite{12}

**Characteristics**

Ground substance is a clear, colorless, and viscous fluid containing glycosaminoglycans and proteoglycans to fix the collagen fibers in the intercellular spaces. Examples of non-fibrous connective tissue include adipose tissue and blood. Adipose tissue gives "mechanical cushioning" to the body, among other functions.\cite{13,14} Although there is no dense collagen network in
adipose tissue, groups of adipose cells are kept together by collagen fibers and collagen sheets in order to keep fat tissue under compression in place (for example, the sole of the foot). Both the ground substance and proteins (fibers) create the matrix for connective tissue.

Types of fibers:

<table>
<thead>
<tr>
<th>Tissue</th>
<th>Purpose</th>
<th>Components</th>
<th>Location</th>
</tr>
</thead>
<tbody>
<tr>
<td>Collagenous fibers</td>
<td>Bind bones and other tissues to each other</td>
<td>Alpha polypeptide chains</td>
<td>tendon, ligament, skin, cornea, cartilage, bone, blood vessels, gut, and intervertebral disc.</td>
</tr>
<tr>
<td>Elastic fibers</td>
<td>Allow organs like arteries and lungs to recoil</td>
<td>Elastic microfibril and elastin</td>
<td>extracellular matrix</td>
</tr>
<tr>
<td>Reticular fibers</td>
<td>Form a scaffolding for other cells</td>
<td>Type III collagen</td>
<td>liver, bone marrow, and lymphatic organs</td>
</tr>
</tbody>
</table>
Function
Connective tissue has a wide variety of functions that depend on the types of cells and the different classes of fibers involved. **Loose and dense irregular connective tissue**, formed mainly by **fibroblasts** and **collagen fibers**, have an important role in providing a medium for oxygen and nutrients to diffuse from **capillaries** to cells, and carbon dioxide and waste substances to diffuse from cells back into circulation. They also allow organs to resist stretching and tearing forces. **Dense regular connective tissue**, which forms organized structures, is a major functional component of **tendons, ligaments** and **aponeuroses**, and is also found in highly specialized
organs such as the cornea. Elastic fibers, made from elastin and fibrillin, also provide resistance to stretch forces. They are found in the walls of large blood vessels and in certain ligaments, particularly in the ligamenta flava.

In hematopoietic and lymphatic tissues, reticular fibers made by reticular cells provide the stroma—or structural support—for the parenchyma—or functional part—of the organ.

Mesenchyme is a type of connective tissue found in developing organs of embryos that is capable of differentiation into all types of mature connective
tissue. Another type of relatively undifferentiated connective tissue is the mucous connective tissue known as Wharton's jelly, found inside the umbilical cord.

Various types of specialized tissues and cells are classified under the spectrum of connective tissue, and are as diverse as brown and white adipose tissue, blood, cartilage and bone. Cells of the immune system, such as macrophages, mast cells, plasma cells and eosinophils are found scattered in loose connective tissue, providing the ground for starting inflammatory and immune responses upon the detection of antigens.
The image summarizes the various categories of connective tissues found in the human body.

General features of connective tissues. The Matrix of most connective tissues is made up of ground substance and protein.
Types of connective tissue include:

1. Connective Tissue Proper:
   
   **Fibroblast cells** are responsible for synthesizing protein fibers for the matrix. **Collagen fibers** are strong, **elastic fibers** are flexible and **reticular fibers** form a supportive framework for organs and basement membranes. There are two subcategories of connective tissue proper.

A. Loose connective tissue

: Thin and soft, this tissue contains many collagen and elastic fibers in a jelly-like matrix. The cells in loose connective tissue are not close together. This tissue functions in binding the skin to underlying structures. There are three types of loose connective tissue.

a. Areolar connective tissue
   
   is a common form of loose connective tissue. It is found in the skin and mucous membranes, where it binds the skin or membrane to underlying tissues such as muscles. It is also found around blood vessels and internal organs where it links and supports them.

b. Adipose connective tissue
   
   is commonly known as fat. This tissue contains fat cells that are specialized for lipid storage. In addition to storing energy, this tissue also cushions and protects the organs.

