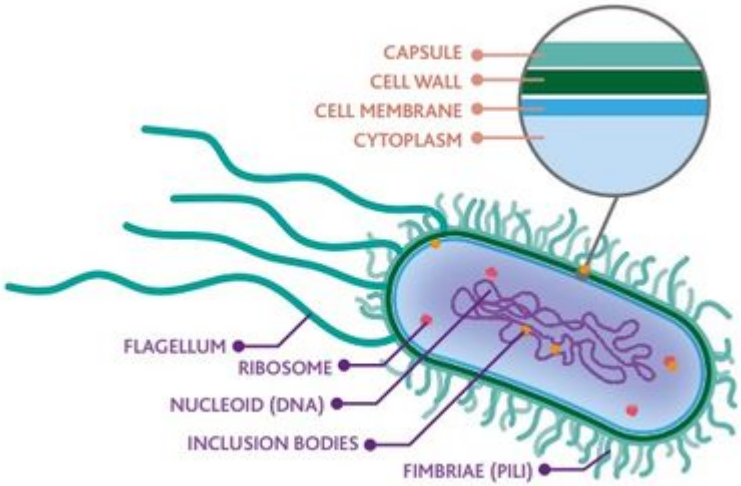
Medical biology Dr. Zainab Kamil Yousif

Bacteria and oral diseases

Introduction



Bacteria are microscopic, single-celled organisms. They are among the earliest known life forms on earth. There are thousands of different kinds of bacteria, and they live in every conceivable environment all over the world. Some are airborne and others are most prevalent in water, soil, plants, animals, and even people.

Bacteria lack a membrane-bound nucleus and other internal structures and are therefore ranked among the unicellular life-forms called prokaryotes. Some bacteria can cause diseases in humans, animals, or plants. Many strains of bacteria are harmless and some are even beneficial, such as those found in the human gastrointestinal tract to aid digestion and produce vitamins. There are few (less than 1% of all bacteria types) that cause illness in humans. Some bacteria can be quite dangerous, resulting in salmonella, pneumonia, or meningitis.

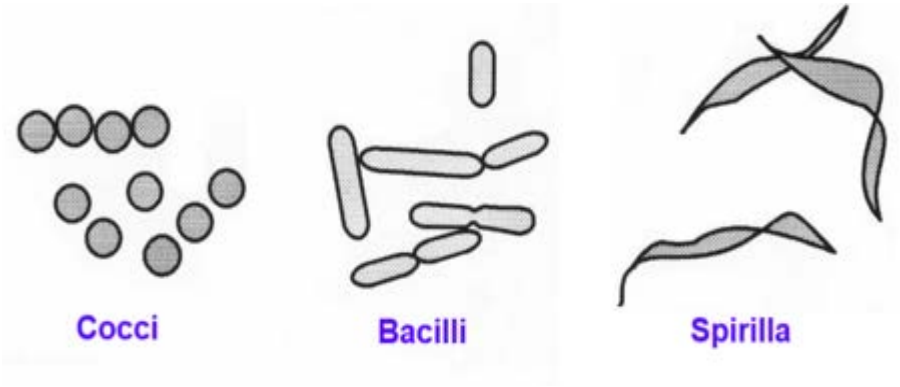
- The global problem of infectious and deadly diseases caused by bacteria.
- Bacterial infections have a large impact on public health.
- As a general rule, bacterial infections are easier to treat than viral infections, since we have an extensive army of antimicrobial agents with activity against bacteria.
- Bacterial resistance to antimicrobials is a rapidly growing problem.
- The most deadly bacterial disease contracted by human beings is mycobacterium tuberculosis, the world's leading infectious disease with more than 1,700,000 deaths per year. As much as 13% of cases are resistant to most antibiotics, and about 6% are resistant or unresponsive to essentially all treatment.
    - Structure

- Bacteria are prokaryotic organisms that carry their genetic information in a double-stranded circular molecule of DNA. Some species also contain small circular plasmids of additional DNA. The cell cytoplasm contains ribosomes and there is both a cell membrane and, in all species except *Mycoplasma*, a complex cell wall. External to the cell wall, some bacteria have capsules, flagella, or pili. Bacteria normally reproduce by binary fission. Under the proper conditions, some bacteria can divide and multiply rapidly. Consequently, some infections require only a small number of organisms to cause potentially infection.

Classification

Several ways include:

- 1- Staining: Gram-positive or Gram-negative based on the characteristics of their cell wall, as seen under a microscope after stains have been administered, a procedure called Gram staining, that was developed in 1882 by Hans Christian Gram. Most bacteria fall into one of these two categories. One of the main differences between gram-positive and gram-negative organisms is that gram-negative bacteria tend to produce an endotoxin that can cause tissue destruction, shock, and death. The two classes of bacteria differ in their antibiotic susceptibilities as well, and different types of antibiotics are effective against them.
- 2- Need for oxygen: Aerobic or Anaerobic, based on their growth responses in the presence and absence of oxygen.
- 3- Scientific names: Bacteria, like other living things, are classified by genus (based on having one or several similar characteristics) and, within the genus, by species. Their scientific name is genus followed by species (for example, Clostridium botulinum). Within a species, there may be different types, called strains. Strains differ in genetic makeup and chemical components. Sometimes certain drugs and vaccines are effective only against certain strains.
- 4- Shapes: All bacteria may be classified as one of three basic shapes: spheres (cocci), rods (bacilli), and spirals or helixes (spirochetes).



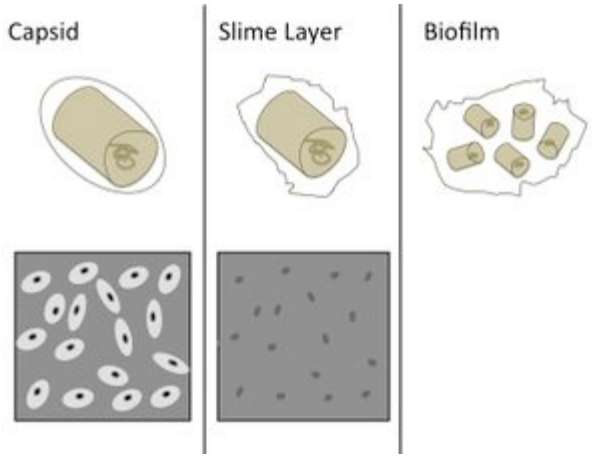
Mode of Action

Each species of bacteria infects certain organs, eg : Neisseria meningitidis normally infects the meninges of the central nervous system, it is not, however, a cause of skin infection.

Disease can be caused by the:

- Destruction of the body's cells by the organism
- Body's immune response to the infection. The immune response is the way in which the body recognizes and defends itself against bacteria, viruses, and other substances that are foreign and harmful. It is the job of the immune system to protect our bodies from harmful invaders by recognizing and responding to antigens.

Bacterial Defences

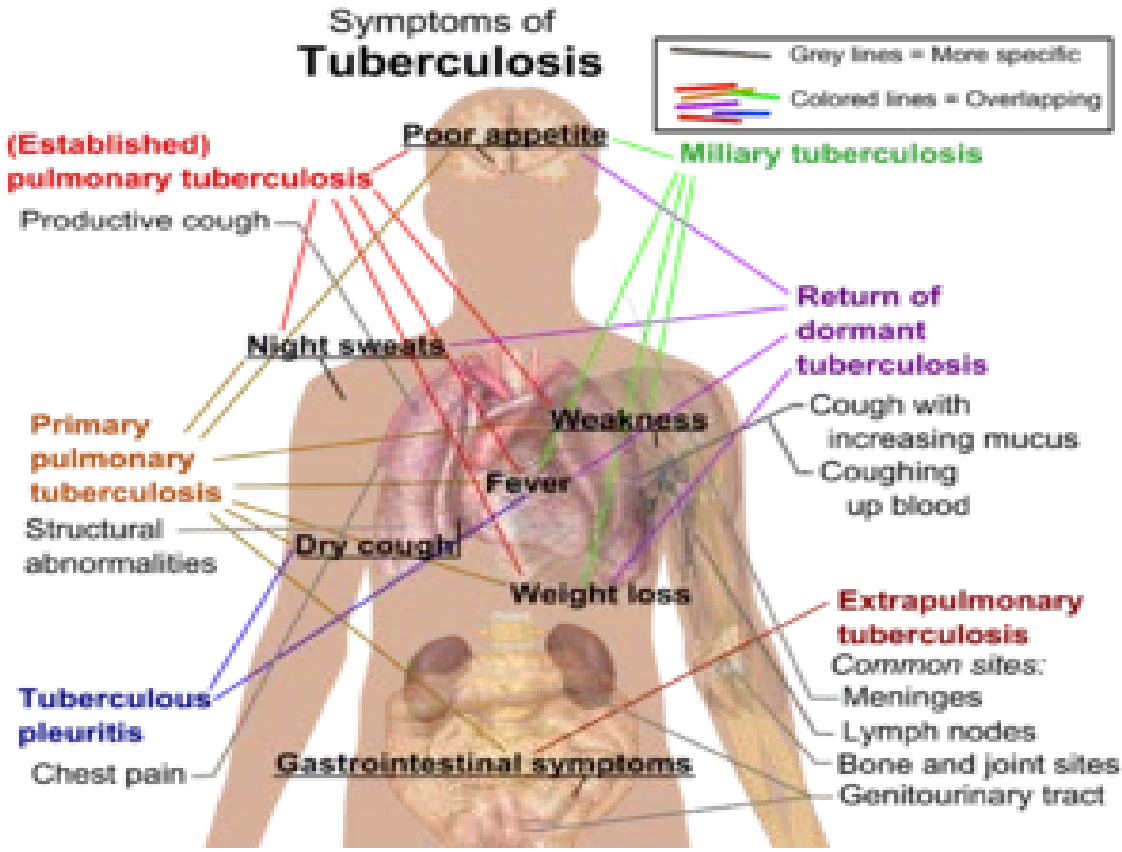


Bacteria have many ways of defending themselves include:

- Biolfilm
- Capsule: Some bacteria are enclosed in a protective capsule which helps prevent white blood cells from ingesting the bacteria.
- Outer membrane: Under the capsule, gram-negative bacteria have an outer membrane that protects them against certain antibiotics. When disrupted, this membrane releases endotoxins. Endotoxins contribute to the severity of symptoms during infections with gram-negative bacteria.
- Spores: an inactive (dormant) form of bacteria. Spores can enable bacteria to survive when environmental conditions are difficult. When conditions are favorable, each spore germinates into an active bacterium.
- Flagella: Long, thin filaments that protrude from the cell surface and enable bacteria to move. Bacteria without flagella cannot move on their own.
- Antibiotic Resistance: Some bacteria are naturally resistant to certain antibiotics. Other bacteria develop resistance to drugs

because they acquire genes from other bacteria that have become resistant or because their genes mutate. The genes that encode for drug resistance can be passed to following generations of bacteria or sometimes even to other species of bacteria.

Most Deadly Bacterial Infections



- Tuberculosis

- Anthrax
- Tetanus
- Leptospirosis
- Pneumonia

- Gonorrhea
- Bubonic Plague
- Syphilis

Oral diseases

Despite the presence of saliva and the mechanical forces of chewing and eating, some microbes thrive in the mouth. These microbes can cause damage to the teeth and can cause infections that have the potential to spread beyond the mouth and sometimes throughout the body.

Dental caries, **tartar**, and **gingivitis** are caused by overgrowth of oral bacteria, usually *Streptococcus* and *Actinomyces* species, as a result of insufficient dental hygiene.

Dental caries

Cavities of the teeth, known clinically as dental caries, are microbial lesions that cause damage to the teeth. If dental caries are not treated, the infection can become an abscess that spreads to the deeper tissues of the teeth, near the roots, or to the bloodstream.

Periodontal Disease

In addition to damage to the teeth themselves, the surrounding structures can be affected by microbes. Periodontal disease is the result of infections that lead to inflammation and tissue damage in the structures surrounding the teeth. The progression from mild to severe periodontal disease is generally reversible and preventable with good oral hygiene.

Figure represent the redness and irritation of the gums are evidence of gingivitis

- Gingivitis can worsen, allowing *Porphyromonas*, *Streptococcus*, and *Actinomyces* species to spread and cause **periodontitis**.
- The herpes simplex virus type 1 can cause lesions of the mouth and throat called **herpetic gingivostomatitis.**

Trench Mouth

When certain bacteria, such as *Prevotella intermedia*, *Fusobacterium* species, and *Treponema vicentii*, are involved and periodontal disease progresses, acute necrotizing ulcerative gingivitis or trench mouth, also called Vincent's disease, can develop. This is severe periodontitis characterized by erosion of the gums, ulcers, substantial pain with chewing, and halitosis

Figure represent inflamed, eroded gums are an example of a mild case of acute necrotizing ulcerative gingivitis, also known as trench mouth.

- Other infections of the mouth include **oral thrush**, a fungal infection caused by overgrowth of *Candida* yeast, and **mumps**, a viral infection of the parotid salivary glands caused by the mumps virus, a paramyxovirus.

Prevention

Prevention is especially important in this age of increasing antibiotic resistance, because treatment can be so difficult to achieve.

Prevention and Control

- **There are three major principals of control of bacterial infection:**
- 1- Eliminate or contain the source of infection, interrupt the chain of transmission, and protect the host against infection or disease (which measure is most effective often depends on the reservoir for the infection).
- 2- There is increasing recognition that elimination of important cofactors, such as air pollution from vehicles or from indoor cooking, can markedly reduce the incidence of bacterial infections.
- 3- Prevention of infection e.g through a vaccine, is generally called primary prevention, treatment of infected people to prevent symptomatic infection is called secondary prevention, and treatment of infected people to prevent transmission to other humans is called tertiary prevention.

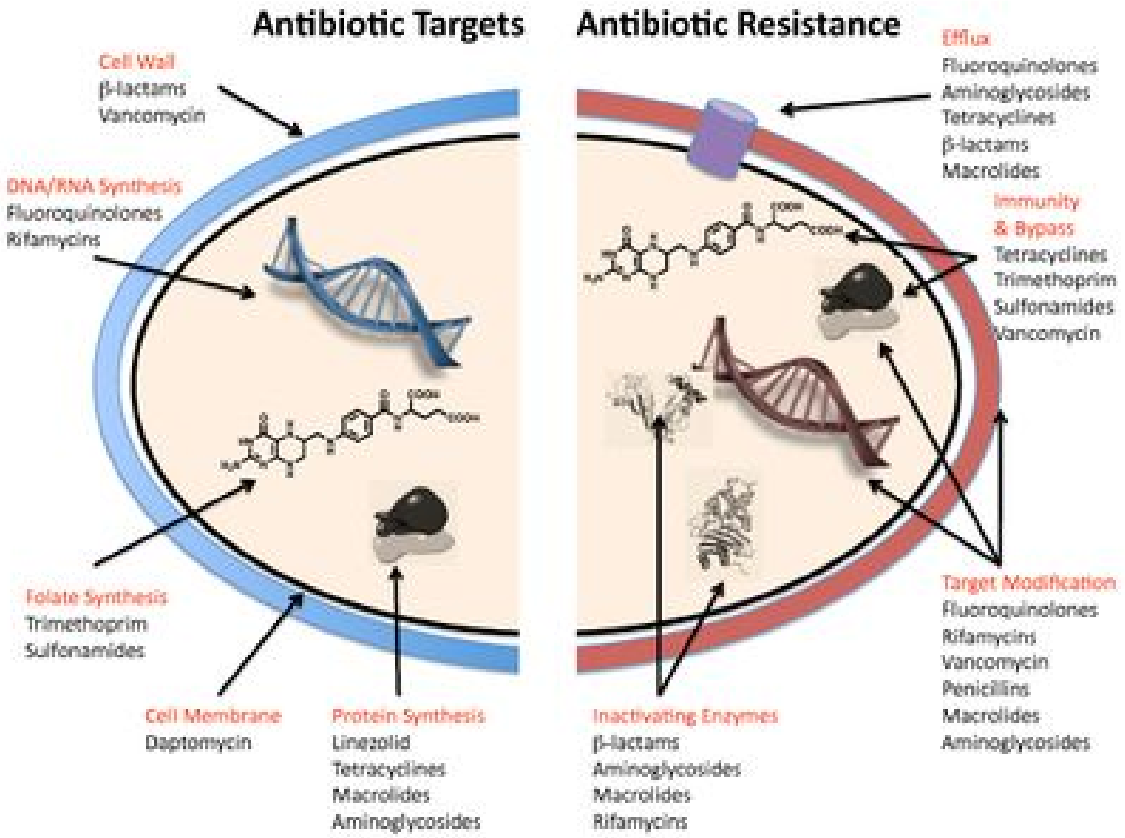
Antibiotic resistance

Antibiotic resistance is one of the biggest threats to global health, food security, and development today.

- Antibiotic resistance can affect anyone, of any age, in any country.
- Antibiotic resistance occurs naturally, but misuse of antibiotics in humans and animals is accelerating the process.
- A growing number of infections – such as pneumonia, tuberculosis, gonorrhoea, and salmonellosis – are becoming harder to treat as the antibiotics used to treat them become less effective.

- Antibiotic resistance leads to longer hospital stays, higher medical costs.

The diagram below, showing the ways in which antibiotics can disrupt bacterial processes, and the methods of antibiotic resistance bacteria often use.



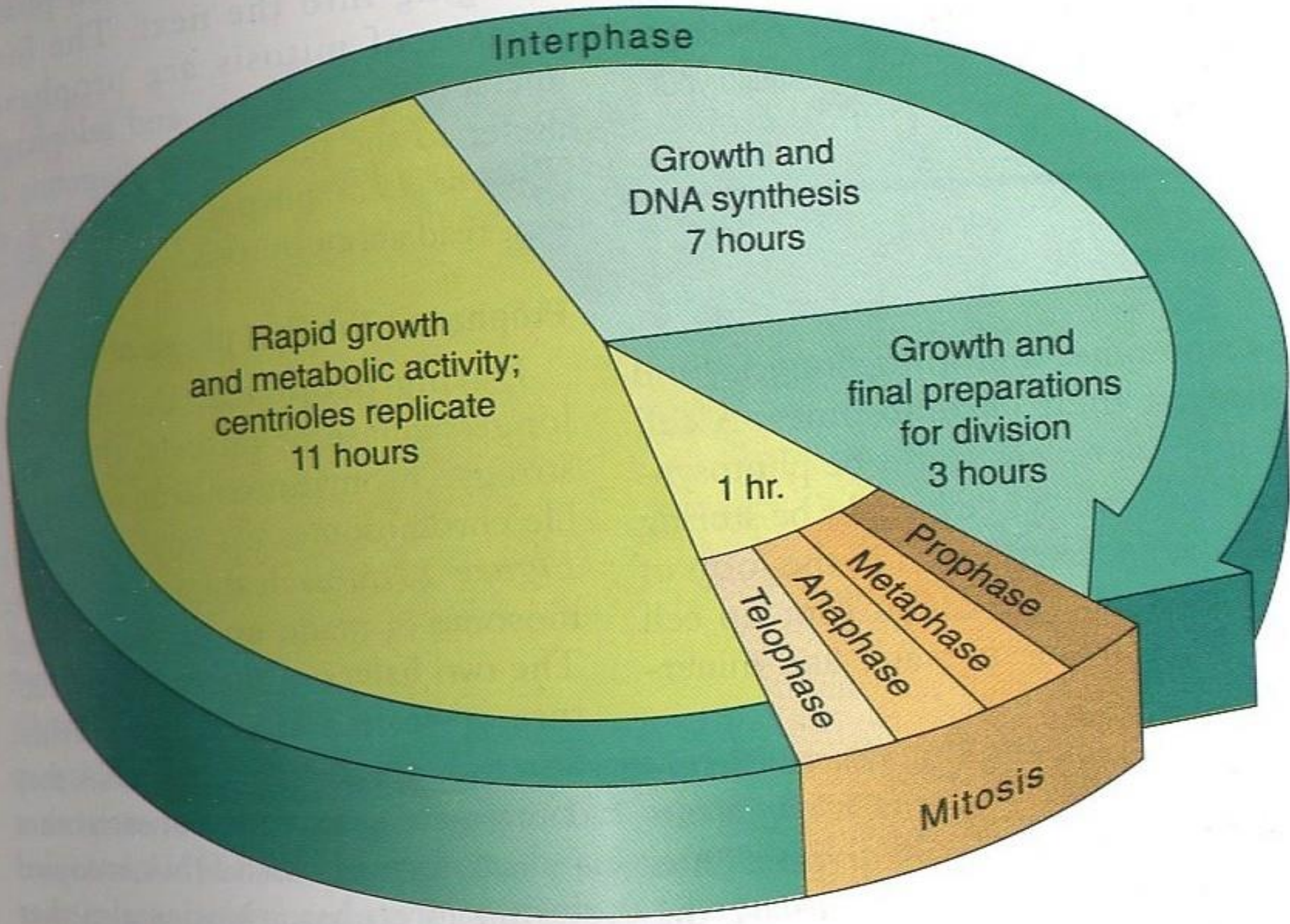
The Cell Cycle- Mitosis and Meiosis

Interphase- G_1, S, G_2

Mitosis or Meiosis

The Cell Cycle

- The sequence of growth and division of a cell


Interphase
Growth and
DNA synthesis
7 hours
Rapid growth
and metabolic activity;
centrioles replicate
11 hours
Growth and
final preparations
for division
3 hours
1 hr.
Prophase
Metaphase
Anaphase
Telophase
Mitosis

Interphase = G_1, S, G_2

- Interphase is when the cell grows, and the organelles double prior to the actual splitting of the nucleus.
- 93% of a cell's life is spent in interphase.
- Interphase has three parts
  - Growth 1 (G_1)
  - Synthesis (S)
  - Growth 2 (G_2)

G_1, S, G_2

- G_1 is when organelles double.
  - Remember each new cell needs a complete set of organelles.
- S when DNA is replicated.
  - Each cell needs a complete and identical set of DNA
- G_2 Proteins needed for Mitosis are produced.

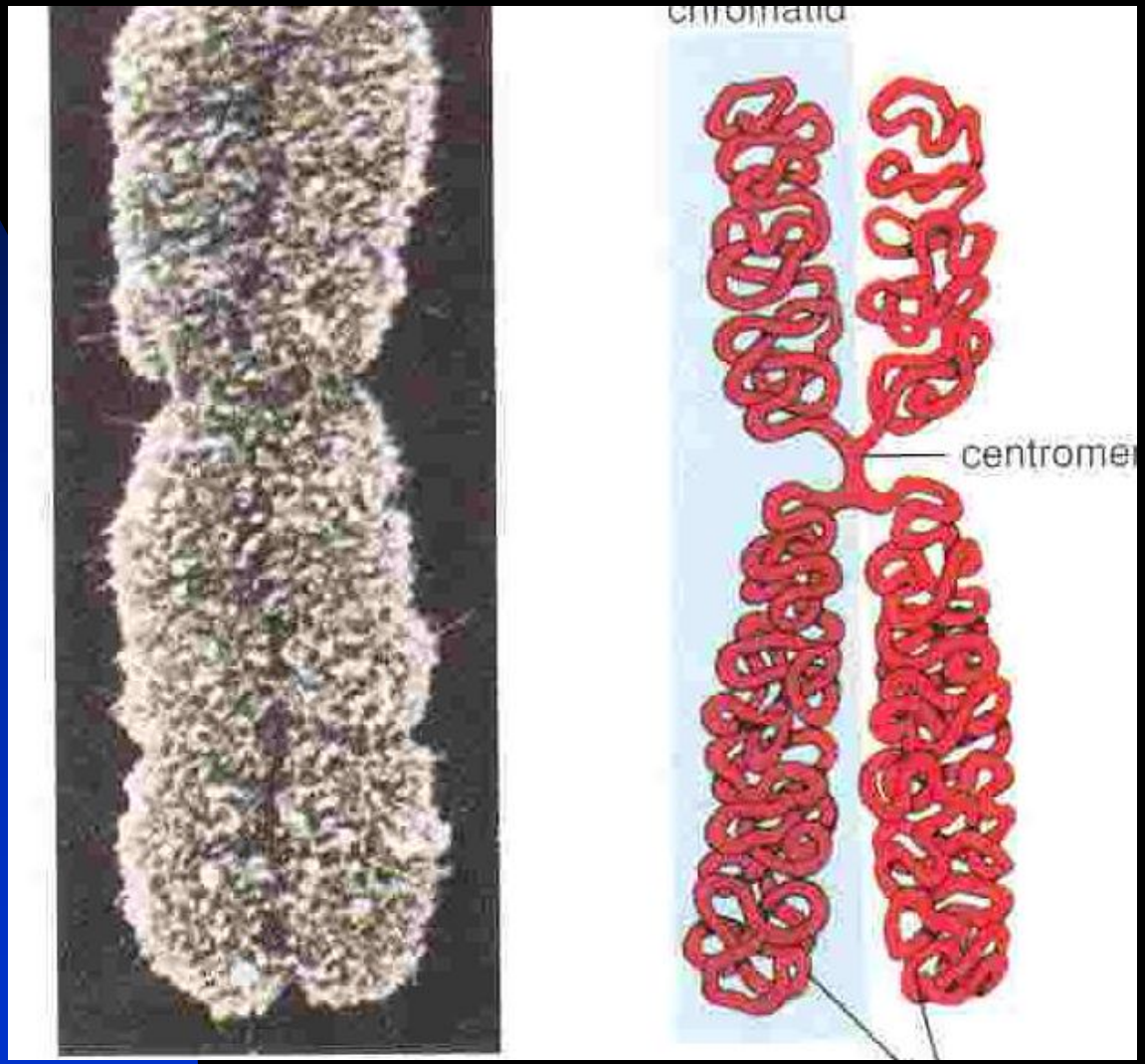
Mitosis

- The process by which the cell nucleus divides into two identical cell nuclei.
- Occurs in a series of steps
  - Prophase
  - Metaphase
  - Anaphase
  - Telophase
    - Cytokinesis

Chromosomes

- Must duplicate and separate during Mitosis
- Structures of the tightly packaged DNA
- DNA is tangled up into a substance of chromatin
- The chromatin is packaged on the chromosome

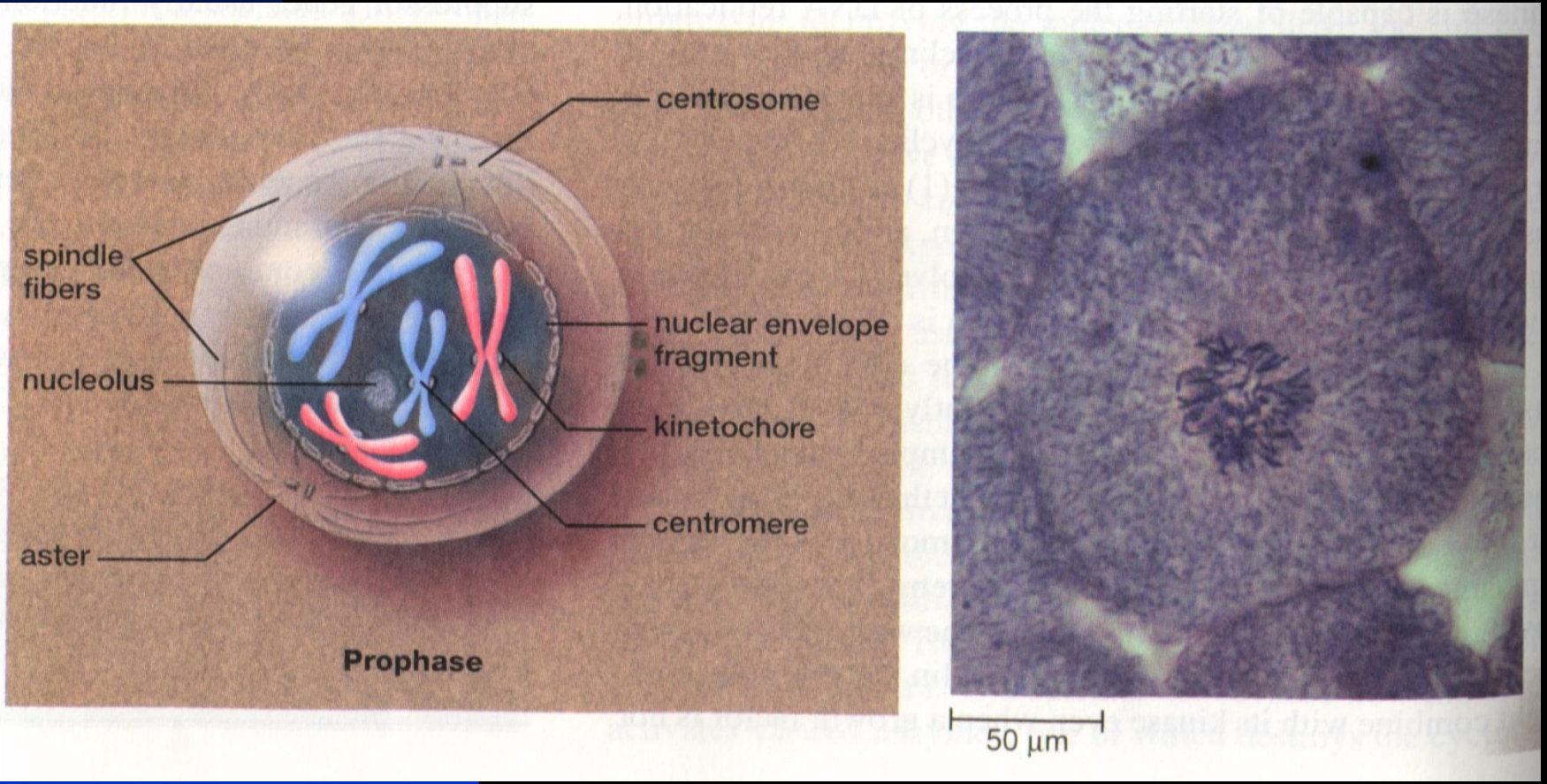
Chromosomal structure



Prophase

- Chromosomes now called chromatids because they doubled to form short thick rods which pair up and line up in the center of the nucleus.
- A centromere connects the two halves of the doubled chromatids.
- Spindle fibers begin to form.
  - Spindle fiber – a fibrous structure from the cytoplasm which forms to the centriole.
- Centrioles move to opposite sides of the cell.
- The nuclear membrane breaks down.

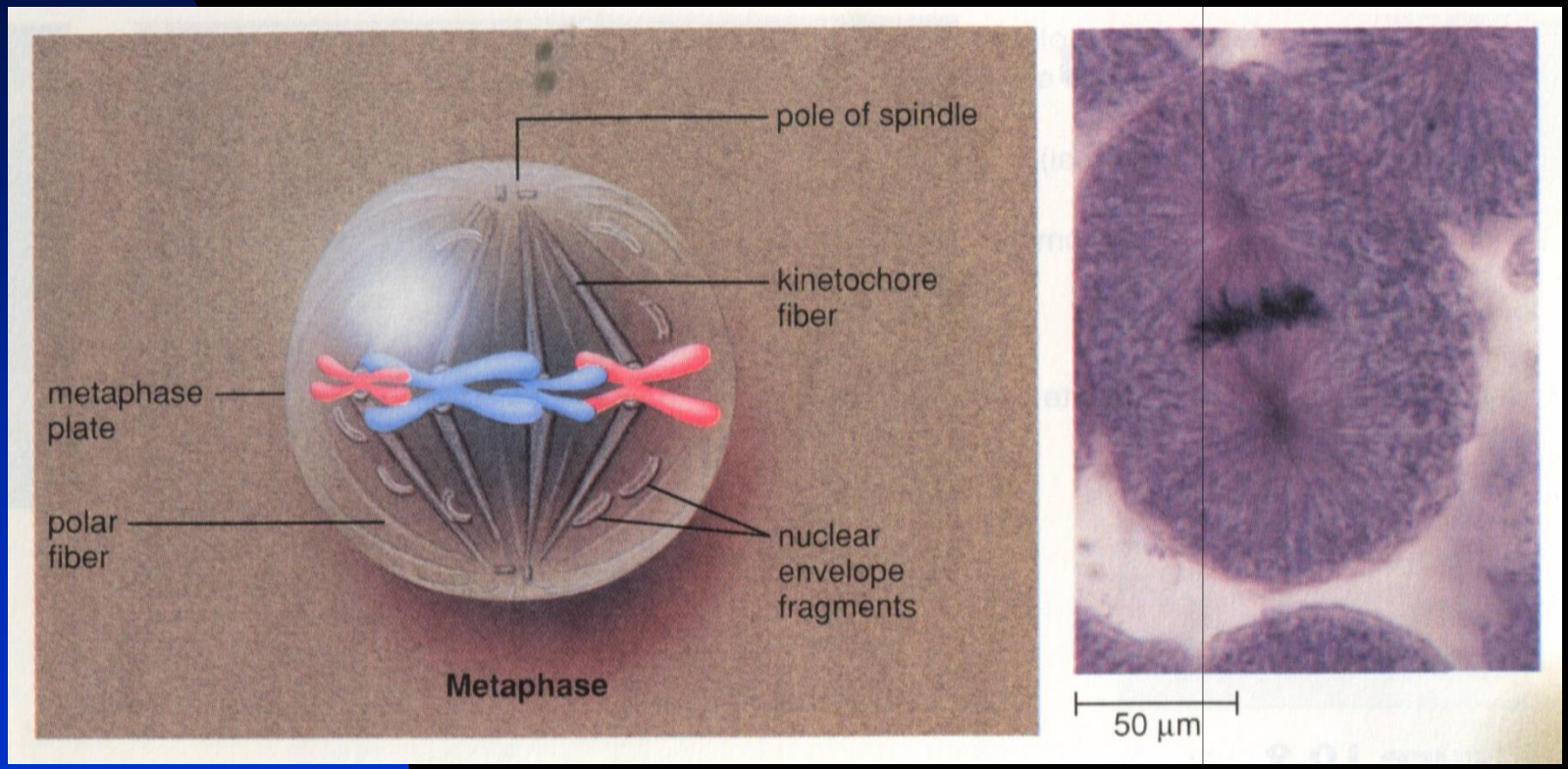
Prophase


centrosome
spindle fibers
nuclear envelope fragment
nucleolus
kinetochore
centromere
aster
Prophase
50 µm

Metaphase

- Centromeres of the chromatid pairs line up in the middle of the cell.
- Metaphase plate- location where the centromeres line up in the center of the cell.
- By the end of metaphase each chromatid has attached to spindle fibers.

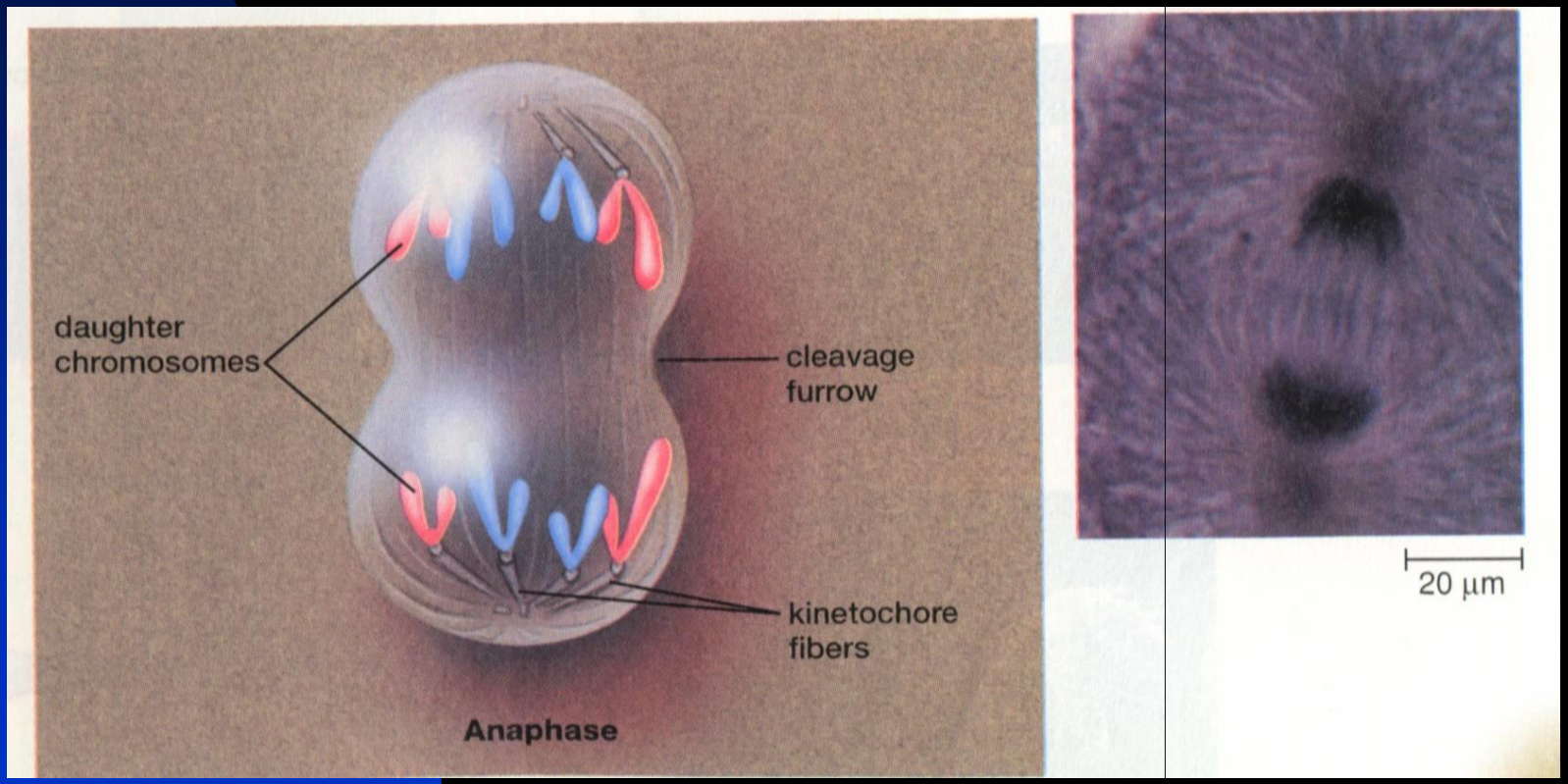
Metaphase


pole of spindle
kinetochore fiber
metaphase plate
polar fiber
nuclear envelope fragments
Metaphase
50 µm

Anaphase

- The spindle fibers pull the chromatids apart.
- This separates each one from its duplicate. These move to opposite sides of the cell.
- Now there are two identical sets of chromosomes.

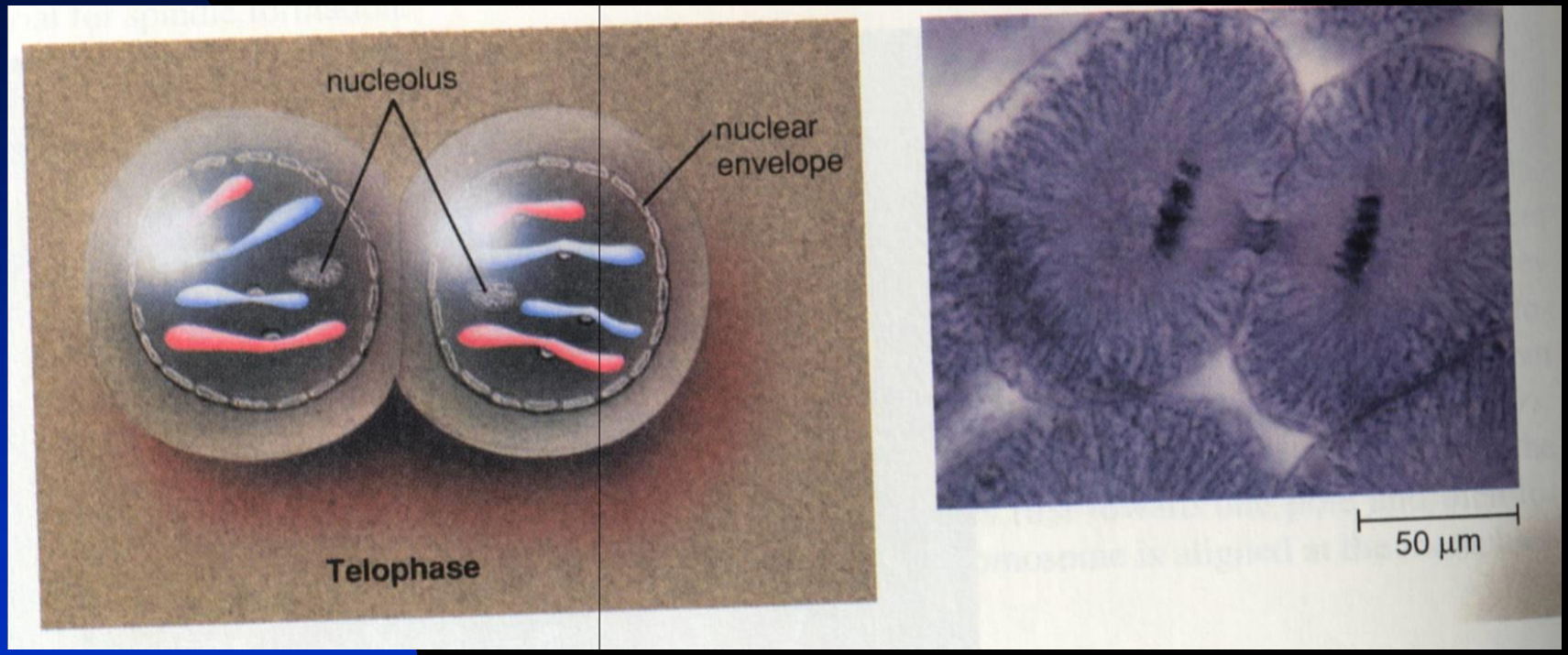
Anaphase


daughter chromosomes
cleavage furrow
kinetochore fibers
Anaphase
20 µm

Telophase

- When the chromosomes reach opposite sides of the cell the spindle fibers break up.
- The nuclear membrane begins to reform.
- A furrow begins to develop between the two sets of chromosomes.

Telophase



Cytokinesis

- The two identical cells completely divide and the cell membrane is completely formed.

Meiosis

- Diploid (2n) - A cell with two of each kind of chromosome.
  - One chromosome from each parent.
- If two body cells were to combine nuclei, the number of chromosomes would double.
- In order for sexual reproduction to occur, each cell involved must reduce its chromosome number by half.
- Haploid (n)- A cell with one of each kind of chromosome.

Haploid cells

- Haploid cells are called gametes
- Gametes are either sperm or eggs
Organism	diploid	gamete
Human	46	23
Pea	14	7
Fruit fly	8	4
Dog	78	39

Meiosis

- Meiosis is the process of cell division in which gametes are formed and the number of chromosomes is halved. So that sexual reproduction and zygote formation can occur.
- Zygote- Fertilized egg which has a diploid number of chromosomes.

Stages of Meiosis

- Interphase-
  - Chromosomes replicate
  - Each chromosome consists of 2 identical sister chromatids
- Prophase I
  - Each Pair of homologous chromosomes come together to form a tetrad.
  - Tetrad- 2 homologous chromosomes come together and the 4 chromatids overlap.

Metaphase I

- Homologous chromosomes line up together in pairs.
  - * In mitosis homologous chromosomes line up in the middle independently of each other.

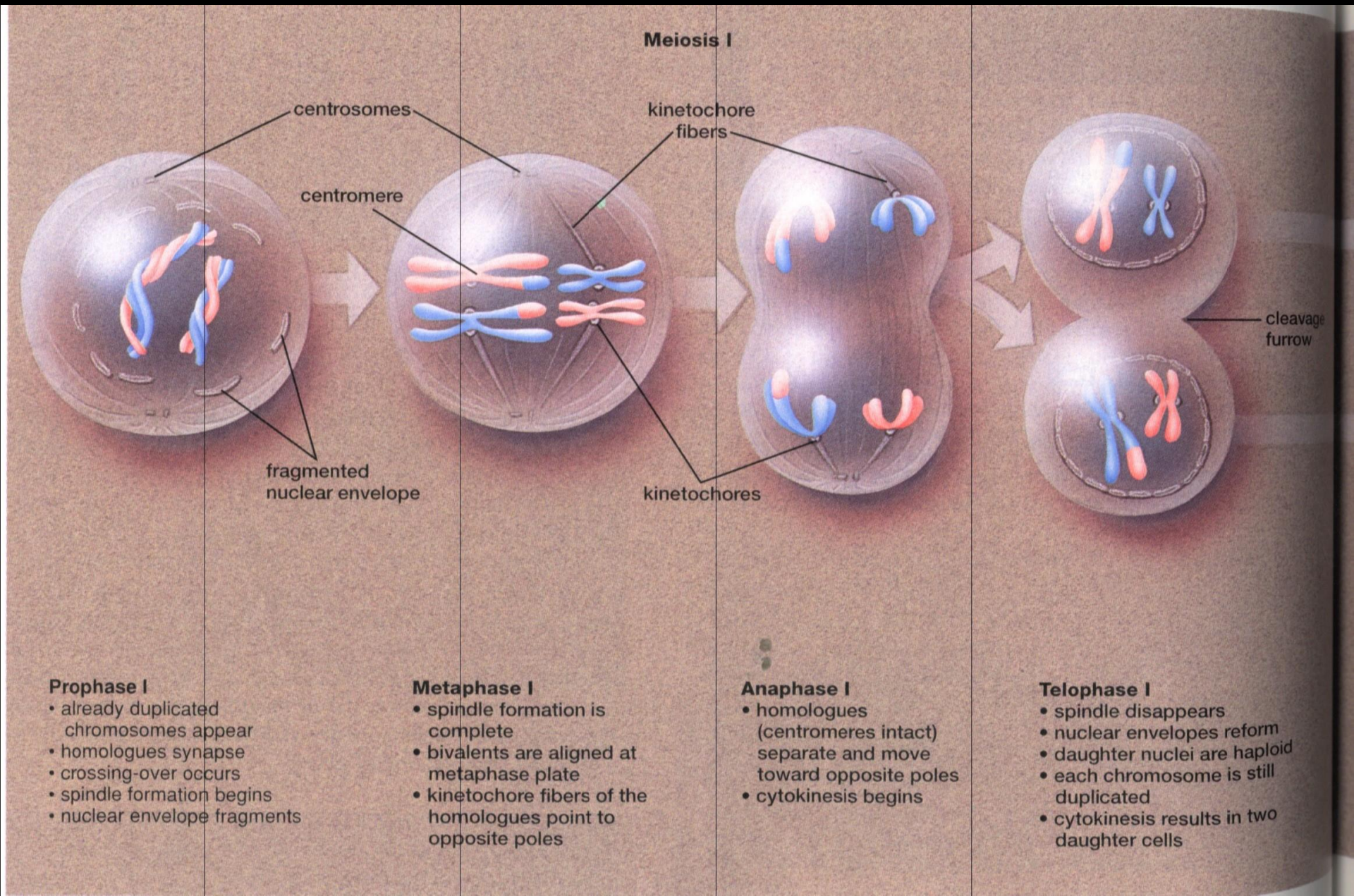
Anaphase I

- Spindle fibers attach to the centromeres of each pair.
- Homologous chromosomes separate and move to opposite ends of the cell.
- Centromeres DO NOT split like they do in mitosis
- Now each cell will get one chromosome from each homologous pair.

