Education
Faculty
Grade 1
2024-2025
Practical

Cell Biology

Lab.1

Lab. Safety

17.10.2024

By
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Introduction

- Laboratory safety rules are a major aspect of every biology lab.

- Each student in biology laboratory must follow specific safety rules and procedures.

Why is Lab Safety Important?

- Lab safety rules and symbols are needed so that students do not injure themselves or their classmates.

Lab Safety Rules

Lab Safety Rules

1-Wear protective clothing .

Protective clothes

- Gloves are essential.
- Lab coats are required.
- Safety glasses (goggles) may be required to avoid splashes.

Lab Safety Rules

2-Laboratory personnel should not wear sandals

Lab Safety Rules

Do <u>NOT</u> Wear:

- Jewelry

- Loose or Baggy clothing

Lab Safety Rules

3-Avoid touching objects (e.g., pencils, cell phones, door handles) while wearing gloves.

4-Pencils, labels, or any other materials should never be placed in your mouth.

5-Caution must be taken when using gas burners. Be sure gas burners are turned off when finished.

Lab Safety Rules

6-Long hair must be tied back or covered to minimize fire hazard or contamination of experiments.

Lab Safety Rules

7- Do not eat food or drink water in the lab.

do not use lab glassware as food or water containers.

Lab Safety Rules

8- Protect your hands safety:

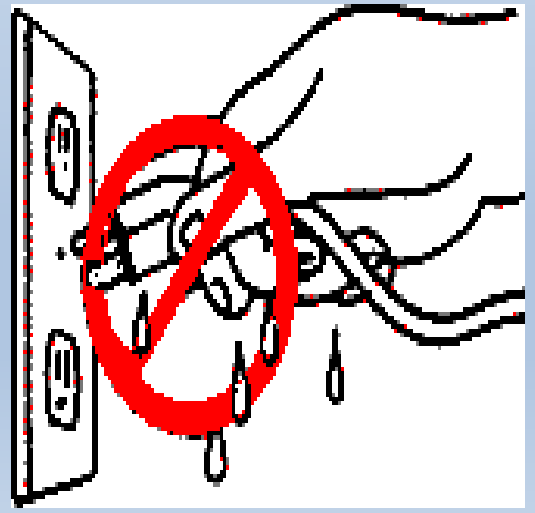
- wash hands after every lab.

- Handle glassware, sharp tools and heated containers carefully.

Lab Safety Rules

9 electrical safety:

- unplug electrical equipment after use.
- keep all electrical cords and wires away from water .



Lab Safety Rules

- 10- Chemical safety:

•-never touch, taste or smell a chemical unless instructed to do so.

- - never mix chemicals unless instructed to do so.
- -keep lids on chemical containers when not in use.

Lab Safety Rules

12- Do not engage in practical jokes or horseplay in the lab.

Lab Safety Rules

13-Keep nonessential books and clothing far away from your work area.

Lab Safety Rules

14-Wipe the bench tops down with disinfectant both before you begin your work and after you have completed your work.

Lab Safety Rules

15- Dispose of waste products according to instructions.

Lab Safety Rules

16-Report all accidents, no matter how minor, to your supervisor!!

Lab Safety Equipment

Lab Safety Equipment

- Safety shower

- Eye wash

Lab Safety Equipment

- Fire Blanket

- Fire Extinguisher

Lab Safety Symbols

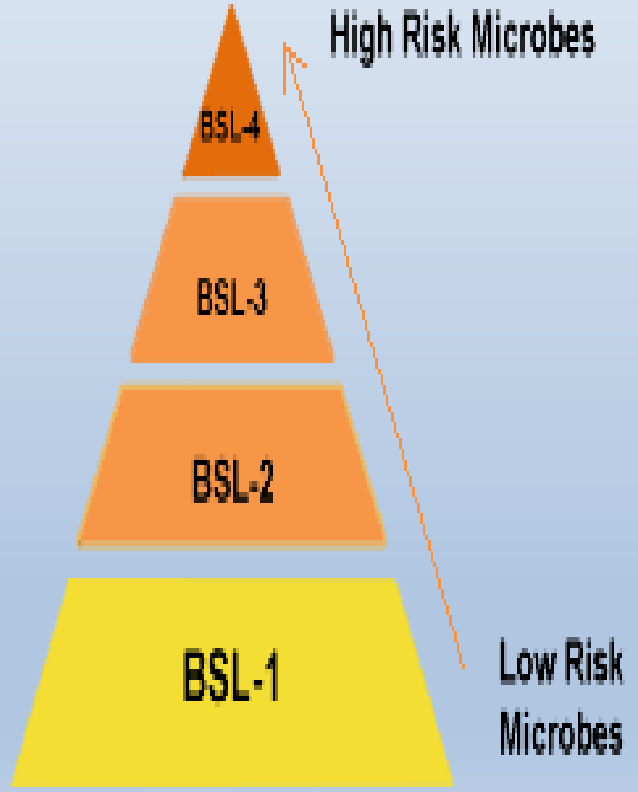
Lab Safety Symbols

- They alert about the possible dangers in the lab.

Biological Safety Levels

Biological Safety Levels

1. **BSL1**
2. **BSL2**
3. **BSL3**
4. **BSL4**



BSL-1

- Not known to cause disease in healthy adult humans

- Safety equipment
  - Minimal requirements
- Facilities
  - Open bench top

BSL-2

  - Associated with mild to moderate disease in humans
- Safety equipment
  - Biological Safety Cabinet and personal protective equipment as needed.
- Facilities
  - BSL-1 plus the availability of a mechanism for decontamination.

BSL-3

  - Associated with serious or potentially lethal disease in humans
- Safety equipment
  - Biological Safety Cabinet and personal protective equipment required.
- Facilities
  - BSL-2 with self-closing double door access and single-pass negative directional airflow.

BSL-4

  - Associated with high risk of life-threatening disease in humans and/or animals
- Safety equipment
  - Biological Safety Cabinet
  - Full-body air-supplied, positive pressure personnel suit
- Facilities
  - BSL-3 plus dedicated air and exhaust, decontamination procedures for exit, separate building, etc.


Thanks for your attention

Education
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Lab.2

Microscope

26.11.2024

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Types of Microscope

1.Compound Light Microscope

The **compound light microscope** uses light to produce a **2D image** with up to **1000X magnification** but has **low resolution**. It's widely used for viewing **individual cells**, including **living ones**.

2.Dissection Microscope (also called Stereo Microscope)

The **dissection microscope** uses light to create a **3D image** and is ideal for observing **larger specimens** during dissection. It has **low magnification** (10X–200X) and cannot view individual cells.

3.Electron Microscope: there are two types:

a.Scanning Electron Microscope

SEM use electron illumination. The image is seen in 3-D. It has high magnification and high resolution. The specimen is coated in gold and the electrons bounce off to give you and exterior view of the specimen. The pictures are in black and white.

b.Transmission Electron Microscope

TEM is electron illuminated. This gives a 2-D view. Thin slices of specimen are obtained. The electron beams pass through this. It has high magnification and high resolution.

4.Phase contrast microscope

5.Fluorescence microscope

6.Interference microscope

7.Dark field microscope

Compound Light Microscope

Microscope Care

- Always carry with 2 hands
- Never touch the lenses with your fingers.
- Only use lens paper for cleaning
- Do not force knobs
- When you are finished with your "scope", rotate the nosepiece so that it's on the low power objective, roll the stage down to lowest level, rubber band the cord, then replace the dust cover.

Microscope Parts & Functions

- **Ocular lens**: magnifies; where you look through to see the image of your specimen (They are usually 10X or 15X power.

- **Arm**: supports the tube and connects it to the base

- **Stage**: the flat platform where you place your slides

- **Coarse adjustment knob** moves stage up and down.

- **Fine adjustment knob:** small, round knob on the side of the microscope used to fine-tune the focus of your specimen after using the coarse adjustment knob Base: the bottom of the microscope, used for support

- **Body tube:** connects the eyepiece to the objective lenses

- **Revolving nosepiece:** the part that holds two or more objective lenses and can be rotated to easily change power

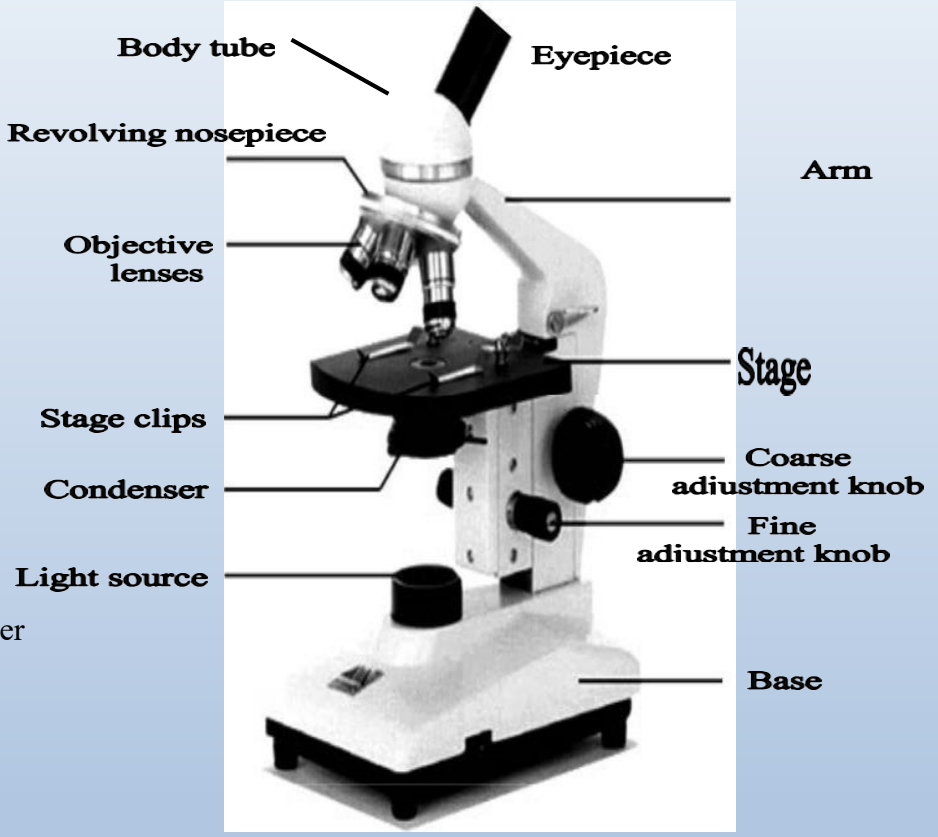
- **Objective lenses:** adds to the magnification usually you will find 3 or 4 objective lenses on a microscope. They almost always consist of 4X, 10X, 40X and 100X powers.

- **Stage clips**: Stage clips hold the slides in place.

- **Mechanical stage:** move the slide around by turning two knobs. One moves it left and right, the other moves it up and down.

- **Condenser:** gathers light and concentrates it into a cone of light that illuminate the specimen with uniform intensity over the entire view field

- **Light source**: project a parallel beam of light onto the sample for illumination.



Roles for Microscope Use

1. Carry the microscope properly.
2. Always begin focusing with the lowest power objective lens (4X).
3. Use the coarse focus only with the 4X objective in place.
4. Crank the lens down as close to the specimen as possible without touching it.
5. Now, look through the eyepiece lens and **focus upward only** until the image is sharp. If you can't get it in focus, repeat the process again.
6. Once the image is sharp with the low power lens, you should be able to simply click in the next power lens and do minor adjustments with the focus knob.
7. Use immersion oil only with the 100X objective (oil immersion lens) in place. Use only
8. ONE drop of oil.
9. Lower the stage and then remove the slide when you are done.
10. ALWAYS clean the microscope when you are done.
11. Always place the 4X objective over the stage and be sure the stage is at its lowest position before putting the microscope away.
12. Turn off the light before putting the microscope away.
13. Return the microscope to the correct cabinet.

Magnification Power and Resolution Power

- **Magnification** is the ability to make small objects seem larger, such as making a microscopic organism visible.
- **Resolution** is the ability to distinguish two objects from each other.
- Light microscopy has limits to both its resolution and its magnification.
- The resolution can be **calculated** as shown:

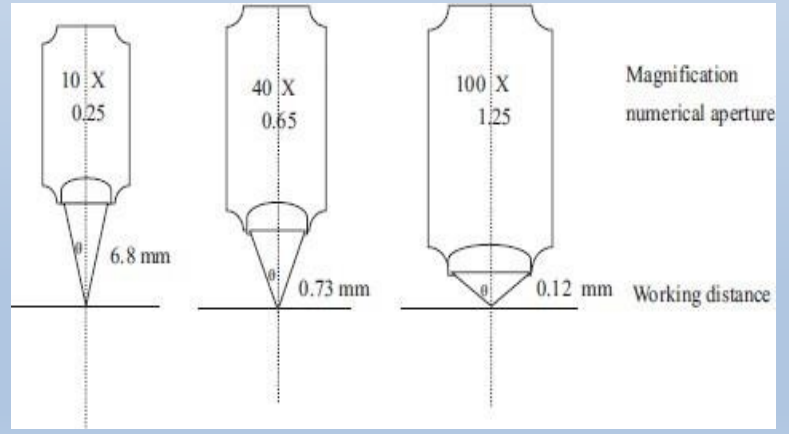
  Maximum resolution: R = (0.061λ) / N.A. Where, **0.61** is a geometrical term,

  λ = wavelength of illumination,

  N.A. = Numerical Aperture, can be calculated:

  N.A. = n sin α

  Where, n = index of refraction of medium, sin α= the angle of incidence of the rays




Thanks for your attention

Education
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Cell Biology

Lab.2

Cell Wall

4.12.2024

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Cell Wall

1. **Cell Wall:**

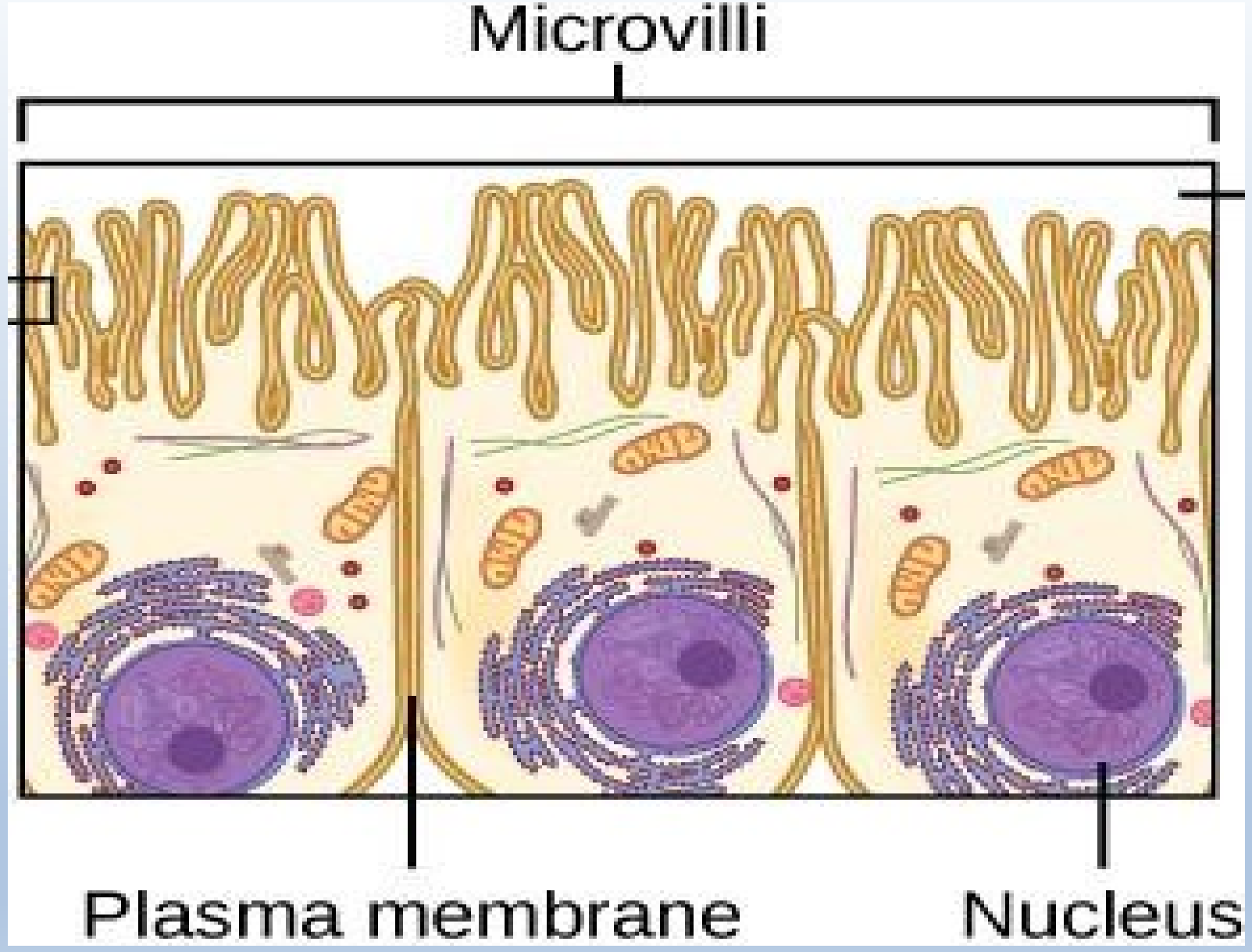
- Found in plant cells and some prokaryotes; absent in animal cells.
- **Composed of:**
  - Plant cells: Cellulose.
  - Fungi: Chitin.
  - Viruses: Protein coat (capsid).
- **Layers in plant cell walls:**
  - Middle lamella.
  - Primary cell wall.
  - Secondary cell wall.
  - https://youtu.be/vdvJ_RkyJgw?si=X1P5BCscXmyR_NWA

2.Plasma Membrane:

- **Present in all cells, separating the cell interior from the environment.**
- Composed of a lipid bilayer; semi-permeable to regulate material exchange.
- **Found beneath the cell wall in bacterial and cells.**
- Functions include nutrient absorption and cell plant connectivity.

3.Key Modifications of the Plasma Membrane:

- **Microvilli:**
  - Finger-like external folds increasing the surface area for absorption.
  - Found in epithelial cells of the digestive system.
  - Contain actin filaments for movement.

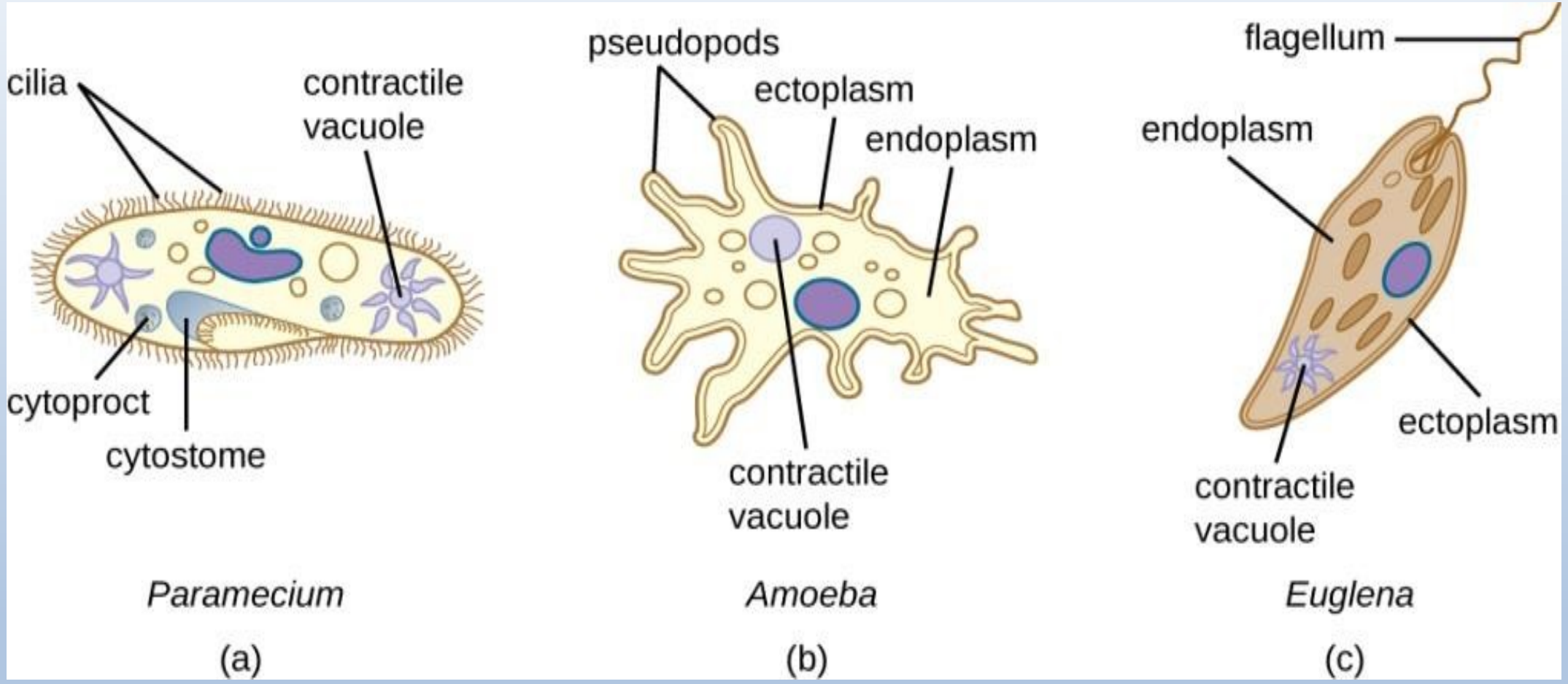

Microvilli
Plasma membrane
Nucleus

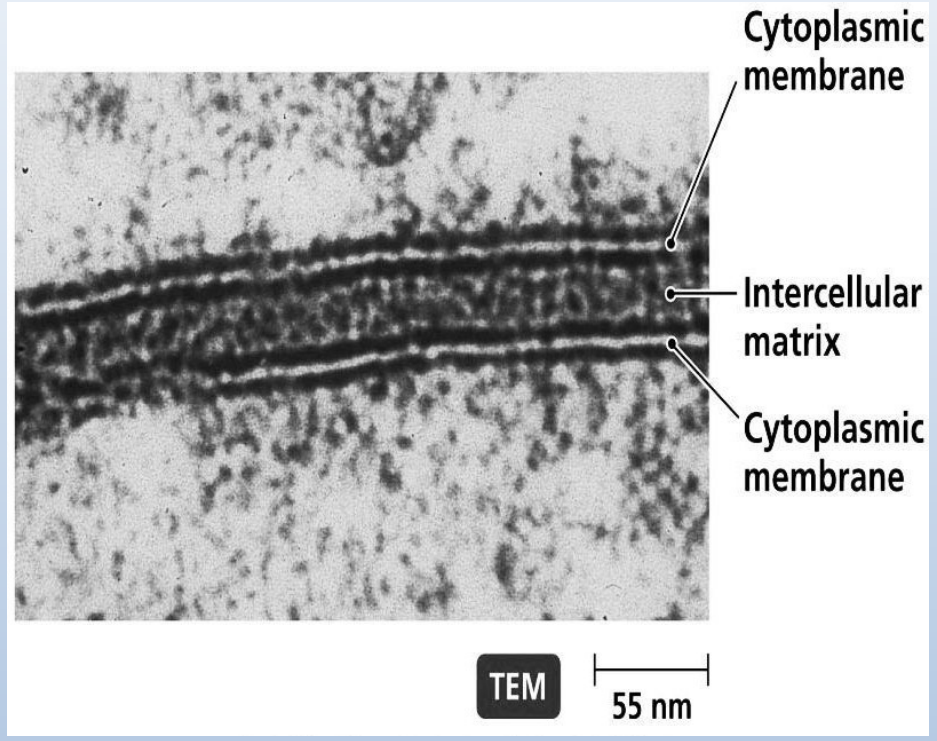
- Cilia and Flagella:
- Found on the apical surface of the plasma membrane; composed of ***microtubules***.
- Serve to move the cell or substances (like fluid or mucus) around the cell.
- Internal structure: "9 + 2" arrangement (9 outer doublets surrounding 2 central microtubules, forming the axoneme).
- Key difference: Length (flagella are longer than cilia).
- Pseudopodia:
- Temporary extensions of the eukaryotic cell membrane and cytoplasm.
- Characteristic of cells involved in processes like cellular movement or engulfing external substances.