- consists of fat cells (adipocytes with a nucleus and stored lipids in their cytoplasm) with a little extracellular matrix. It stores fat for energy and provides insulation.

C. Reticular connective tissue
   
   is mostly composed of reticular protein fibers which make a skeleton, known as stroma, for the lymphatic and white blood cells.
This type of tissue is found in spleen and other lymphatic system structures.

Reticular Connective Tissue

This is a loose connective tissue made up of a network of reticular fibers that provides a supportive framework for soft organs.

B. Dense connective tissue

proper: This tissue consists of three categories, dense regular connective tissue, dense irregular connective tissue, and elastic connective tissue. These tissues differ on the arrangement and composition of the fibrous elements of the extracellular matrix.

a. Dense regular connective tissue

has extracellular fibers that all run in the same direction and plane. Muscle tendons are a type of dense regular connective tissue.

b. Dense irregular connective tissue

contains collagen and elastic fibers which are found running in all different directions and planes. The dermis of the skin is composed of dense irregular connective tissue.
c. Elastic connective tissue

Made up of freely branching elastic fibers with fibroblasts in the spaces between the fibers, this tissue allows the kind of stretch that is found in the walls of arteries.

(a) Dense regular connective tissue

(b) Dense irregular connective tissue

consists of collagen fibers packed into parallel bundles. (b) Dense irregular connective tissue consists of collagen fibers interwoven into a mesh-like network.

2. Cartilage

This connective tissue is relatively solid and is a non-vascularized tissue (does not have a blood supply). The matrix is produced by cells called chondroblasts. When these cells slow down, they reside in small spaces called lacunae. These mature cells in the lacunae are called chondrocytes. There are three types of cartilage:

: hyaline cartilage, elastic cartilage, and fibrocartilage.

A. Hyaline cartilage
is the most common type of cartilage, contains many collagen fibers and is found in many places including the nose, between the ribs and the sternum and in the rings of the trachea.

B. **Elastic cartilage**

has many elastic fibers in the matrix and supports the shape of the ears and forms part of the larynx.

C. **Fibrocartilage** is tough and contains many collagen fibers and is responsible for cushioning the knee and for forming the disks between the vertebrae.

Cartilage is a connective tissue consisting of collagenous fibers embedded in a firm matrix of chondroitin sulfates. (a) Hyaline cartilage has chondrocytes in lacunae within a matrix. (b) Fibrocartilage has chondrocytes in lacunae within collagen fibers in a matrix. (c) Elastic cartilage has chondrocytes in lacunae within elastic fibers in a matrix.
3. **Bone**: A hard, mineralized tissue found in the skeleton. The bone matrix contains many collagen fibers as well as inorganic mineral salts, calcium carbonate, and calcium phosphate, all features that make it a very rigid structure. Bone cells, called osteoblasts, secrete the osteoid substance that eventually hardens around the cells to form an ossified matrix. The **osteon** forms the basic unit of compact bone. Within the osteon, the osteocytes (mature bone cells) are located in lacunae. Because the bone matrix is very dense, the osteocytes get their nutrition from the central canal via tiny canals called canaliculi.

The image shows a micrograph as well as an illustration of the cross-section of the compact bone tissue.

- The osteon (made of osteocytes, central (Haversian) canal, and canaliculi) are visible.
Bone Cells

There are four main subtypes of bone cells, as shown in the diagram below. Each type has a different form and function:

1. Osteocytes are star-shaped bone cells that make up the majority of bone tissue. They are the most common cells in mature bone and can live as long as the organism itself. They also control the function of bone cells called osteoblasts and osteoclasts.

2. Osteoblasts are cells with single nuclei that synthesize new bone. They function in organized groups of connected cells called osteons to form the organic and mineral matrix of bone.