Telophase I

- Spindle fibers break down
- Chromosomes uncoil
- Cytoplasm divides
- Another cell division is needed because the number of chromosomes has not been reduced
- After telophase I there maybe a short interphase, but not always. It is important to note that if a cell does have a second interphase, there is No replication of chromosomes.

Meiosis I


Meiosis I
centrosomes
centromere
fragmented nuclear envelope
kinetochore fibers
kinetochores
cleavage furrow
Prophase I
• already duplicated chromosomes appear
• homologues synapse
• crossing-over occurs
• spindle formation begins
• nuclear envelope fragments
Metaphase I
• spindle formation is complete
• bivalents are aligned at metaphase plate
• kinetochore fibers of the homologues point to opposite poles
Anaphase I
• homologues (centromeres intact) separate and move toward opposite poles
• cytokinesis begins
Telophase I
• spindle disappears
• nuclear envelopes reform
• daughter nuclei are haploid
• each chromosome is still duplicated
• cytokinesis results in two daughter cells

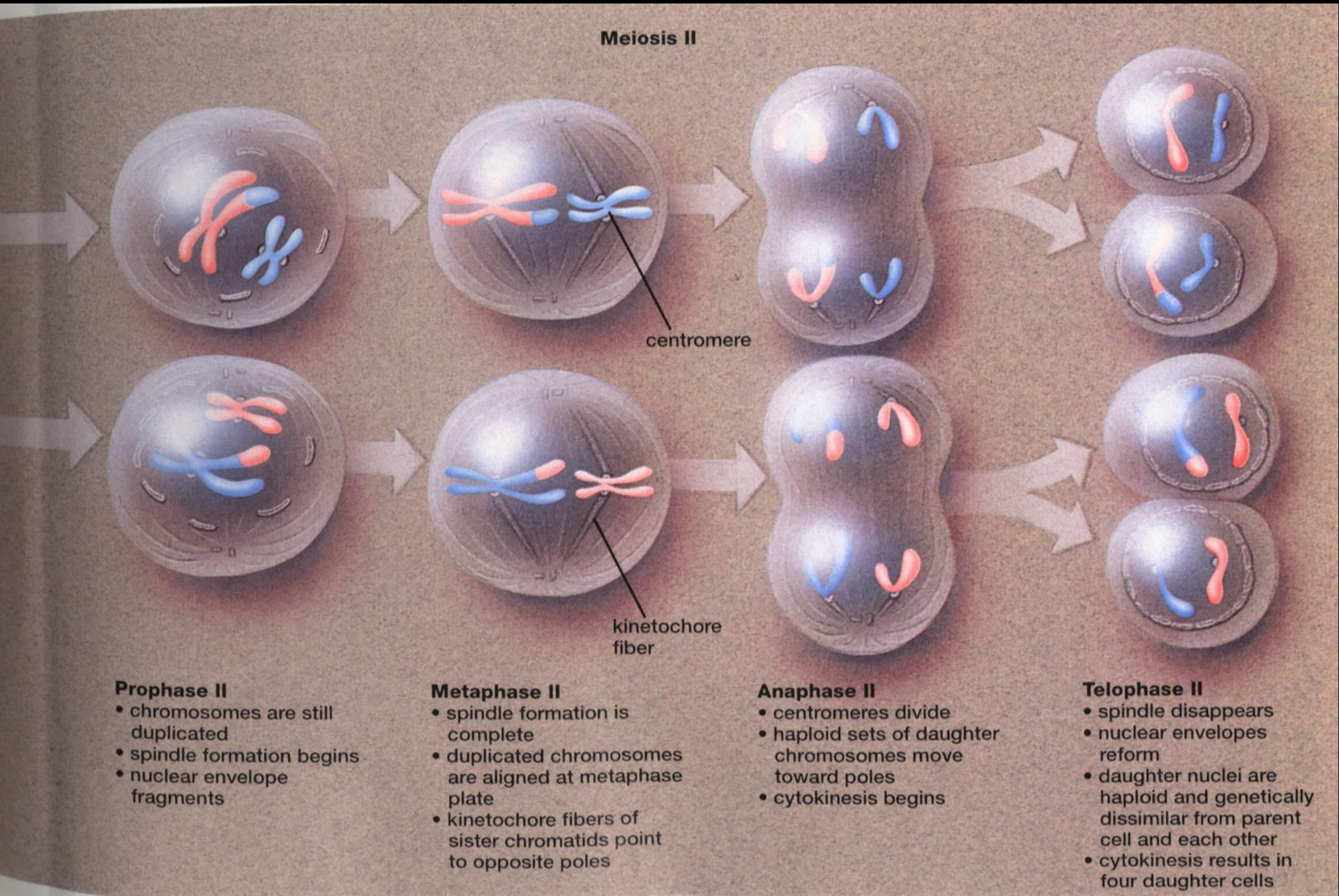
Meiosis II

- Is basically just like mitosis, but remember the chromosomes did not duplicate in interphase II.
- Prophase II
  - Chromosomes begin to line up in the middle of the cell.
  - Spindle fibers begin to form
- Metaphase II
  - Chromosomes line up on the metaphase plate

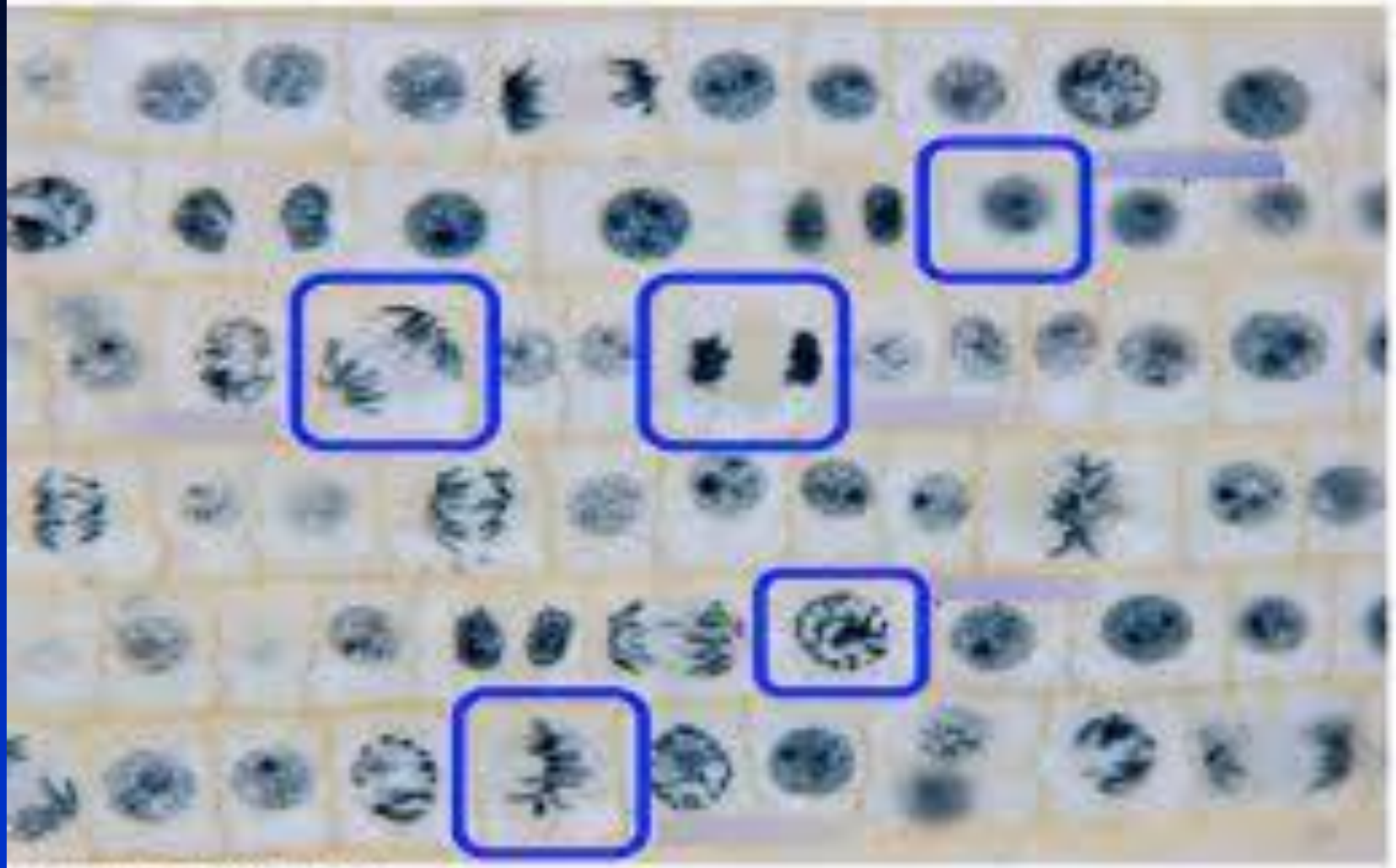
Meiosis II

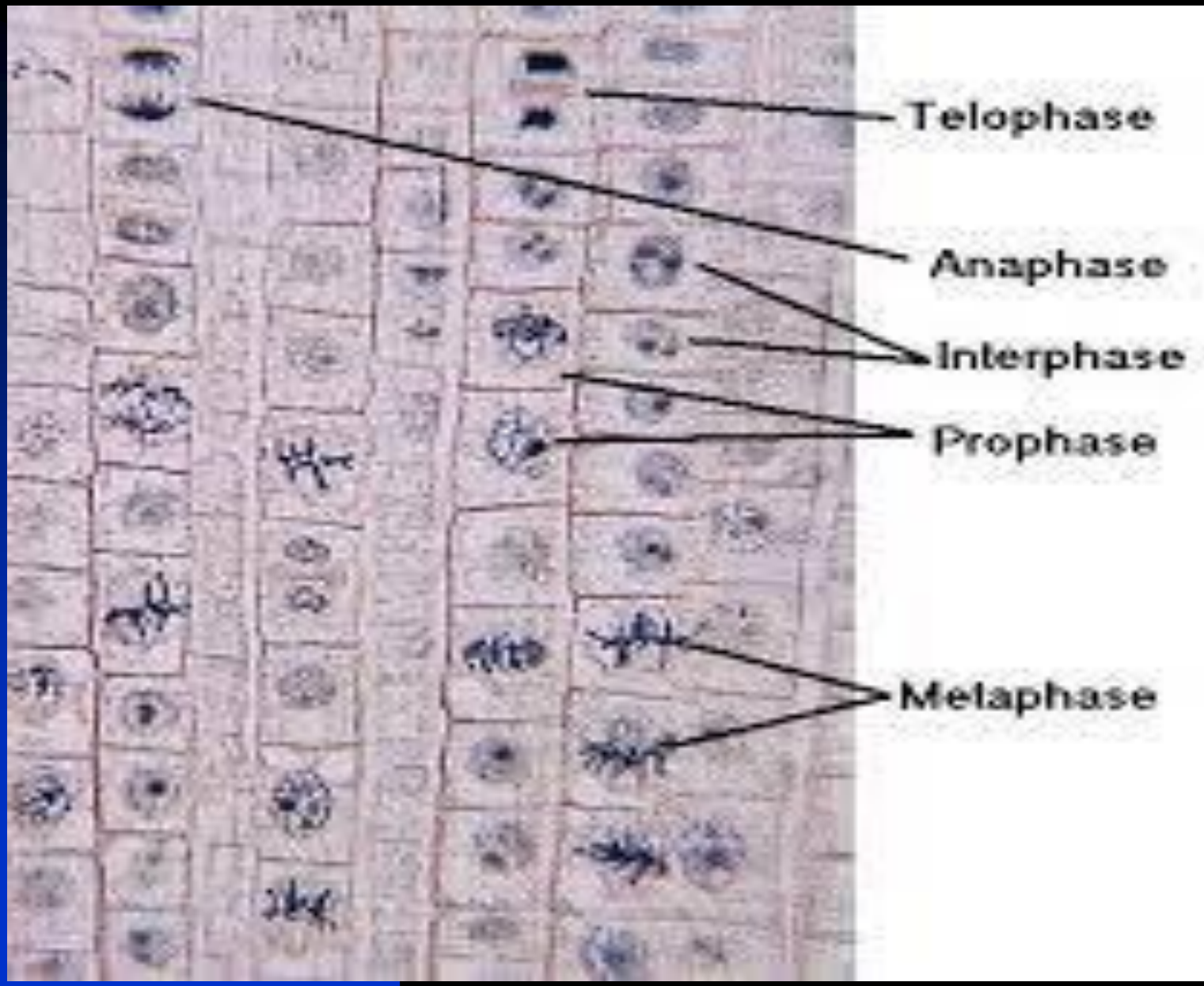
- Anaphase II
  - Centromeres split
  - Sister chromatids separate and move to opposite sides of the cell
- Telophase II
  - Nuclei reform
  - Spindle fibers disappear
  - Cytoplasm divides into two.
- The number of chromosomes in each daughter cell has now been reduced by half.

Meiosis II


Meiosis II
centromere
kinetochore fiber
Prophase II
• chromosomes are still duplicated
• spindle formation begins
• nuclear envelope fragments
Metaphase II
• spindle formation is complete
• duplicated chromosomes are aligned at metaphase plate
• kinetochore fibers of sister chromatids point to opposite poles
Anaphase II
• centromeres divide
• haploid sets of daughter chromosomes move toward poles
• cytokinesis begins
Telophase II
• spindle disappears
• nuclear envelopes reform
• daughter nuclei are haploid and genetically dissimilar from parent cell and each other
• cytokinesis results in four daughter cells

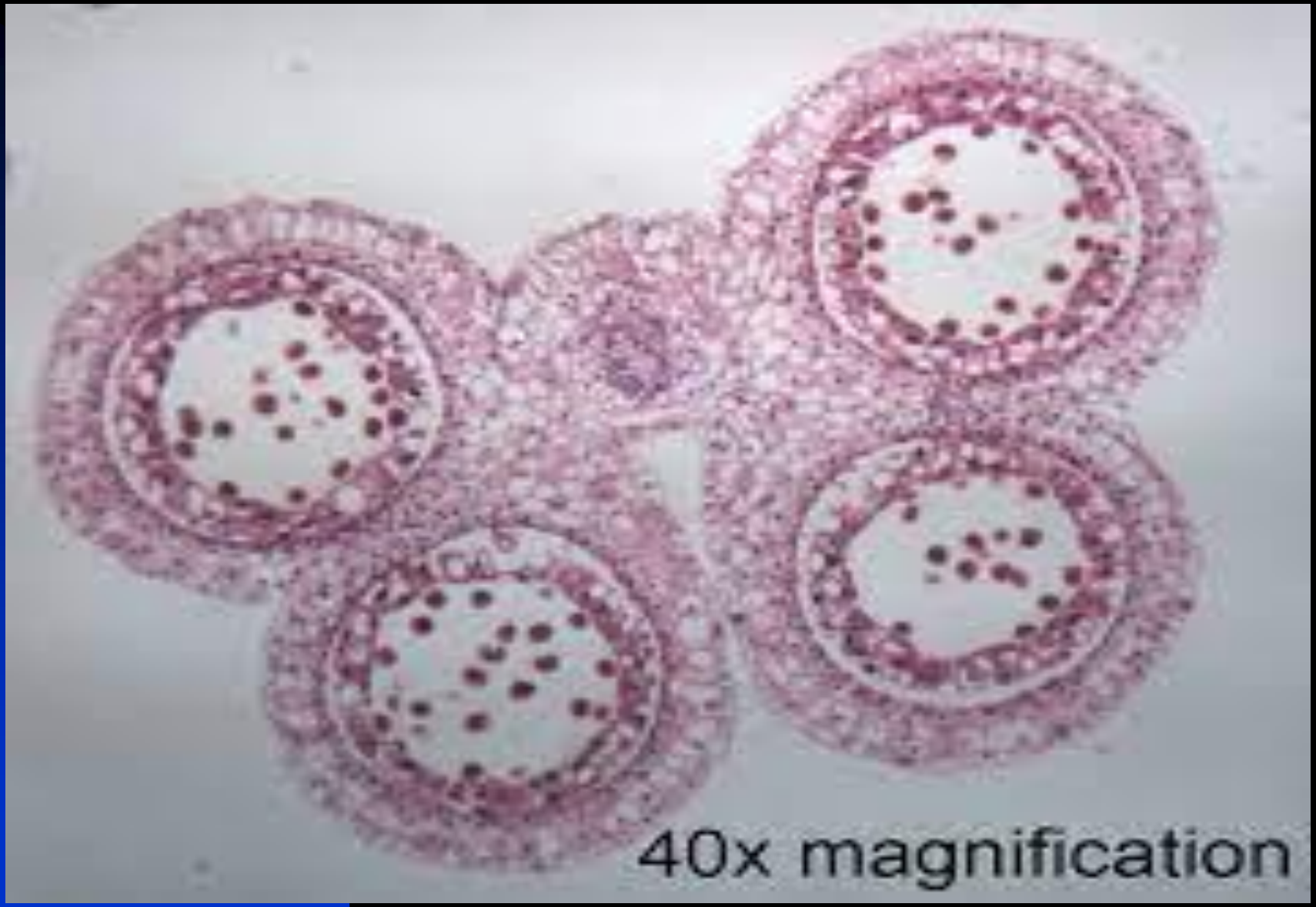
Cell Cycle Stages in an Onion Root Tip



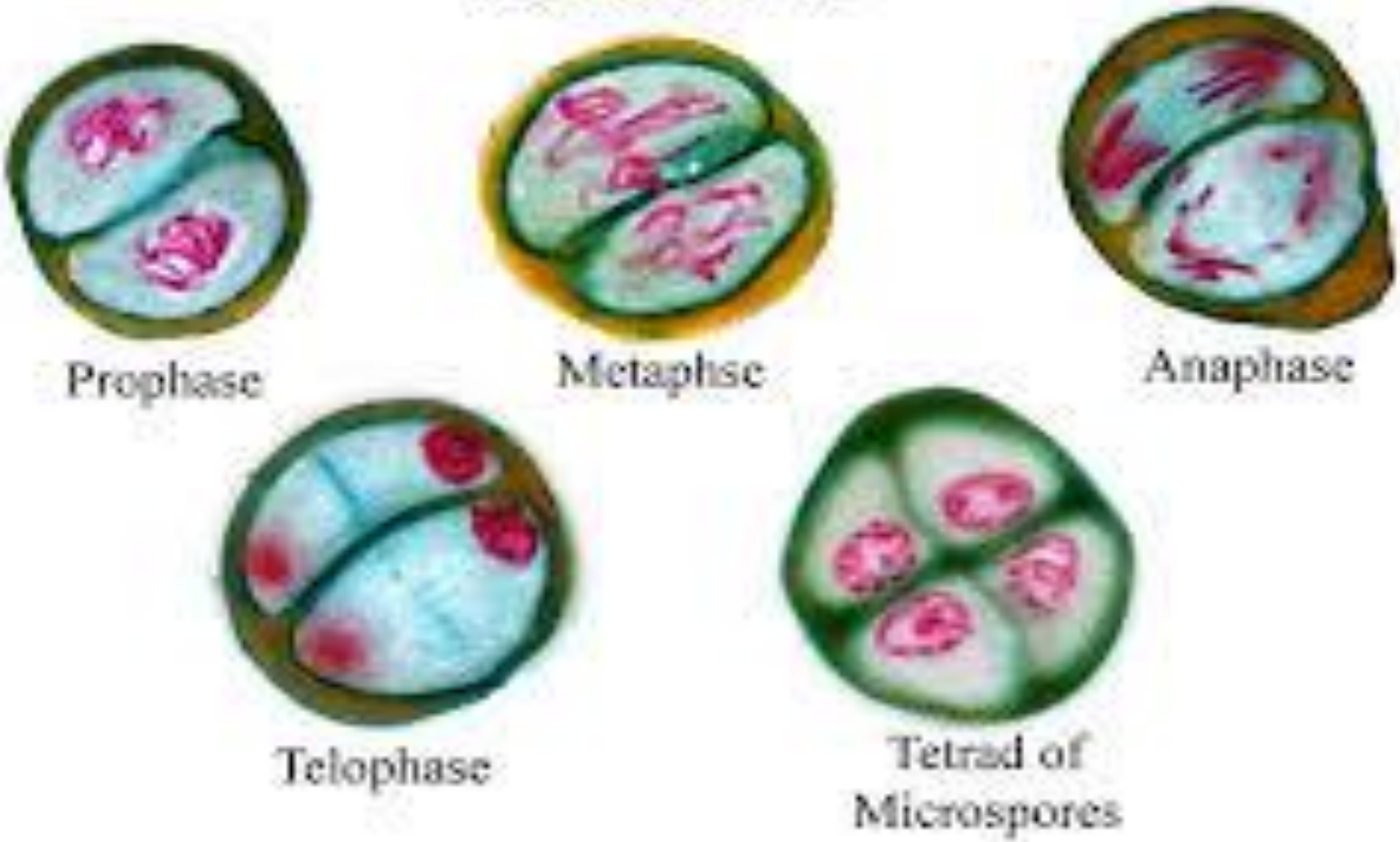

Telophase
Anaphase
Interphase
Prophase
Melaphase

Prophase II - lily anther

- It is easy to tell that we are in the second division since there are now two cells
- Meiosis II is just like mitosis except we are dealing with haploid nuclei


40x magnification

Meiosis II


Prophase
Metaphse
Anaphase
Telophase
Tetrad of
Microspores

Genetics and its role in oral diseases

Zainab kamil yousif

Medical biology

First year

Genetics •

Is a branch of biology concerned with the • study of genes, genetic variation, and heredity in organisms. Though heredity had been observed for millennia, Gregor Mendel, a scientist and Augustinian friar working in the 19th century, was the first to study genetics scientifically.

- Genetics is the study of genes and tries to explain what they are and how they work. Genes are how living organisms inherit features or traits from their ancestors; for example, children usually look like their parents because they have inherited their parents' genes. Genetics tries to identify which traits are inherited, and explain how these traits are passed from generation to generation.

- Genes are made from along molecule called DNA, which is copied and inherited across generations. DNA is made of simple units that line up in a particular order within this large molecule. The order of these units carries genetic information, similar to how the order of letters on a page carries information. The language used by DNA is called the genetic code, which lets organisms read the information in the genes. This information is the instructions for constructing and operating a living organism.

- The information within a particular gene is not always exactly the same between one organism and another, so different copies of a gene do not always give exactly the same instructions. Each unique form of a single gene is called an allele. As an example, one allele for the gene for hair color could instruct the body to produce much pigment, producing black hair, while a different allele of the same gene might give garbled instructions that fail to produce any pigment, giving white hair.
- Mutations are random changes in genes and can create new alleles. Mutations can also produce new traits, such as when mutations to an allele for black hair produce a new allele for white hair. This appearance of new traits is important in evolution.

Elementary genetics

- Each chromosome (of which each human cell has 46) is comprised of two long, double-stranded molecules called DNA. A DNA chain is a linear sequence of “bases” consisting of only four types: A, T, G, and C. Thus, a segment of a DNA molecule might read as …G-G-G-A-A-G-G-C-A…. The previous section on Molecular Evolution reviews the topic. A human chromosome is compressed within the cell nucleus . Groups of a few hundred to several thousand bases along this DNA chain constitute a gene.

Terminology

Genetic Terminology

- Gene - Segment of DNA that codes for formation of a protein
- Locus – Position of gene on a chromosome
- Trait - any characteristic that can be passed from parent to offspring
- Heredity - passing of traits from parent to offspring
- Genetics - study of heredity

Genetics Terminology

- Dominant - trait which stays visible
- Recessive - trait which disappeared
- Alleles - alternate forms of a gene for a trait
- Genotype - genetic makeup of a trait
- Phenotype - physical appearance of a trait
- Homozygous - both alleles are the same
- Heterozygous - two alleles are different

Mandel’s law of inheritance

Gregor Mendel, through his work on pea plants, discovered the fundamental laws of inheritance. He deduced that genes come in pairs and are inherited as distinct units, one from each parent. Mendel tracked the segregation of parental genes and their appearance in the offspring as dominant or recessive traits.

-

Mendel's Garden Pea Plant Experiment

	Flower Colour	Plant Height	Seed Color	Seed Shape	Pod Colour	Pod Shape	Flower Position
Dominant Trait	 Purple	 Tall	 Yellow	 Round	 Green	 Inflated (full)	 Axial
Recessive Trait	 White	 Short	 Green	 Wrinkled	 Yellow	 Constricted (flat)	 Terminal

Modes of inheritance

Dominant alleles mask the effect of recessive alleles but co-dominant alleles have joint effects.

The gene composition (i.e. allele combination) for a specific trait is referred to as the genotype. The genotype of a particular gene will typically be either homozygous or heterozygous.

-

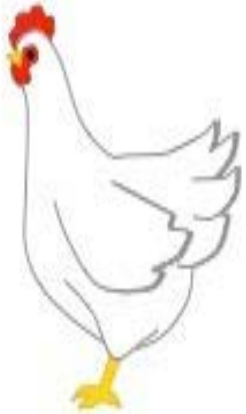
The observable characteristics of a specific trait (i.e. the physical expression) is referred to as the phenotype. The phenotype is determined by both the genotype and environmental influences.

-
-

Complete Dominance (Mouse Coat Colour)

Phenotype	Black	Black	Brown
Genotype	BB	Bb	bb

Co-dominance (Chicken Feathering)



Phenotype	Black	Speckled	White
Genotype	C^BC^B	C^BC^W	C^WC^W

Linkage

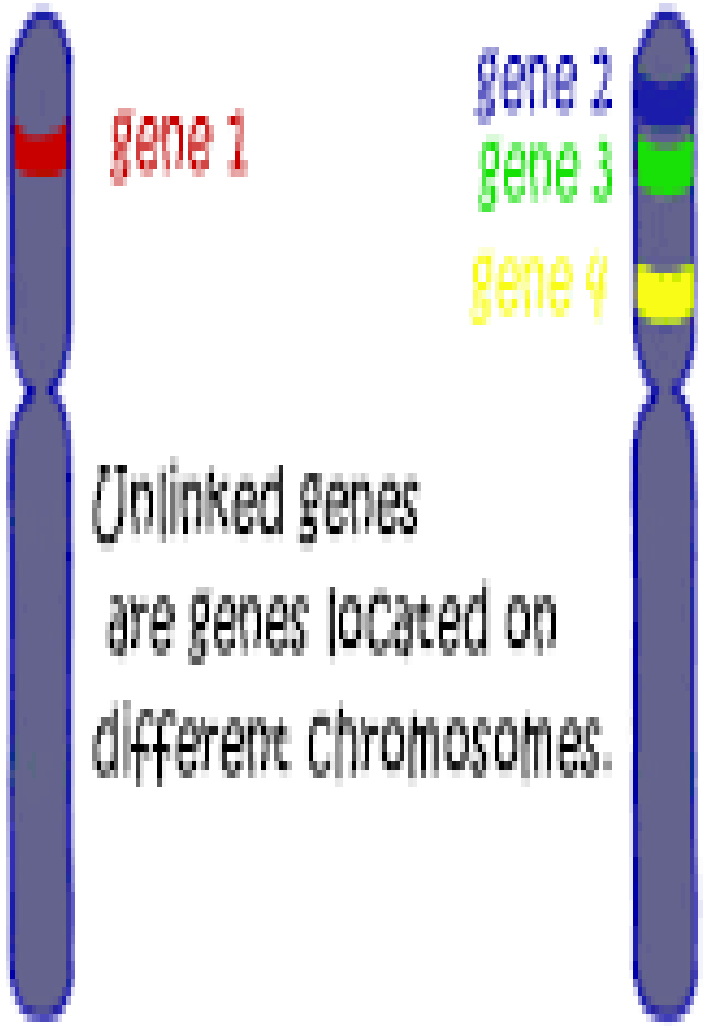
- Genetic linkage is the tendency of DNA sequences that are close together on a chromosome to be inherited together during the meiosis phase of sexual reproduction. Two genetic markers that are physically near to each other are unlikely to be separated onto different chromatids during chromosomal crossover, and are therefore said to be more *linked* than markers that are far apart. In other words, the nearer two genes are on a chromosome, the lower the chance of recombination between them, and the more likely they are to be inherited together. Markers on different chromosomes are perfectly *unlinked*.

Genetic linkage

- Genetic linkage is the tendency of alleles that are located close together on a chromosome to be inherited together during meiosis.

- Genes whose loci are nearer to each other are less likely to be separated on to different chromatids during chromosomal crossover, and are therefore said to be genetically ***linked***.

- In other words, the nearer two genes are on a chromosome, the lower is the chance of a swap occurring between them, and the more likely they are to be inherited together.



Unlinked genes are genes located on different chromosomes.

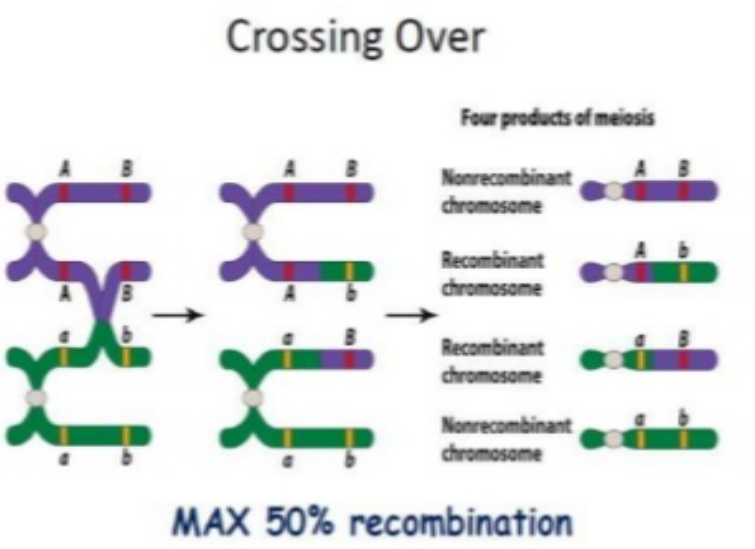
Linkage group

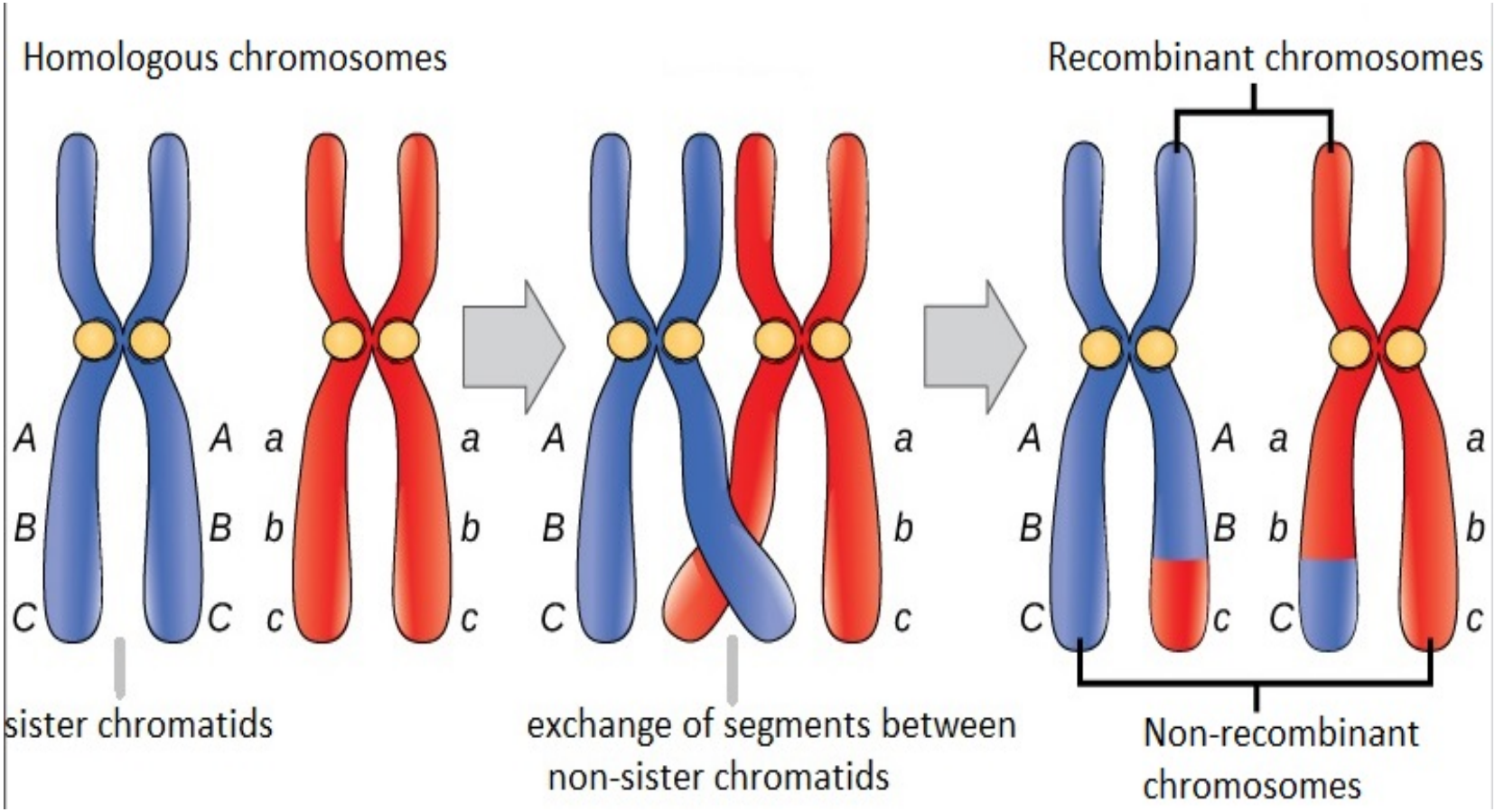
A set of genes at different loci on the same gene that except for crossing over tend to be inherited together.

Crossing over sex linkage

Crossing Over

- A random exchange of DNA between two non-sister chromatids of homologous chromosomes.
- Results in recombination of genetic material




Homologous chromosomes
Recombinant chromosomes
A
B
C
A
a
b
c
a
A
B
C
a
b
c
A
B
C
A
a
b
c
a
sister chromatids
exchange of segments between
non-sister chromatids
Non-recombinant
chromosomes

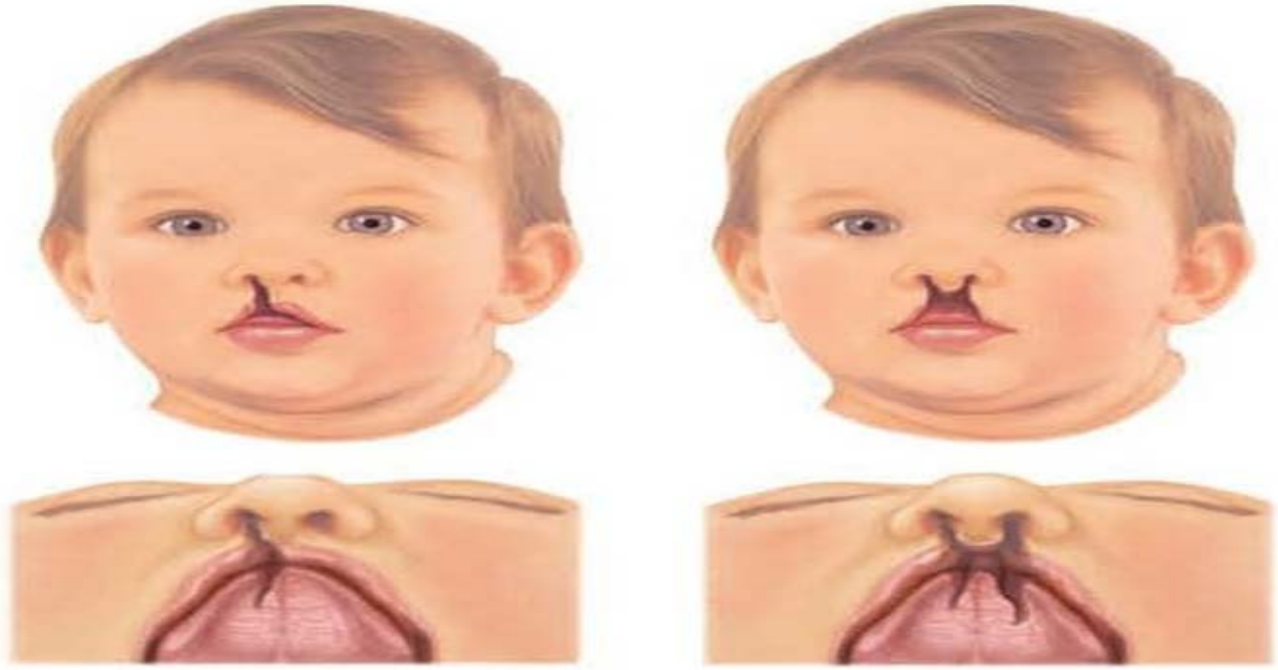
	Linkage	Crossing over
1.	The genes present on chromosome stay close together	It leads to separation of linked genes
2.	It involves same chromosome of homologous chromosome	It involves exchange of segments between non-sister chromatids of homologous chromosome.
3.	It reduces new gene combinations	It increases variability by forming new gene combinations. lead to formation of new organism

Table 3.4: Differences between linkage and crossing over

Types of Genetic Oral/Dental Abnormalities

- There are the most typical genetic disorders that affect teeth, health, and appearance.

- **Cleft Lip & Cleft Palate**
- This is the most common craniofacial deformity linked to family history. It involves the incomplete fusion of the lip or palate.



Unilateral Bilateral

FIGURE 7.6 • Cleft lip and cleft palate.

- **Anodontia**
- Anodontia is a congenital defect causing missing teeth. Children born with this defect usually get their baby teeth but have one or more missing primary teeth. This disorder can cause spacing errors due to third molars, upper lateral incisors and lower second premolars that fail to develop.

- **Amelogenesis Imperfecta**
- Amelogenesis imperfecta involves defective tooth enamel, which is the hard substance protecting the tooth crown. This leaves teeth sensitive to temperature and prone to wear.
- **Supernumerary Teeth**
- Some people have extra permanent teeth that may not emerge. Those that do emerge can appear anywhere in your mouth. They often have a cone-shaped crown with a short root.

- **Malocclusion**
- Known as bad bite, this disorder causes crowding due to the incorrect number of teeth and misalignment of the jaw. Surgical and nonsurgical interventions can restore function and reduce pain.
- **Gum Disease**
- Gum disease results from a bacterial infection that damages the tissues supporting your teeth. The disease can be reversed with proper dental care and hygiene. Heredity also impacts your likelihood to develop gingivitis, which is linked to diabetes, stroke and heart disease.

- **Gingival Fibromatosis**
- This overgrowth of gum tissue is caused by collagen overproduction.
- **Oral Cancer**
- Oral cancer starts as a white or red spot in the mouth. Most oral cancers involve alcohol or tobacco use in patients over age 40. However, genetics also play a factor.

- **Canker Sores**
- Canker sores are white or gray ulcers with a red border inside your mouth. They are caused by immune system deficiencies and bacterial infections. Hereditary predisposition may also play a role in the frequency and probability of getting them.
-

Thank you •

General connective tissue

Is the most abundant and widely distributed tissue in complex animals .It is quite diverse in structure and function ,but even so all types have three components :

1- specialized cells 2- ground substrates 3- protein fibers

The ground substrates is non-cellular material that separates the cells and varies in consistency from solid , semifluid to fluid ,the fibers three types 1-**white collagen** fibers contain collagen a protein that give the flexibility and strength 2-**reticular** fibers are very thin collagen fibers that are highly branched and form delicate supporting networks **.3- yellow elastic** fibers contain elastin ,a protein that not as strong as collagen but is more elastic. The ground substance plus the fibers together are referred to as connective tissue matrix .

Functions of Connective Tissue

1-forms capsules that surround the organs of the body .

2-Makes up tendons ,ligaments and aereolar tissue that fills the spaces between the tissues .

3-Bone ,cartilage and adipose tissue are specialized types of c.t that support the soft tissue of the body and store fat .

4-Role in defending the organism due to the phagocytosis & immune-competent cells .

5-Play role in cell nutrition.

6- Provide physical barriers .

7- Specific protein called antibodies are produced by plasma cells in the c.t.

Connective tissue

Connective tissue is classified into :-

I-*Connective tissue Proper*

I-1 Loose connective tissue:

I-1-a- Connective tissue Proper Loose connective tissue ,Areolar :

supported epithelium and also many internal organs have cells called fibroblasts separated by jellylike matrix containing whit collagen fibers and yellow elastic fibers ,macrophages cell , mast cells, and some white blood cells.

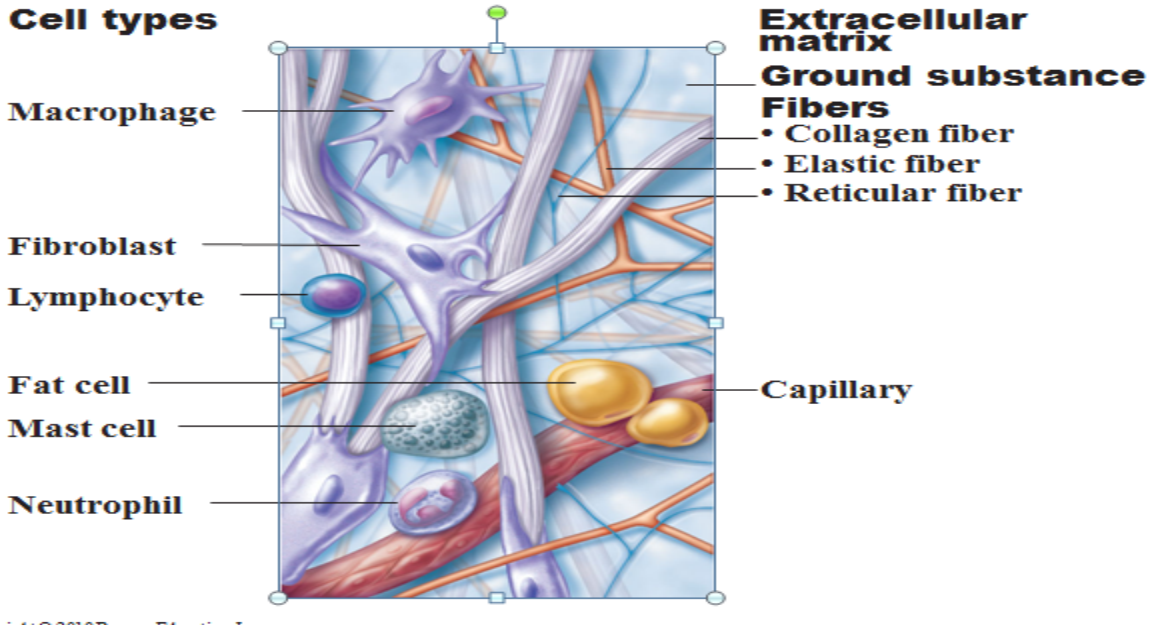
Found in lungs ,arteries and urinary bladder allows these organs to expand .

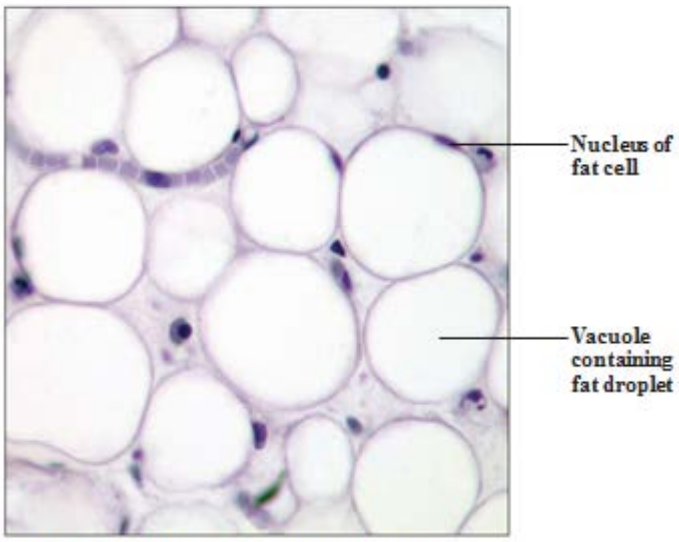
Function: It forms a protective, wraps and cushions organs. such as muscles , blood vessels and nerves ; its macrophages phagocytize bacteria; plays important role in inflammation.

I-1-b- Connective tissue proper : loos connective tissue ,Adipose: serves as the body's primary energy reservoir and protects organs .It is loose c.t composed mostly of enlarged fibroblasts that store fat .This specialized fibroblasts are called adipocytes nucleus pushed to the side by large fat droplet. In mammals ,adipose tissue is found particularly beneath the skin ,around kidneys and on the surface of the heart .

The number of adipocytes in an individual is fixed .When a person gains weight ,the cells become larger and when weight is lost ,the cells shrink . In obese people the individual cells may be up to five times larger than normal .Most adipose tissue is white but in newborns and hibernating mammals some is brown due to an increased number of mitochondria that can produce heat .

Figure 4.7 Areolar connective tissue: A prototype (model) connective tissue.





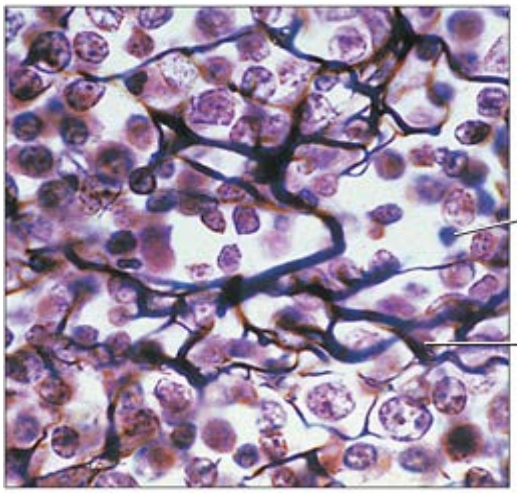
Photomicrograph: Adipose tissue from the subcutaneous layer under the skin (350x).

I-1-c- Connective tissue proper: loose connective tissue, reticular :

Network of reticular fibers in a typical loose ground substance; reticular cells lie on the network.

Function: Fibers form a soft internal skeleton (stroma) that supports other cell types including white blood cells mast cells ,macrophage .

Location: Lymphoid organs (lymph nodes, bone marrow, and spleen).



Photomicrograph: Dark-staining network of reticular connective tissue fibers forming the internal skeleton of the spleen (350x).

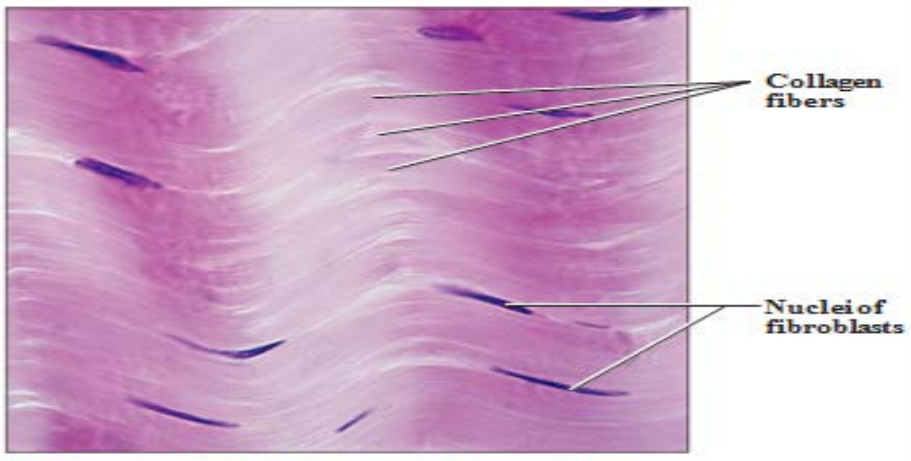
1-2-Dense connective tissue:

a-dense connective tissue: dense regular

contains many collagen fibers that are packed togetherPrimarily parallel collagen fibers; a few elastic fibers major cell type is the fibroblast

Function: Attaches muscles to bones or to muscles; attaches bones to bones; withstands great tensile stress when pulling force is applied in one direction.

This type of tissue has more specific functions than dose loos c.t. **Found in** tendons ,which connect muscles to bonesand ligaments which connect bone to other bones at joints .



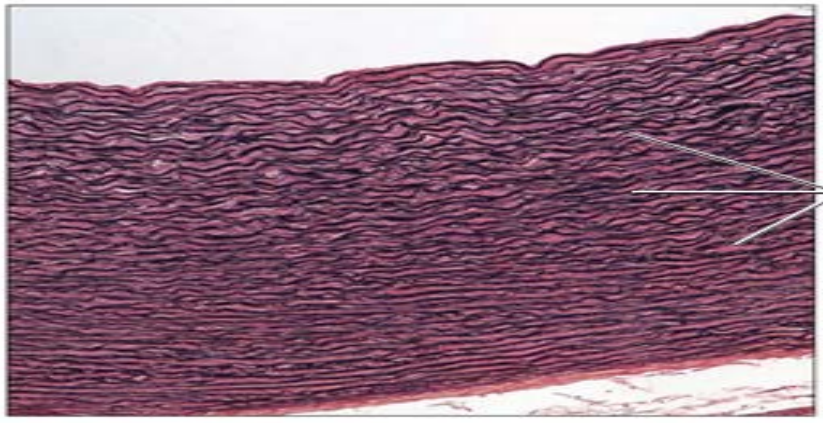
Photomicrograph: Dense regular connective tissue from a tendon (500x).

b-: dense connective tissue, dense irregular

Primarily irregularly arranged collagen ,fibers; some elastic fibers major cell type is the fibroblast . Able to withstand tension exerted in many directions; provides structural strength. ***Found in*** Fibrous capsules of organs and of joints; dermis of the skin; submucosa of digestive tract**.**

c-dense connective tissue, elastic

containing a high proportion of elastic fibers . Allows recoil of tissue following stretching; maintains pulsatile flow of blood through arteries; aids passive recoil of lungs following inspiration. **Found in** Walls of large arteries؛ within certain ligaments associated with the vertebral column; within the walls of the bronchial tubes.



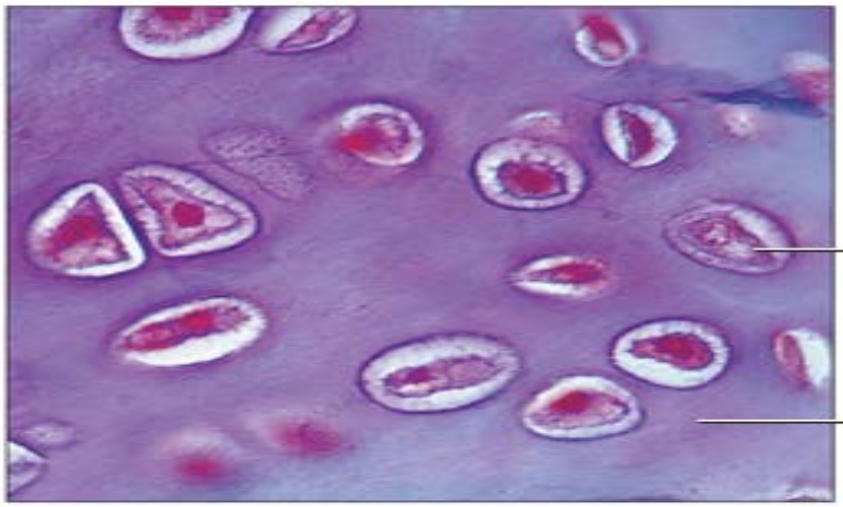
Photomicrograph: Elastic connective tissue in the wall of the aorta (250×).

II- Specialize connective tissue

II-1- Special C.T. Cartilage in cartilage the cells lie in small chambers called lacunae separated by matrix that is solid yet flexible .unfortunately because this tissue lacks a direct blood supply ,it heals very slowly .there are three types of cartilage distinguished by the type of fiber in the matrix .

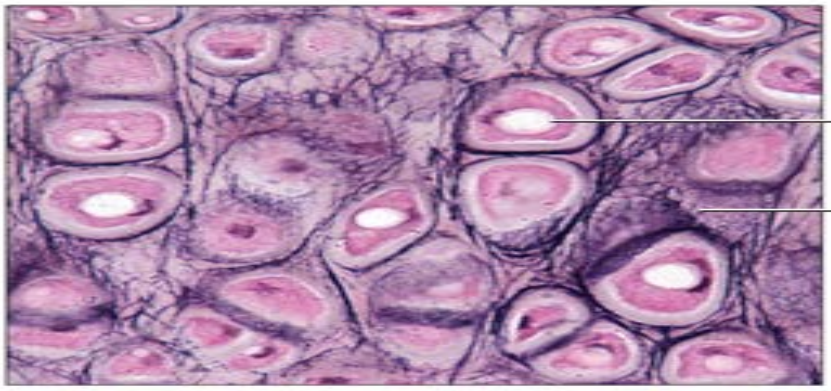
Hyaline cartilage : most common type contain only very fine collagen fibers .The matrix has a white ,translucent appearance chondroblasts produce the matrix and when mature(chondrocytes) lie in lacunae .Supports and reinforces؛ has resilient cushioning properties resists compressive stress

It is found in nose and at the ends of long bones and ribs .and it forms rings in the walls of respiratory passages .The fetal skeleton also is made of this type of cartilage. Later, the cartilaginous fetal skeleton is replaced by bone .



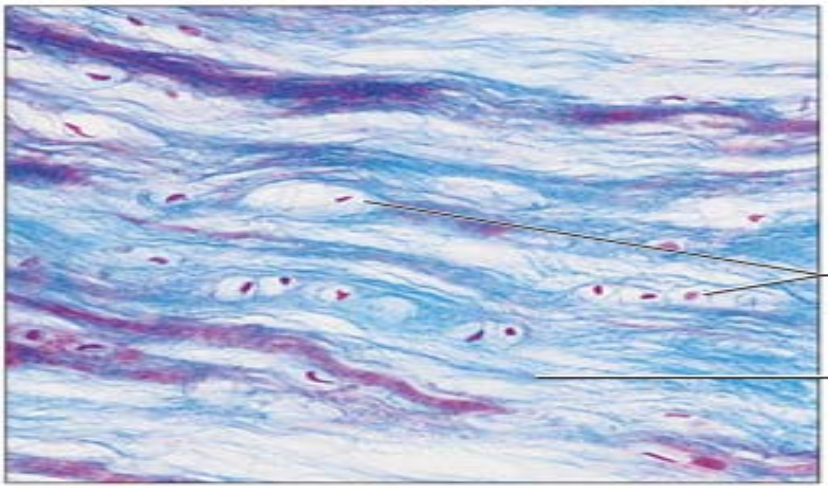
Photomicrograph: Hyaline cartilage from the trachea (750x).

Elastic cartilage: Similar to hyaline cartilage, but more elastic fibers in matrix for this reason its more flexible .Maintains the shape of a structure while allowing Supports the external ear (pinna); epiglottis .



Photomicrograph: Elastic cartilage from the human ear pinna; forms the flexible skeleton of the ear (800x).

Fibrocartilage: :Matrix similar to but less firm than that in hyaline cartilage; strong , thick collagen fibers predominate. Tensile strengthwith the ability to absorb compressive shock Intervertebral discs; and the wedges in knee joint.



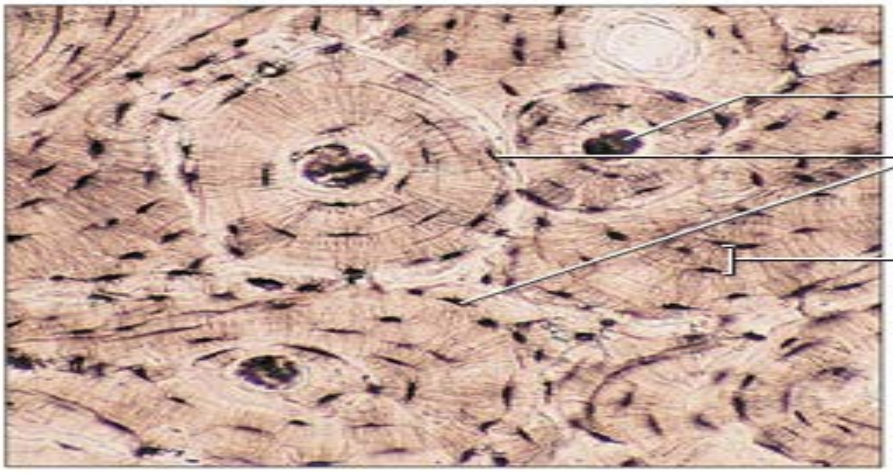
Photomicrograph: Fibrocartilage of an intervertebral disc (125x). Special staining produced the blue color seen.

II-2-Special C.T. Bone :-Bone is the most rigid it consists of an extremely hard matrix of inorganic salts ,notably calcium salts ,deposit around protein fibers ,especially collages fibers .The inorganic salts give bones rigidly and the protein fibers provide elasticity and strength much as steel rods do in reinforced concrete . Hard, calcified matrix containing many collagen fibers; osteocytes lie in lacunae.

Osteoblasts and osteocytes are involved in the formation and mineralization of bone; osteoclasts are involved in the resorption of bone tissue. Modified (flattened) osteoblasts become the lining cells that form a protective layer on the bone surface. The mineralized matrix of bone tissue has an organic component of mainly collagen called ossein and an inorganic component of bone mineral made up of various salts. Bone tissue is a mineralized tissue of two types, cortical bone and cancellous bone. Other types of tissue found in bones include bone marrow, endosteum, periosteum, nerves, blood vessels and cartilage.

In the human body at birth, there are over 270 bones. but many of these fuse together during development, leaving a total of 206 separate bones in the adult. The largest bone in the body is the femur or thigh-bone, and the smallest is the stapes in the middle ear.

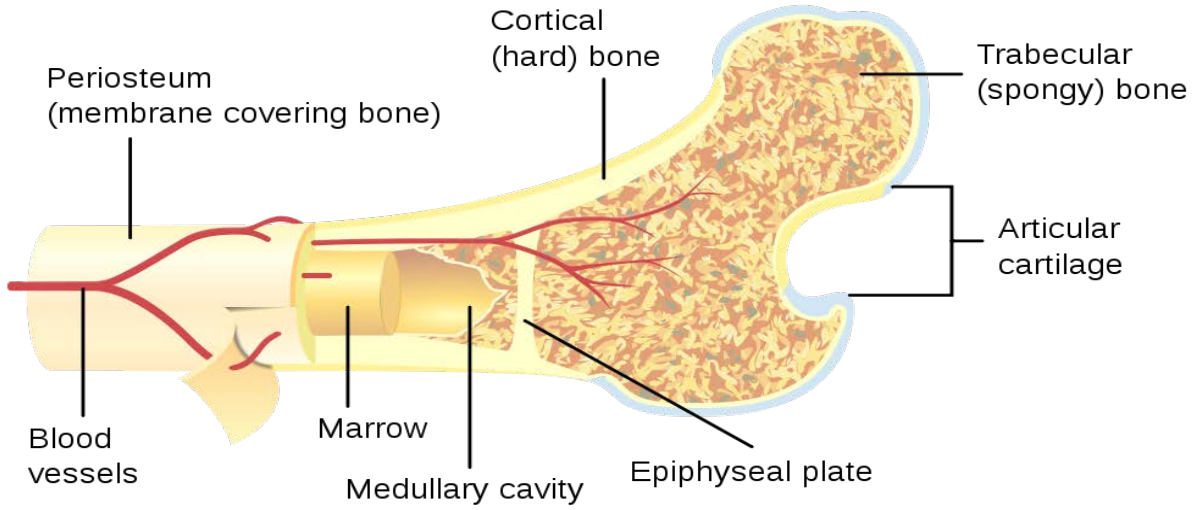
Structure of bone



Photomicrograph: Cross-sectional view of bone (125x).

Compact bone : makes up the shaft of along bone .It contains cylindrical structural units called osteons (haversian system) the central canal of each osteon surrounded by rings of hard matrix .Bone cells (osteocyte) are located in spaces called lacunae between the ring of matrix .blood vessels in the central canal carry nutrients that allow bone to renew itself . Thin extension of bone cells within canaliculi(minutes canals) connect the cells to each others and to the central canal . The hollow shaft of long bones such as the femur (thigh bone) is filled with yellow bone marrow . The ends of long bone contains spongy bone .

Spongy bone contains numerous bony bars and plates ,separated by irregular spaces although lighter than compact bone spongy bone is still designed for strength . Just as braces are used for support in buildings the solid proteins of spongy bone follow lines of streets .Spongy bone is also the sit of red bone marrow which is critical to produced of blood cells .



II-c-Blood:-Which consists of formed elements and plasma , formed elements in the blood consist of the many kinds of blood cells and the platelets .Blood transports nutrients and oxygen to tissue fluid and removes carbon dioxide and other wastes . It helps distribute heat and also play role in fluid ,ion and pH balance .

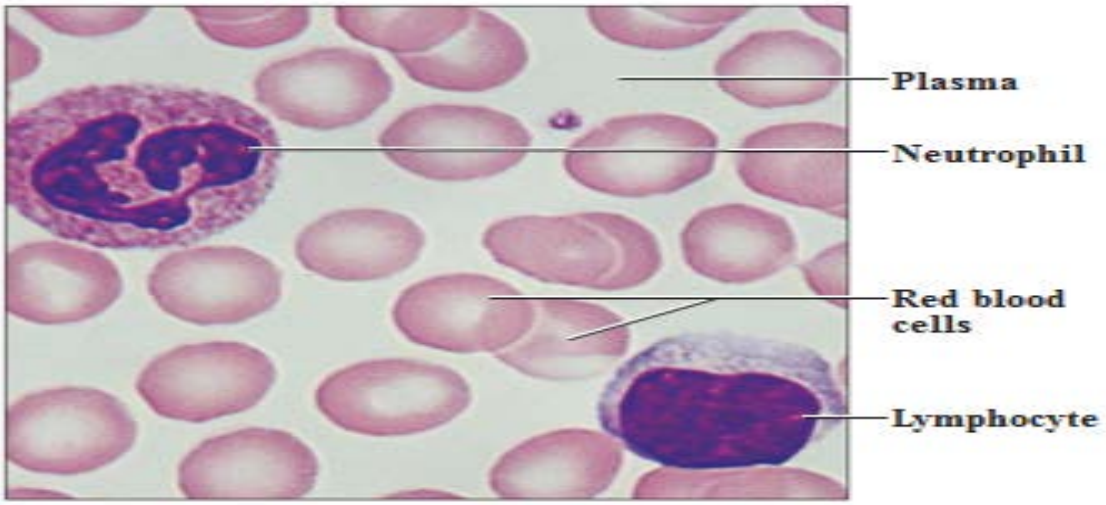
Red blood cells :- are small disk-shaped cells without nuclei .The absence of nucleus makes the cells biconcave . red pigment because of hemoglobin .

White blood cells Leucocytes:- usually large have nucleus without staining would appear translucent .When blood smear staining W.B.C looks blue or purple .The function is fight by two way 1- Phagocytosis 2- Produced antibodies .Neutrophils ,lymphocyte ,Monocyte ,Eosinophil ,Basophils

Platelets :- are not complete cells they are fragments of large cells present only in bone marrow .When blood vessels is damaged platelets help to form plug that seals the vessel and injured tissues release molecules that help the clotting process.

Lymph :- is a fluid connective tissue located in lymphatic vessels .Lymphatic vessels absorb excess tissue fluid and return it to the cardiovascular system .

Lymph node composed of reticular c.t .plus specialized white blood cells called lymphocyte remove any foreign materials from lymph .lymph node may enlarge when these cell respond to an infection .



Photomicrograph: Smear of human blood (1860x); two white blood cells (neutrophil in upper left and lymphocyte in lower right) are seen surrounded by red blood cells.

Epithelial tissues (Simple, Stratified, Glandular)

Histology:- is the study of tissues. Tissues are composed of cells and the products of cells.

There are four type of tissue :-

I-Epithelial Tissues :Tissue that covers and lines organs and organisms, found on the surface separated from the connective tissue by basal lamina.

II- connective tissue : Tissue that supports and connects , not found on the surface.

III-Muscle Tissue : Tissue that contracts and produces motion and/or locomotion .

V-Nerve Tissue : Tissue that response to stimuli and conducts impulses ,communication of information.

1-Epithelial Tissue

Major Tissue components :

1-Cells 2- Fibers 3-molecules of extracellular Matrix (ground substance) .

Classification of epithelial tissue based on:-

A-Cell shape. B- Cell layer. C-Specializations of Epithelial cells.

A-Cell shape

1-Squamous cells .

Flat or thin cytoplasm, the nuclei bulge above the cytoplasmic thickness.

Functional characteristic: Thin cytoplasmic adaptation for diffusion .

2-Cuboidal cells:-Square cells with round centrally located nuclei.

Functional characteristic: Organelles for energy production and secretory activity.

3-Columnar cells

Tall or "column like" cells, normally oval shaped nuclei located near the attached surface.

Functional characteristic: Organelles for energy production and secretory activity .

B-Cell layer

1-Simple Epithelium = Single layer

2-Stratified Epithelium = Two or more layers of cells.

Basal layer: generative (mitosis), Surface layer: mature cell type .

C-Specializations of Epithelial cells

Cilia: contain microtubules, used to move materials across the surface of a cell

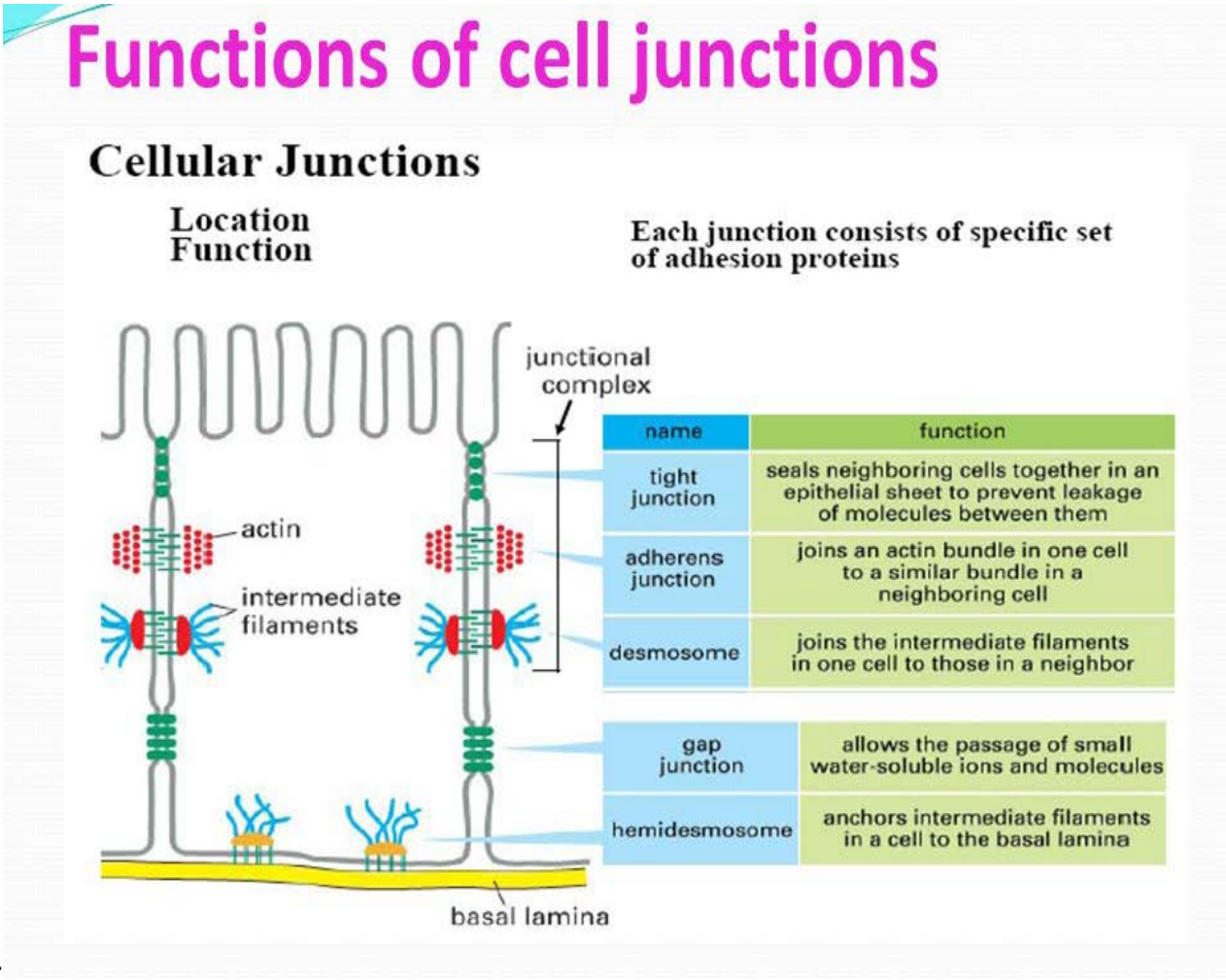
Microvilli: increase surface area for absorption.

Cellular junctions :several membrane associated structures contribute to cohesion and communication between cells .

--Tight junctions (occluding junctions). Most apical ,forming a band completely encirculing each cell. Tight junctions block the flow of fluids between epithelial cells. This tight adherence prevents materials from leaking between the cells; tight junctions are typically found in epithelial tissues that line internal organs and cavities, and comprise most of the skin. For example, the tight junctions of the epithelial cells lining your urinary bladder prevent urine from leaking out into the extracellular space.

--Gap or communicating junctions :-A **gap junction** connects adjacent cells via protein channels, allowing the direct movement of small molecules and ions from the cytoplasm of one cell to the cytoplasm of the next cell. Gap junctions can also open and close in response to electrical or metabolic signals from nearby cells, which coordinates the functions of tissues. For example, gap junctions in the intercalated discs of cardiac muscle facilitate the rapid movement of ions between cells, allowing heart cells to contract almost simultaneously.

--Desmosomes:- A **desmosome** is a strong cell junction that reduces mechanical stress by connecting cells via specialized proteins at anchoring junctions and helping maintain tissue strength. These junctions penetrate the cell membrane and attach to the cell's cytoskeleton, a network of protein filaments throughout the cytoplasm that gives the cell its shape. Desmosomes are particularly important in epithelial and cardiac muscle tissues where stress is encountered regularly.



-

In epithelial tissue fibers reduced , cells attached to basement membrane, fibers secreted by epithelial cells at their attached surface Matrix Extremely reduced.

The principal functions of epithelial tissues are:

1-the covering and lining of surfaces (skin ,intestines)

2-absorption (intestines)

3-secretion (glands)

4-sensation (gustative and olfactory)

5-contractility (myoepithelial cells).

Basal lamina structure : It appears as dense layer 20-100 nm thick consisting of a delicate network of very fine fibrils (lamina densa) and an electron –lucent layer on one or both sides of the lamina densa called lamina lucida, the function of BM are

Functions of B.M.

1-structural functions as supporting the cells and attach cells to the underlying connective tissue .

2- filter substances entering epithelium from below .

3- concentrate mitogenic growth factors .

4-form a base for epithelial repair and regeneration

Classification of simple Epithelial tissue

Epithelia are divided into two main groups according to their structure and function .

1- covering or lining epithelia

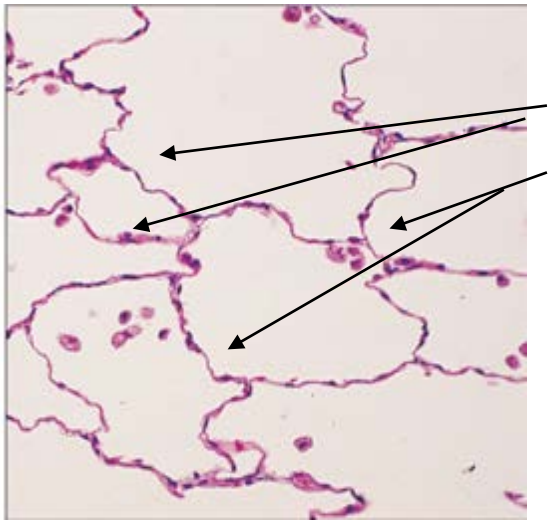
2-secretory or glandular epithelia

1- covering or lining epithelia

1-Simple Squamous Epithelium (S.S.E),

Single layer of cells, flattened cells with disc –shaped central nuclei and sparse cytoplasm mesothelium lining body cavities, endothelium lining blood vessels.

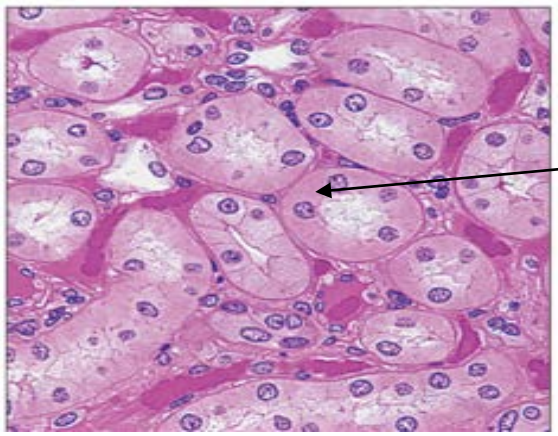
Simple Squamous epithelium can be found in the renal corpuscle in the kidney cortex and Henli's loop. All capillaries are S. S. E. as well as the lining of the heart and blood vessels. and alveolar sacs of the lung**.**



.Air sacs of lung tissue

Nuclei of squamous epithelial cells

Simple squamous epithelial tissue 125 X



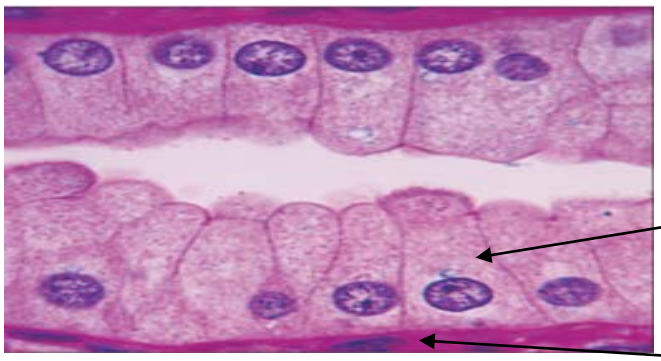
Simple cuboidal Epithelial cells in kidney tube 430 X

2-Simple Cuboidal Epithelium

Single layers of "cube like" cells can be found in the follicles in the thyroid gland, tubules of the nephrons in the kidney. They form the secretory epithelium and ducts of many glands such as the salivary glands, kidney tube and the thyroid gland . Function Absorption ,secretion of mucus ,enzymes and other substances ,ciliated type propels mucus (or reproductive cells) by ciliary action.

3-Simple Columnar epithelium.

Single layer of tall, column like cells. oval shape of nuclei. some cells bear cilia; layer may contain mucus secreting unicellular glands (goblet cells)



simple columner epithelial cell of the stomach mucosca 860 X

4-Pseudostratified Ciliated Columnar

Columnar cells appear to be in layers but are not. All cells are attached to the basement membrane.
The layered appearance is due to the different positions of the nuclei of these cells**.**

1-Basal cells are short and irregular with their nuclei near the basement membrane.

2-Pyramidal cells have their nuclei about in the center of the cell, midway between the base and the free epithelial surface.

3-Columnar cells extend from the basement membrane to the free surface. Only cells that reach the free surface have cilia.

Some Pseudostratified epithelia have only 2 types of cells.

In Respiratory epithelium there are all three types of cells.

-Stratified Epithilium, 2 or more layers of cells, protection for surfaces exposed to chemical attack .

Many cell shapes may be found. Superficial layer of the epithelium contains the distinguishing cell type that gives the name to the epithelium.

1-Stratified Squamous Epithilium Thick membrane composed of several cell layer ; basal cells are cuboidal or columnar and metabolically active ;surface cells are flattened (Squamous) ,basal cells are active in mitosis and the cells of the more superficial layer protects underlying tissue in areas subjected to abrasion .

Squamous cells on the free surface found in Epidermis of the skin, esophagus, vagina, rectum.

a-Non-Keratinized epithelium, (Internal, esophagus etc)

b-Keratinized epithelium , dry (Skin) the surface cells are full of keratin and dead .

2- **StratifiedCuboidal Epithilium** Cuboidal cells on the free surface found in sweat glands ,developing ovarian follicles .

3-Stratified Columnar Epithilium The stratified columnar epithelium has multiple layers of cells in which the apical layer is made up of columnar cells while the deeper layer can be either cuboidal or columnar. As in the case of other stratified epithelium, the cells in the deeper layers might be different than the layer on the top. The modification of the cells on the apical surface is based on the location and function of the epithelial tissue. This epithelium is relatively rare and is only found in some areas throughout the body. It is found in the conjunctiva, pharynx, anus, and male urethra.

4- Pseudostratified

Single layer of cells but looks stratified (2or more layers) all cells rest on the basement membrane , nuclei at different levels is located in the trachea, upper respiratory tract, and in the male reproductive system

5-Transitional (Urinary) Epithelium

-Found in urinary bladder ,urethra ,calyx of kidney .

A- basal layer is made up of cuboidal cells.

B-Intermediate layer of pear – shaped ,, balloon ,, cells .

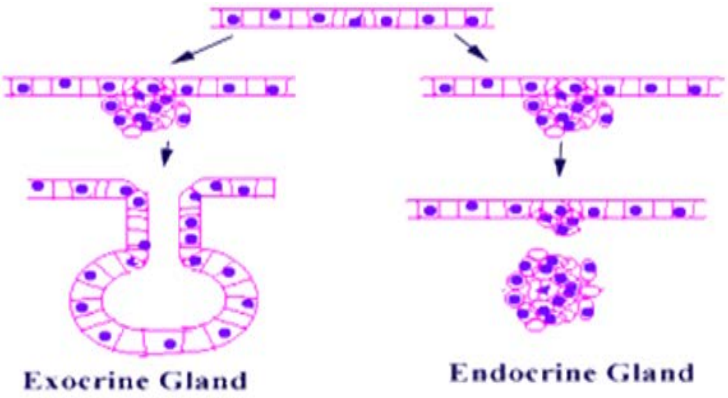
C- Superficial layer cells are larger than the others .

Relaxed (contracted) state . cells cuboidal to columnar in appearance . 6 layers of cells .

Stretched state . cells stretched and flattened 2-3 layers of cells . In extreme distension these cells may appear almost squamous .

2-secretory or glandular epithelia

Glands –All glands (exocrine and endocrine) are produces by epithelial tissue .



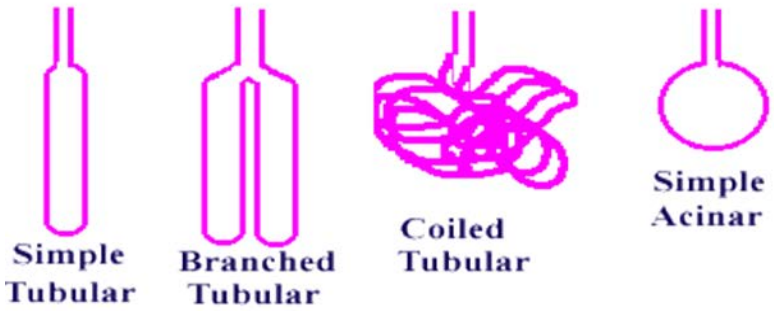
Exocrine Glands secrete onto epithelial surfaces, ducts: carry exocrine secretions to surfaces.

Endocrine Glands secret into tissue spaces & blood vessels, ductless glands, secrete hormones into the bloodstream.

Simple unicellular glands

These are found scattered among the epithelial cells. The goblet cells in intestinal epithelia and the mucous cells in the respiratory tract are simple Unicellular Glands.

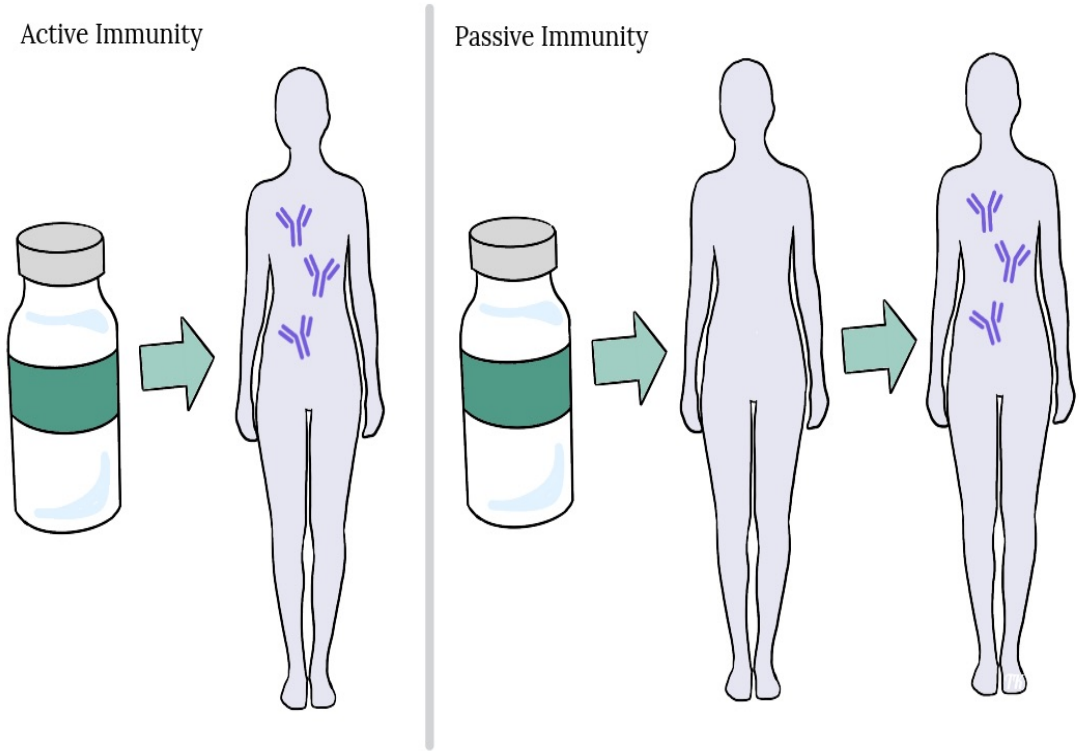
Multicellular Glands These glands result from the in growth of the epithelium into the underlying connective tissue and are connected to the epithelial surface by a duct. The cells in the lower portion of the gland become secretory in nature, producing either mucus or a watery secretion(serous). The secretory portion may be tubular or acinar, simple or branched, or a combination of these**.**



Immunity

Immunity refers to the body's ability to prevent the invasion of pathogens. Pathogens are foreign disease-causing substances, such as bacteria and viruses, and people are exposed to them every day. Antigens are attached to the surface of pathogens and stimulate an immune response in the body. An immune response is the body's defense system to fight against antigens and protect the body.

There are several types of immunity, including innate immunity, passive immunity, and acquired/active immunity.This image is a visual showing active immunity as a process of exposing the body to an antigen to produce an adaptive immune response, while passive immunity "borrows" antibodies from another person.



1. **Innate immunity**

   is general protection that a person is born with, including physical barriers (skin, body hair), defense mechanisms (saliva, gastric acid), and general immune responses (inflammation). This type of immunity is considered non-specific. Although the immune system does not know exactly what kind of antigen is invading the body, it can respond quickly to defend against any pathogen.

2. **Passive immunity**

   is the body's capacity to resist pathogens by "borrowing" antibodies. For example, antibodies can be transferred to a baby from a mother's breast milk, or through blood products containing antibodies such as immunoglobulin that can be transfused from one person to another. The most common form of passive immunity is that which an infant receives from its mother. Antibodies are transported across the placenta during the last one to two months of pregnancy. As a result, a full-term infant will have the same antibodies as its mother. These antibodies will protect the infant from certain diseases for up to a year, and act to defend against specific antigens. Although beneficial, passive immunity is temporary until the antibodies are gone (wane), since the body has not produced the antibodies.

3. **Acquired (adaptive) immunity**

   is a type of immunity that develops from immunological memory. The body is exposed to a specific antigen (which is attached to a pathogen) and develops antibodies to that specific antigen. The next time said antigen invades, the body has a memory of the specific antigen and

already has antibodies to fight it off. Acquired immunity can occur from exposure to an infection, wherein a person gets a disease and develops immunity as a result. Acquired immunity also occurs from vaccination wherein the vaccine mimics a particular disease, causing an immune response in the vaccinated individual without getting them ill.

How does the immune system work?

The immune system defends the body against substances it sees as harmful or foreign. These substances are called antigens.

Antigen is any substance that can spark an immune response,they may be germs such as bacteria,fungus and viruses or they might be chemicals or toxins or foreign body, and they could be cells that are damaged from things like cancer or sunburn, or our own cells that is faulty or dead.

When your immune system recognizes an antigen, it attacks it. This is called an immune response. Part of this response is to make antibodies. Antibodies are proteins that work to attack, weaken, and destroy antigens. The body also makes other cells to fight the antigen. Afterwards, the immune system remembers the antigen. If it sees the antigen again, it can recognize it. It will quickly send out the right antibodies, so in most cases, you don't get sick. This protection against a certain disease is called immunity.

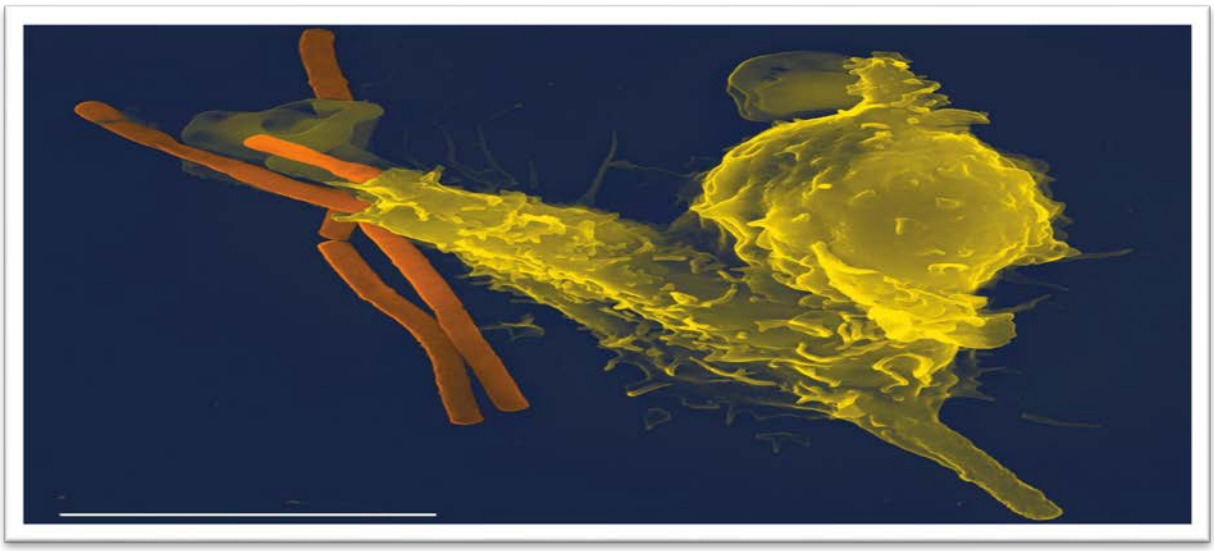
The parts of the immune system

The immune system has many different parts, including:

- Skin, which can help prevent germs from getting into the body
- Mucous membranes, which are the moist, inner linings of some organs and body cavities. They make mucus and other substances which can trap and fight germs.
- White blood cells, which fight germs
- Organs and tissues of the lymph system, such as the thymus, spleen, tonsils, lymph nodes, lymph vessels, and bone marrow. They produce, store, and carry white blood cells.

White blood cells

White blood cells are also called leukocytes. They circulate in the body in blood vessels and the lymphatic vessels that parallel the veins and arteries. White blood cells are on constant patrol and looking for pathogens. When they find a target, they begin to multiply and send signals out to other cell types to do the same.



White blood cell (yellow), attacking anthrax bacteria (orange).

Our white blood cells are stored in different places in the body, which are referred to as lymphoid organs. These include the following:

- **Thymus** — a gland between the lungs and just below the neck.
- **Spleen** — an organ that filters the blood. It sits in the upper left of the abdomen.
- **Bone marrow** — found in the center of the bones, it also produces red blood cells.
- **Lymph nodes** —small glands positioned throughout the body, linked by lymphatic vessels.

There are two main types of leukocyte:

1. Phagocytes

These cells surround and absorb pathogens and break them down, effectively eating them. There are several types, including:

- **Neutrophils** — these are the most common type of phagocyte and tend to attack bacteria.
- **Monocytes** — these are the largest type and have several roles.
- **Macrophages** — these patrol for pathogens and also remove dead and dying cells.
- **Mast cells** — they have many jobs, including helping to heal wounds and defend against pathogens.