- https://youtube.com/shorts/pmJbNvBIePE?si=G2NtfY7Lwmr_SQ_e

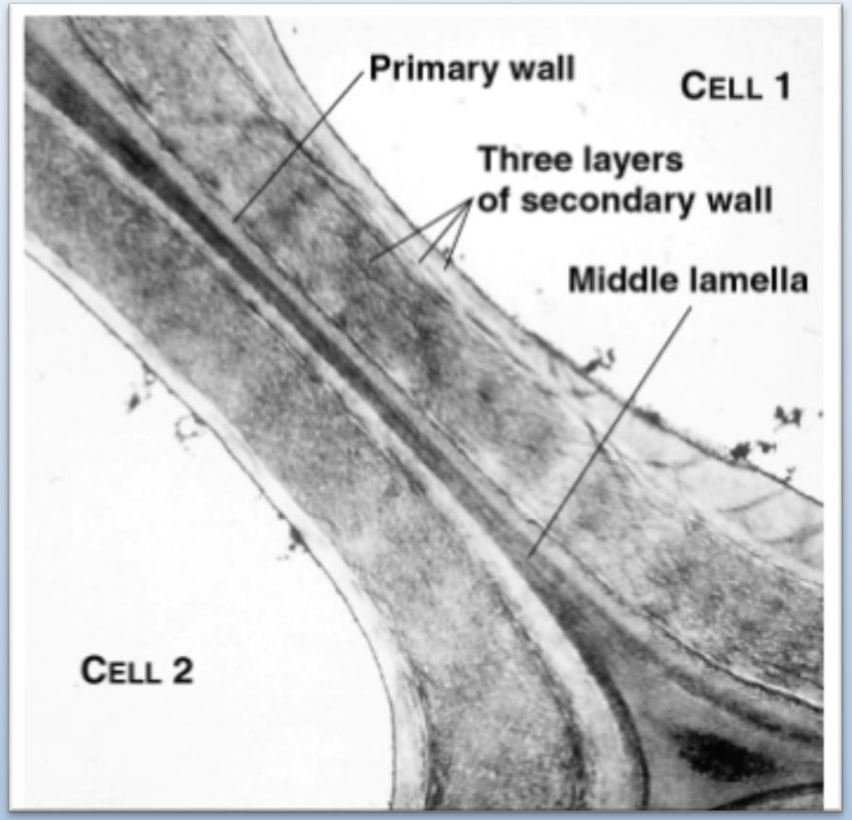
Pseudopodia Overview:

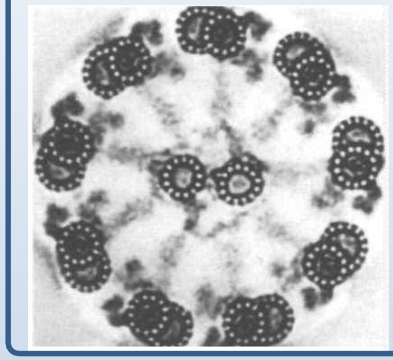
- **Composition:** Primarily made of actin filaments; may also include microtubules and intermediate filaments.
- **Functions:**
  - Motility: Enables cell movement.
  - Ingestion: Engulfs particles (e.g., during phagocytosis).
- **Occurrence:** Typically found in amoebas and other eukaryotic cells.
- https://youtu.be/mv6Ehv06mXY?si=Mgr2UlHxMJhQ0cUq


cilia
contractile vacuole
cytoproct
cytostome
Paramecium
(a)
pseudopods
ectoplasm
endoplasm
contractile vacuole
Amoeba
(b)
flagellum
endoplasm
ectoplasm
contractile vacuole
Euglena
(c)

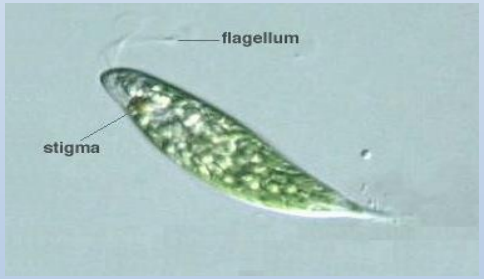


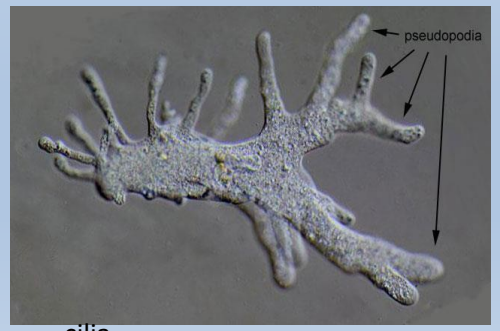
Ultrastructure of Cell wall





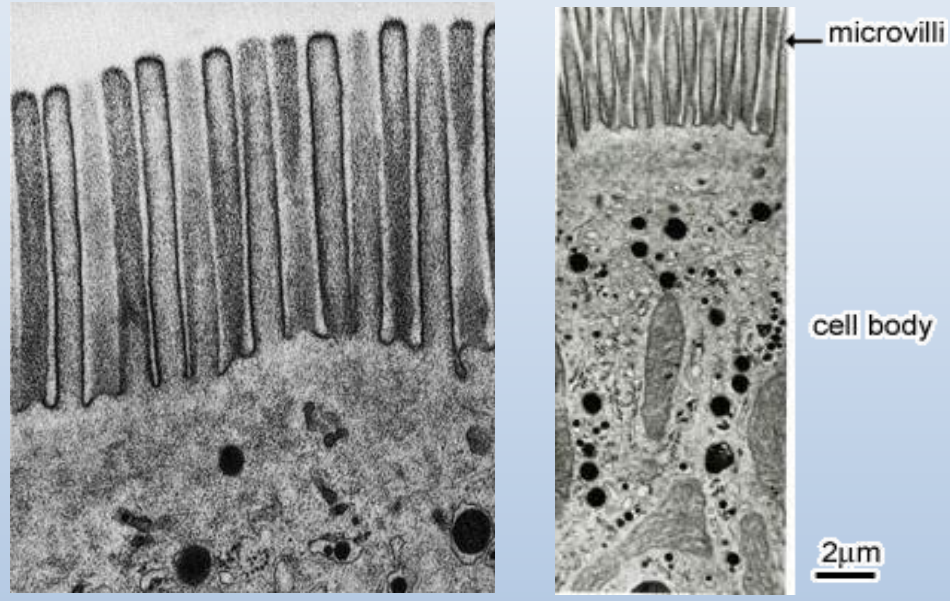
Ultrastructure of Cilia and Flagella





cilia

Pseudopodia in Amoeba



Ultrastructure of Microvilli


Thanks for your attention

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Cell Biology

Lab.4

The Cytoplasm

17.12.2024

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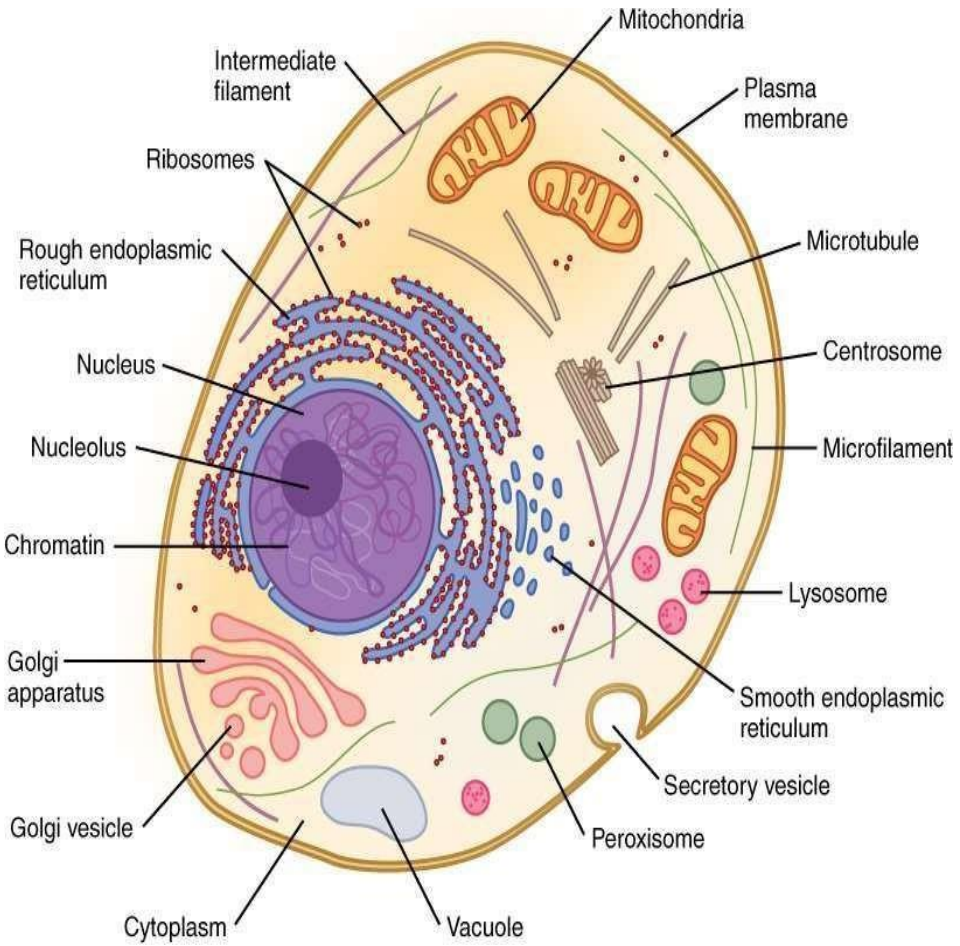
CYTOPLASM

- **Thick, gel-like semitransparent fluid** that is found in both plant and animal cell.
- The constituent parts of cytoplasm are **cytosol, cell organelles and cytoplasmic inclusions.**
- Bounded by the plasma membrane and contains many organelles in a eukaryotic cell (cell containing membrane bounded nucleus).



CYTOSOL

- The cytosol, the aqueous part of the cytoplasm outside all of the organelles, also contains its own distinctive proteins.
- It accounts for almost 70% of the total cell volume.
- Gelatinous substance consisting mainly of cytoskeleton filaments, organic molecules, salt and water.
- Chemically, the cytoplasmic matrix is composed of many chemical elements in the form of atoms, ions and molecules.

ORGANELLES

Following organelles are present in the Cytoplasm:-

a) Mitochondria

b) Endoplasmic Reticulum

c) Golgi Apparatus

d) Lysosomes

e) Peroxisomes

f) Vacuole

Practical part

1. Divide the class into 4 groups
2. Each group take a different plant sample
3. Put a drop of distilled water over the slide
4. Another group they must put iodine instead of distilled water
5. Put the sample on the slide
6. Cover it with cover slip
7. Exam the sample under the low power Lense (4X) of microscope
8. Transfer it to the power the 10X and 40X to recognize the cell cytoplasm and its some organelles
9. Draw it in your lab. notebook


Thanks for your attention

Education Faculty Grade 1 2024-2025 Practical

Cell Biology

Lab.5

Cytoplasmic Organelles:

Golgi Complex and Endoplasmic Reticulum

24.12.2024

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Golgi Apparatus

1. Overview:

The Golgi apparatus (Golgi body or complex) processes and packages proteins and lipids for transport or secretion.

2. Functions:

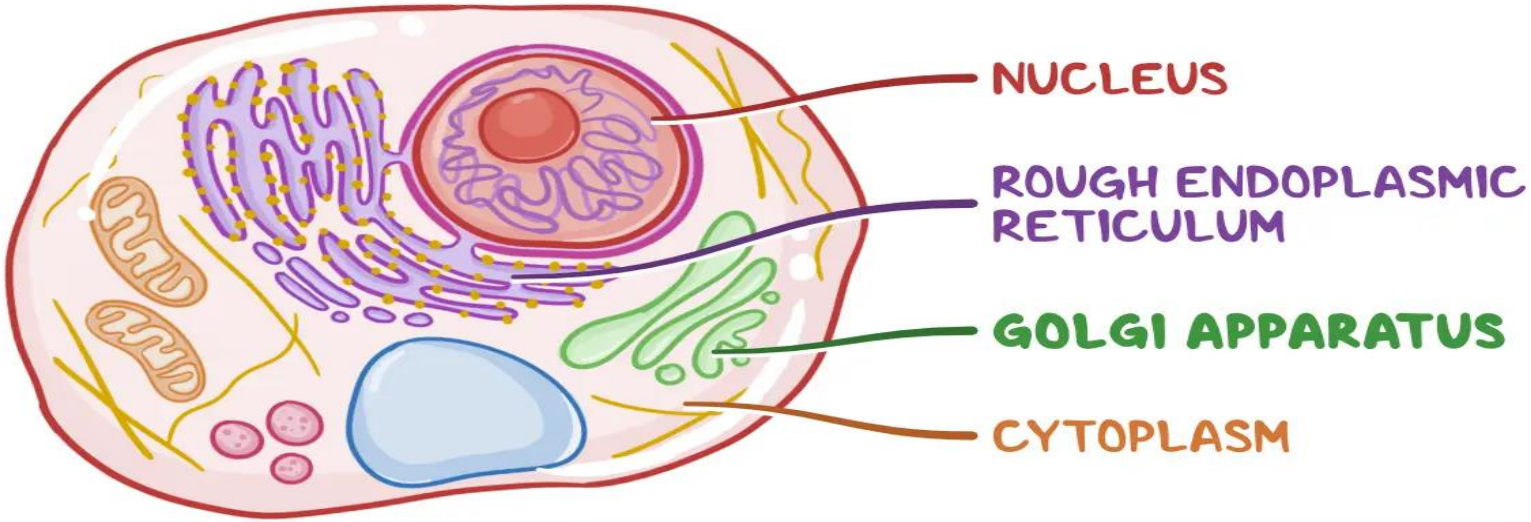
Modifies proteins from the rough endoplasmic reticulum (RER).

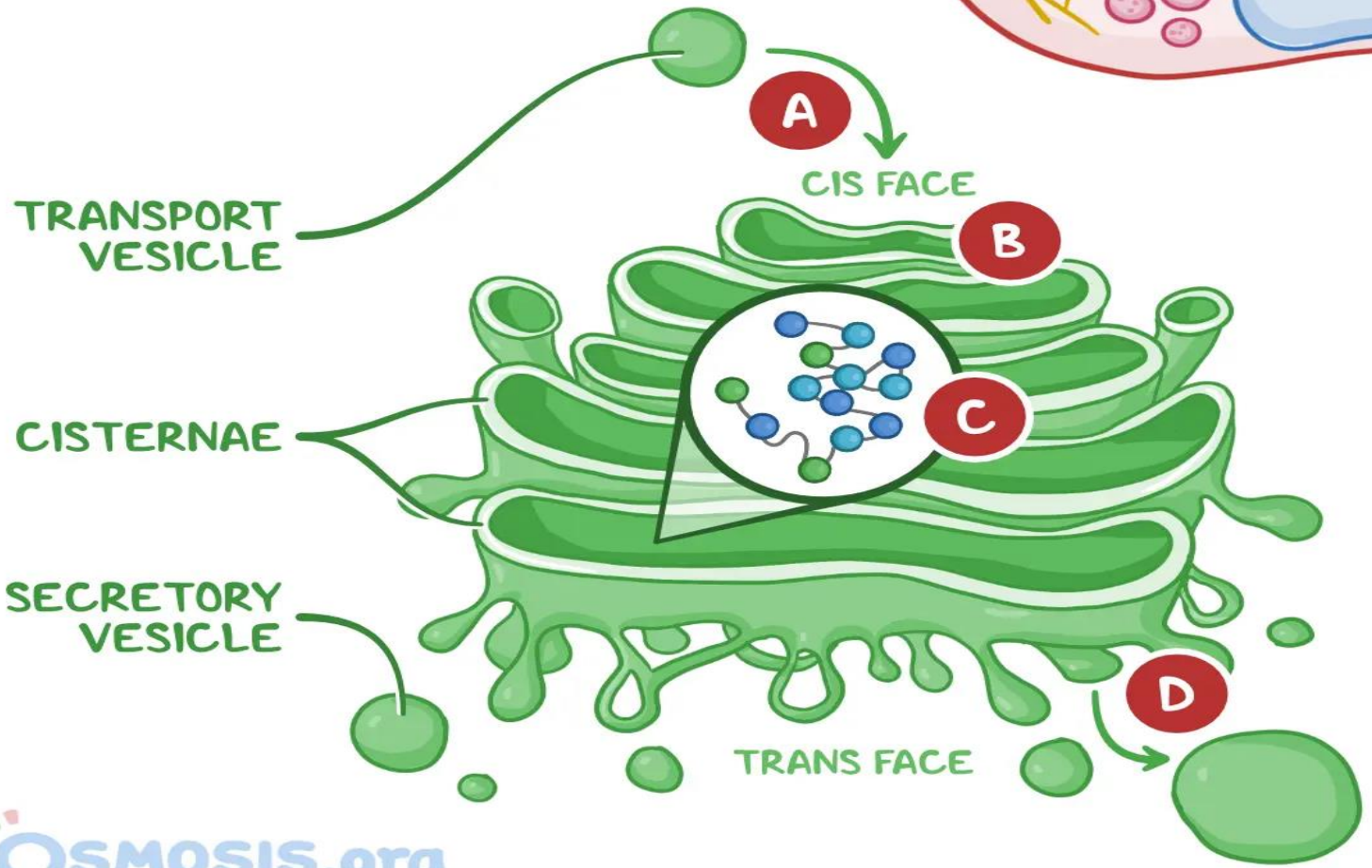
Synthesizes complex polysaccharides in plant cells.

Appears as black sheets or grains under a light microscope when stained with **osmium or silver**.

BACKGROUND

* TYPE of ORGANELLE in EUKARYOTIC CELLS
* PROCESSES & PACKAGES PROTEINS & LIPID MOLECULES
  ~ aka GOLGI BODY or COMPLEX





FUNCTION

- **A** TRANSPORT VESICLES BRING MOLECULES from ROUGH ENDOPLASMIC RETICULUM
- **B** MOLECULES FUSE with MEMBRANE & are SORTED BASED on DESTINATION
- **C** MOLECULES UNDERGO REMODELING & MODIFICATIONS in CISTERNAE
- **D** MODIFIED MOLECULES are SECRETED OUT of CELL or to ANOTHER ORGANELLE

3. Structure:

Composed of stacks of flattened sacs called cisternae, typically 3 to 20 per stack.

Contains specific enzymes for molecule modification.

4. Process:

Transport vesicles deliver molecules from the RER to the **cis face** (entry side).

Molecules are sorted, remodeled, and processed in the cisternae.

Finished molecules exit via the **trans face** (exit side) for secretion or further transport.

5. Key Roles:

Central in cellular trafficking and modification.

Essential for complex polysaccharide synthesis in plants.

Cellular trafficking is the movement of molecules within a cell to specific locations, ensuring proper cellular function and organization.

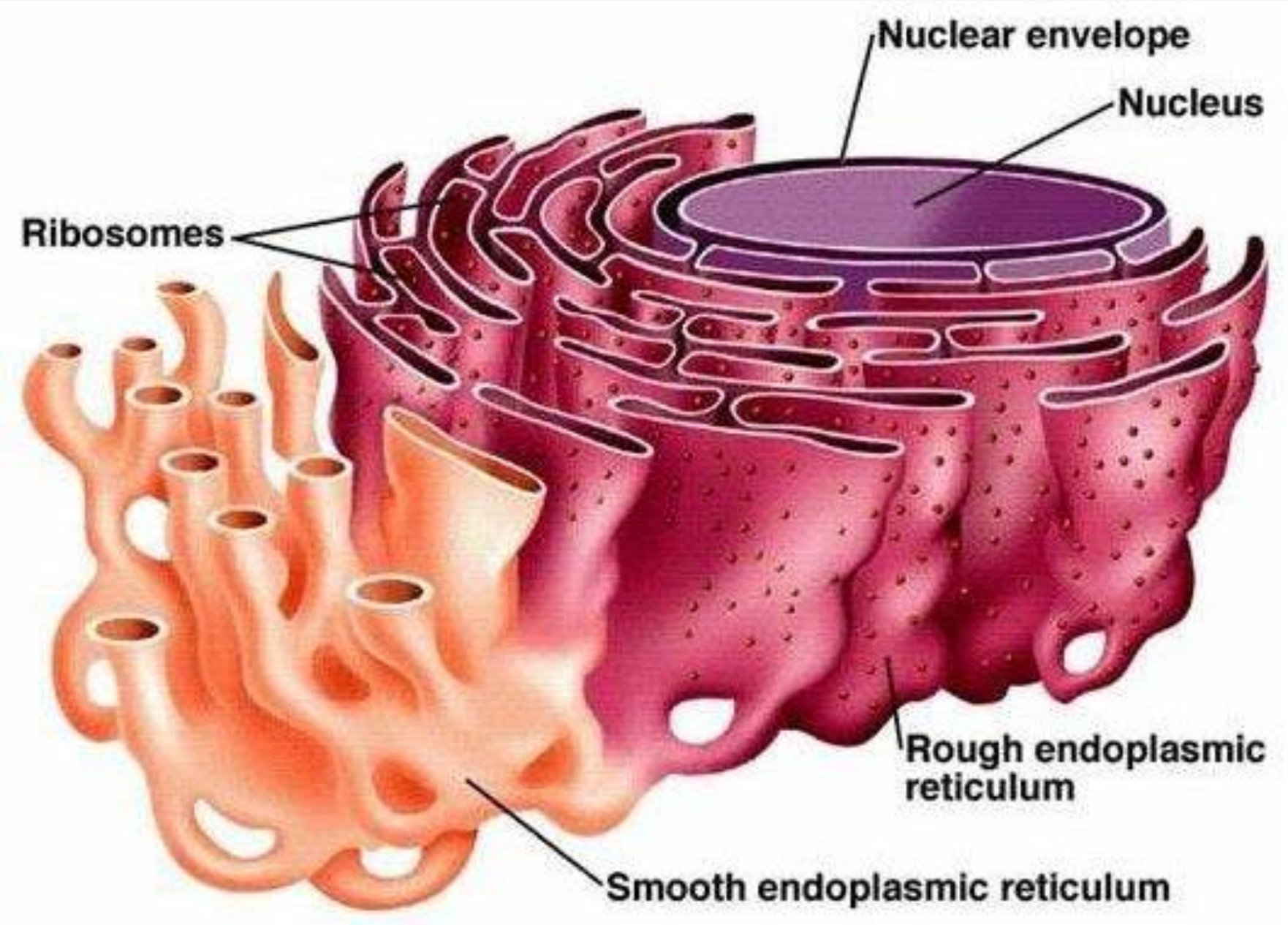
Rough Endoplasmic Reticulum (RER)

Structure: Studded with ribosomes, giving it a rough appearance.

Function: Synthesizes and processes proteins destined for secretion, membranes, or specific organelles.

Location: Found near the nucleus, connected to the nuclear envelope.

Specialization: Abundant in cells with high protein synthesis activity, such


Nuclear envelope
Nucleus
Ribosomes
Rough endoplasmic reticulum
Smooth endoplasmic reticulum

Smooth Endoplasmic Reticulum (SER)

Structure: Lacks ribosomes, giving it a smooth appearance.

Function: Synthesizes lipids, metabolizes carbohydrates, and detoxifies drugs and toxins.

Role in Cells: Stores calcium ions in muscle cells and aids in steroid hormone production in endocrine cells.

Location: Often extends from the rough endoplasmic reticulum.


Thanks for your attention

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Lab.6

Plastids

29.12.2024

Overview of Types, Structures, and Functions

Cell Biology

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Introduction to Plastids

Plastids are essential organelles in plants and algae.

Double membrane structure.

Roles:

1. Manufacture and storage of food.

2. Photosynthesis, amino acid synthesis, lipid storage.

Types of Plastids

1. **Proplastids**:

   Undifferentiated, derived from meristem cells.

2. **Differentiated Plastids**:

3. 1. Chloroplasts

4. 2. Chromoplasts

5. 3. Leucoplasts

Chloroplasts

Location:

Mesophyll cells of leaves (well-developed); epidermal cells (less developed).

Structure:

Oval shape, double membrane, stroma.

Components: Grana, peripheral reticulum, DNA, ribosomes.

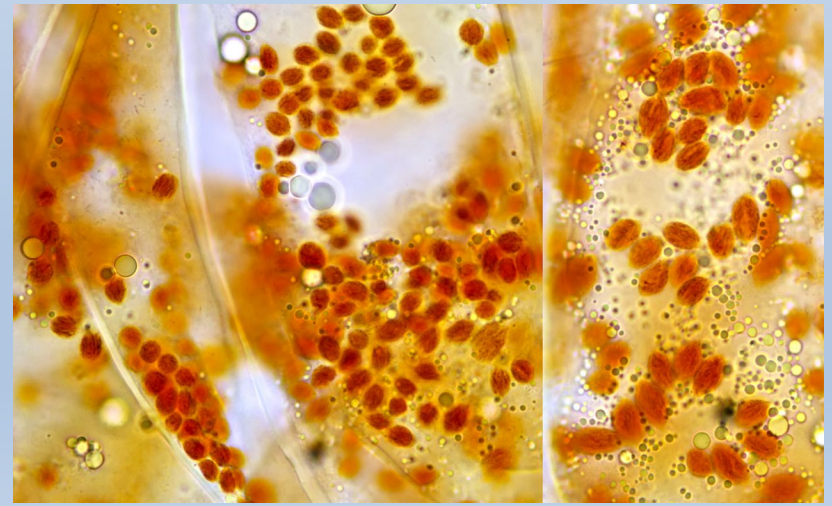
Function:

Photosynthesis (converts light to chemical energy).

Chromoplasts

- Brightly colored plastids.
- Found in flowers, fruits, and other pigmented parts of plants.
- Contain carotenoids that attract pollinators.
- **Role:**

Visual attractors for pollination.

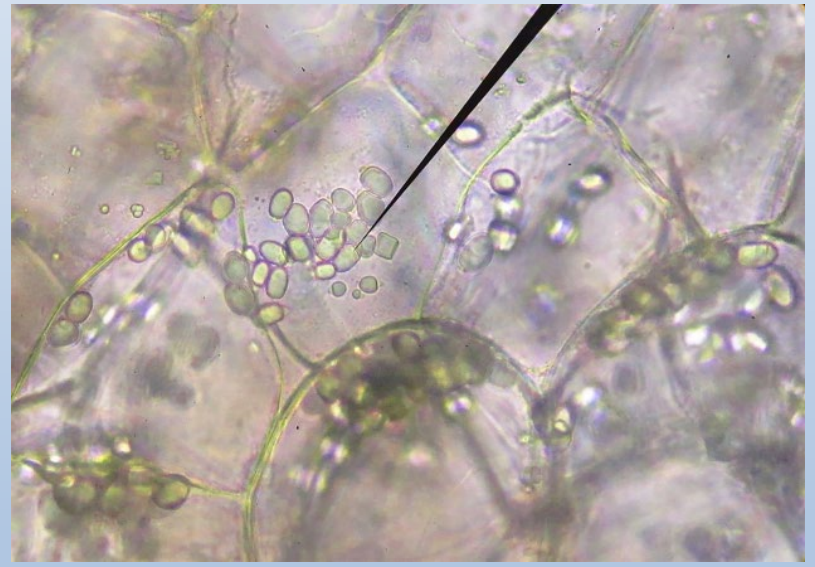


Leucoplasts

Colorless plastids found in roots, tubers, and stems.

Functions:

1. Starch storage (e.g., amyloplasts).
2. Lipid storage (e.g., elaioplasts).
3. Protein storage (e.g., proteinoplasts).



Found in deeper tissues, not exposed to light.

Unique Features of Chloroplasts

- Shape Variations:
- Spiral (Spirogyra), spherical, star-shaped (Zygnema).
- Collar-shaped (Ulothrix), cup-shaped (Chlamydomonas).

Summary

- Plastids play vital roles in plant metabolism and development.
- Types include chloroplasts, chromoplasts, and leucoplasts.
- Functions range from photosynthesis to nutrient storage and pigment accumulation.

Practical Part

- Make a slide from the green plant leaves to see the chloroplast
- Make a slide from the colored flower petals to see the chromoplast
- Draw both images in your notebook


Thanks for your attention

Education Faculty Grade 1 2024-2025 Practical

Cell Biology

Lab.7 Mitochondria

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Outlines

- Introduction mitochondria
- Structure
- Staining
- Observation under microscopic and shapes

Learning outcome:

- At the end of this class you will be able to:
- 1- understand the structure, function and the shape of mitochondria.
- 2- Identify the shape of mitochondria under microscope.

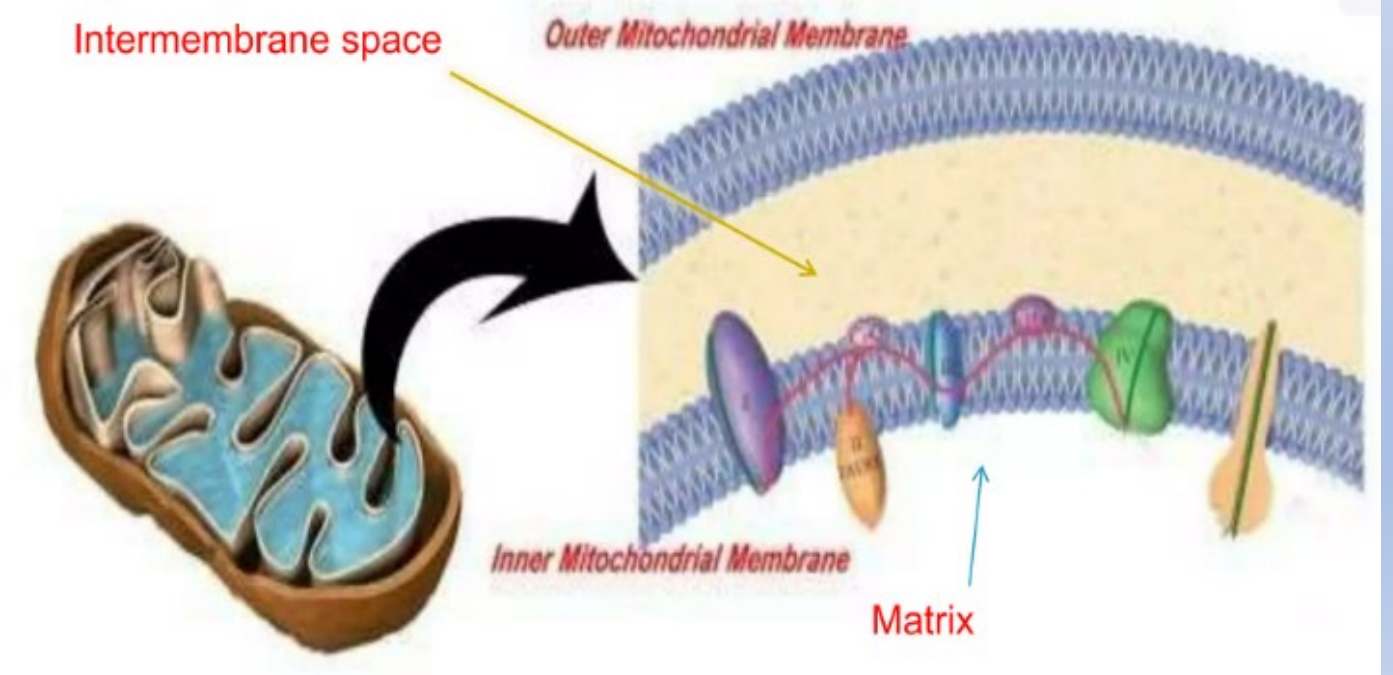
Introduction

- The mitochondrion (plural mitochondria) (Greek)
- It is a **double membrane** bound **organelle** found **eukaryotic cell**.
- the primary function of which is to **generate large quantities of energy in the form of adenosine triphosphate (ATP).** Mitochondria are typically round to oval in shape and range in size from 0.5 to 10 µm.
- Mitochondria are unlike other cellular organelles in that they have two distinct membranes and a **unique genome (mit.DNA)** and **reproduce** by **binary fission**;

Structure

- The structure comprises an **outer membrane**, an **inner membrane**, and a gel-like material called the **matrix**. The outer membrane and the inner membrane are made of proteins and phospholipid layers separated by the **intermembrane space**.

