Al-Furat Al-Awsat Technical University,Najaf Technical Institute, Department of Forensic Techniques

Human Biology (4)
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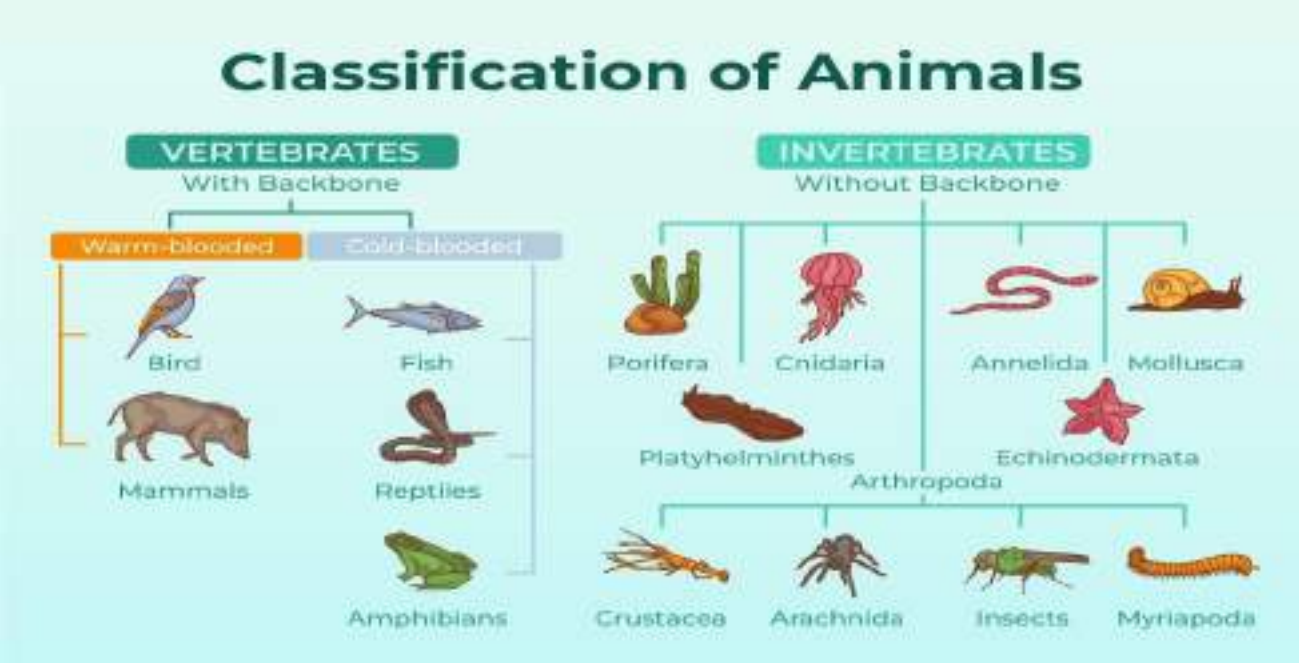
Biological classification

Animal kingdom

The whole animal kingdom is divided into two main groups. They are Vertebrates and Invertebrates.

Animals with backbone are called vertebrates. They are found in land, oceans, rivers, forests, mountains and even in deserts. This group can be further divided into smaller groups by their characteristics. They are fish, amphibians, reptiles, birds, and mammals.



Plant kingdom

Kingdom Plantae includes all the plants
The plant kingdom has the following characteristic features:
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- They are eukaryotic, multicellular and non-motile
- autotrophic organisms.
- contains a rigid cell wall.
- Plants have chloroplast and chlorophyll pigment, which is required for photosynthesis.
- They reproduce asexually by vegetative propagation or sexually.

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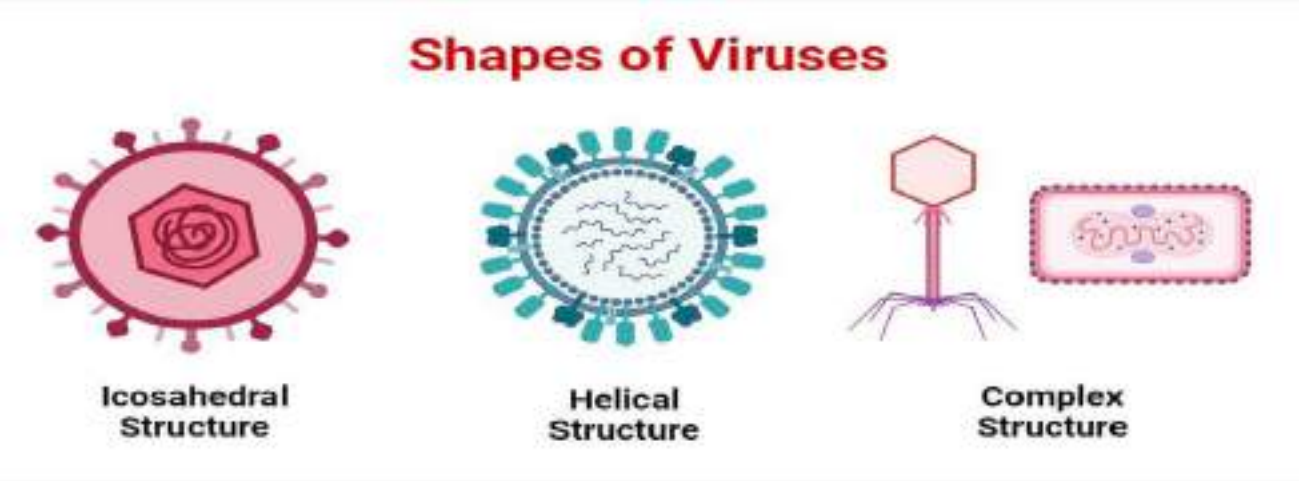
Viruses

Structure and Function of Viruses

- Viruses are tiny and smaller in its size, ranging between 30-50 nm.
- do not contain cells and lack a cell wall but are surrounded by a protective protein coating called the capsid.
- contain either RNA or DNA as the genetic material.

Viruses mainly depend on a host to deliver the complex metabolic machinery of prokaryotic or eukaryotic cells for propagation. The main task of the virus is to carry its DNA or RNA genome to the host cell, which then can be transcribed by the host cell. The viral genome structure is packed in a capsulated symmetric protein. The protein associated with nucleic acid (also known as nucleoprotein) produces the nucleocapsid with the genome.



Bacteria

Bacteria are one-celled microscopic living organisms (ranged from 0.5-2.0 micron in diameter) it can be seen just under light microscope with the aid of oil immersion lenses (100x). Bacteria could be found everywhere.

They can be either

Beneficial bacteria

as in the process of fermentation (such as in vinegar and dairy production), also many bacteria play important role in decomposition.

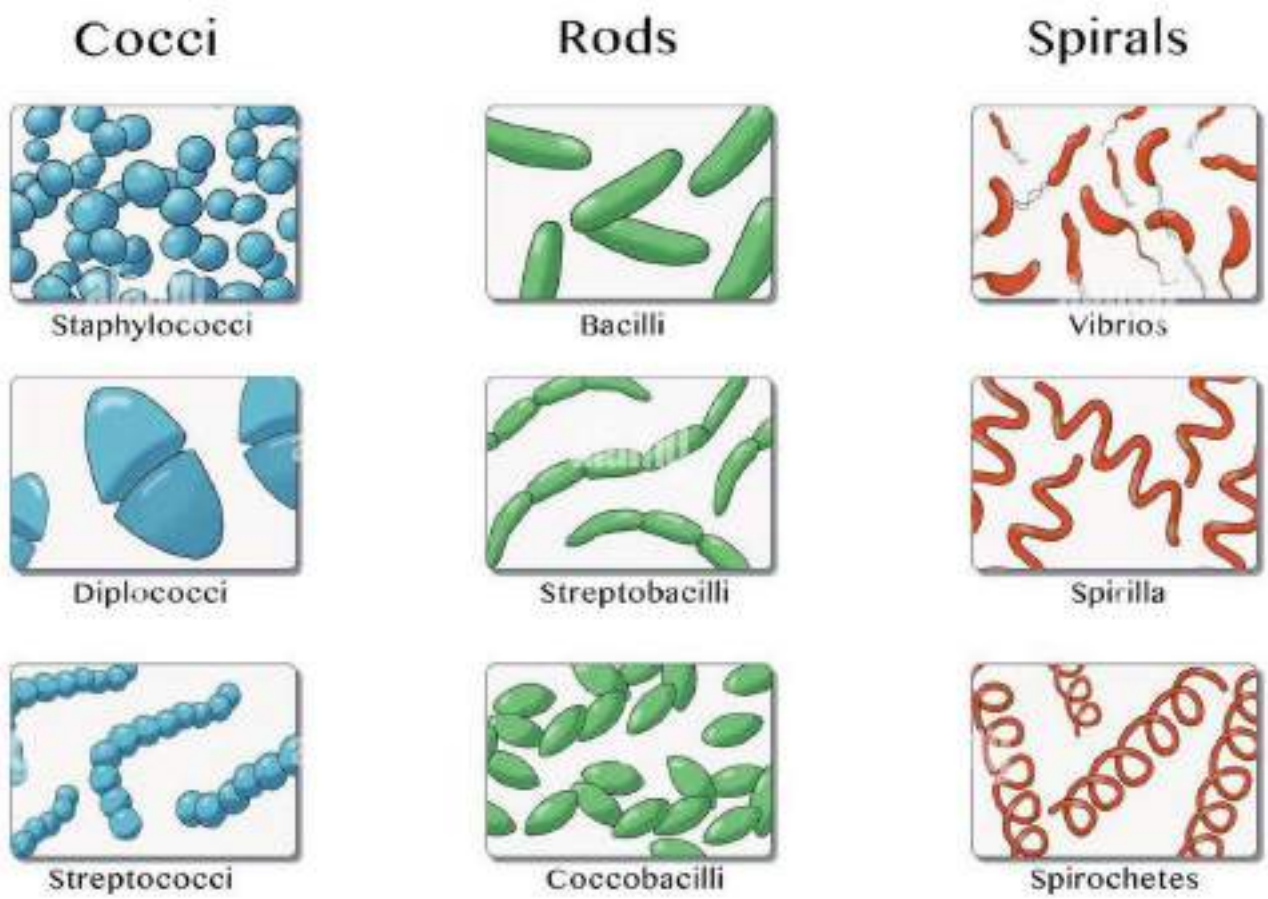
Pathogenic bacteria

that could cause a disease when enters any living body (human or animal) and it can spread through water, air, soil and through physical contact