3. Osteogenic cells are undifferentiated stem cells that differentiate to form osteoblasts in the tissue that covers the outside of the bone.

4. Osteoclasts are very large, multinucleated cells that are responsible for the breakdown of bones through resorption. The breakdown of bone is very important in bone health because it allows for bone remodeling.

Four sub-types of bone cells in the human skeletal system: Osteocytes (maintain bone tissues), Osteoblast (form bone matrix), Osteogenic cells (stem cell), Osteoclasts (reabsorb bone)
4. Blood

: Considered a type of fluid connective tissue because the matrix of blood is not solid. The fluid matrix is called plasma, and formed elements of this tissue include white blood cells, red blood cells, and platelets.

Figure: The cells and cellular components of human blood are shown. Red blood cells deliver oxygen to the cells and remove carbon dioxide. White blood cells (including neutrophils, monocytes, lymphocytes, eosinophils, and basophils) are involved in the immune response. Platelets form clots that prevent blood loss after injury.
White Blood Cells

(Also called leukocytes) are even more variable than bone cells. Five subtypes of white blood cells are shown in the figure below. All of them are immune system cells involved in defending the body, but each subtype has a different function. They also differ in the normal proportion of all leukocytes they make up.

1. Monocytes make up about 5 percent of leukocytes. They engulf and destroy (phagocytize) pathogens in tissues.
2. Eosinophils make up about 2 percent of leukocytes. They attack larger parasites and set off allergic responses.
3. Basophils make up less than 1 percent of leukocytes. They release proteins called histamines that are involved in inflammation.
4. Lymphocytes make up about 30 percent of leukocytes. They include B cells and T cells. B cells produce antibodies against non-self antigens, and T cells destroy virus-infected cells and cancer cells.
5. Neutrophils are the most numerous white blood cells, making up about 62 percent of leukocytes. They phagocytize single-celled bacteria and fungi in the blood.

White Blood Cells

Five sub-types of human white blood cells in the human immune system: monocyte, eosinophil, basophil, lymphocyte, neutrophil
Muscle cells form the active contractile tissue of the body known as muscle tissue or muscular tissue. Muscle tissue functions to produce force and cause motion, either locomotion or movement within internal organs. Muscle tissue is separated into three distinct categories: visceral or smooth muscle, found in the inner linings of organs; skeletal muscle, typically attached to bones, which generate gross movement; and cardiac muscle, found in the heart, where it contracts to pump blood throughout an organism.

Muscle tissue is made up of cells that have the unique ability to contract or become shorter. There are three major types of muscle tissue, as pictured below: skeletal, smooth, and cardiac muscle tissues.

1. **Skeletal muscles** are striated, or striped in appearance, because of their internal structure. Skeletal muscles are attached to bones, and when they pull on the bones, they enable the body to move. Skeletal muscles are under voluntary control.

2. **Smooth muscles** are nonstriated muscles. They are found in the walls of blood vessels and in the reproductive, gastrointestinal, and respiratory tracts. Smooth muscles are not under voluntary control.

3. **Cardiac muscles** are striated and found only in the heart. Their contractions cause the heart to beat. Cardiac muscles are not under voluntary control.
The body contains three types of muscle tissue:

(a) skeletal muscle

(b) smooth muscle

(c) cardiac muscle
Neural tissue (Nervous tissue)

Cells comprising the central nervous system and peripheral nervous system are classified as nervous (or neural) tissue. In the central nervous system, neural tissues form the brain and spinal cord. In the peripheral nervous system, neural tissues form the cranial nerves and spinal nerves, inclusive of the motor neurons.

Nervous tissue is made up of neurons and other types of cells generally called glial cells. Neurons transmit electrical messages and the other cells play supporting roles.