- Outer Membrane
- Intermembrane space
- Inner Membrane
- Cristea
- Matrix



Cristea

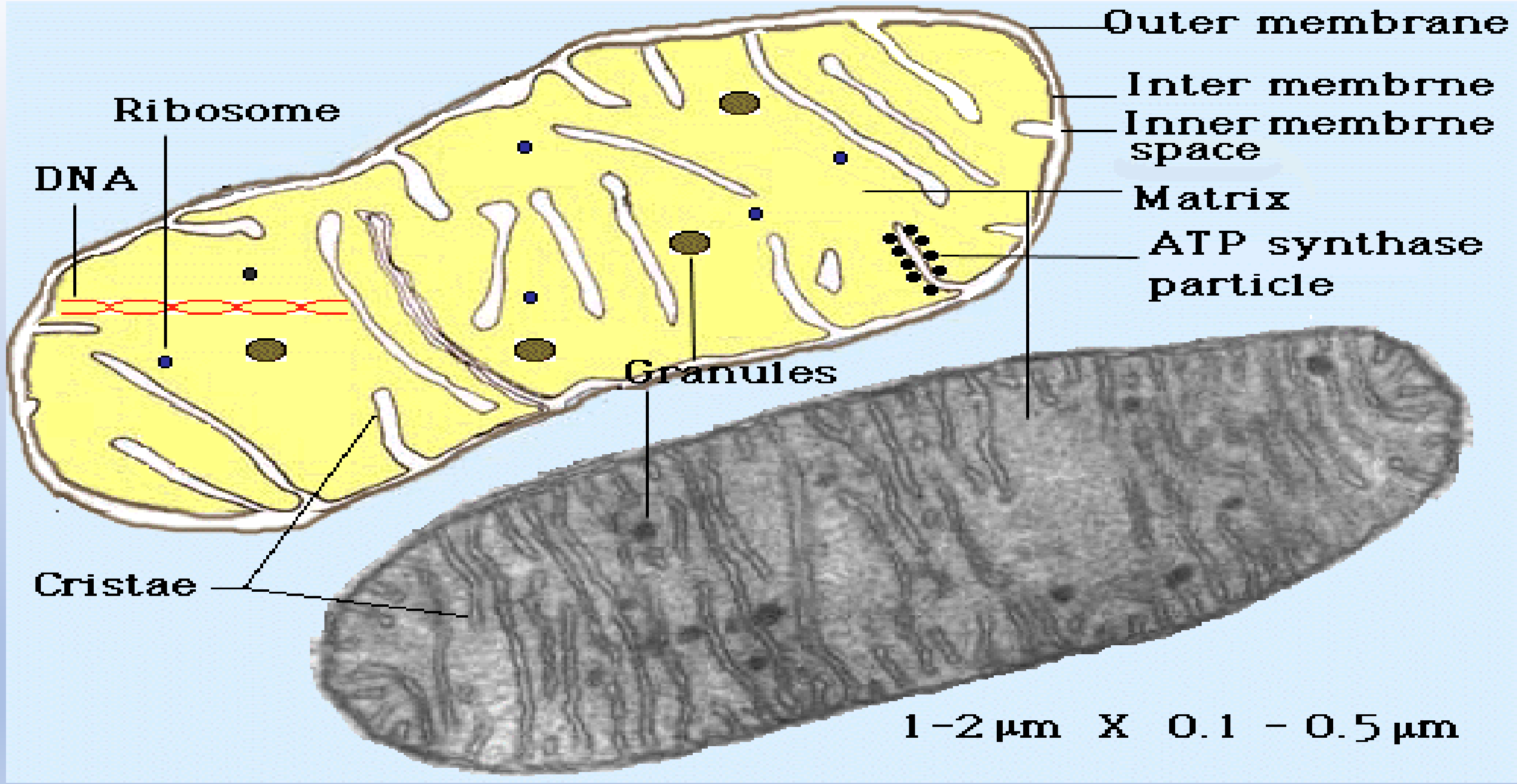
- In the inner membrane of mitochondria.
- Helps in increasing the surface area inside the organelle. The cristae and the proteins of the inner membrane aid in the production of ATP molecules and aerobic cellular respiration.

Mitochondrial matrix

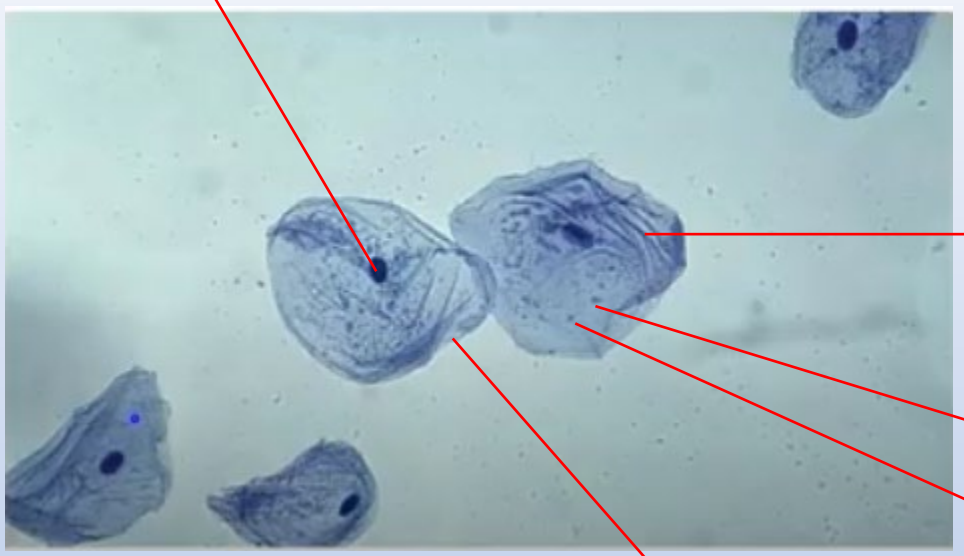
- Is a viscous fluid that contains a mixture of enzymes and proteins.
- The enzymes present in the matrix play an important role in the synthesis of ATP molecules.

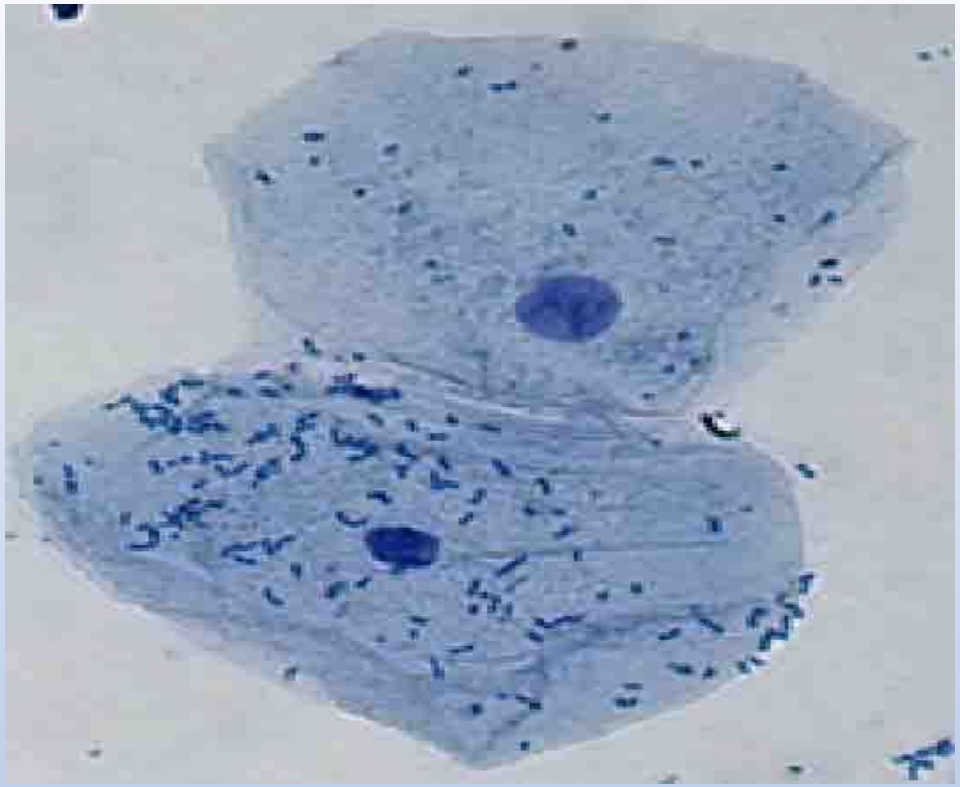
Janus Green B: is a basic dye and vital stain used in histology. It is also used to stain mitochondria.

It can be seen under a light microscope in living cells, after staining them with ***Janus green dye and tetrazolium salts**, and then mitochondria appear as **bright granules tending to a greenish-blue color,** and after a few minutes their color changes to red and then disappears.

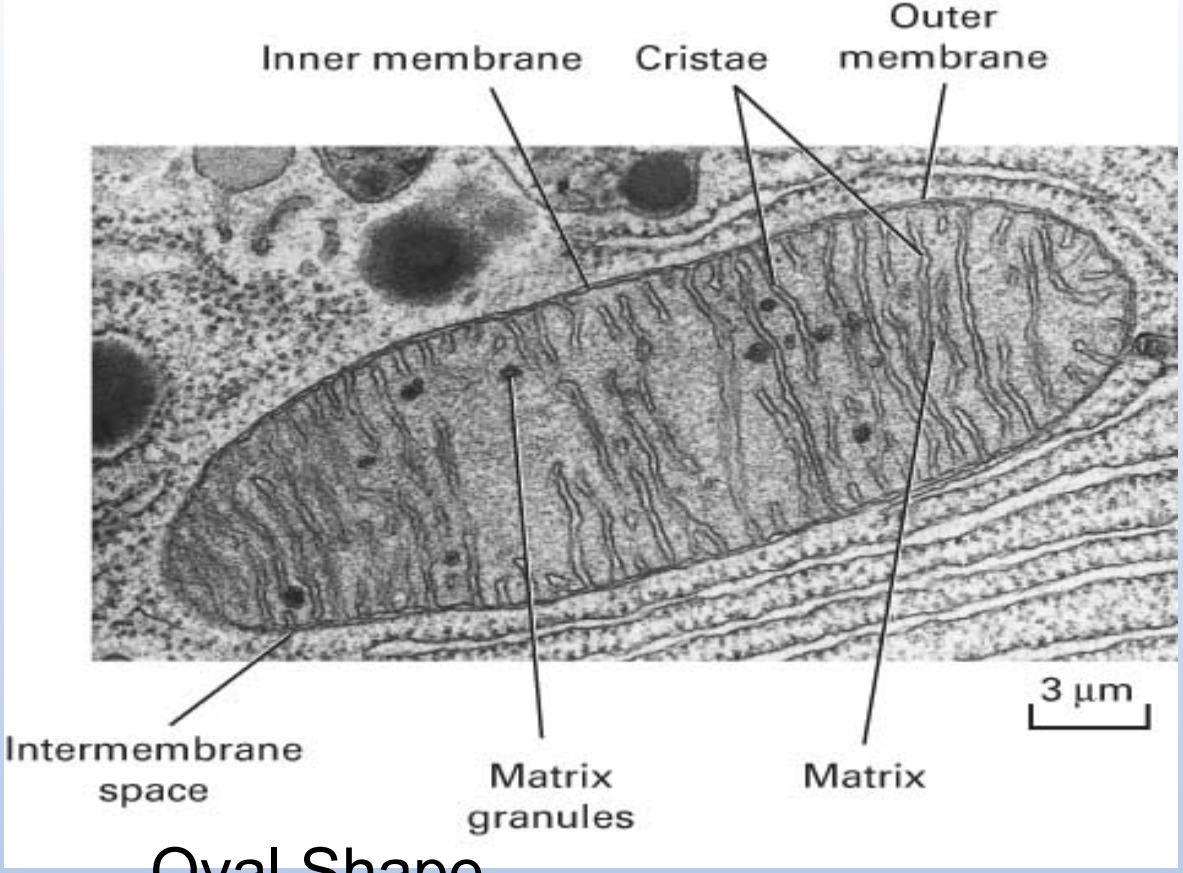


Mitochondria structure

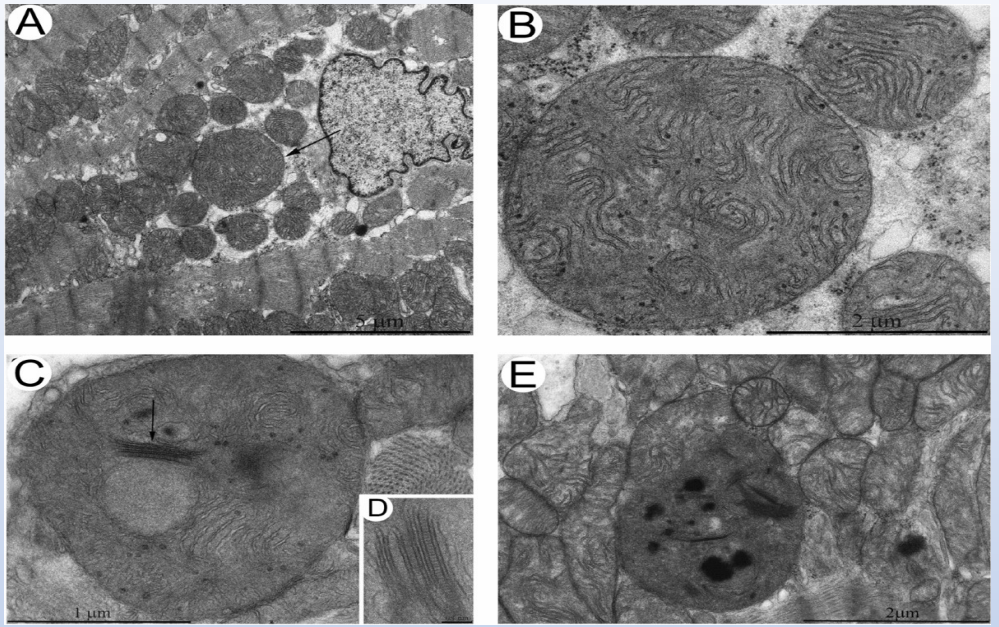




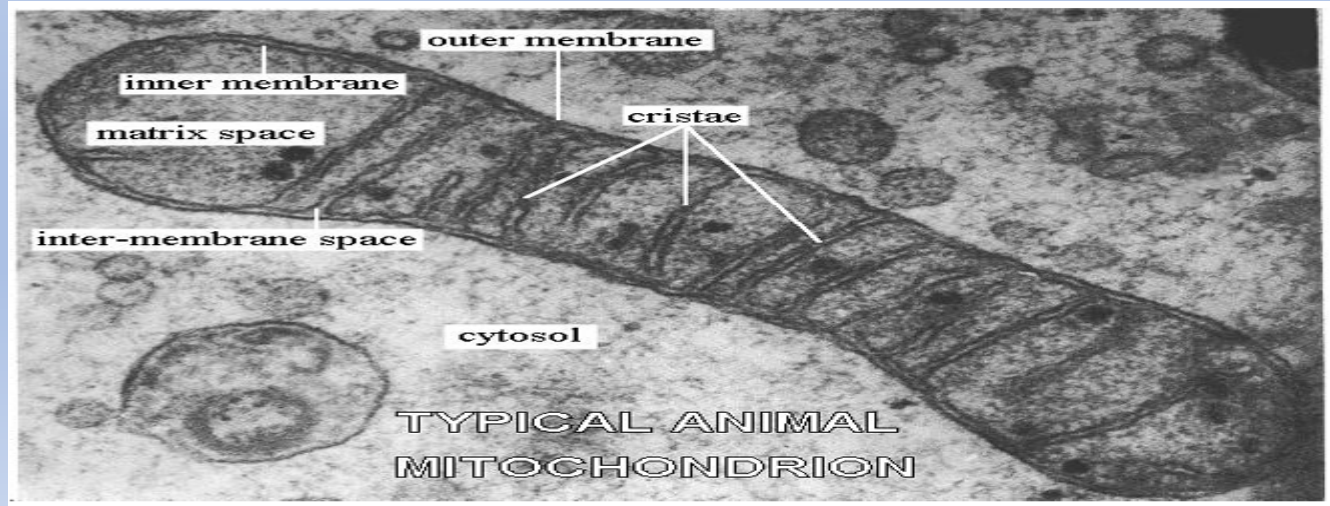
Mitochondria under light microscope



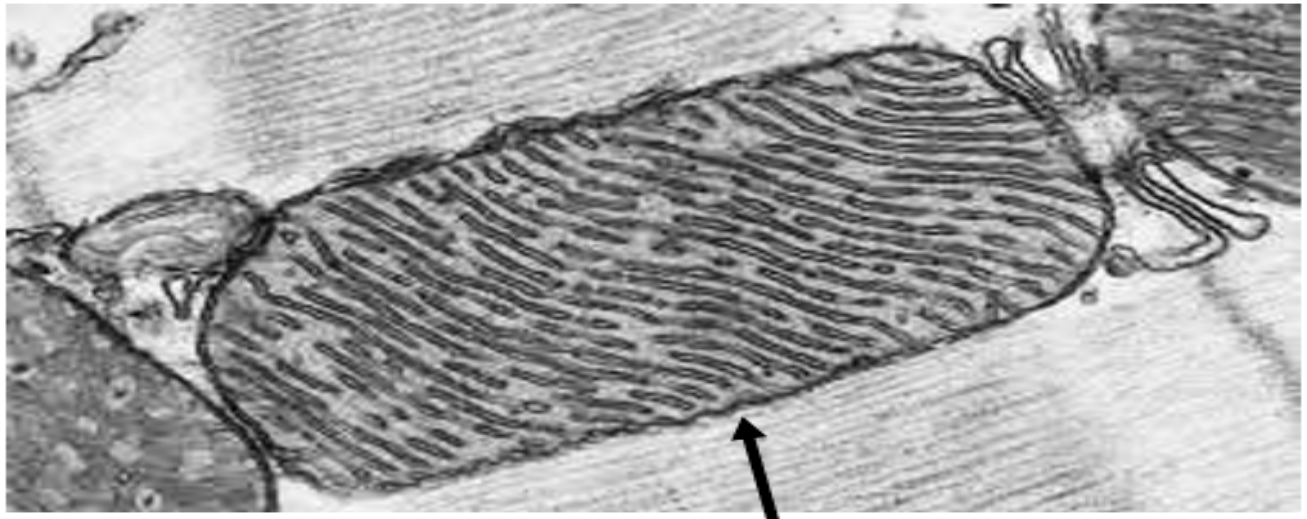
Oval Shape



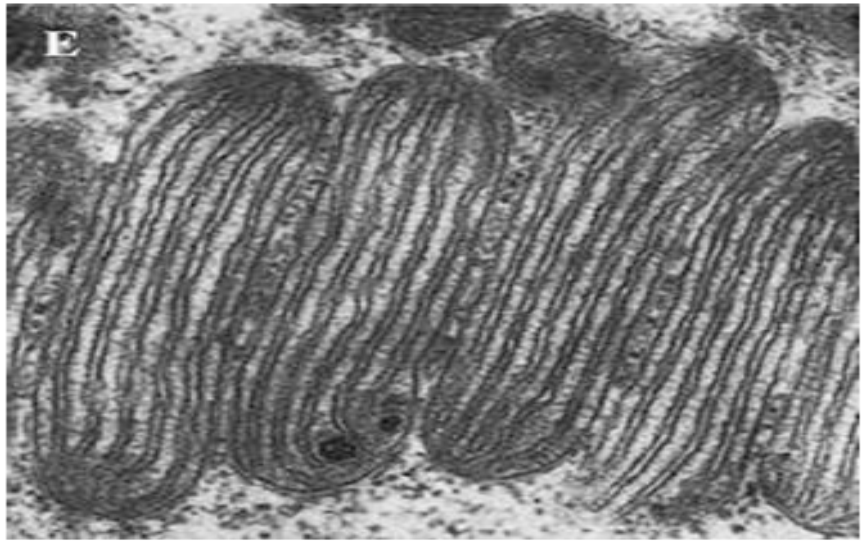
Spherical Shape



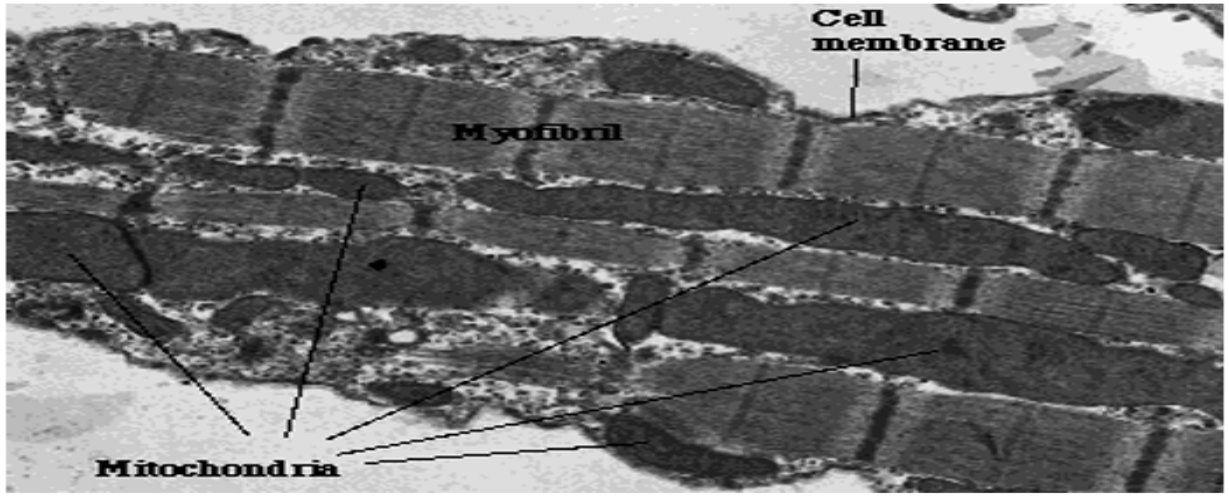
Elongated shape



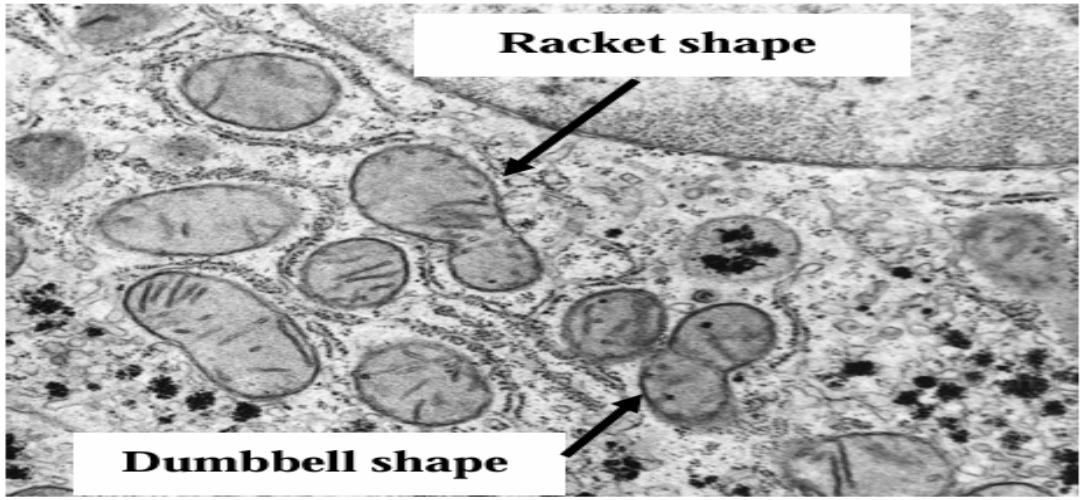
Cylindrical shape



Elongated shape



Uniform distribution of mitochondria



Random distribution of mitochondria

Education Faculty Grade 1 2024-2025 Practical

Cell Biology

Lab.8
Paraplasm

By
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Outlines

1- Paraplasm and Protoplasm

2- Secondary granules

3- Lipid droplets

4-Cytoplasmic pigments

5- Crystals

6-Glycogen and Starch granules

Learning outcomes:
At the end of this class the student will be able to:

1- understand the structure of paraplasm.

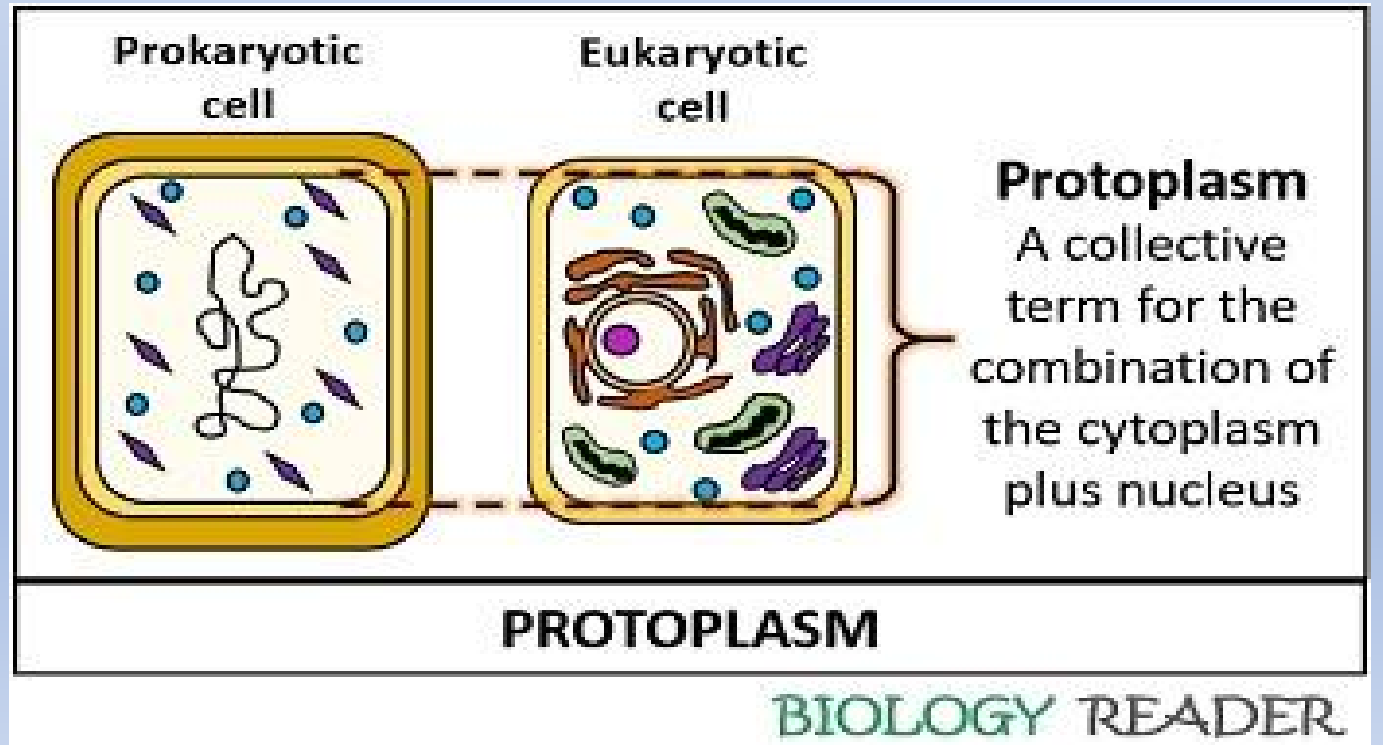
2- Identify and describe the function and structure of Secondary granules, Lipid droplets, Cytoplasmic pigments, Crystals and Glycogen and Starch granules.

Paraplasm

The non-vital contents of living protoplasm, such as yolk-granules, oil-drops, etc.