2. Lymphocytes

Lymphocytes help the body to remember previous invaders and recognize them if they come back to attack again. Lymphocytes begin their life in bone marrow. Some stay in the marrow and develop into B lymphocytes (B cells), others head to the thymus and become T lymphocytes (T cells). These two cell types have different roles:

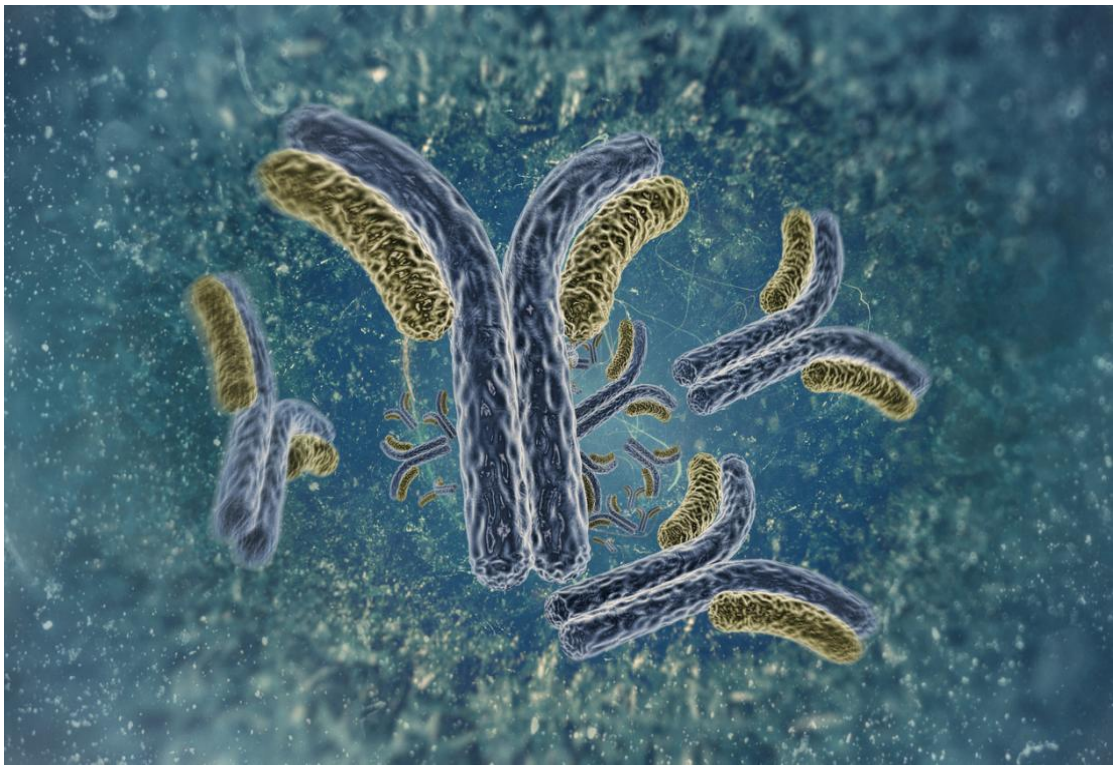
- **B lymphocytes** — they produce antibodies and help alert the T lymphocytes.
- **T lymphocytes** — they destroy compromised cells in the body and help alert other leukocytes.

The role of B lymphocytes

Once B lymphocytes spot the antigen, they begin to secrete antibodies. Antibodies are special proteins that lock on to specific antigens. Each B cell makes one specific antibody. For instance, one might make an antibody against the bacteria that cause pneumonia, and another might recognize the common cold virus. Antibodies are part of a large family of chemicals called immunoglobulins, which play many roles in the immune response:

- **Immunoglobulin G (IgG)** — marks microbes so other cells can recognize and deal with them.
- **IgM** — is expert at killing bacteria.
- **IgA** — congregates in fluids, such as tears and saliva, where it protects gateways into the body.
- **IgE** — protects against parasites and is also to blame for allergies.

- **IgD** — stays bound to B lymphocytes, helping them to start the immune response.



B lymphocytes secrete antibodies that lock onto antigens.

The role of T lymphocytes

There are distinct types of T lymphocytes:

Helper T cells (Th cells) — they coordinate the immune response. Some communicate with other cells, and some stimulate B cells to produce more antibodies. Others attract more T cells or cell-eating phagocytes.

Killer T cells (cytotoxic T lymphocytes) — as the name suggests, these T cells attack other cells. They are particularly useful for fighting viruses. They work by recognizing small parts of the virus on the outside of infected cells and destroy the infected cells.

Immune system disorders: Because the immune system is so complex, there are many potential ways in which it can go wrong. Types of immune disorder fall into three categories:

Immunodeficiencies

These arise when one or more parts of the immune system do not function. Immunodeficiencies can be caused in a number of ways, including age, obesity, and alcoholism. In developing countries, malnutrition is a common cause. AIDS (Acquired ImmunoDeficiency Syndrom) is an example of an acquired immunodeficiency caused by HIV (Human Immunodeficiency Virus). In some cases, immunodeficiencies can be inherited, for instance, in chronic granulomatous disease where phagocytes do not function properly.

Autoimmunity

In autoimmune conditions, the immune system mistakenly targets healthy cells, rather than foreign pathogens or faulty cells, they cannot distinguish self from non-self. Autoimmune diseases include celiac disease, type 1 diabetes, rheumatoid arthritis.

Hypersensitivity

With hypersensitivity, the immune system overracts in a way that damages healthy tissue. An example is anaphylactic shock where the body responds to an allergen so strongly that it can be life-threatening.

General introduction

WHAT IS BIOLOGY?

The science which deals with the study of living objects and their life processes is called biology (Greek words, bios – life, logos – study). It covers all aspect of the study of living creatures like occurrence, classification, ecology, economic importance, external form, organization, internal structure, nutrition, health and other.

Branches of Biology:

There are three major branches of biology – botany, zoology and microbiology. **Botany** is the branch of biology which deals with the study of different aspects of plants.

Zoology is the branch of biology connected with the study of different aspects of animals. Aristotle is known as the father of Zoology.

Microbiology is the branch of biology dealing with the study of different aspects of microorganism. Leeuwenhoek is known as the father of Microbiology.

MAIN BRANCHES OF BIOLOGY

Some of the main branches of biology are briefly discussed below:

1. **Taxonomy:** It is the science of identification, nomenclature and classification of organisms.
2. **Morphology:** It is the study of external form, size, shape, colour, structure and relative position of various living organ of living beings.
3. **Anatomy:** It is the study of internal structure which can be observed with unaided eye after dissection.
4. **Histology:** It is the study of tissue organization and structure as observed through light microscope.
5. **Cytology:** It is the study of form and structure of cells including the behaviour of nucleus and other organelles
6. **Cell Biology:** It is the study of morphological, organizational, biochemical, physiological, genetic, developmental, pathological and evolutionary aspects of cell and its components.

7. **Molecular Biology:** It is the study of the nature, physicochemical organization, synthesis working and interaction of biomolecules that bring about and control various activities of the protoplasm.
8. **Physiology:** It is the study of different types of body functions and processes.
9. **Embryology:** It is the study of fertilization, growth, division and differentiation of the zygote into embryo or early development of living beings before the attainment of structure and size of the offspring.
10. **Ecology:** It is the study of living organisms is relation to other organism and their environment.
11. **Genetics:** It is the study of inheritance of characters or heredity and variations. Heredity is the study of expression and transmission of traits from parents to offspring.
12. **Evolution:** It studies the origin of life as well as new types of organism from the previous ones by modifications involving genetic changes and adaptations.
13. **Virology:** It is the study of viruses in all their aspects.

General characteristics of living things

When examining the characteristics of organisms, there are two basic categories of organisms- **living** and **non-living**. There are several characteristics that exist to classify an organism as a living thing. Living organisms must be made of cells, reproduce, use energy, grow and develop, respond to stimuli, adapt to their environment, and maintain homeostasis. Non-living organisms, then, lack one or more of these characteristics. For example, plants and animals are living while rocks and cars are not living. It is important to understand the basic characteristics of organisms because these features determine how scientists classify, study and discuss all matter. Because of this information, all living matter can be classified in a complex taxonomy system that shaped the way organisms are named and studied.

These are the three characteristics of living organisms.

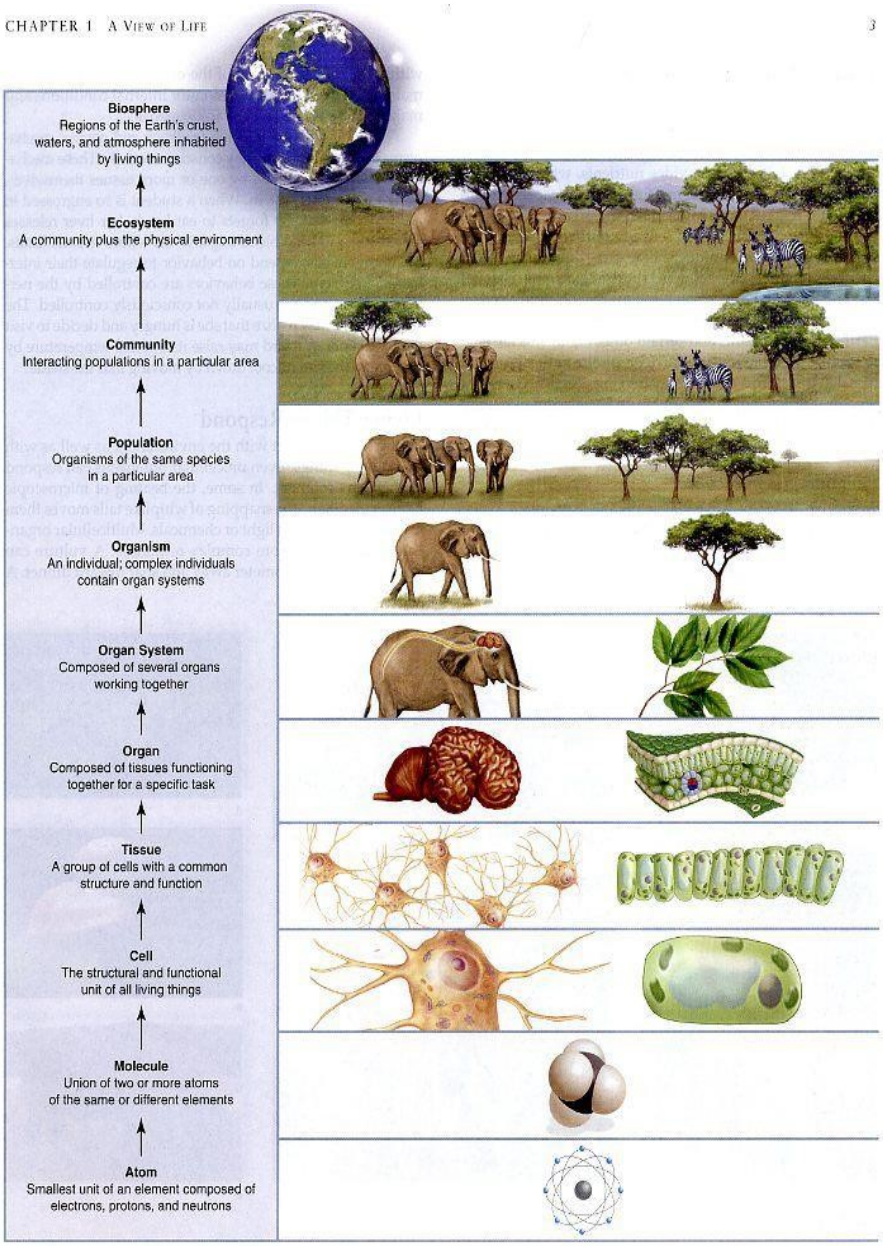
1- **Living things are organized**
2- **Living things obtain and use energy**
3- **Living things MaintainHomeostasis.**

4- Reproduction.

5- Living things adaptations

1- Living things are organized: - The levels of organization began with atoms which are the basic units of matters, atoms combine with other atoms of the same or different elements to form molecules. The cell composed of variety of molecules working to gather, organism may be **Unicellular, paramecia _ Multicellular, human.** Many living things that are unicellular – they consist of a single cell. Other living things are multicellular, consisting of many cells – many trillions of cells in the case of human adult. The cell is in several senses the basic unit of a living organism. There are more than 200 distinct kinds of cells in the human body. All living things are composed of cells, and all cells arise from pre-existing cells

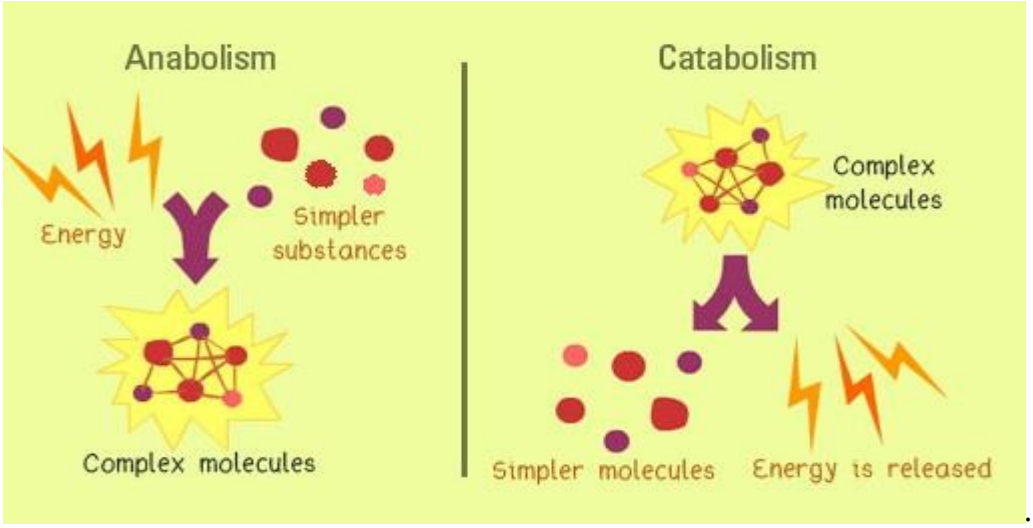
Similar cells combine to form tissue (nerve tissue), tissue make up organs (brain), organs work to gather in system (brain work with spinal cord and a network of nerves to form nervous system). Organ systems are joined to gather to form a complete living organism such as a human.



2- Living things obtain and use energy: - Cells cannot survive on their own. They need power to stay alive. They need energy to perform functions such as growth, maintaining balance, repair, reproduction, movement and defence. This means all living organisms must obtain and use energy to live.

Energy is the power to do things. This power comes in many ways and forms, but they can all be linked to the sun. It is the source of all energy.

The process of obtaining and using energy by living organisms are best explained by three important scientific terms namely **Anabolism, Catabolism and Metabolism**.



❖ **Anabolism (constructive anabolism)**

This is a process whereby living organisms use simpler substances to put together, or build complex substances such as carbohydrates, proteins and fats for storage. Such an activity is known as an anabolic activity. **Nutrition** is anabolism process as it helps in the building up of the body tissue.

A living organism can either make its own food or depend on others to make food for them. For example, green plants produce their own food from a process called photosynthesis. They use the chloroplasts in their cells to capture energy in sunlight. They combine it with water and carbon dioxide from the air to produce sugars for themselves. Other organisms take diffusible and non- diffusible complex organic substance as food (**ingestion**) in animals. The non-diffusible foods substance is converted into diffusible forms (**digestion**). The digestion food is absorbed and distributed in to various parts of the body and is ultimately converted into protoplasm (assimilation). The undigested waste matter is passed out of the body as feces (egestion) or defecation

❖ **Catabolism (destructive catabolism)**

This is when the cells in living organisms, breakdown complex substances and molecules into simpler substances, often to release energy for use.

- **Respiration**

a catabolism process as it tends to destroy the tissue substances by oxidation. It involves intake the oxygen and outgo of carbon dioxide. Oxygen oxidizes the tissue substances, CO2 and water are produced and energy is liberated. This energy is utilized for performance of various bodily functions.

- **Metabolism**

This is the sum of all the chemical reactions (anabolic and catabolic activities) that go on in the cells of living organisms. It is a continuous process because the moment metabolism stops, the living organism will die.

3-Living things Maintain Homeostasis :-To survive it is imperative that an organism maintain a stat of biological balance or homeostasis ,temperature , moisture level, acidity or other physiological factors must remain within the tolerance range of the organism .Homeostasis is maintained by systems that monitor internal conditions and make routine and necessary adjustments .

Examples of homeostasis include the regulation of body temperature, the pH of extracellular fluid, or the concentrations of sodium, potassium and calcium ions. Muscular activity generates heat as a waste product .This heat is removed from our bodies by sweating .

pH :- In human pH need to be maintained within a narrow range .The pH of blood is 7.4 that is slightly basic (alkaline) .If the blood pH drops to about 7 acidosis results .If the blood pH rises to about 7.8 alkalosis results .Both conditions can be life threatening , so the blood must be kept around 7.4 .

4-Reproduction: - is the process through which new organisms, or offspring, are produced by a parent organism.

Asexual reproduction (fission ,budding and fragmentation) involves **one parent** organism and produces an **identical offspring**. Bacteria reproduce **asexually** as well as some animals such as starfish that use asexual reproduction to regenerate limbs.

Sexual reproduction involves **two parent** organisms and produces a genetic combination of the two. In sexual reproduction, the offspring has a **unique genetic code** because of the variety of combinations that could occur from parents. Most living organism use the chemical DNA (deoxyribonucleic acid) as the physical carrier of inheritance and the genetic information .Some organisms such as retrovirus (of which HIV is a member) use RNA (ribonucleic acid) as the carrier .

5-Living things adaptations:- adaptations are modification that make organism better able to function in a particular environment , penguins are adapted to an aquatic existence in the Antarctic . An extra layer of downy feathers is covered by short , thick feathers that form a waterproof coat ,feet and tails serves as rudders in the water .flat feet also allow them to walk on land . a polar bear has very thick fur to trap their body heat in the cold artic temperatures

6- Living things respond: - In order to survive, living things must respond to stimuli in their environment. This responsiveness is active and requires a set of systems to detect a change and respond to it. Living things change according the light, temperature, and chemicals in their environment. An example of this would be a person touching a hot stove and immediately pulling their hand away.

7- Excretion: - All living things excrete. As a result of the many chemical reactionsoccurring in cells, they have to get rid of waste products which might poison the cells. Excretion is defined as the removal of toxic materials, the waste products of metabolism and substances in excess from the body of an organism.

8- Secretion:- The living things produce many useful substances such as enzymes ,hormones….etc. These substances are produced in different parts of body and are sent to other parts.

9- Growth and development: -. Growth can be the adding of cells to an organism to cause it to change in size or mass. This can also be exhibited in the change of appearance or form. For example, tadpoles develop into frogs with the addition of cells and the change of appearance.

10- Movement or motility: - Most of the animals move bodily from one place to another with the help of certain organs or organelles, this called ***locomotion***.

11-Interactions: - living things interact with their environment as well as each other. Organisms obtain raw materials and energy from the environment or another organism. The various types of symbioses (organismal interactions with each other) are examples of this interaction .

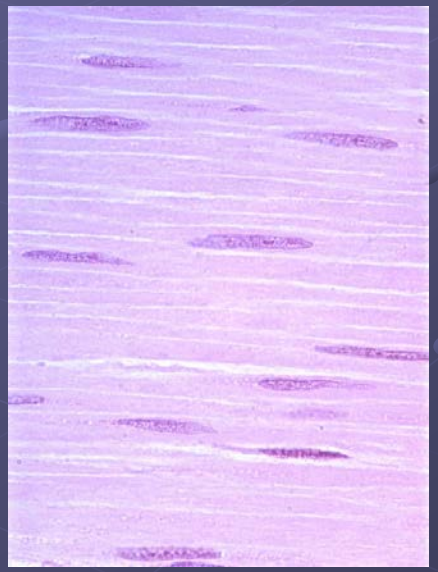
Symbiosis: - An interaction between two or more species living together, may be **parasitic**, commensal or **mutualism**, The relationship between two organism .

12-Death: - Living things ultimately suffer from death.

Muscle Tissue

There are 3 types of muscle tissue:

- skeletal
- smooth
- cardiac



III-Muscular tissue

Without these muscles,

* Nothing in the body would move

*No body movement would occur .

*Muscular tissue composed of cells (muscle fibers) .

*Muscular fiber contain actin filaments and myosin filaments whose interaction accounts for movement .The muscles are also important in the generation of body heat

Classification of Muscle Cells

- Striated vs. Nonstriated

  striated have a banded appearance (stripes)
- Single nucleus or multinucleated cells
- Muscle cells can be controlled

  voluntarily (consciously)

  or

  involuntarily (automatically)

Skeletal Muscle Structures

-Muscle tissue (muscle cells or fibers)

-Connective tissues

- **Nerves**
- **Blood vessels**

How is muscle tissue organized at the tissue level?

Organization of Connective Tissues

Muscles have 3 layers of connective tissues

1-Epimysium-Exterior collagen layer ,Connected to deep fascia Separates muscle from surrounding tissue

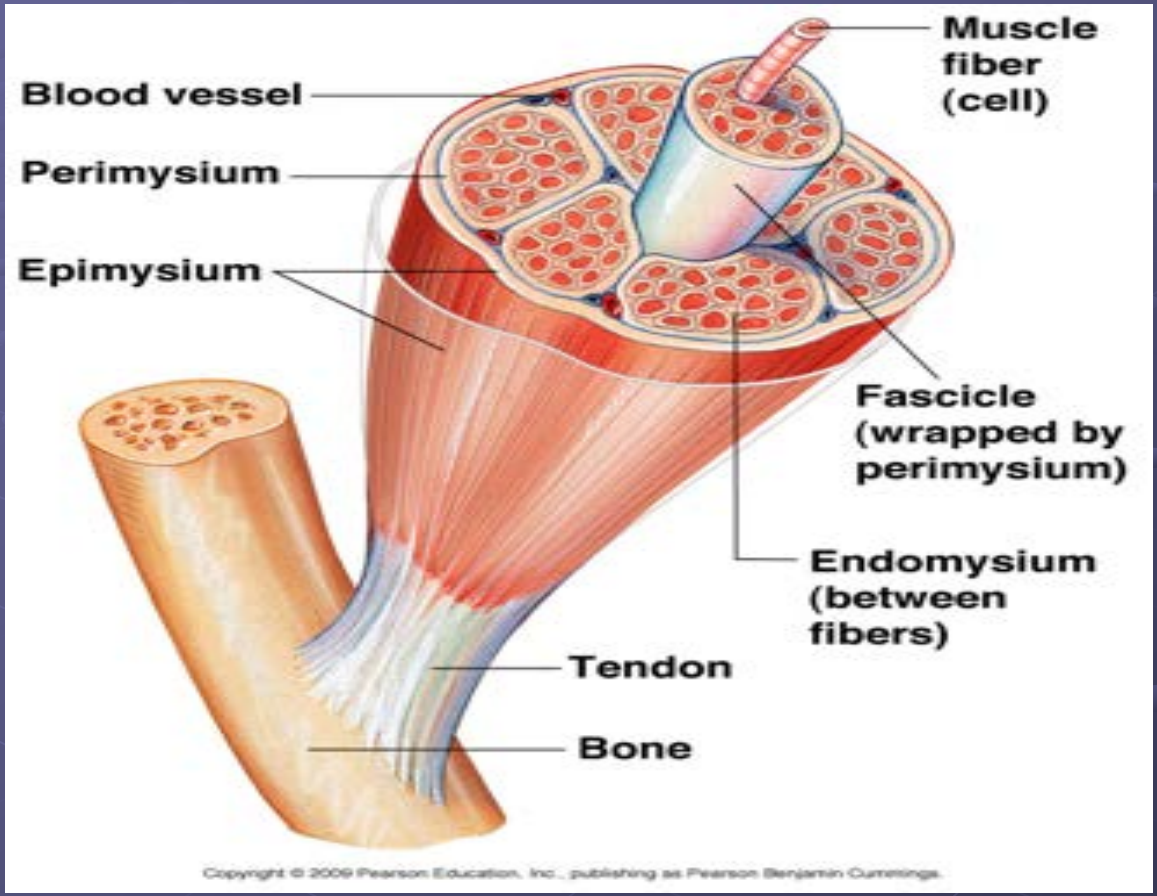
2-Perimysium- Surrounds muscle fiber **) .** bundles (fascicles

Contains blood vessel and nerve supply to fascicles

3-Endomysium – Surrounds individual cells (muscle fibers) .

Contains capillaries and nerve fibers contacting muscle cells ,Contains satellite cells (stem cells) that repair damage **.**

.


Muscle fiber (cell)
Blood vessel
Perimysium
Epimysium
Fascicle (wrapped by perimysium)
Endomysium (between fibers)
Tendon
Bone
Copyright © 2009 Pearson Education, Inc., publishing as Pearson Benjamin Cummings.

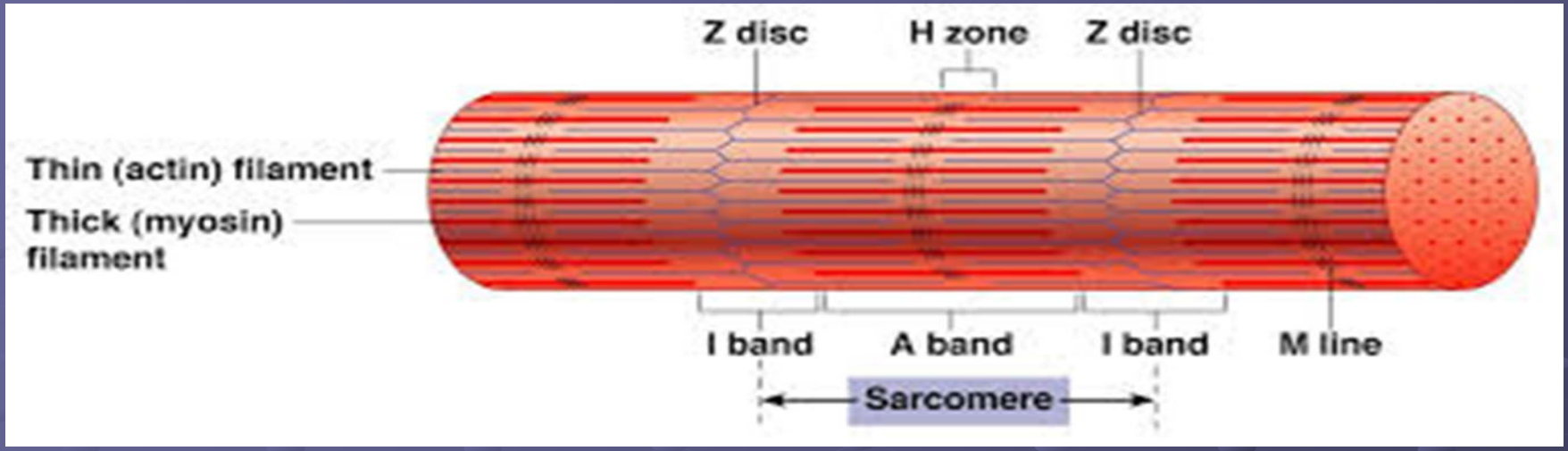
Skeletal muscles are voluntary muscles, controlled by nerves of the central nervous system .

Blood Vessels

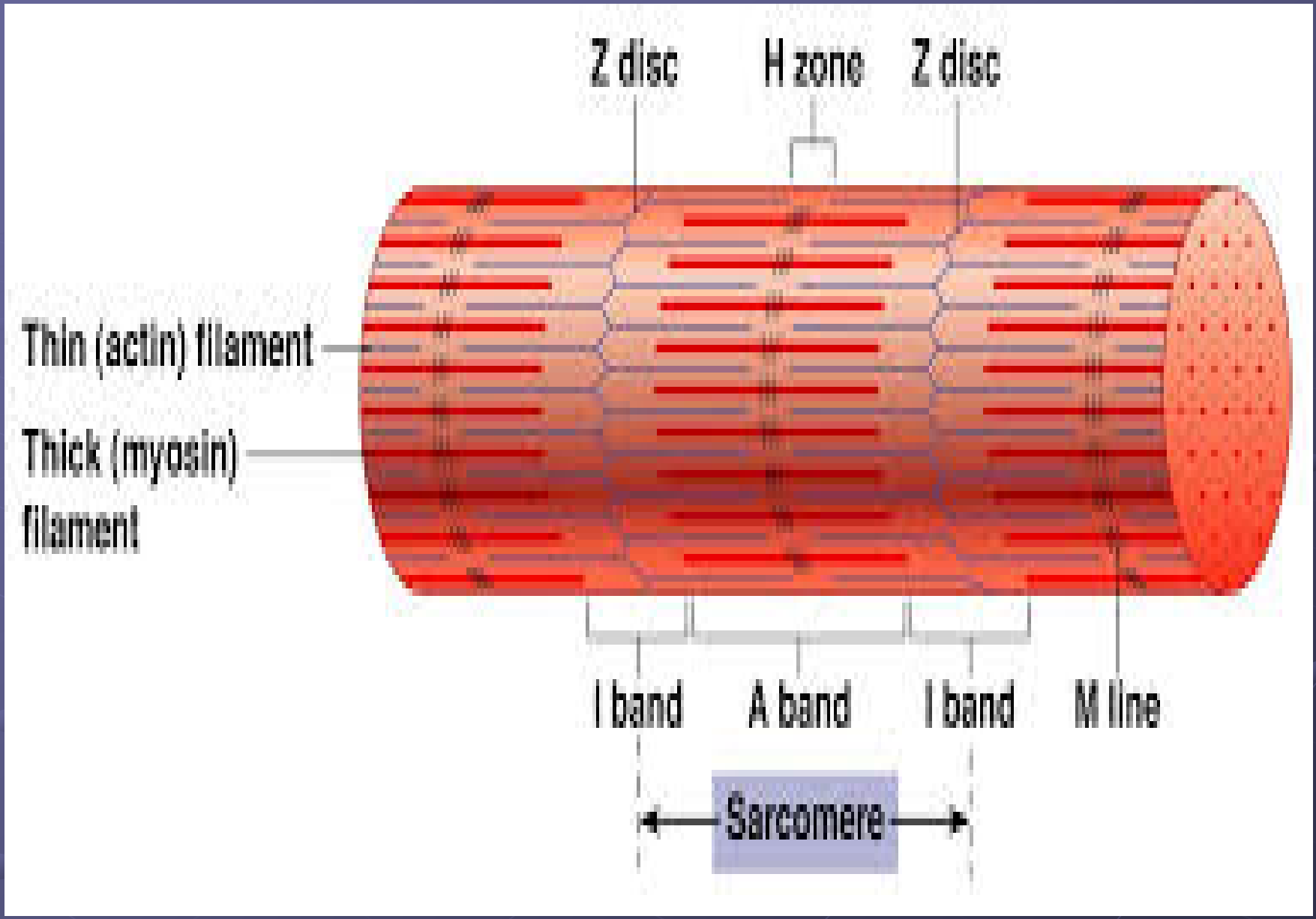
Muscles have extensive vascular systems that supply large amounts of oxygen supply nutrients carry away wastes

Skeletal muscle fiber:-

- Skeletal muscle fibers (cells) are actually a multinucleated syncytium formed by the fusion of individual small muscle cells or myoblasts, during development., They are filled with longitudinally arrayed subunits called myofibrils. The myofibrils are made up of the myofilaments myosin (thick filaments) and actin (thin filaments). The striations reflect the arrangement of actin and myosin filaments and support structures.



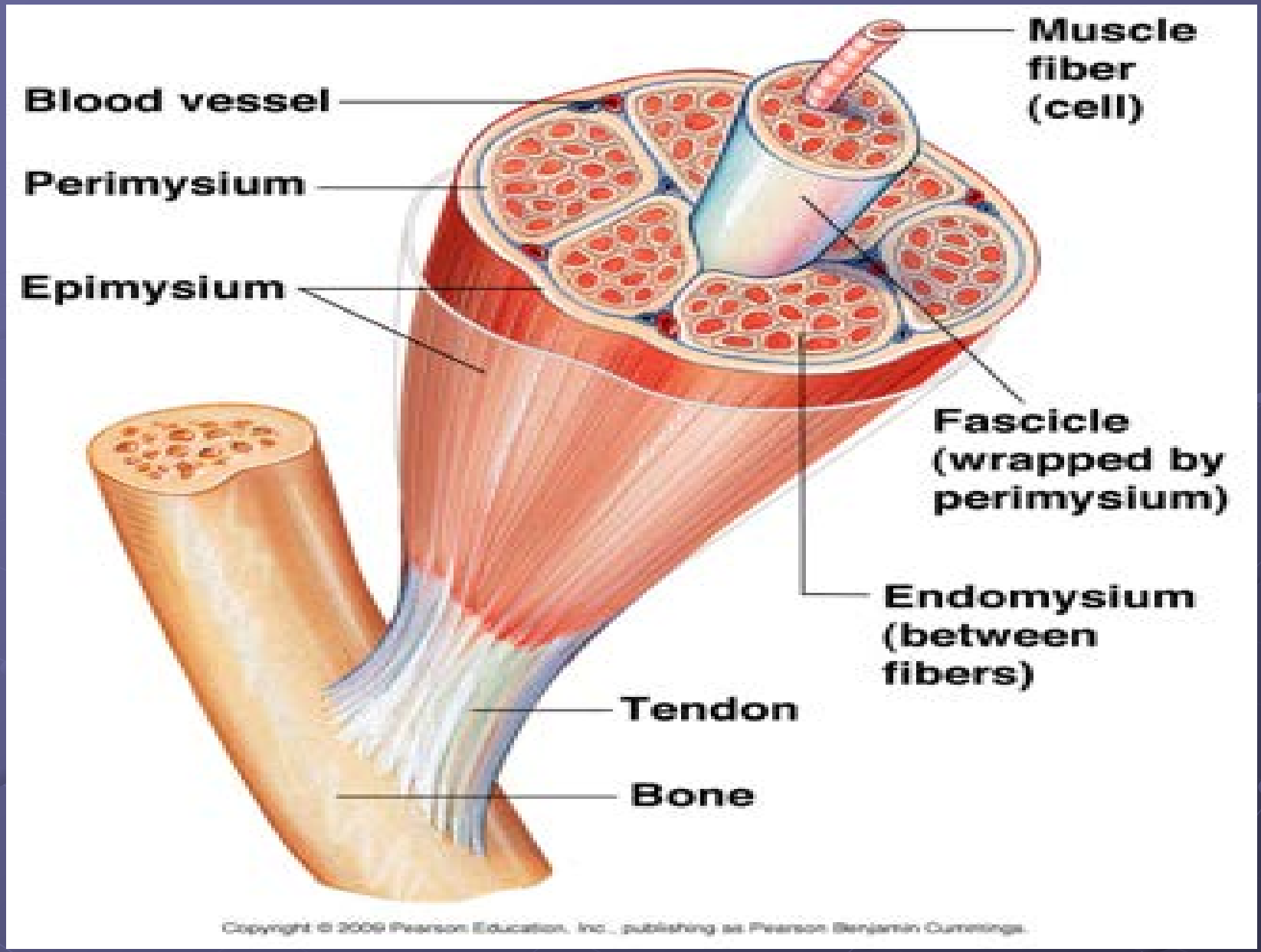
- The individual contractile units are called sarcomeres. A myofibril consists of many sarcomeres arranged end to end. skeletal muscle have alternating pattern of dark and light bands,
- A (anisotropic)
- I (isotropic) band.
- The I band is bisected by a dense zone called the Z line, to which the thin filaments of the I band are attached

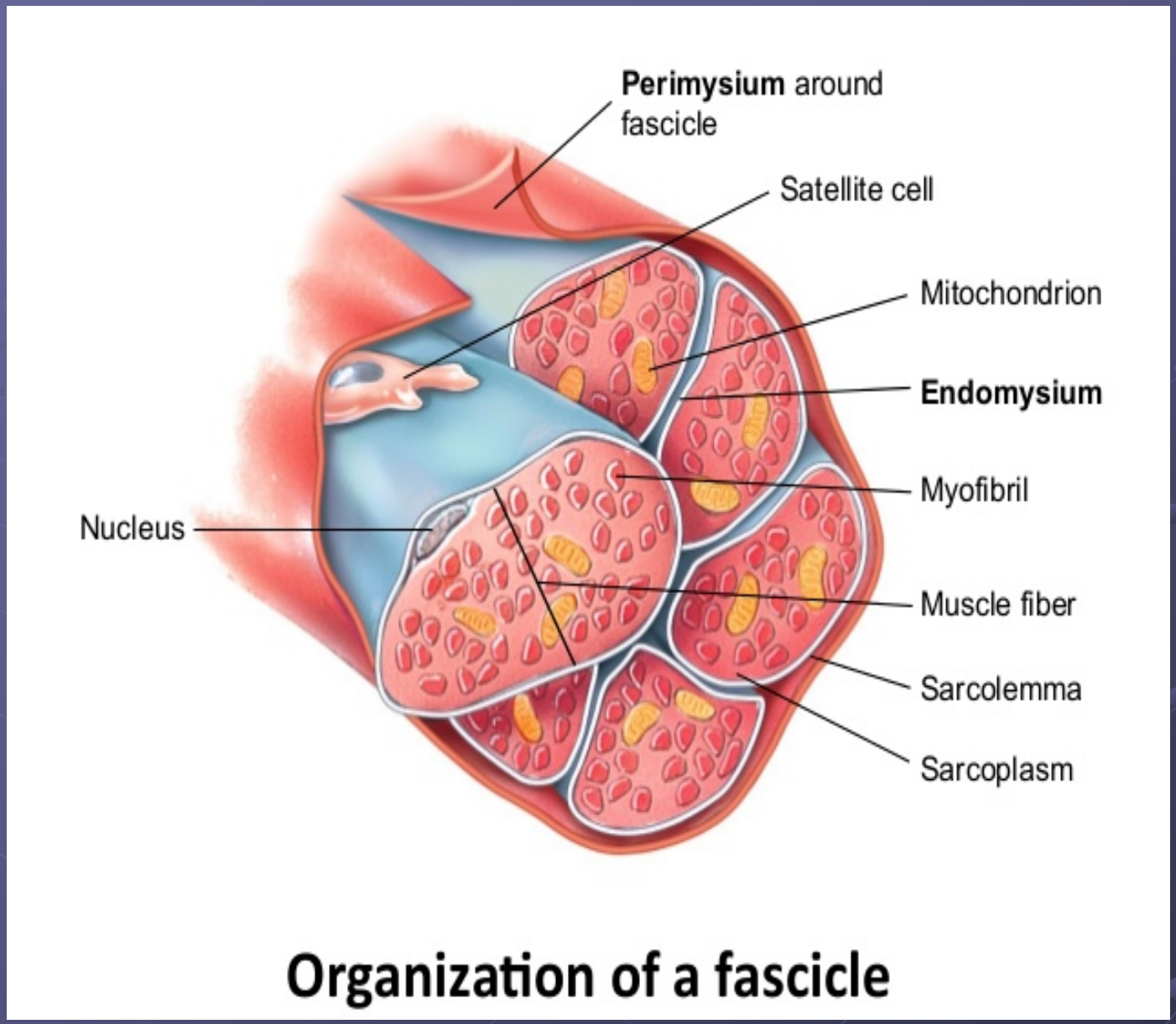

Z disc
H zone
Z disc
Thin (actin) filament
Thick (myosin) filament
I band
A band
I band
M line
Sarcomere

- The nuclei are located peripherally, immediately under the plasma membrane (sarcolemma). The thickness of individual muscle fibres varies (depending for example on location in the body and exercise) but each fibre is of uniform thickness throughout its length. Skeletal muscle fibres do not branch

How is muscle tissue organized at the tissue level?
Organization of Connective Tissues

- 1-Epimysium-Exterior collagen layer ,Connected to deep fascia Separates muscle from surrounding tissue
- 2-Perimysium- Surrounds muscle fiber bundles (fascicles
- Contains blood vessel and nerve supply to fascicles
- 3-Endomysium – Surrounds individual cells (muscle fibers) .
- Contains capillaries and nerve fibers contacting muscle cells ,Contains satellite cells (stem cells) that repair damage .



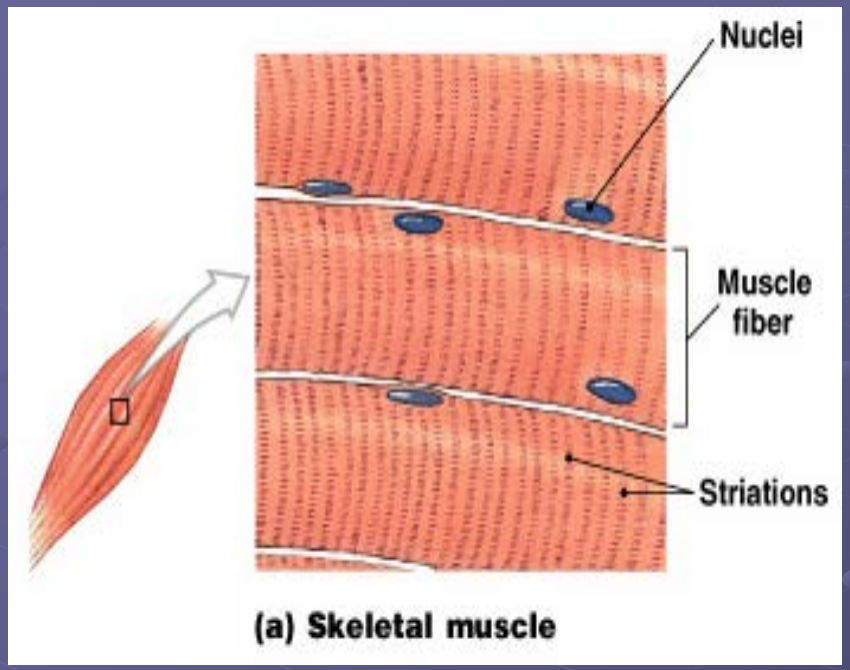


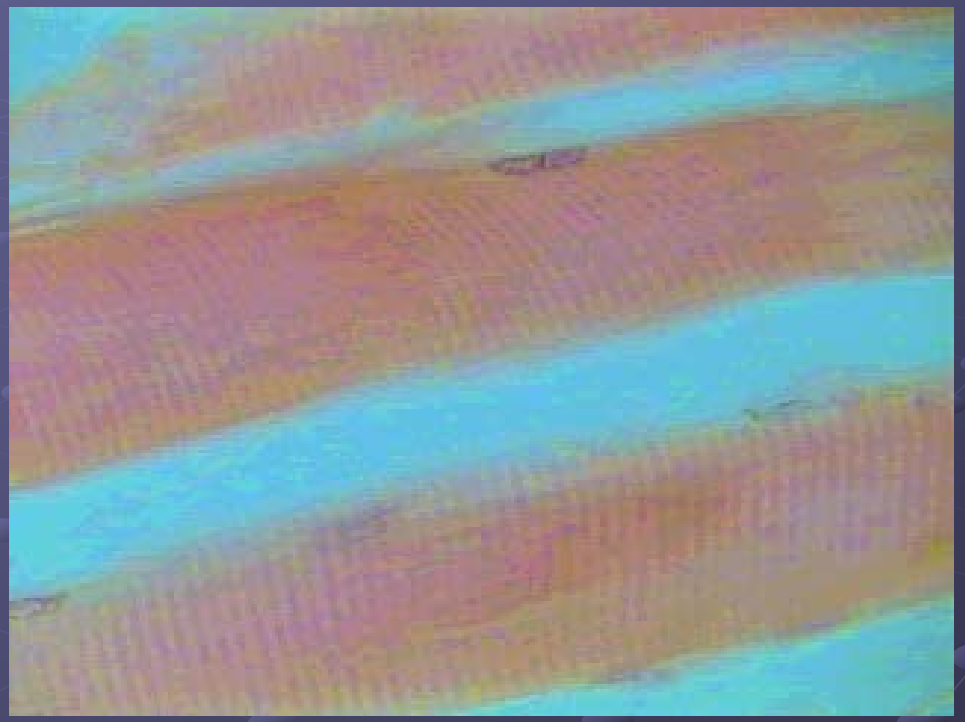
Organization of a fascicle

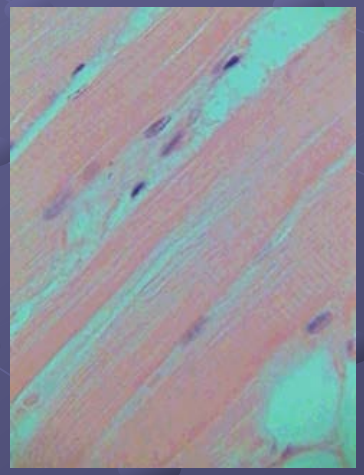
Skeletal Muscle Cells

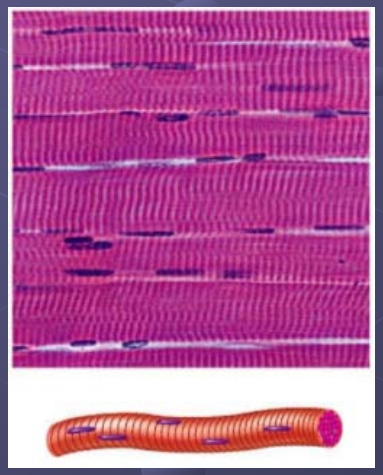
- Striated, voluntary, and multinucleated
- are long, thin and cylindrical; they are attached to bones and move our skeleton
- are usually called "muscle fibers"
- do not divide to create new cells
- new fibers are produced by stem cells
- Striations -- cross stripes (bands) run perpendicular to the cells

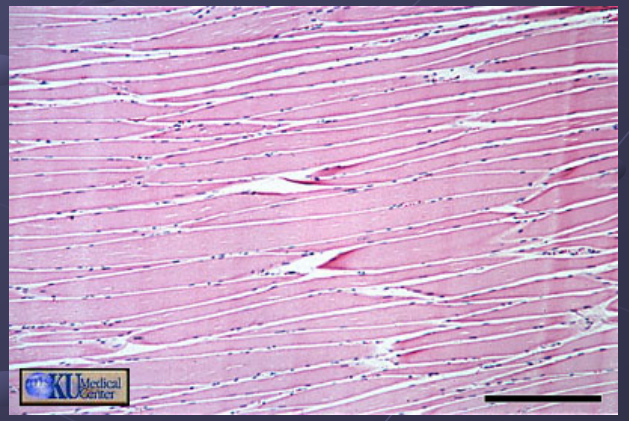
Skeletal Muscle Tissue











- Nerves
- Skeletal muscles are voluntary muscles, controlled by nerves of the central nervous system .
- Blood Vessels
- Muscles have extensive vascular systems that supply large amounts of oxygen supply nutrients carry away wastes

Function of skeletal muscle

1-Maintain body position and posture

2-Support soft tissues

3-Guard body openings (entrance/exit)

4-Maintain body temperature

5-Store Nutrient reserves

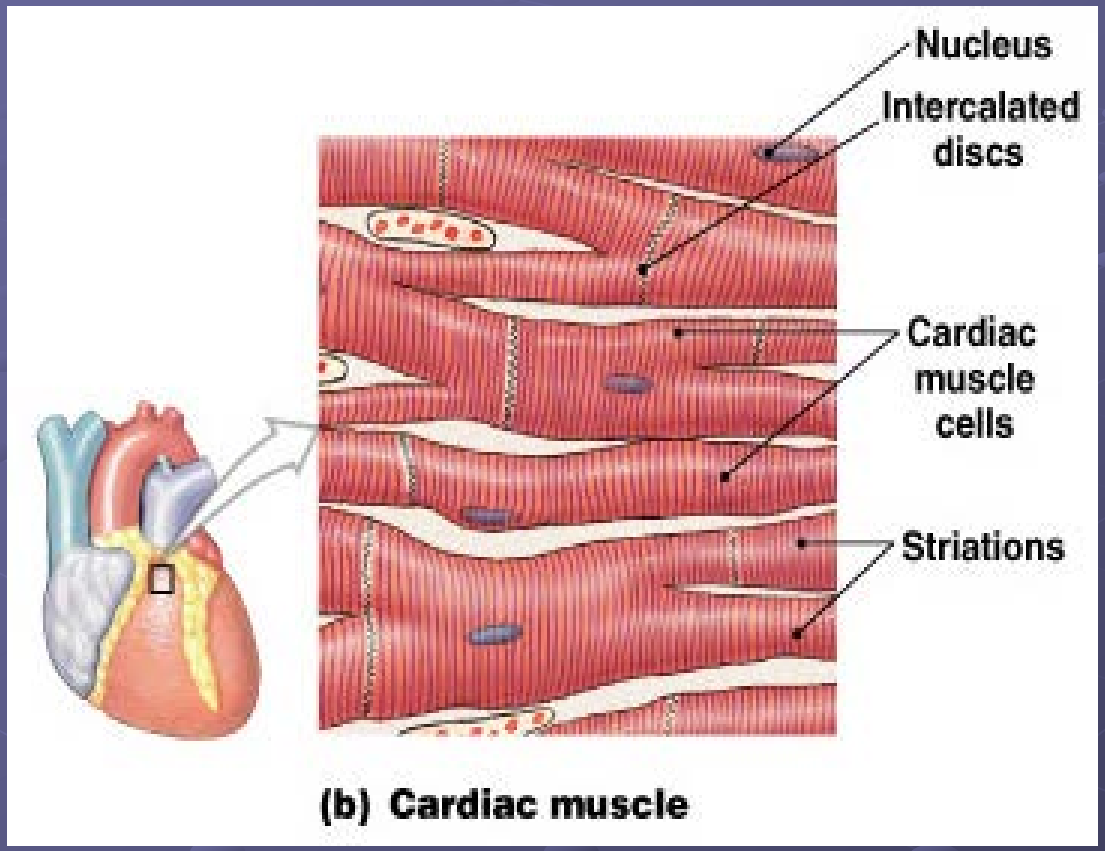
Cardiac Muscle Cells

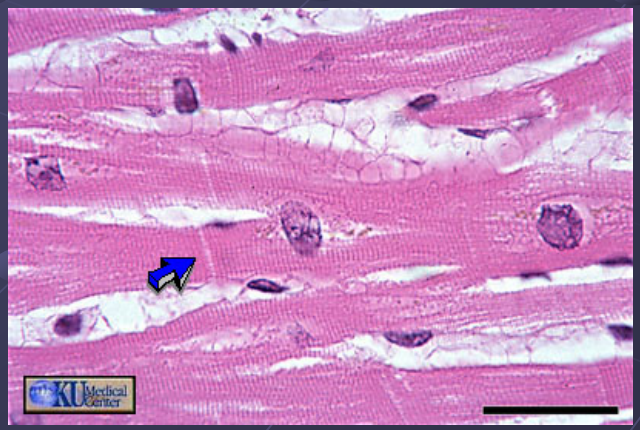
- are called “cardiocytes” and found in heart walls
- branching cells connect at intercalated disks which allow contractions to occur faster
- are regulated by pacemaker cells which control contraction of the heart muscles
- striated, involuntary, and single nucleus

- Intercalated discs consist of several types of cells junctions whose purpose is to facilitate the passage of an electrical impulse from cell to cell and to keep the cells bound together during constant contractile activity.

- Specialized fibres, called Purkinje fibres, Purkinje fibres are of larger diameter than ordinary cardiac fibres, with fewer myofibrils and an extensive, well-defined clear area around the nucleus. They conduct impulses at a rate about four times faster than that of ordinary cardiac fibres and serve to coordinate the contraction of the atria and ventricles

Cardiac Muscle Tissue





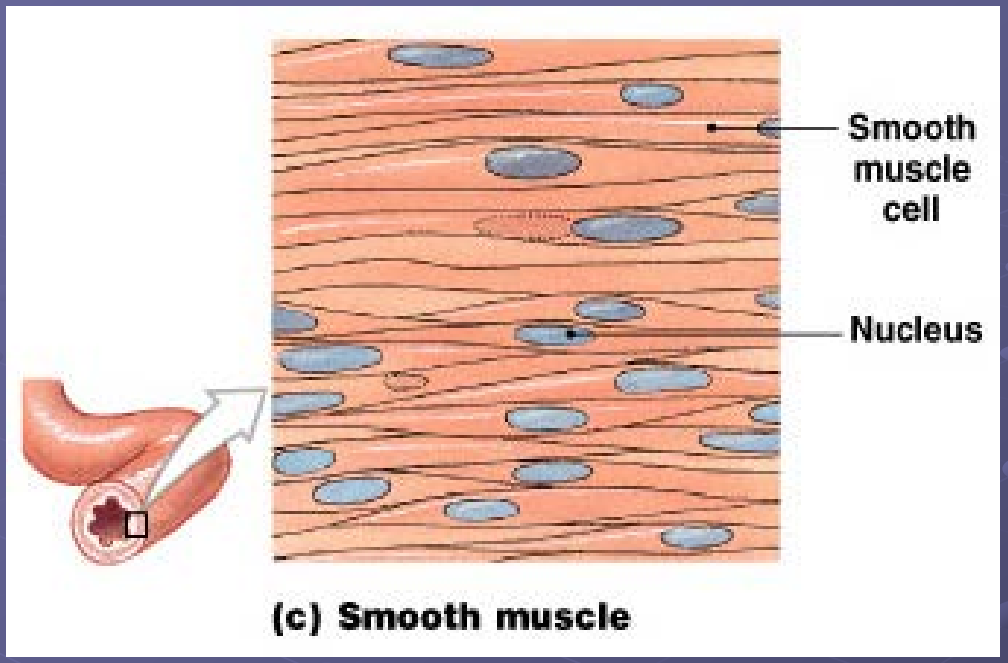
3-Smooth(visceral) Muscle tissue :- is so named because the cells lack striations . smooth muscle fibers are intrinsically contractile but responsive to autonomic and hormonal stimuli. They are specialized for slow, prolonged contraction. The spindle – shaped cells each with a single nucleus, form layers in which the thick middle portion of one cell is opposite the thin ends of adjacent cells . cells can divide and regenerate new cells .Consequently ,the nuclei form an irregular pattern in the tissue .Smooth muscle is not under voluntary control and therefore is said to be involuntary .Smooth muscle found in the walls of viscera (intestine ,stomach and other internal organs) .and blood vessels ,contracts more slowly than skeletal muscle but can remain contracts for a longer time

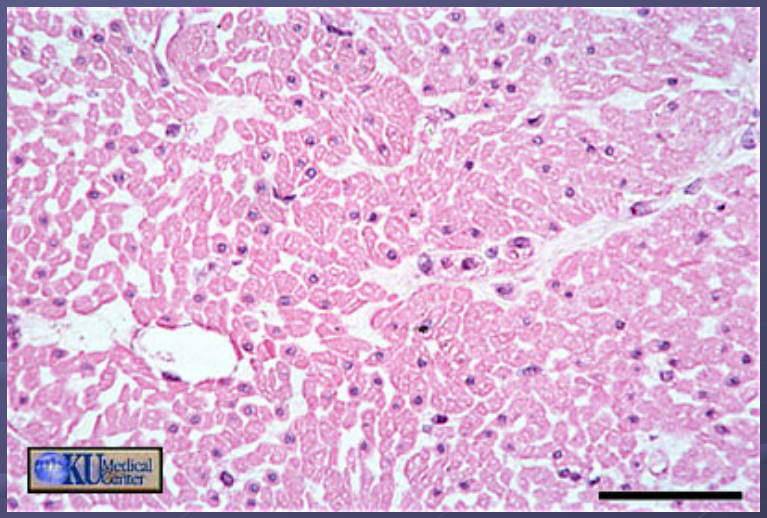
When the smooth muscle of the intestine contracts ,food moves along its lumen .When the smooth muscle of the blood vessels contracts blood vessels constrict ,helping to raise blood pressure .Small amounts of smooth muscle are also found in the iris of the eye and in the skin . One distinguishing physiological feature of smooth muscle is its ability to secrete connective tissue matrix. In the walls of blood vessels and the uterus in particular, smooth muscle fibers secrete large amounts of collagen and elastin.

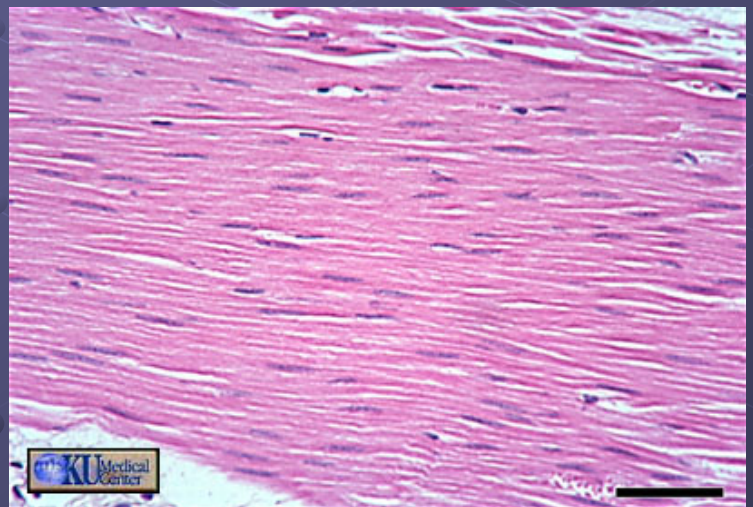
Smooth Muscle Cells

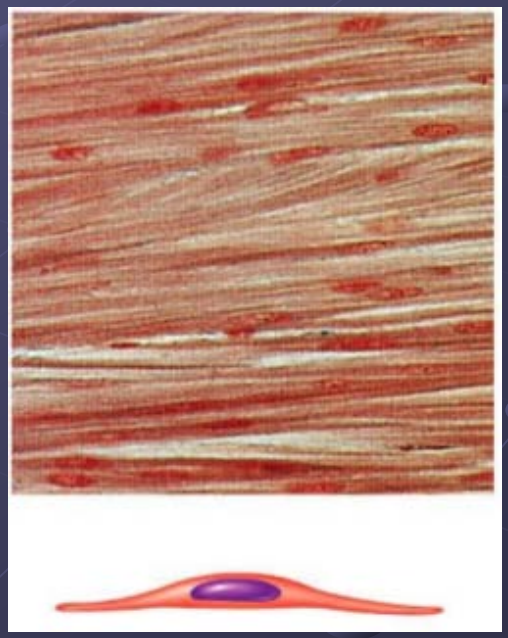
- are small and pointed at their ends
- can divide and regenerate new cells
- non-striated, involuntary, and single nucleus
- found in hollow organs like the intestine, bladder, lungs, and blood vessels
- move substances through hollow opening by contracting slowly; they squeeze things through like a tube of toothpaste

Smooth Muscle Tissue





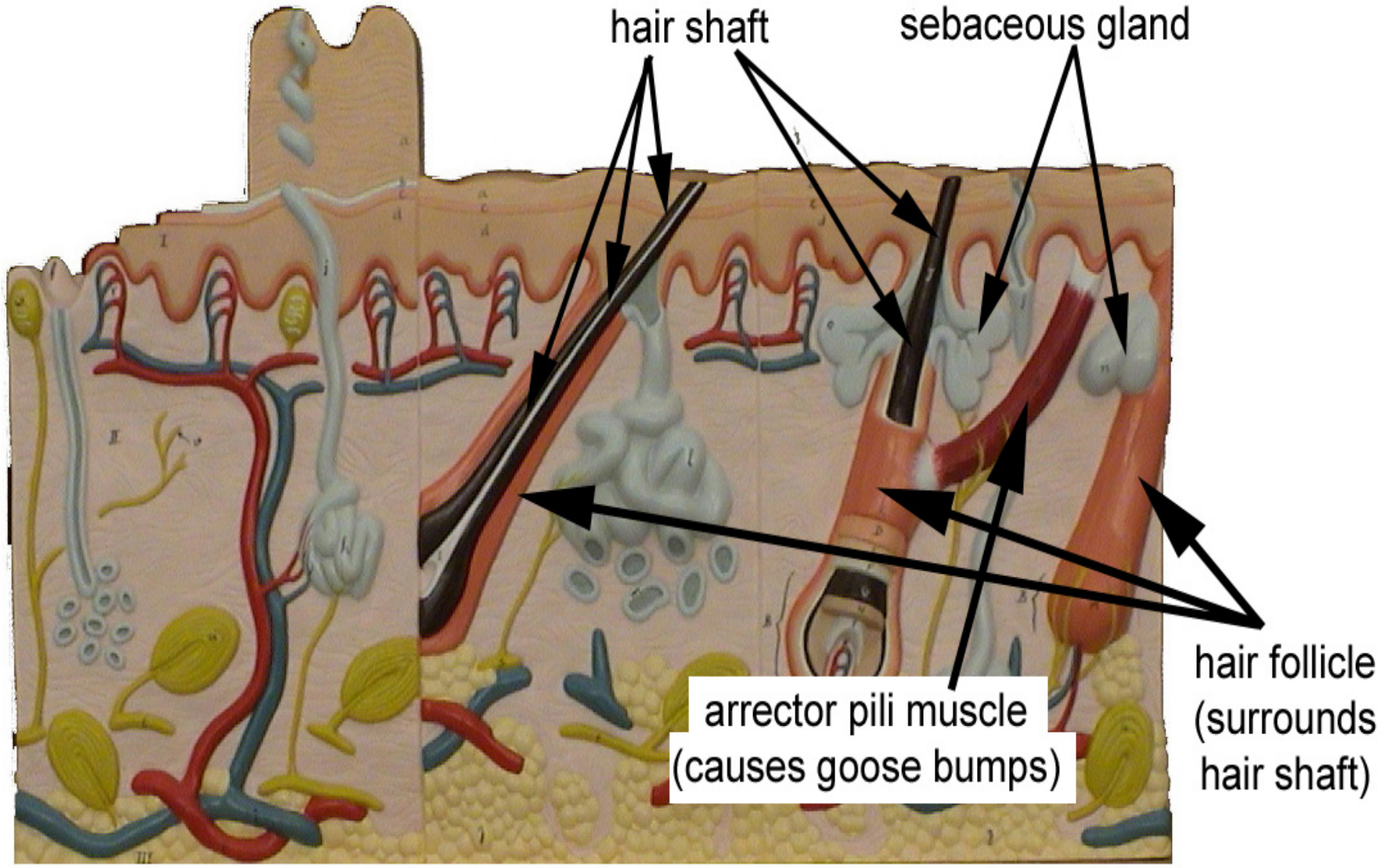




- One distinguishing physiological feature of smooth muscle is its ability to secrete connective tissue matrix. In the walls of blood vessels and the uterus in particular, smooth muscle fibres secrete large amounts of collagen and elastin.

Role of Smooth Muscle in Body Systems

- Forms around other tissues
- In blood vessels:- regulates blood pressure and flow-
- In reproductive and glandular systems:- produces movements
- In digestive and urinary systems:- forms sphincters -
- produces contractions
- -In integumentary system :- arrector pili muscles cause goose bumps :-


hair shaft
sebaceous gland
hair follicle
(surrounds
hair shaft)
arrector pili muscle
(causes goose bumps)

Review What You've Learned…

Muscle Type	Striated?	# of nuclei	**Voluntary or Involuntary**
Skeletal	Yes	Multi-nucleated	Voluntary
Cardiac	Yes	Single Nucleus	Involuntary
Smooth	No	Single Nucleus	Involuntary

Medical Parasitology :

Medical parasitology is the science that deals with organisms living in the human body (the host) and the medical significance of this host-parasite relationship.

ASSOCIATION BETWEEN PARASITE AND HOST

A parasite is a living organism, which takes its nourishment and other needs from host; the host is an organism which supports the parasite. The parasites included in medical parasitology are protozoa, helminthes, and some arthropods .

Parasites can also be classified as: -
Ectoparasite: Ectoparasites inhabit only the body surface of the host without penetrating the tissue. Lice, ticks and mites are examples of ectoparasites.

Endoparasite: A parasite, which lives within the body of the host and is said to cause an infection is called an endoparasite. Most of the protozoan and helminthic parasites causing human disease are endoparasites. - Free-living parasite: It refe rs to nonparasitic stages of active existence, which live independent of the host, e.g. cystic stage of Naegleria fowleri.

KINDS OF HOSTS

Definitive host – a host that harbors a parasite in the adult stage or where the parasite undergoes a sexual method of reproduction.
• **Intermediate host -** harbors the larval stages of the parasite or an asexual cycle of development takes place. In some cases, larval development is completed in two different intermediate hosts, referred to as first and second intermediate hosts.
• **Paratenic host –** a host that serves as a temporary refuge and vehicle for reaching an obligatory host, usually the definitive host, i.e. it is not necessary for the completion of the parasites life cycle.
• **Reservoir host –** a host that makes the parasite available for the transmission to another host

HOST-PARASITE RELATIONSHIPS
Host-parasite relationships are of following types : Symbiosis • Commensalism • Parasitism.
1-Symbiosis
Both host and parasite are dependent upon each other • None of them suffers any harm from the association .E.x. is the relationship between certain species of flagellated protozoa living in the gut of termites.

Commensalism - Only the parasite derives benefit from the association without causing any injury to the host. E.x. Most of the normal flora of the humans' body can be considered as commensals.

Parasitism • The parasite derives benefits and the host is always harmed due to the association .The parasite cannot live an independent life **-** an association where one of the partners is harmed and the other lives at the expense of the other. E.x. Worms like *Ascaris lumbricoides* reside in the gastrointestinal tract of man, and feed on important items of intestinal food causing various illnesses.

EFFECT OF PARASITES ON THE HOST

The damage which pathogenic parasites produce in the tissues of the host may be described in the following two ways;

(a) Direct effects of the parasite on the host

• Mechanical injury - e.g. Hydatid cyst causes blockage of ducts such as blood vessels producing infraction.

• Deleterious effect of toxic substances- in *Plasmodium falciparum*

• Deprivation of nutrients,

(b) Indirect effects of the parasite on the host:

Immunological reaction: Tissue damage may be caused by immunological response of the host, e.g. nephritic syndrome following Plasmodium infections., e.g. fibrosis of liver after deposition of the ova of Shistosoma.

Laboratory diagnosis – depending on the nature of the parasitic infections, the following specimens are selected for laboratory diagnosis:

a) **Blood** – in those parasitic infections where the parasite circulates in the blood stream, (malaria) the parasites are found inside the red blood cells .

b) **Stool** – examination of the stool it in the diagnosis of intestinal parasitic infections and also for those helminthic parasites Amoebiasis, Giardiasis, etc. In the case of helmithic infections, the adult worms, their eggs, or larvae are found in the stool.

c) **Urine** – when the parasite localizes in the urinary tract, examination of the urine will be of help in establishing the parasitological diagnosis. For example in urinary Schistosomiasis, eggs of *Schistosoma haematobium* are found in the urine.

d) **Sputum** – examination of the sputum is useful in the following:

• In cases where the habitat of the parasite is in the respiratory tract, as In amoebic abscess of lung or in the case of amoebic liver abscess burst in gin to the lungs, the trophozoites of *E. histolytica* are detected in the sputum.

e) **Biopsy material** - varies with different parasitic infections. For example spleen punctures in cases of kala-azar, muscle biopsy in cases of Cysticercosis .

f) **Urethral or vaginal discharge** – for *Trichomonas vaginalis*.

Prevention and control Preventive measures designed to break the transmission cycle are crucial to successful parasitic eradication. Such measures include:
 Reduction of the source of infection.
Sanitary control of drinking water and food.
 Proper waste disposal .
The use of insecticides and other chemicals used to control the vector population.
 Protective clothing that would prevent vectors from resting in the surface of the body and inoculate pathogens during their blood meal.
 Good personal hygiene.

CLASSIFICATION OF MEDICAL PARASITOLOGY

Parasites of medical importance come under the kingdom called protista and animalia.Protista includes the microscopic single-celled eukaroytes known as protozoa. In contrast, helminthes are macroscopic, multicellular worms possessing well differentiated tissues and complex organs belonging to the kingdom animalia. Medical Parasitology is generally classified into:

• **Medical Protozoology -** Deals with the study of medically important protozoa.

• **Medical Helminthology -** Deals with the study of helminthes (worms) that affect man.

• **Medical Entomology -** Deals with the study of arthropods which cause or transmit disease to man.

GENERAL CHARACTERISTICS OF MEDICALLY IMPORTANT PARASITES

Medically important protozoa, helminthes, and arthropods .

1- **PROTOZOA**: unicellular parasites , The cytoplasm consists of an outer layer of hyaline ectoplasm and an inner voluminous granular endoplasm. The ectoplasm functions in protection, locomotion, and ingestion of food, excretion, and respiration. In the cytoplasm there are different vacuoles responsible for storage of food, digestion and excretion of waste products. The nucleus also functions in reproduction and maintaining life.

TABLE 1. CLASSIFICATION OF THE PATHOGENIC PROTOZOA:

PROTOZOA	***ORGAN OF LOCOMOTION***	***IMPORTANT HUMAN PATHOGENS***
1. Rhizopoda	Pseudopodia	*Entamoeba histolytica*
2. Mastigophora (Flagellates)	Flagella	Trypanosomes,Leishmania Trichomonas ,Giardia
3. Sporozoa,	None, exhibit a slight Amoeboid movement	Plasmodium.Spp
4. Ciliates	Cilia	*Balantidium coli*

(2) HELIMINTHS:

The heliminthic parasites are multicellular,. The helminthes of importance to human beings are divided into three main groups with the peculiarities of the different categories described in table 2.

TABLE 2. DIFFERENTIATING FEATURES OF HELMINTHESCESTODE TREMATODE NEMATODE

	CESTODE	**TREMATODE**	**NEMATODE**
Shape	Tape like, segmente	, Leaf like Un segmented	Elongated Cylindrical
Sexes	Not separate (monoecious)	Not separate(monoecious) Except blood flukes which are dioecious	Separate.(diecious)
"Head" End	Suckers: with hooks Suckers:	no hooks	No suckers, and hooks
Alimentary canal	Absent	Present	Present and but incomplete
Body cavity	Absent	Absent	Present

(3) ARTHROPODS

Arthropods, ,segmented body with jointed appendages. They have a hard exoskeleton, which helps enclose and protect the muscles and other organ .Arthropods affect the health of humans by being either direct agents for disease or agents for disease transmission.

CLASSIFICATION OF PROTOZOA

Protozoa of medical importance are classified based on their **morphology** and **locomotive** system as described below:

Rhizopoda(Amoebas)- *Entamoeba histolytica*

Flagellates – *Giarda lamblia*, *Trichomonas vaginalis*, Trypanosoma Spp, Leishmania Spp
Ciliophora - *Balantidium coli*
Coccidian - ***Toxoplasma gondii*, Plasmodium** species Protozoan pathogens can also be grouped according to the location in the body where they most frequently cause disease.

Type and location	**Species**	**Disease**
Intestinal tract	*Entamoeba histolytica* *Giardia lamblia* *Balantidium coli*	Ambiasis Giardiasis Balantidiasis
Urogenital tract	*Trichomonas vaginalis*	Trichomoniasis
Blood and tissue	Plasmodium species *Toxoplasma gondii* Trypanasoma species Leishmania species Naegleria species	Malaria Toxoplasmosis Trypanosomiasis Leishmaniasis Amoebic Meningoencephalitis

AMOEBIASIS
INTRODUCTION
Amoebas primitive unicellular microorganisms with a relatively simple life cycle which can be divided into two stages:
• Trophozoite – actively motile feeding stage.
• Cyst – quiescent, resistant, infective stage.
-Reproduction :binary fission,
-Motility by pseudopodia (“false foot”)

1.1. *Entamoeba histolytica*
Morphological features
(a) Trophozoites
-Viable trophozoites 10-60μm in diameter.
- Motility is rapid ,progressive , and unidirectional, through pseudopods.
- The nucleus is characterized by evenly arranged chromatin on the nuclear membrane and the presence of a small, compact , centrally located karyosome.

-The cytoplasm is finely granular with few ingested bacteria or debris in vacuoles. In the case of dysentery ,however , RBCs may be visible in the cytoplasm, and this feature is diagnostic for *E. histolytica*.

(b) Cyst

10-20μm. The immature cyst has inclusions namely; glycogen mass and chromatoidal bars.

Life cycle

_Intestinal infections occur through the ingestion of a mature quadric nucleate infective **cyst**, contaminated food or drink and also by hand to mouth contact.
It is then passed unaltered through the **stomach**, as the cyst wall is resistant to gastric juice.
-In terminal ileum (with alkaline pH), excystation takes place.
-Trophozoites being **actively motile** invade the tissues and ultimately lodge in the Sub-mucous layer of the large bowel. grow and multiply by binary fission.
-Trophozoites are responsible for producing lesions in **amoebiasis.**
A certain number of trophozoites come from tissues into lumen of bowel and are first transformed into pre-cyst forms.
Pre-cysts secret a cyst wall and become a uninucleate cyst. Eventually, mature ***quadrinucleate cysts*** form. These are th***e infective forms.***
Both mature and immature cysts may be passed in faeces. Immature cysts can mature in external environments and become infective .

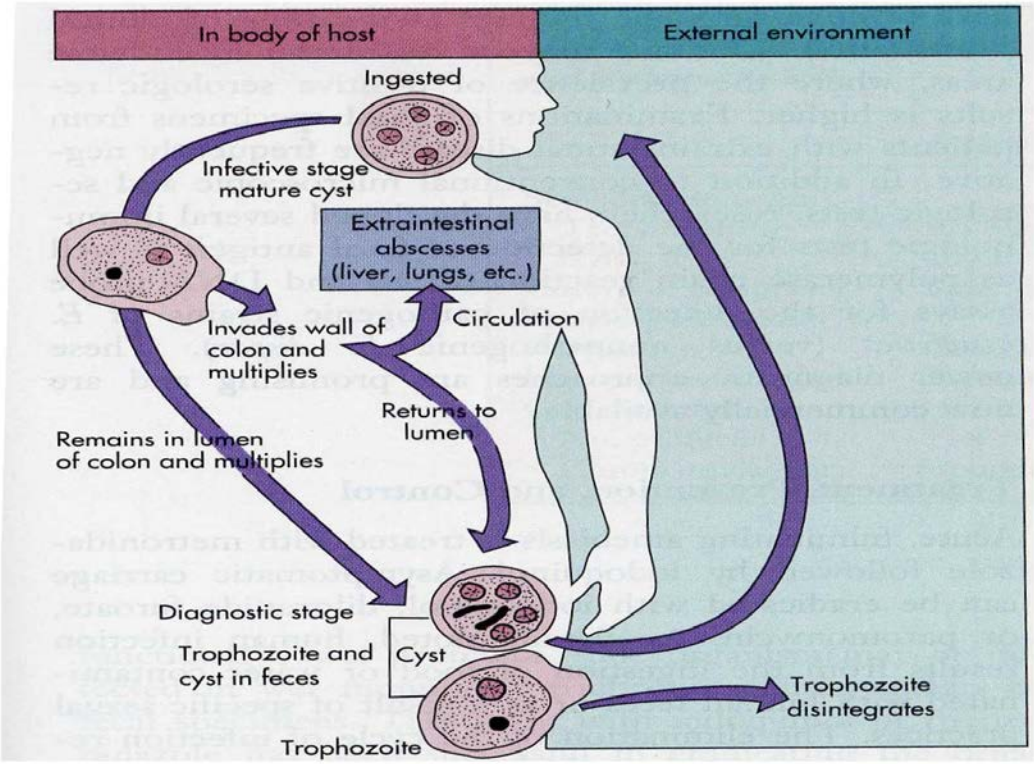


Figure-1 life cycle of ***Entamoeba histolytica***

Pathogenesis

Trophozoites divide and produce extensive local necrosis in the large intestine. Invasion into the deeper mucosa. This can lead to secondary involvement of other organs, primarily the liver but also the lungs, brain, and heart.

Clinical features

, intestinal amebiasis, or extera intestinal amebiasis . Diarrhea , flatulence, and cramping are complaints of symptomatic patients.

Laboratory diagnosis

In intestinal amoebiasis:

• Examination of a fresh dysenteric fecal specimen trophozoite stage. (Motile amoebae containing red cells are diagnostic of amoebic dysentery).

• Examination of formed or semi-formed feces for cyst stage.

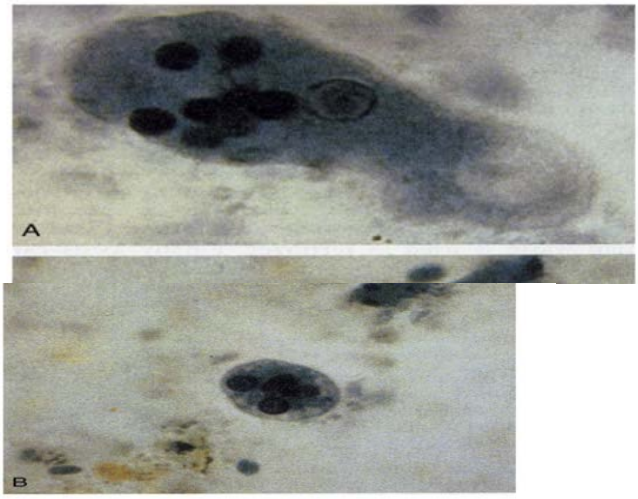


Figure 2-*E.histolytica* trophozoite (A) *E. histolytica* Cyst(B)

Treatment

Acute, fulminating amebiasis is treated with metrondiazole followed by iodoquinol .

Prevention

Introduction of adequate sanitation measures and education about the routes of Transmission .Avoid eating raw vegetables grown by sewerage irrigation .

OTHER AMEBAE INHABITING THE ALIMENTARY CANAL

Most of these amoebae are commensal organisms that can parasitize the human gastrointestinal tract.

Entamoeba gingivalis- only the trophozoite stage presents, and encystation probably does not occur. *E.gingivalis*is a commensal, living primarily on exudates from the margins of the gums, and grow best on unhealthy gums. No specific treatment is indicated. However the presence of *E.gingivalis* suggests a need for better oral hygiene. The infection can be prevented by proper care of the teeth and gums.

Naegleria fowleri- the trophozoites occur in two forms. Amoeboid forms with single pseudopodia and flagella forms with two flagella which usually appear a few hours after flooding water or in CSF. Naegleria trophozoites in a section of spinal cord from a patient with amoebic Meningoecephalitis

PATHOGENIC FLAGELLATES

INTRODUCTION

Flagellates are unicellular microorganisms. Their locomotion is by flagella and reproduction is by simple binary fission. There are three groups of flagellates:

• Luminal flagellates
Giardia lamblia
• Hemoflagellates
Trypanosoma species.
Leishmania species.
• Genital flagellates
Trichomonas vaginalis

Luminal flagellates
. ***Giardia lamblia***
Important features– the life cycle consists of two stages, the trophozoite and cyst.
. It is bilaterally symmetrical, pear-shaped with two nuclei (large central karyosome), four pairs of flagella, and a suction disc with which it attaches to the intestinal wall. The oval cyst is thick-walled with four nucleus and several internal fibera. Transmission is by ingestion of the infective cyst.

Pathogenesis
Infection with ***G.lamblia is*** initiated by ingestion of cysts. Gastric acid stimulates excystation, with the release of trophozoites in duodenum and jejunum. The trophozoites can attach to the intestinal villi by the ventral sucking discs without penetration of the mucosa lining, but they only feed on the mucous secretions. In symptomatic patients, however, mucosa-lining irritation may cause increased mucous secretion and dehydration .

Clinical features
Clinical disease: Giardiasis
Symptomatic giardiasis ranges from mild diarrhea to severe malabsorption syndrome. Usually, the onset of the disease is sudden and consists of foul smelling, watery diarrhea, abdominal cramps, flatulence. Blood & pus are rarely present in stool specimens.

Laboratory diagnosis Examination of diarrheal stool- trophozoite or cyst, or both may be recovered in wet preparation.

Treatment
For asymptomatic carriers and diseased patients the drug of choice is quinacrine hydrochloride or metronidazole.

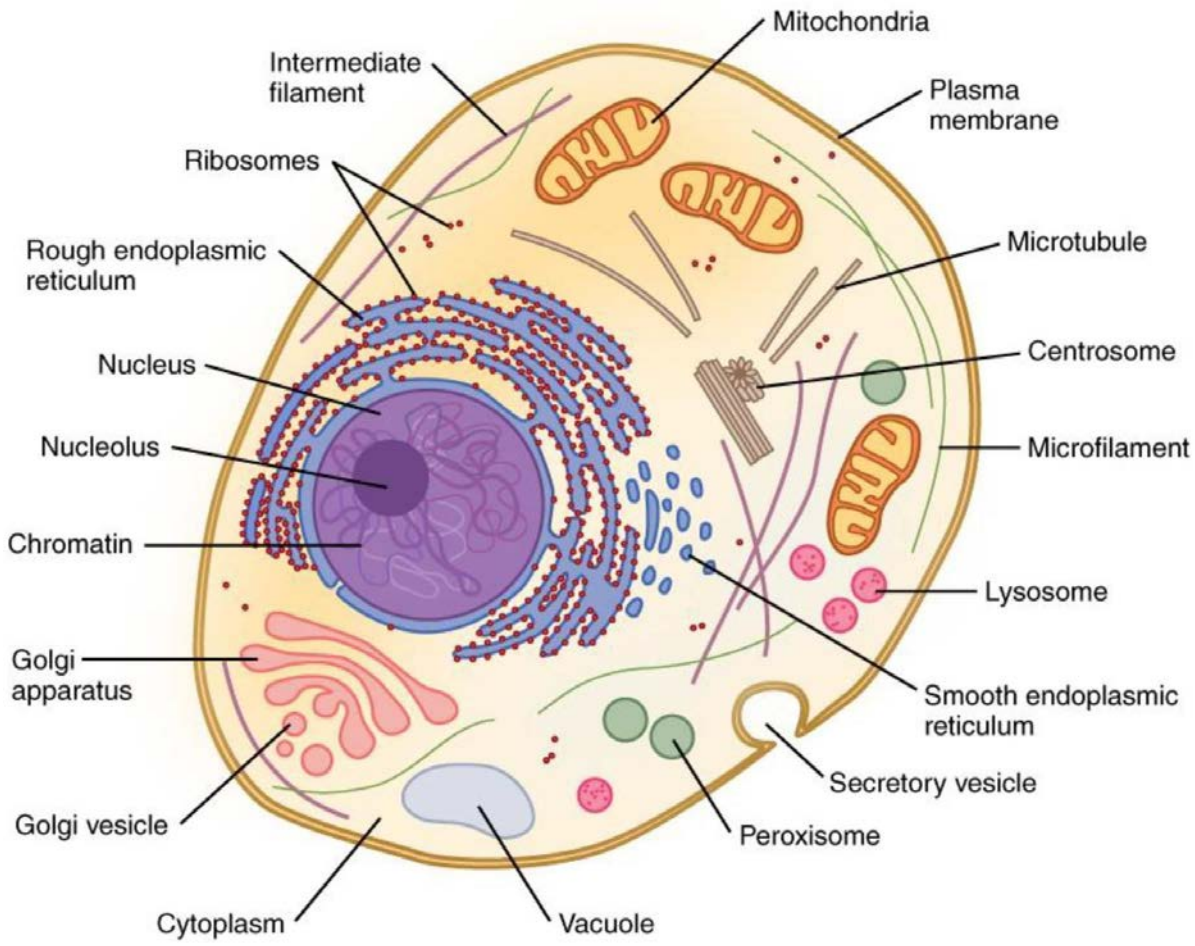
Trichomonas vaginalis **, trichomoniasis.**
Important features- it is a pear-shaped organism with a central nucleus and four anterior flagella; and undulating membrane extends about two-thirds of its length. It exists only as a trophozoite form. Transmission is by sexual intercourse.
The trophozoite is found in the urethra & vagina of women and the urethra &prostate gland of men.

Trichomanas tenax– was first recovered from the mouth ,specifically in tartar from the teeth. There is no known cyst stage. The trophozoite has a pyriform shape and is smaller and more slender than that of *T.hominis*. Diagnosis is based on the recovery of the organism from the teeth, gums, or tonsillar crypts, and no therapy is indicated

Plasma membrane structure

A **cell** is the smallest living thing in the human organism, and all living structures in the human body are made of cells. There are hundreds of different types of cells in the human body, which vary in **shape** (e.g. round, flat, long and thin, short and thick) and size (e.g. small granule cells of the cerebellum in the brain (4 micrometers), up to the huge oocytes (eggs) produced in the female reproductive organs (100 micrometers) and function.

However, all cells have three main parts, the **plasma membrane**, the **cytoplasm** and the nucleus. The **plasma membrane** (often called the cell membrane) is a thin flexible barrier that separates the inside of the cell from the environment outside the cell and regulates what can pass in and out of the cell.



Internally, the cell is divided into the cytoplasm and the nucleus. The **cytoplasm** is where most functions of the cell are carried out. It looks a bit-like mixed fruit jelly, where the watery jelly is called the **cytosol**; and the different fruits in it are called **organelles**. The cytosol also contains many molecules and ions involved in cell functions. Different organelles also perform different cell functions, and many are also separated from the cytosol by membranes. The largest organelle, the **nucleus** is separated from the cytoplasm by a nuclear envelope (membrane). It contains the DNA (genes) that code for proteins necessary for the cell to function.

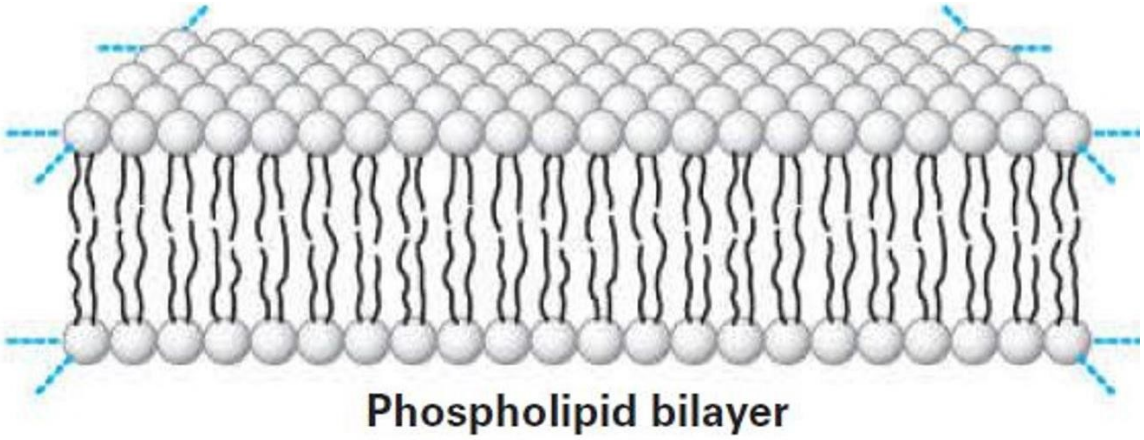
1- The cell membrane, or plasma membrane

The cell membrane, or plasma membrane, is a biological membrane that surrounds the cytoplasm of a cell. In animals, the plasma membrane is the outer boundary of the cell, while in plants and prokaryotes it is usually covered by a cell wall. This membrane serves to separate and protect a cell from its surrounding environment. Membranes have been chemically analyzed and found to be made of proteins and lipids, therefore, the Membrane Structure has 4 components:

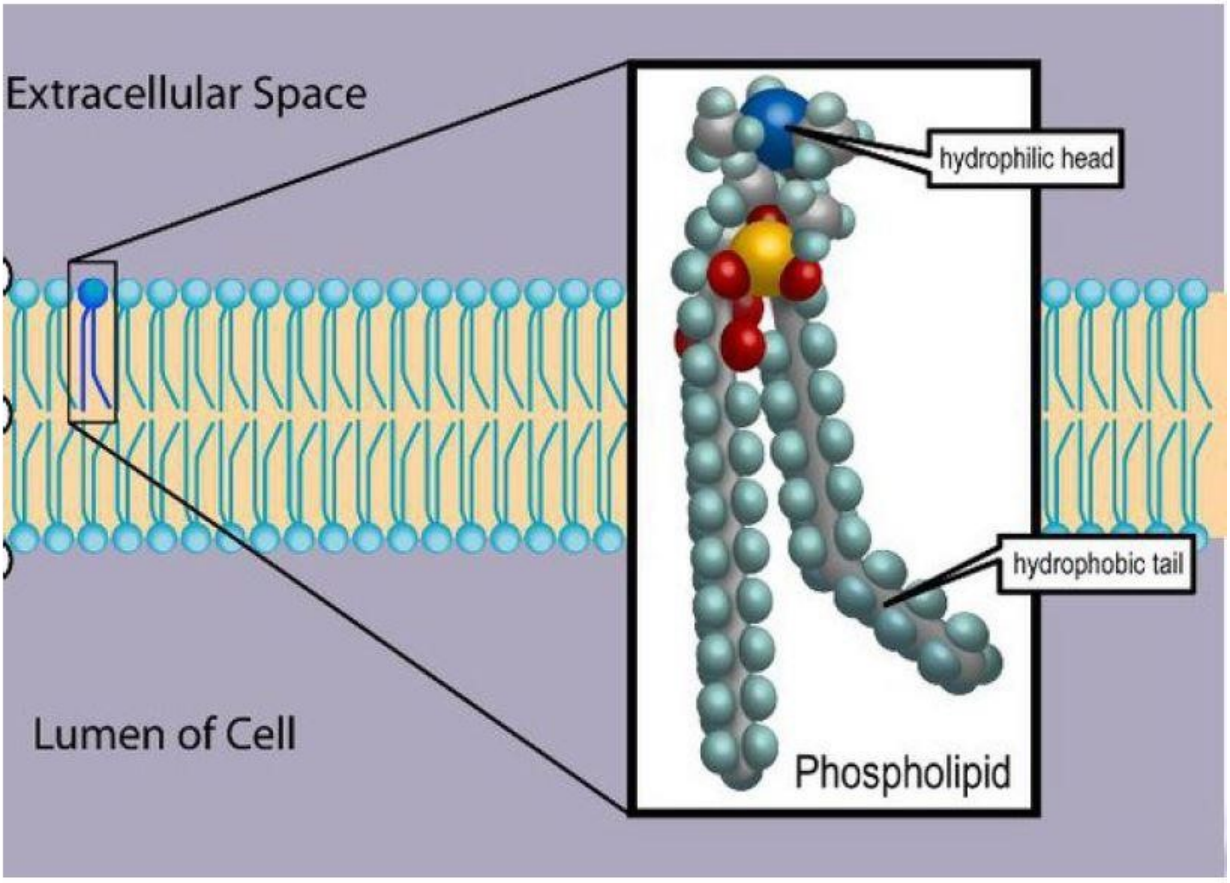
1. Phospholipid bilayer.
2. Transmembrane proteins (Integral membrane protein).
3. Interior protein network (Peripheral membrane proteins).
4. Cell surface markers.

1- Phospholipid bilayer

It is made mostly from a double layer of phospholipids, which are amphiphilic (partly hydrophobic and partly hydrophilic). Hence, the layer is called a phospholipid bilayer. The plasma (cell) membrane separates the inner environment of a cell from the extracellular fluid. It is composed of a fluid **phospholipid bilayer** (two layers of phospholipids) as shown in **figure below (Fig 2)**, and other molecules. Not many substances can cross the phospholipid bilayer, so it serves to separate the inside of the cell from the extracellular fluid.