Nervous tissue makes up the central nervous system (mainly the brain and spinal cord) and peripheral nervous system (the network of nerves that runs throughout the rest of the body). There are four types of nervous tissues:

1. Gray matter
   is nervous tissue that is found only in the brain and spinal cord which is also called the central nervous system. Gray matter is mostly composed of the cell bodies of the neurons. Gray matter is important for information processing.

2. White matter
   is nervous tissue that is found in the brain and spinal cord, where it connects and facilitates communication between gray matter areas. White matter is also found in the nerves of the peripheral nervous system.

3. Nerves make up most of the peripheral nervous system. They are long, branching tissues that carry electrical messages between the central nervous system and the remainder of the body.

4. Ganglia (singular, ganglion) are also found in the peripheral nervous system. Ganglia are mostly made up of cell bodies of neurons outside of the central nervous system. They are tissues that act as relay points for messages transmitted through nerves.
Biology theoretical Lecture11
Antibiotic

An antibiotic is a type of antimicrobial substance active against bacteria.

It is the most important type of antibacterial agent for fighting bacterial infections, and antibiotic medications are widely used in the treatment and prevention of such infections. They may either kill or inhibit the growth of bacteria. A limited number of antibiotics also possess antiprotozoal activity.

Antibiotics are not effective against viruses such as the common cold or influenza; drugs which inhibit viruses are termed antiviral drugs antivirals rather than antibiotics.
Sometimes, the term antibiotic - literally "opposing life from the Greek roots ov't anti, "against" and Bios bios, "life" - is broadly used to refer to any substance used against microbes, but in the usual medical usage, antibiotics (such as penicillin) are those produced naturally (by one microorganism fighting another), whereas nonantibiotic antibacterials (such as sulphonamides and antiseptics) are fully synthetic. However, both classes have the same goal of killing or preventing the growth of microorganisms, and both "Antibacterials" are included in antimicrobial chemotherapy. "Antibacterials" include antiseptic drugs, antibacterial soaps, and chemical disinfectants, whereas antibiotics are an important class of antibacterials used more specifically in medicinals and sometimes in livestock feed.
Antibiotics have been used since ancient times. Many civilizations used topical application of moldy bread, with many references to its beneficial effects arising from ancient Egypt, Nubia, China, Serbia, Greece, and Rome. The first person to directly document the use of molds to treat infections was John Parkinson (1567-1650). Antibiotics revolutionized medicine in the 20th century. Alexander Fleming (1881-1955) discovered

the modern day penicillin in 1928, the widespread use of which proved significantly beneficial during wartime. However, the effectiveness and easy access to antibiotics have also led to their overuse and some bacteria have evolved resistance to them. The World Health Organization has classified antimicrobial resistance as a widespread "serious threat [that] is no longer a prediction for the future, it is happening right now in every region of the world and has the potential to affect anyone, of any age, in any country."
Antibiotic

*Drug class*

Testing the susceptibility of *Staphylococcus aureus* to antibiotics by the Kirby-Bauer disk diffusion method – antibiotics diffuse from antibiotic-containing disks and inhibit growth of *S. aureus*, resulting in a zone of inhibition.
Medical uses

Antibiotics are used to treat or prevent bacterial infections, T12) and sometimes protozoan infections. (Metronidazole is effective against a number of parasitic diseases). When an infection is suspected of being responsible for an illness but the responsible pathogen has not been identified, an empiric therapy is adopted. [13] This involves the administration of a broad-spectrum antibiotic based on the signs and symptoms presented and is initiated pending laboratory results that can take several days. 142] [13] When the responsible pathogenic microorganism is already known or has been identified, definitive therapy can be started. This will usually involve the use of a narrow-spectrum antibiotic. The choice of antibiotic given will also be based on its cost. Identification is critically important as it can reduce the
OG and toxicity of the antibiotic therapy and also made the possibility of the emergence of antimicrobial
name bil Towe, antibiotics may be given for non-complicated scato podiel antibiotics may be given as a preventive mere and this is only limited to at-risk
populations suc in those with a weleed immine system (partienny in HIV sest peevent pneumonia), those taking surse de ce petents, and to having surgery. The men wurde procedures are to help prevent infection of indio. They are an impetant role in detal antibiotie prophecies where there may brevet bedremo consequent infective endocarditis. Antibiotics stre ville used to prevent infection in cases of neutropenia partenerly cancer - moted. CD
Administration

here are many different routes of administration for antibiotic treatment. Antibiotics are usually taken by mouth.