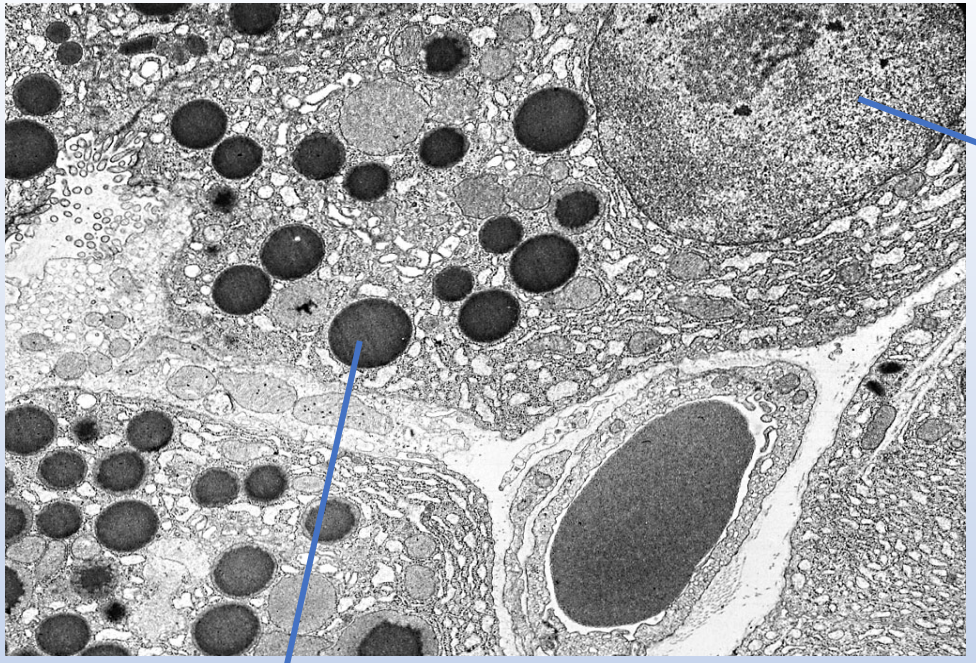
Protoplasm:

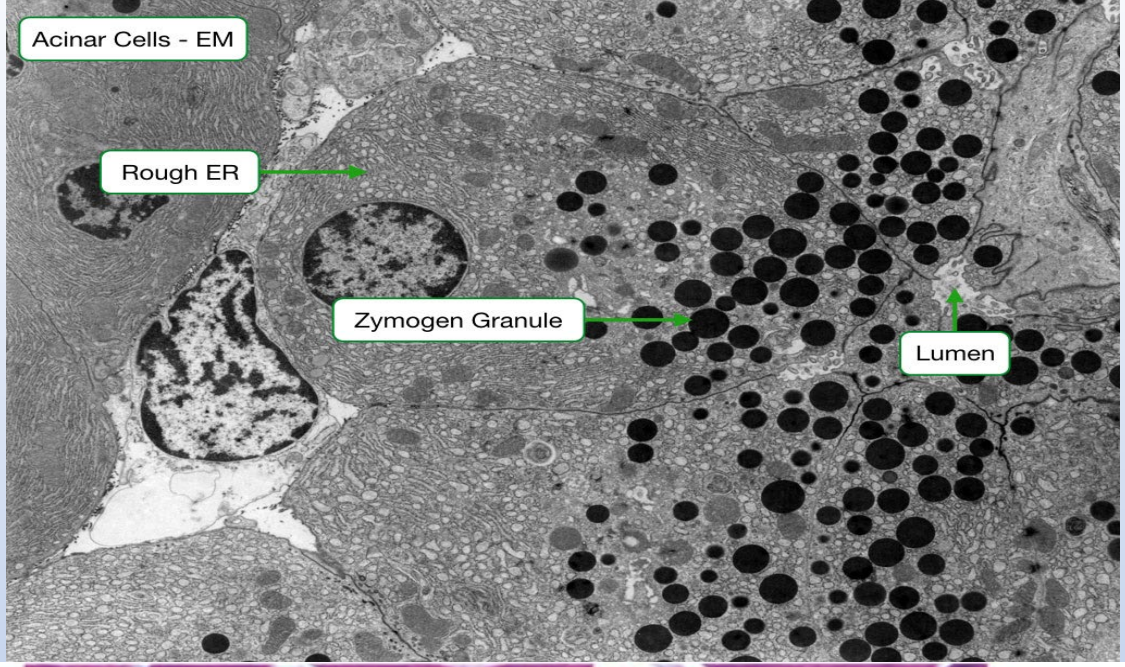
The colourless material comprising the living part of a cell, including the cytoplasm, nucleus, and other organelles.

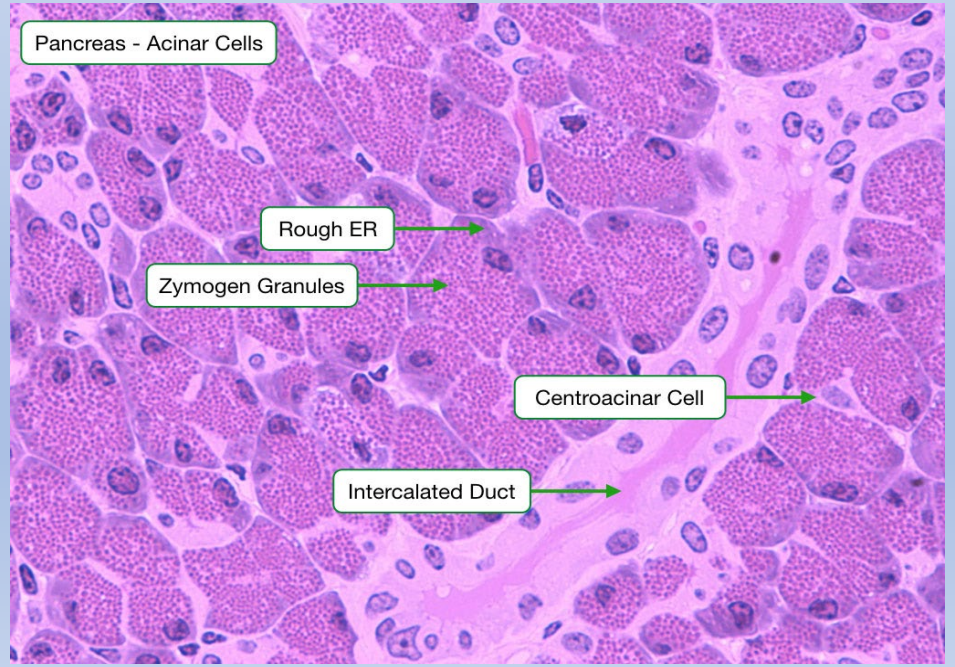


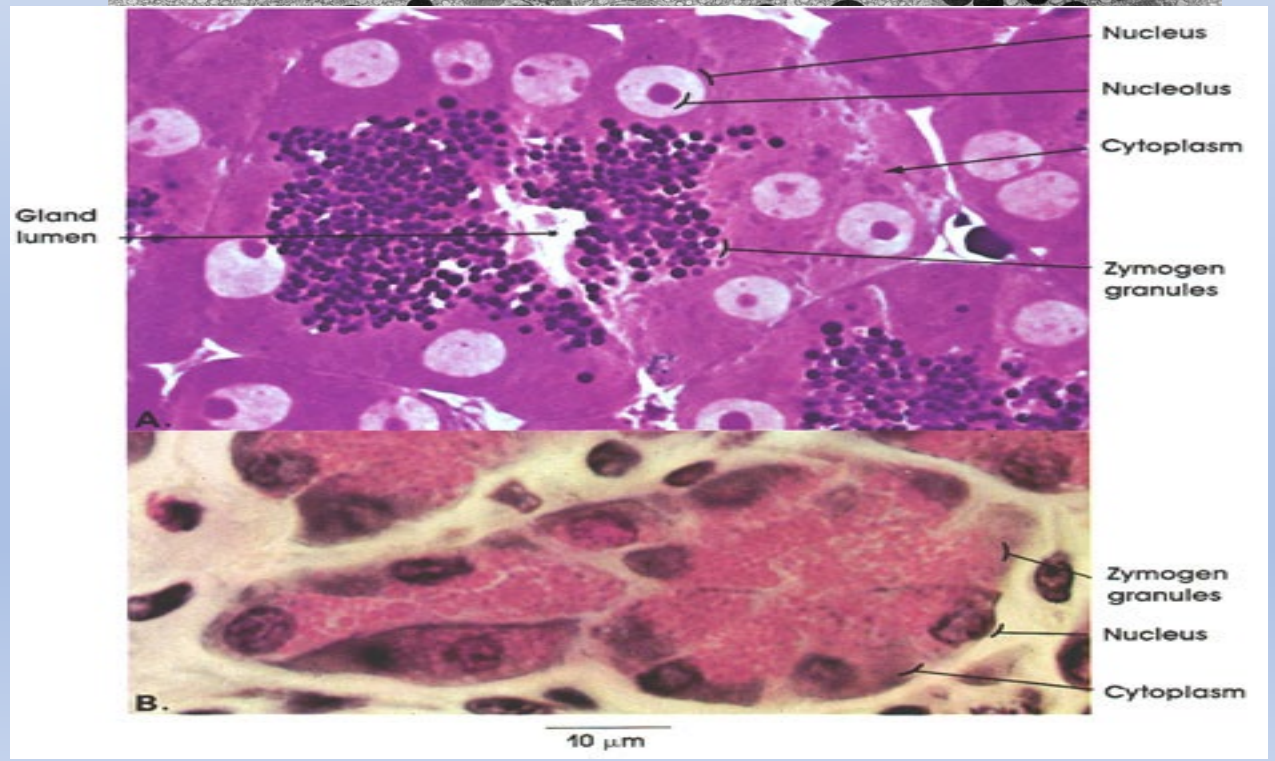
1- Secretory granules

are special structures inside cells that store certain substances for secretion.
function as storage compartments for secretory products and are the main organelles involved in regulated secretion.
Secretory granules are a key feature of **storage cells**, such as **neurosecretory**, **glandular**, and **epithelial cells**. Examples include **zymogen granules**, which store substances like **tears, acids, digestive enzymes, mucus, milk, and proteins for secretion.**


Nucleus
Secretory granules

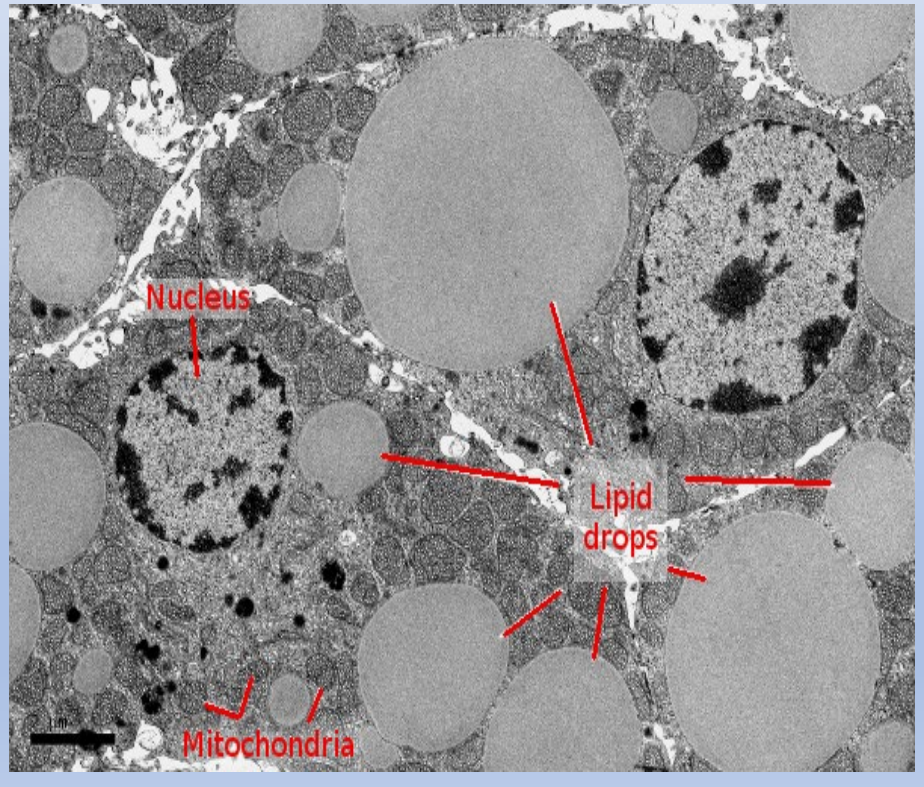

Acinar Cells - EM
Rough ER
Zymogen Granule
Lumen

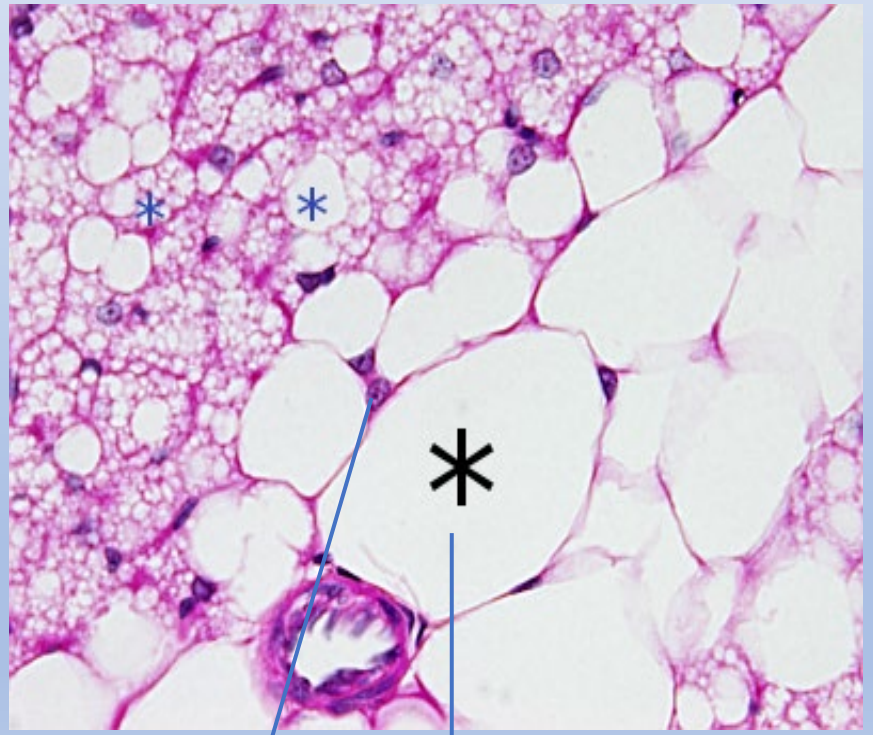

Pancreas - Acinar Cells
Rough ER
Zymogen Granules
Centroacinar Cell
Intercalated Duct

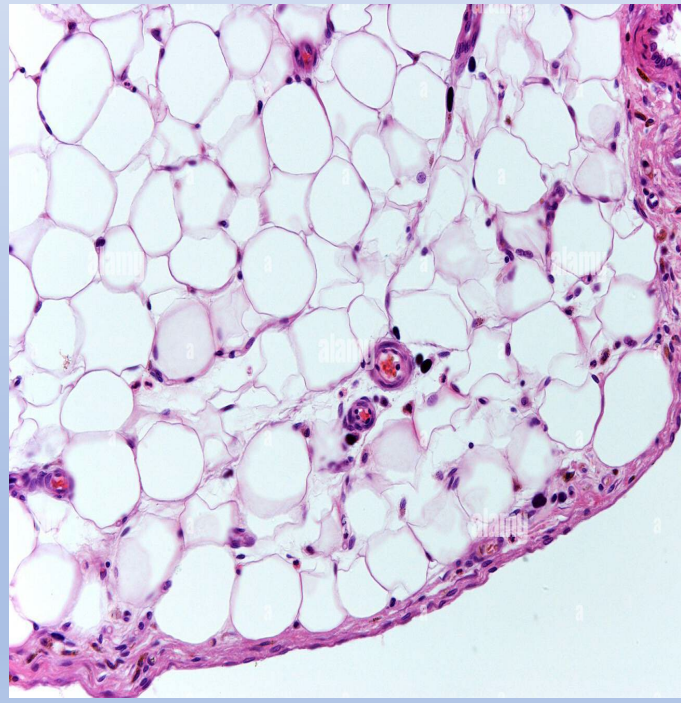

Nucleus
Nucleolus
Cytoplasm
Gland lumen
Zymogen granules
A.
B.
Zymogen granules
Nucleus
Cytoplasm
10 µm

2- Lipid droplets

are small fat stores, largest in adipose tissue, where they are used for **fat storage and production**. In other cells, they **provide energy or help make components like membranes and fatty secretions**.



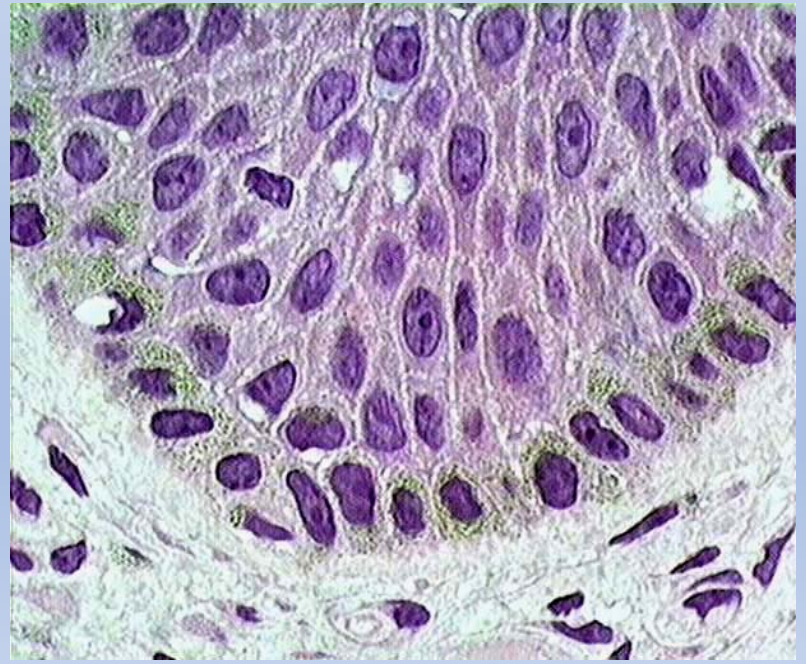


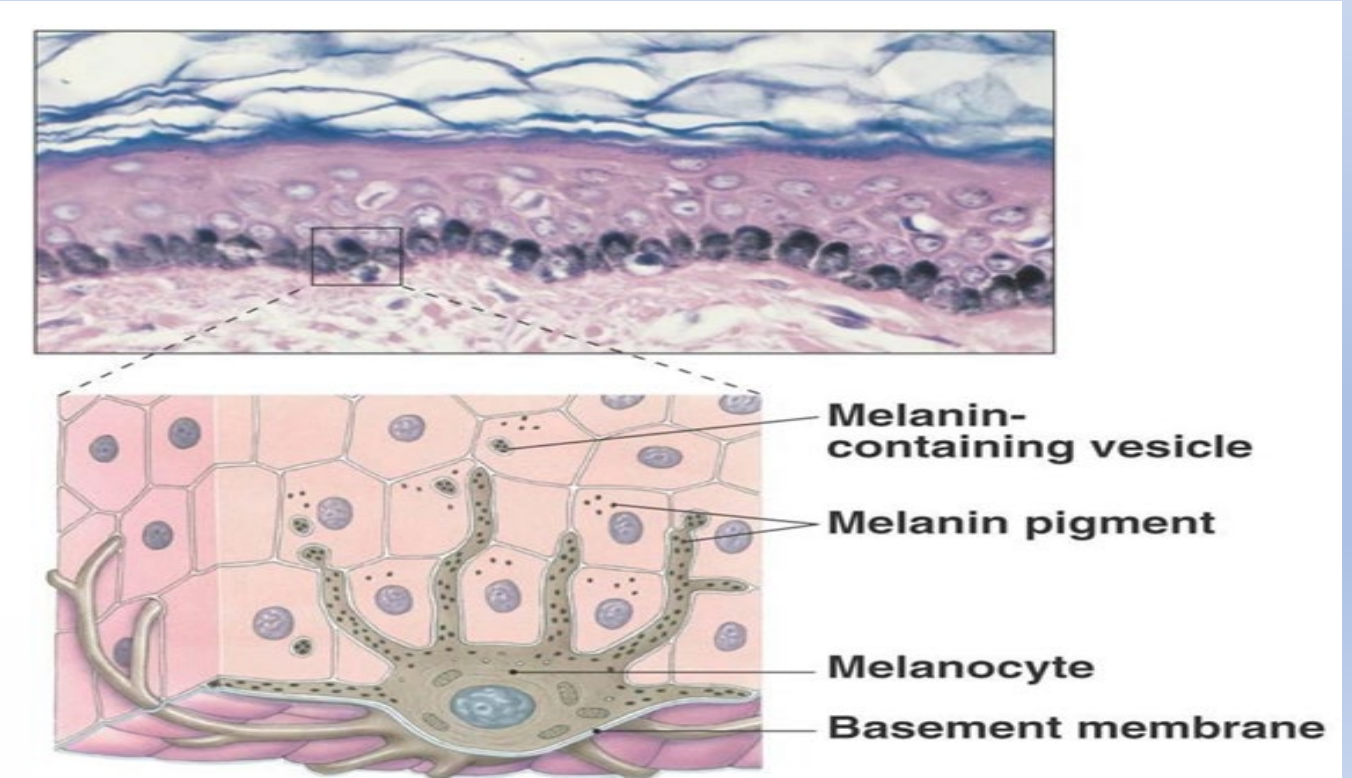


3- Cytoplasmic pigments:

Cytoplasmic pigments, or **chromatophores**, are color-producing cells found in animals like amphibians, fish, and reptiles. They contain pigments that determine skin and organ color. **Mammals and birds** use **melanocytes** for coloration, with **melanin** being the most common pigment.

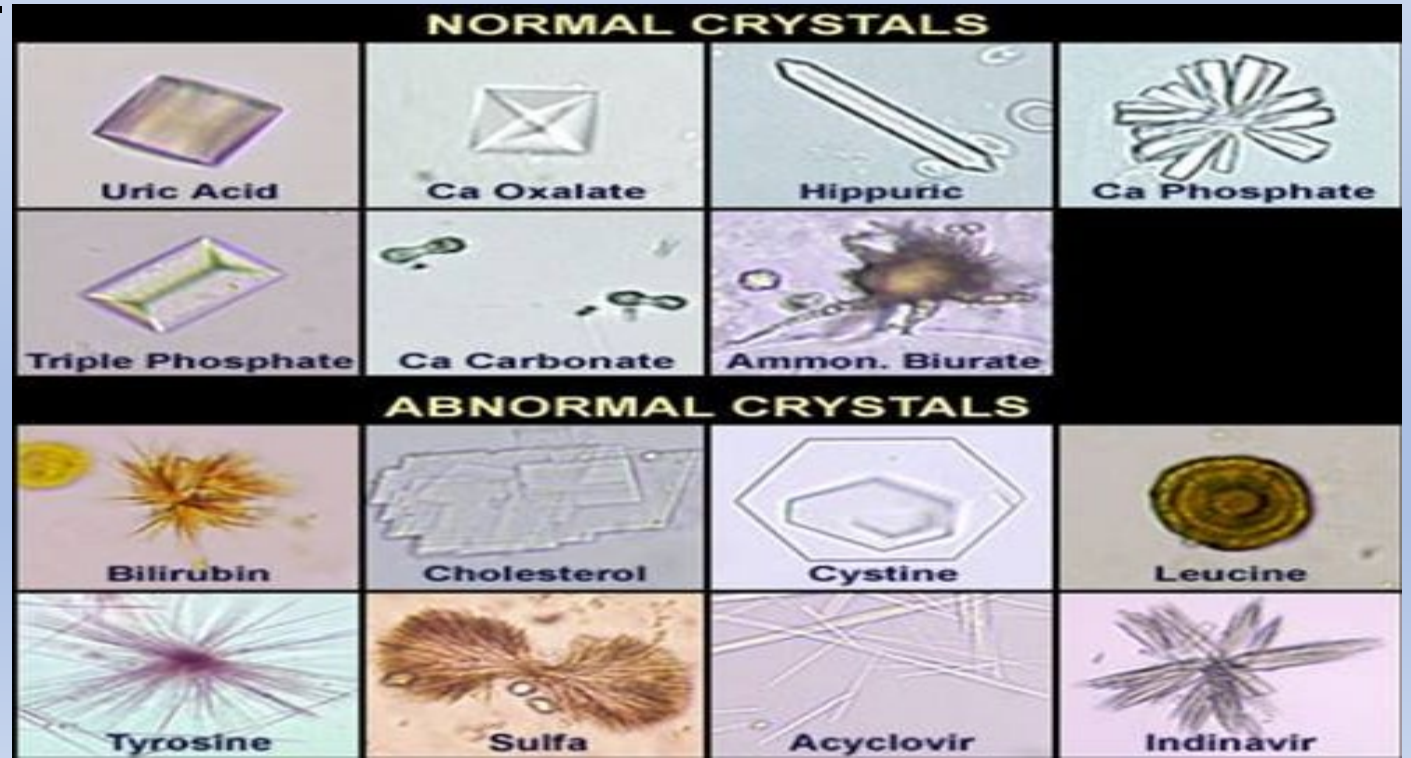
Pigments are natural coloring substances in plants and animals that alter the color of light through selective absorption, **such as chlorophyll, which gives plants their green color.**





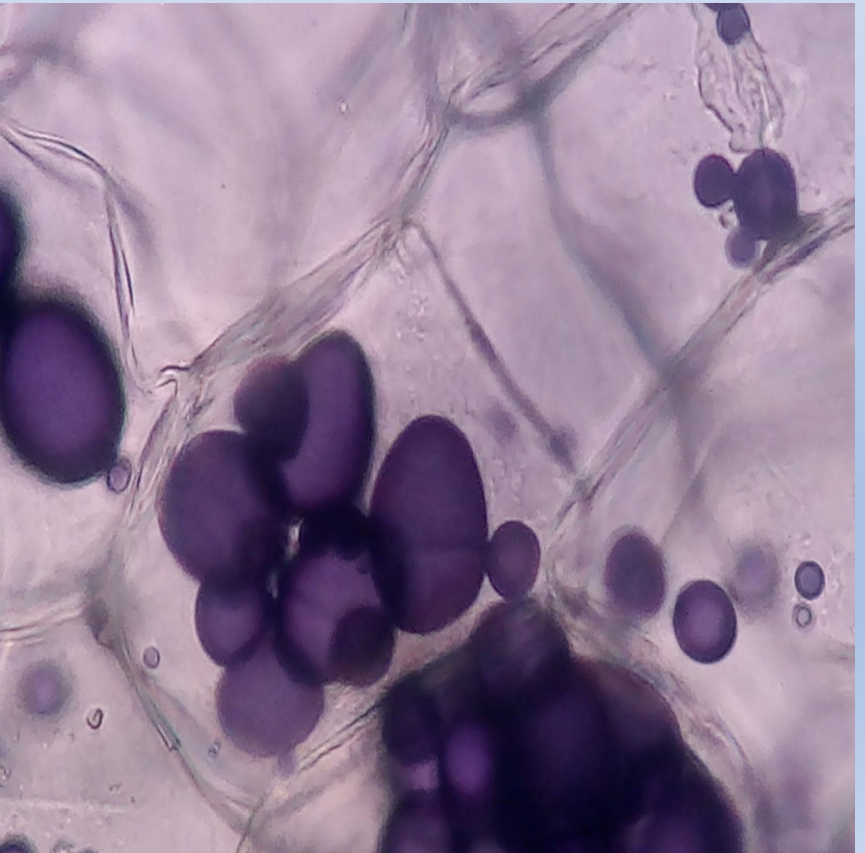
4- Crystals

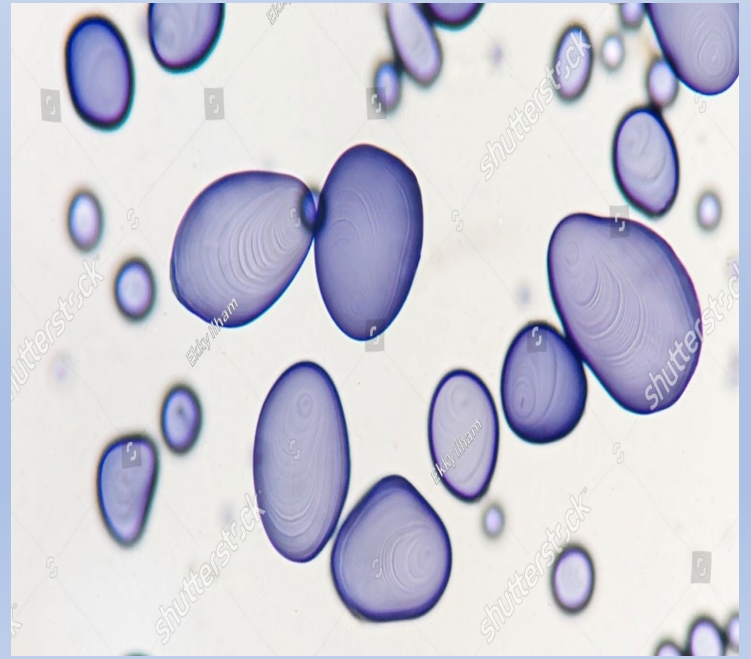
Crystals can form in some cells, usually made of **protein**, and **lack a membrane**. They have organized geometric shapes and vary in size, often around 5 microns long and 3 microns wide. Crystals can appear in different shapes, like **needles, rectangles, or irregular forms**, and are **found in the cytoplasm** or elsewhere in the cell. Their presence often indicates poor cell health, such as in red blood cells when hemoglobin crystallizes. The crystal's shape can help identify its material and the cell's condition.

