

Laboratory Class 1: Similarity and Difference in the Cell Structure of Prokaryotes and Eukaryotes. Cell Structure of Bacteria, Fungi, Plants, and Animals

Objective:

- To compare and contrast the structural organization of prokaryotic and eukaryotic cells.
- To study and describe the cell structures of different organisms: bacteria, fungi, plants, and animals.

Equipment and Materials:

- Light microscope, prepared slides of bacteria, fungal cells, plant cells, and animal cells.
- Staining reagents (e.g., crystal violet, iodine for bacterial cell staining).
- Prepared samples of various microorganisms and tissues for microscopic examination.

Procedure:

- 1. Observation of Prokaryotic Cells:**
 - Prepare bacterial slides and observe under the microscope.
 - Focus on identifying the lack of membrane-bound organelles, simple structure, and rigid cell wall.
- 2. Observation of Eukaryotic Cells:**
 - Examine prepared slides of fungal, plant, and animal cells.
 - Identify structures such as the nucleus, vacuoles, and other membrane-bound organelles.
- 3. Comparison:**
 - Draw and label diagrams for both prokaryotic and eukaryotic cells.
 - Create a table to summarize the differences and similarities in their structures.

Assessment:

- Discuss the key differences in organization and complexity between prokaryotic and eukaryotic cells.
 - Compare specific features in the cells of bacteria, fungi, plants, and animals.
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Laboratory Class 2: Investigation of the Structure, Biology, Biochemical Aspects, and Functions of the Cell Membrane

Objective:

- To study the structure of the cell membrane, its biological and biochemical properties, and its functional roles in the cell.

Equipment and Materials:

- Phospholipid models or diagrams, electron micrographs of membranes.
- Chemicals for simulating membrane permeability (e.g., alcohol, detergents).
- Light microscopes, osmosis and diffusion setups, egg osmosis experiment.

Procedure:

- 1. Observation of Membrane Structure:**
 - Use models and diagrams to explore the lipid bilayer, membrane proteins, and cholesterol.
- 2. Permeability Experiment:**
 - Conduct experiments on membrane permeability using substances that affect lipid bilayers (e.g., alcohol, detergents).
- 3. Osmosis and Diffusion:**
 - Perform the osmosis experiment with eggs or dialysis bags to observe selective permeability.

Assessment:

- Write a report detailing the structure of the membrane, its selective permeability, and its functional roles in processes like osmosis and diffusion.
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Laboratory Class 3: Investigation of the Structure, Biology, Biochemical Aspects, and Functions of Membrane-Bound Organelles (Endoplasmic Reticulum, Golgi Apparatus, Vacuoles, Peroxisomes, Lysosomes)

Objective:

- To explore the structure, functions, and biochemical roles of membrane-bound organelles in the cell.

Equipment and Materials:

- Prepared slides or electron micrographs of cells showing organelles.
- 3D models of organelles, reagents for cell fractionation.
- Biochemical assays (e.g., enzyme activity for lysosomes).

Procedure:

- 1. Observation and Identification:**
 - Examine prepared slides or micrographs of cells and locate the endoplasmic reticulum, Golgi apparatus, vacuoles, peroxisomes, and lysosomes.
- 2. Biochemical Function Study:**
 - Discuss the roles of the rough and smooth ER in protein and lipid synthesis.
 - Analyze the function of the Golgi apparatus in modifying, packaging, and sorting cellular products.
- 3. Lysosome Activity Assay:**
 - Perform an enzyme activity assay to study lysosomal functions in breaking down cellular waste.

Assessment:

- Provide a detailed explanation of each organelle's structure and role within the cell.
- Include experimental observations and conclusions on the biochemical functions of these organelles.

Laboratory Class 4: Investigation of the Structure, Biology, Biochemical Aspects, and Functions of Non-Membrane Bound Organelles (Ribosomes, Centrosomes, Cytoskeleton)

Objective:

- To study the structure and functions of non-membrane-bound organelles such as ribosomes, centrosomes, and cytoskeletal elements.

Equipment and Materials:

- Electron micrographs, 3D models, and prepared cell slides.
- Fluorescence microscopy for cytoskeleton visualization (optional).
- Actin and tubulin staining kits.