In more severe cases, particularly deep-seated systemic infections, antibiotics can be given intravenously or by injection, where the site of is easily accessed,

antibiotics may be given topically in the form of eye drops onto the conjunctiva for conjunctivitis or ear drops for ear infections and acute cases of swimmer's ear. Topical use is also one of the treatment options for some skin conditions including acne and cellulitis. [7] Advantages of topical application include achieving high and sustained concentration of antibiotic at the site of infection; Reducing the potential for systemic
absorption and toxicity, and total volumes of antibiotic required are reduced, thereby also reducing the risk of antibiotic misuse. [18] Topical antibiotics applied over certain types of surgical wounds have been reported to reduce the risk of surgical site infections. [19] However, there are certain general causes for concern with topical administration of antibiotics. Some systemic absorption of the antibiotic may occur; The quantity of antibiotic applied is difficult to accurately dose, and there is also the possibility of local hypersensitivity reactions or contact dermatitis occurring. [18] It is recommended to administer antibiotics as soon as possible, especially in life-threatening infections. Many emergency departments stock antibiotics for this purpose. [20]
antibiotic consumption are widely between countries.

The WHO report on zavole of antibiotics con published in 2015 and 2015 data from countries. As measured in defined daily desesper Log inhabitants per day.

Moglie had the lushest consumption with a rate of 64 Burundi had the lowest at 4-6 Amatllin and morcillin / comme and were the most front co
Side effects

Antibiotics are screened for any negative effects before their approval for clinical use, and are usually considered safe and well tolerated.

However, some antibiotics have been associated with a wide extent of adverse side effects ranging from mild to very severe depending on the type of antibiotic used, the microbes targeted, and the individual patient. [22] [23] Side effects may reflect the pharmacological or toxicological properties of the antibiotic or may involve hypersensitivity or allergic reactions. [C41] Adverse effects range from fever and nausea to major allergic reactions, including photodermatitis and anaphylaxis. [24]
bo Commonside - effects included wilting from disruption of the species composition to the intestinal for samplin worth of pathogenic bacteria, such as Clostrid treatment ambelp preventblote asociated disbeli overgrowth of yeast species of the gas candid in the who and vaginal area. Til Milton side effects can result from interaction administration of a que totle with systemic with the pool of brdon damage from the corticoster Sementtiti malo do the mitocondrion, bacteri delved alle found in yol, Incoding selle Mitochondrial damage cause coidiative stress in cells and has been ested as a mechism for side effect on coquines They slow to affect cho
Choosing Wisely

5 QUESTIONS to Ask Your Doctor Before You Take Antibiotics

1. Do I really need antibiotics?
2. What are the risks?
3. Are there simpler, safer options?
4. How much do they cost?
5. How do I safely take antibiotics?

Use these questions to talk to your doctor about when you need antibiotics and when you don’t.

Health advocacy messages such as this one encourage patients to talk with their doctor about safety in using antibiotics.
Alcohol

Tabactions between alcohol and oral antibiotics may or may not effects and decreased efficacy of the theme while moderate alcohol common is unlikely to interfere with many common antibiotics, there are specific types of antibiotics, with which alcohol consumption may cause some side effects. Therefore, protection of side effects and effectiveness depend on the type of antibiotic ministered. Atitie sich al, metronide, cephamadol, teperpendim, durazodone, edifiram - live chemical con with alcohol by inhibiting its blown by taldede dehyd, which you want and shorts of behan addition, the yedine and erythromycin site may be reduced by alcohol consumption. Wel heat of soil on antibiotic activity include altered activity of the liver nya tutmak down the biote model
Pharmacodynamics