(Fig 2)



Phospholipid

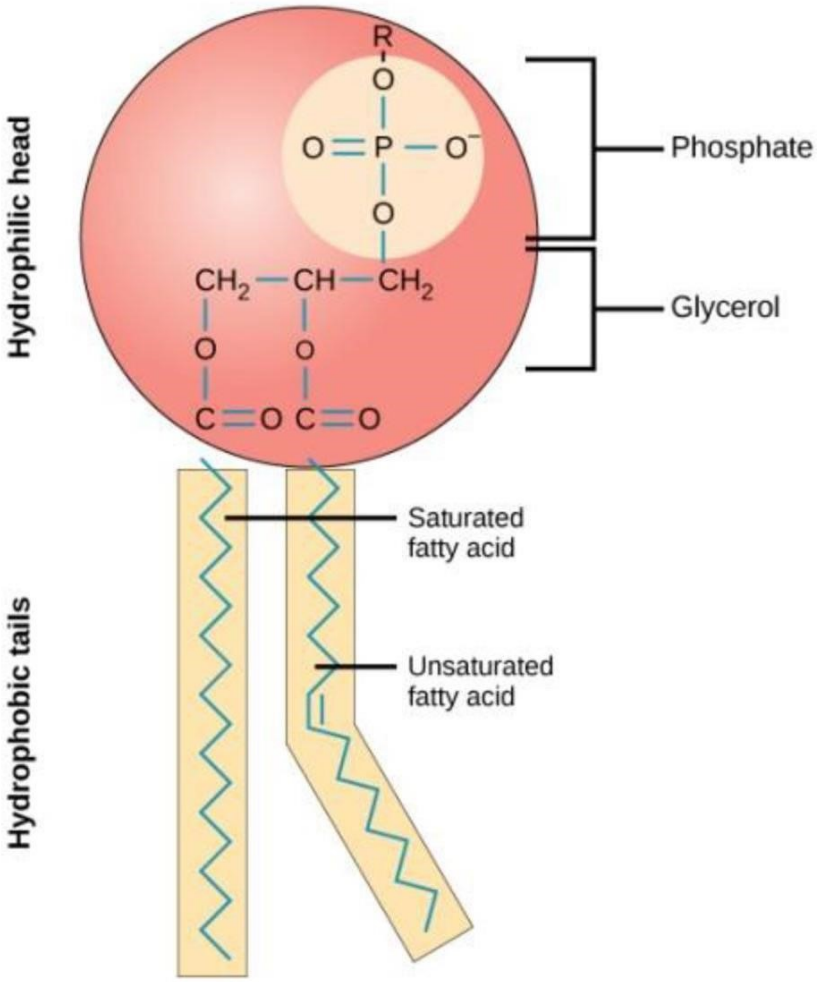
(Figure 3)

Phospholipid structure consists of

One **Phosphate group** attached to the glycerol.

One **glycerol**– a 3-carbon polyalcohol acting as a backbone for the phospholipid.

Two **fatty acids** attached to the glycerol.



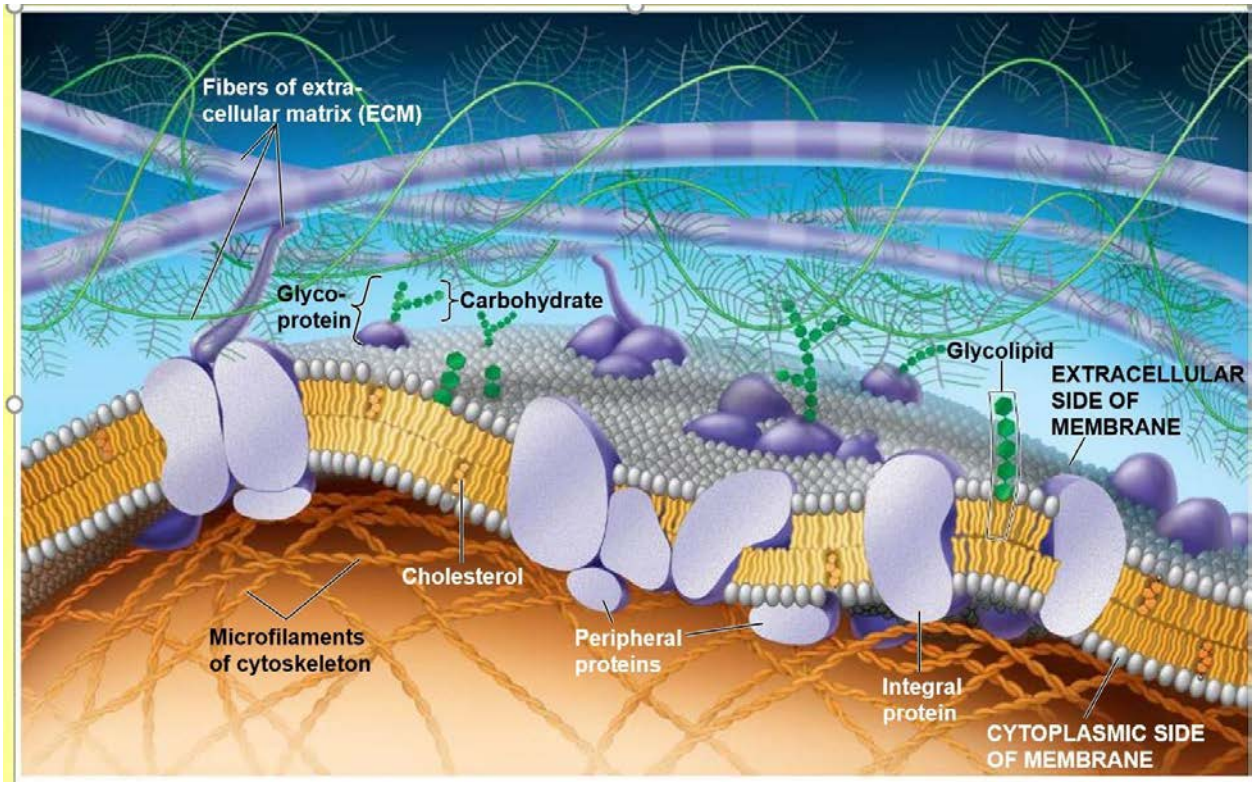
(Figure 4)

2- Transmembrane proteins (Integral membrane protein).

A transmembrane protein (TP) is a type of integral membrane protein that spans the entirety of the cell membrane. Many transmembrane proteins function as gateways to permit the transport of specific substances across the membrane. Integral membrane proteins are embedded in the phospholipid bilayer. Most integral proteins contain residues (amino acids) with hydrophobic side chains that interact with fatty acyl groups of the membrane phospholipids, thus anchoring the protein to the membrane. Most integral proteins span the entire phospholipid bilayer **(See Fig 5)**.

3- Interior protein network (Peripheral membrane proteins.

Peripheral membrane proteins **DON'T** interact with the hydrophobic core of the phospholipid bilayer. Instead they are usually bound to the membrane indirectly by interactions with integral membrane proteins or directly by interactions with lipid polar head groups **(See Fig 5)**.

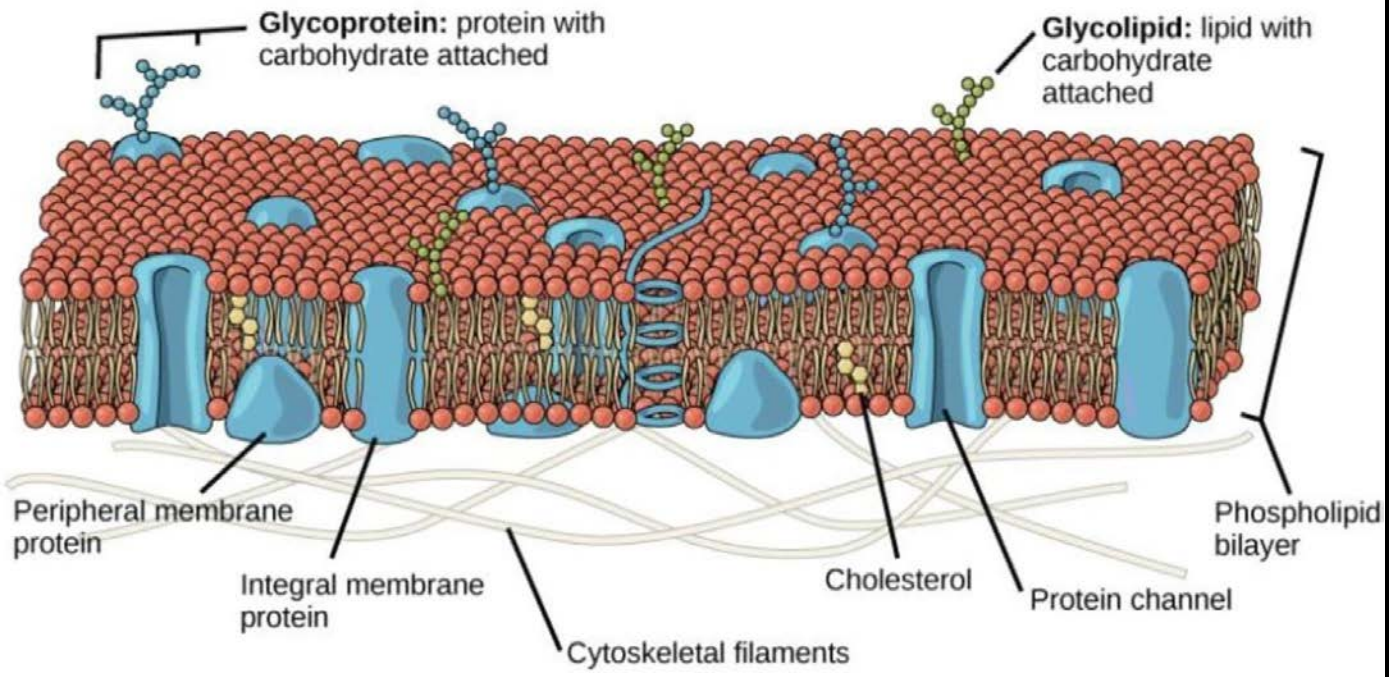


(Figure 5)

4- Cell surface markers.

Cell surface markers are special proteins and carbohydrates attached to the cell membrane. While some proteins have the task of allowing the transport of molecules across the membrane, cell surface markers play a role in inter-cellular communication and recognition. In short, cell surface markers are like a fingerprint, specific to each kind of cell, and capable of being identified according to what kinds of markers are present on the membrane.

Other molecules found in the membrane include **Cholesterol, Glycolipids and Glycoproteins**, some of which are shown in figure below. Cholesterol, a type of lipid, makes the membrane a little stronger (**See Fig 6**).



(Fig 6)

The membrane is semi-permeable, and selectively permeable, in that it can either let a substance (molecule or ion) pass through freely, pass through to a limited extent or not pass through at all. Cell surface membranes also contain receptor proteins that allow cells to detect external signalling molecules such as hormones.

The function of the plasma membrane proteins

1- Channel proteins: allows H ions to flow across the inner mitochondria membrane. Without this movement of H ions ATP would never be produce.

2- Carrier proteins: -Transport sodium and potassium ions across the plasma membrane of a nerve cell without this carrier protein nerve impulse conduction with impossible.

3-Cell recognition proteins: - recognized pathogen.

4- Receptor proteins

5- Enzymatic protein

6-Junction proteins structures that allow cells to interact with each other, there are three type of junctions

***Adherents junctions, (anchoring junctions)**

***Gap junctions) (communicating junction) *Tight**

junctions (occluding junctions).

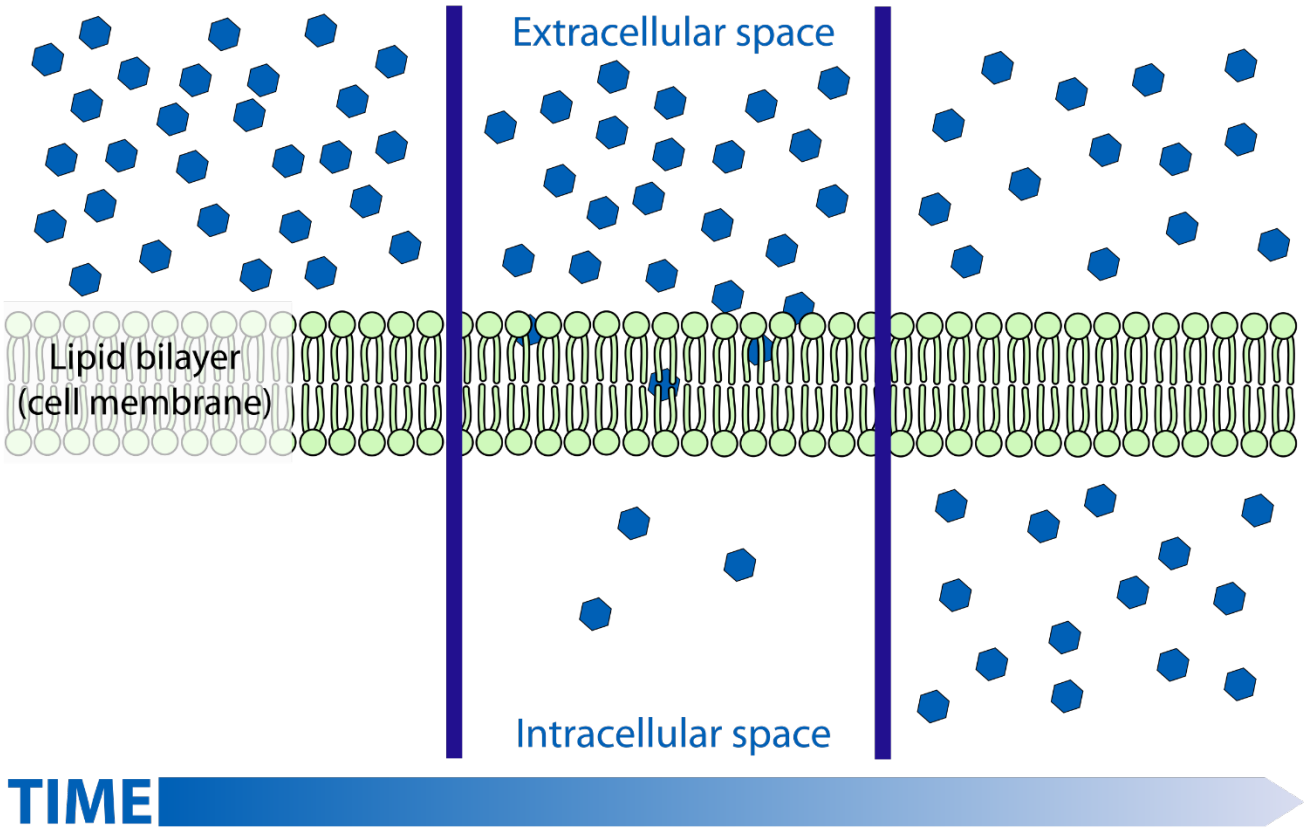
Passage of materials across cell membrane

What is cell transport? It is the movement of substances across the cell membrane either into or out of the cell. Sometimes things just move through the phospholipid bilayer. Other times, substances need the assistance of a protein, like a channel protein or some other transmembrane protein, to cross the cell membrane. Cell transport includes passive, active and Bulk transport.

A- Passive transport is a movement of ions and other atomic or molecular substance across cell membranes without need of energy input. It does not require an input of cellular energy because it is instead driven by the tendency of the system to grow in entropy. The rate of passive transport depends on the permeability of the cell membrane, which, in turn, depends on the organization and characteristics of the membrane lipids and proteins. The four main kinds of passive transport are:

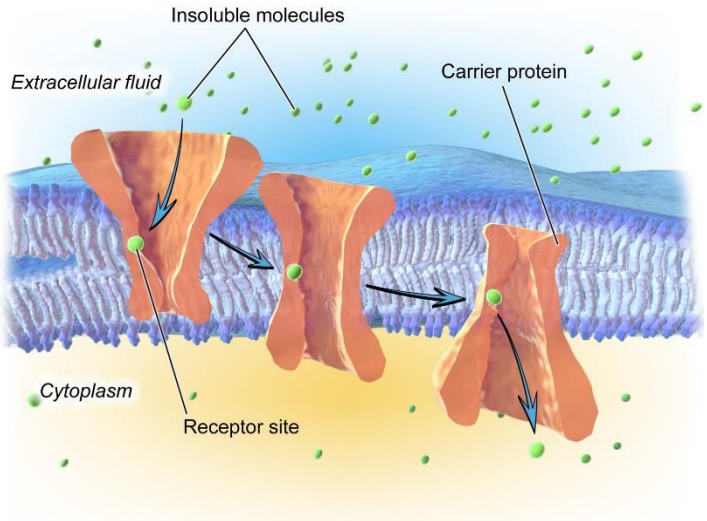
1- Simple diffusion

Diffusion is the net movement of material from an area of high concentration to an area with lower concentration. The difference of concentration between the two areas is often termed as the concentration gradient, and diffusion will continue until this gradient has been eliminated (See Fig below).



2- Facilitated diffusion.

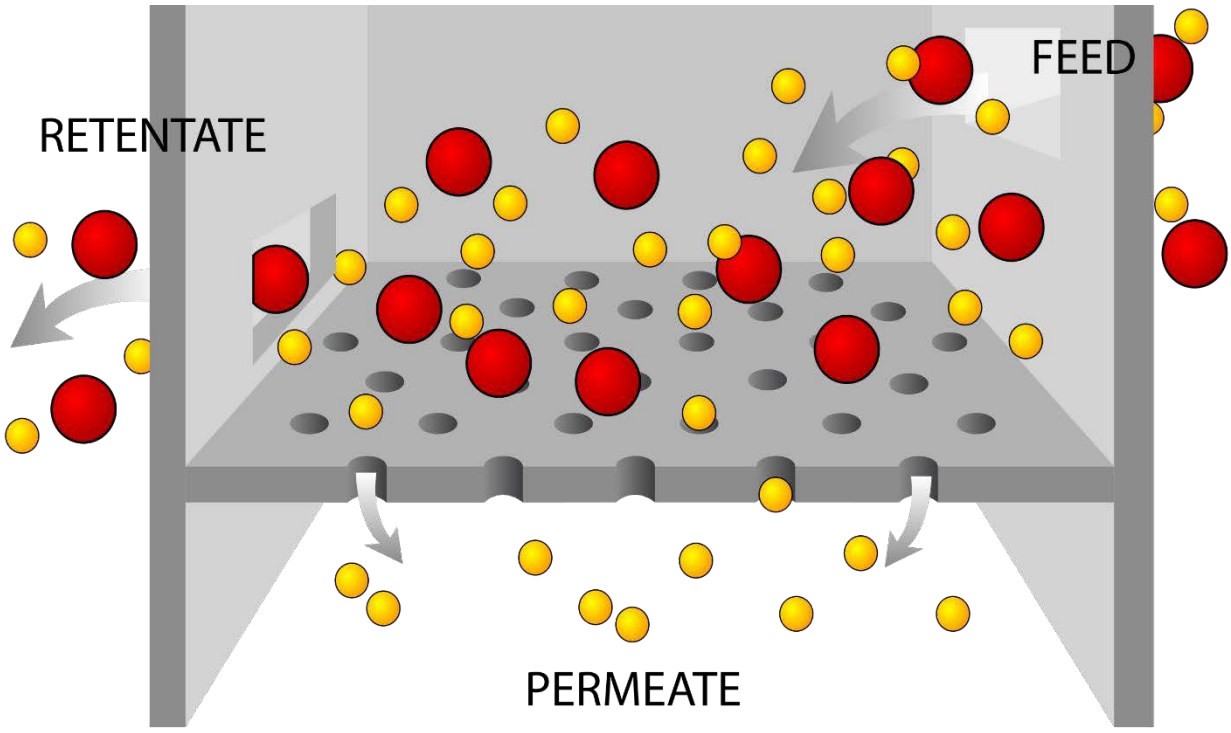
Facilitated diffusion, also called carrier-mediated osmosis, is the movement of molecules across the cell membrane via special transport proteins that are embedded in the plasma membrane by actively taking up or excluding ions (See Fig below).



Facilitated Diffusion

3- Filtration.

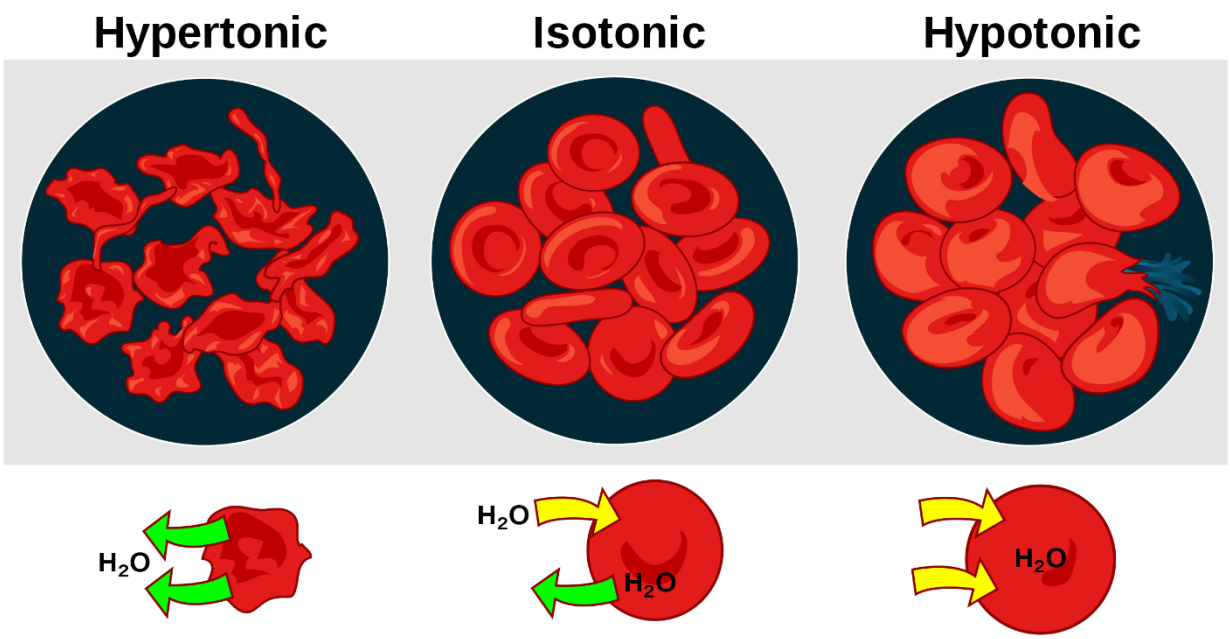
Filtration is movement of water and solute molecules across the cell membrane due to hydrostatic pressure generated by the cardiovascular system. Depending on the size of the membrane pores, only solutes of a certain size may pass through it. For example, the membrane pores of the Bowman's capsule in the kidneys are very small, and only albumins, the smallest of the proteins, have any chance of being filtered through. On the other hand, the membrane pores of liver cells are extremely large, but not forgetting cells are extremely small to allow a variety of solutes to pass through and be metabolized (See Fig below).



4- Osmosis.

Osmosis is the movement of water molecules across a selectively permeable membrane. The net movement of water molecules through a partially permeable membrane from a solution of high-water potential to an area of low water potential. A cell with a less negative water potential will draw in water (Water moves from areas of where water potential is higher (or less negative), to areas where it is lower (or more negative)),but this depends on other factors as well such as solute potential (pressure in the cell e.g. solute molecules) and pressure potential (external pressure e.g. cell wall). There are three types of Osmosis solutions: the isotonic solution, hypotonic solution, and hypertonic solution. Isotonic solution is when the extracellular solute concentration is balanced with the concentration inside the cell. In the Isotonic solution, the water molecules still move between the solutions, but the rates are the same from both directions, thus the water movement is balanced between the inside of the cell as well as the outside of the cell. A hypotonic solution is when the solute concentration outside the cell is lower than the concentration inside the cell. In hypotonic solutions, the water moves into the cell, down its concentration gradient (from

higher to lower water concentrations). That can cause the cell to swell. Cells that don't have a cell wall, such as animal cells, could burst in this solution. A hypertonic solution is when the solute concentration is higher (think of hyper - as high) than the concentration inside the cell. In hypertonic solution, the water will move out, causing the cell to shrink (See Fig below).



B- Active transport

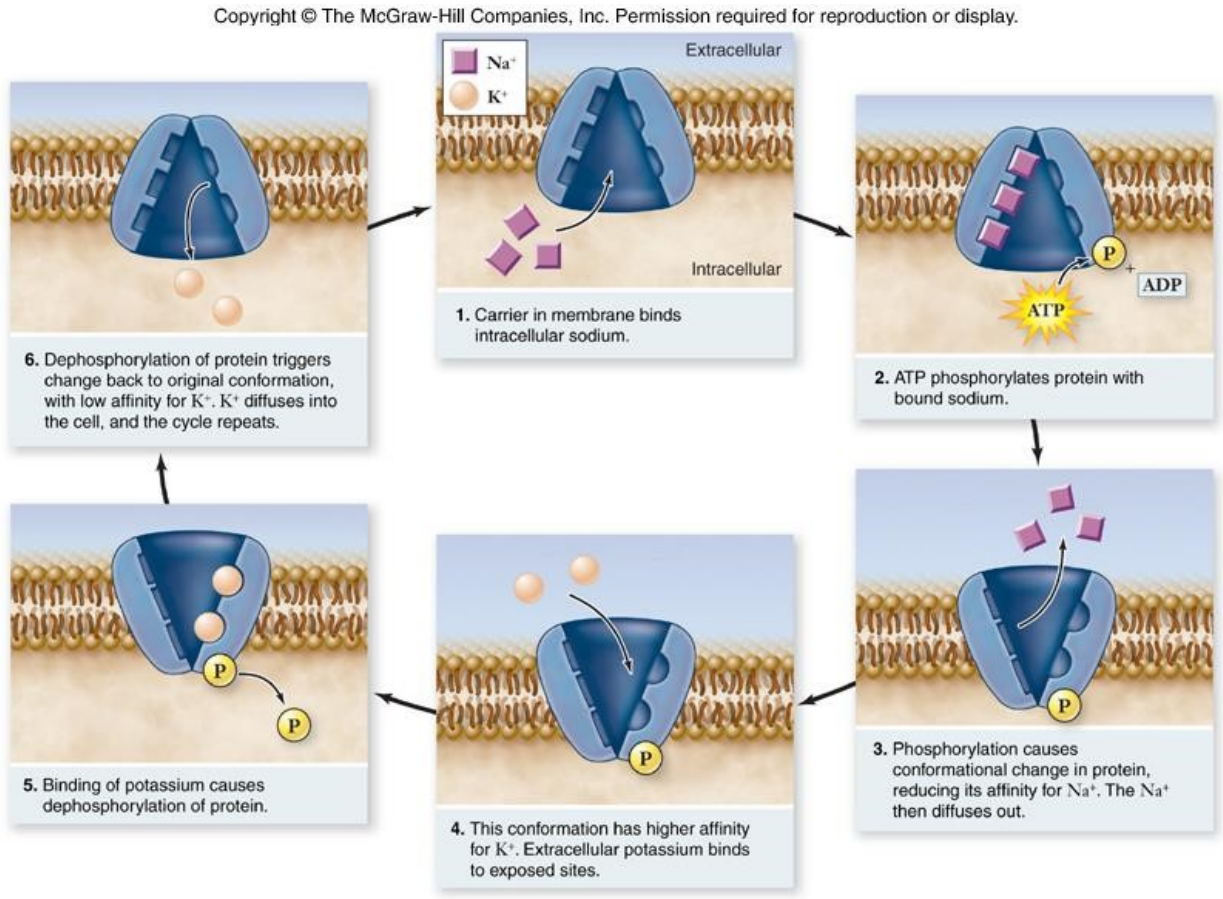
Carrier proteins used in active transport include:

1- Uniporters – move one molecule at a time
2- Symporters – move two molecules in the same direction
3- Antiporters – move two molecules in opposite directions **For example:**

First example of Uniporters is the glucose transporter that is found in erythrocytes.

Second example of Symporter is the glucose symporter SGLT1 (Sodium-glucose transport proteins), which co-transport one glucose (or galactose) molecule into the cell for every two sodium ions that is imports into the cell. This symporter is located in the small intestines, heart, and brain.

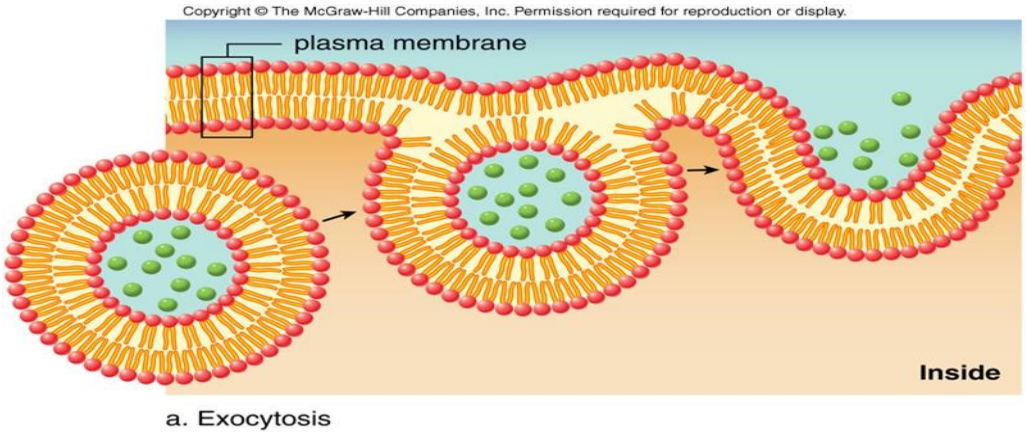
Third example of antiporters is Sodium-potassium (Na+-K+) pump which is used to move 3 Na+ out of the cell and 2 K+ into the cell



C- Bulk transport

Endocytosis and **exocytosis** are both forms of bulk transport that move materials into and out of cells, respectively, via vesicles. In the case of endocytosis, the cellular membrane folds around the desired materials outside the cell. The ingested particle becomes trapped within a pouch, known as a vesicle, inside the cytoplasm. Often enzymes from lysosomes are then used to digest the molecules absorbed by this process. Substances that enter the cell via signal mediated electrolysis

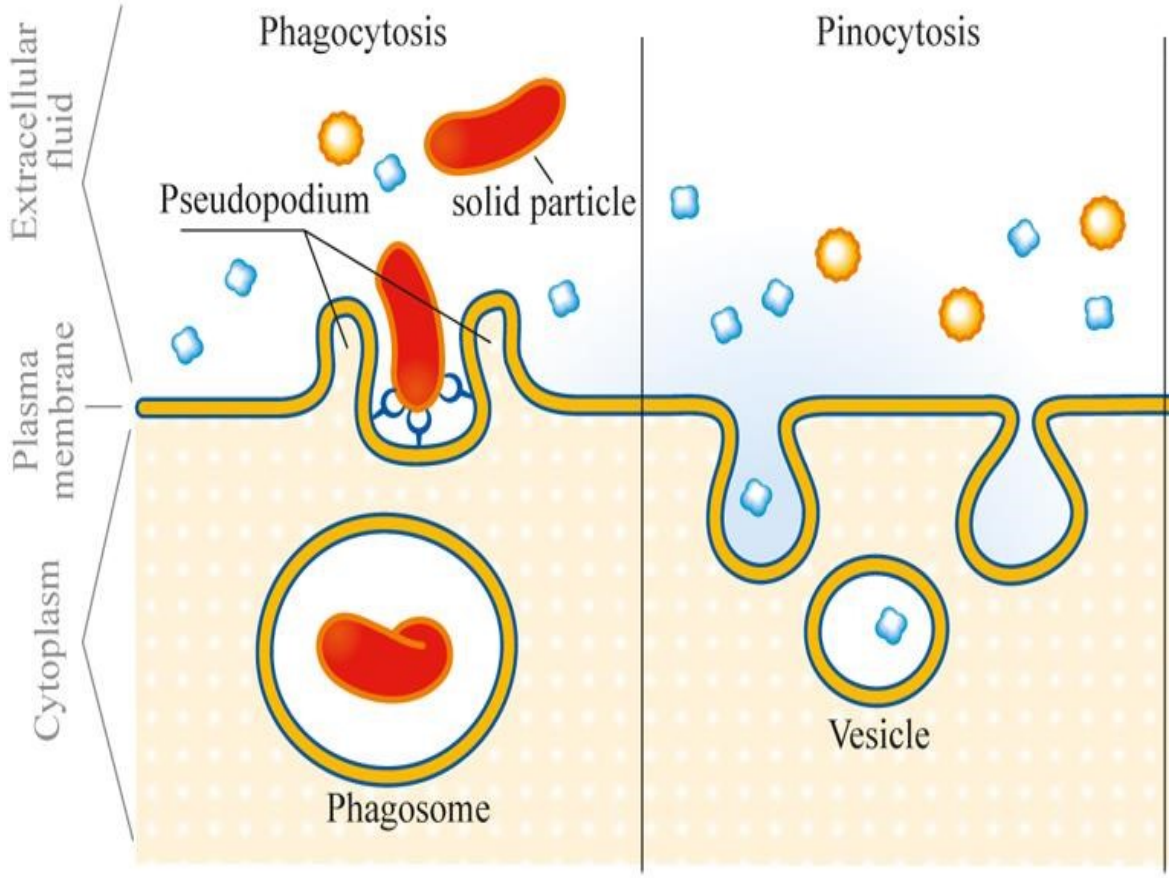
include proteins, hormones and growth and stabilization factors. Viruses enter cells through a form of endocytosis that involves their outer membrane fusing with the membrane of the cell (See Fig below).



a. Exocytosis

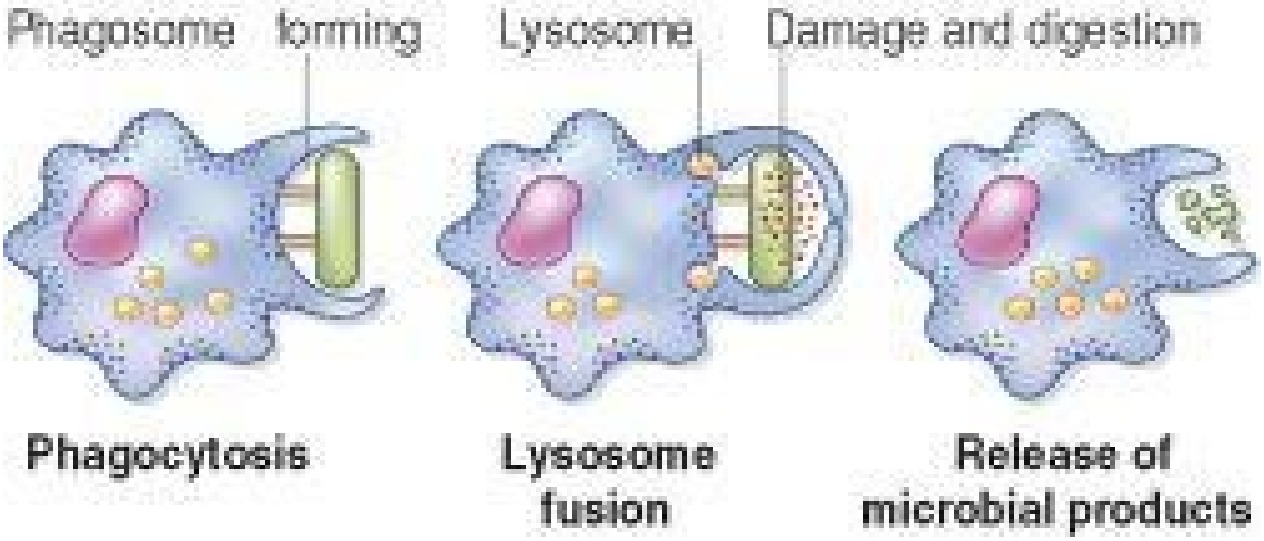
Biologists distinguish two main types of endocytosis: **pinocytosis** and **phagocytosis**.

In pinocytosis, cells engulf liquid particles (in humans this process occurs in the small intestine, where cells engulf fat droplets). In phagocytosis, cells engulf solid particles



Phagocytosis:

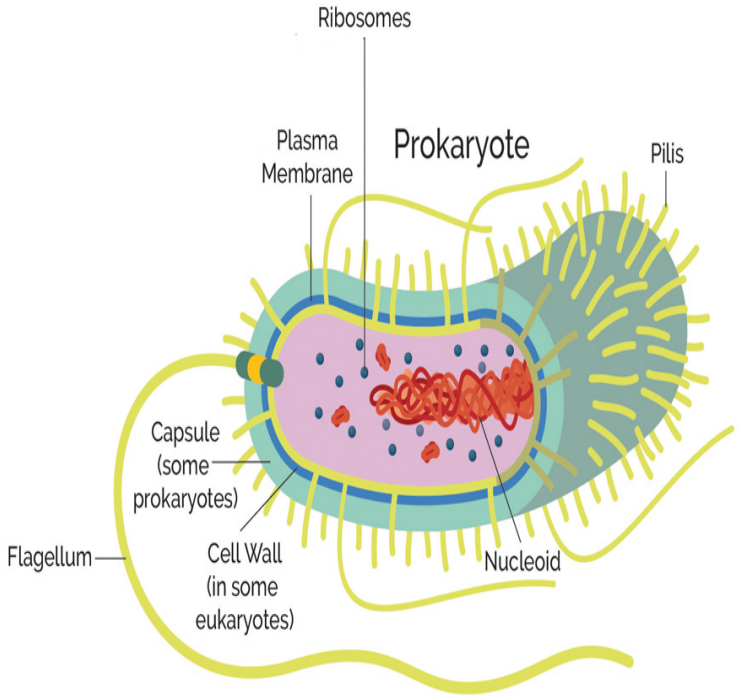
In a multicellular organism's immune system, phagocytosis is a major mechanism used to remove pathogens and cell debris. The ingested material is then digested in the phagosome. Bacteria, dead tissue cells, and small mineral particles are all examples of objects that may be phagocytized. Some protozoa use phagocytosis as means to obtain nutrients.


Phagosome forming
Lysosome
Damage and digestion
Phagocytosis
Lysosome fusion
Release of microbial products

Every living organism falls into one of two groups: eukaryotes or prokaryotes. Cellular structure determines which group an organism belongs to. We will explain in detail what prokaryotes and eukaryotes are and outline the differences between the two.

Prokaryote definition

Prokaryotes are unicellular organisms that lack membrane-bound structures, the most noteworthy of which is the nucleus. Prokaryotic cells tend to be small, simple cells, measuring around 0.1-5 μm in diameter.



The key structures present in a prokaryote cell

While prokaryotic cells do not have membrane-bound structures, they do have distinct cellular regions. In prokaryotic cells, DNA bundles together in a region called the nucleoid.

Prokaryotic cell features

Prokaryotic bacterial cell contain:

- **Nucleoid:** A central region of the cell that contains its DNA.
- **Ribosome:** Ribosomes are responsible for protein synthesis.
- **Cell wall:** The cell wall provides structure and protection from the outside environment. Most bacteria have a rigid cell wall made from carbohydrates and proteins called peptidoglycans.
- **Cell membrane:** Every prokaryote has a cell membrane, also known as the plasma membrane, that separates the cell from the outside environment.
- **Capsule:** Some bacteria have a layer of carbohydrates that surrounds the cell wall called the capsule. The capsule helps the bacterium attach to surfaces.
- **Fimbriae:** Fimbriae are thin, hair-like structures that help with cellular attachment.
- **Pili:** Pili are rod-shaped structures involved in multiple roles, including attachment and DNA transfer.
- **Flagella:** Flagella are thin, tail-like structures that assist in movement.

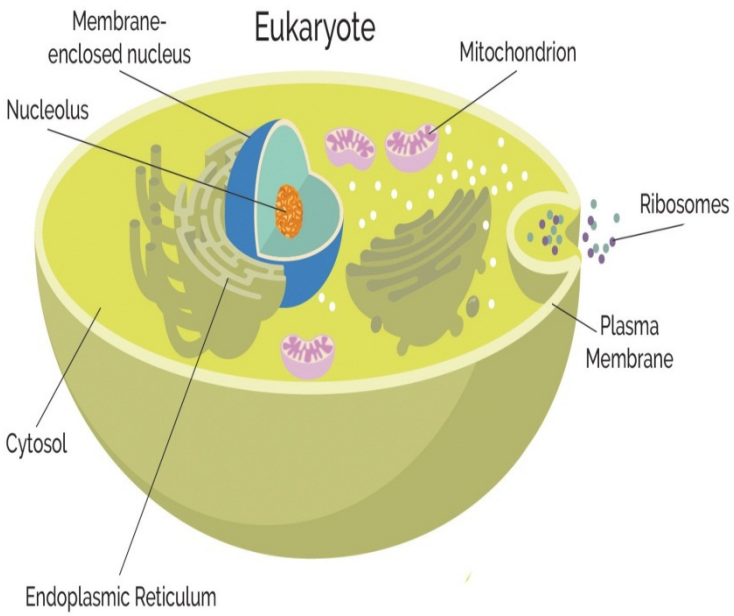
Examples of prokaryotes

Bacteria and archaea are the two types of prokaryotes.

prokaryotes do not have mitochondria. Mitochondria are only found in eukaryotic cells. This is also true of other membrane-bound structures like the nucleus and the Golgi apparatus.

Eukaryote definition

Eukaryotes are organisms whose cells have a nucleus and other organelles enclosed by a plasma membrane. Organelles are internal structures responsible for a variety of functions, such as energy production and protein synthesis.



The key structures present in a eukaryote cell.

Eukaryotic cells are large (around 10-100 μm) and complex. While most eukaryotes are multicellular organisms, there are some single-cell eukaryotes.

Eukaryotic cell features

Within a eukaryotic cell, each membrane-bound structure carries out specific cellular functions. The primary components of eukaryotic cells are:

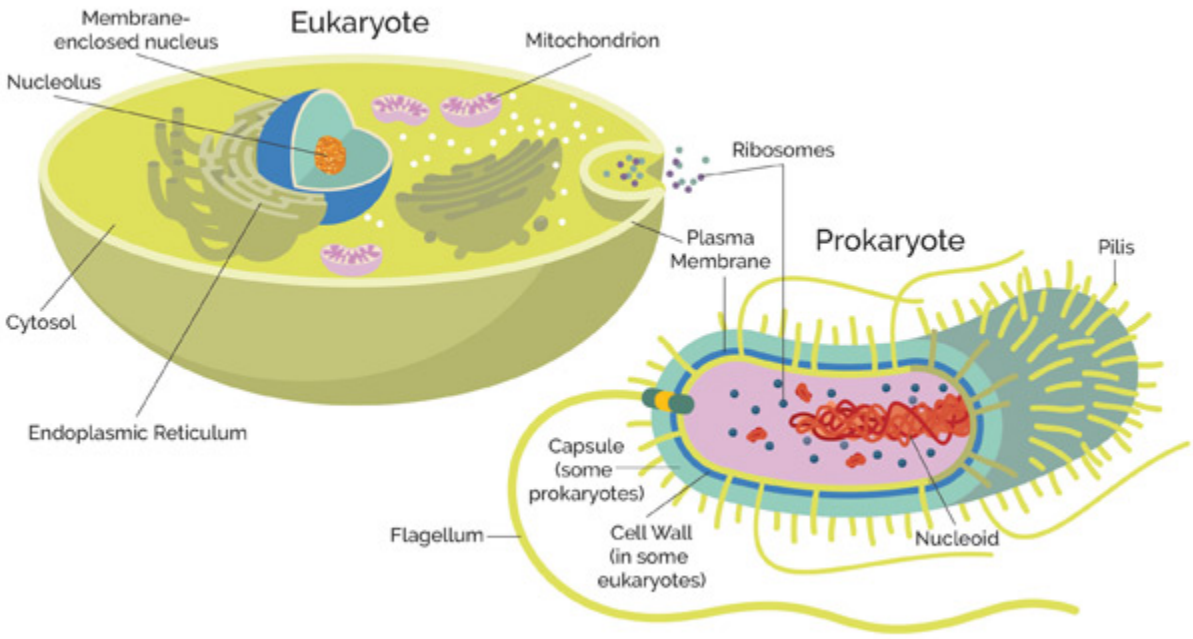
- **Nucleus:** The nucleus stores the genetic information in chromatin form.
- **Nucleolus:** Found inside of the nucleus, the nucleolus is the part of eukaryotic cells where ribosomal RNA is produced.
- **Plasma membrane:** The plasma membrane is a phospholipid bilayer that surrounds the entire cell and encompasses the organelles within.
- **Cytoskeleton or cell wall:** The cytoskeleton or cell wall provides structure, allows for cell movement, and plays a role in cell division.
- **Ribosomes:** Ribosomes are responsible for protein synthesis.
- **Mitochondria:** Mitochondria, also known as the powerhouses of the cell, are responsible for energy production.
- **Cytoplasm:** The cytoplasm is the region of the cell between the nuclear envelope and plasma membrane.
- **Cytosol:** Cytosol is a gel-like substance within the cell that contains the organelles.
- **Endoplasmic reticulum:** The endoplasmic reticulum is an organelle dedicated to protein maturation and transportation.
- **Vesicles and vacuoles:** Vesicles and vacuoles are membrane-bound sacs involved in transportation and storage.