The bacteria can classify according to their shape

* **Cocci** (Spherical)
Diplococci e.g.: Streptococcus pneumoniae
Chain (Cocci) e.g.: Streptococcus pyogenes
Cluster or Grape like shape e.g.: Staphylococcus aureus
***Bacilli**
Short Bacilli e.g.: Bacillus subtilis.
Long Bacilli e.g.: Lactobacillus. spp.
Coccobacilli e.g.: like members of Enterobacteriaceae family (Escherichia coli, Shigella, Salmonella).

***Kidney shape**: e.g.: Neisseria gonorrhea.
comma shape: e.g.: Vibrio cholera.
Spiral shape: e.g.: Helicobacter pylori



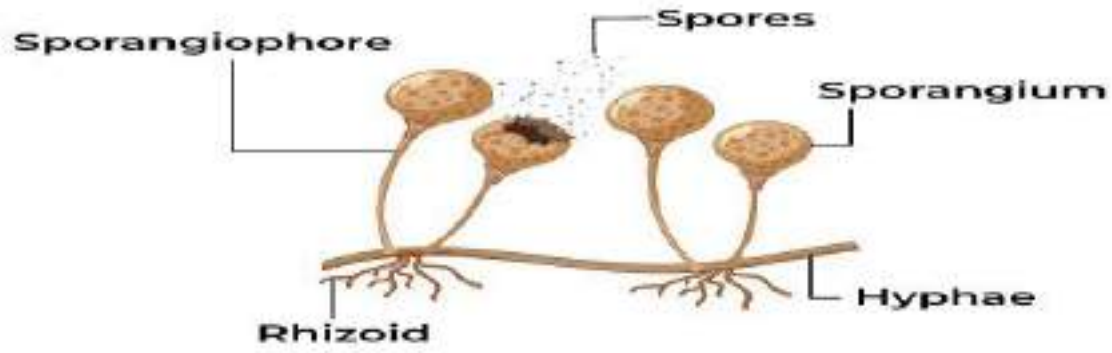
The Bacteria are divided in two groups according to the reaction with Gram stain.

• **Gram positive bacteria**. e.g.: Streptococcus, Staphylococcus, Bacillus and Clostridium.

• **Gram Negative Bacteria**. e.g. All the members of Enterobacteriaceae (Escherichia coli, Shigella, Salmonella,.....)

Fungus

Fungi are defined as microscopic, eukaryotic, achlorophyllus, heterotrophic, unicellular or multicellular organisms containing chitin or cellulose in their cell wall and reproduce both sexual and asexual means. Eg. Unicellular Yeast and Multicellular moulds



Morphology

1. Moulds (Molds): Filamentous fungi Ex: Aspergillus sp.,

2. Yeasts: Single celled cells that buds Ex: Saccharomyces cerviciae

3. Yeast like: Similar to yeasts but produce pseudohyphae (chains of conidia binding together) Eg: Candida albicans

4. Dimorphic: Fungi existing in two different morphological forms at two different environmental conditions

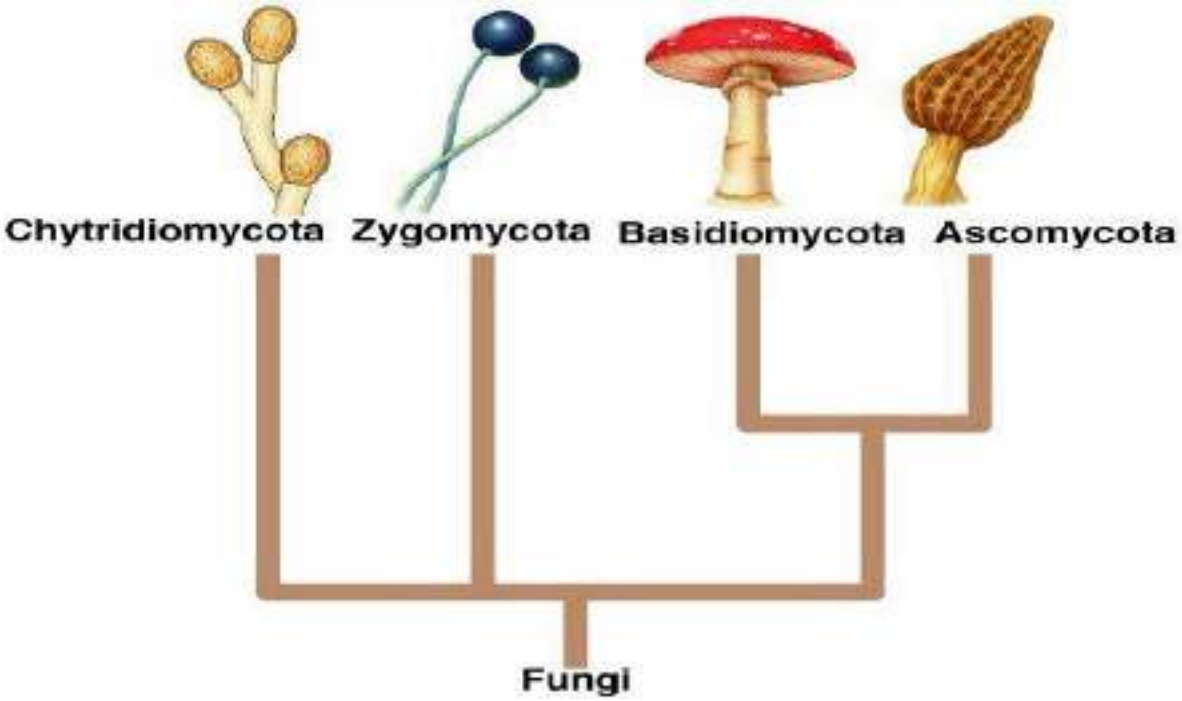
Classification based on Sexual reproduction:

1. Zygomycetes: which produce through production of zygospores.

2. Ascomycetes: which produce endogenous spores called ascospores in cells called asci.

3. Basidiomycetes: which produce exogenous spores called basidiospores in cells called basidia.

4. Deuteromycetes (Fungi imperfecti): fungi that are not known to produce any sexual spores (ascospores or basidiospores).



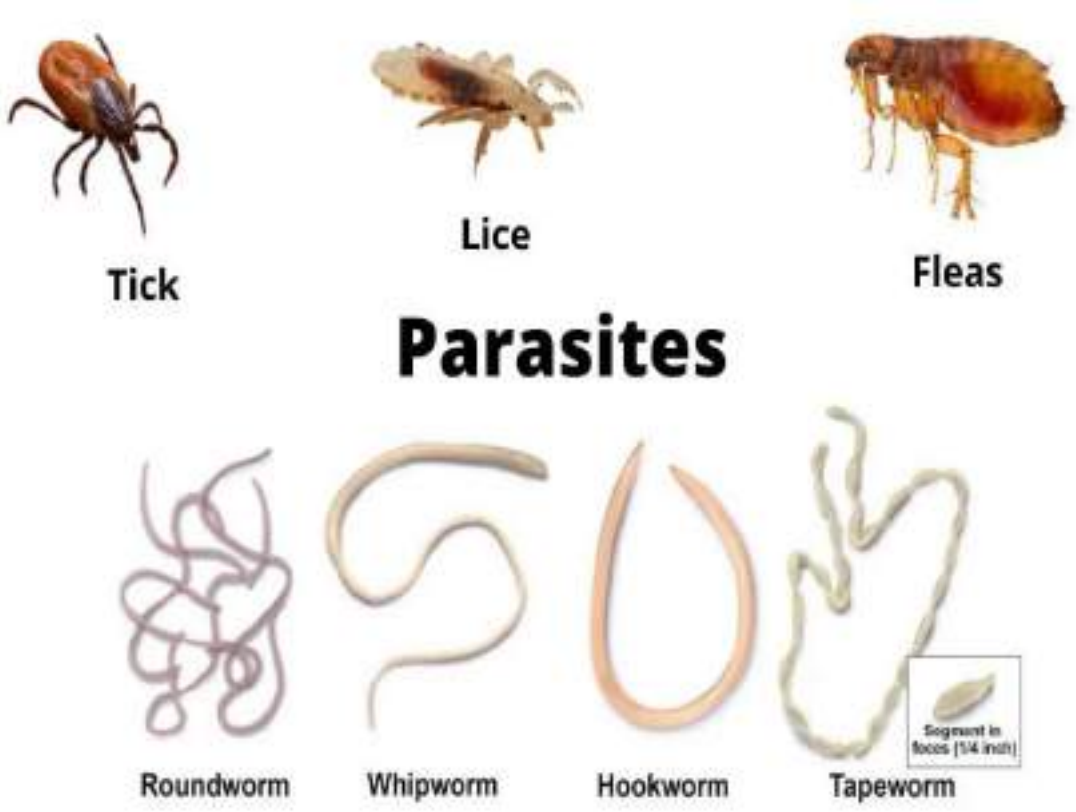
Fungal infections

are any disease or condition you get from a fungus. They usually affect your skin, hair, nails or mucous membranes but they can also infect your lungs or other parts of your body

Parasites

Parasites are organisms that live off other organisms, or hosts, to survive. Some parasites don't noticeably affect their hosts. Others grow, reproduce, or invade organ systems that make their hosts sick, resulting in a parasitic infection.