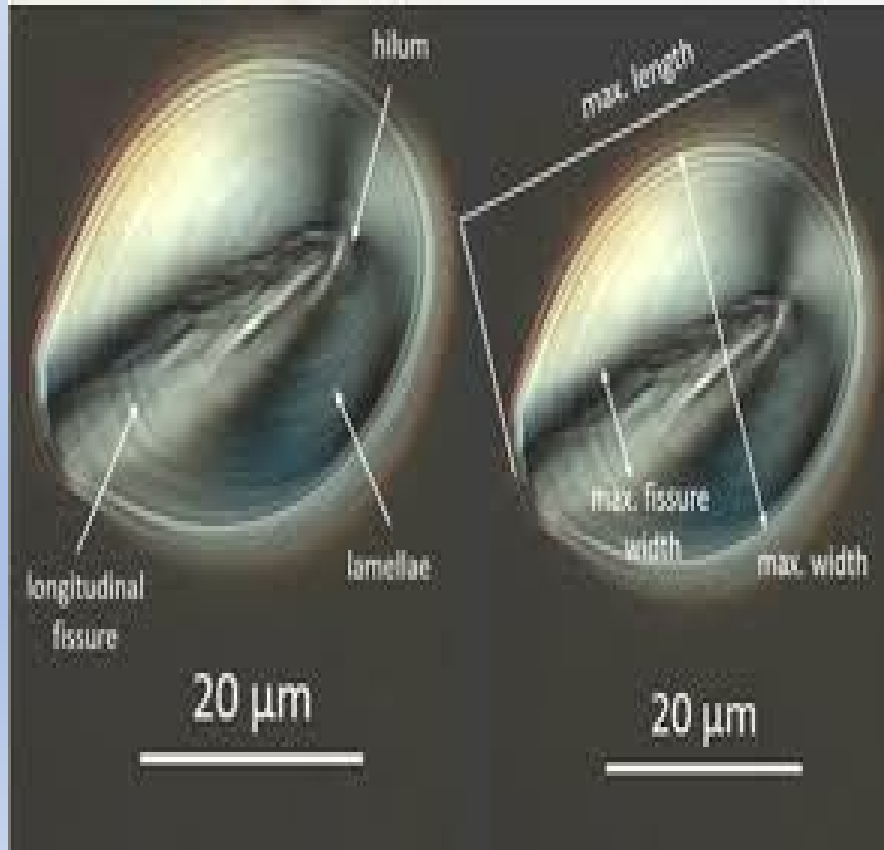


5- Glycogen and Starch granules

Glycogen, the **energy storage in animals**, is a highly branched and compact glucose polymer.
Starch, the **energy storage in plants**, consists of two glucose polymers: linear amylose and branched amylopectin. Both are white powders when dry.







Education
Faculty
Grade 1
2024-2025
Practical

Cell Biology

Lab.10
Chromosome Types and Cell Cycle

11.03.2025

By
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Learning outcomes:

At the end of the class the student will be able to:

1- understand the chromosome structure.

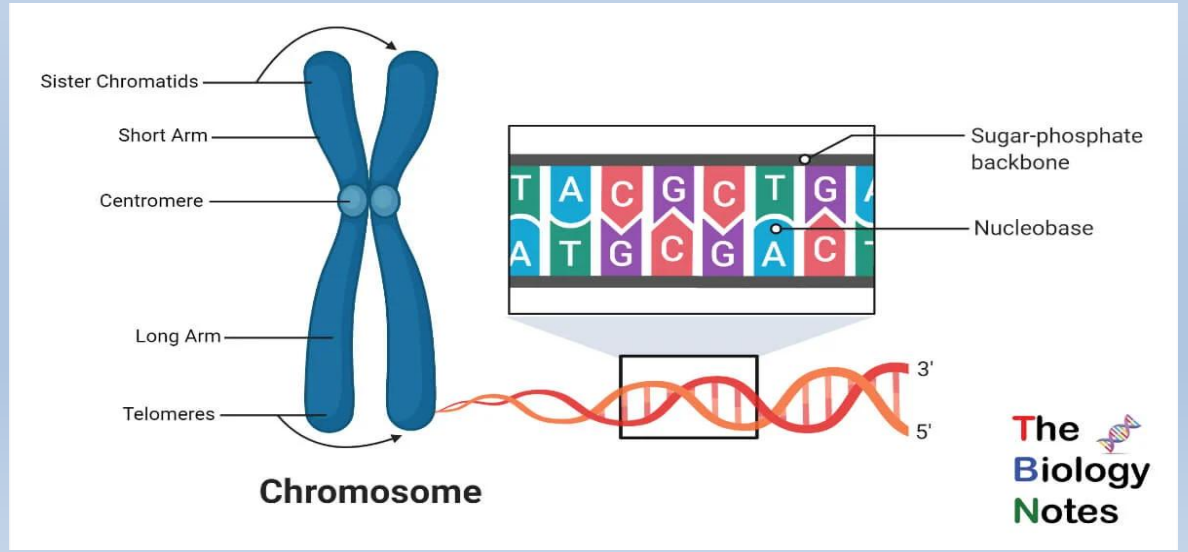
2- identify the different life cycle stages.

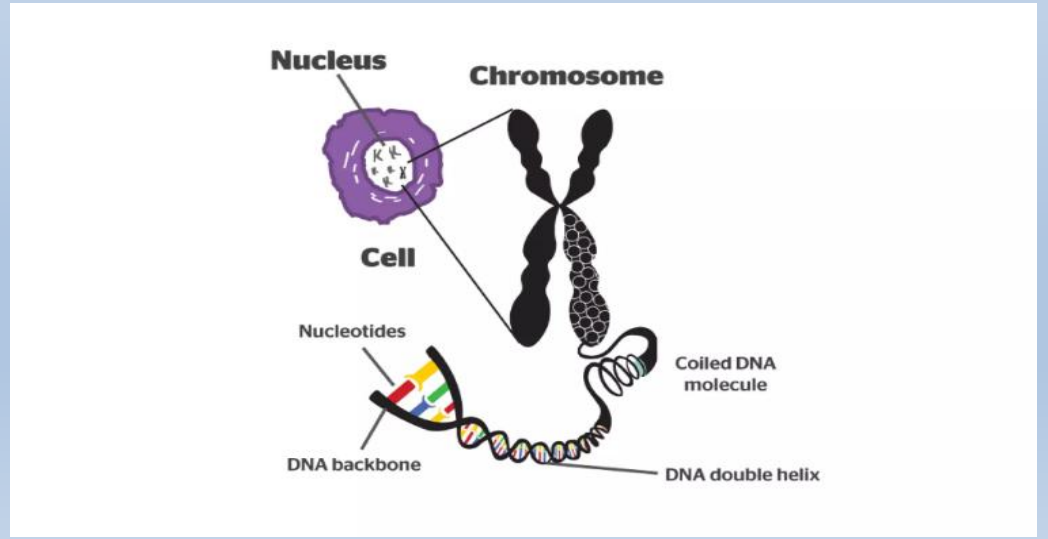
Outlines:

- Chromosome
- Feature of Eukaryotic Chromosome
- Number and shape of chromosomes
- Structural of Chromosomes
- Cell Cycle

Chromosomes

- The term initiated from **Chroma= colour, Some= body**
- The chromosome were first described by straubberg in 1875
- A threadlike structure of **nucleic acids** and **protein** found in the nucleus of most living cells, carrying genetic information in the form of genes.
- Each chromosomes is made up of DNA tightly coiled proteins called histone that support it structure.
- A **centromere** is a constricted region of a chromosome that separates it into a short arm (p) and a long arm (q).





Feature of Eukaryotic Chromosome

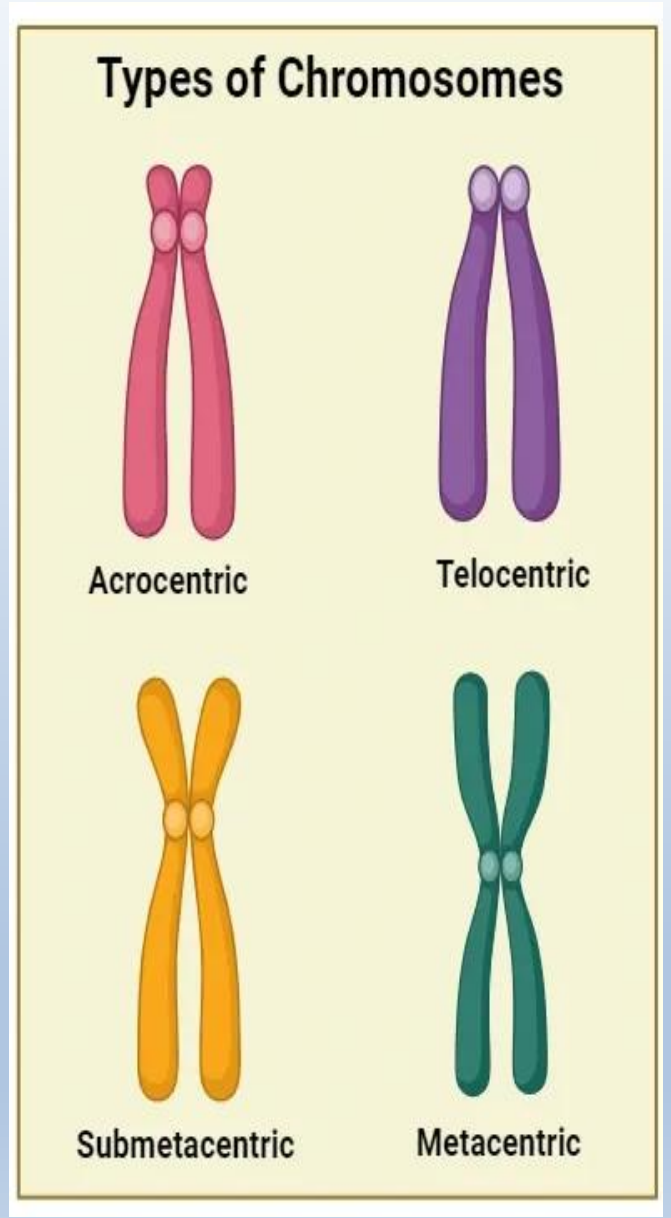
- Chromosome are best visible during metaphase
- Chromosome vary in shape, size, and number, in different species of plant and animals.
- Chromosomes have property of self duplication and mutation.
- Chromosomes are composed of DNA, RNA, and Protein.

Number and shape of chromosomes

- Human cells have **46** chromosomes (**23** identical pairs) (**44** Autosomes and **2** sex chromosomes).
- Dog **78**
- Horse **64**
- Chicken **78**

- Chromosomes generally exits in three different shapes, ***viz., rod shape, J shape, and V shape.***

Chromosome shape
Rood shaped Road like
Achro centric J shaped
L shaped Hook shaped
V shaped



Structural of Chromosomes

1. Centromere
2. Chromatid
3. Secondary construction and satellite
4. Telomere
5. Chromomere
6. Chromonema
7. Matrix

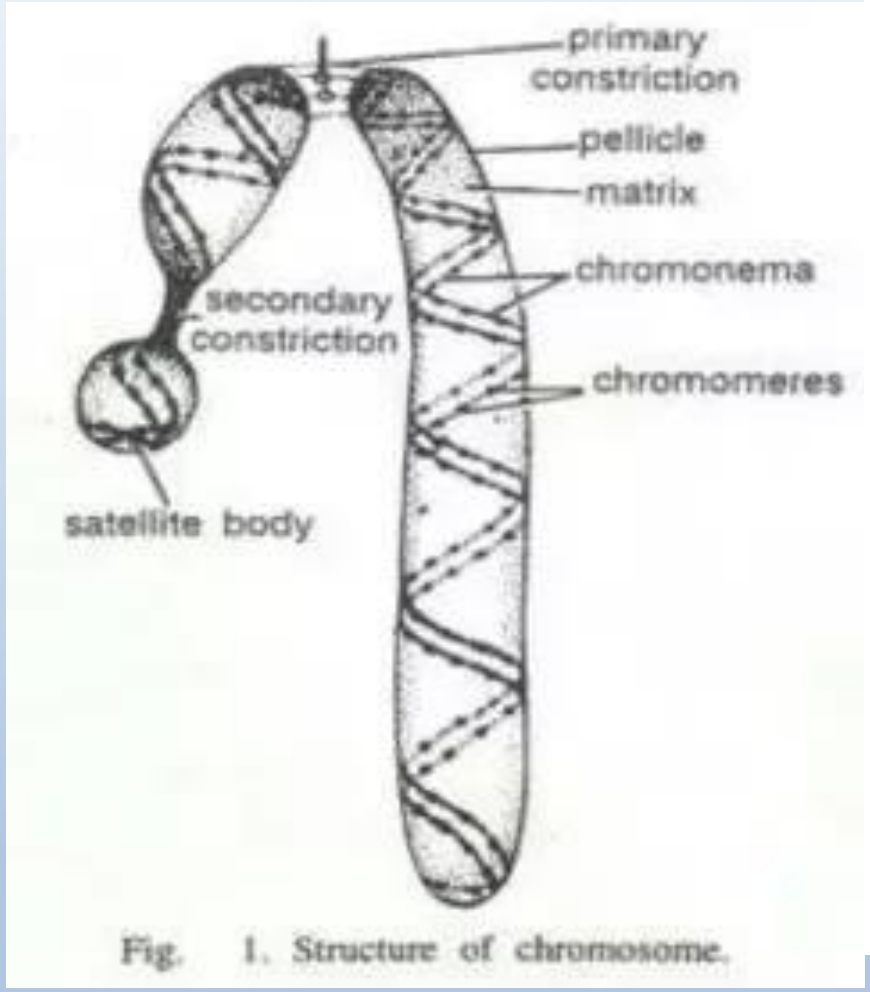
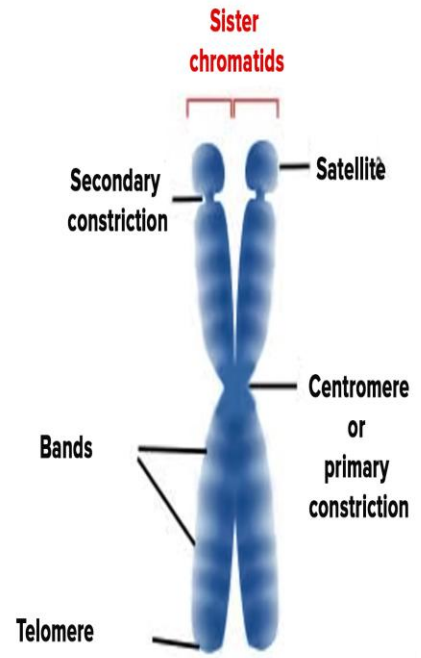
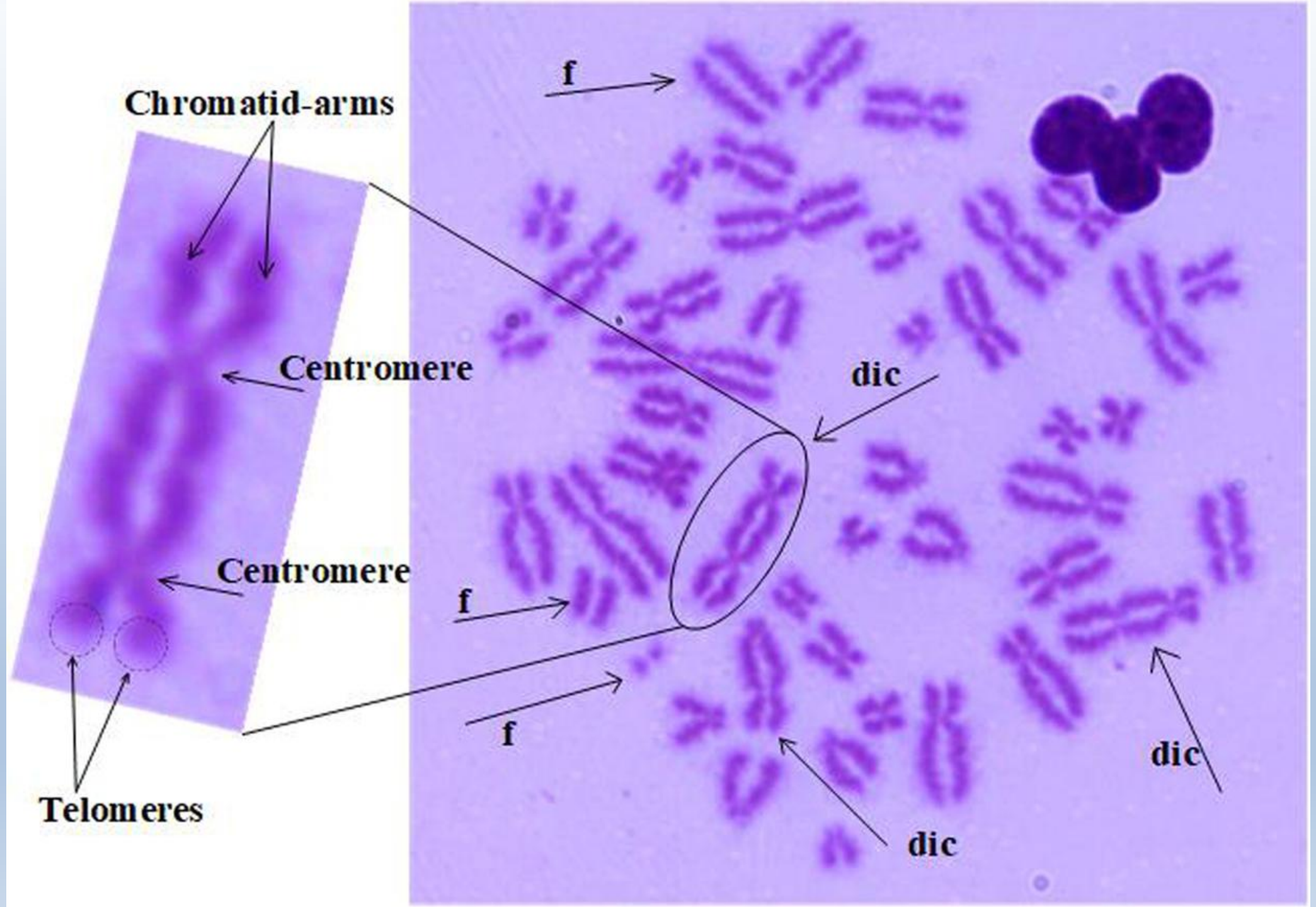


Fig. 1. Structure of chromosome.



https://youtu.be/8yK4RfzCYU4?si=iREnU2R8PJpC5EL4


Chromatid-arms
Centromere
Centromere
Telomeres
f
f
f
dic
dic
dic

Phases of Cell Cycle

Interphase

The cell grows and copies its DNA

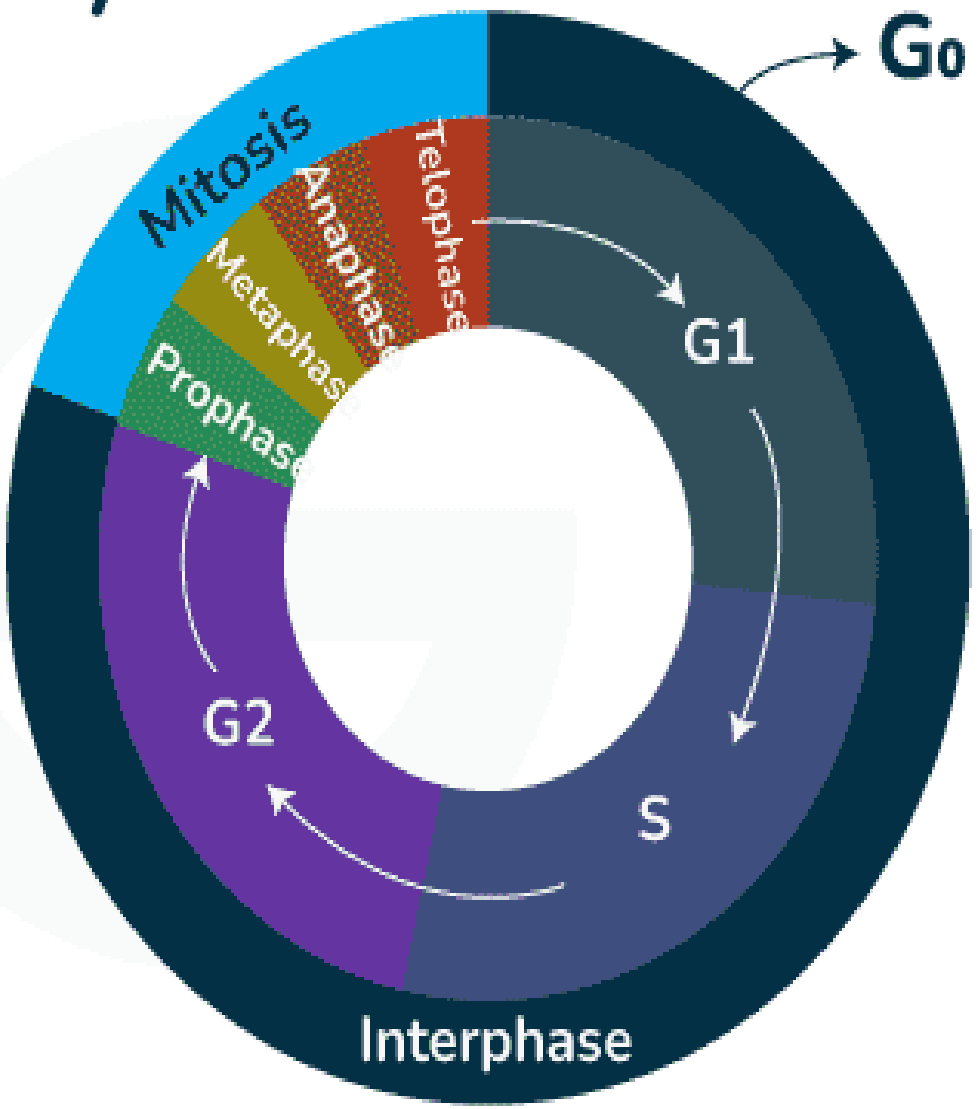
- G1 : Cell growth
- S : DNA Synthesis
- G2 : More growth, Preparation for mitosis

Mitosis

The cell divides its DNA and cytoplasm, forming two new cells

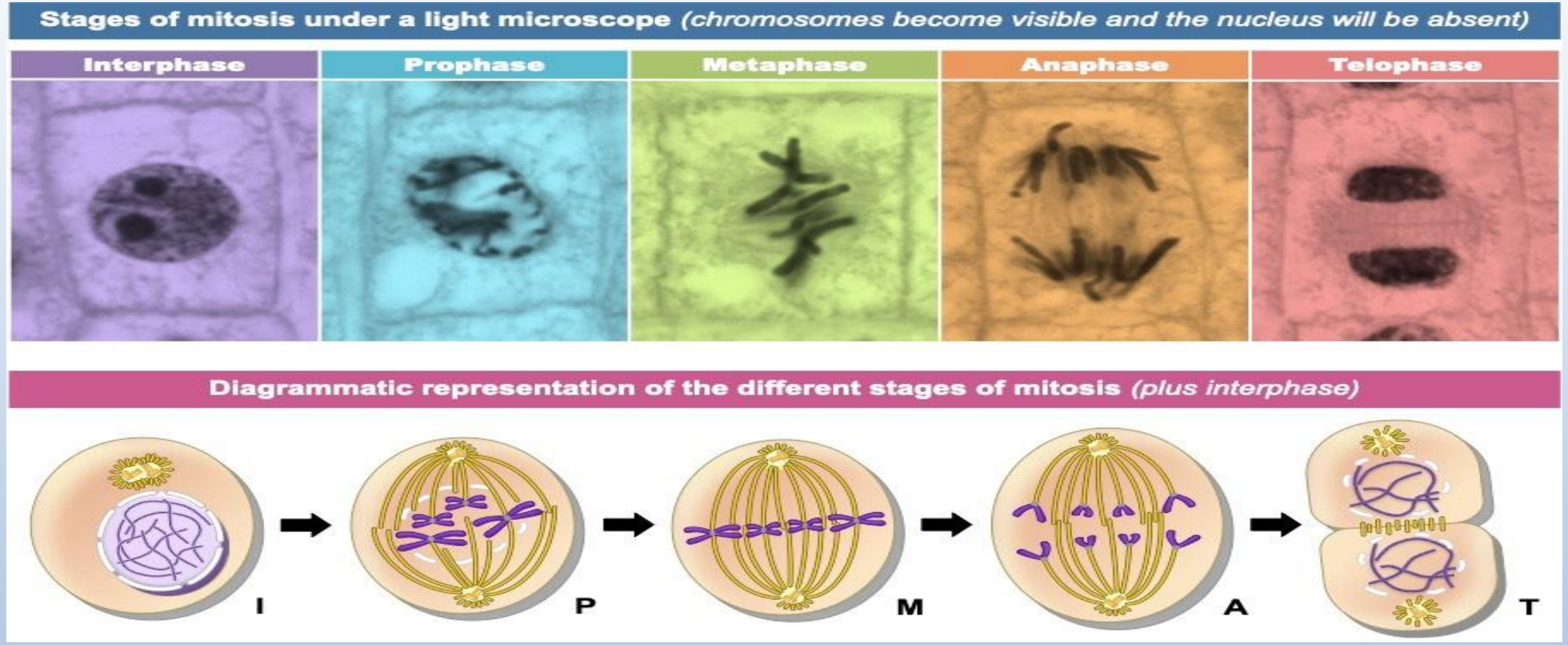
- Prophase
- Metaphase
- Anaphase
- Telophase

G_0 : Resting state where the cell performs its functions and is not preparing to divide.



- Mitosis is divided into four stages:

- Prophase: the chromosomes condense and become visible, the nuclear envelope breaks down and spindle fibres start forming during this stage
- Metaphase: in this stage, the chromosome aligns the equator region of the cell and gets attached to the spindle fiber at the centromere region
- Anaphase: the sister chromatids are pulled apart in this stage and they move toward the opposite poles of the cell
- Telophase: the chromosome begins to decondense and the nuclear envelope is formed around the chromosome sets while the spindle fibers begin to disintegrate.



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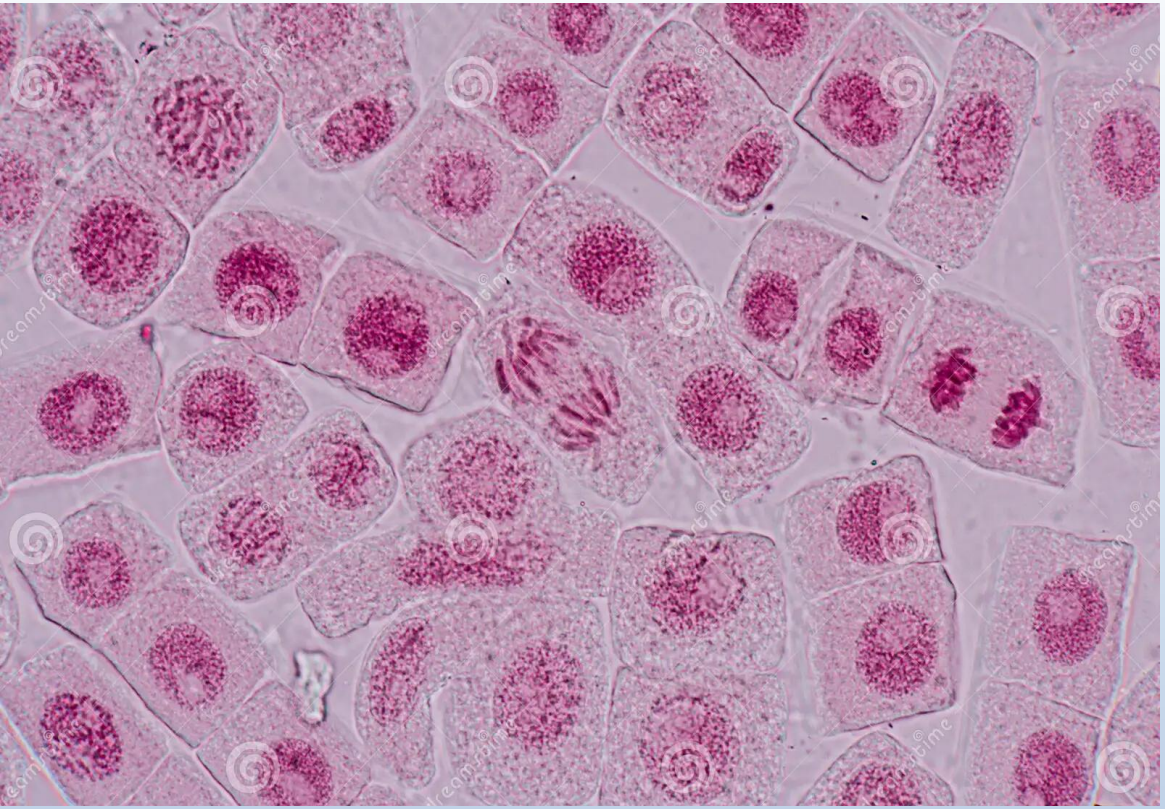

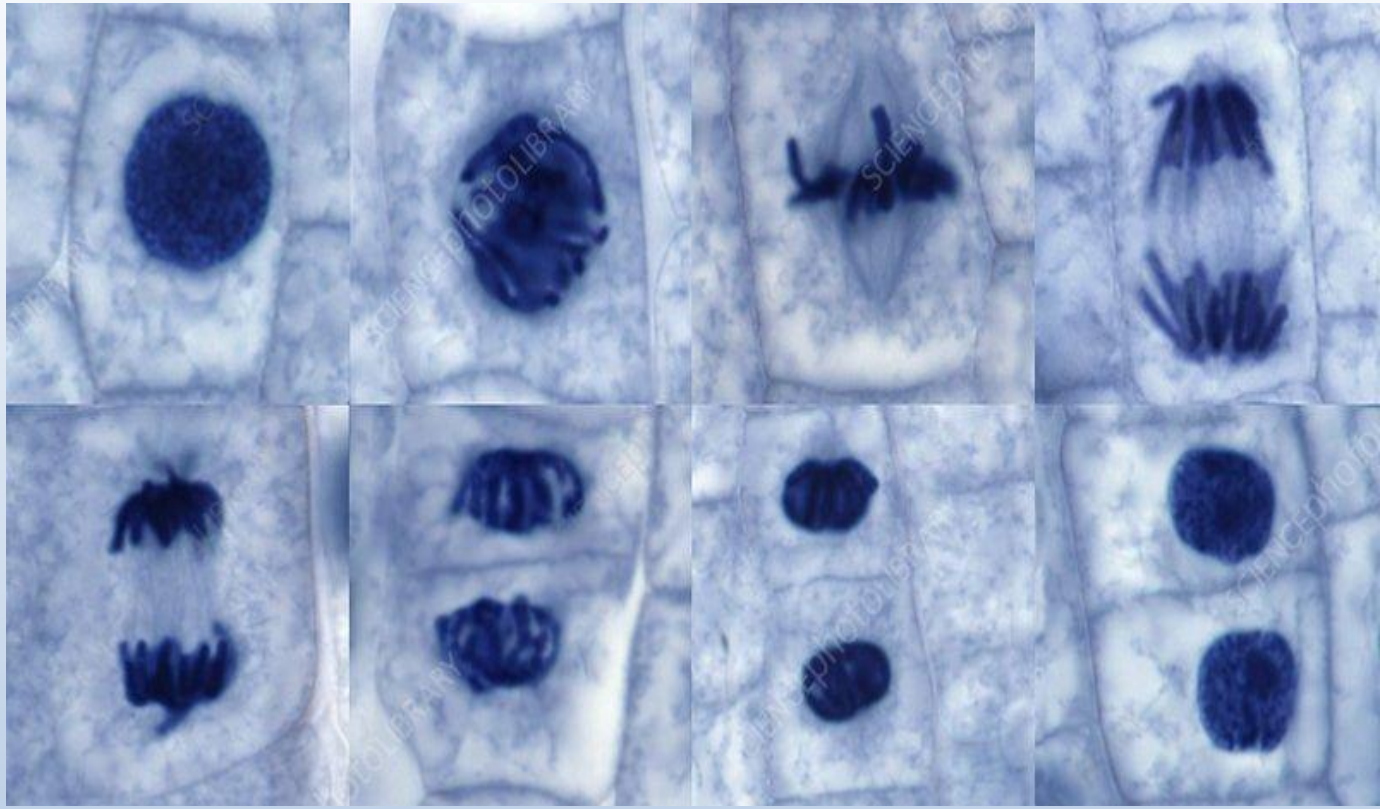

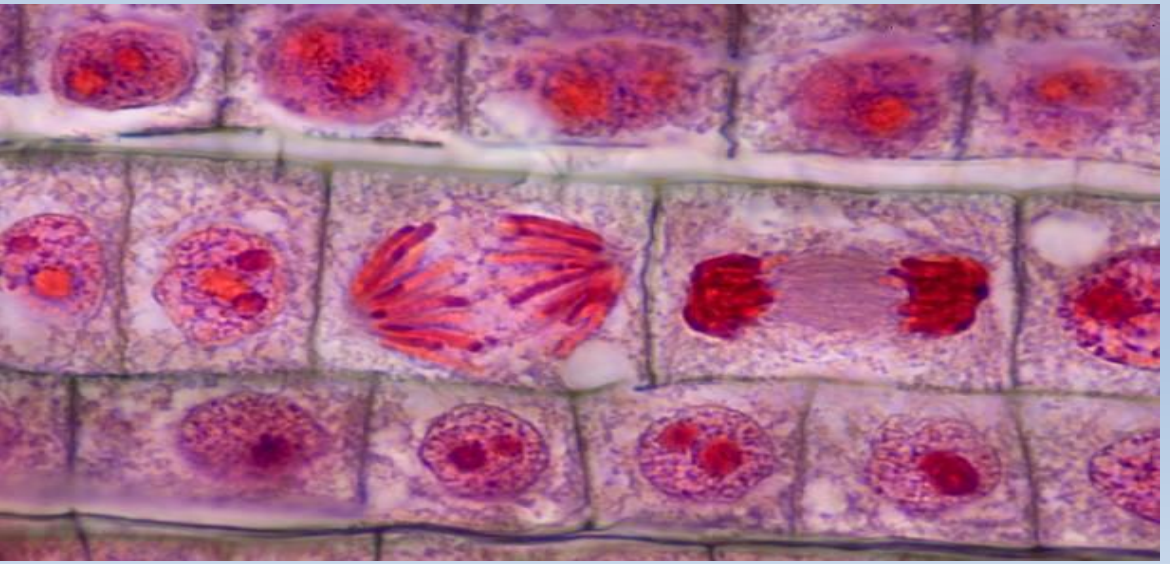

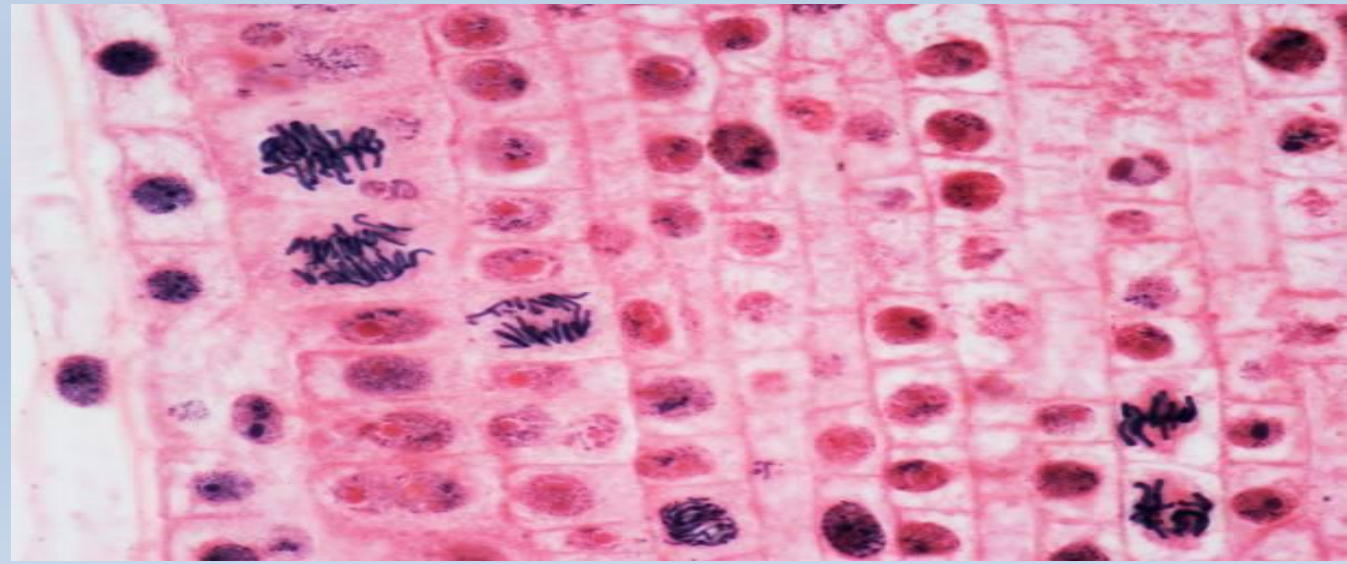


Thanks for your attention

Education
Faculty
Grade 1
2024-2025
Practical

Cell Biology

Lab.10
18.03.2025
Cell Cycle

By
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Learning outcomes

At the end of this class you will be able:

- Understand the phases of cell cycle.
- Differentiate between different phases of mitosis.

Outlines

- Cell cycle
- Interphase
- Mitosis

Cell cycle

A cell cycle is a series of events that takes place in a **cell** as it **grows and divides.**

A cell spends most of its time in what is called **interphase**, and during this time it grows, replicates its chromosomes, and prepares for cell division.

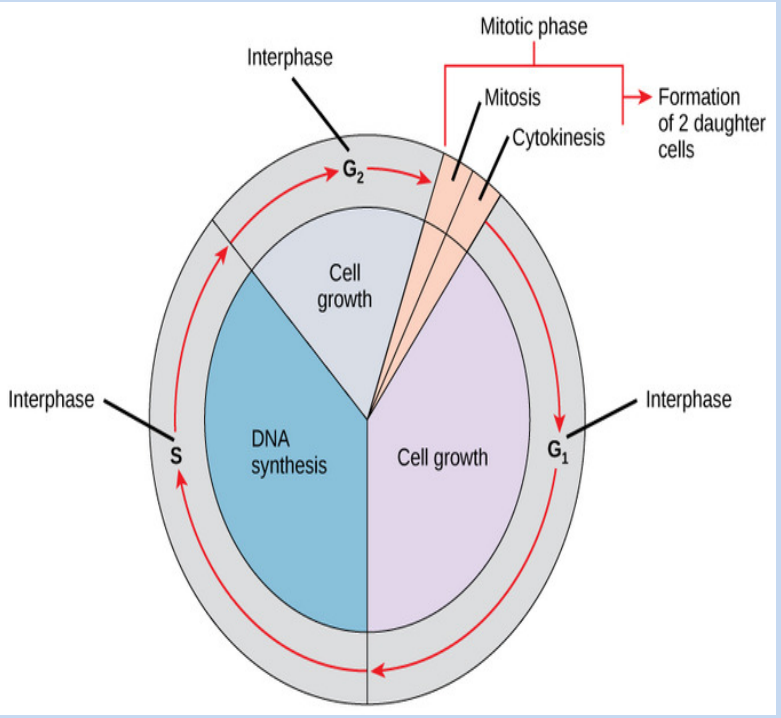
The cell then leaves interphase, undergoes mitosis, and completes its division. The resulting cells, known as daughter cells, each enter their own interphase and begin a new round of the cell cycle.

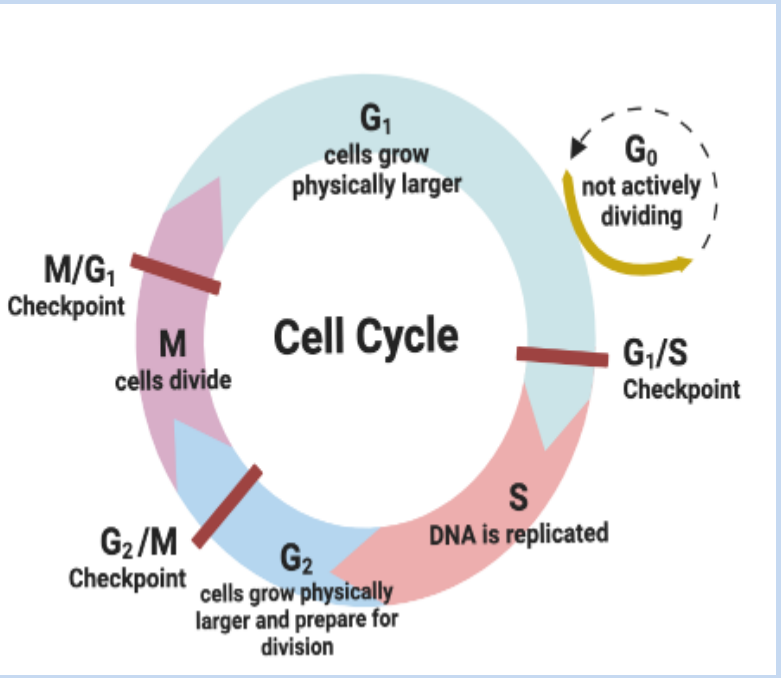
- **Interphase**

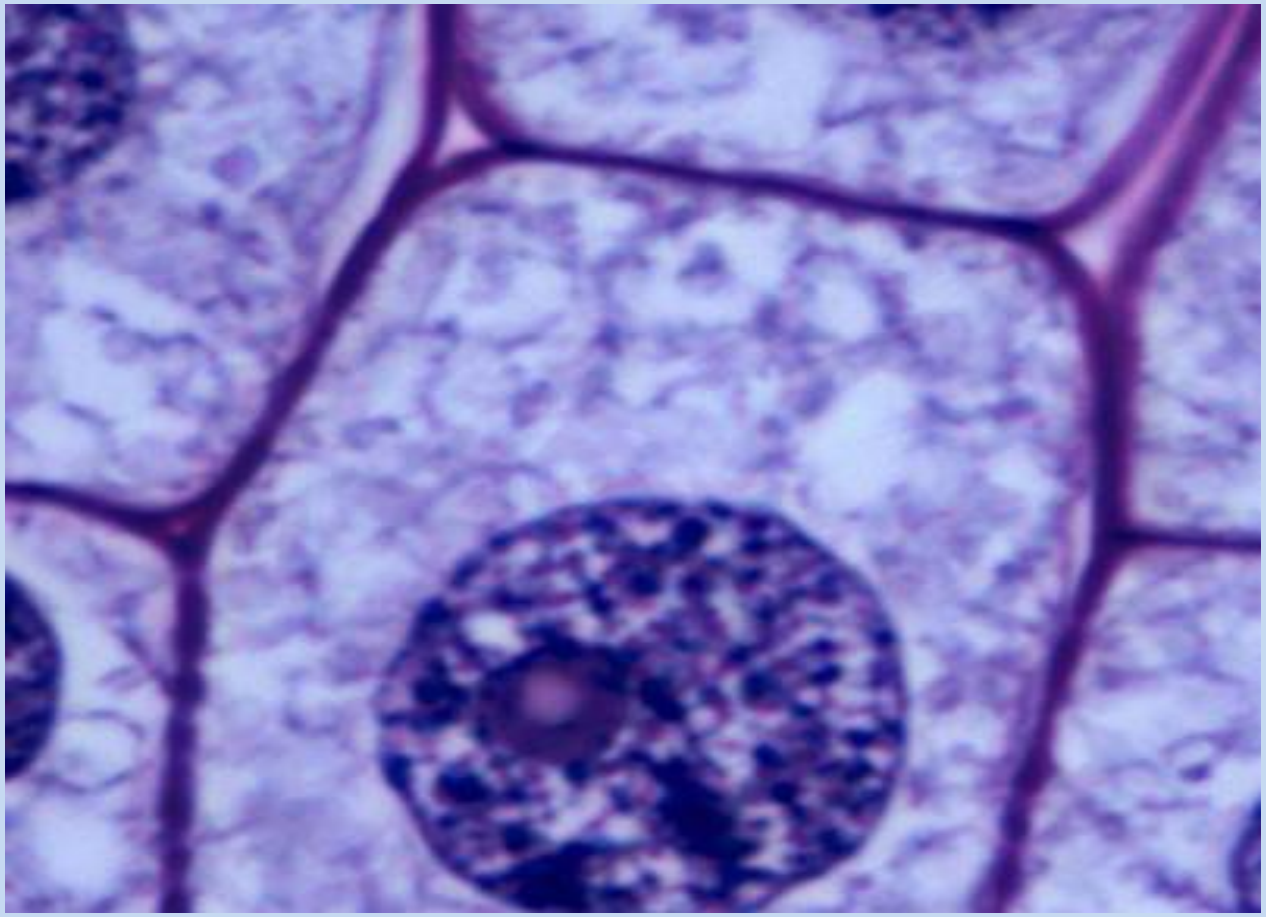
Interphase: the stage in the life cycle of a cell where the cell grows and DNA is replicated.

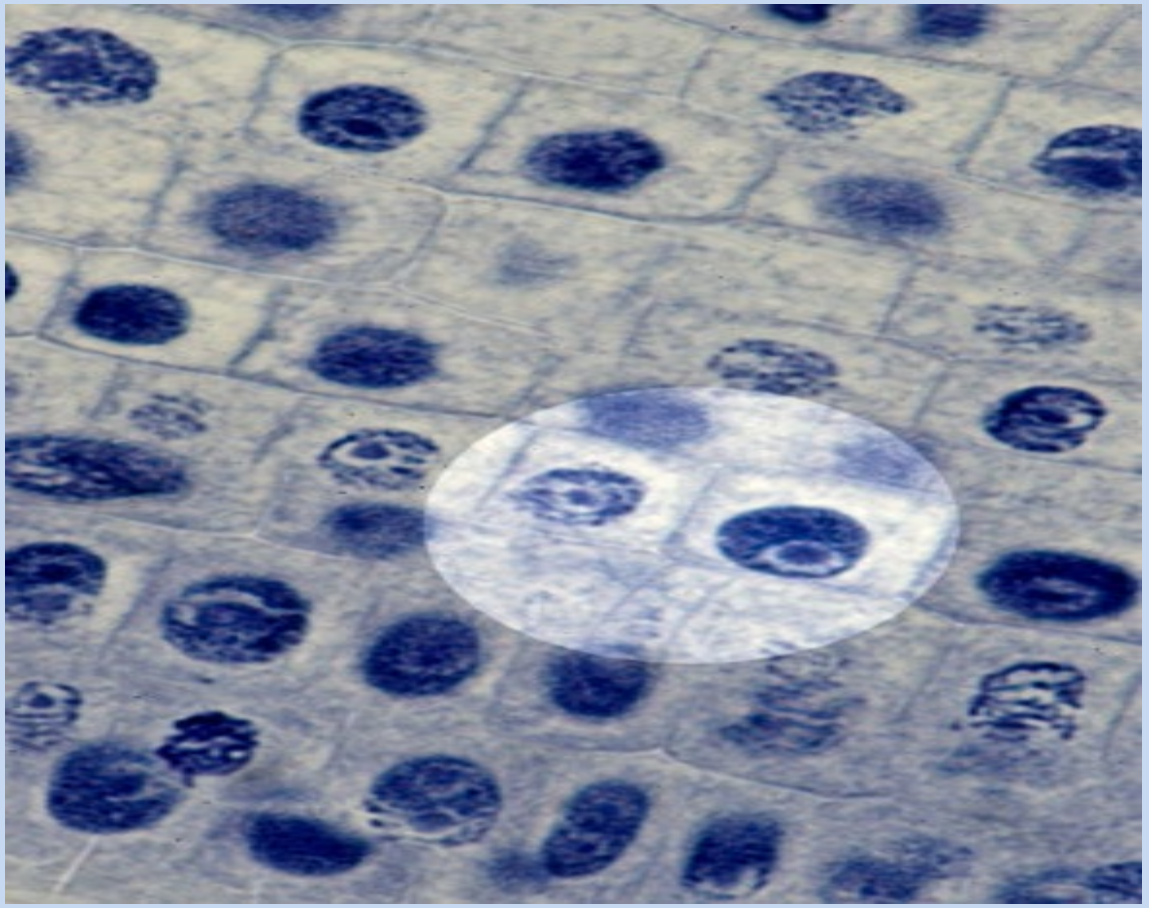
The stages includes:

- Sometimes the cell cycle consisting G0 phase, also known as the resting phase, is the time when the cell is neither dividing nor preparing to divide
- G1 phase: the phase of the cell between mitosis and initiation of replication of the genetic material of the cell. During this phase, the cell is **metabolically active and continues to grow without replicating its DNA**.
- S Phase: During this phase **DNA replication results in the formation of identical pairs of DNA molecules**, sister chromatids, that are firmly attached to the centromeric region.
- G2 phase: the cell has grown, DNA has been replicated, and now the cell is almost ready to divide.





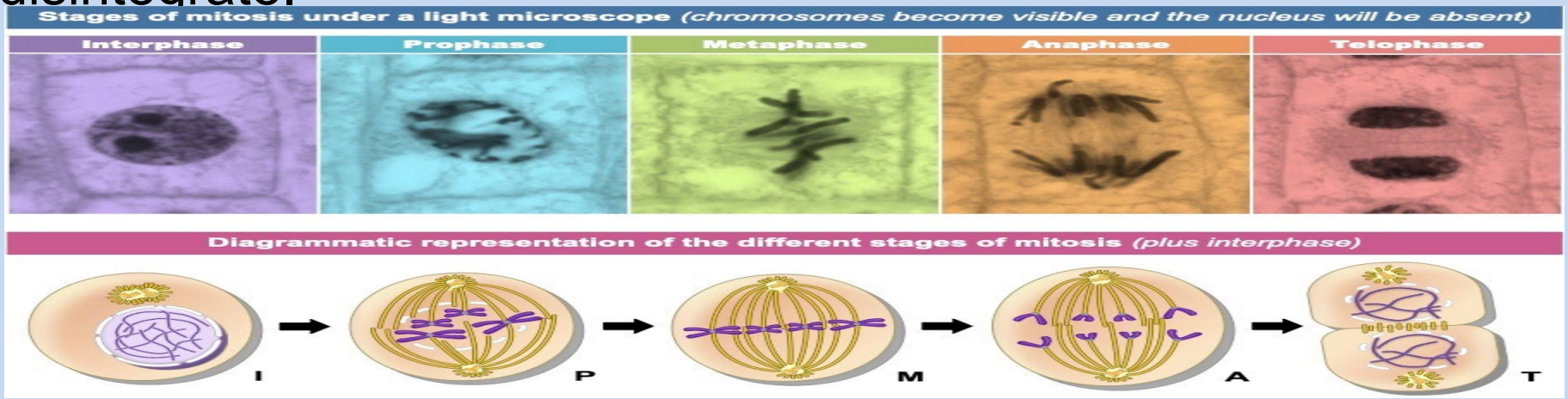


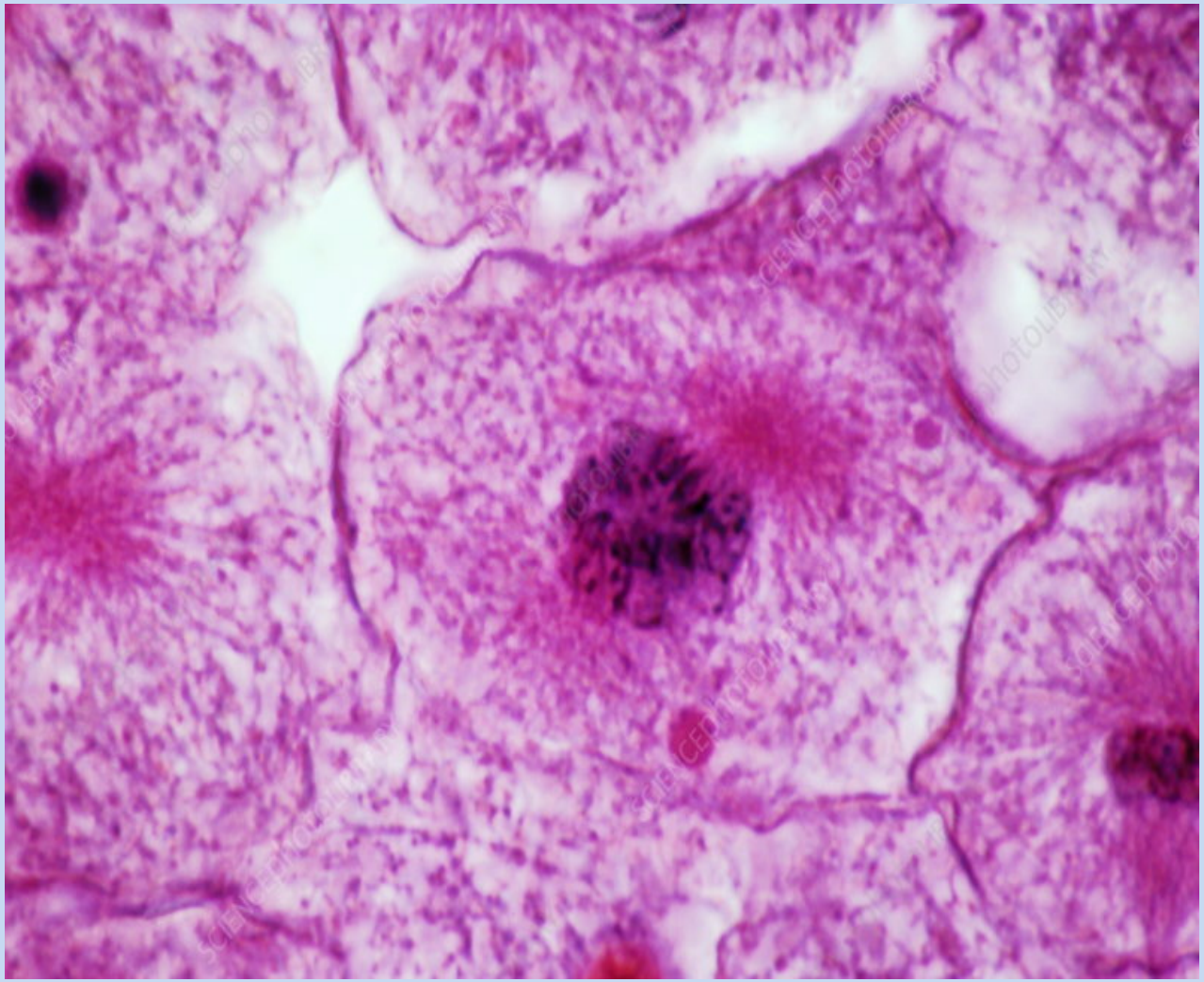


Interphase

Mitosis

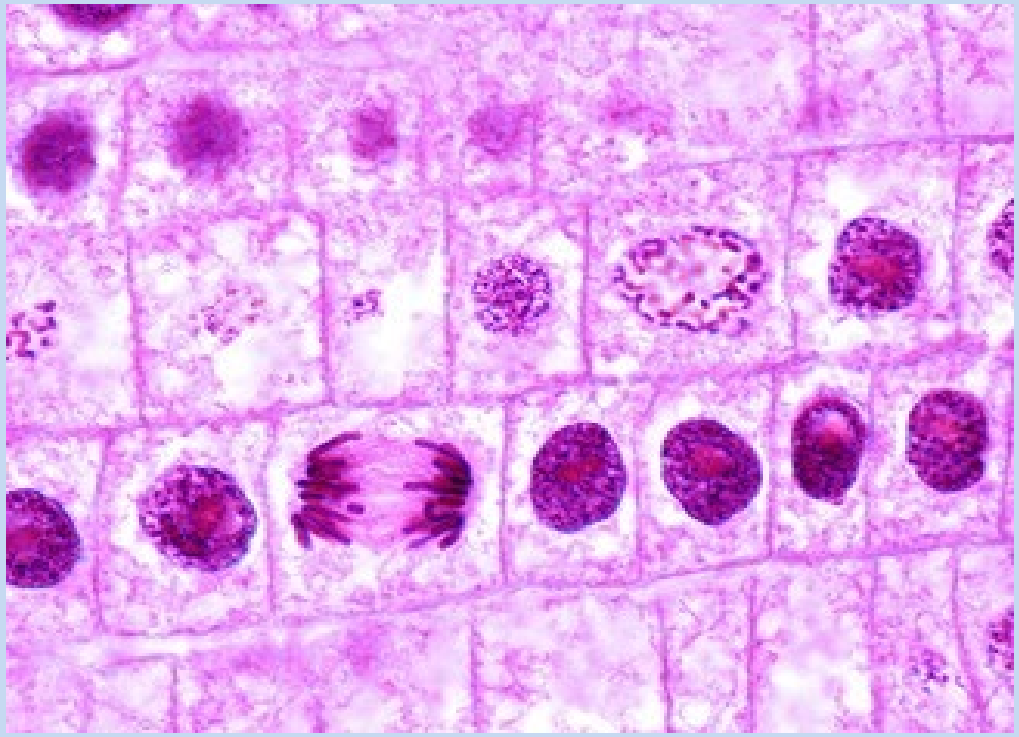
- Mitosis is divided into four stages:
- Prophase: the chromosomes condense and become visible, the nuclear envelope breaks down and spindle fibres start forming during this stage
- Metaphase: in this stage, the chromosome aligns the equator region of the cell and gets attached to the spindle fiber at the centromere region
- Anaphase: the sister chromatids are pulled apart in this stage and they move toward the opposite poles of the cell
- Telophase: the chromosome begins to decondense and the nuclear envelope is formed around the chromosome sets while the spindle fibers begin to disintegrate.



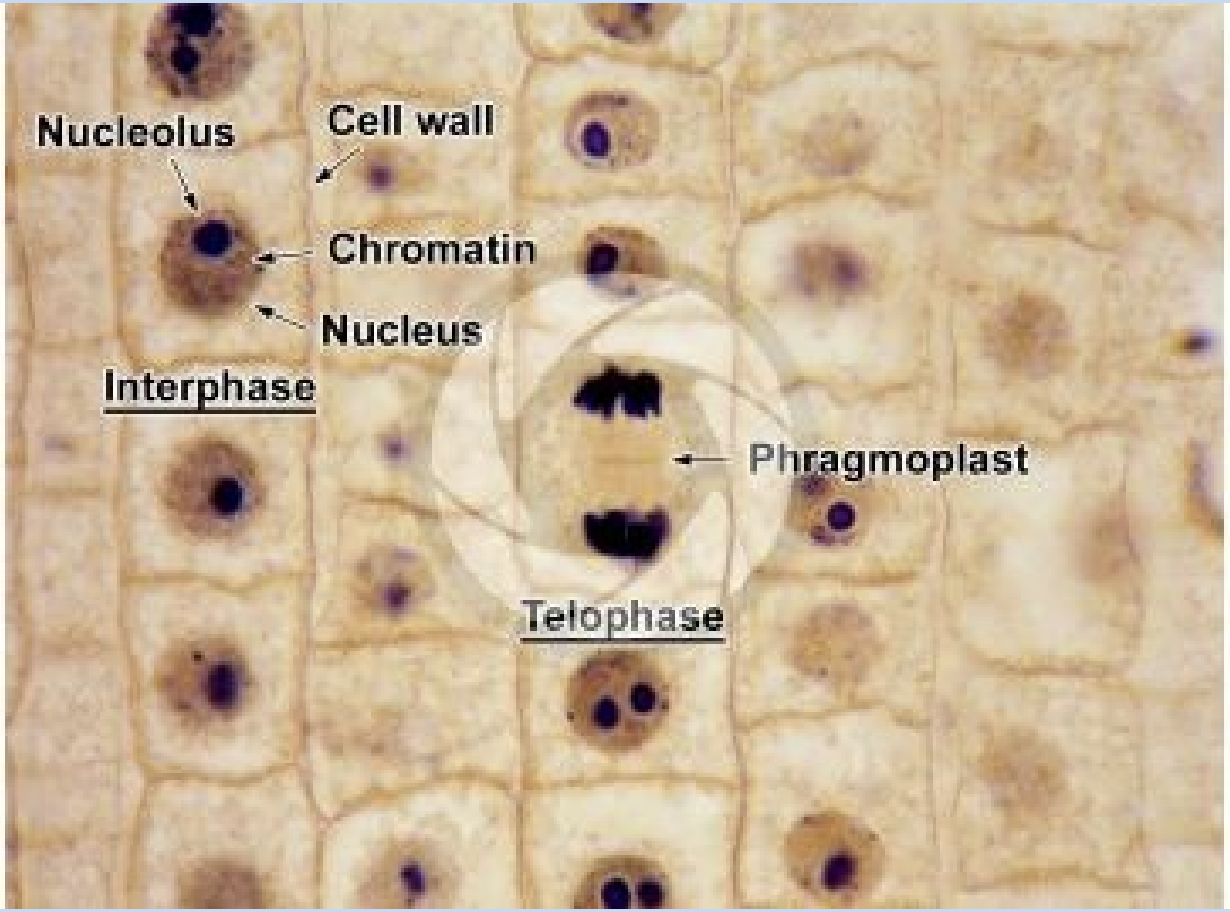


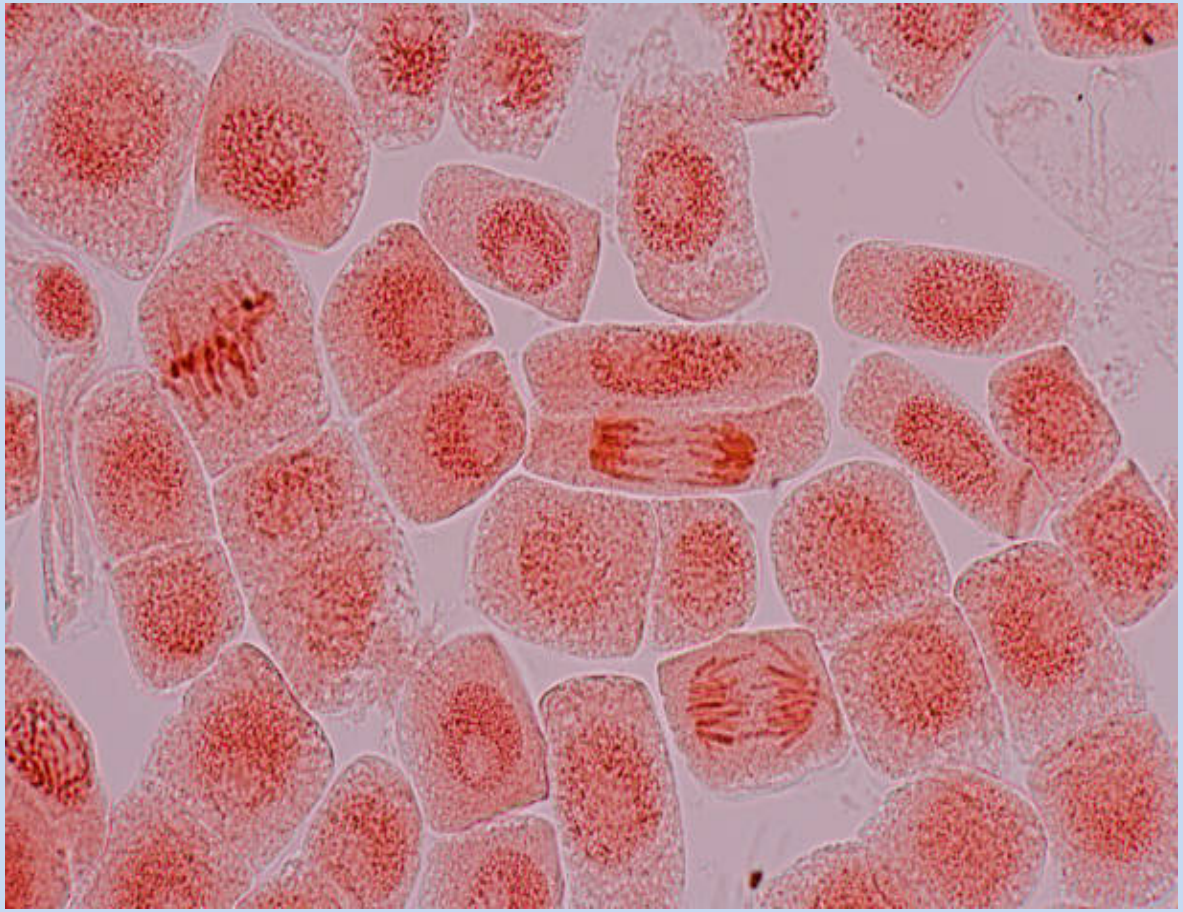
Prophase Mitosis

Metaphase Mitosis



Anaphase mitosis





Telophase Mitosis

https://youtu.be/e6N9_RhD10Q?feature=shared


Thanks for your attention

Education
Faculty
Grade 1
2024-2025
Practical

Cell Biology

Lab. 12
Direct Cell division
Amitosis

By
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Learning outcomes:

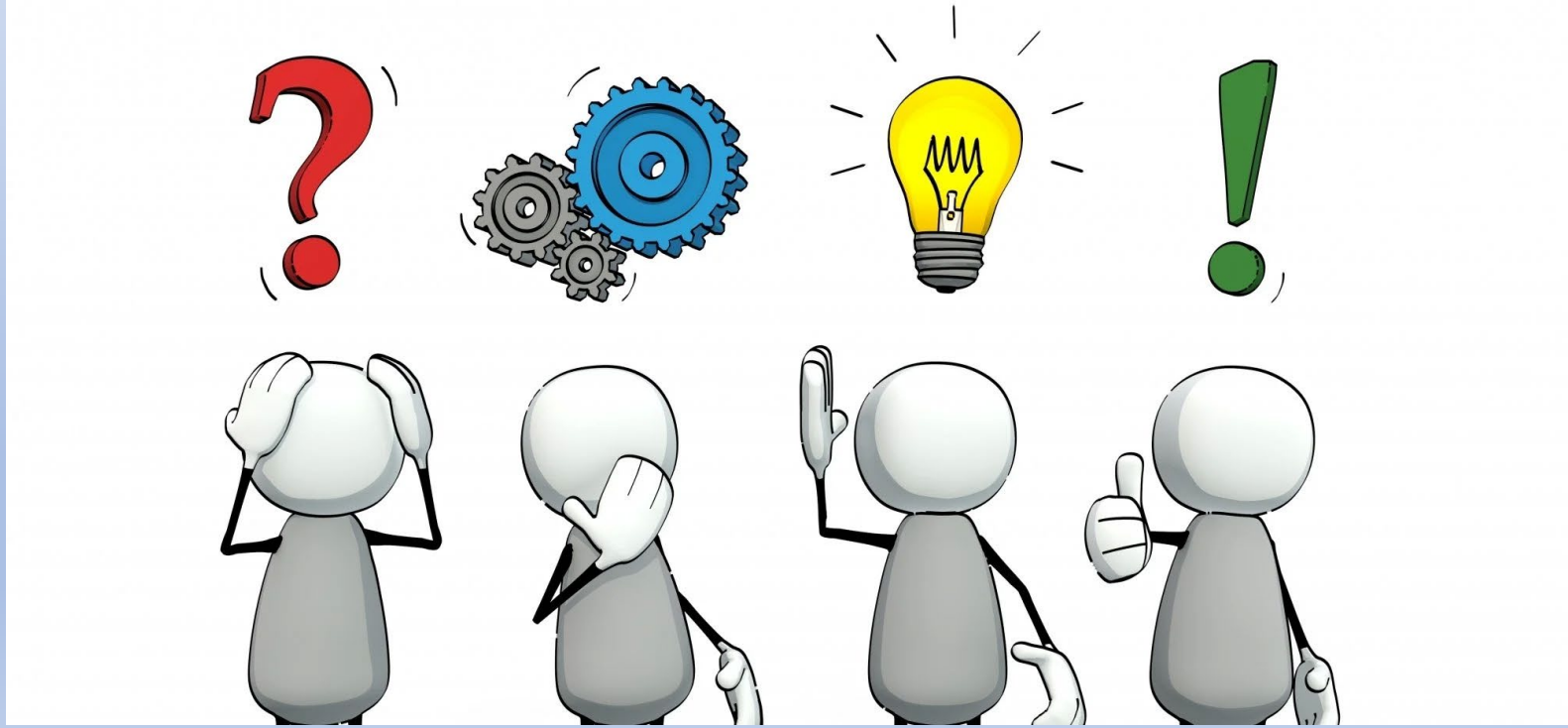
At the end of class student will be able to:

- Understand the concept of cell division.
- Identify different types of cell division.
- Describe the process of amitosis .
- Recognize the characteristics of amitosis.

Outlines:

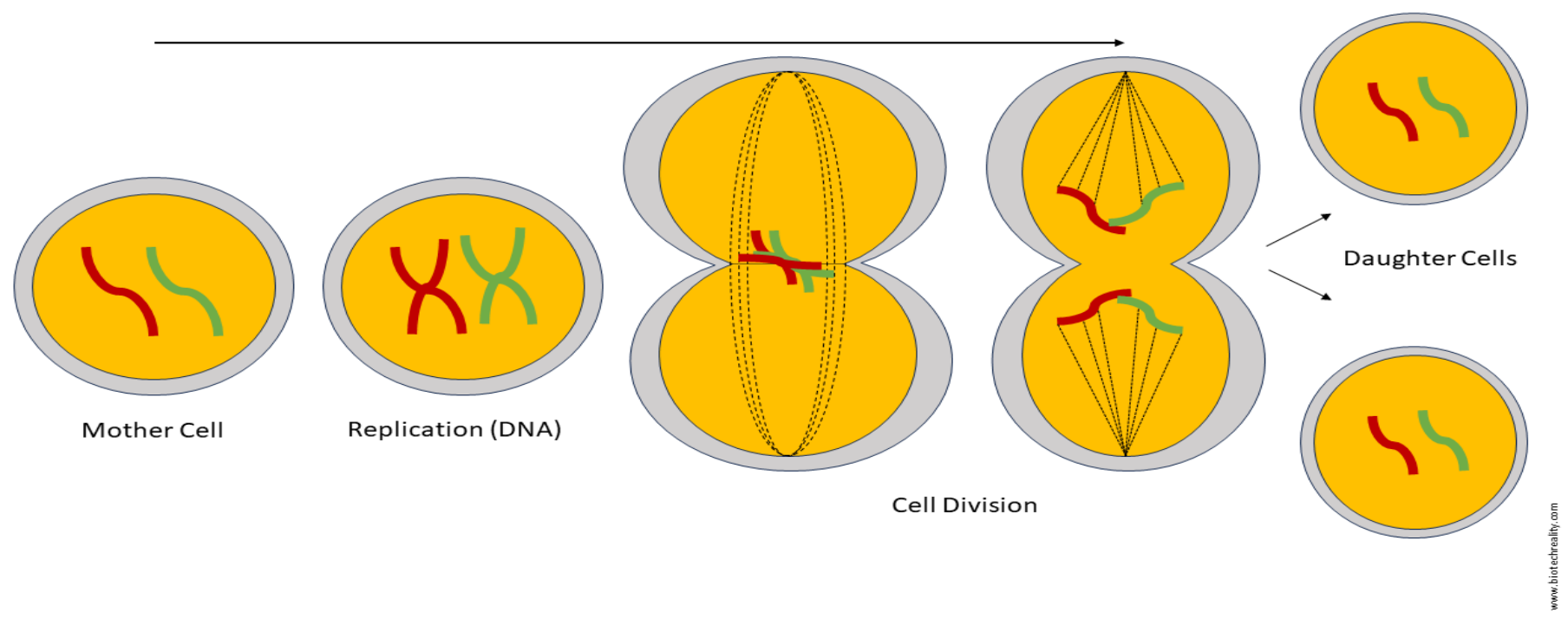
- Cell division
- Types of cell division
- Amitosis

Why is a cell division?



Cell division

- Cell division is the process in which a parent cell divides, giving rise two or more daughter cells.
- It is an essential biological process in many organisms. It is the means used by multicellular organisms in order to **grow, repair, and reproduce.**



Types of Cell Division

The three types of cell division that occur in animal cells are :

Mitosis Indirect Division (asexual)

Amitosis Direct Division (asexual)

Meiosis Reduction Division (sexual)

Direct cell division (Amitosis)

- Amitosis is the direct cell division.

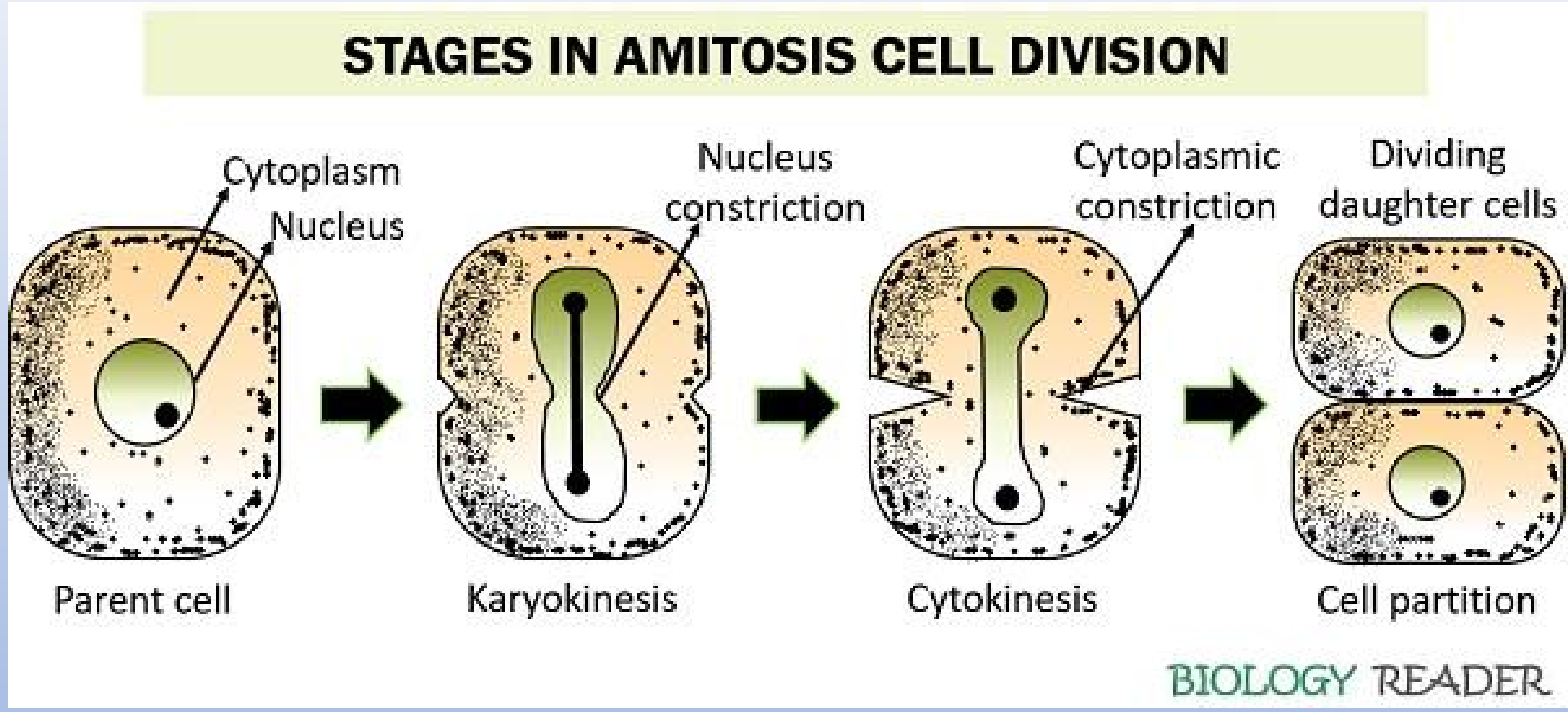
Amitosis is a simple form of cell division where the nucleus and cytoplasm split directly without the complex steps of mitosis.
•Found in some **unicellular organisms** and specialized cells that need rapid division, example **Bacteria, yeast, and Amoeba**

- **There is no spindle synthesis.**
- **The nuclear membrane does not disappear.**

- There are two steps in amitosis : (i) **Karyokinesis**, (ii) **Cytokinesis**.

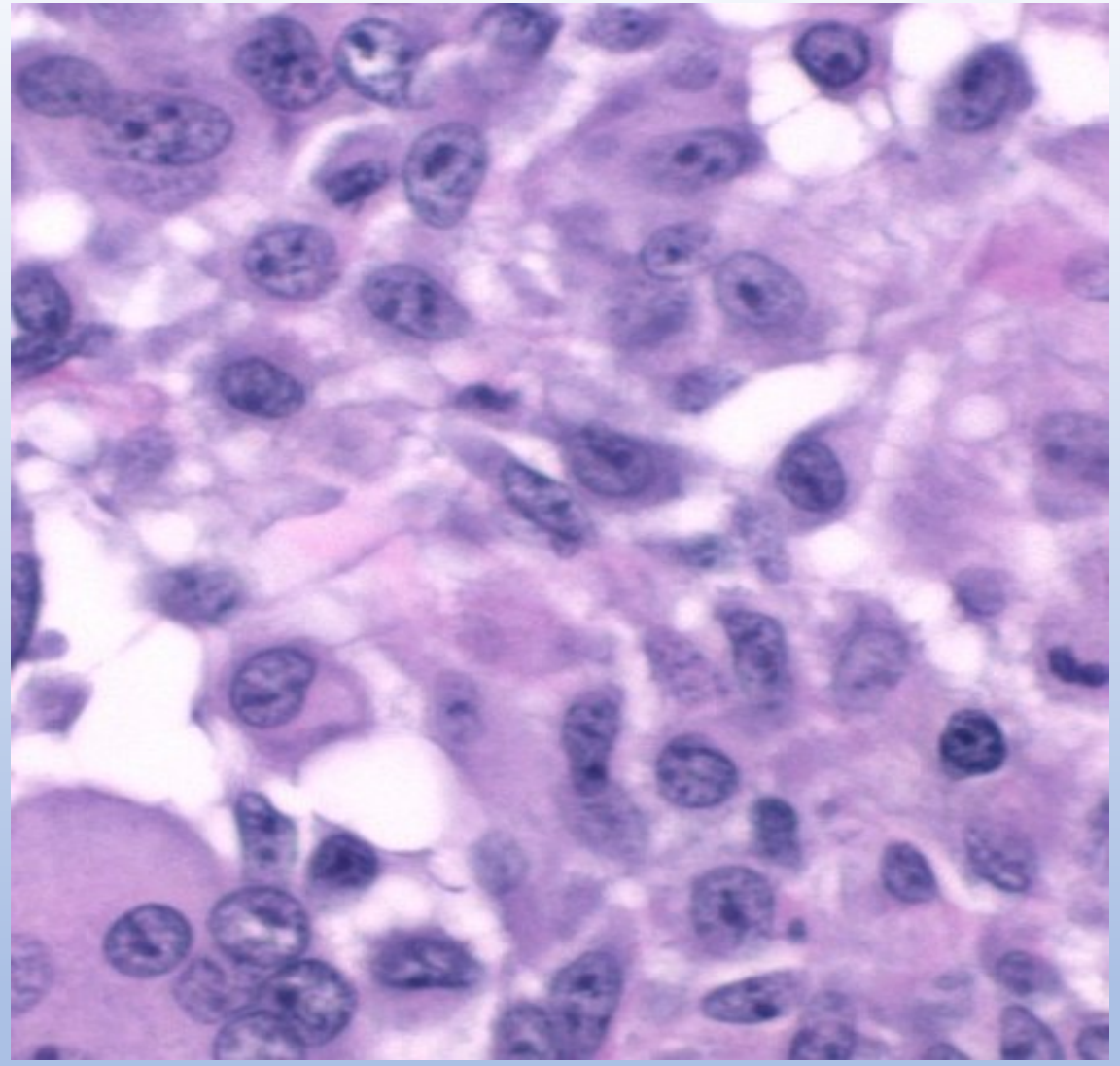
- Divide into three stages

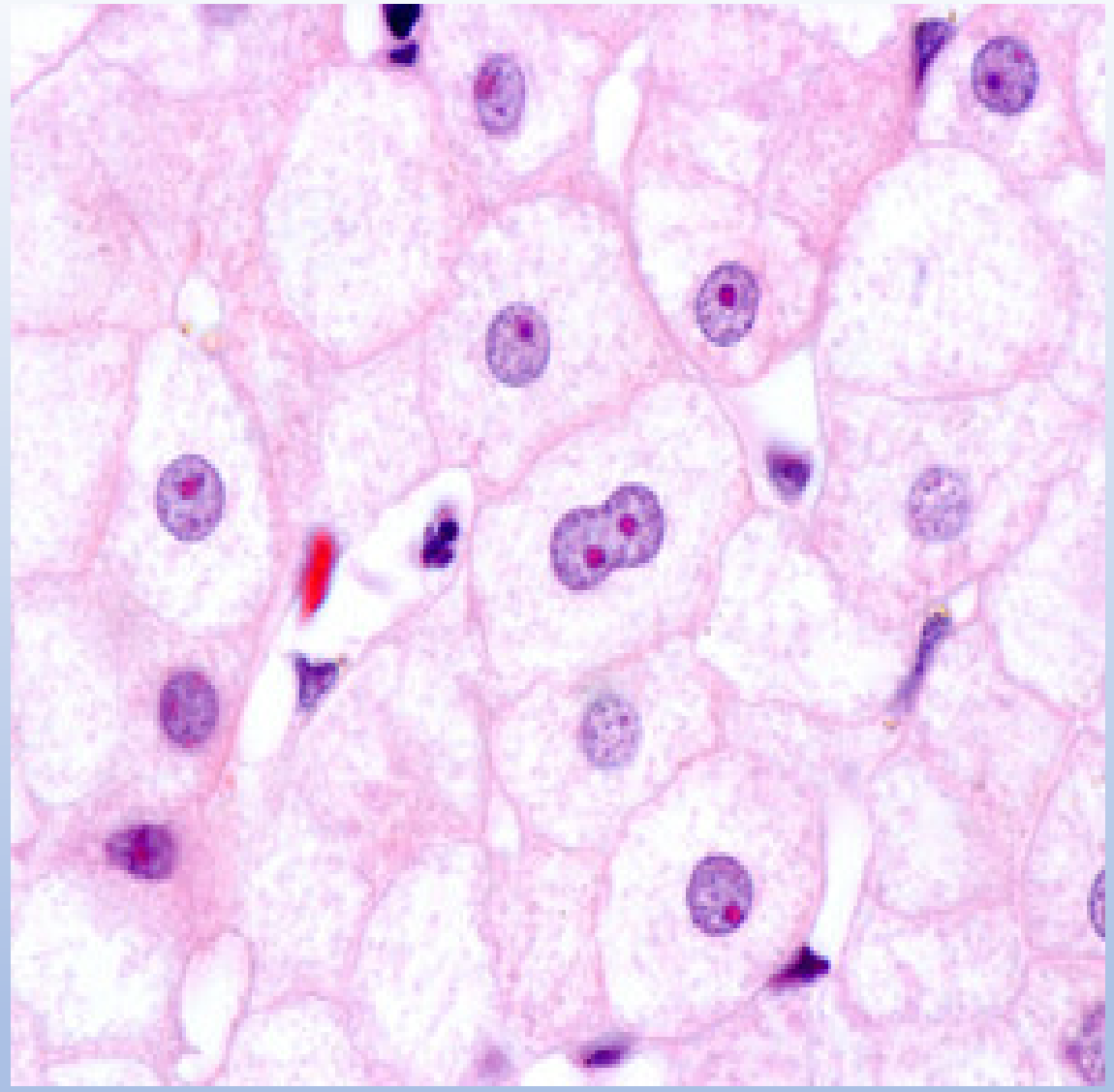
- Nuclear Elongation: The nucleus stretches and starts to divide.
- Nuclear Splitting: The nucleus splits into two parts without forming chromosomes.
- Cytoplasmic Division: The cytoplasm constricts and divides, forming two daughter cells.


STAGES IN AMITOSIS CELL DIVISION
Cytoplasm
Nucleus
Nucleus constriction
Cytoplasmic constriction
Dividing daughter cells
Parent cell
Karyokinesis
Cytokinesis
Cell partition
BIOLOGY READER

Procedure:

- **1. Sample preparation:**
- Take a small piece of **soft coconut endosperm** (or alternatively, aged stem parenchyma from an herbaceous plant).
- Place the tissue on a clean microscope slide.
- **2. Staining:**
- Add 1–2 drops of **methylene blue** or **aceto-carmine** stain to the tissue.
- Let it sit for **5–10 minutes** to stain the nuclei clearly.
- **3. Squashing the sample:**
- Place a cover slip over the tissue.
- Gently **press (squash)** the tissue using a blunt object to spread the cells into a thin layer.
- **4. Microscopic observation:**
- Examine under **low power**, then switch to **high power** magnification.
- Look for **cells showing a nucleus that appears to be dividing without clear chromosomal structures** or spindle formation.
- You might observe:
  - A **nucleus with a constriction** or appearing to be **pinching into two**.
  - Absence of visible mitotic spindles or metaphase plates.
  - **Uneven nuclear distribution** or **double nuclei** in a single cell without cytokinesis.