Other common organelles found in many, but not all, eukaryotes include the Golgi apparatus, chloroplasts and lysosomes.

Examples of eukaryotes

Animals, plants, fungi, algae and protozoans are all eukaryotes.

Key similarities between prokaryotes and eukaryotes



A comparison showing the shared and unique features of prokaryotes and eukaryotes

All cells, whether prokaryotic or eukaryotic, share these four features:

1. DNA
2. Plasma membrane
3. Cytoplasm
4. Ribosomes

Comparing prokaryotes and eukaryotes

All life on Earth consists of either eukaryotic cells or prokaryotic cells. Prokaryotes were the first form of life. Scientists believe that eukaryotes evolved from prokaryotes around 2.7 billion years ago.

The primary distinction between these two types of organisms is that eukaryotic cells have a membrane-bound nucleus and prokaryotic cells do not. The nucleus is where eukaryotes store their genetic information. In prokaryotes, DNA is bundled together in the nucleoid region, but it is not stored within a membrane-bound nucleus.

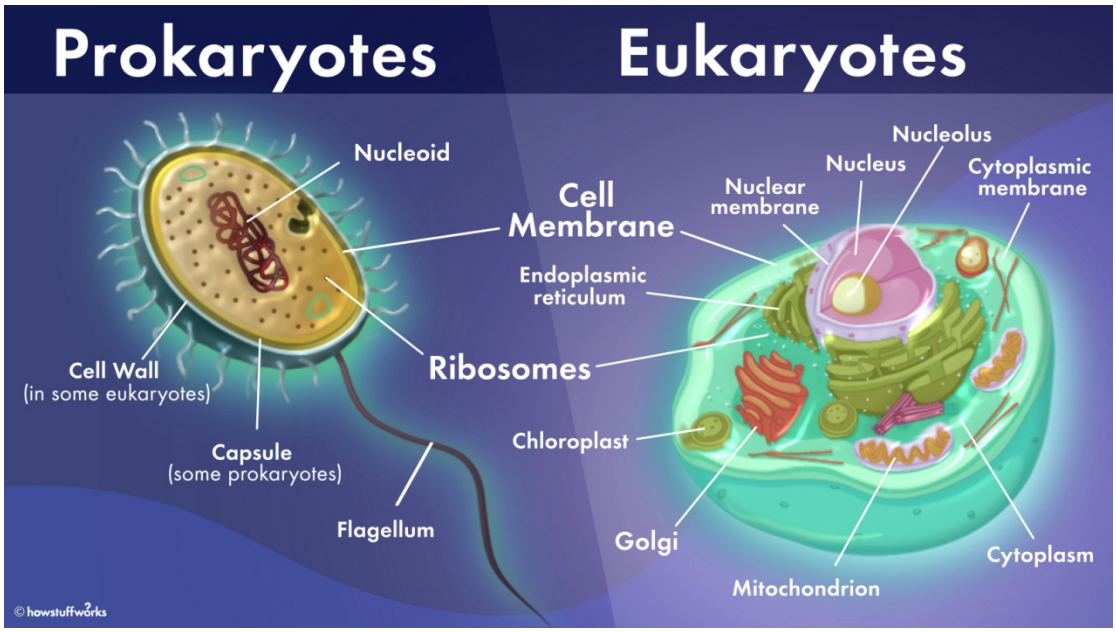
The nucleus is only one of many membrane-bound organelles in eukaryotes. Prokaryotes, on the other hand, have no membrane-bound organelles. Another important difference is the DNA structure. Eukaryote DNA consists of multiple molecules of double-stranded linear DNA, while that of prokaryotes is double-stranded and circular.

Transcription and translation in prokaryotes vs eukaryotes

In prokaryotic cells, transcription and translation are coupled, meaning translation begins during mRNA synthesis.

In eukaryotic cells, transcription and translation are not coupled. Transcription occurs in the nucleus, producing mRNA. The mRNA then exits the nucleus, and translation occurs in the cell’s cytoplasm.

The key differences between prokaryotes and eukaryotes



Prokaryotes and eukaryotes vary in several important ways - these differences include structural variation - whether a nucleus is present or absent, and whether the cell has membrane-bound organelles, and molecular variation, including whether the DNA is in a circular or linear form. The differences are summarized in the

	Prokaryote	**Eukaryote**
Nucleus	Absent	Present
Membrane-bound organelles	Absent	Present
Cell structure	Unicellular	Mostly multicellular; some unicellular
Cell size	Smaller (0.1-5 μm)	Larger (10-100 μm)
Complexity	Simpler	More complex
DNA Form	Circular	Linear
Examples	Bacteria, archaea	Animals, plants, fungi, protists

Replication of DNA, RNA

Zainab kamil yousif

Medical biology

First year

Replication of DNA

- DNA replication is the process by which a cell makes an identical copy of its DNA. This process is performed at the beginning of every cell division so that when the cell divides, each daughter cell will inherit an identical copy of the DNA.

Requirements for DNA replication

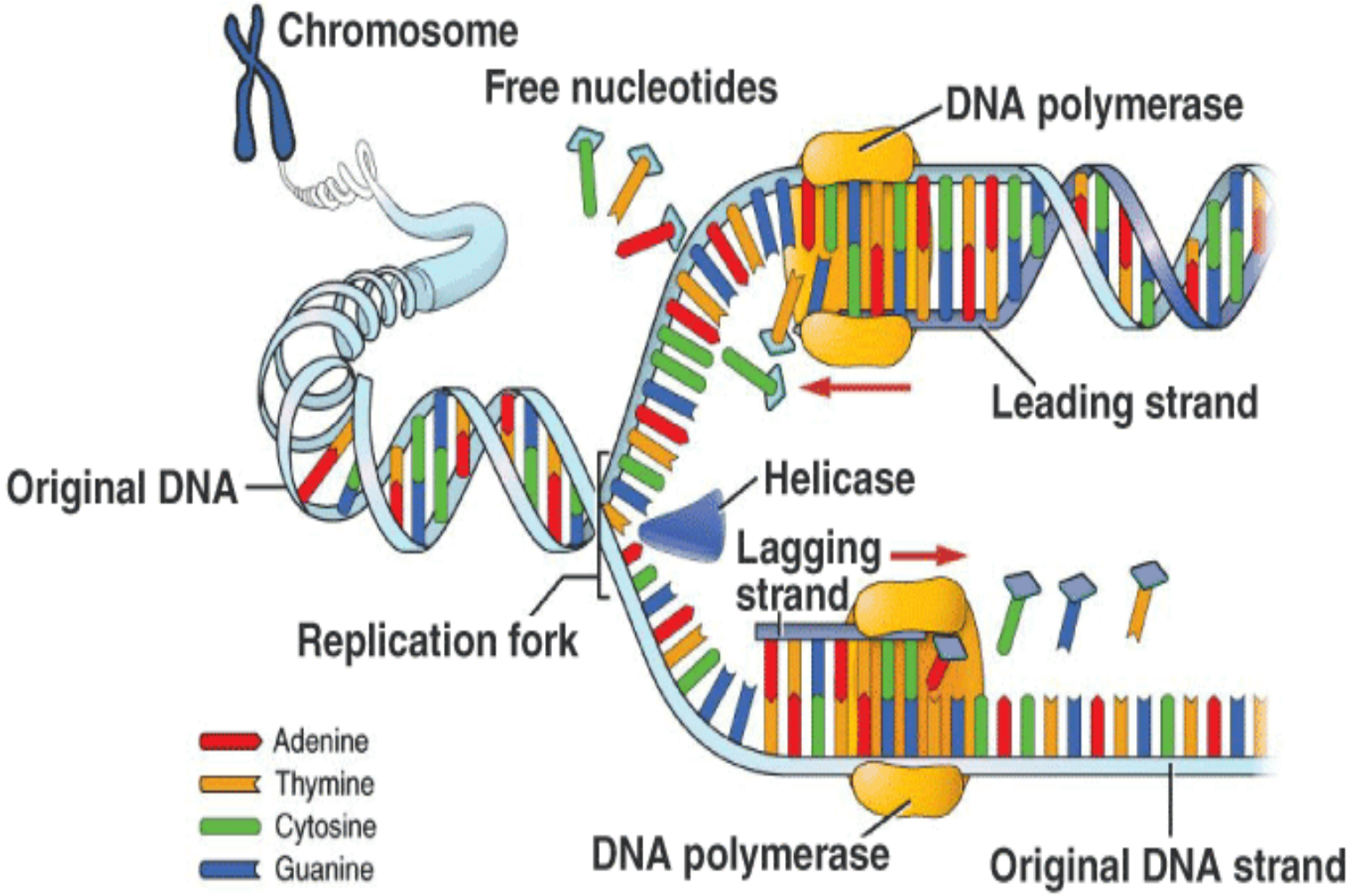
-1- Original DNA template: DNA is a double helix made of two complementary strands. Each strand can be used as a template to create a new DNA molecule.

- 2- Free DNA nucleotides : needed to form the new strands.

- 3- DNA polymerase : an enzyme that adds new nucleotides to a growing strand of DNA.

- 4- Primers : A primer is a short strand of nucleotides that will bind to the 3’ end of the template DNA strand allowing DNA polymerase to add free DNA nucleotides.

DNA REPLICATION



Preparation for Replication

Step 1: Replication Fork Formation •

Before DNA can be replicated, the double stranded • molecule must be “unzipped” into two single strands. DNA has four bases called **adenine (A)**, **thymine (T)**, **cytosine (C)** and **guanine (G)** that form pairs between the two strands. Adenine only pairs with thymine and cytosine only binds with guanine. In order to unwind DNA, these interactions between base pairs must be broken. This is performed by an enzyme known as DNA **helicase**. DNA helicase disrupts the hydrogen bonding between base pairs to separate the strands into a Y shape known as the **replication fork**. This area will be the template for replication to begin.

- DNA is directional in both strands, signified by a 5' and 3' end. This notation signifies which side group is attached the DNA backbone. The **5' end** has a phosphate (P) group attached, while the **3' end** has a hydroxyl (OH) group attached. This directionality is important for replication as it only progresses in the 5' to 3' direction. However, the replication fork is bi-directional; one strand is oriented in the 5' to 3' direction **(leading strand)** while the other is oriented 3' to 5‘ **(lagging strand)**.

Replication Begins •

Step 2: Primer Binding •

- Once the DNA strands have been separated, a short piece of RNA called a **primer** binds to the 3' end of the strand. The primer always binds as the starting point for replication. Primers are generated by the enzyme **DNA primase**.

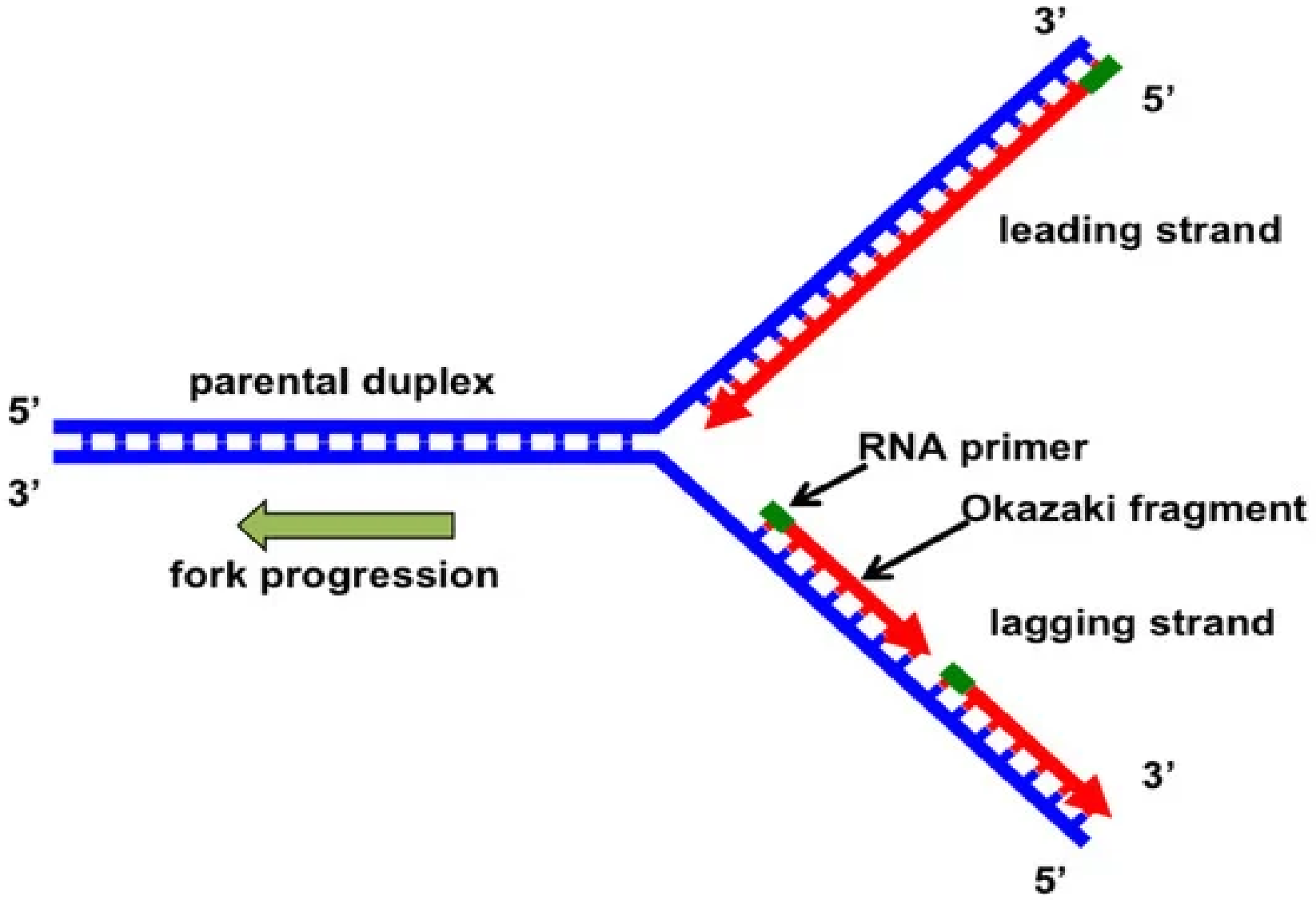
DNA Replication: Elongation

Step 3: Elongation

Enzymes known as **DNA polymerases** are responsible creating the new strand by a process called elongation. There are five different known types of DNA polymerases in bacteria

- DNA polymerase III binds to the strand at the site of the primer and begins adding new base pairs complementary to the strand during replication. In eukaryotic cells, polymerases alpha, delta, and epsilon are the primary polymerases involved in DNA replication. Because replication proceeds in the 5' to 3' direction on the leading strand, the newly formed strand is continuous.

The **lagging strand** begins replication by binding with multiple primers. Each primer is only several bases apart. DNA polymerase then adds pieces of DNA, called **Okazaki fragments**, to the strand between primers. This process of replication is discontinuous as the newly created fragments are disjointed.


3’
5’
leading strand
parental duplex
5’
3’
RNA primer
Okazaki fragment
fork progression
lagging strand
3’
5’

Step 4: Termination

- Once both the continuous and discontinuous strands are formed, an enzyme called **exonuclease** removes all RNA primers from the original strands. These primers are then replaced with appropriate bases. Another enzyme called **DNA ligase** joins Okazaki fragments together forming a single unified strand.

- Once completed, the parent strand and its complementary DNA strand coils into the double helix shape. In the end, replication produces two DNA molecules, each with one strand from the parent molecule and one new strand.

- **Types of RNA(transfer,messenger and ribosomal)**
- RNA is a ribonucleic acid that helps in the synthesis of proteins in our body. This nucleic acid is responsible for the production of new cells in the human body. It is usually obtained from the DNA molecule. RNA resembles the same as that of DNA, the only difference being that it has a single strand unlike the DNA which has two strands and it consists of an only single ribose sugar molecule in it. Hence is the name Ribonucleic acid. RNA is also referred to as an enzyme as it helps in the process of chemical reactions in the body.

- **Basic Structure of RNA**
- The basic structure of RNA is shown in the figure below-
- The ribonucleic acid has all the components same to that of the DNA with only 2 main differences within it. RNA has the same nitrogen bases called the adenine, Guanine, Cytosine as that of the DNA except for the Thymine which is replaced by the uracil. Adenine and uracil are considered as the major building blocks of RNA and both of them form base-pair with the help of 2 hydrogen bonds.
- RNA resembles a hairpin structure and like the nucleotides in DNA, nucleotides are formed in this ribonucleic material (RNA). Nucleosides are nothing but the phosphate groups which sometimes also helps in the production of nucleotides in the DNA.

- **Functions of RNA**
- The ribonucleic acid – RNA, which are mainly composed of nucleic acids, are involved in a variety of functions within the cell and are found in all living organisms including bacteria, viruses, plants, and animals. These nucleic acid functions as a structural molecule in cell organelles and are also involved in the catalysis of biochemical reactions. The different types of RNA are involved in various cellular process. The primary functions of RNA:
- Facilitate the translation of DNA into proteins
- Functions as an adapter molecule in protein synthesis
- Serves as a messenger between the DNA and the ribosomes.
- They are the carrier of genetic information in all living cells
- Promotes the ribosomes to choose the right amino acid which is required in building up of new proteins in the body.

- **Types of RNA:**
- There are various types of RNA, out which most well-known and most commonly studied in the human body are :
- tRNA – Transfer RNA
- The transfer RNA is held responsible for choosing the correct protein or the amino acids required by the body in-turn helping the ribosomes. It is located at the endpoints of each amino acid. This is also called as soluble RNA and it forms a link between the messenger RNA and the amino acid.

- rRNA-Ribosomal RNA
- The rRNA is the component of the ribosome and are located within the in the cytoplasm of a cell, where ribosomes are found. In all living cells, the ribosomal RNA plays a fundamental role in the synthesis and translation of mRNA into proteins. The rRNA is mainly composed of cellular RNA and are the most predominant RNA within the cells of all living beings.
- mRNA – Messenger RNA.
- This type of RNA functions by transferring the genetic material into the ribosomes and pass the instructions about the type of proteins, required by the body cells. Based on the functions, these types of RNA is called the messenger RNA. Therefore, the mRNA plays a vital role in the process of transcription or during the protein synthesis process.
-

Thank you•

4-The Nervous System

Nervous Tissue

The Nervous system has three major functions

Sensory -gathers information about changes occurring within(internal) and around the body(external); sensory receptors, at ends of peripheral nerves end signals to CNS (central nervous system) .

examples – light, oxygen levels, body temperature.

Integration – interpretation of sensory information (information processing); complex (higher order) functions .create thoughts, add to memory, make decisions, etc

Motor – response to information processed through stimulation of effectors .(sending of signals to muscles and/or glands to elicit a response) .

muscle contraction .-

glandular secretion -

Organs of the nervous system can be divided into two groups:-

The central nervous system (CNS) is composed

-Brain

-Spinal cord. These neurons cannot regenerate if damaged .

The peripheral nervous system (PNS) is made up of peripheral nerves that connect the CNS to the rest of the body. These neurons can regenerate if damaged .

.**31** pairs of spinal nerves

.**12** pairs of cranial nerves

PNS can be subdivided into 2 divisions :-

1-Autonomic

-Cranial & spinal nerves connecting CNS to heart, stomach, intestines, glands

-Controls unconscious activities .

.**2-Somatic**

-Cranial & spinal nerves connecting CNS to skin & skeletal muscles

-Oversees conscious activities .

Autonomic division of the nervous system can be subdivided into 2 divisions:-

.1-Parasympathetic

-Decreases heart rate, pupil size, bronchiole dilation, blood glucose, blood to skeletal muscle

-Increases digestion, urinary output

-"rest and digest"

.2-Sympathetic

-Decreases digestion, urinary output

-Increases heart rate, pupil size, bronchiole dilation, blood glucose, blood to skeletal muscle

-fight or flight".

Nervous Tissue is composed of two major cell types:

1- Neurons 2- neuroglial cells.

Neurons (Nerve cells) are specialized cells that conduct electrical impulses . An average human body has about 1 trillion neuron

All neurons have the same basic structure:-

1-Dendrites extend from the cell body .These are fairly short, with lots of branches, and they are the points at which nerve impulses are received by the cell.

2-The cell body (perikaryon) The cell body contains the major portion of the cytoplasm and nucleus of the neuron . Most of the cell bodies of neurons are in the central nervous system (brain and spinal cord), or in the ganglia (which lie just outside the spinal cord) of the peripheral nervous system.

3-The axon: a single nerve 'fiber' which transmits impulses to the distal end. Axons can be very long - around 1 meter, and vary in diameter from 0.2 to 20 µm . Long axons are covered by myelin, a white fatty substance produced by Schwann cells. Narrow gaps in the myelin sheath between Schwann cells are called nodes of Ranvier.

Nerves are cable-like bundles of axons .

Classification of Neurons

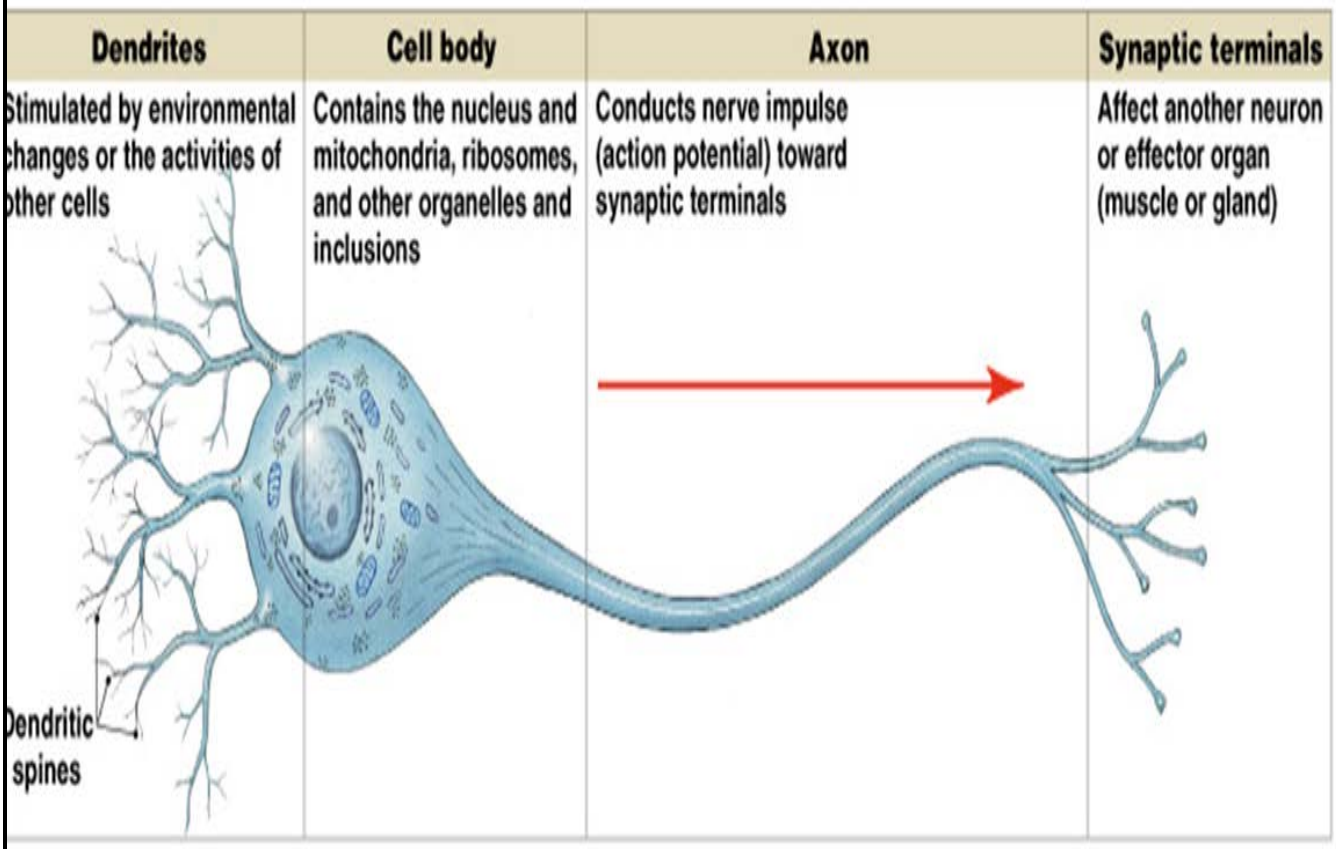
-:There are three basic shapes to the neurons

a-Multipolar (the commonest) - most motor neurons are multipolar. Brain or spinal cord

b-Bipolar (single axon and single dendrite) - special neurons in the sensory
. pathways for sight, smell and balance

c-unipolar -Single process extends from cell body

-Outside of brain & spinal cord .



Neuroglia (glial cells)

CNS neuroglia:-microglia , oligodendrocytes , ,astrocytes , ,ependymal cells

PNS neuroglia:-Schwann cells (neurolemmocytes) , satellite cells.

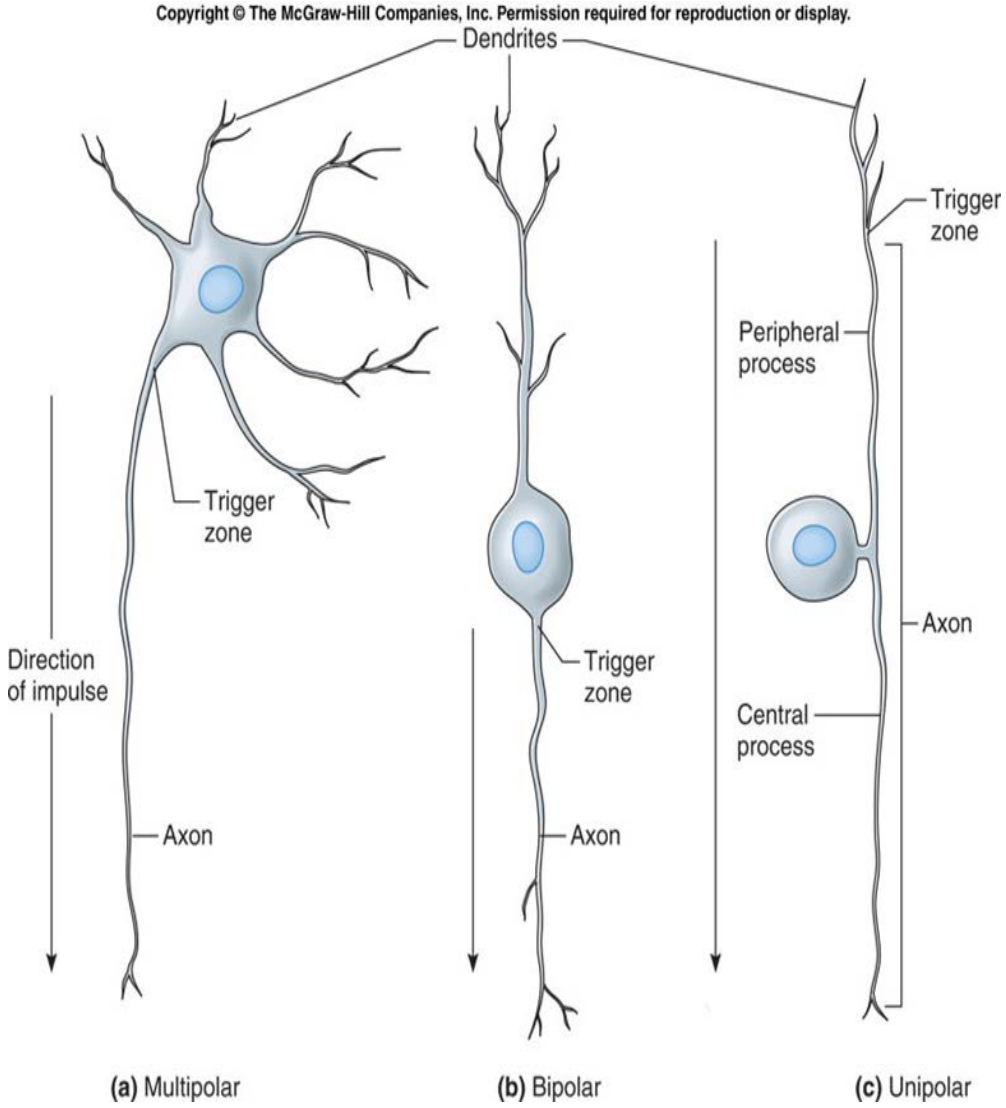
-Microglia "brain macrophages"

These types of cell are less common. They have a role in immune defense and become phagocytic(engulf bacteria) in response to infections or tissue damage ,supporting neurons .

-Oligodendrocytes

Myelin is formed by oligodendrocytes in the CNS brain , (and by Schwann cells. in the PNS Myelinated axons transmit impulses faster than

unmyelinated axons



-Astrocyte

These cells are the most common type of supporting cell. They are involved in metabolic exchange between neurons and blood provide nutrients to neurons and produce hormone known asglial cell –derived growth factor, which is being study as possible treatment for Parkinson disease and other diseases caused by neuron degeneration .stimulate the formation of scar tissue secondary to CNS injury ..

-Ependymal cells. These cells line the ventricles of brain and central canal of spinal canal

They have cilia on their luminal surface produce, monitor & help circulate CSF (cerebrospinal fluid) ..

Peripheral nervous system

In the peripheral nervous system, there are :-

- **Schwann** cell surround all axons of neurons in the PNS creating a neurilemma around them. Neurilemma allows for potential regeneration of damaged axons

creates myelin sheath around most axons of PNS --

-Satellite cells- support groups of cell bodies of neurons within ganglia of the PNS.

Synapses

Synapses are formed between two neurons, or between a neuron and a target cell, such as a muscle cell.

Between two neurons, synapses can form between :-

an axon and a dendrite (axodendritic)

an axon and an axon (axoaxonic)

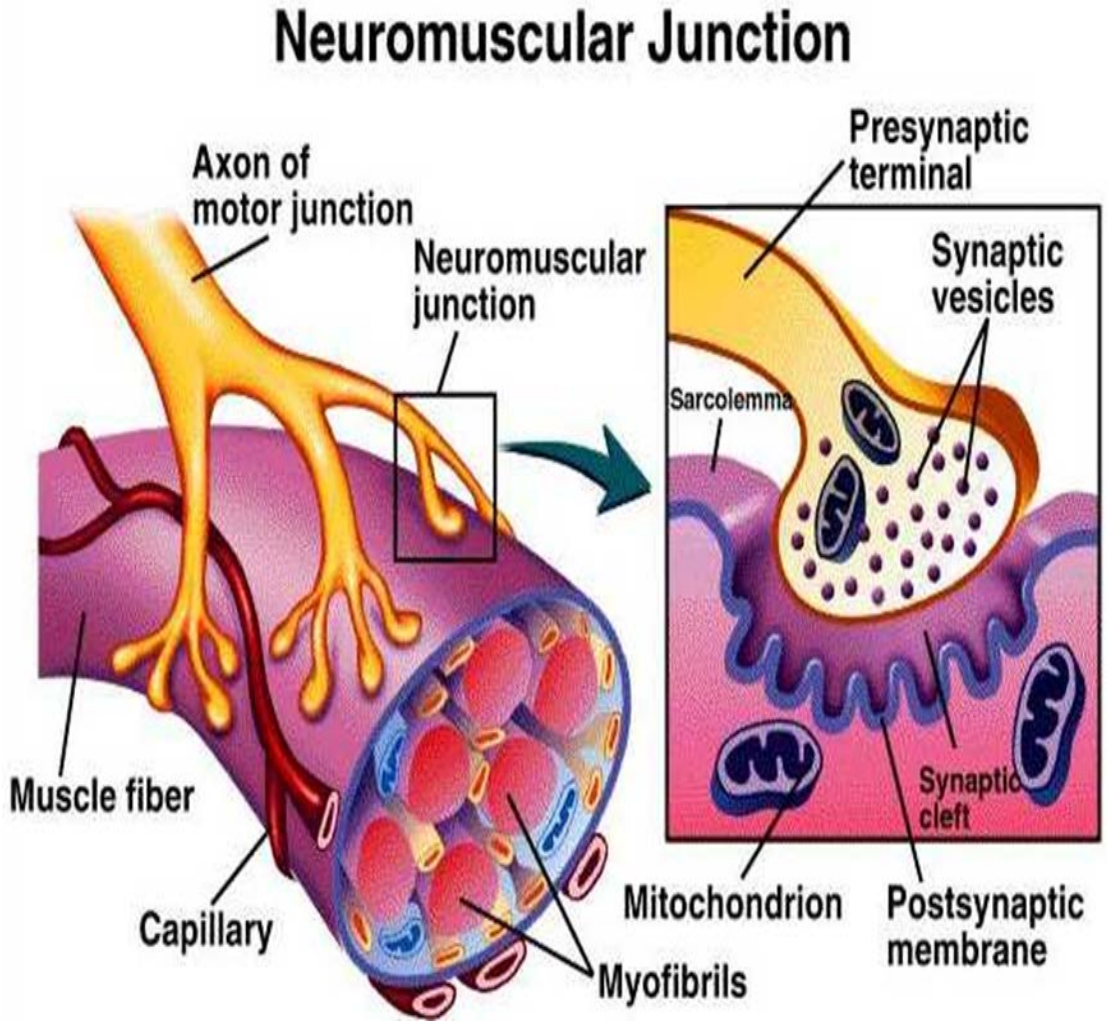
an axon and a cell body (axosomatic)

Chemical synapses are common

presynaptic terminal - part which delivers the nerve impulse

postsynaptic terminal - part which receives the impulse

synaptic cleft - gap between the pre- and post synaptic membranes.



References:

1-Textbook of histology .2017.4th edition.

2-From Cells to Organs: A Histology Textbook and Atlas. 2003, 1st edition.

MEDICAL HELMINTHOLOGY

INTRODUCTION

Medical helminthology is concerned with the study of helminthes or parasitic worms. Helminthes are (multi-cellular organisms).They cause anemia and malnutrition. In children they cause a reduction in academic performance .Helminthes also cause economic loss as a result of infections of domestic animals.

The sources of the parasites are different. Exposure of humans to the parasitesmay occur in one of the following ways:

1. Contaminated soil ,water (cercariae of blood flukes)
2-Food (Taenia in raw meat).
3. Domestic or wild animals harboring the parasite (as in echinococcus in dogs).
4. Person to person (as in *Enterobius vermicularis*
5. Oneself (auto-infection) as in *Enterobius vermicularis.*

They enter the body through different routes including: mouth, skin and there respiratory tract by means of inhalation of airborne eggs.

The helminthes are classified into three major groups. These are:

1. Trematodes (Flukes)
2. Nematodes (Round worms)
3. Cestodes (Tape worms)

The Trematodes and Cestodes are groups of flat worms.

MEDICALLY IMPORTANT TREMATODES (FLUKES)

INTRODUCTION

Trematodes belong to the phylum platyhelminthes. They are found in a wide range of habitats. The great majority inhabit the alimentary canal, liver, bile duct,ureter and bladder of vertebrate animals. According to the sites they inhabit, there are four groups of flukes. These are :Blood flukes, Intestinal flukes, Liver flukes, and Lung flukes

1. BLOOD FLUKES

These are flukes that reside mainly in the blood vessels of various organs and the schistosomes are the prototype and the commonest flukes in our country.

SCHISTOSOMIASIS (BILHARZIASIS)

It is estimated that about 600 million people in 79 countries suffer from schistosomiasis (Bilharziasis). The schistosomes cause intestinal, hepatosplenic,pulmonary, urogenital, cerebral and other forms of schistosomiasis.

Schistosome is the only fluke with separate sexes. The female worm lies in the gynecophoral canal of the male.

There are five medically important species:

1. *Schistosoma mansoni*: causes intestinal schistosomiasis.

2. *Schistosoma haematobium*: causes vesical (urinary) schistosomiasis.

3. *Schistosoma japonicum*: causes intestinal schistosomiasis

4. *Schistosoma intercalatum*: causes intestinal schistosomiasis.

5. *Schistosoma mekongi*: causes intestinal schistosomiasis.

Intestinal schistosomiasis.

Habitat - This species lives in the **veins of the intestine.**

Stream and lake-based transmission is common.

The snail hosts that harbor ***S. mansoni*** are the genera ***Biomphalaria***

Morphology

Male: The male ranges in size from 1-1.4 cm in length and the body is covered by coarse tubercles. It has 6-9 testes

Female : The female is 1.5-2.0 cm in length. The ovary is present in the anterior third. It lays about 100-300 eggs daily. The uterus is short containing few ova.

Urinary schistosomiasis.

- *Schistosoma haematobium*

Habitat - The worm lives in the **veins of the bladder** of humans.

The snail hosts that harbor ***S.haematobium*** are the genera **Bulinus.**

Male : The male ranges in size from 1-1.5 cm in length. The body is covered byfine tubercles. It has 4-5 testes.

Female: The female ranges in size from 2-2.5 cm in length. The ovary is presentin the posterior third. Uterus is long containing many ova. It lays about 20-200 eggs daily.

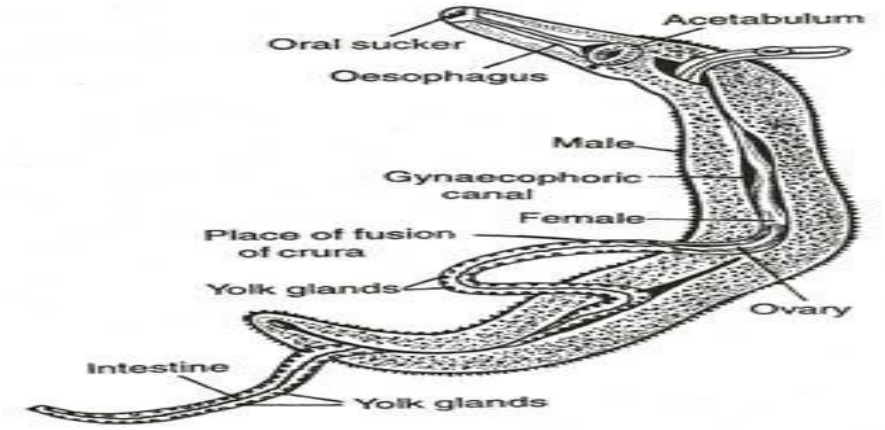


Fig. 191. *Schistosoma* (Male and female)

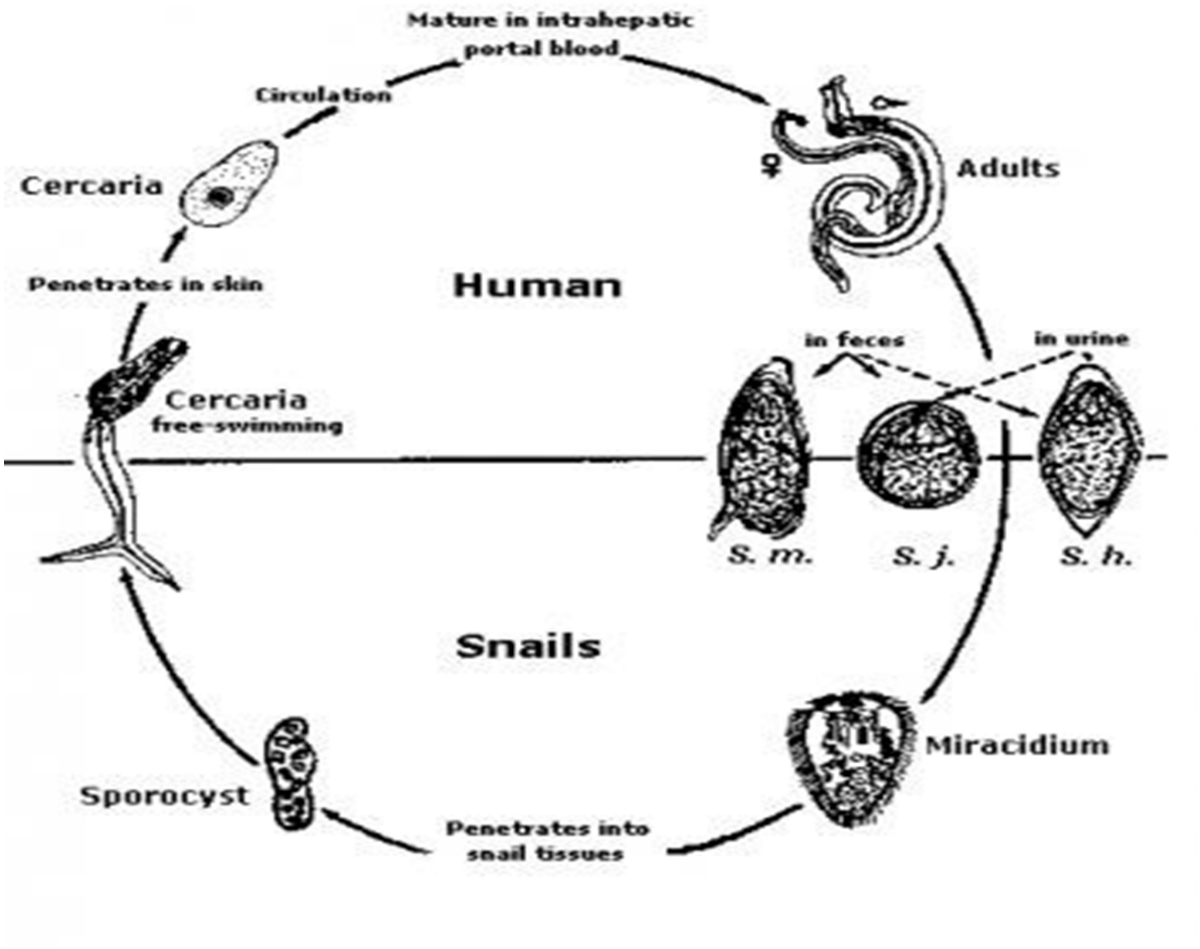
LIFE CYCLE OF SCHISTOSOMES

1-Adult worms reside in pairs: the female lying in the gynecophoral canal of themale. After fertilization, **eggs** are passed into the venules.

2-A larval form – the **miracidium** - develops within the egg. Its lytic enzymes and the contraction of the venule rupture the wall of the venule liberating the egg into the perivascular tissues of the intestine (*S. mansoni*) or urinary bladder (*S. haematobium*).

3-The eggs pass into the lumens and organs and are evacuated in the feces (*S.mansoni*) or the urine (*S. haematobium*).

4-On contact with fresh water the **miracidia** hatch from the eggs and swim about until they find the appropriate **snail**, which they penetrate. After two generations of sporocyst development and multiplication within the snail, the **fork-tailed cercariae** emerge. Infection to man takes place during bathing or swimming. The **cercariae penetrate the skin**(Infective stage), are carried into the systemic circulation and pass through to the portal vessels. Within the intrahepatic portion of the portal system, the worms feed and grow to maturity.



Symptoms and complications

Patients infected with *S. haematobium* suffer from terminal haematuria and painful micturition. There is inflammation of the urinary bladder (cystitis), andenlargement of spleen and liver. Patients infected with *S. mansoni* suffer from cercarial dermatitis (swimmers itch) and dysentery (mucus and blood in stool) as well as enlargements of the spleen and liver.*S. haematobium* causes squamous cell carcinoma in the bladder.

Laboratory Diagnosis

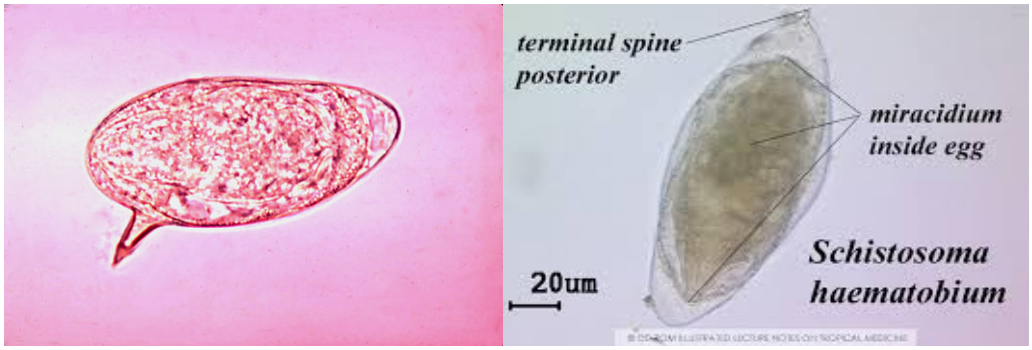
S. mansoni

♦ Microscopic examination of the stool for eggs The egg has characteristic lateral spine.

S. haematobium:

♦ Examination of the urine Egg has terminal spine.

♦ Biopsy from bladder



NEMATODES (ROUND WORMS)

All the important human parasites of the Phylum Nemathelminthes (belong to the Class Nematoda.

GENERAL CHARACTERISTICS OF NEMATODES

They are un-segmented, elongated and cylindrical. They have separate sexeswith separate appearances. They have a tough protective covering or cuticle.They have a complete digestive tract with both oral and anal openings. Thenematodes are free living (Majority) or parasites of humans, plants or animals.

The parasitic nematodes:

The nematodes are generally light cream-white colored. Their life cycle includes: egg, larvae and adult.