Procedure:

- 1. Observation of Ribosomes and Cytoskeleton:**
 - Use electron micrographs or models to study ribosomes and understand their role in protein synthesis.
 - Stain and visualize the cytoskeleton using specific dyes or antibodies.
- 2. Cytoskeleton Analysis:**
 - Examine microtubules, actin filaments, and intermediate filaments to understand their role in cell shape, movement, and intracellular transport.
- 3. Centrosome Function:**
 - Study the role of the centrosome in organizing microtubules and facilitating cell division.

Assessment:

- Report the structure and functions of non-membrane-bound organelles.
- Discuss how ribosomes, the cytoskeleton, and centrosomes contribute to cellular processes like protein synthesis and division.

Laboratory Class 5: Investigation of the Structure, Biology, Biochemical Aspects, and Functions of Two-Membrane Bound Organelles (Mitochondria, Nucleus, Plastids)

Objective:

- To examine the structure, functions, and biochemical processes of two-membrane-bound organelles: mitochondria, nucleus, and plastids (chloroplasts).

Equipment and Materials:

- Prepared slides of plant and animal cells.
- Mitochondrial and chloroplast isolation kits.

- DNA staining agents, electron micrographs.

Procedure:

1. **Mitochondrial and Plastid Isolation:**
 - Isolate mitochondria or chloroplasts from tissue samples and analyze their structure under a microscope.
2. **Nuclear Function Study:**
 - Use DNA stains to observe the nucleus and study its role in cell division and gene expression.
3. **Mitochondrial Function:**
 - Discuss the role of mitochondria in cellular respiration and energy production.
 - Conduct a simple experiment on mitochondrial enzyme activity.

Assessment:

- Provide a comprehensive report on the structure, functions, and biochemical roles of mitochondria, the nucleus, and plastids.
- Discuss how these organelles contribute to essential cellular processes like energy production, genetic control, and photosynthesis.

Laboratory Class 6: Investigation of the Structure, Biology, Biochemical Aspects, and Functions of Viruses. Cellular Inclusions and Their Functions

Objective:

- To study the structure, life cycle, and biochemical functions of viruses.
- To understand the types and functions of cellular inclusions in different cells.

Equipment and Materials:

- Electron micrographs of viruses, virus models.
- Prepared slides of cells with inclusions (e.g., glycogen granules, lipid droplets).
- Virus replication cycle diagrams.

Procedure:

1. **Virus Structure and Replication:**
 - Examine electron micrographs and models to identify viral components (capsid, nucleic acids).
 - Study viral replication stages: attachment, penetration, replication, assembly, and release.
2. **Cellular Inclusions:**
 - Observe prepared slides of cells with inclusions and identify structures like glycogen granules, pigments, and lipid droplets.
 - Discuss the functions of these inclusions in storage and metabolism.

Assessment:

- Write a report detailing virus structure and life cycle.
- Describe the types and roles of cellular inclusions.

Laboratory Class 7: Mitosis in Plant and Animal Cells. Meiosis and the Structure of Meiotic Chromosomes

Objective:

- To study the phases of mitosis in plant and animal cells.
- To understand the process of meiosis and examine the structure of meiotic chromosomes.

Equipment and Materials:

- Prepared slides of plant root tips and animal cells in different stages of mitosis.
- Prepared slides showing meiosis in gametogenesis.
- Microscope, diagrams of meiotic chromosomes.

Procedure:

1. **Mitosis:**
 - Observe and identify the stages of mitosis: prophase, metaphase, anaphase, and telophase.
 - Compare mitosis in plant and animal cells.
2. **Meiosis:**
 - Study the stages of meiosis I and II and examine meiotic chromosomes during different stages of gametogenesis.

Assessment:

- Compare and contrast mitosis and meiosis.
 - Provide diagrams of mitotic and meiotic stages with descriptions of key processes.
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Laboratory Class 8: Investigation of the Structure and Functions of Epithelial Tissues (Simple and Multilayer). Classification

Objective:

- To study the structure and functions of simple and stratified epithelial tissues.
- To classify different types of epithelial tissues based on structure and function.

Equipment and Materials:

- Prepared slides of epithelial tissues (simple squamous, cuboidal, columnar, stratified squamous, etc.).
- Microscope, histology diagrams for classification.

Procedure:

1. **Observation of Simple Epithelium:**
 - Examine simple squamous, cuboidal, and columnar epithelium under the microscope.

- Identify the structure and functional roles of each type.
- 2. **Observation of Stratified Epithelium:**
 - Study stratified squamous and other multilayered epithelium and their protective roles.