Parasitic infections are a big problem in tropical and subtropical regions of the world.



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Cell cycle and cell division

Cell Cycle :. The cell cycle is the sequence of events or changes that occur between the formation of cell and its division into daughter cells.

1. Prokaryotic: cells divide by binary fission, in which the DNA replicates and then the cell divides in two. That's all - no mitosis, no spindle, no nothing!
2. 2- Eukaryotic :A cell typically goes through phases during its life, beginning with growth before it can divide.

The cell cycle incorporates two principal phases:-

1-Interphase

♦**-Gap1(G1) phase** :- the cell gathers nutrients and synthesizes RNA and proteins necessary for DNA synthesis and chromosome replication.

♦**-Synthesis (S) phase**:- chromosome replicates and produce identical chromatids (or sister chromatids) held together by a structure known as the Centromere

♦**- Gap2(G2) phase**:- The cell prepares for cell division. During this phase, the cell examines its replicated DNA in preparation for cell division. This is a period of cell growth and reorganization of cytoplasmic organelles before entering the M phase

2-M phase (Mitosis

Mitosis is a type of cell division in which a parental cell produces two similar daughter cells that resemble the parental cell in terms of chromosomal number. The process of cell division includes division of both the nucleus (karyokinesis) and the cytoplasm (cytokinesis). Mitosis consists of five phases

***1-Prophase* :-** The chromosomes condense into compact structures. The nuclear membrane breaks down to form a number of small vesicles. A structure known as the **centrosome** duplicates and migrate to opposite ends of the cell. The centrosomes organize the production of microtubules that form the **spindle fibers** that constitute the **mitotic spindle**.

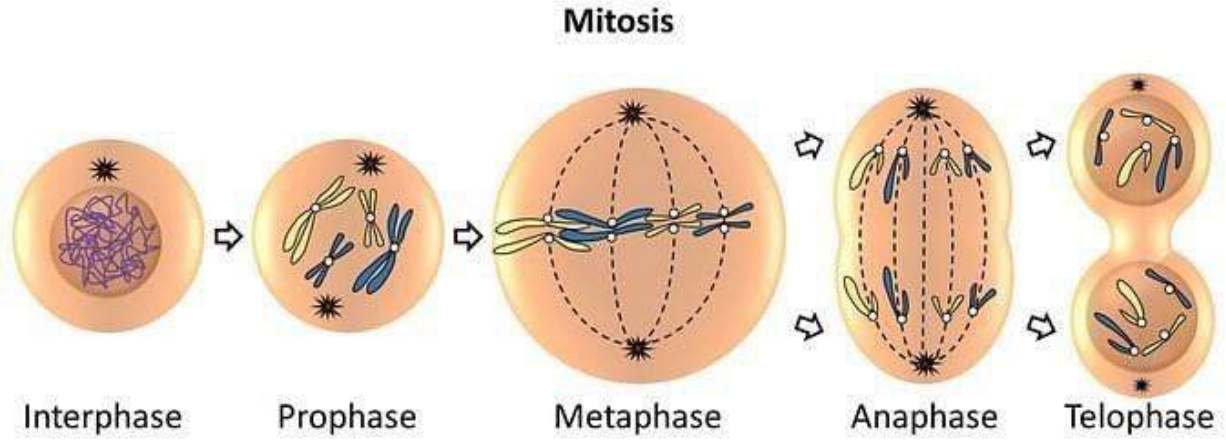
***2-prometaphase* :-** The spindle fibers bind to a structure associated with the centromere of each chromosome called a **kinetochore**. Individual spindle fibers bind to a kinetochore structure on each side of the centromere. The chromosomes continue to condense.

3- Metaphase :- The chromosomes migrate to **the equatorial plane** in the midline of cell called **metaphase plate** by mitotic spindle

4-Anaphase :- The centromeres divide, and the sister chromatids of each chromosome are move to the opposite ends of the cell, pulled by spindle fibers attached to the kinetochore regions

5-Telophase :- The final stage of mitosis, The nuclear membrane reforms around the chromosomes grouped at either pole of the cell, the chromosomes uncoil and become diffuse, and the spindle fibers disappear.

Cytoplasm division (cytokinesis) :- undergo cytokinesis through the formation of a cleavage furrow. A ring of microtubules contract, pinching the cell in half



Meiosis

Meiosis is a type of cell division in which the daughter cells receive only half of the original set of chromosome of the parental cell. Hence it is also called **reduction division**. Meiosis occurs only in germinal cells found in male gonad (testis), female gonad (ovary), The reproductive cells have diploid (2n) number of chromosomes. They are a haploid paternal set and a haploid maternal set. But the reproductive cells have to undergo meiotic division to produce the gametes containing haploid (n) number of chromosomes. Meiosis takes place in two successive stages namely **Meiosis I** and **Meiosis II**.

Meiosis I:-

1-Prophase I :- Prophase I is subdivided into the following five stages.

• Leptotene. chromosomes start to condense.

• Zygotene. homologous chromosomes become closely associated (synapsis) to form pairs of chromosomes (bivalents) consisting of four chromatids (tetrads).

• Pachytene :-crossing over between pairs of homologous chromosomes to form chiasmata , in this phase involves transposition of DNA strands between two different chromosomes

• Diplotene. homologous chromosomes start to separate but remain attached by chiasmata..

• Diakinesis. The homologous chromosomes condense and shorten to reach their maximum thickness, and the nuclear envelope disintegrates.

2-Prometaphase I :- Spindle apparatus formed, and chromosomes attached to spindle fibers by kinetochores.

3-Metaphase I :- Homologous pairs of chromosomes (bivalents) arranged as a double row along the metaphase plate. The homologous chromosomes are cleaved from chiasmata and the chromosomes separate. the nuclear envelope has broken down, the spindle microtubules begin to interact with the chromosomes through the kinetochore

4-Anaphase I :- Chromosomes consisting of two chromatid , move to separate poles . each of the daughter cells is now haploid (23 chromosome), but each chromosome has two chromatids .

5- Telophase I :-Nuclear envelope may reform , each half of the cell has a haploid set of chromosomes; each chromosome still consists of two sister chromatids and the cytoplasm divides

Meiosis II

Meiosis-II occurs soon after meiosis-I. There is no duplication of chromosomes ,without S phase . meiosis II separates the chromatids producing tow daughter cell each with 23 chromosome (haploid) ,and each chromosome has only one chromatid .

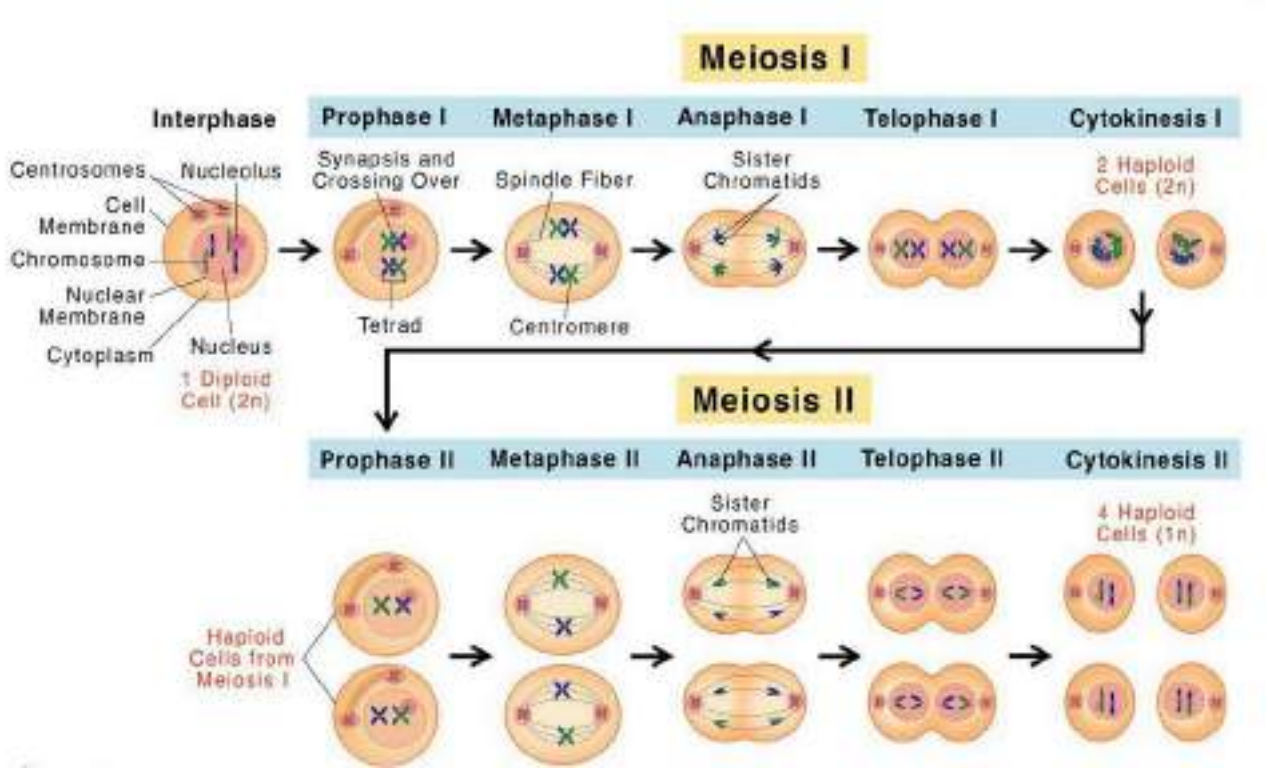
Prophase-II:- • The chromosomes start condensing again , Spindle fibers begin to appear and The nuclear envelope and nucleolus disappear

Metaphase-II:- • The Chromosomes arrange in the equatorial plate , The Spindle fibers connect to the centromere by kinetochore .

Anaphase-II:- • The centromeres of all the chromosomes undergo longitudinal splitting. The chromatids of each chromosome separate and they move towards opposite poles.

Telophase-II:- • The chromosomes arrive at the poles and undergo decondensation to become thin and nuclear envelope is formed. • Nucleolus also appears • The spindle fibers disappear

Cytokinesis :- separates the cytoplasm the formation of cleavage furrow. A ring of microtubules contract, pinching the cell in half .At the end of meiosis, there are four daughter cells, each with a haploid set of unduplicated chromosome



gametogenesis

• A gamete produced by a male is called a sperm, and the process that produces a mature sperm is called spermatogenesis. During this process, a sperm cell grows a tail and gains the ability to "swim," like the human sperm cell shown in the figure below.

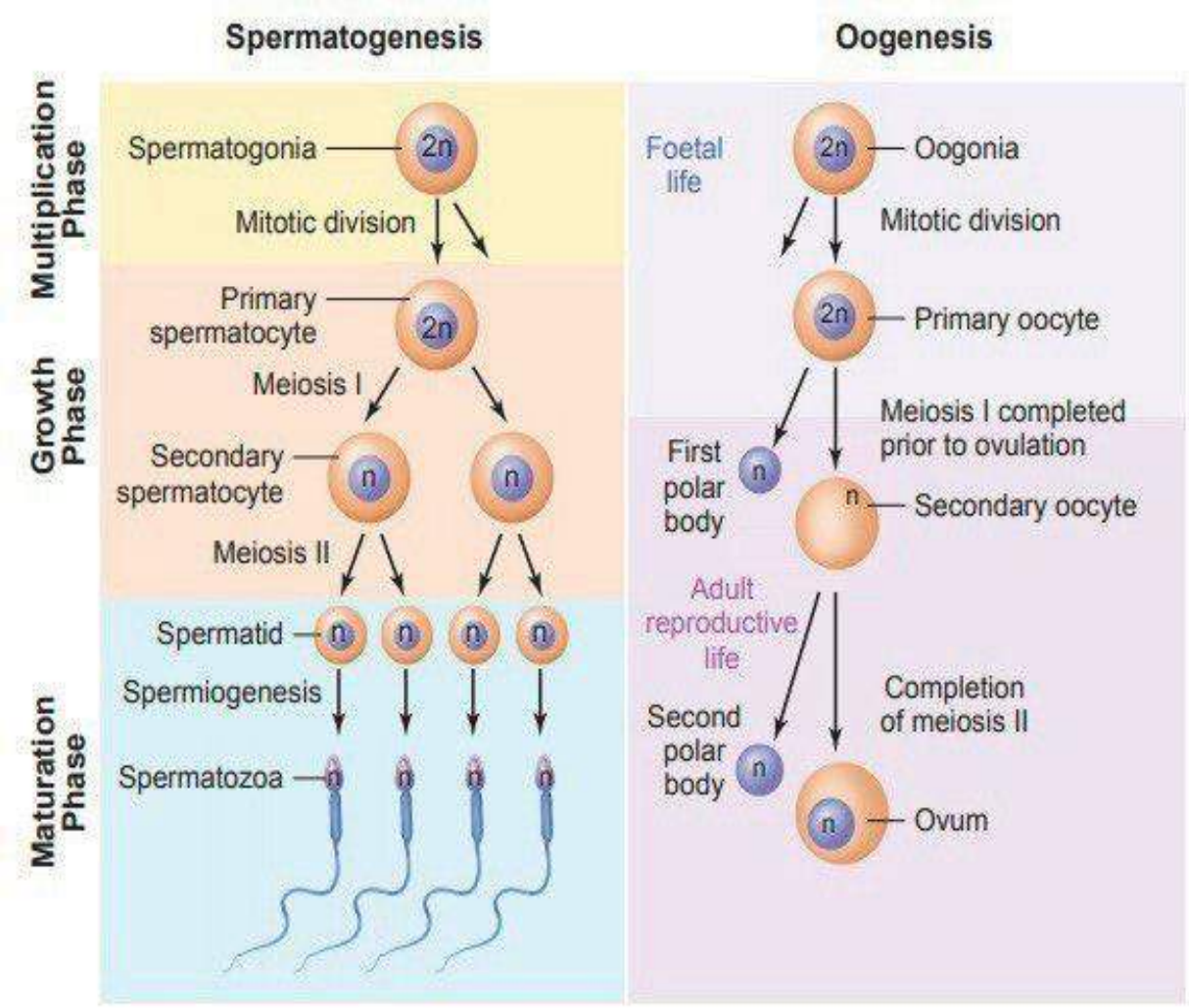
• A gamete produced by a female is called an egg, and the process that produces a mature egg is called oogenesis. Just one egg is produced from the four haploid cells that result from meiosis. The single egg is a very large cell, as you can see from the human egg.

Spermatogenesis

Spermatogenesis occurs in the wall of the seminiferous tubules, with stem cells at the periphery of the tube and the spermatozoa at the lumen of the tube. Immediately under the capsule of the tubule are diploid, undifferentiated cells. These stem cells, called spermatogonia (singular: spermatagonium), go through mitosis with one offspring going on to differentiate into a sperm cell, while the other gives rise to the next generation of sperm.

Oogenesis

Oogenesis occurs in the outermost layers of the ovaries. As with sperm production, oogenesis starts with a germ cell, called an oogonium (plural: oogonia), but this cell undergoes mitosis to increase in number, eventually resulting in up to one to two million cells in the embryo



Cells and Cell Theory

The **cell** (from **Latin** *cella*, meaning "small room") The study of cells is called **cell biology**, cellular biology, or cytology.
Cells are the structural, functional, and biological units of all living beings.
Each cell contains a fluid called the cytoplasm, which is enclosed by a membrane. A cell is the structural and fundamental unit of life. The study of cells from its basic structure to the functions of every cell organelle is called Cell Biology. Robert Hooke was the first Biologist who discovered cells.
All organisms are made up of cells. They may be made up of a single cell (unicellular), or many cells (multicellular). Cells are the building blocks of all living beings.

The basic elements of the classical cell theory state that

- all living things are composed of one or more cells
- cells are the basic unit of structure and function in living things
- cells are produced from other cells.

characteristics of Cells

Following are the various essential characteristics of cells:

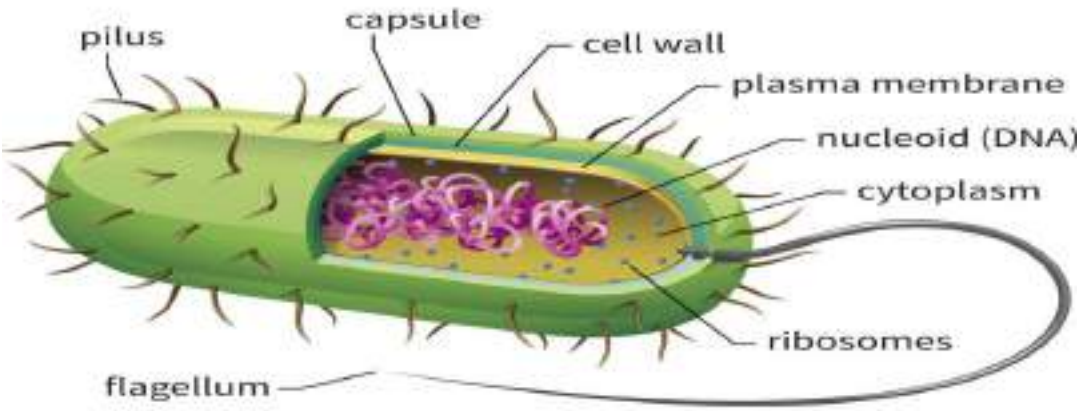
- Cells provide structure and support to the body of an organism.
- The cell interior is organised into different individual organelles surrounded by a separate membrane.
- The nucleus (major organelle) holds genetic information necessary for reproduction and cell growth.
- Every cell has one nucleus and membrane-bound organelles in the cytoplasm.

Types of Cells

1-Prokaryotic Cells

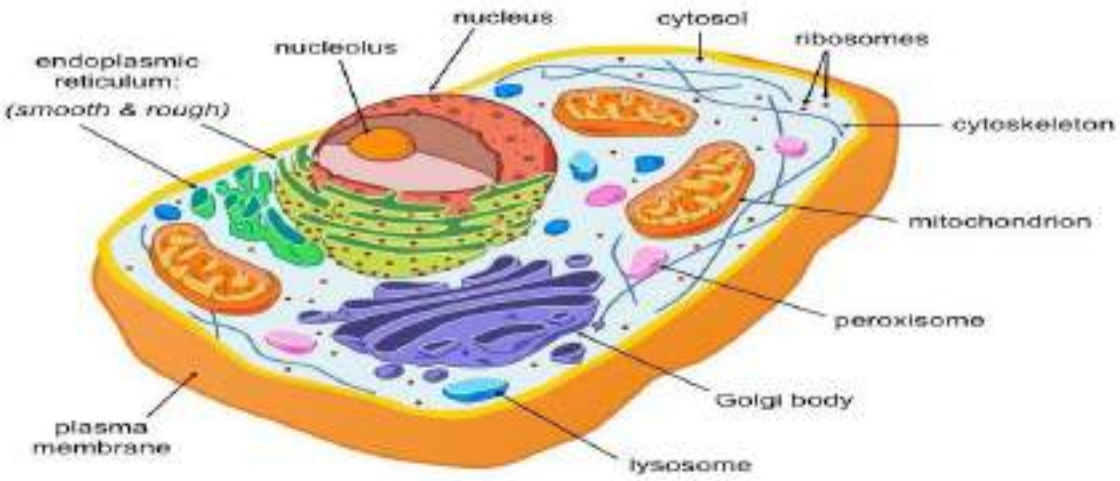
- Prokaryotic cells have no nucleus. Instead, some prokaryotes such as bacteria have a region within the cell where the genetic material is freely suspended. This region is called the nucleoid.
- They all are single-celled microorganisms. Example bacteria.

- The cell size ranges from 0.1 to 0.5 µm in diameter.
- DNA is a single loop .
- Prokaryotes reproduce by binary fission.



2-Eukaryotic Cells

- Eukaryotic cells are characterized by a true nucleus.
- The size of the cells ranges between 10–100 µm in diameter.
- This broad category involves plants, fungi and animals.
- DNA is organized into chromosomes.
- They reproduce sexually as well as asexually.



Cell Structure

The cell structure contains individual components with specific functions essential to carry out life's processes.

1- Cell Wall

- ✓ The cell wall is the most noticeable part of the plant's cell structure. It is made up of cellulose and pectin.
- ✓ The cell wall is present in plant cells. It protects the plasma membrane and other cellular components. The cell wall is also the outermost layer of plant cells

2- Cell Membrane

- ✓ The cell membrane supports and protects the cell.
- ✓ It controls the movement of substances in and out of the cells.
- ✓ It separates the cell from the external environment.
- ✓ The cell membrane is present in all the cells.

3- Cytoplasm

- ✓ The cytoplasm is a thick, clear, jelly-like substance present inside the cell membrane.
- ✓ The cell organelles such as endoplasmic reticulum, vacuoles, mitochondria, ribosomes, are suspended in this cytoplasm.

4) Nucleus

- ✓ The nucleus contains the hereditary material of the cell, the DNA.
- ✓ The nucleus is surrounded by the nuclear envelope that separates the DNA from the rest of the cell.
- ✓ The nucleus protects the DNA.

Cell Organelles

Cell Organelles	function
Nucleolus	The nucleolus is the site of ribosome synthesis. Also, it is involved in controlling cellular activities and cellular reproduction
Nuclear membrane	The nuclear membrane protects the nucleus by forming a boundary between the nucleus and other cell organelles.
Chromosomes	Chromosomes play a crucial role in determining the sex of an individual. Each human cells contain 23 pairs of chromosomes
Endoplasmic reticulum	The endoplasmic reticulum is involved in the transportation of substances throughout the cell. It plays a primary role in the metabolism of carbohydrates, synthesis of lipids, steroids and proteins.
Golgi Bodies	Golgi bodies are called the cell's post office as it is involved in the transportation of materials within the cell
Ribosome	ribosomes use RNA as instructions to make protein.
Mitochondria	The mitochondrion is called "the powerhouse of the cell." It is called so because it produces ATP – the cell's energy currency
Lysosomes	Lysosomes protect the cell by engulfing the foreign bodies entering the cell and helps in cell renewal. Therefore, it is known as the cell's suicide bags
Chloroplast	Chloroplasts are the primary organelles for photosynthesis. It contains the pigment chlorophyll
Vacuoles	Vacuoles stores food, water, and other waste materials in the cell

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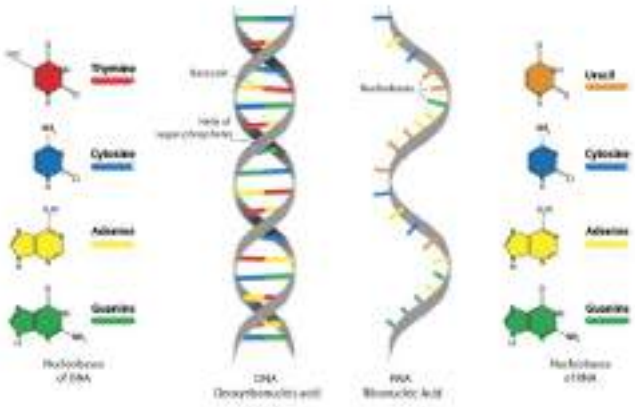
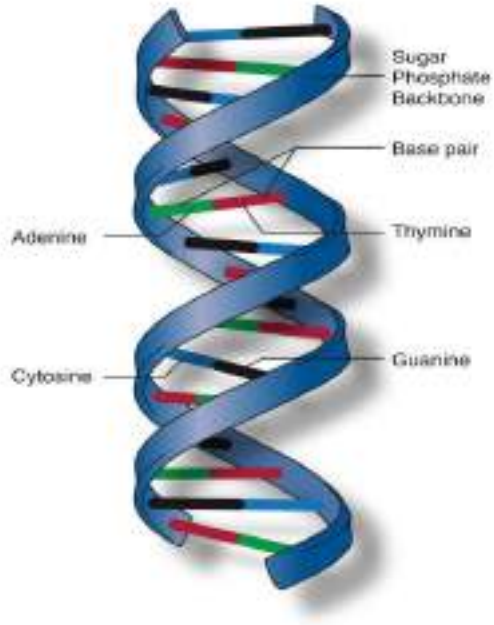
Nucleic acids (DNA & RNA)

Structure

DNA stands for (deoxyribonucleic acid), and RNA stands for (ribonucleic acid). Both are composed of nucleotides, which are the building blocks of nucleic acids. Nucleotides have three parts: a phosphate group, a sugar, and a nitrogenous base. The sugar in DNA is deoxyribose, while the sugar in RNA is ribose. The nitrogenous bases in **DNA** are adenine (A), thymine (T), cytosine ©, and guanine (G). The nitrogenous bases in **RNA** are adenine (A), uracil (U), cytosine ©, and guanine (G).



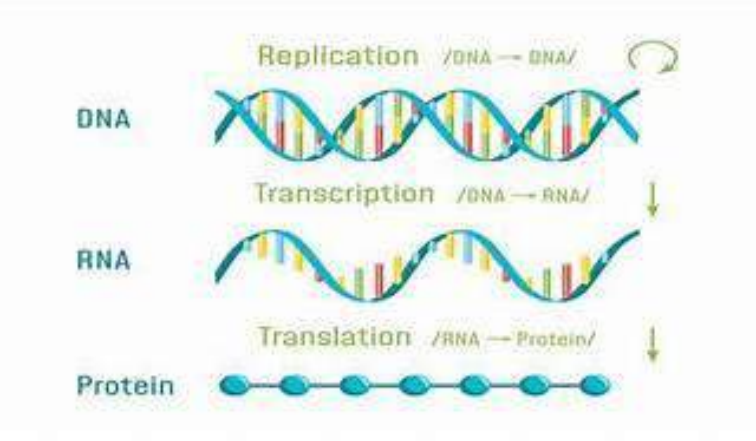


DNA and RNA have different structures and functions.

DNA is usually double-stranded, forming a double helix shape. The two strands are held together by hydrogen bonds between complementary bases: A pairs with T, and C pairs with G. DNA stores the genetic information that determines the traits and functions of an organism. DNA is located in the nucleus of eukaryotic cells, and in the cytoplasm of prokaryotic cells.

RNA is usually single-stranded, but it can fold into complex shapes. RNA can perform various roles in the cell, such as carrying the genetic information from DNA to the ribosomes, where proteins are synthesized. This type of RNA is called **messenger RNA (mRNA).** RNA can also help in the process of protein synthesis by forming the structure of the ribosomes, where mRNA is translated into amino acids. This type of RNA is called **ribosomal RNA (rRNA).** RNA can also transfer the amino acids to the ribosomes, where they are joined together to form proteins. This type of RNA is called **transfer RNA (tRNA).**

DNA and **RNA** are essential for life, as they encode and regulate the expression of genes, which are the units of heredity. DNA and RNA can also be **used** as forensic evidence, as they can be extracted from biological samples, such as blood, saliva, hair, or skin cells, and analyzed to identify individuals or determine their genetic relationships. DNA and RNA analysis can help solve crimes, identify victims, or establish paternity.



The mechanism of DNA replication is the process by which a cell copies its genetic material (DNA) before cell division. DNA replication involves several steps and many proteins and enzymes that work together to ensure the accuracy and completeness of the new DNA molecules. Here is a brief overview of the main steps of DNA replication:

- **The first step** is the formation of the replication fork, which is a Y-shaped structure where the two strands of the double helix are separated by an enzyme called DNA helicase.

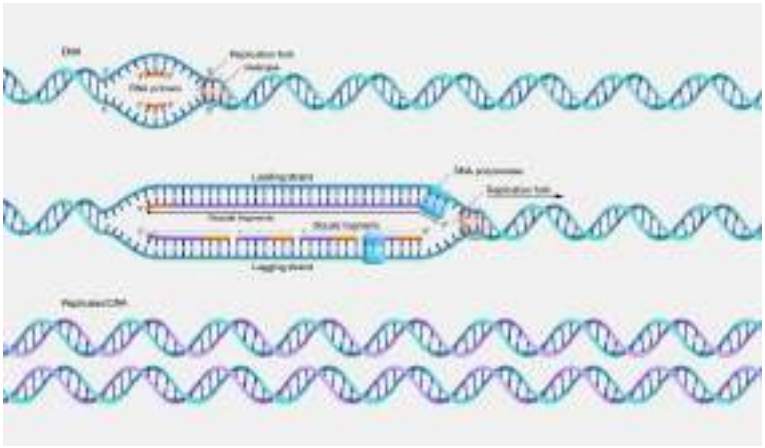
- **The second step** is the synthesis of the leading and lagging strands. The leading strand is the strand that is synthesized continuously in the same direction as the movement of the replication fork. The lagging strand is the strand that is synthesized discontinuously in the opposite direction of the replication fork. Both strands are synthesized by an enzyme called DNA polymerase, which adds nucleotides to the 3' end of the growing DNA chain, following the base-pairing rules (A with T, and C with G). However, DNA polymerase cannot start the synthesis from scratch, but needs a short RNA primer that is complementary to the template strand. The primer is made by another enzyme called DNA primase. On the leading strand, only one primer is needed at the beginning of the replication.

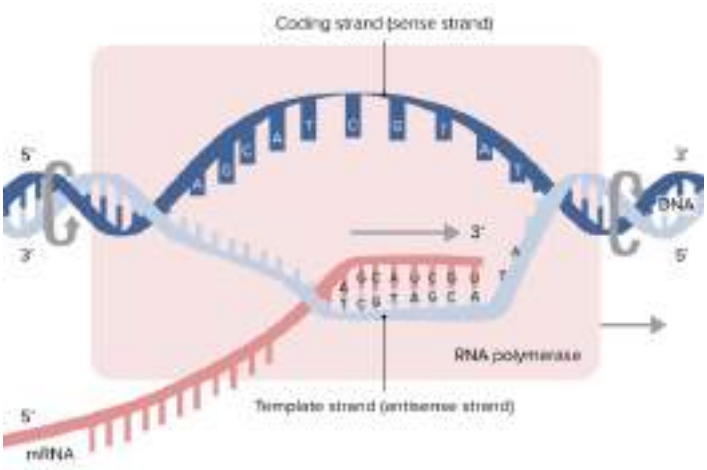
- **The third step** is the removal of the RNA primers and the joining of the Okazaki fragments. The RNA primers are removed by another enzyme called DNA polymerase I, which replaces them with DNA nucleotides.

- **The fourth step** is the proofreading and repair of the newly synthesized DNA. DNA polymerase has a proofreading function that can detect and correct errors in the DNA synthesis, such as mismatched or missing bases. However, some errors may escape the proofreading and cause mutations in the DNA.

Transcription is a process that involves copying a segment of DNA into RNA. Transcription can have different meanings depending on the context, such as in biology, linguistics, or music. In this response, I will focus on the biological meaning of transcription, which is related to genomics and gene expression.

In biology, transcription is the first step of gene expression, which is the use of genes to make proteins and other molecules that perform various functions in the cell. Transcription occurs in three main stages: **initiation**, **elongation**, and **termination**.





In initiation, an enzyme called RNA polymerase binds to a specific region of DNA called the promoter, which signals the start and direction of a gene.

In elongation, RNA polymerase moves along the DNA template strand and adds complementary RNA nucleotides to the growing RNA strand. The RNA nucleotides are adenine (A), uracil (U), cytosine ©, and guanine (G), which are similar to the DNA nucleotides, except that U replaces thymine (T).

In termination, RNA polymerase reaches a sequence of DNA called the terminator, which signals the end of the gene.

The RNA strand produced by transcription is called the primary transcript, and it may undergo further processing before becoming functional. For instance, in eukaryotes, the primary transcript may be **modified** by **adding a cap** and a **tail**, **splicing out introns**, and **editing some nucleotides**.. The RNA strand may also have different types and functions depending on the gene it is transcribed from. For example, if the gene encodes a protein, the RNA strand is called messenger RNA (mRNA), and it serves as a template for protein synthesis.

Roles in the Cell

DNA is responsible for storing genetic information and passing it on to future generations. It is also involved in protein synthesis and cell division. RNA plays a crucial role in protein synthesis, as it carries genetic information from DNA to ribosomes, where it is used to create proteins. RNA also helps regulate gene expression and is involved in the immune response.

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Human Biology (5)
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Anatomy of head and neck

the Scalp :

• The scalp is the part of the skin that covers the cranial vault, from the eyebrows anteriorly to the external occipital protuberance posteriorly, and from the zygomatic arches laterally1.

• The scalp has important roles in protecting the brain, regulating body temperature, and facilitating facial expressions1.

• The scalp consists of five layers, which can be remembered by the mnemonic SCALP: Skin, Connective tissue, Aponeurosis, Loose areolar tissue, and Pericranium.

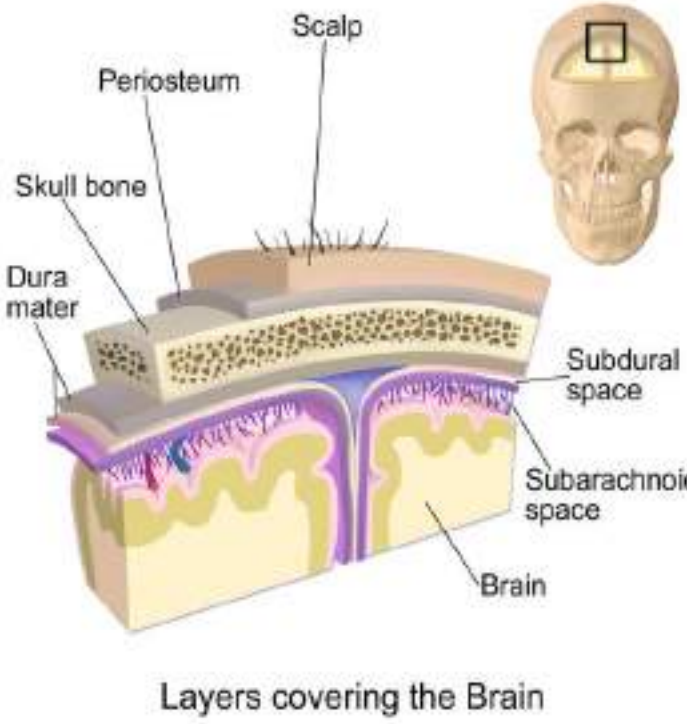
• The scalp receives a rich blood supply from branches of the external carotid artery and the ophthalmic artery, and is innervated by branches of the trigeminal nerve and the cervical plexus.

• The scalp is a common site of injuries, infections, and tumors, which can have serious consequences due to the anatomical features of the scalp.

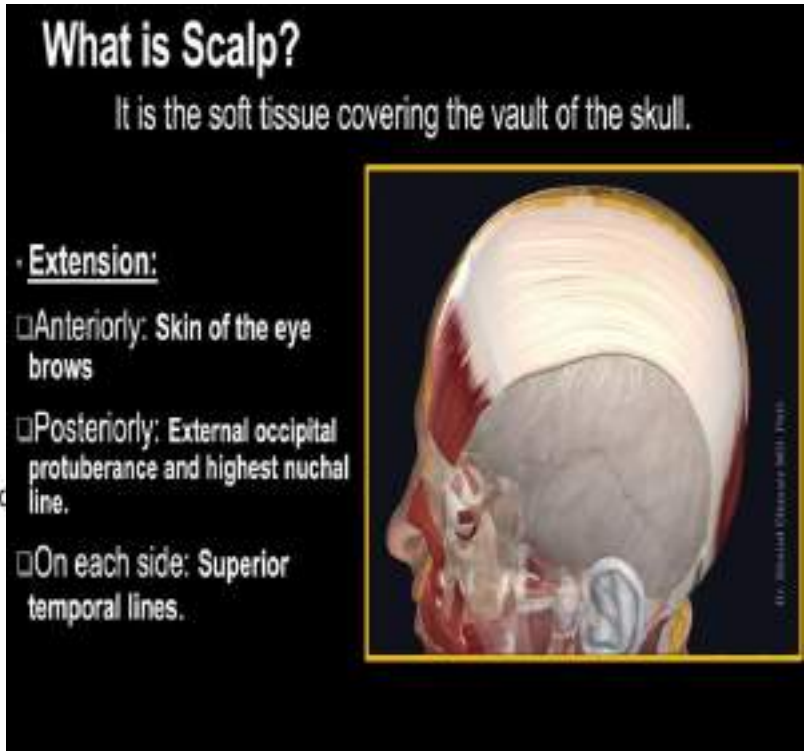
Layers of the Scalp

The layers of the scalp are the five anatomical structures that cover the skull and protect the brain. They are:

1. Skin: The outermost layer that contains hair, glands, blood vessels, and nerves12.
2. Connective tissue: A dense layer that connects the skin to the aponeurosis and contains the main arteries, veins, and nerves of the scalp1.
3. Aponeurosis: A thin, tendon-like sheet that connects the frontalis and occipitalis muscles and acts as a common tendon for the facial expression muscles1.
4. Loose areolar tissue: A thin layer that separates the aponeurosis from the periosteum and contains emissary veins that connect the extracranial and intracranial venous systems1. This is the “danger area” of the scalp, where infections can spread to the brain1.
5. Pericranium: The outer layer of the skull bones that provides nutrition and repair to the bone1.