Amitosis Division

Activity

- **What structure is responsible for moving chromosomes during cell division?**
  a) Nucleolus
  b) Centromere
  c) Spindle fibers
  d) Endoplasmic reticulum
- Amitosis involves the breakdown of the nuclear membrane.(True/False)
- Cytokinesis occurs after karyokinesis in amitosis. (True/False)
- Amitosis is considered a type of sexual reproduction. (True/False)
- Chromosomes become visible during amitosis. (True/False)
- **Application and Critical Thinking Questions:**
- Why might some cells use amitosis instead of mitosis? Give examples.
- Compare the presence or absence of the spindle apparatus and nuclear membrane behavior in amitosis vs mitosis.
- How does the simplicity of amitosis benefit rapidly dividing cells such as bacteria or amoeba?

Education
Faculty
Grade 1
2024-2025
Practical

Cell Biology

Lab.13 Mitochondria Meiosis Division

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Objective

- To understand the stages and significance of meiosis, a specialized type of cell division essential for sexual reproduction in eukaryotes, and to distinguish it from mitosis both theoretically and practically.

Learning outcomes

- Explain the purpose and outcome of meiosis.
- Identify and describe the key stages of meiosis I and meiosis II.
- Distinguish between meiosis and mitosis based on chromosome number and cellular processes.
- Observe and recognize stages of cell division using microscopy.
- Demonstrate proper staining and slide preparation techniques for studying dividing cells.

Outlines

- Introduction to Meiosis
- Facts about Meiosis
- Phases of Meiosis I
- Phases of Meiosis II
- Practical Observation of Mitosis

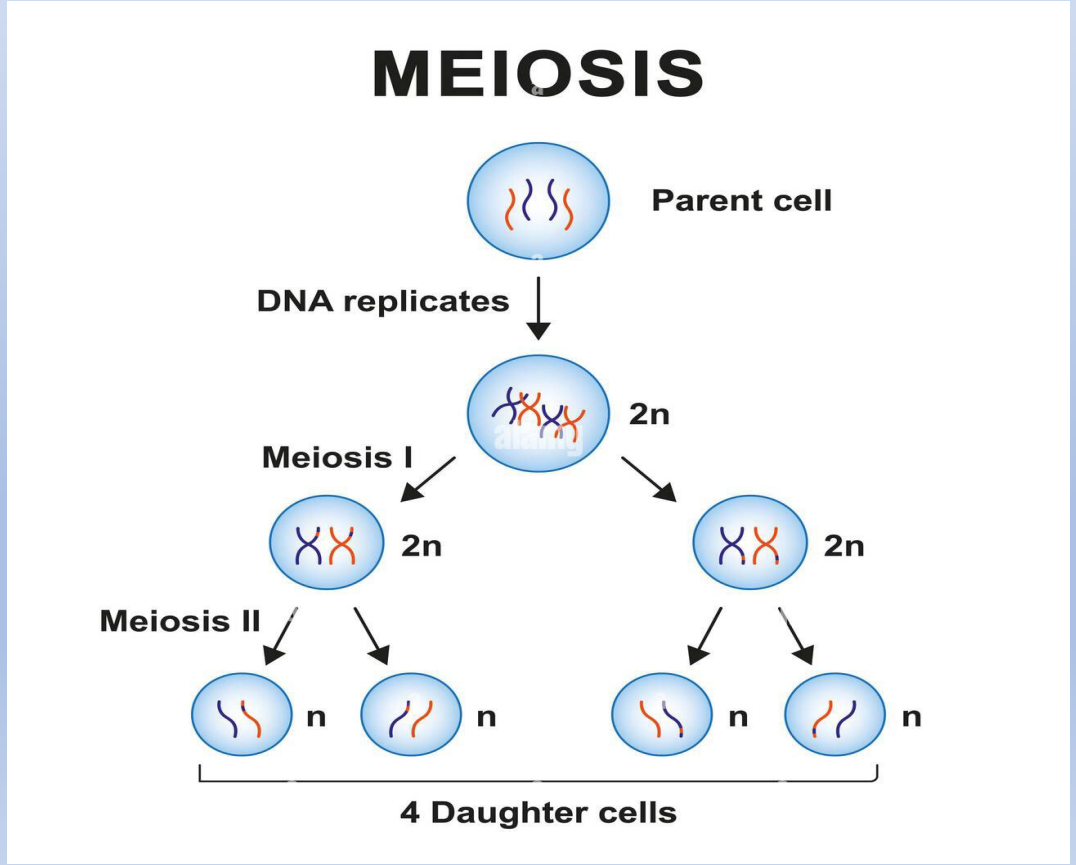
What is Meiosis cell division

Meiosis is a special type of cell division necessary for **sexual reproduction** in **eukaryotes**.

Meiosis begins with on **diploid** cell containing two copies of each chromosomes.

One form the mother and one from its father.

Produces four **haploid cells** containing one copy of each chromosome.



Facts about meiosis

Meiosis is the type of cell division by which germ cell are produced.

Two meiotic divisions

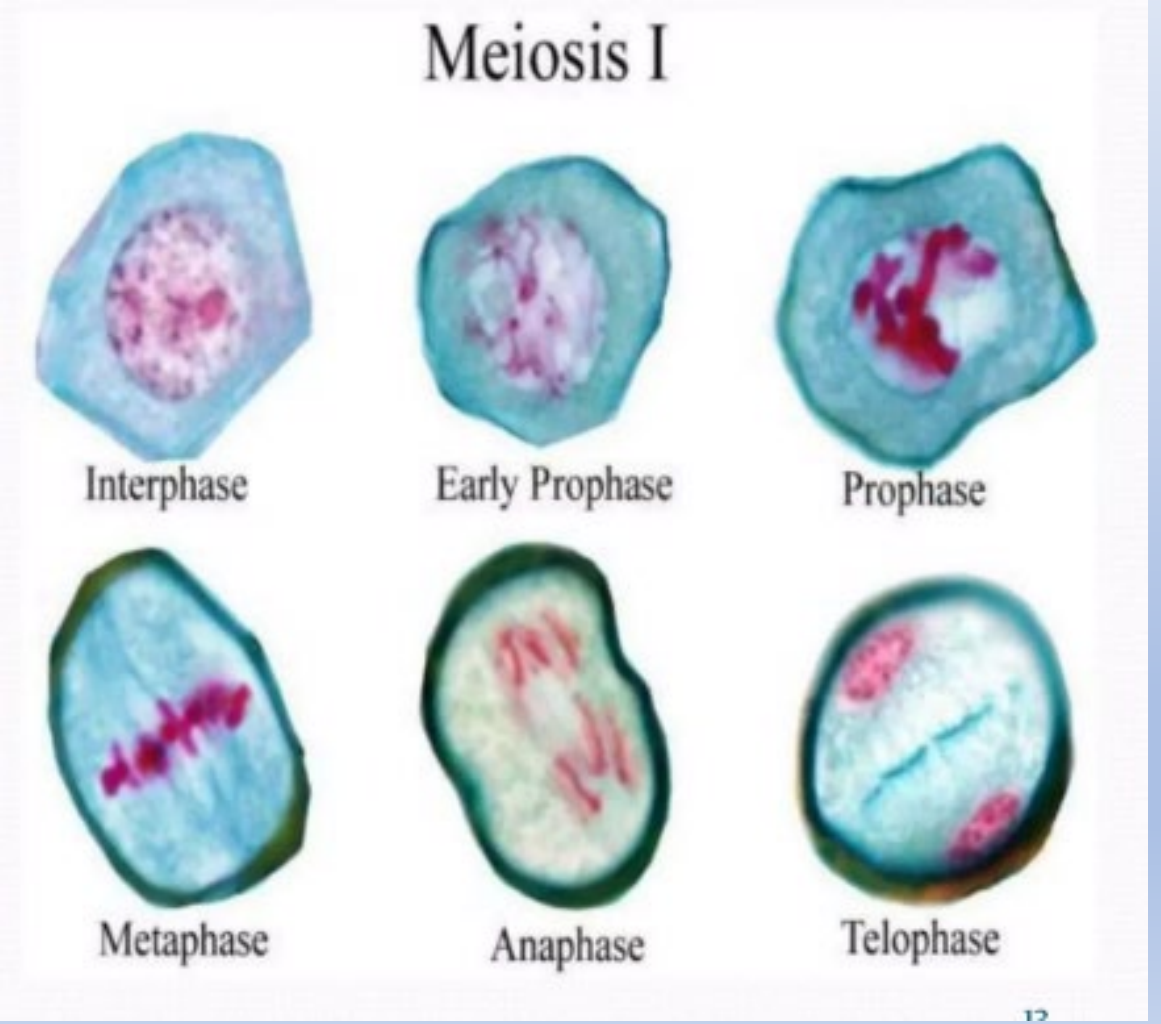
Meiosis I
Meiosis II

- Called **Reduction division**
- Original cell is diploid (2n).
- Four daughter cells produced that are monoploid (1n).
- Daughter cells contain half the number of chromosomes as the original cell.
- Produces gametes (eggs & sperm).
- During meiosis , DNA replicates **once**, but nucleus divides **twice**.

Phases of Meiosis I

Meiosis I : the reduction division diploid mother cell produces 2 haploid cells.

Prophase I
Metaphase I
Anaphase I
Telophase I



- **1. Prophase I**
- This is the longest and most complex phase, Chromosomes begin to condense, Homologous chromosomes pair up (**synapsis**), **forming bivalents or tetrads**. **Crossing over occurs—exchange of genetic material between homologous** chromosomes at chiasmata, Synaptonemal complex dissolves, homologs start to separate but remain connected at chiasmata, Final chromosome condensation; nuclear envelope begins to break down.
- 2. **Metaphase I** Paired homologous chromosomes (bivalents) align at the metaphase plate, spindle fibers attach to kinetochores of homologous chromosomes (not sister chromatids).
- 3. **Anaphase I** Homologous chromosomes (not sister chromatids) are pulled to opposite poles, the reduction in **chromosome number happens** here.
- 4. **Telophase I and Cytokinesis** Chromosomes reach poles, nuclear envelopes may reform. Cytoplasm divides, forming two haploid cells, each with half the number of chromosomes (but each chromosome still has sister chromatids).

Meiosis: two stages

Interphase germ cell in gonads

Meiosis I

Prophase I *Synapsis for crossing over*

Metaphase I

Segregation
Homologous pairs are separated
reducing chromosome number by half

Anaphase I *Independent assortment*

Telophase I

Meiosis II

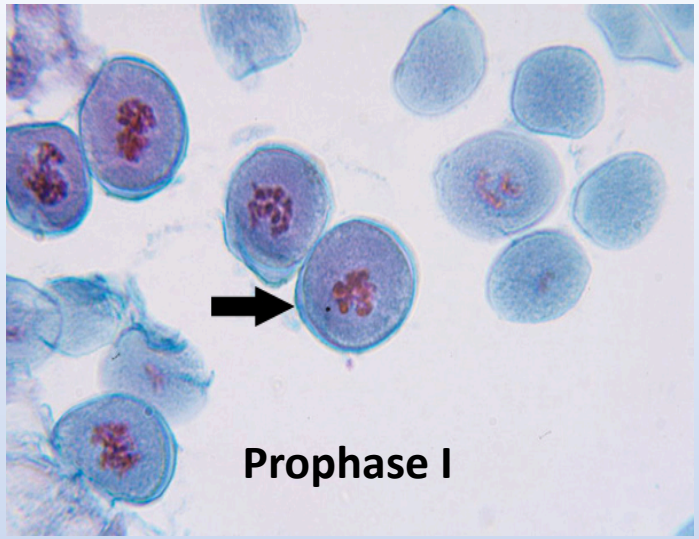
Prophase II

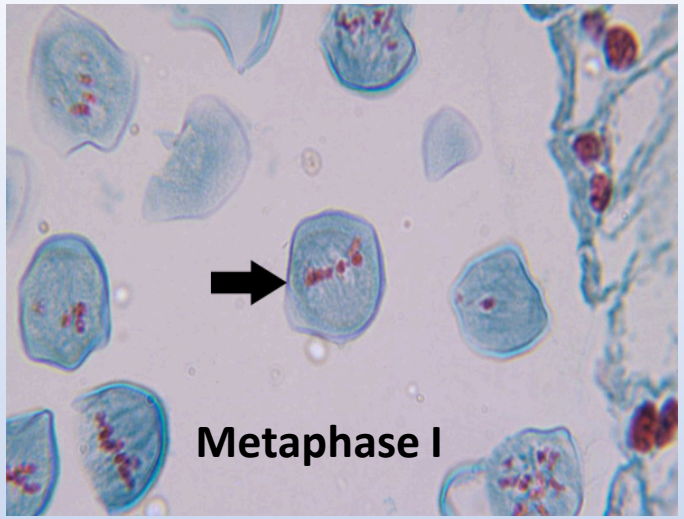
Metaphase II

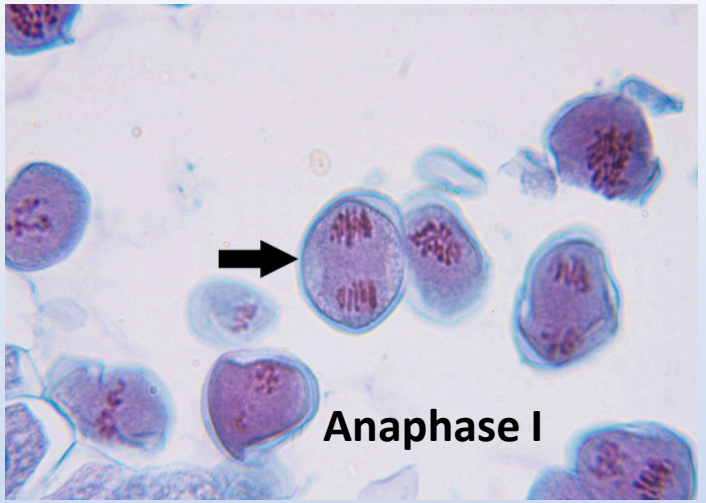
Sister chromatids are separated
producing four haploid gametes

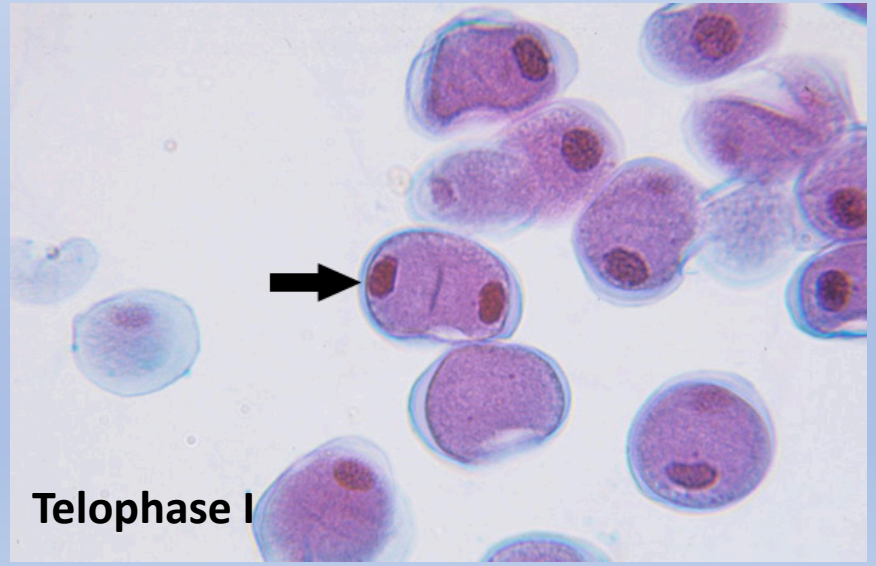
Anaphase II

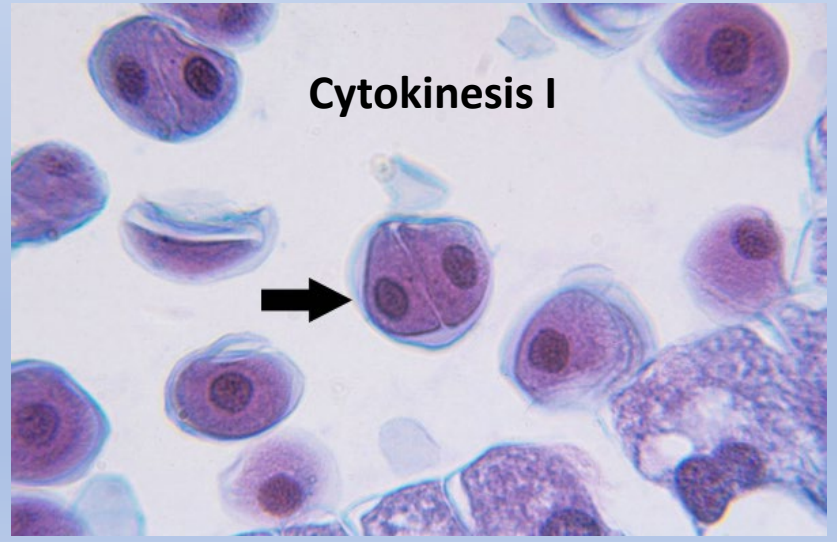
Telophase II


Prophase I


Metaphase I


Anaphase I

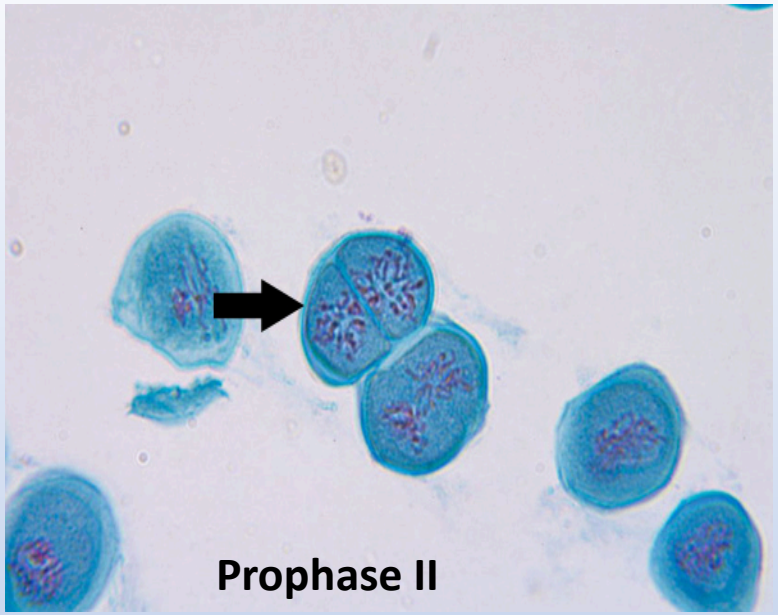

Telophase I

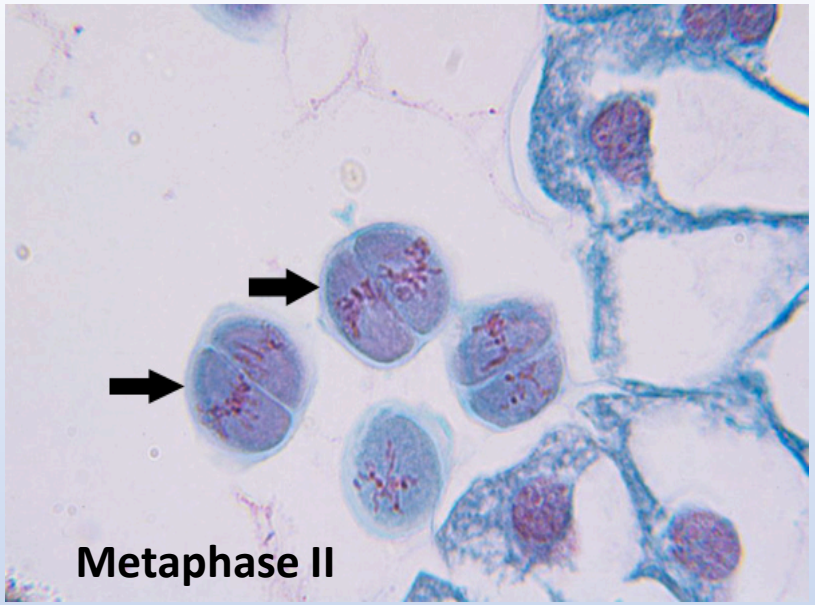

Cytokinesis I

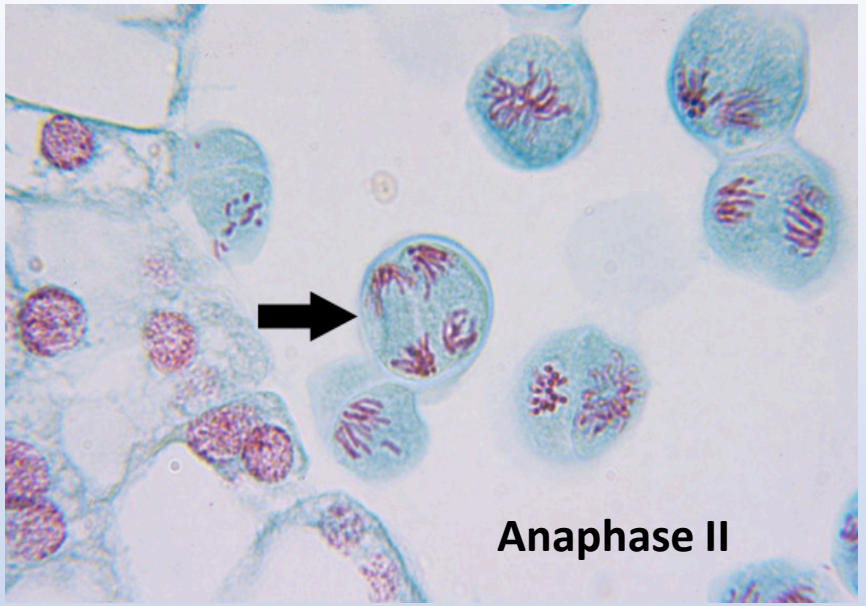
- **Meiosis II (Equational Division)**
- This resembles mitosis, separating sister chromatids.
- 1. Prophase II Chromosomes condense again (if decondensed), spindle forms in each haploid cell.
- 2. Metaphase II Chromosomes align at the metaphase plate, but now with only one chromosome from each homologous pair.
- 3. Anaphase II Sister chromatids finally separate and move to opposite poles.
- 4. Telophase II and Cytokinesis Chromatids arrive at poles, nuclei reform.

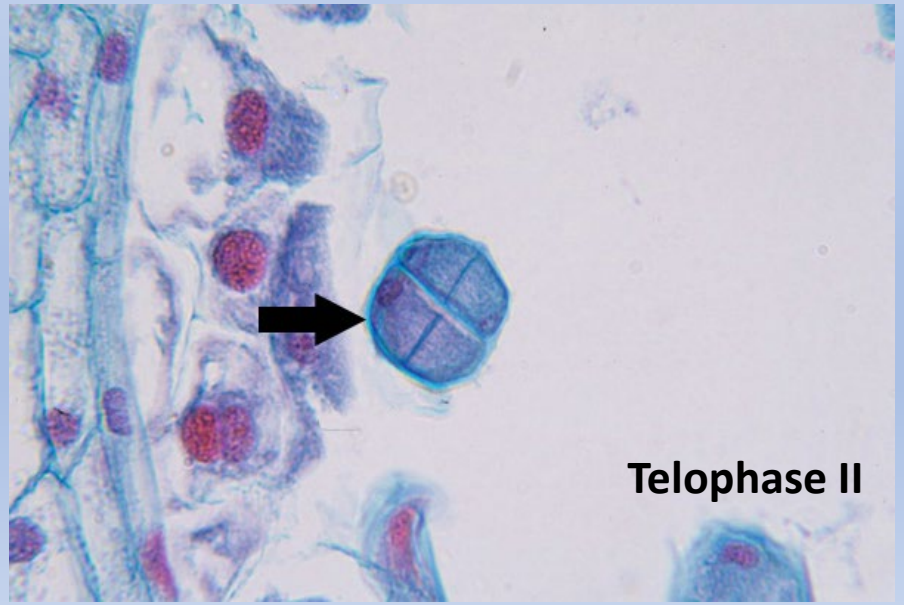
  Cytoplasm divides again, forming four genetically distinct **haploid cells**.

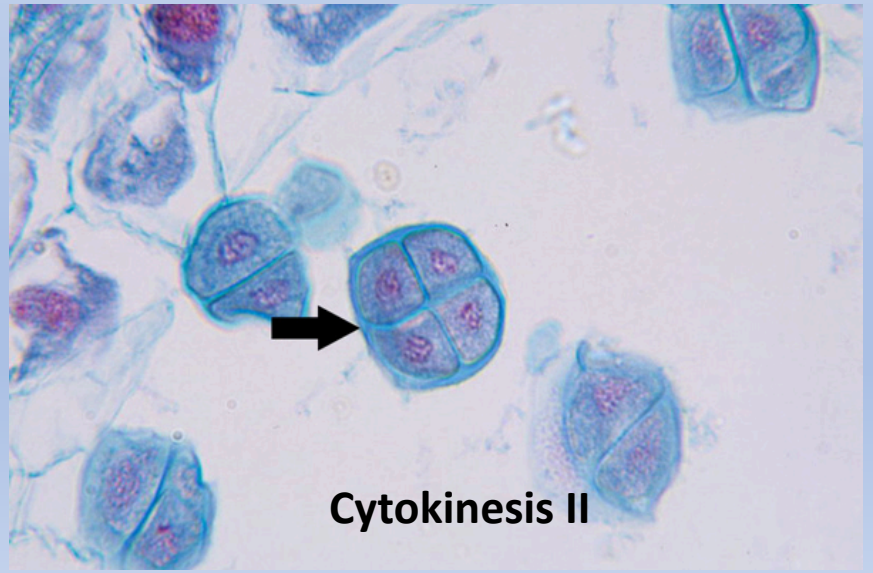
https://youtu.be/kQu6Yfrr6j0?feature=shared


Prophase II


Metaphase II


Anaphase II


Telophase II


Cytokinesis II

Practical Procedure:

Aim: To observe stages of mitosis in onion (Allium cepa) root tip cells using **methylene blue stain.**

Materials Required:

Onion bulb Beaker (100 mL)Razor blade or scalpel Forceps Glass slide and cover slip Dropper Watch glass or Petri dish1N HCl (hydrochloric acid)Methylene blue stain (1–2%)Compound microscope Distilled water Filter paper/blotting paper Spirit lamp or Bunsen burner (optional, for gentle heating)

Procedure:1. Root Tip Preparation Place the onion bulb on a beaker filled with water, root side down. Allow it to grow for 3–5 days until root tips are 1–2 cm long.2. Fixation (to kill and preserve cells) Cut 1–2 cm of the growing root tips using a scalpel. Place them in a Petri dish or test tube. Add a few drops of 1N HCl and leave for 5 minutes (or gently heat for 2–3 minutes to soften the cell walls).3. Staining Rinse the root tips with distilled water. Stain the softened root tips with 1–2% methylene blue solution for about 5–10 minutes. This stains the chromatin/DNA and makes mitotic stages visible.4. Slide Preparation Take one stained root tip and place it on a glass slide. Add a drop of water (optional) and gently press it using the blunt end of a needle or the flat side of a scalpel to spread the cells into a thin layer ("squash" technique). Carefully place a cover slip over it to avoid air bubbles.5. Microscopic Observation Place the slide under a compound microscope. Start with the low-power objective to locate the cells, then switch to high power. Look for cells showing different mitotic stages: Prophase – condensed chromosomes Metaphase – chromosomes aligned at the center Anaphase – chromosomes pulled apart Telophase – formation of two nuclei Interphase – resting stage (not mitosis) Precautions: Handle acids and stains with care; wear gloves. Ensure root tips are freshly grown for clear mitosis stages. Avoid overheating during acid treatment. Press the cover slip gently to avoid breaking or damaging the cells.

https://youtube.com/shorts/DvykzQstyrc?si=_9sN5iyP5O8SxYFQ

Summary

Meiosis is a reduction division essential for producing gametes in sexually reproducing organisms. It involves two successive divisions following one DNA replication, resulting in four genetically diverse haploid cells. Meiosis I separates homologous chromosomes, while Meiosis II separates sister chromatids. The lab session included a practical component on mitosis using onion root tips to visualize stages such as prophase, metaphase, anaphase, and telophase under a microscope after appropriate staining. Understanding meiosis and mitosis is crucial for grasping key principles of genetics and cell biology.