Assessment:

- Write a report classifying epithelial tissues and explaining their functions.
 - Provide labeled diagrams of observed epithelial tissue types.
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Laboratory Class 9: Investigation of the Structure of Various Epithelial Glands and Determination of the Type of Secretion

Objective:

- To study the structure of different types of epithelial glands.
- To determine the type of secretion (merocrine, apocrine, holocrine).

Equipment and Materials:

- Prepared slides of exocrine and endocrine glands (e.g., sweat glands, salivary glands, thyroid).
- Microscope, histological diagrams of glandular tissues.

Procedure:

1. **Observation of Glandular Structures:**
 - Examine different gland types (tubular, alveolar, acinar) and identify their structure.
2. **Secretion Types:**
 - Discuss and observe examples of merocrine, apocrine, and holocrine secretion.

Assessment:

- Provide diagrams and descriptions of the observed gland structures.
 - Explain the differences between the types of secretion mechanisms.
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Laboratory Class 10: Structure of the Blood of Amphibians and Humans, Hematopoietic Organs, and Lymphoid Tissue

Objective:

- To compare the structure of amphibian and human blood.
- To study the structure of hematopoietic organs and lymphoid tissues.

Equipment and Materials:

- Blood smear slides of amphibians and humans.

- Slides of bone marrow, spleen, lymph nodes.
- Microscope, staining reagents.

Procedure:

1. **Observation of Blood Cells:**
 - Examine blood smears to compare amphibian and human erythrocytes, leukocytes, and platelets.
2. **Hematopoietic Organs and Lymphoid Tissue:**
 - Study bone marrow, spleen, and lymph node slides to identify different types of immune cells.

Assessment:

- Write a comparison of amphibian and human blood structure.
 - Describe the function of hematopoietic and lymphoid organs.
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Laboratory Class 11: Investigation of the Structure of Fibrous Connective Tissues

Objective:

- To study the structure and function of fibrous connective tissues, including loose and dense connective tissue.

Equipment and Materials:

- Prepared slides of fibrous connective tissues (e.g., tendons, ligaments, dermis).
- Microscope, histology diagrams.

Procedure:

1. **Observation of Loose and Dense Connective Tissues:**
 - Identify collagen and elastic fibers in prepared slides of loose and dense connective tissue.
 - Discuss the functional differences between loose and dense tissues.

Assessment:

- Provide diagrams and descriptions of fibrous connective tissue structure.
 - Explain the functional roles of loose vs. dense connective tissue.
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Laboratory Class 12: Investigation of the Structure of Reticular, Adipose, Mucous, and Cartilaginous Tissues

Objective:

- To study the structure and function of reticular, adipose, mucous, and cartilaginous tissues.

Equipment and Materials:

- Prepared slides of reticular, adipose, mucous, and cartilage tissues.
- Microscope, histology charts.

Procedure:

1. **Observation of Tissue Types:**
 - Examine reticular tissue in lymphoid organs, adipose tissue in fat depots, mucous tissue in the umbilical cord, and cartilage in joints.
2. **Functional Analysis:**
 - Discuss the role of each tissue type in the body, such as support, energy storage, and protection.

Assessment:

- Write a report on the observed tissues, including diagrams and functional explanations.
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Laboratory Class 13: Investigation of the Structure of Bone Tissue**Objective:**

- To study the structure, organization, and functions of bone tissue.

Equipment and Materials:

- Prepared slides of compact and spongy bone.
- Bone models, microscope, histological diagrams.

Procedure:

1. **Observation of Bone Structure:**
 - Examine compact and spongy bone under the microscope, identifying osteons, Haversian canals, and trabeculae.
2. **Discussion of Bone Function:**
 - Explain the roles of bone tissue in support, protection, and mineral storage.

Assessment:

- Provide a detailed description and diagrams of bone structure.
 - Discuss the functional significance of bone tissue components.
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Laboratory Class 14: Investigation of Striated and Smooth Muscle Tissues**Objective:**

- To study the structure and function of striated (skeletal and cardiac) and smooth muscle tissues.

Equipment and Materials:

- Prepared slides of skeletal, cardiac, and smooth muscle tissues.
- Microscope, muscle tissue models.

Procedure:

1. **Observation of Muscle Types:**
 - Examine the structural differences between skeletal, cardiac, and smooth muscle tissues under the microscope.
2. **Functional Analysis:**
 - