Medical BIO. LAB.
2025/2026

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Medical Biology Laboratory

Course Overview

- Introduces students to histology, parasitology, and microbiology.
- Focuses on practical examination of tissues, cells, microorganisms, and structures.
- Emphasizes accurate structure identification, understanding tissue function, and learning laboratory techniques.

Lab 1: Lab Safety

Lab Safety Importance

- Protects researchers, students, and staff from hazards.
- Essential protocols prevent accidents.
- Maintains a controlled environment for precise scientific investigation.

Fundamentals of Lab Safety

Personal Protective Equipment Overview

- **Gloves, lab coats, and eye protection:** Essential for shielding against chemical spills, biological agents, and debris.
- **Respiratory protection:** Required in settings with airborne contaminants like fine particulates or volatile chemicals.

This graph illustrates essential lab safety equipment for conducting experiments safely.

Fundamentals of Lab Safety *cont.*

Guidelines for Appropriate Lab Dress

- ❑ Tie long hair back.
- ❑ Avoid loose clothing for fire safety.
- ❑ Wear full-cover footwear.

Fundamentals of Lab Safety *cont.*

Chemical Safety Overview

- ❑ Importance of proper labeling and storage following GHS.
- ❑ Separation of incompatible chemicals in specific units.
- ❑ Companionship of Material Safety Data Sheets (MSDS) for handling, storage, disposal, and emergency measures.

GHS= Globally Harmonized System

DO NOT FORGET TO:

- ❑ Notify the instructor if chemical spills.
- ❑ Rinse with water for 15 minutes.
- ❑ Wash hands after labs.

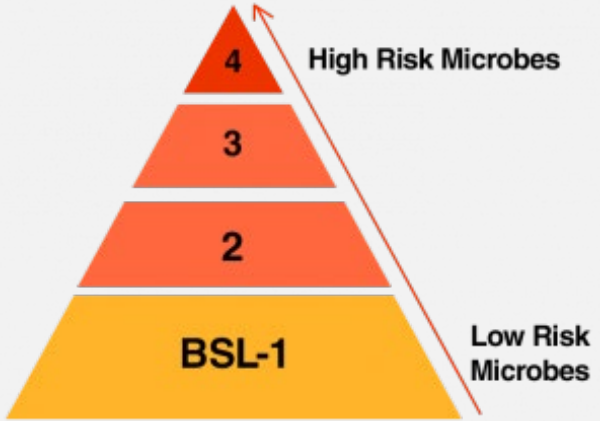
Fundamentals of Lab Safety *cont.*

Biological Safety Overview

- ❑ Handling biological materials using Biosafety Levels (BSL).
- ❑ BSL-1 for non-pathogenic materials, BSL-4 for high-risk pathogens.
- ❑ Proper waste disposal including autoclaving, chemical inactivation, and biohazard disposal.

Biosafety Levels Overview

- BSL-1: Lowest risk level, minimal protective measures.
- BSL-2: Moderate-risk organisms, lab coats, gloves, basic containment.
- BSL-3: High-risk pathogens, stringent safety protocols, controlled lab access, specialized ventilation, protective gear.
- BSL-4: Highest biosafety level, involving dangerous pathogens, maximum containment persons, full-body suits, and demanding access controls.



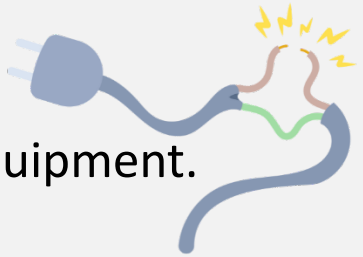
Fundamentals of Lab Safety *cont.*

Fire and Electrical Safety Overview

Fire Prevention:

- ❑ Use designated areas for flammable materials.
- ❑ Store in flame-resistant cabinets.
- ❑ Understand the usage of fire extinguishers and blankets.
- ❑ Never leave the heat source unattended.
- ❑ Use tongs or gloves before handling.
- ❑ Avoid placing hot glassware on the desk or in cold water.

Electrical Hazards:



- ❑ Regularly inspect electrical equipment.
- ❑ Avoid overloading circuits.
- ❑ Only use electrical plugs in outlets.
- ❑ Unplug equipment after use.
- ❑ Keep cords, wires, and appliances away from water.

Fundamentals of Lab Safety *cont.*

Sharp Object Safety Guidelines

- ❑ Always cut away from fingers and body.
- ❑ Carry sharp objects with pointed and angled tips.
- ❑ Never catch falling sharp instruments.
- ❑ Only grasp sharp instruments by handles.
- ❑ Dispose of broken glass and sharp objects.

Friendly Reminder

Safety is not a choice; it is necessary. Every care taken now leads to a safer tomorrow.

Safety Symbols

Biohazardous Material Identification

- Three interlocking circles in orange or red.
- Indicates the presence of bacteria, viruses, disease-causing agents.

Safety Symbols

Toxic Material Symbol Overview

- Skull and crossbones.
- Represents toxic chemicals/organisms.
- Can be inhaled, ingested, or absorbed.

Safety Symbols

Flammable Material Symbol Overview

- ❑ Flame icon.
- ❑ Warns of easily ignited substances.

Safety Symbols

Corrosive Material Symbol Overview

- ❑ Defines substance causing skin burns.
- ❑ Identifies materials corroding metals.

Safety Symbols

Compressed Gas Symbol Overview

- ❑ Gas cylinder icon.
- ❑ Symbolizes pressurized gas containers.
- ❑ Hazardous if improperly handled.

Safety Symbols

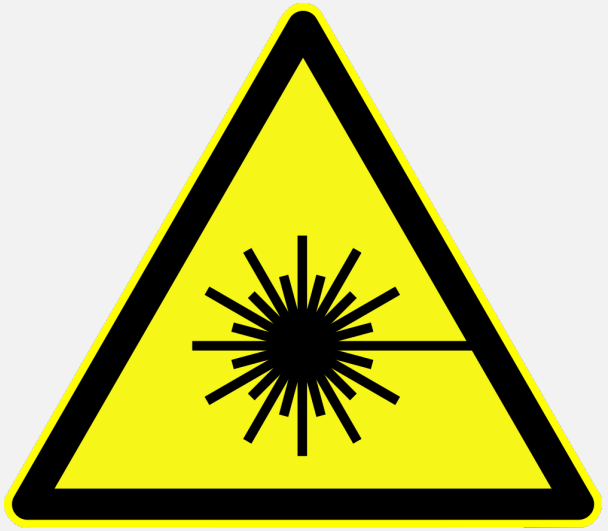
Radiation Symbol Overview

- ❑ Three-leafed icon.
- ❑ Indicates areas with radiation.
- ❑ Suitable for radiolabeled compounds or X-ray equipment.

Safety Symbols

Laser Hazard Symbol

- Starburst with radiating beams.
- Used in labs requiring eye and skin protection.



Safety Symbols

Oxidizing Agent Symbol Overview

- Circle with flames.
- Warns of chemicals causing combustibility or explosion.

Safety Symbols

Electrical Hazard Symbol

- ❑ Lightning bolt in triangle.
- ❑ Indicates areas with electrical equipment.
- ❑ May pose shock or fire hazards.

Safety Symbols

General Warning Symbol Overview

- ❑ Exclamation mark in triangle.
- ❑ Used for general alerts.
- ❑ Often paired with additional information.

Safety Symbols

Eye Protection Required Symbol

- ❑ Indicates mandatory areas for eye protection.
- ❑ Prevents injury from chemicals/organic agents.

Remember..

Safety is more than simply a guideline; it is our shared obligation to care for each other.

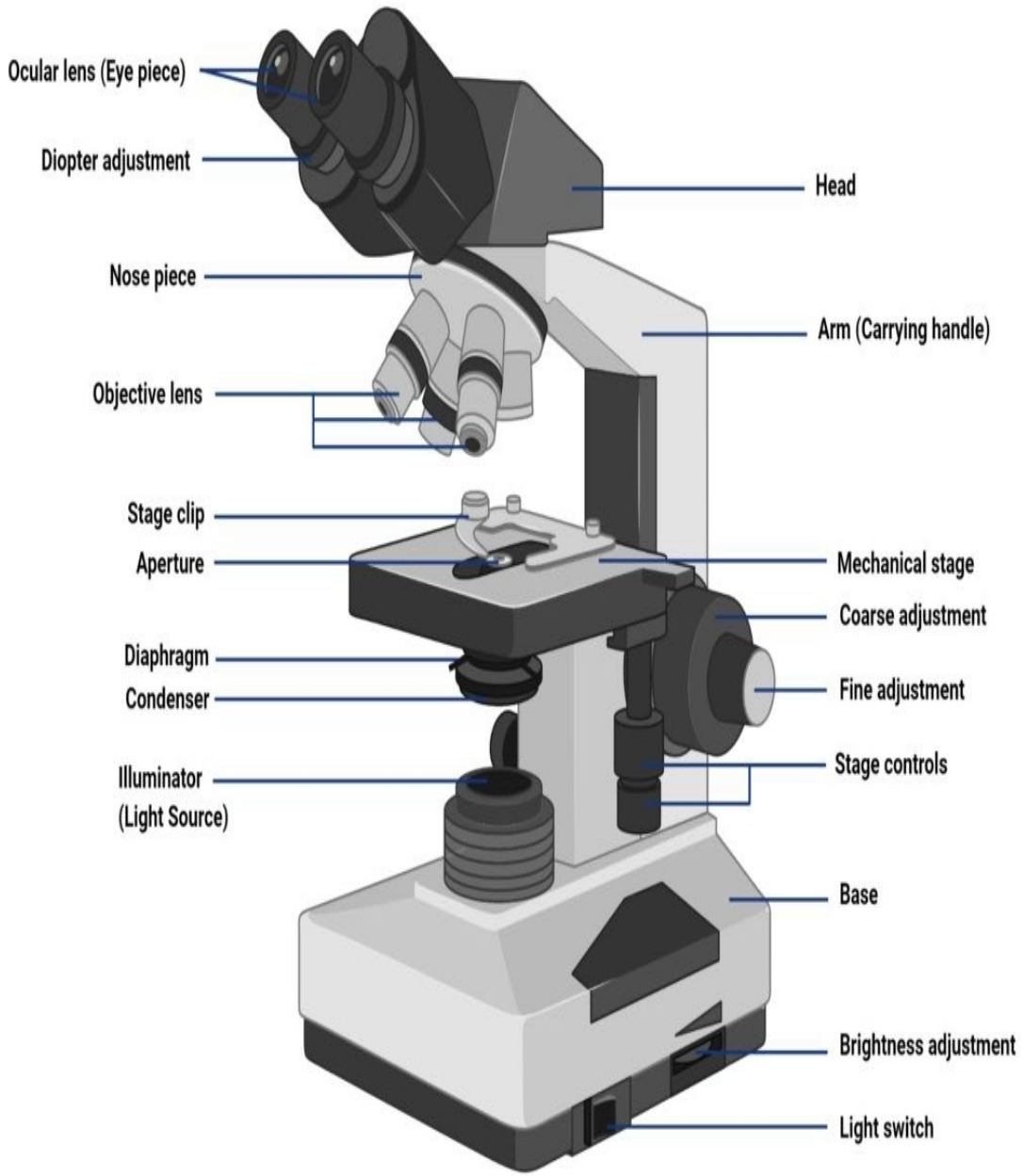
Emergency Procedures in Labs

- Handling chemical or biological spills with spill kits and first aid stations.
- Knowing the location of emergency exits, eyewash stations, and showers.
- Regular review of evacuation and shelter-in-place protocols.

Assignment

Discuss what might happen if people don't follow safety rules, using examples from past lab accidents or cases that have been recorded.

What are the parts of the light microscope?



Principles of Light Microscopy

- Light microscopy is based on the principles of light refraction and magnification.
- A light source illuminates the sample, and lenses bend (or refract) the light to magnify the resulting image.

Parts of The Light Microscope

- The components of a light microscope are **categorized into optical, mechanical, and lighting systems**, each performing distinct roles. Presented in the next slides is a thorough breakdown of these components.

A- Optical Components

These components magnify the specimen.

1) **Eyepiece (Ocular Lens):**
- Located at the top of the microscope.
- Magnifies the image produced by the objective lens (usually 10x).

2) **Objective Lenses:**
- Positioned on the rotating nosepiece.
- Provide varying magnification levels (e.g., 4x, 10x, 40x, 100x [oil immersion]).

3) **Condenser Lens:**
- Focuses light from the illumination source onto the specimen.
- Enhances resolution and contrast.

4) **Iris Diaphragm:**
- Adjusts the amount of light that reaches the specimen.
- Helps control contrast.

Condenser Lens

Iris Diaphragm

B- Mechanical Components

These parts support and adjust the specimen and optical system.

1) Body Tube:

- To hold the eyepieces

2) **Prism:-** To reflect the image from the objective lens to the ocular lens.

3) Nosepiece (Turret):

- Holds the objective lenses.
- Can be rotated to switch between different magnifications.

4) Mechanical Stage:

- Flat platform where the slide is placed.
- Includes clips or a mechanical stage for holding and moving the slide.

5) Stage Adjustment Knobs:

- Allow precise movement of the slide in the X (horizontal) and Y (vertical) directions.

5-1- Coarse Focus Knob:

- Moves the stage up and down for general focusing.
- Used with low-power objectives.

5-2- Fine Focus Knob:

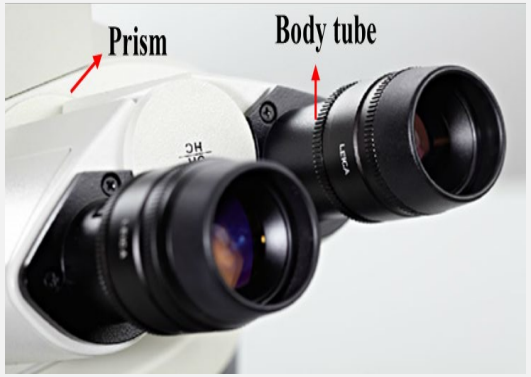
- Allows for precise focusing.
- Used with high-power objectives.

6) Base:

- Provides stability to the microscope.

7) Arm:

- Connects the base and the head of the microscope.
- Used for carrying the microscope.



Mechanical stage clips

Mechanical stage

C- Illumination Components

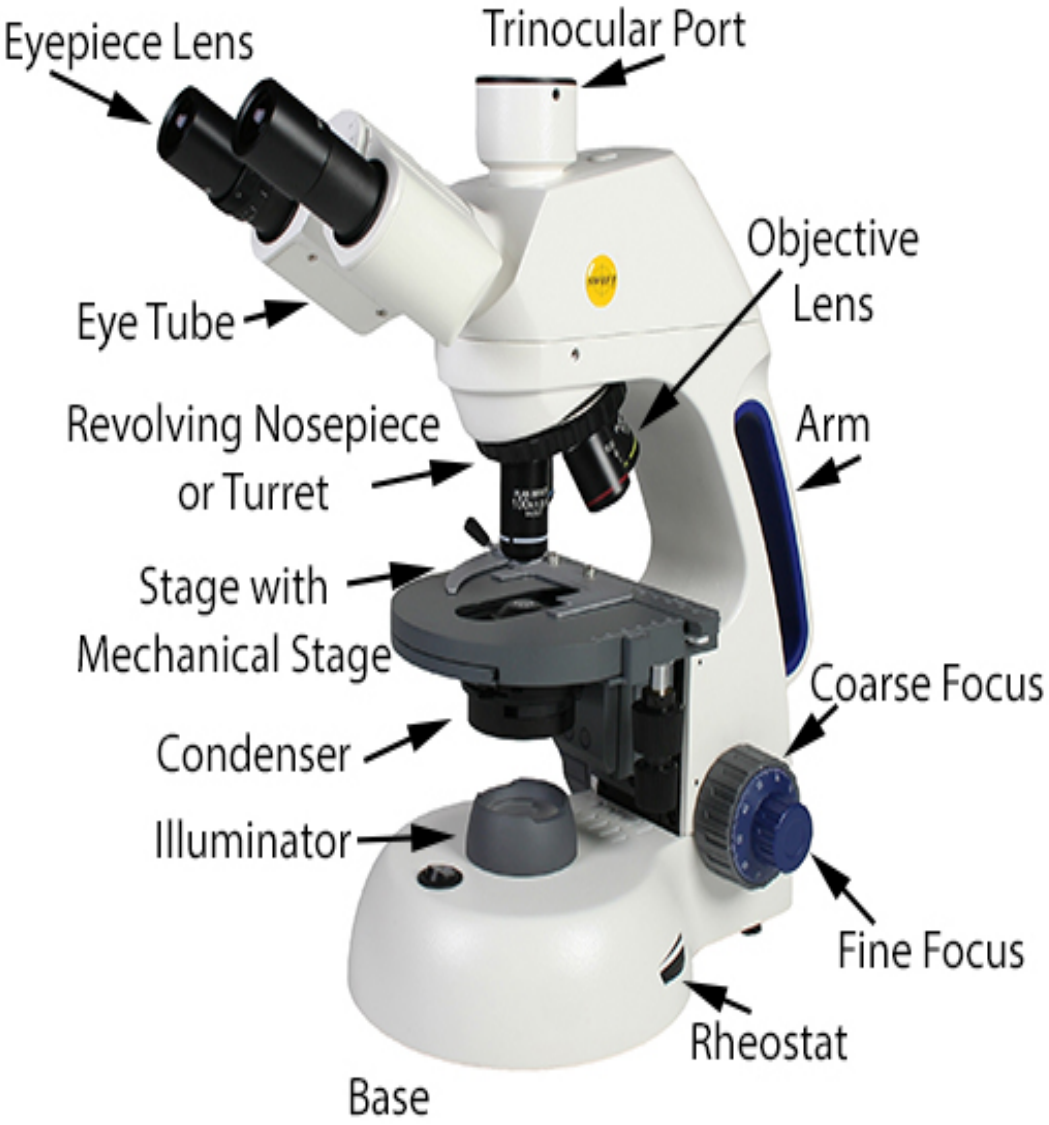
These provide the light necessary for viewing the specimen.

1- Illuminator:

- Located at the base of the microscope.
- Can be a mirror or a built-in electric light.

2- Rheostat (Dimmer Switch):

- Controls the intensity of the light source.



Magnification

- Your microscope has 3 magnifications: Scanning, Low and High. Each objective will have written the magnification. In addition to this, the ocular lens (eyepiece) has a magnification. The total magnification is the ocular x objective

Total Magnification:

Scanning

X

= 40 X

4X Scanning Objective 10X Eyepiece

Low power

X

= 100 X

10X Objective 10X Eyepiece

High power

X

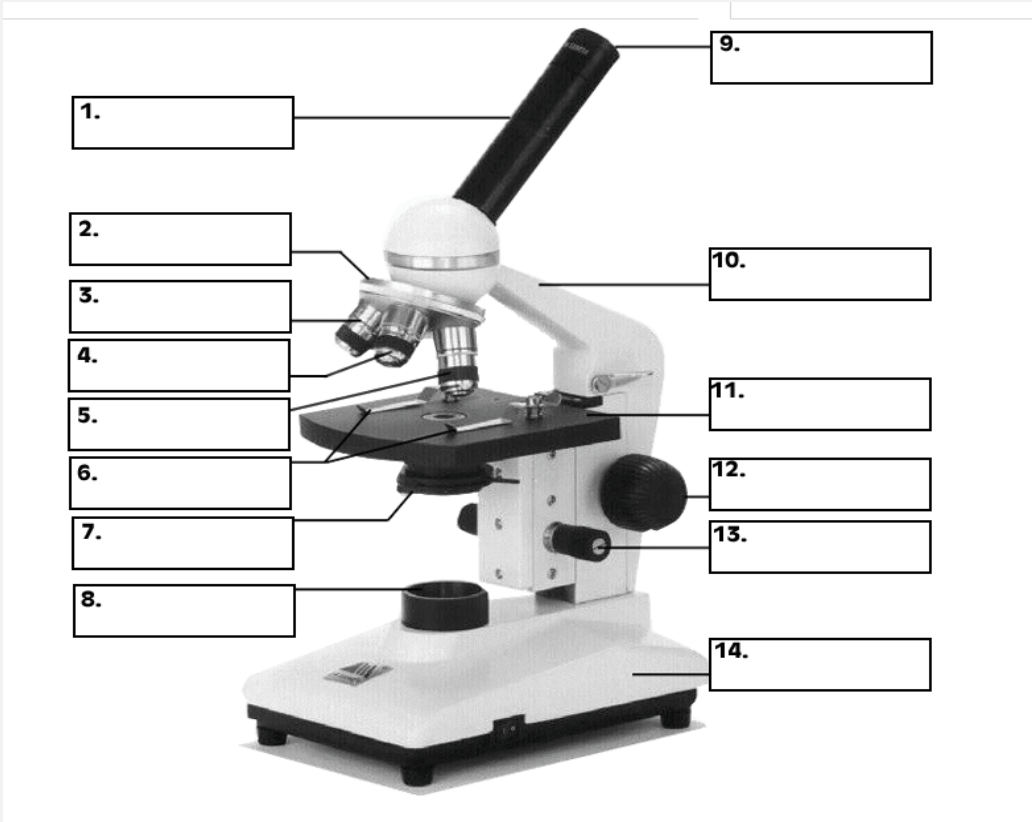
= 400X

40X Objective 10X Eyepiece

Let's Practice

Lab #2

Identify the part of the light microscope in the figure below :



Calculate the missing information in the Table?

Ocular Lens	Objective Lens	Power of Magnification
10	4	
5		200
	10	120

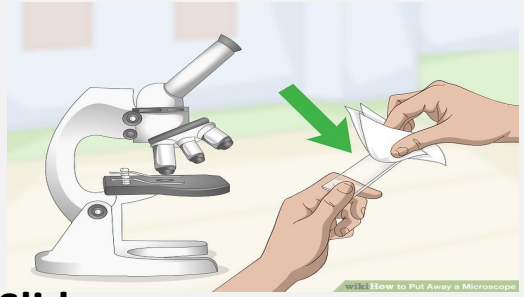
Lab 3: Instructions for Using a Light Microscope

1. Set Up the Microscope

- Place the microscope on a stable, flat surface.
- Ensure the light source or illuminator is plugged in (if electric).

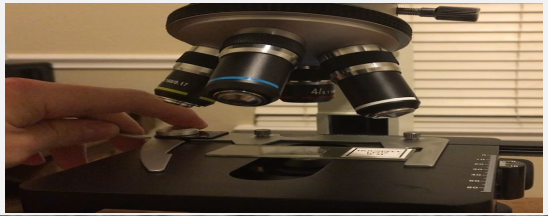
2. Prepare the Specimen

- Place your sample on a clean microscope slide.
- Cover it with a coverslip if needed.
- Maybe you already have prepared a fixed slide.



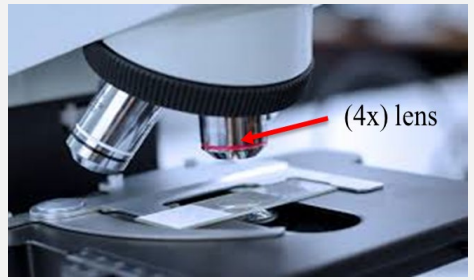
Position the Slide

- Place the slide on the stage.
- Use the stage clips to hold it in place.



4. Select the Objective Lens

- Rotate the nosepiece to the smallest scanner objective lens (**Always start with 4x**).

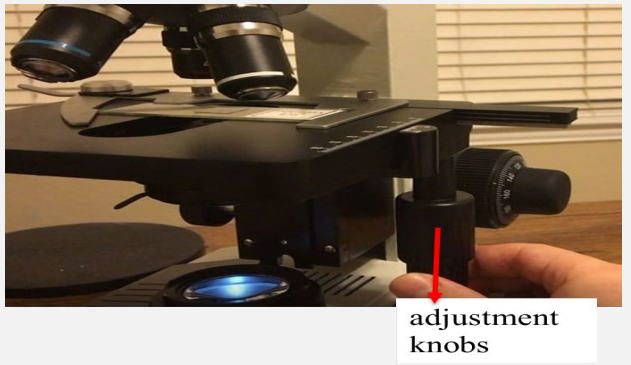


5. Adjust the Light

- Turn on the light source or adjust the mirror to focus light onto the slide.

6. Focus the Image

- Look through the eyepiece and adjust the interpupillary distance for comfort.
- Use the coarse focus knob to bring the specimen into general focus (**using for 4x and 10 x lens**).
- Adjust with the fine focus knob for a sharp image (**using for 40 x and 100x lens**).
- Look through the ocular lens and define the area to be examined



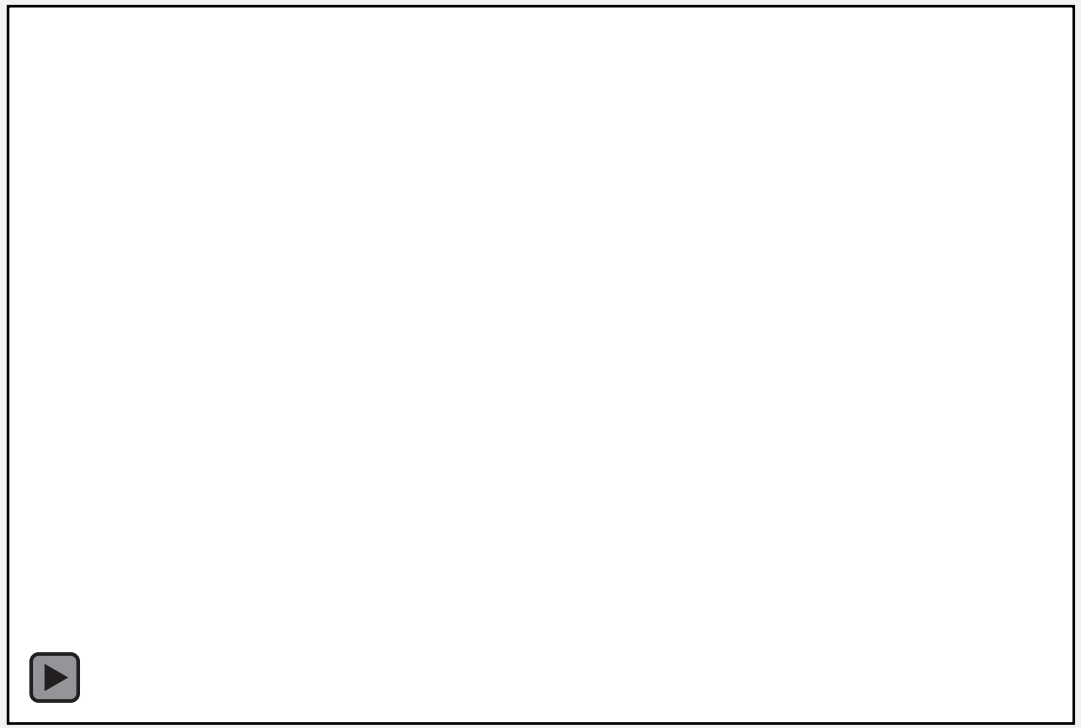
7. Increase Magnification

- Use the low power objective lens (10x) to enlarge the image, refocus using the coarse adjustment knob
- Use the high power objective lens (40x) to define required details. Refocus using only the fine focus knob.

After Using the Light Microscope

1. Return the nosepiece to the lens (4x)
2. Lower the stage and remove the slide carefully.
3. Clean the lenses with lens paper if needed.
4. Turn off the light source and unplug the microscope.
5. Cover the microscope to protect it from dust.

Overview of How to Use a Light Microscope



Note: The user's eyes will be able to see properly if the interpupillary distance (the space between the two eyepieces) is set to 64 using the ocular lenses.

Lab 4: Introduction to Mitosis

Definition:

- Mitosis is the process of nuclear division in eukaryotic cells that produces two identical daughter cells.

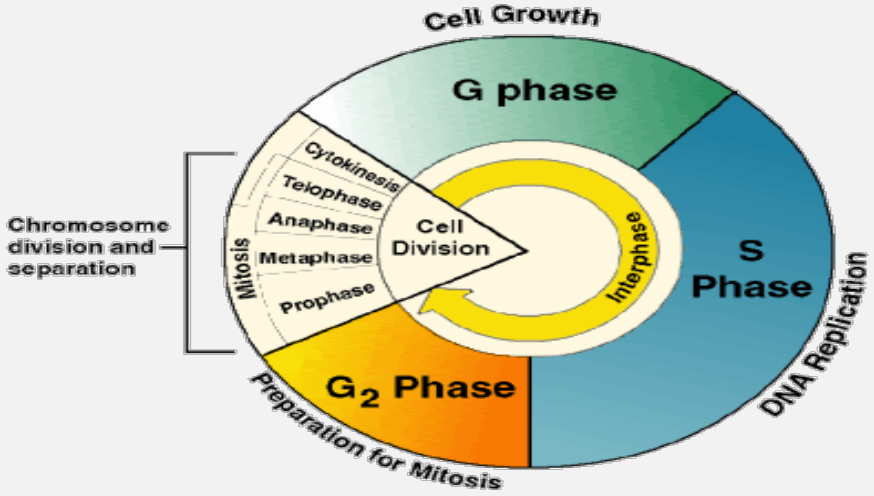
- **Importance:**

1) Growth and development.
2) Tissue repair.
3) Maintenance of genetic stability.

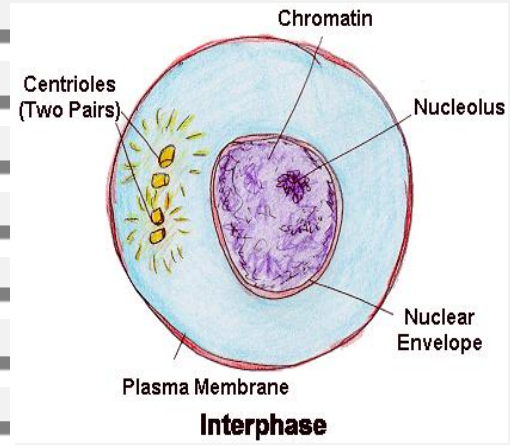
Cell Cycle Overview

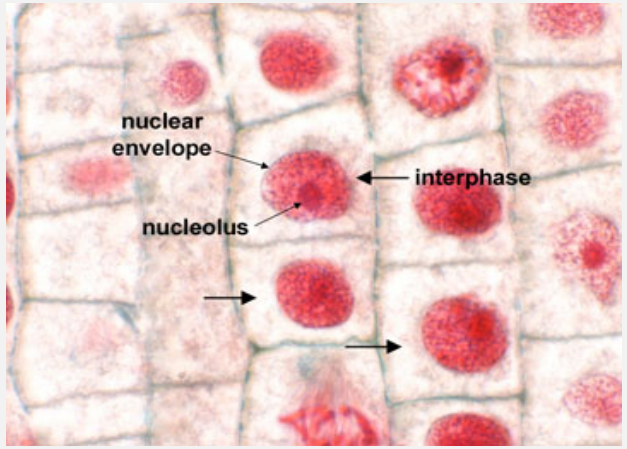
- Mitosis is a crucial part of the cell cycle.
- Cell cycle can be divided into:

1) Interphase (G1, S, G2).
2) M Phase (Mitosis and Cytokinesis).



Interphase is generally known as the DNA synthesis phase.
Structural change:-
1- Extended and condensed threads of chromatin material.
2- Intact nucleolus
3- continuous nuclear envelope
4- The cytoplasm of the cell consists of two pairs of centrioles, from which rays of microtubules extend to form a structure called asters, which leads to the formation of mitotic spindle fibers.

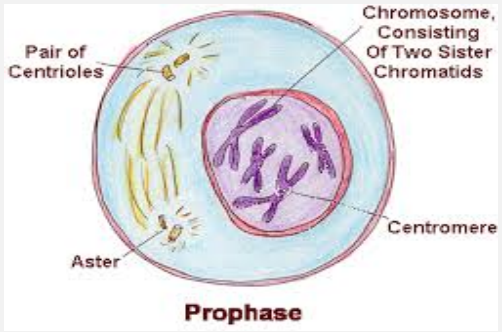


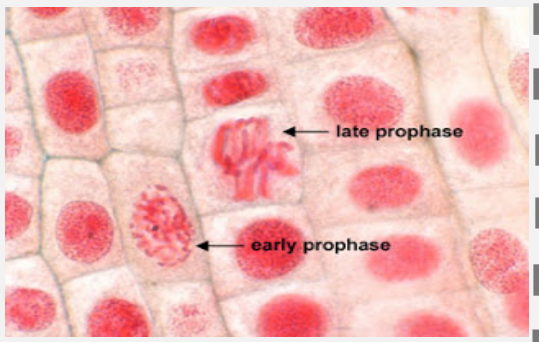


Phases of Mitosis

1- Prophase:

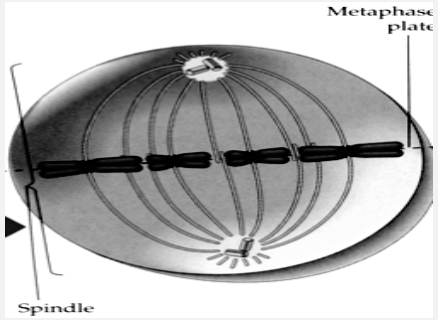
- ✓ Chromatin condenses into visible chromosomes.
- ✓ The nuclear envelope dissolves.
- ✓ Spindle fibers form.

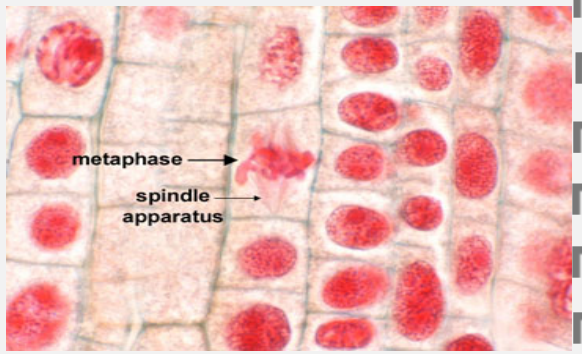




2- Metaphase:

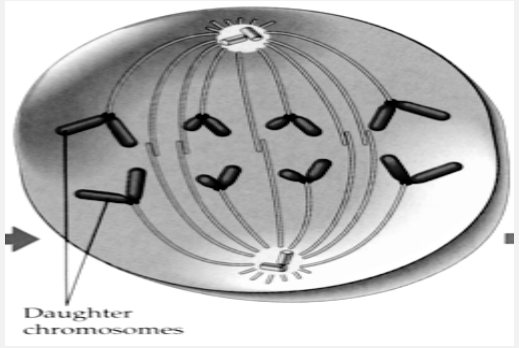
- ✓ Chromosomes align at the metaphase plate.
- ✓ Spindle fibers attach to kinetochores.

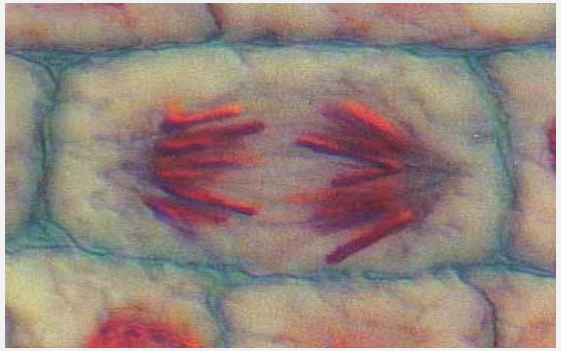




3- Anaphase:

- ✓ Sister chromatids separate and move to opposite poles.

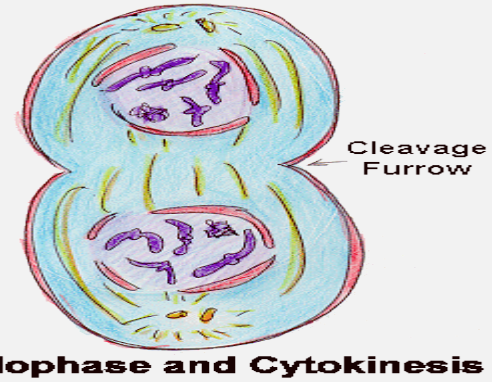


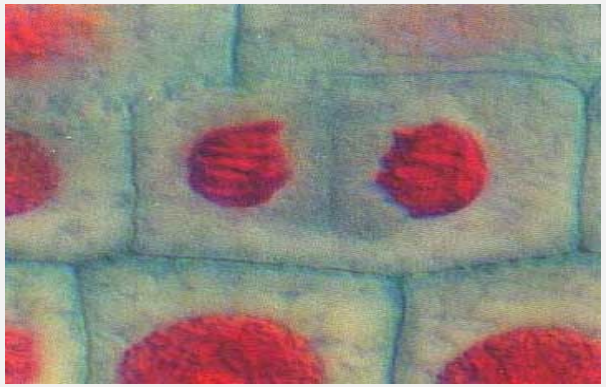


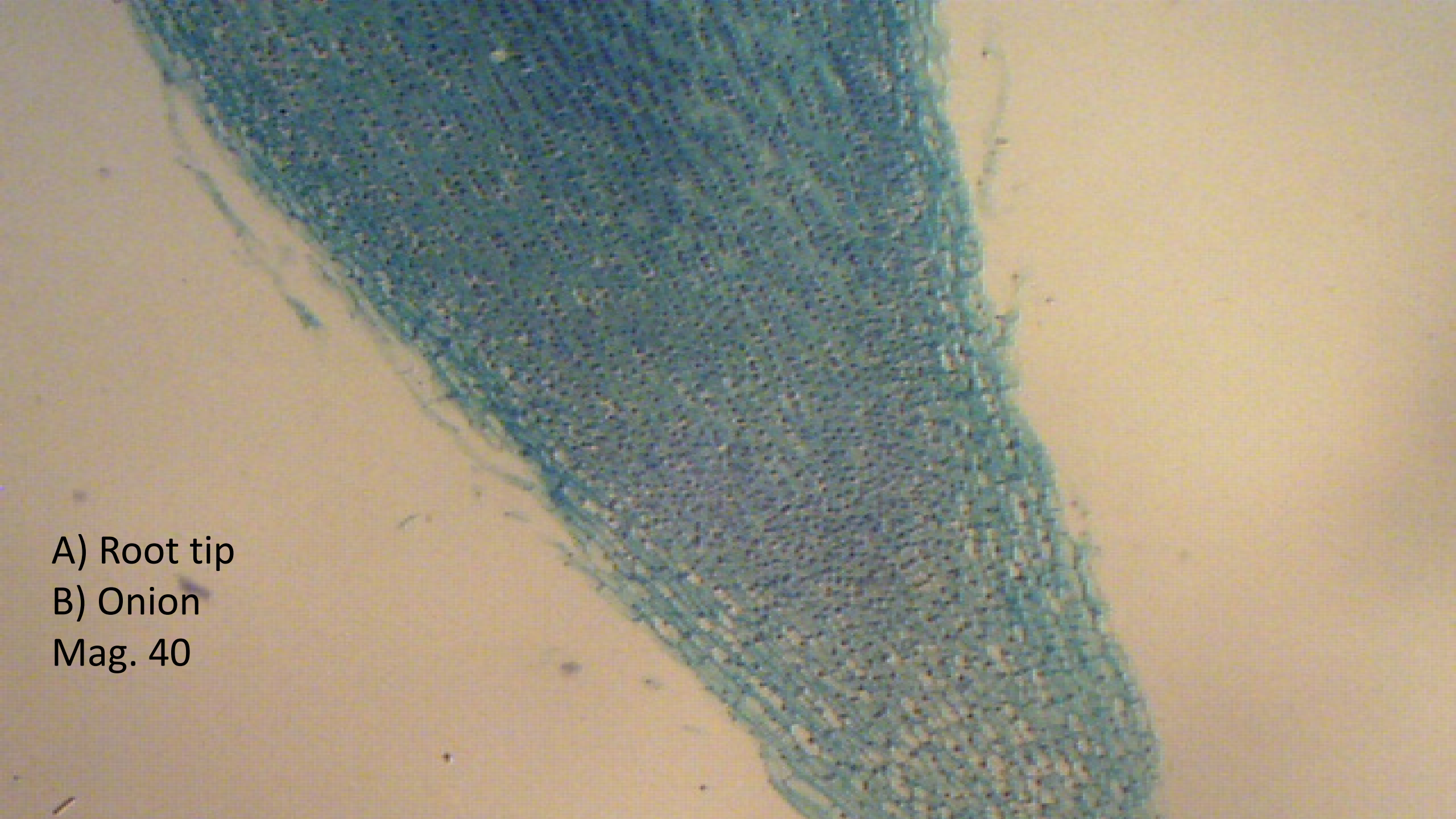
4- Telophase:

- ✓ Chromosomes decondense.
- ✓ Nuclear envelopes re-form around daughter nuclei.
- ✓ Spindle fibers disassemble.

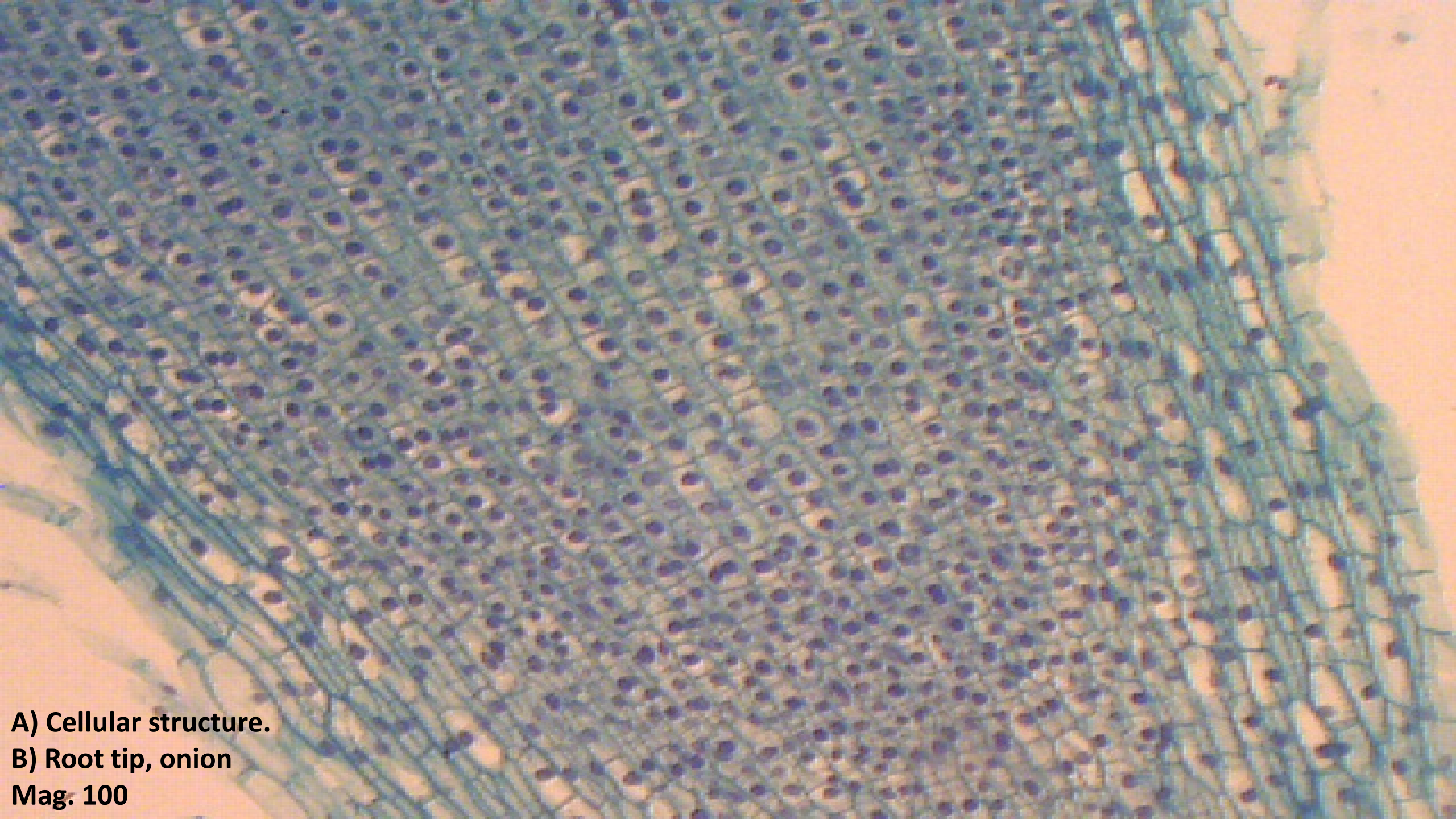
Cytokinesis is the division of the cytoplasm to form two distinct cells.







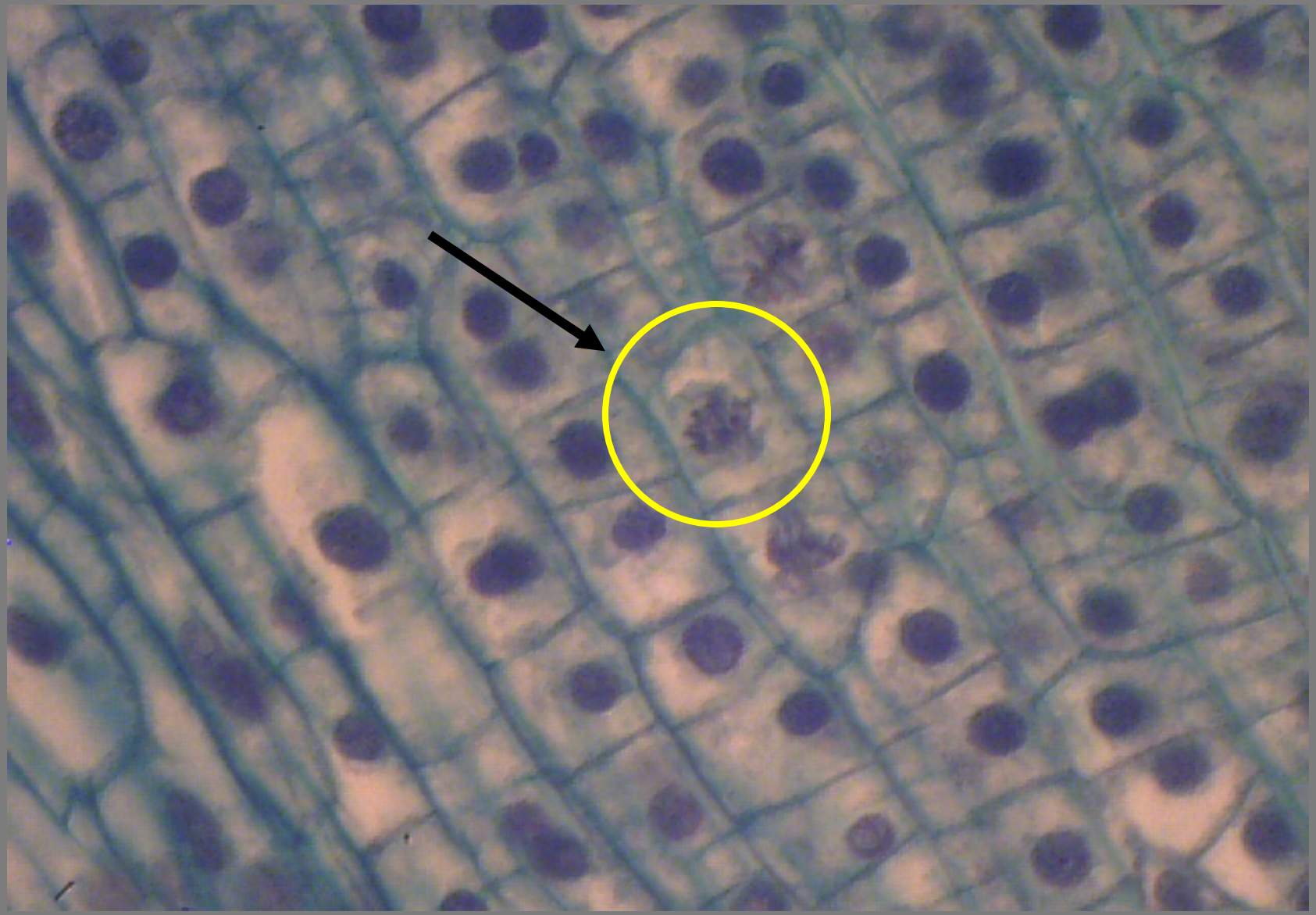
A) Root tip
B) Onion
Mag. 40



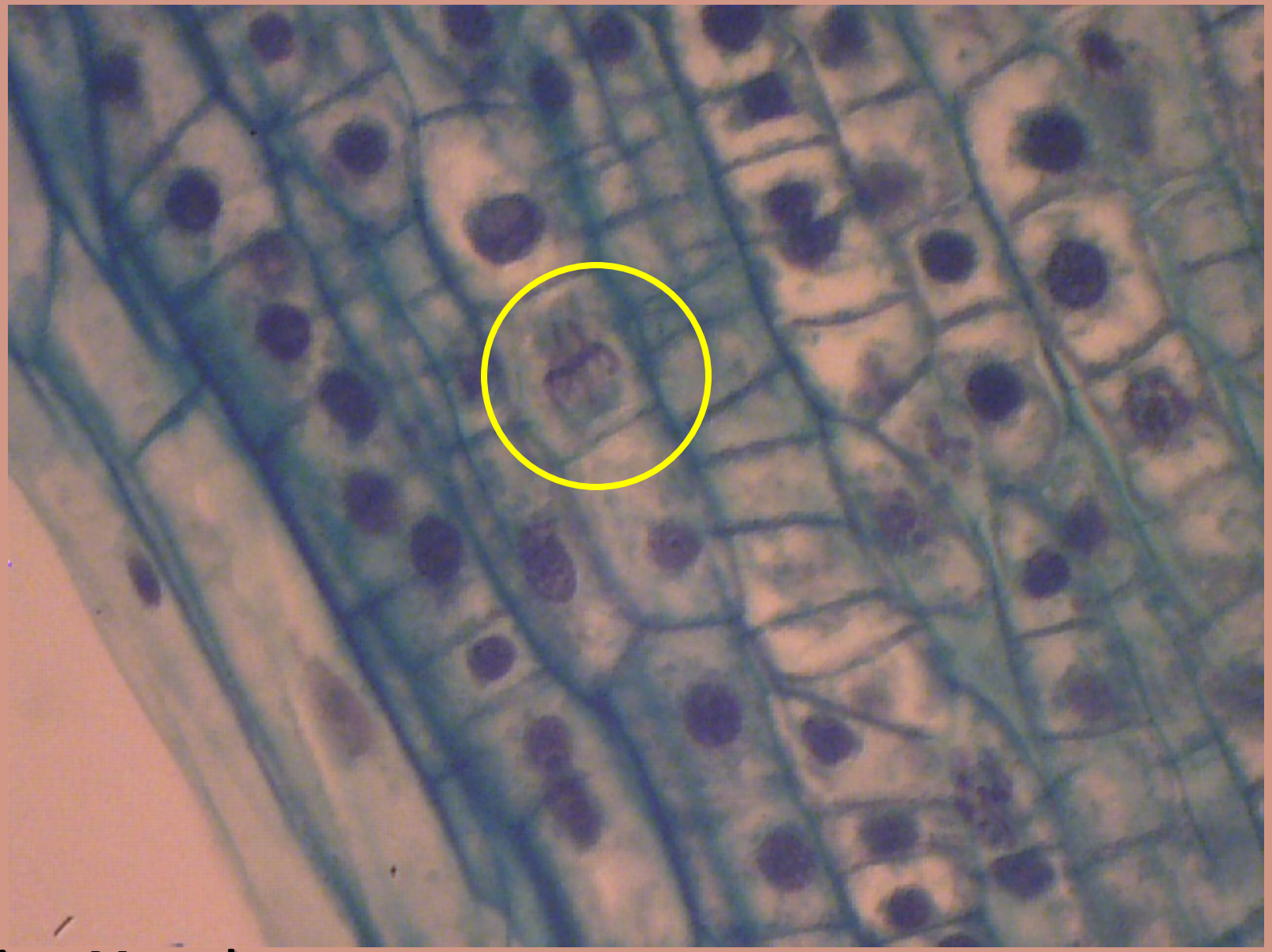
A) Cellular structure.
B) Root tip, onion
Mag. 100

A) Interphase, non-dividing cell
B) Root tip, onion
Mag. 400

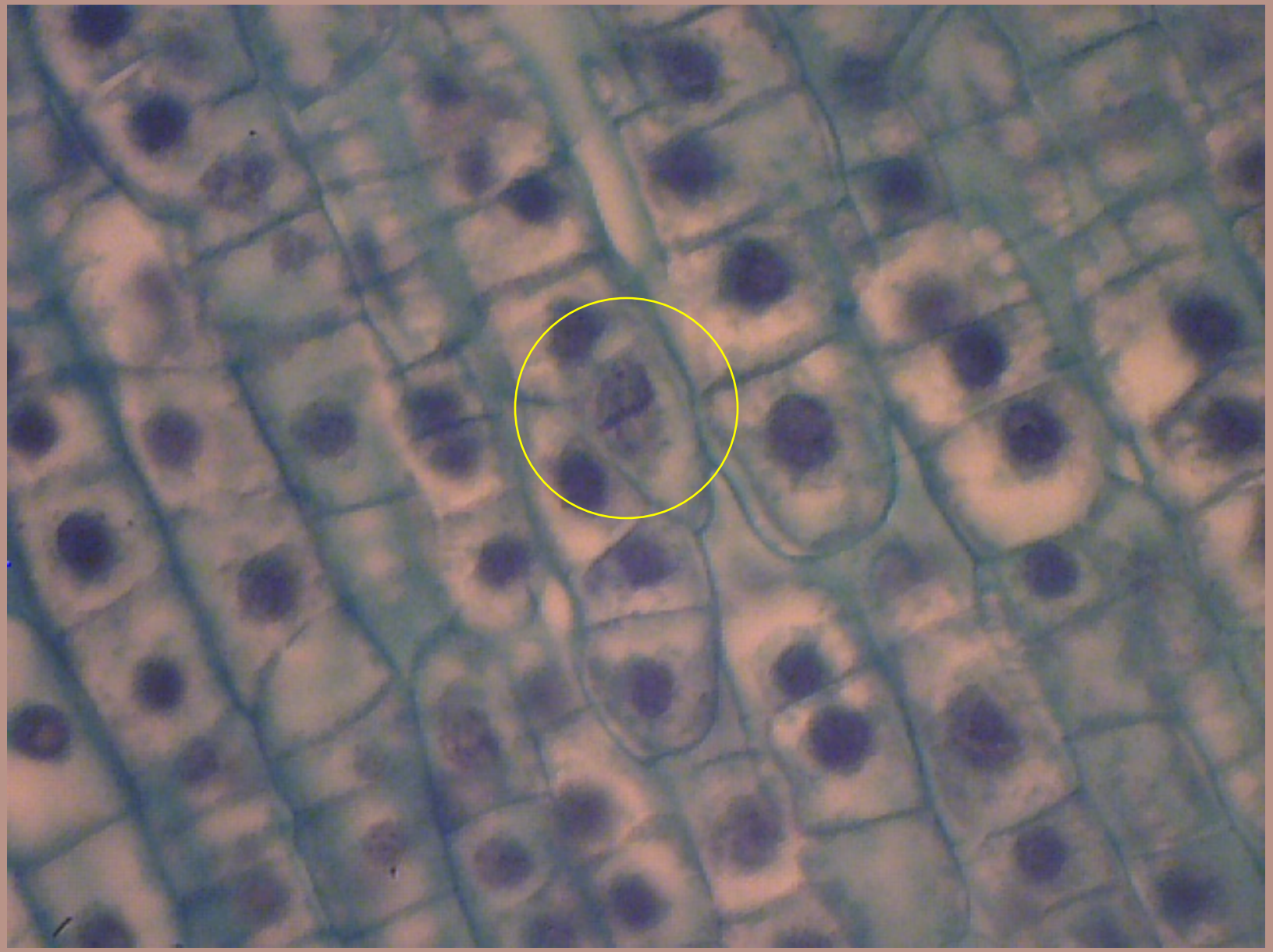

A) Mitotic division, Early Prophase
B) Root tip, onion
Mag. 400



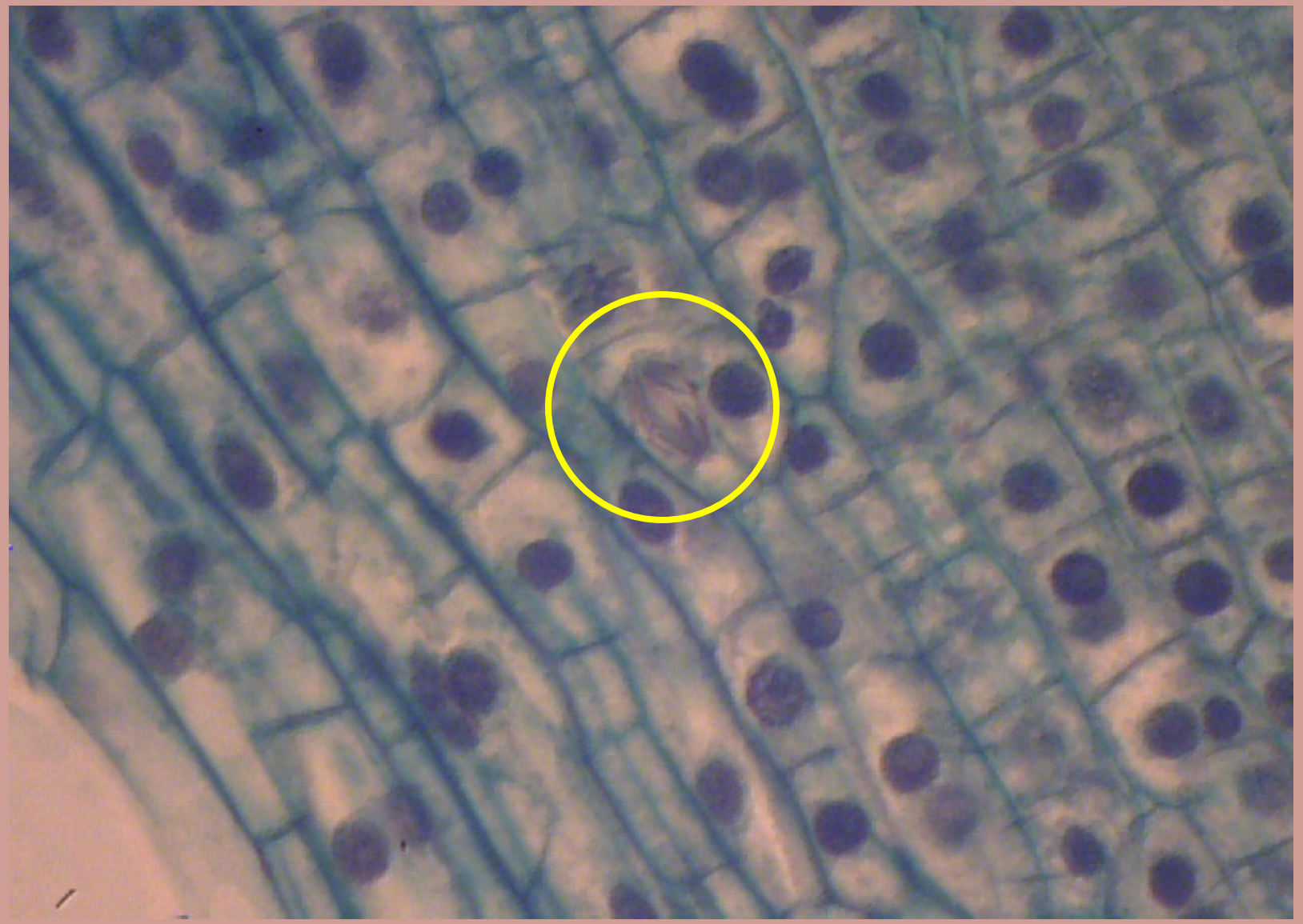
A) Mitotic division, Late prophase
B) Root tip, onion
Mag. 400



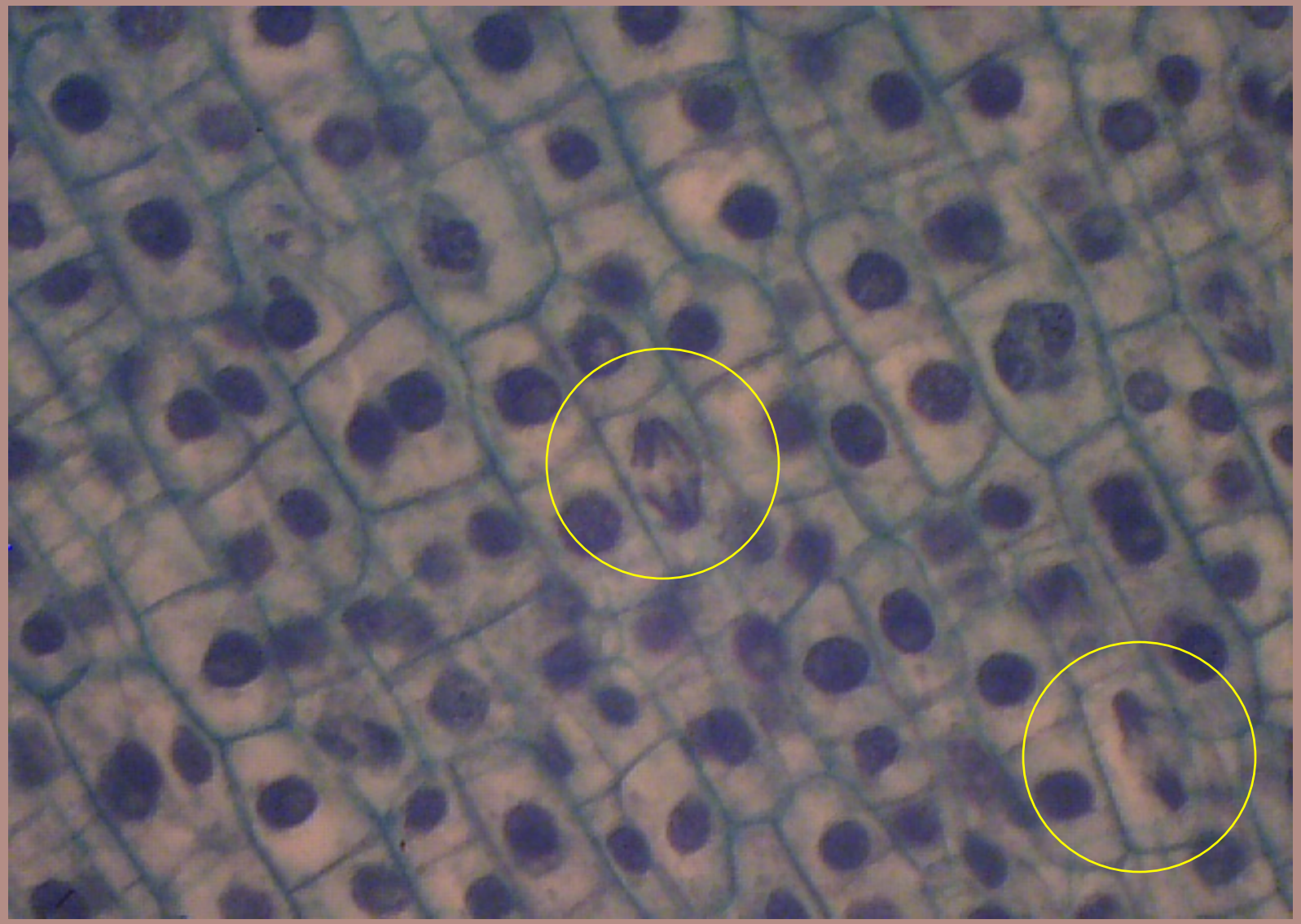
A) Mitotic division, Metaphase
B) Root tip, onion
Mag. 400



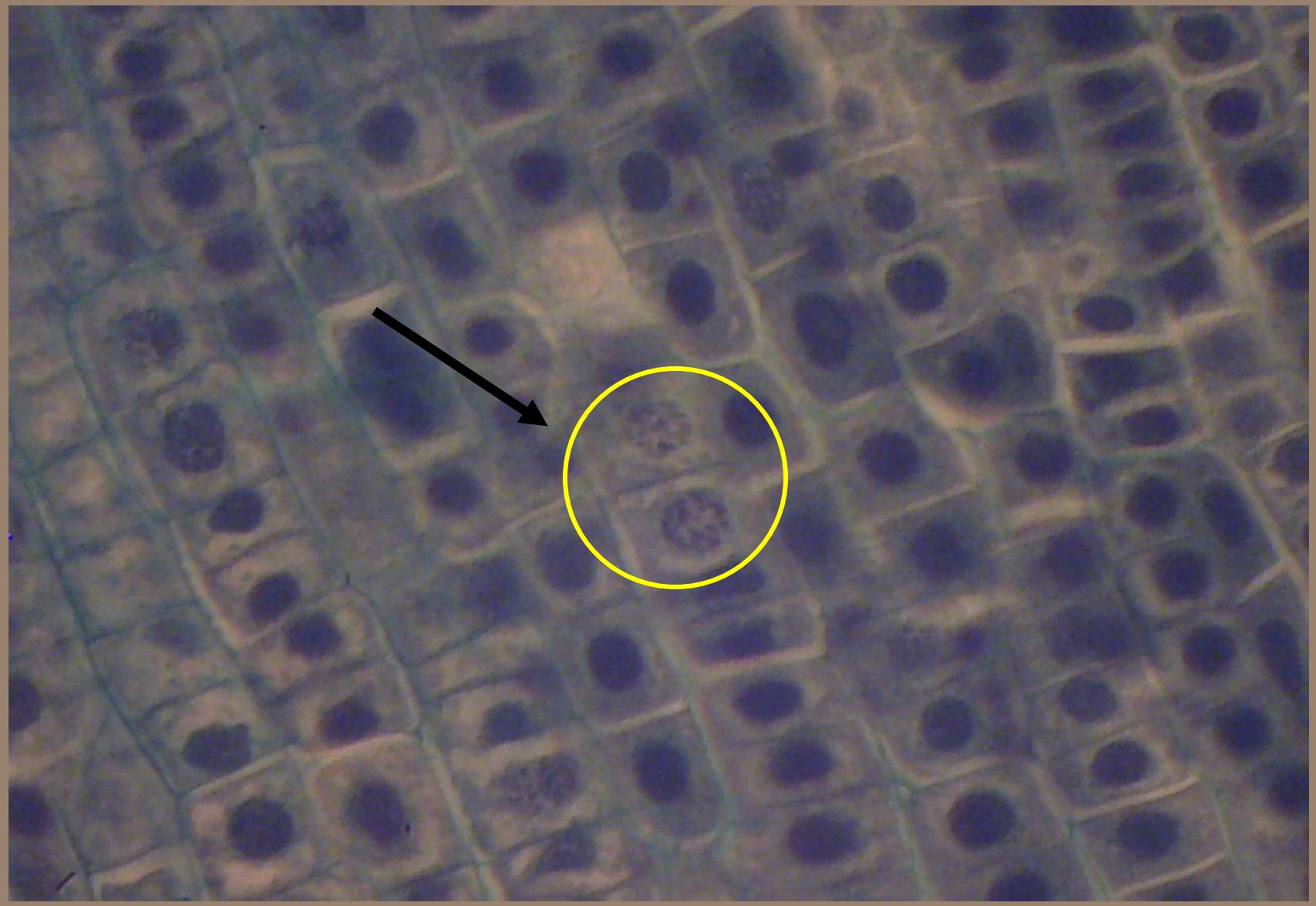
A) Mitotic division, Metaphase
B) Root tip, onion
Mag. 400



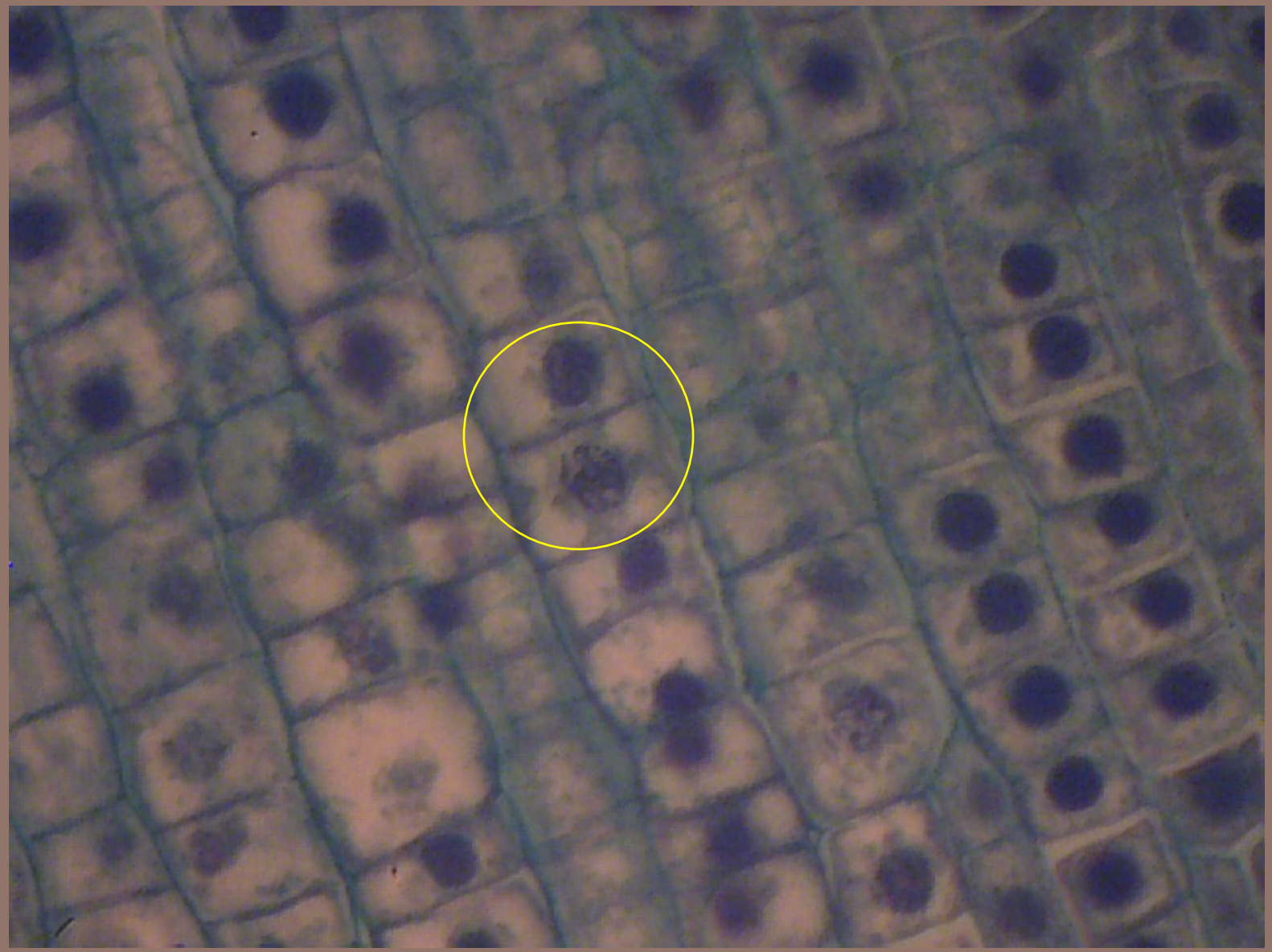
A) Mitotic division, Early anaphase
B) Root tip, onion
Mag. 400



A) Mitotic division, Early and late anaphase
B) Root tip, onion
Mag. 400



A) Mitotic division, Late Telophase
B) Root tip, onion
Mag. 400

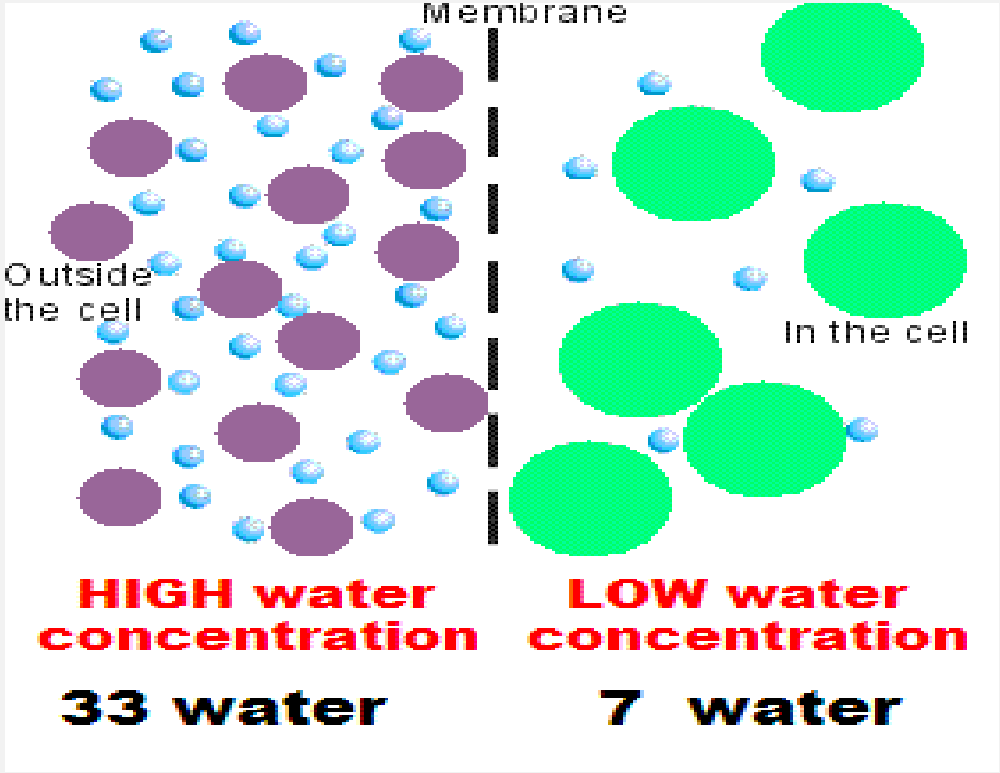


A) Mitotic division, Late Telophase
B) Root tip, onion
Mag. 400

Lab 5: Tonicity

- **Tonicity** is a measure of the ability of a solution to cause a change in cell shape or tone caused by the osmotic flow of water