The successful outcome of antimicrobial therapy with antibacterial compounds depends on several factors. These include host defense mechanisms, the location of infection, and the pharmacokinetic and pharmacodynamic properties of the antibacterial. (48) The bactericidal activity of antibacterials may depend on the bacterial growth phase, and it often requires ongoing metabolic activity and division of bacterial cells. [49] These findings are based on laboratory studies, and in clinical settings have also been shown to eliminate bacterial infection [48] [50]. Since the activity of antibacterials depends frequently on its concentration, [51] in vitro characterization of antibacterial activity commonly includes the determination of the minimum inhibitory concentration and minimum bactericidal concentration of an antibacterial. [48] [52] To predict clinical outcome, the antimicrobial activity of an antibacterial is usually combined with its pharmacokinetic profile.
Combination therapy

In important infectious diseases, including tuberculosis, combination therapy (i.e., the concurrent application of two or more antibiotics) has been used to delay or prevent the emergence of resistance. In acute bacterial infections, antibiotics as part of combination therapy are prescribed for their synergistic effects to improve treatment outcome as the combined effect of both antibiotics is better than their individual effect. [54] [55] Methicillin-resistant Staphylococcus aureus infections may be treated with a combination therapy of fusidic acid and rifampicin. [54] Antibiotics used in combination may also be antagonistic and the combined effects of the two antibiotics may be less than if one of the antibiotics was given as a monotherapy.
For example, chloramphenicol and tetracyclines are antagonists to penicillins. However, this can vary depending on the species of bacteria. In general, combinations of a bacteriostatic antibiotic and a bactericidal antibiotic are antagonistic. In addition to combining one antibiotic with another, antibiotics are sometimes co-administered with resistance-modifying agents. For example, B-lactam antibiotics may be used in combination with B-lactamase inhibitors, such as clavulanic acid or sulbactam, when a patient is infected with a B-lactamase producing strain of bacteria.
Antibiotics are commonly classified based on their mechanism of action, chemical structure, or spectrum of activity. Most target bacterial functions or growth processes. Those that target the bacterial cell wall (penicillins and cephalosporins) or the cell membrane (polymyxins), or interfere with essential bacterial enzymes (rifamycins, lipiarzycins, quinolones, and sulfonamides) have bactericidal activities.
Protein synthesis inhibitors (macrolides, lincosamides, and tetracyclines) are usually bacteriostatic (with the exception of bactericidal

Further categorization is based on their target specificity. "Narrow-spectrum" antibiotics target specific types of bacteria, such as gram-negative or gram-positive, whereas broad-spectrum antibiotics affect a wide range of bacteria. Following a 40-year break in discovering classes of antibacterial compounds, four new classes of antibiotics were introduced to clinical use in the late 2000s and early 2010s: cyclic lipopeptides (such as daptomycin), glycylcyclines (such as tigecycline), and oxazolidinones (such as linezolid), and lipiaarmycins (such as fidaxomicin)
Production

With advances in medicinal chemistry, most modern antibacterials are semisynthetic modifications of various natural compounds [62]. These include, for example, the beta-lactam antibiotics, which include the penicillins (produced by fungi in the genus Penicillium), the cephalosporins, and the carbapenems. Compounds that are still isolated from living organisms are the aminoglycosides, while other antibacterials -- for example, the sulfonamides, the quinolones, and the oxazolidinones -- are produced by chemical synthesis. [62] Many antibacterial compounds are relatively small molecules with a molecular weight of less than 1000 daltons.
Since the first pioneering efforts of Howard Morey and Chain in 1939, the importance of antibiotics including antibacterials, to medicine has led to intense research to produce antibacterials at large scales. Following screening of antibacterials against a wide range of bacteria, production of the active compounds is carried out using fermentation, usually in strongly aerobic conditions.