Layers covering the Brain



The head and neck are two regions of the human body that are essential for survival, communication, and movement. The head contains the brain, which controls all the functions of the body, as well as the eyes, ears, nose, mouth, and other sensory organs. The neck connects the head to the trunk and supports it in various positions. The head and neck are composed of several structures that have different functions and origins.

The skull is a bony structure that encloses and protects the brain. It consists of two main parts: the cranial vault (or cranium) and the facial skeleton (or face). The cranial vault forms a protective shell around the brain and contains openings for nerves, blood vessels, and muscles. The facial skeleton consists of 22 bones that form the shape of the face and support its movements.

The skin is a thin layer of tissue that covers most of the body surface. It has several functions, such as protecting from infection, regulating temperature, sensing stimuli, and producing vitamin D. The skin consists of three layers: epidermis (the outermost layer), dermis (the middle layer), and hypodermis (the innermost layer). The epidermis contains keratinocytes (skin cells) that produce keratin (a protein) to form scales or hairs. The dermis contains blood vessels, nerves, hair follicles, sweat glands, sebaceous glands, and other structures that support skin function. The hypodermis contains adipose tissue (fat cells) that store energy.

Human Biology (5)
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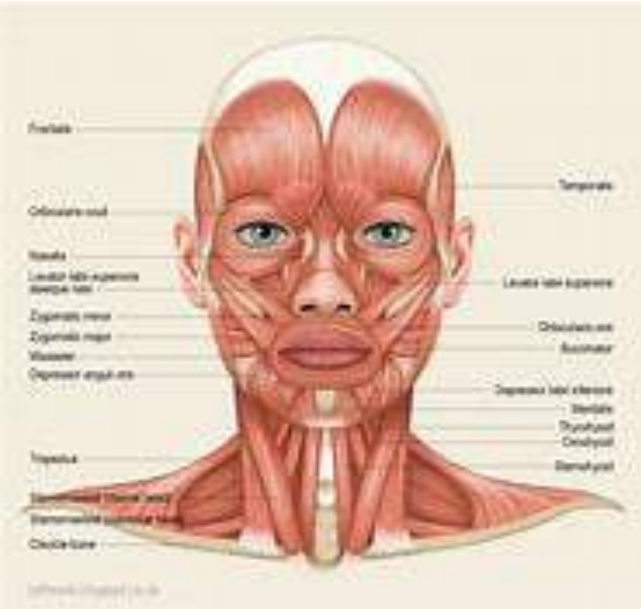
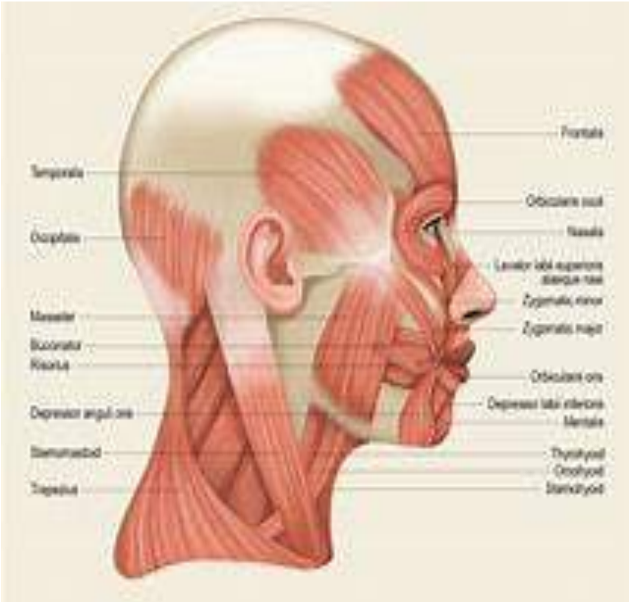
The muscles of mastication are four muscles that are involved in chewing food. They are located in the lower jaw (mandible) and consist of masseter (the main muscle), temporalis (the muscle on each side), medial pterygoid (the muscle on each side), and lateral pterygoid (the muscle on each side). These muscles work together to move the mandible up and down, forward and backward, side to side.





The facial muscles are five groups of muscles that control facial expressions. They are located in different parts of the face: orbital (around each eye), nasal (around each nostril), oral (around each corner of mouth), auricular (around each ear), and scalp/neck/shoulder/upper arm/upper arm/upper arm/upper arm/upper arm/upper arm/upper arm/upper arm/upper arm/upper arm/upper arm/upper arm/upper arm/upper arm/upper arm/upper arm/ upper arm (around the neck and shoulder) . These muscles work together to move the eyebrows, nose, lips, cheeks, jaw, tongue, and other facial features.

The salivary glands are three pairs of glands that produce saliva for moistening food in preparation for swallowing. They are located in different parts of the mouth: parotid gland near each ear; submandibular gland below each jaw; sublingual gland under each tongue; lacrimal gland near each eye; palatine gland behind each cheek; tonsillar glands at base of throat.

The arteries are blood vessels that carry oxygen-rich blood from heart to different parts of body. There are many arteries in head region but some important ones are:

- Common carotid artery: it arises from brachiocephalic trunk at base of neck; it divides into internal carotid artery anteriorly; external carotid artery posteriorly.
- Internal carotid artery: it runs along internal surface of skull; it gives off several branches such as anterior cerebral artery anteriorly; middle cerebral artery laterally; posterior cerebral artery posteriorly.
- External carotid artery: it runs along external surface of skull; it gives off several branches such as ophthalmic artery anteriorly; maxillary artery laterally.
- Ophthalmic artery: it supplies blood to eye.
- Maxillary artery: it supplies blood to face.
- Facial nerve: it arises from pons at base of brainstem; it passes through foramen magnum at base of skull; it gives off several branches such as zygomatic nerve lateral to eye; nasopalatine nerve near nose; auricular branch near ear; trigeminal nerve superiorly; mandibular branch inferiorly.

The nerves are bundles or cords formed by axons or nerve fibers that transmit electrical impulses between different parts of body or between body parts and brain. There are many nerves in head region but some important ones are:

- **Trigeminal nerve: it is one cranial nerve with three divisions:**
  - Olfactory nerve superiorly;
  - Maxillary nerve laterally;
  - Mandibular nerve inferiorly.
  - Trigeminal nerve provides sensation to face, teeth, gums, tongue

The cervical vertebrae are the seven bones that form the neck region of the spine, between the skull and the thoracic vertebrae. The cervical vertebrae are the smallest and most delicate of the vertebrae, but they have important roles in supporting the head, allowing head and neck movements, and protecting the spinal cord and the vital structures in the neck. The cervical vertebrae are named and numbered from C1 to C7, from superior to inferior. The first two cervical vertebrae, C1 and C2, are also known as the atlas and the axis, respectively, and have unique shapes and functions. The rest of the cervical vertebrae, from C3 to C7, are considered typical and share similar features.