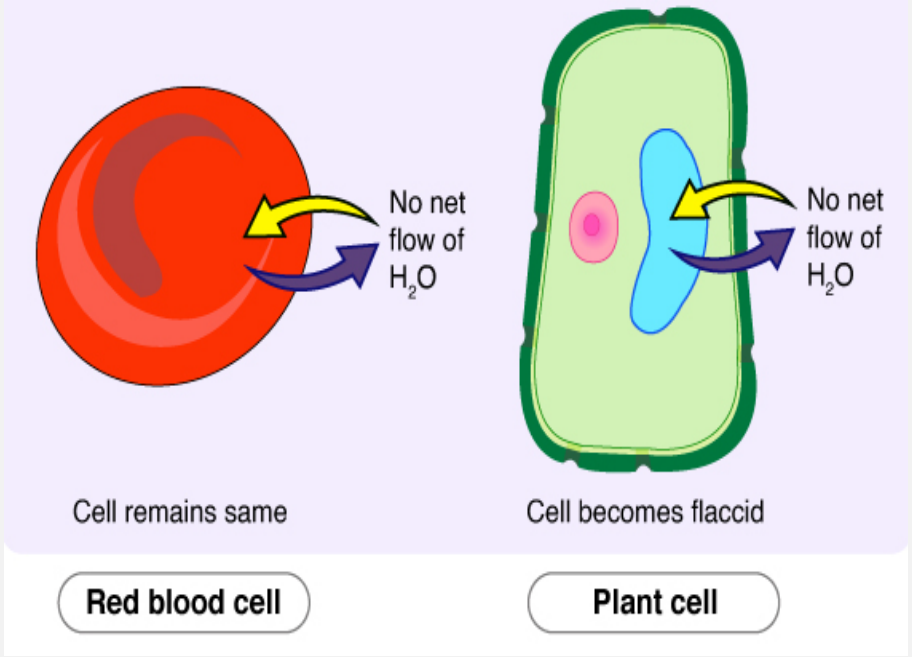
- **Osmosis** is the flow of water down the concentration gradient (from an area of high concentration to an area of low concentration)



Solution Types

1- Isotonic Solution

- Water movement across the semipermeable membrane is **equal in both directions**.
- The amount of water entering the cell matches the amount leaving it.
- Plant cells in an isotonic solution become **flaccid**.
- A 0.9% NaCl (saline) solution is isotonic for animal cells.

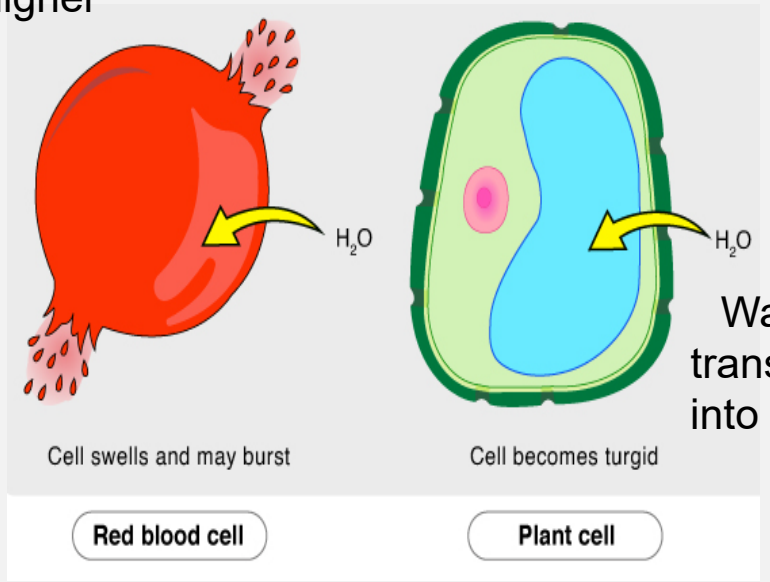


2- Hypotonic Solution

- There are more substances than water inside the cell. The <u>concentration</u> will try to even out. When RBCs are placed in **distilled water** they will swell
- Water will enter the cell. This causes the cell to swell (get larger) until it may burst.
- Hypotonic Plant cells are **Turgid**. The Process of swelling animal cells is called **hemolysis**

Solute concentration inside the cell is higher

Solute concentration inside the cell is higher

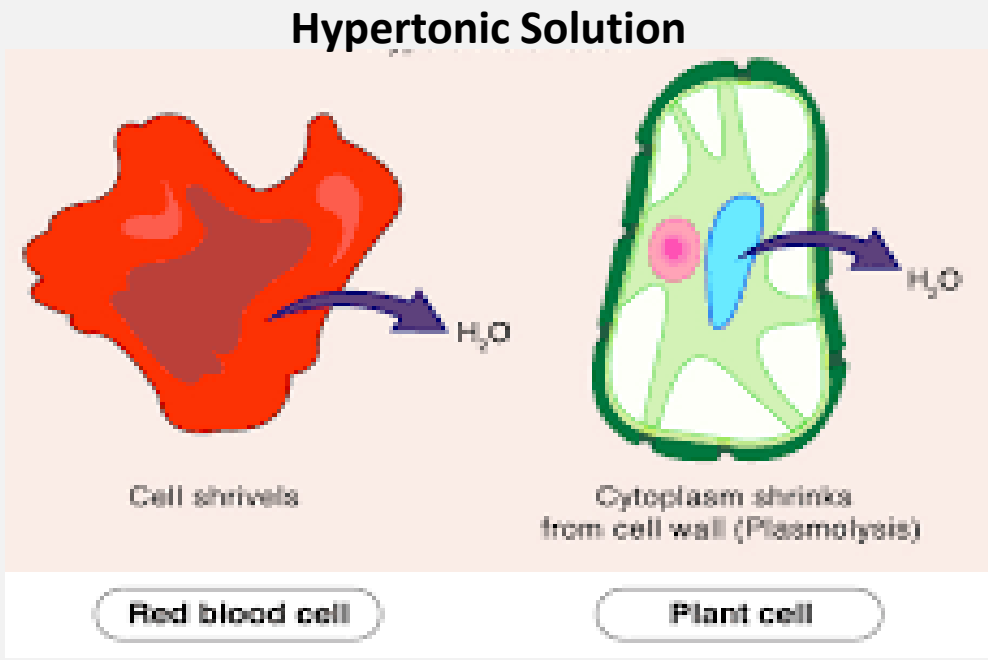


Water is transported into the cell

Hypotonic Solution

Hypertonic Solution

- There are fewer substances than water inside the cell. The concentration will try to even out. When RBCs are placed in **water (Any concentration of NaCl that is higher than 0.9%)** they will shrink
- Water will **leave the cell**. This causes the cell to shrink (get smaller)
- Hypertonic Plant cells are **Plasmolyzed**.
- The Process of shrinking animals' cells is called **crenation**



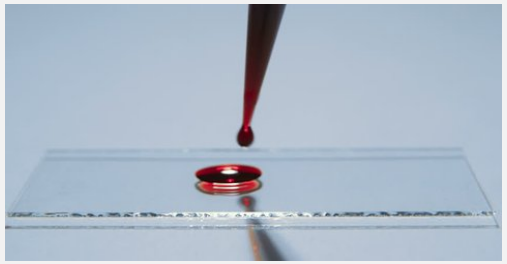
Tonicity

Tonicity of Solution	Concentration of Solute (outside of cell)	Water (outside of cell)	Net Movement	End-product
Isotonic	Same as cell	Same as cell	None	None
Hypotonic	Less than cell	More than cell	Cell gains water	Swells, turgor pressure
Hypertonic	More than cell	Less than cell	Cell loses water	Shrinks plasmolysis

Experiment To Test Tonicity

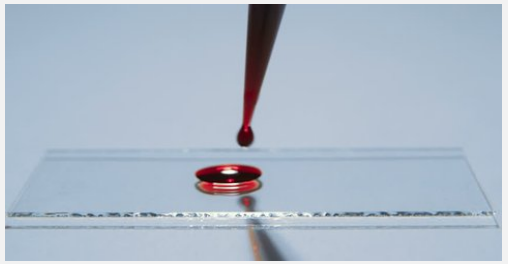
1) Obtain a 3 clean microscope slide and a cover slip
2) Clean the finger with ethanol and use a lancet to get the blood sample
3) Apply a small drop of blood to the center of all three slide
5) Place one drop of the isotonic solutions (normal saline) to the first slide, one drop of the hypotonic solutions (distilled water) to the second slide, and one drop of hypertonic solutions (Any concentration of NaCl that is higher than 0.9%) to the third slide
6) Place the cover slip over the blood/saline mixture, avoiding trapping large bubbles underneath.
7) Observe cell morphology under the microscope.

Experiment To Test Tonicity



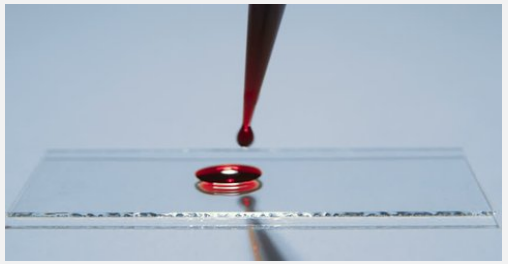
Isotonic

Normal saline
0.9 Nacl



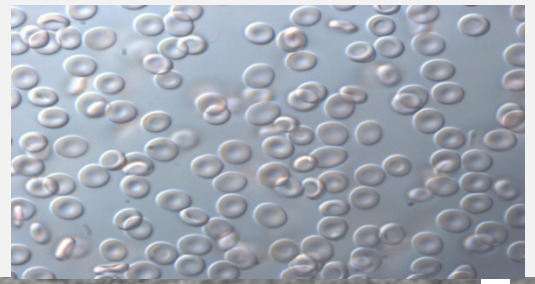
Hypotonic

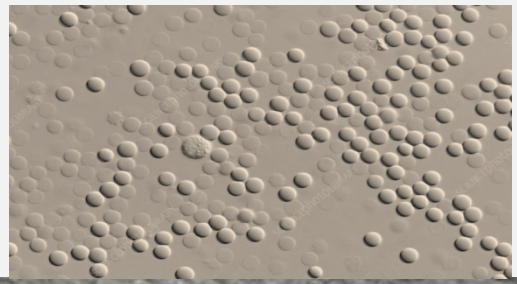
Distilled water

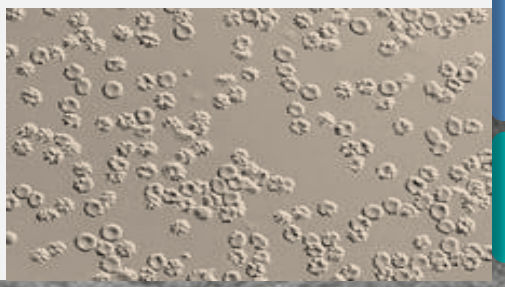


Hypertonic

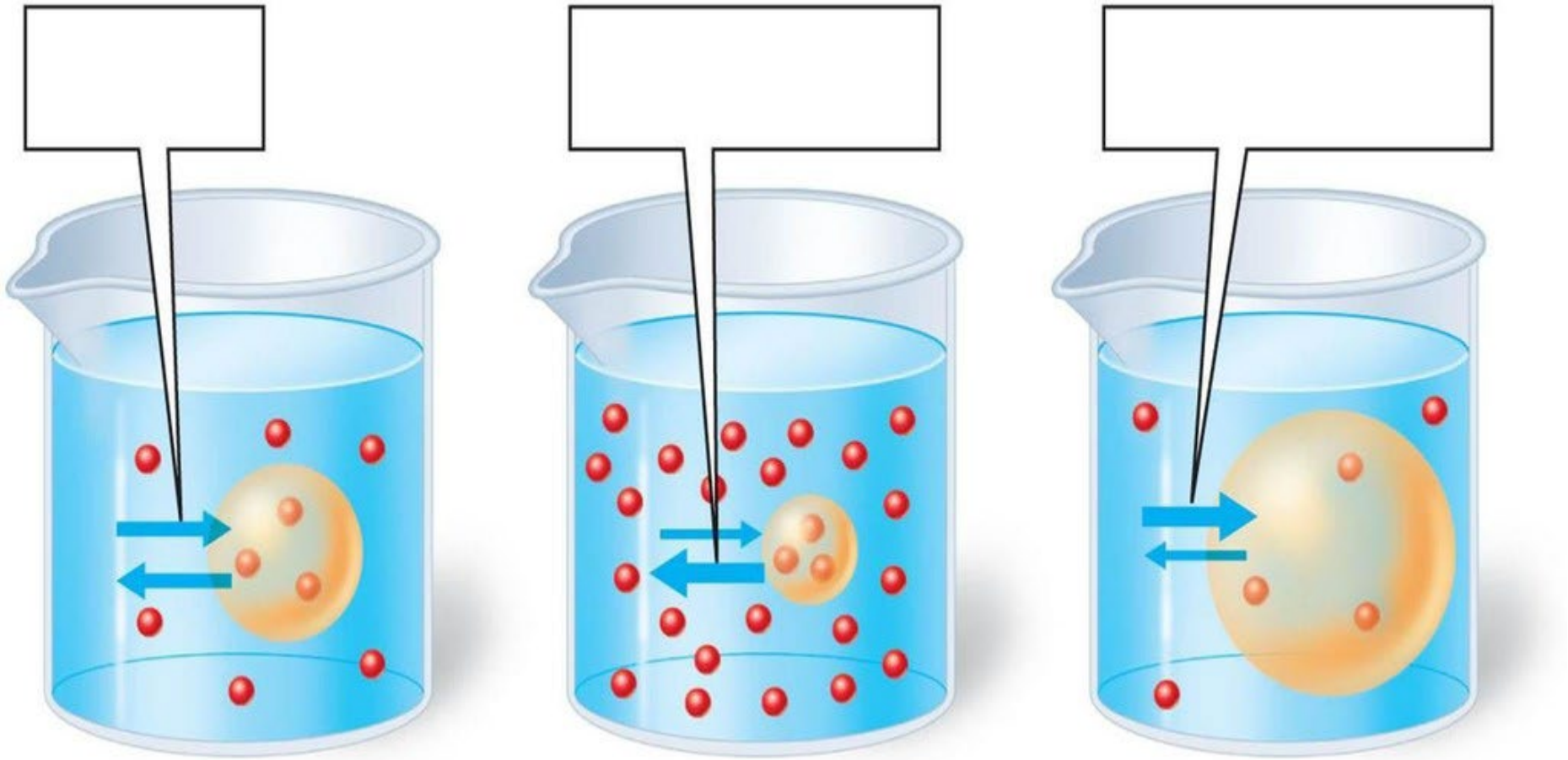
Any concentration of NaCl that is higher than 0.9%.







Quiz



Lab 6: Wet mount slide

1) Materials:-

1- clean slide

2- cover slip

3- sticker

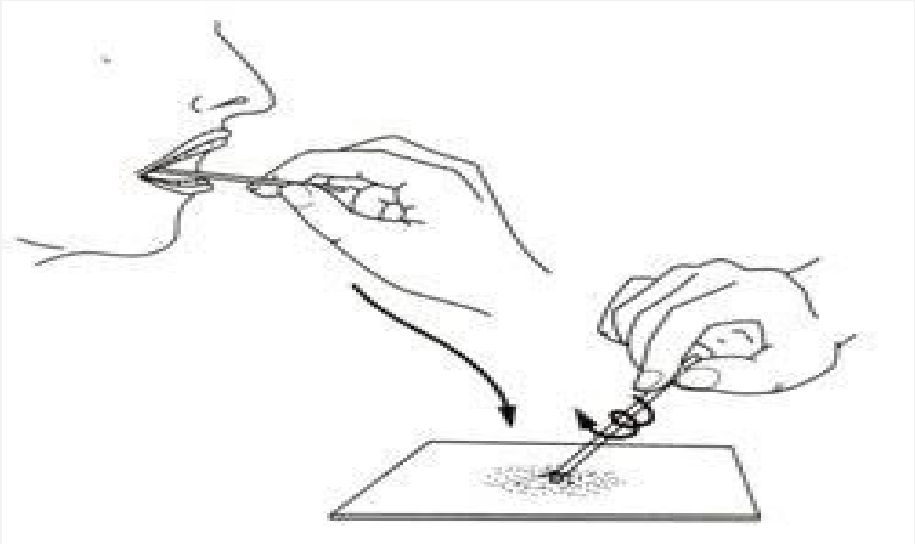
4- methylene blue stain

5- Distilled water

6- Rack

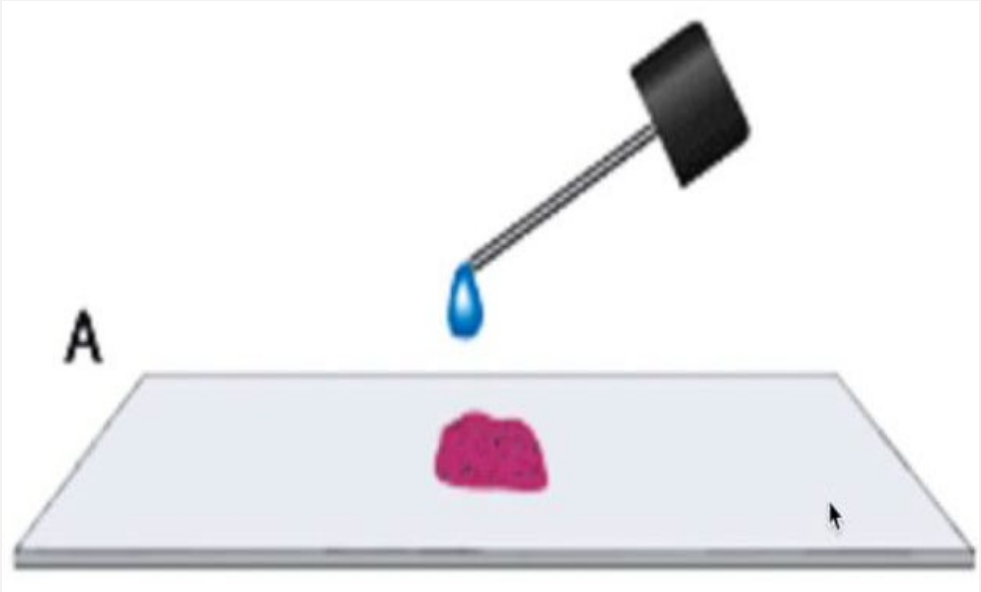
7- Microscope

Preparing a wet mount slide



1- Take a piece of tissue from the epithelium of the cheek or pallet by using sterilized sticker.

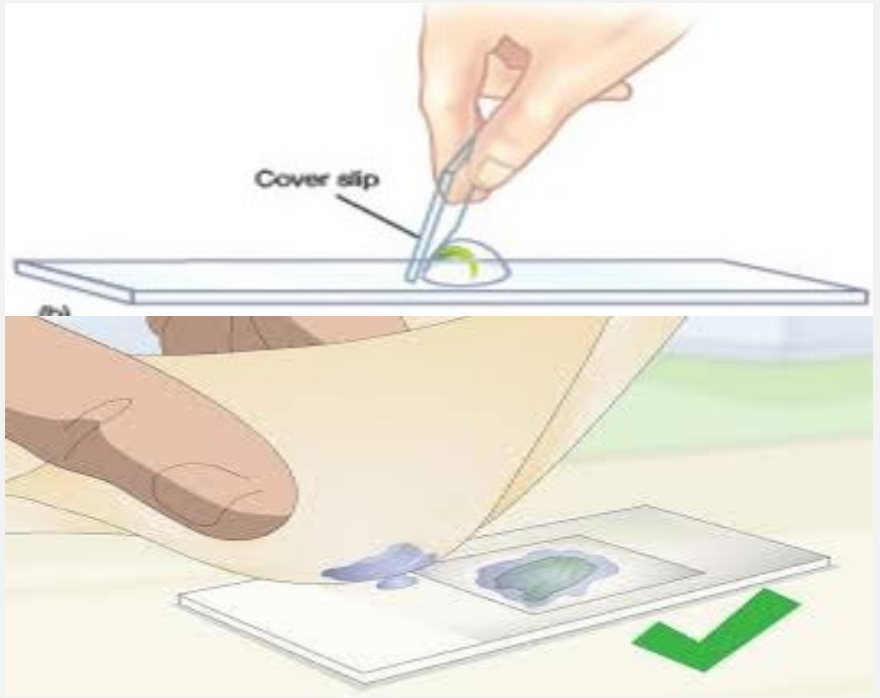
2- Swab the scrubbed tissue on empty slide.



3- Put one drop of methyline blue or crystal violet on the slide where you have spread the cells and wait for 3 minutes.

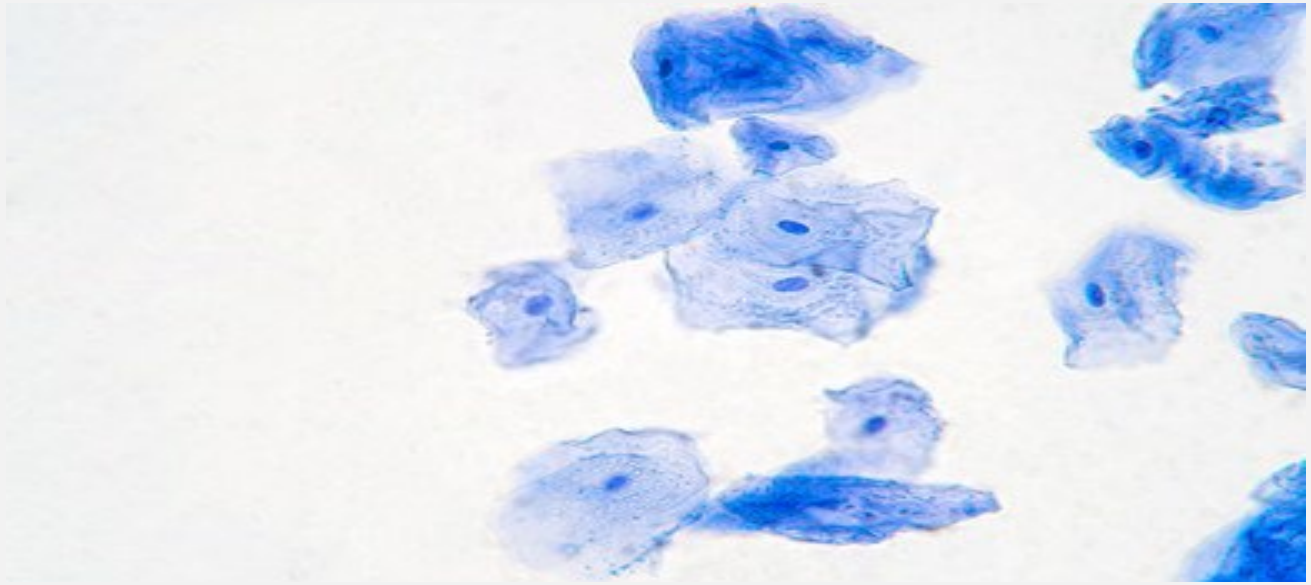
Preparing a wet mount slide

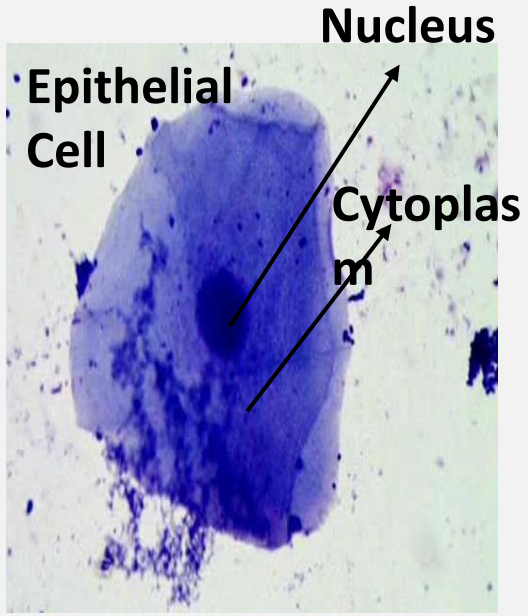
4- Wash up the stain using a distilled water.



5- Slowly lower the upper edge of the cover slip onto the specimen, the excess water should be absorbed with paper.

Preparing a wet mount slide





6- Examine under light microscope

- **Why we prepare a wet mount slide?**

The water helps support the sample and it fills the space between the cover slip and the slide allowing light to pass easy through the slide, the sample, and the cover slip.

- **Why is it necessary to stain the wet mount of cheek cells?**

Since many cells appear nearly colorless, staining is a vital part of the wet mount process.

- **Why are cheek cells easily collected from the mouth?**

The cheek cells are abraded by food and teeth, making them among the fastest-growing cells in the body. This means they are easily collected from the mouth