The parasitic nematodes are divided into:

1. **Intestinal nematodes**

1.1. Intestinal nematodes with tissue stage

A. *Ascaris lumbricoides*

B. Hookworms

1.2. Intestinal nematodes without tissue stage

A. *Enterobius vermicularis*

2. Tissue and blood dwelling nematodes

2.1. Filarial worms .

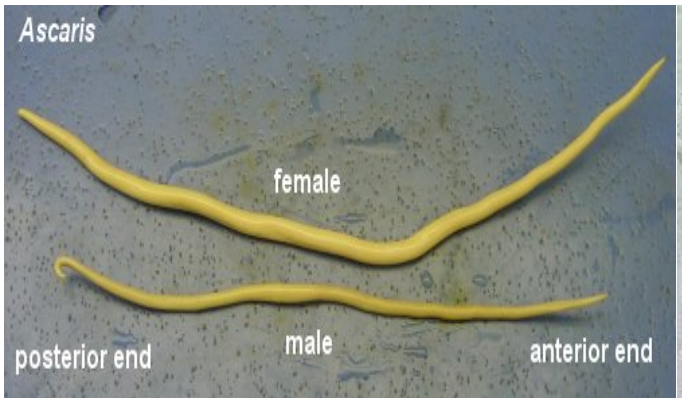
INTESTINAL NEMATODES WITH TISSUE STAGE

Ascaris lumbricoides

These are common roundworms infecting more than 700 million people World wide.

Morphology:

Male adult worm measures 15-20 cm in length. The posterior end is curved ventrally. The female worm measures 20-40 cm in length. Its posterior end is straight.



Infective stage and modes of infection:
The egg containing larva when ingested with contaminated raw vegetables causes ascariasis.

Life cycle:
Ingested **eggs** (infective stage)hatch in the duodenum. The larvae penetrate the intestinal wall and circulate in the blood. From the heart they migrate to the lungs, ascend to the trachea, descend to the esophagus and finally reach the small intestine to become adult. The female pass immature eggs which pass to the soil and mature in 2 weeks .

Pathogenicity and clinical features
Adult worms in the intestine cause abdominal pain and may cause intestinal obstruction especially in children. Larvae in the lungs may cause inflammation of the lungs (Loeffler's syndrome) – pneumonia-like symptoms.

Diagnosis
1. Examination of stool for eggs The egg is ovoid, covered by albumin
2. Demonstration of adult worms .

HOOK WORMS
There are two species of hookworm:
1. Ancylostoma duodenale
2. *Necator americanus*
The adults are found in the small intestines of man .

***Ancylostoma duodenale*:**
Grayish-white in color. The body is slightly ventrally curved. The anterior end follows the body curvature.
Male: The male measures 10 cm in length. The posterior end is broadened The teeth-like plates that are used to attach the hookworm to the surface of the intestinal tract. Filariform larvae (infective stage) of hookworm.
Female: The female measures 12 cm in length. The posterior end is straight
Infective stage and method of infection:
The filariform larva infects by skin penetration .

Pathogenicity
Adult worms in the intestine feed on blood causing iron deficiency anemia. The larvae may cause inflammation of the lungs.
Diagnosis: Examination of stool by direct saline smear to detect the eggs.

Intestinal nematodes without tissue stage *Enterobius vermicularis*
(pin worm or thread worm)
Enterobius vermicularis is a small white worm with thread-like appearance. The worm causes enterobiasis. Infection is common in children.
Morphology
Male: The male measures 5 cm in length. The posterior end is curved
Female: The female measures 13 cm in length. The posterior end is straight.

Infective stage
Infection is by ingestion of eggs containing larvae with contaminated raw vegetables.
Mode of infection
-By direct infection from a patient (Fecal-oral route).

-Autoinfection: the eggs are infective as soon as they are passed by the female worm. If the hands of the patient get contaminated with these eggs, he/she will infect him/herself again and again. Aerosol inhalation from contaminated sheets and dust.

Life cycle
Adult worm lives in the large intestine. After fertilization, the male dies and thefemale moves out through the anus to glue its eggs on the peri-anal skin. Thistakes place by night. The egg, -convex and contains larva. When the eggs are swallowed, they hatch in the small intestine and the
larvae migrate to the large intestine to become adult.

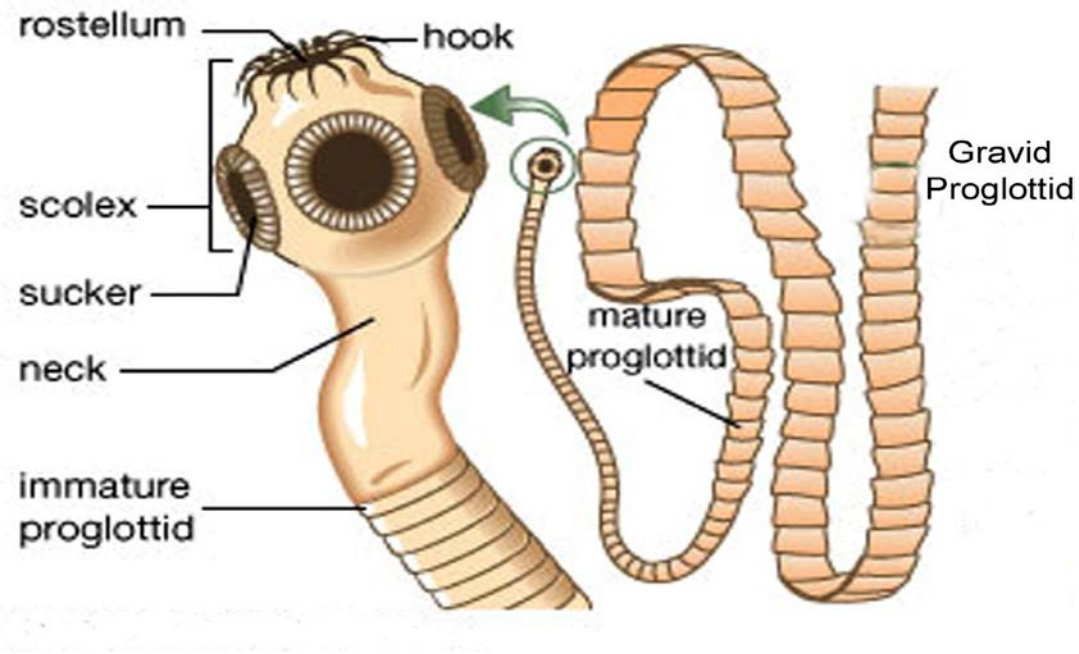
Clinical presentation
The migration of the worms causes allergic reactions around the anus and during night it causes nocturnal itching and enuresis. The worms may obstruct the appendix causing appendicitis.

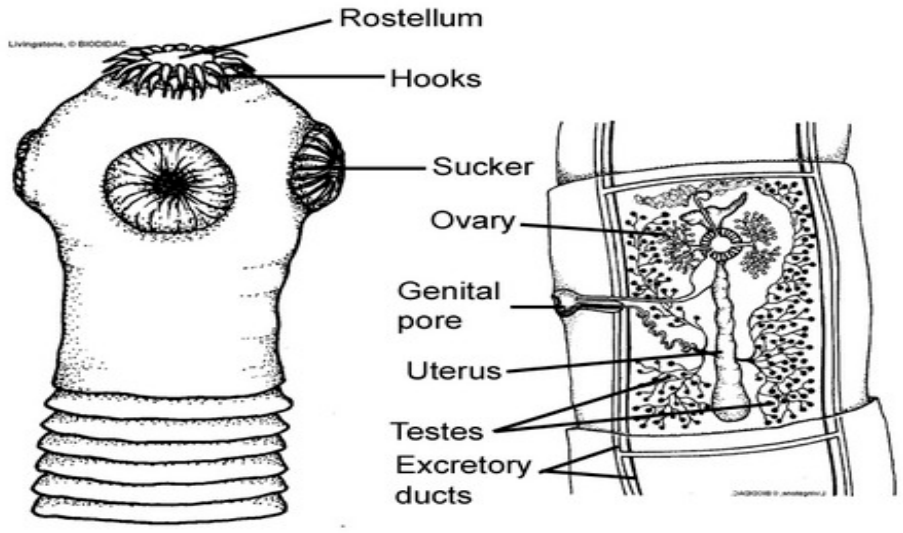
Diagnosis
♦ Eggs in stool: Examination of the stool by direct saline smear to detect the egg .

CESTODES (TAPEWORMS)
INTRODUCTION

The tapeworms are hermaphroditic and require an intermediate host. The adult tapeworms found in humans have flat body, white or grayish in color. They consist of an anterior attachment organ or scolex and a chain of segments (proglottids). The is the entire body except the scolex. The scolex has suckers or grooves. It has rosetellum, which has 1 or 2 rows of hooks situated on the center of the scolex.

Adult tapeworms inhabit the small intestine, where they live attached to the mucosa. Tapeworms do not have a digestive system. Their food is absorbed from the host's intestine.





TAENIA SAGINATA (BEEF TAPEWORM)

In adult stage, *T. saginata* inhabits the upper jejunum where it may survive for as long as 25 years. It causes intestinal infection, Taeniasis. It has worldwide distribution.These are one of the true and segmented tapeworms. Their body is divided into three regions;

1. Scolex: the hold fast organ2. Neck: posterior to the scolex3. Stobilla: the main bulk, made up of proglottids .

Morphology:

Adult worm measures 5-10 meters in length. The pyriform scolex has 4 suckers but no rostellum. The mature segments have irregularly alternate lateral genitalpores. Each of the terminal segments contains only a uterus 15-30 lateral branches.

Life cycle

The adult worm lives in the small intestine of man. Gravid segments pass out in the stool and become disintegrated and eggs come out to the soil. The gravid proglottid uterus contains about 100,000 eggs. The egg of *T. saginata*is round, about 40 microns in diameter. The 6-hooked embryo is enclosed in a radially striated embryophore. Eggs are ingested by an intermediate host, cattle. The 6- hooked embryo escapes from its shell, penetrates through the intestinal wall into the blood vessels and is carried to the muscles where it develops into a larval stage, **cysticercus bovis** Infection to man takes place by the ingestion of raw or insufficiently cooked beef. In the small intestine of man, the head of the cysticercus gets invaginated and the body becomes segmented.

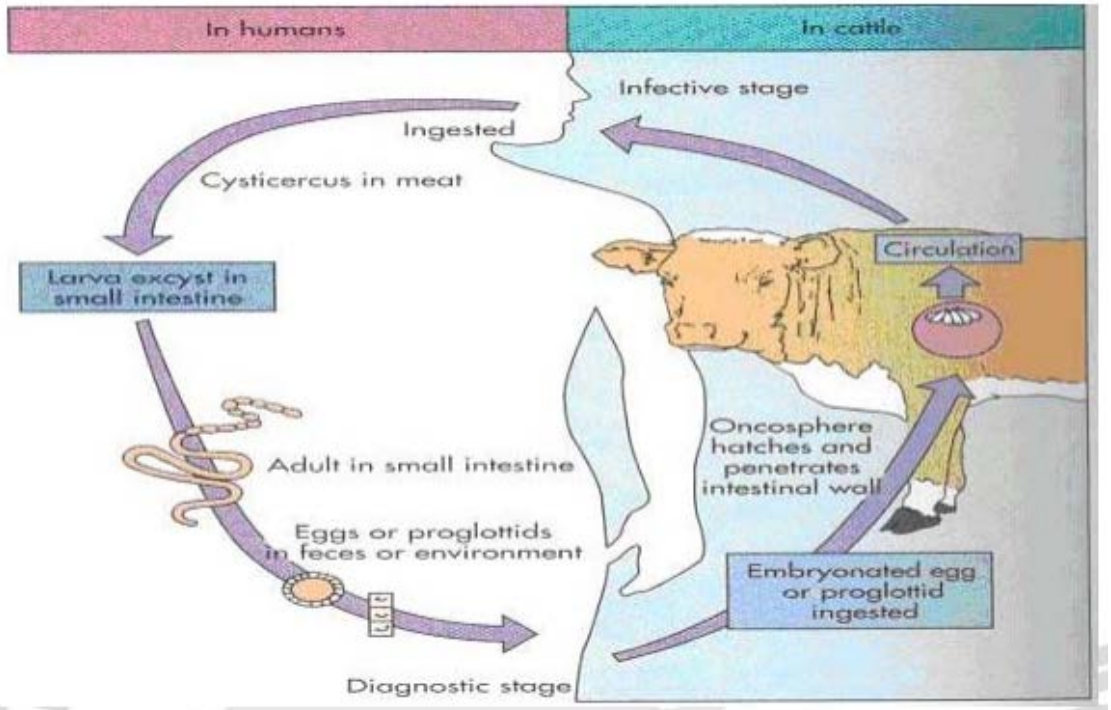


Fig 1.21. Life cycle of *Taenia saginata*

Pathogenicity

Infected persons may complain of epigastric pain, abdominal discomfort, diarrhea, weight loss, hunger sensation, vomiting, etc.

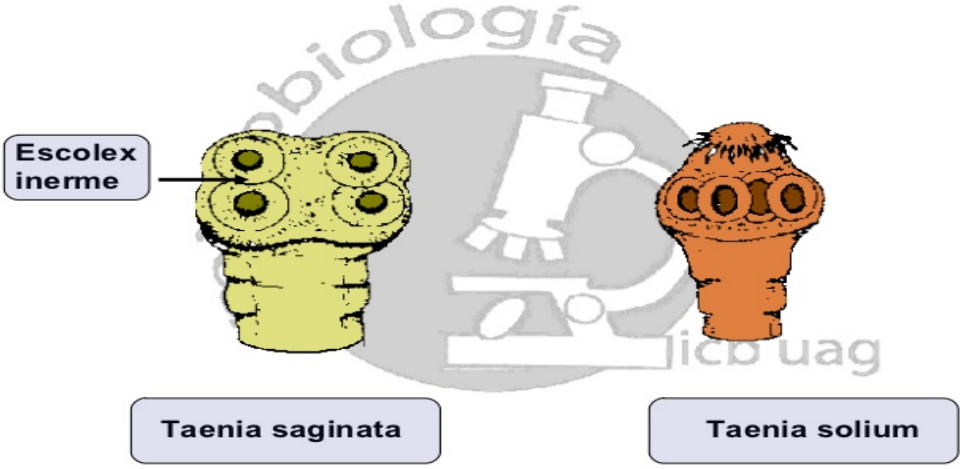
Diagnosis

Recovery of the gravid segments or the eggs from the stool .

Comparison between *Taenia saginata* and *Taenia solium* species

	Taenia saginata	*Taenia solium*
Length	(m) 5-10	2-3
Proglottid number	1000-2000	800-900
Hooklets	Absent	Present
Suckers	Pigmented	Non-Pigmented
Uterus branch	15-30	5-10

Diferencias entre Taenia solium de T. saginata



Diferencias entre Taenia solium de T. saginata

References

1-Paniker's Textbook of Medical Parasitology. 2018, 8th edition

2-Essentials of Medical Parasitology .2014, 1st edition.

3-Diagnostic medical parasitology .2007 ,5th edition.

4-Human parasitology. 2012 ,4th edition.

Medical parasitology

Haemoflagelates
Leishmania Species
Clinical disease
- Veseral leishmaniasis
- Cutaneous leishmaniasis
- Mucocutaneous leishmaniasis

The species of leishmania exist in two forms, amastigote (a flagellar) and promastigote (flagellated) in their life cycle. They are transmitted by certain species of sand flies (Phlebotomus&Lutzomyia).

Leishmania donovani (veseralleishmaniasis)
Important features- the natural habitat of *L.donovaniin* man is the reticuloendothelial system of the viscera, in which the amastigote multiplies by 48 simple binary fission until the host cells are destroyed.

Pathogenesis

In visceral leishmaniasis, the organs of the reticuloendothelial system (liver, spleen and bone marrow) are the most severely affected organs, spleen bone marrow .results in anemia, leukopenia. The spleen and liver become markedly enlarged,

Clinical features Symptoms begin with fever, weakness, and diarrhea; chills and sweating that may resemble malaria symptoms are also common early in the infection. As organisms proliferate & invade cells of the liver and spleen, marked enlargement of the organs, weight loss, anemia., (kala-azar) dermal leishmaniasis, occurs.

Laboratory diagnosis

• Examination of tissue biopsy, spleen aspiration, bone marrow aspiration or lymph node aspiration in properly stained smear (e.g. Giemsa stain).

Culture of blood, bone marrow, and other tissue often demonstrates the Old World Cutaneous Leishmaniasis (Oriental sore)

Clinical disease

L.***tropica*** minor -dry cutaneous leishmaniasis

L.***tropica*** major- wet cutaneous leishmaniasis

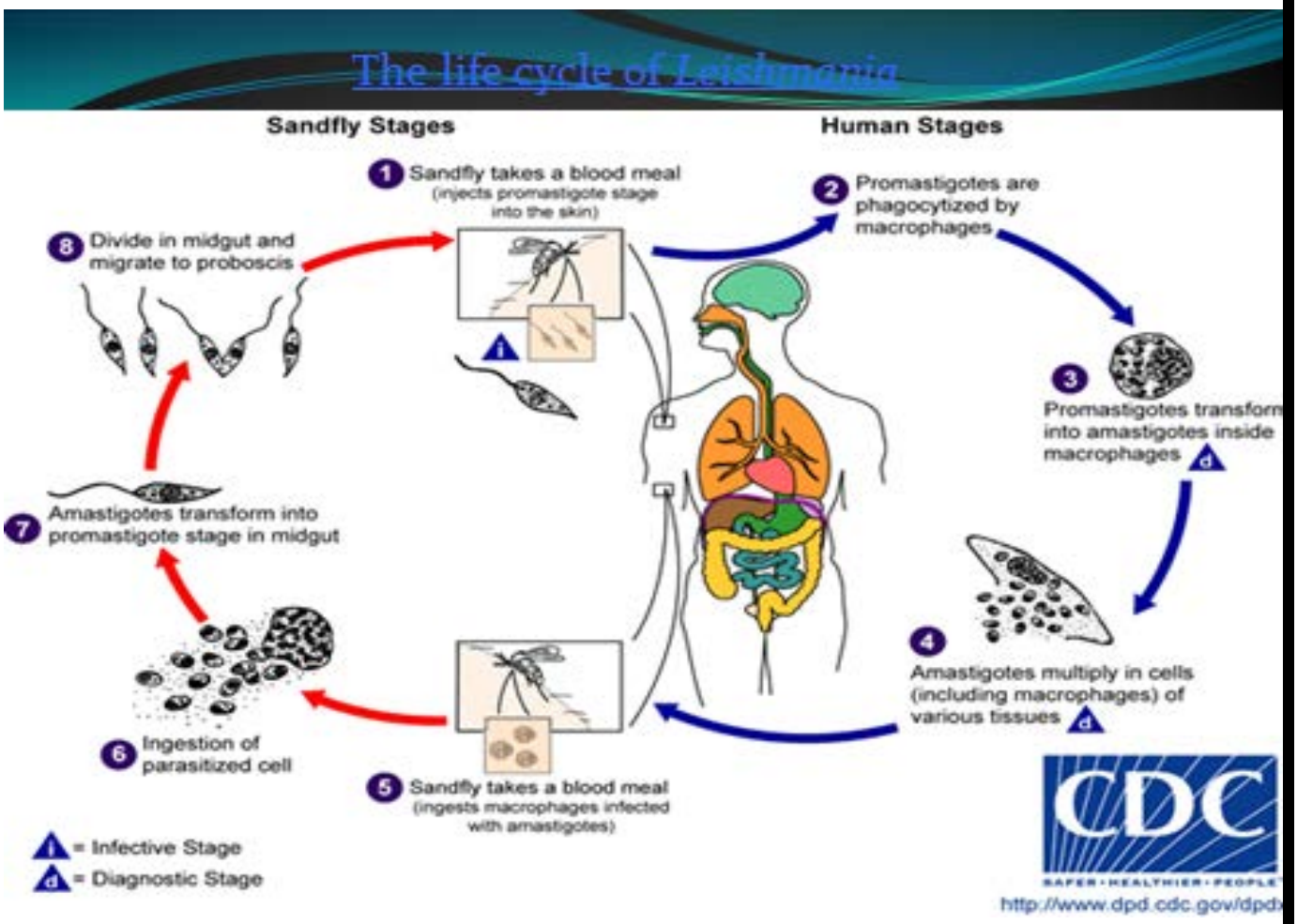
Clinical features

The first sign, a red papule, appears at the site of the fly's bite. This lesion becomes irritated, with intense itching, and begins to enlarge & ulcerate. the ulcer becomes hard,. secondary bacterial infection may complicate the disease. This leads to the formation of disfiguring nodules over the surface of the body.

Prevention

-Prompt treatment & eradication of ulcers

-Control of sand flies & reservoir hosts



Trypanosomiasis

Etiologic agents

Trypanosoma brucei complex– African trypanosomiasis (sleeping sickness)

Trypanosoma cruzi– American trypanosomiasis (Chagas' disease)

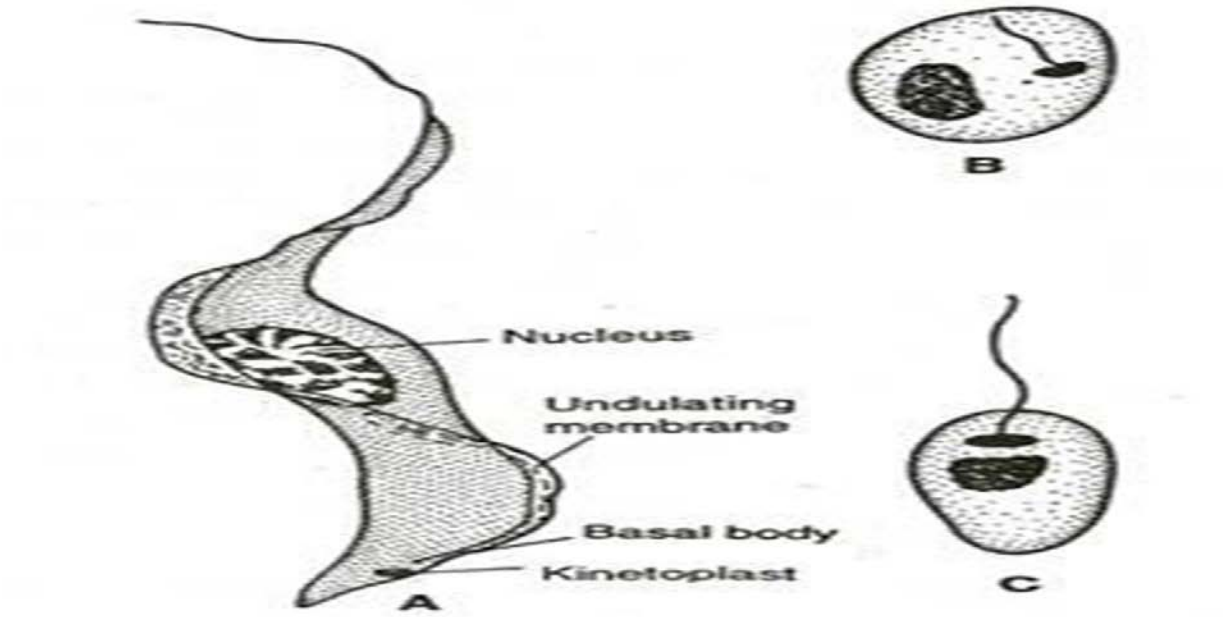


Fig. 185. *Trypansoma cruzi*. A. Trypanosoma from. B. Leishmanial from 3. Crithidial form.

Important features

Typical trypanosome structure is an elongated spindle-shaped body that , a centrally situated nucleus , an undulating membrane proceeding forward along the margin of the cell membrane and a single free flagellum at the anterior end

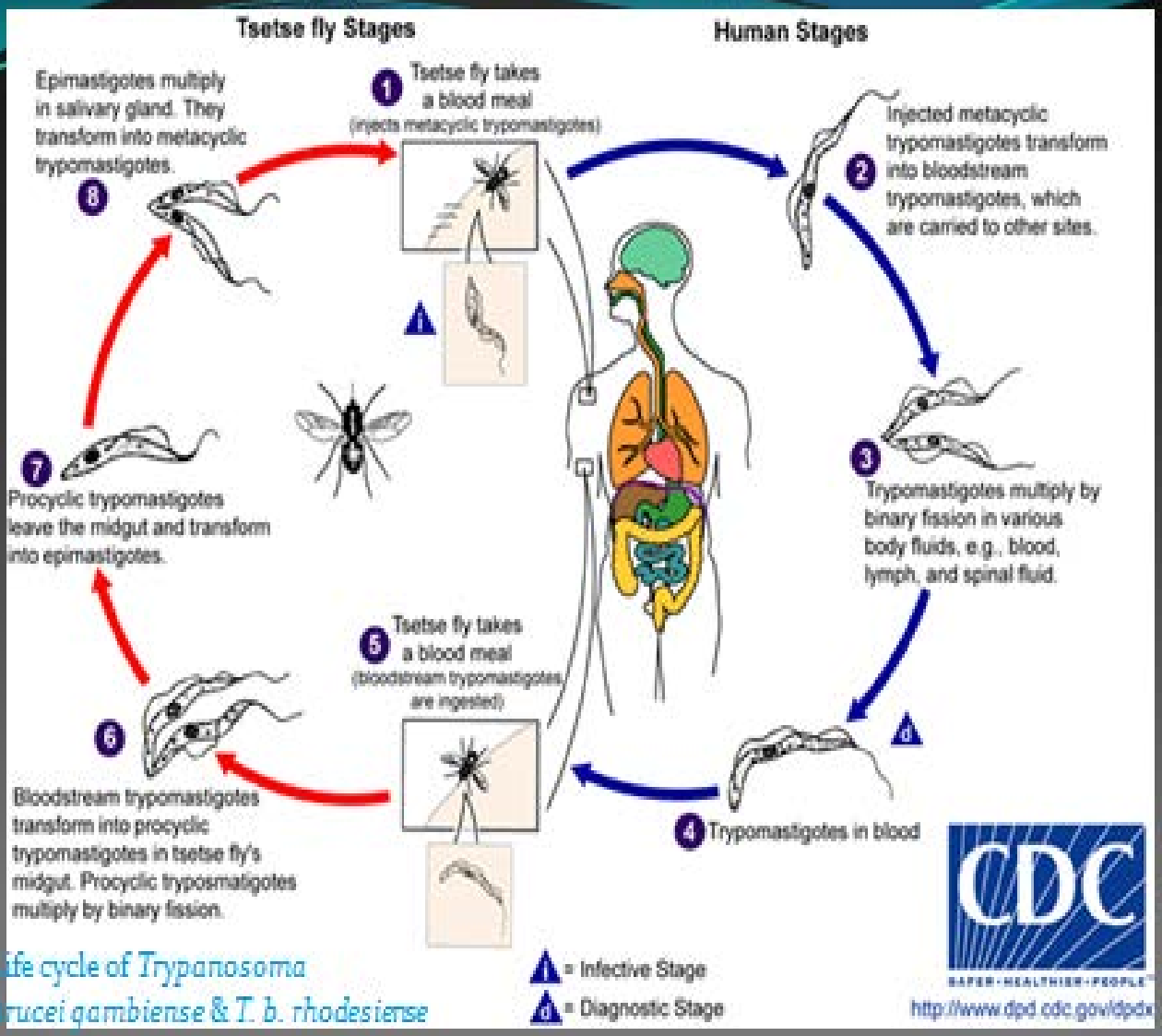
1. **African trypanosomiasis**

causative agents of the African typanosomiasis, transmitted by insect bites. The vector for both is the tsetse fly.

Pathogenesis

The trypomastigotes(infected stage)spread from the skin through the blood to the lymph node and the brain. The (sleeping sickness) usually progresses to coma , cyclical fever spike (approximately every 2 weeks).

African Trypanosomiasis



Life cycle of *Trypanosoma brucei gambiense* & *T. b. rhodesiense*

MEDICALLY IMPORTANT CILIATES

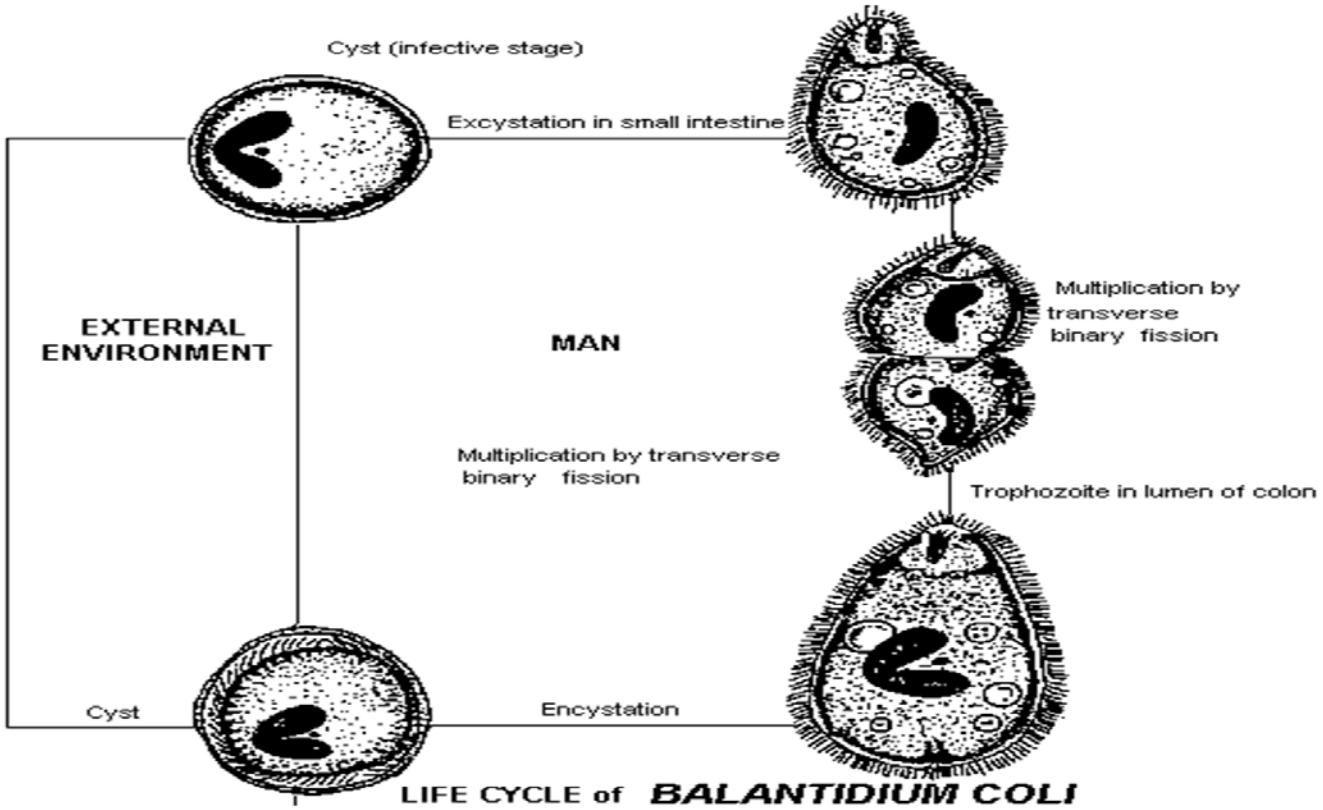
Balantidiasis

The intestinal protozoan ***Balantidium coli*** the only member of the ciliate group

that is pathogenic for humans. Disease produced by ***B. coli*** similar to amebiasis, because the organisms elaborate proteolytic and cytotoxic substances that mediate tissue invasion and intestinal ulceration.

Life cycle

The life cycle of ***B. coli*** simple, involving ingestion of infectious cysts, excystation, and invasion of trophozoites into the mucosal lining of the large intestine. The trophozoite is covered with rows of hair like cilia that aid in motility. Morphologically more complex than amebae, *B.coli* has a funnel-like primitive mouth called a cytostome, a large (macro) nucleus and a small (micro) nucleus involved in reproduction.



LIFE CYCLE of **BALANTIDIUM COLI**

Adapted and redrawn from NCDC

Life Cycle

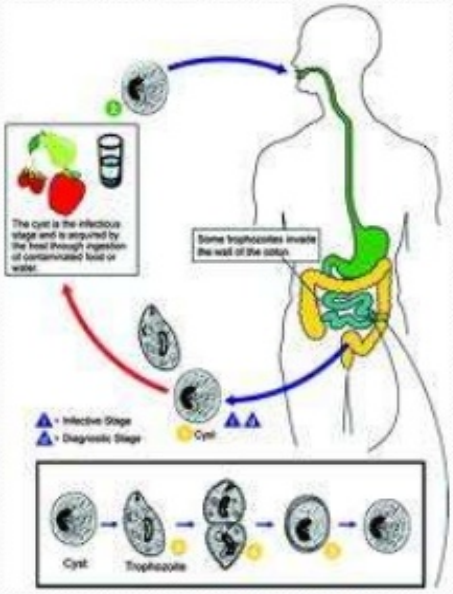
Life cycle is as follow :

The cyst is the infective stage of Balantidium coli life cycle.

Once the cyst is ingested via feces-contaminated food or water, it passes through the host digestive system.

There, excystation takes place in small intestine.

Excystation produces a trophozoite from the cyst stage.



Clinical features

Symptomatic disease is characterized by abdominal pain, tenderness, nausea, anorexia, and watery stools with blood and pus. Ulceration of the intestinal mucosa, as with amebiasis, can be seen; a secondary complication caused by bacterial invasion into the eroded intestinal mucosa can occur.

Laboratory Diagnosis

Microscopic examination of feces for trophozoite and cysts is performed.

COCCIDIA (SPOROZOA)

INTRODUCTION

Coccidia are members of the class sporozoa, Phylum Apicomplexa. Apical complex is present at some stage and consists of elements visible with electron microscope. The life cycle is characterized by an alternation of generations, i.e. sexual (gametogony) and asexual (schizogony) reproduction and most members of the group also share alternative hosts. The locomotion of a mature organism is by body flexion, gliding, or undulation of longitudinal ridges. The genus Plasmodium that are the causes of malaria is the prototype of this class.

Malaria

There are four species normallyi nfecting humans, namely, *Plasmodium falciparum*, *Plasmodium vivax*, *Plasmodium ovale*, and *Plasmodium malariae*.

Life cycle

The life cycle of malaria is passed in two hosts (alternation of hosts) and has sexual and asexual stage (alternation of generations).

1- Vertebrate host - man (intermediate host), where the asexual cycle takes place. The parasite multiplies by schizogony and there is formation of male and female gametocytes (gametogony).

2- Invertebrate host - mosquito (definitive host) where the sexual cycle takes place. Union of male and female gametes ends in the formation of

sporozoites (sporogony).

The life cycle passes in four stages:

Three in man:- Pre – erythrocytic schizogony

Erythrocytic schizogony

- Exo- erythrocytic schizogony

One in mosquito - Sporogony

Introduction into humans- when an infective female Anopheles mosquito bites

man, it inoculates saliva containing sporozoites (infective stage).

Pre- Erythrocyticschizogony- sporozoites reach the blood stream and the liver, initiating a cycle of schizogony. Multiplication occurs in tissue schizonts, to form thousands of tiny merozoites. Merozoites are then liberated on rupture of schizonts about 7th – 9th day of the bites and enter into the blood stream. These merozoites either invade the RBC's or other liver cells. In case of P. falciparumand possibly *P. malariae,* all merozoites invade RBC's without re-invading liver cells. However,

For *P. vivax* and *P. ovale*, some merozoites invade RBC's and some re-invade

liver cells initiating further Exo-erythrocyticschizogony, which is responsible for

relapses.

Erythrocytic schizogony (blood phase) The merozoites reinvade fresh RBC's repeating the schizogonic cycles Erythrocytic merozoites do not reinvade the liver cells. So malaria transmitted by blood transfusion reproduces only erythrocytic cycle .

Gametogony

Some merozoites that invade RBC's develop into sexual stages (male and female gametocytes). These undergo no further development until taken by the mosquito.

Sporogony (extrinsic cycle in mosquito)

When a female Anopheles mosquito vector bites an infected person, it sucks

blood containing the different stages of malaria parasite. All stages other than

gametocytes are digested in the stomach.

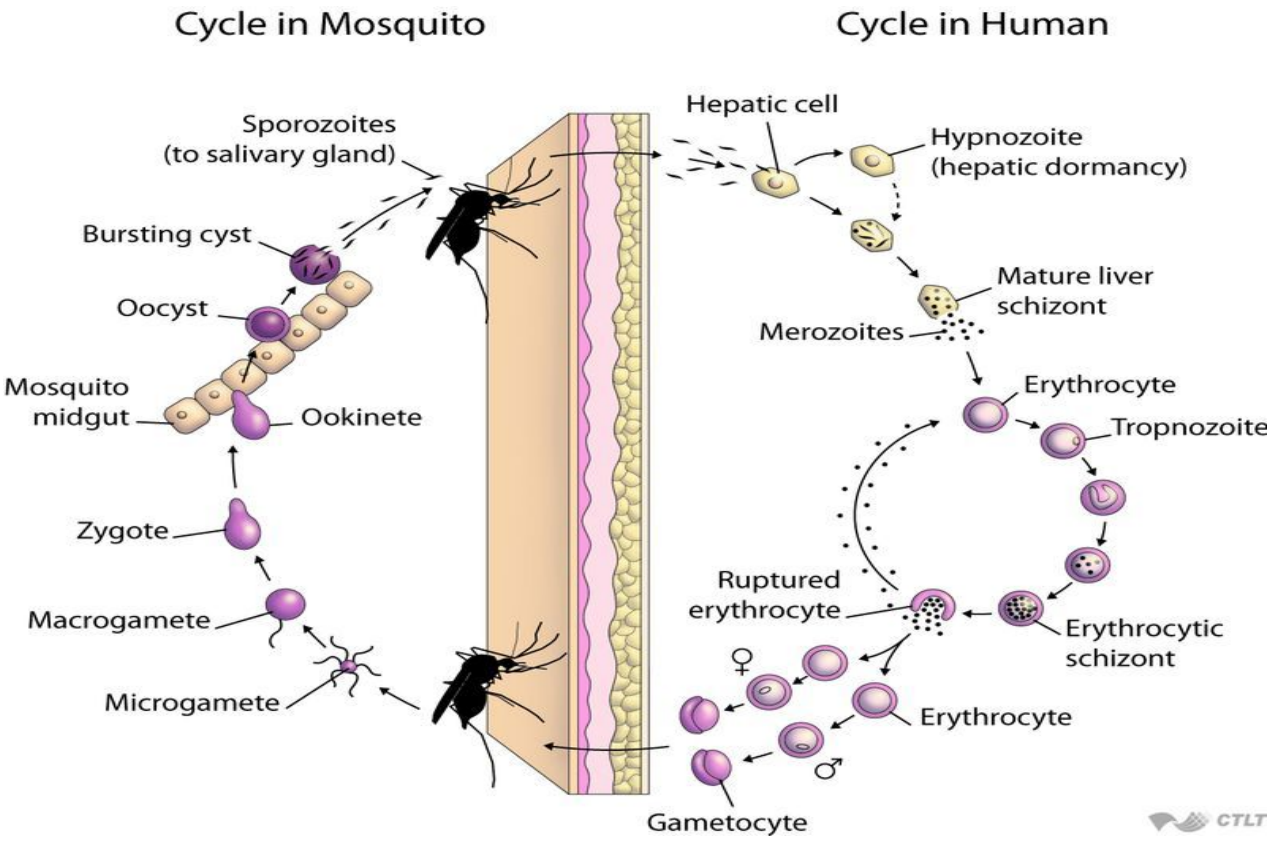
The microgametocyte.

The microgametocyte ex-flagellation.divides by reduction division into 6-8 pieces, which migrate to the periphery., microgametes, are actively motile and separate from the gametocyte.

The macrogametocyte by reduction division becomes a macrogamete.

Fertilization occurs by entry of a micro gamete into the macro gamete forming a zygote. The zygote changes into a worm like form, the ookinete, which penetrates the wall of the stomach to develop into a spherical oocyst. The oocystes increase in size. Thousands of sporozoites develop inside the oocysts. Oocysts rupture and sporozoites are liberated in the body cavity and migrate everywhere particularly to the salivary glands. Now the mosquito is infective

The sporogonous cycle in the mosquito takes 8-12 days depending on temperature



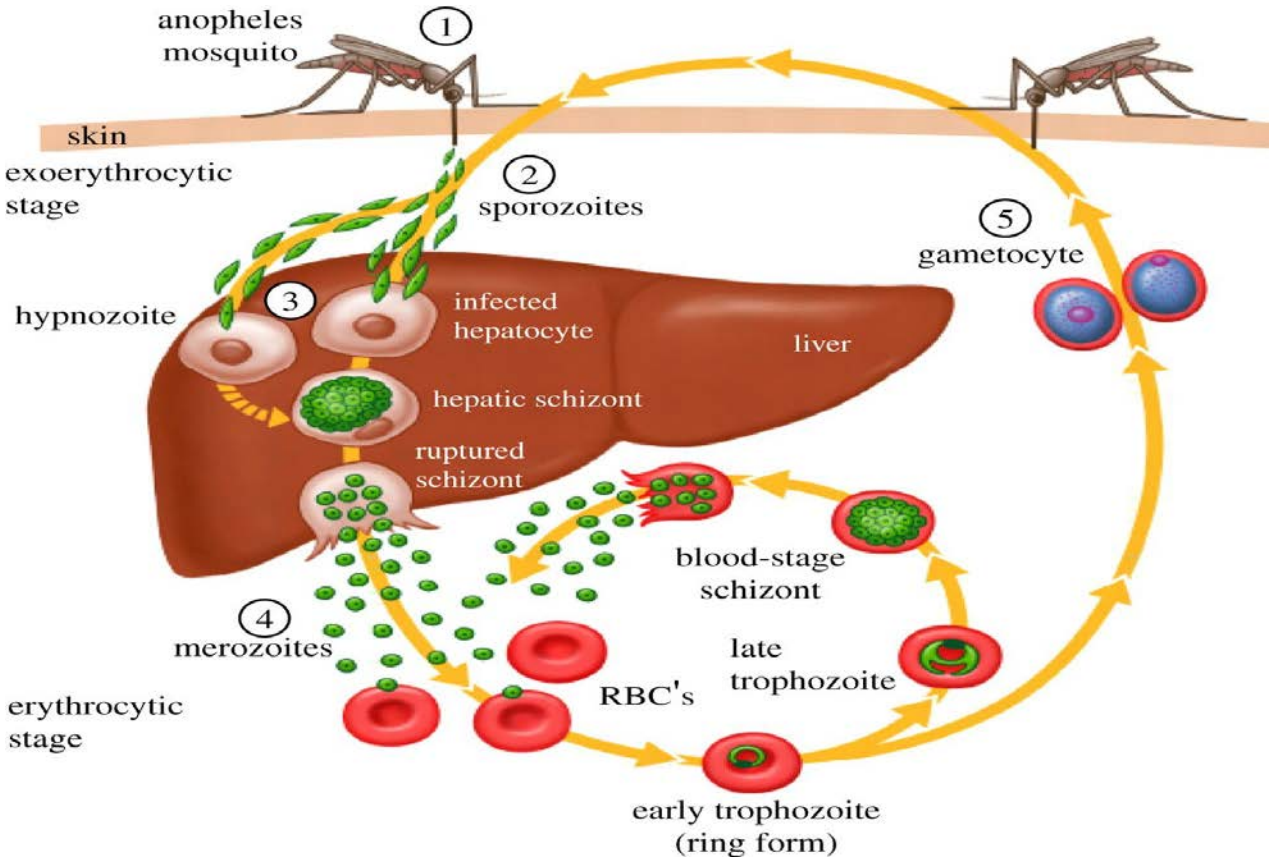


Table 2. Characteristics of infection with the five species of Plasmodia infecting humans

Characteristics	*Plasmodium falciparum*	*P.knowlesi*	*P.malariae*	*P.ovale*	*P.vivax*
Pre-erythrocytic stage (days)	5-7	8-9	14-16	9	6-8
Pre-patent period (days)	9-10	9-12	15-16	10-14	11-13
Erythrocytic cycle (days)	48	24	72	50	48
Red cells affected	All	All	Mature erythrocytes	Reticulocytes	Reticulocytes
Parasitaemia per µL • Average • Maximum	 20,000-500,000 2,000,000	 600-10,000 236,000	 6000 20,000	 9000 30,000	 20,000 100,000
Febrile paroxysm (hours)	16-36 or longer	8-12	8-10	8-12	8-12
Severe malaria	Yes	Yes	No	No	Yes
Relapses from liver forms	No	No	No	Yes	Yes
Recurrences	Yes (treatment failure)	Yes	Yes (as long as 30-50 years after primary attack)	No	Yes (treatment failure)

Other coccidian parasites Toxoplasma gondii– causes toxoplasmosis.

Toxoplasma gondii – causes toxoplasmosis. The definitive host is the

domestic cat and other felines. Humans and other mammals are intermediate hosts. T.gondii is usually acquired by ingestion and transplacental transmission from an infected mother to the fetus can occur. Human–to–human transmission, other than transplacental transmission, does not occur. After infection of the intestinal epithelium, the organisms spread to other organs, especially the brain, lungs, liver, and eyes. Most primary infections in immunocompetent adults are asymptomatic. Congenital infection can result in abortion, stillbirth, or neonatal disease with encephalitis, chorioretinitis and hepatosplenomegaly. Fever, jaundice, and intracranial calcifications are also seen. For the diagnosis of acute and congenital infections, an immunofluorescence assay for detection of antibody is used. Microscopic examination of Giemsa–stained preparations shows crescent–shaped trophozoite. Cysts may be seen in the tissue. Treatment is with a combination of sulfadiazine and pyrimethamine.

References

1-Diagnostic medical parasitology .2007 ,5th edition.

2-Human parasitology .2012 , 4th edition.