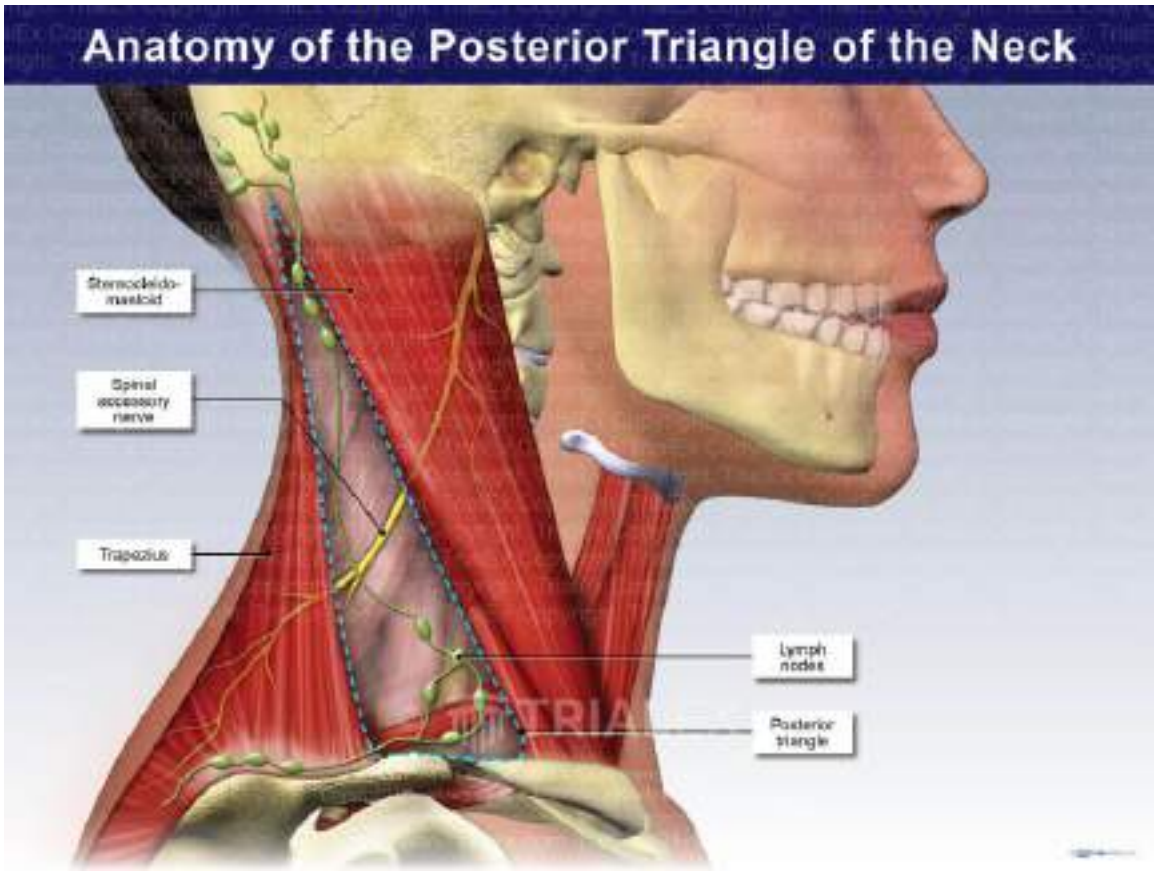
Structure and Function of the Cervical Vertebrae

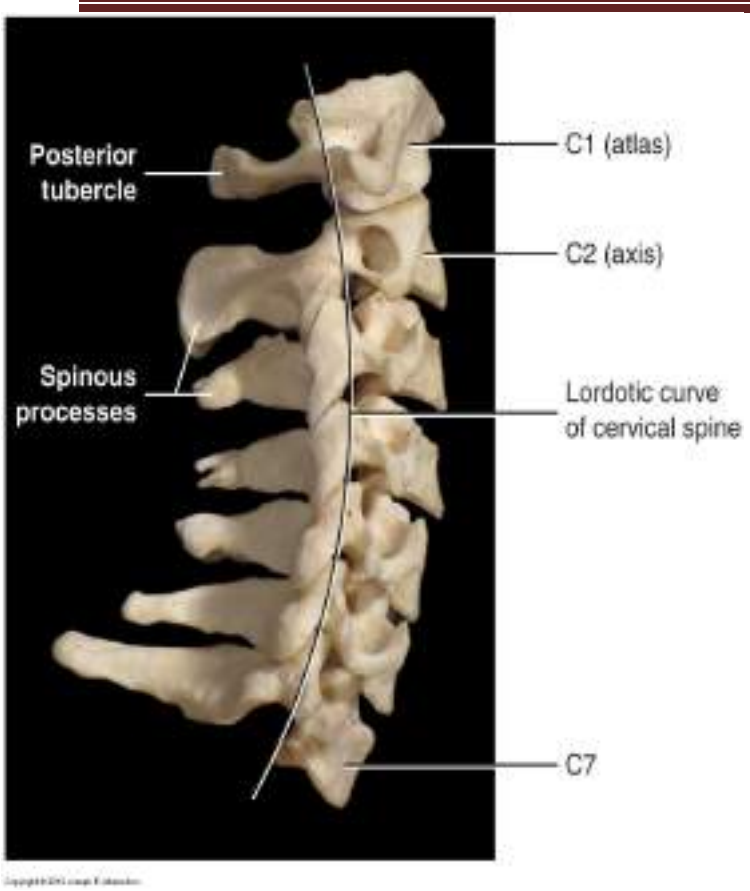
Each cervical vertebra consists of a vertebral body, a vertebral arch, and seven processes. The vertebral body is the cylindrical part of the vertebra that faces anteriorly and supports the weight of the head and the upper body.

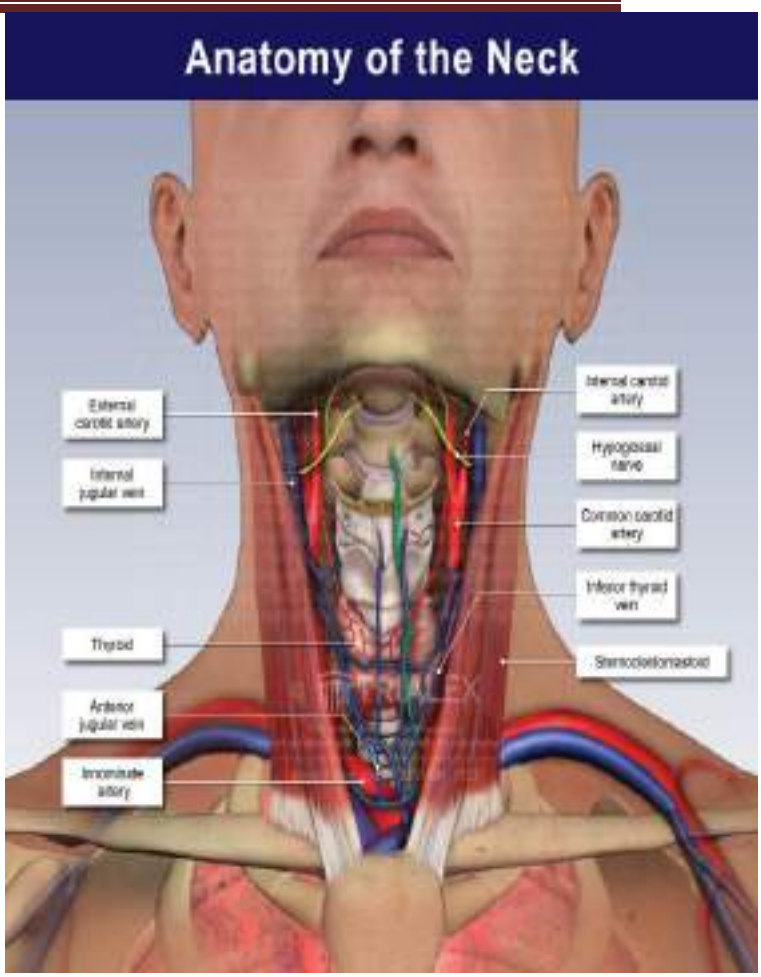
The vertebral arch is the posterior part of the vertebra that surrounds the vertebral foramen, a large opening that contains the spinal cord and its protective membranes. The processes are bony projections that serve as attachment sites for muscles, ligaments, and joints.

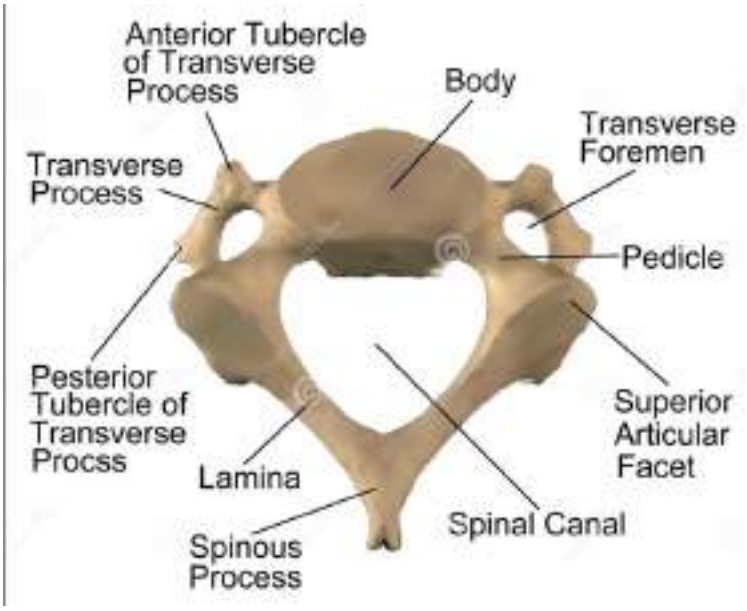
The processes include the spinous process, the transverse processes, and the articular processes. The spinous process is a single, midline projection that extends posteriorly from the vertebral arch and can be felt as a bony prominence on the back of the neck.

The transverse processes are two lateral projections that extend from the junction of the vertebral body and the vertebral arch. The transverse processes have a distinctive feature in the cervical vertebrae: the transverse foramina, which are small openings that transmit the vertebral arteries and veins. The articular processes are four projections that arise from the junction of the pedicles and the laminae, the two parts of the vertebral arch. The articular processes have smooth surfaces called facets that form joints with the adjacent vertebrae. The superior articular processes face upward and articulate with the inferior articular processes of the vertebra above. The inferior articular processes face downward and articulate with the superior articular processes of the vertebra below. The joints between the articular processes are called facet joints or zygapophyseal joints, and they allow gliding movements between the vertebrae.




Posterior tubercle
C1 (atlas)
C2 (axis)
Spinous processes
Lordotic curve of cervical spine
C7


Anatomy of the Neck


Anterior Tubercle of Transverse Process
Body
Transverse Foremen
Transverse Process
Pedicle
Pesterior Tubercle of Transverse Procss
Superior Articular Facet
Lamina
Spinal Canal
Spinous Process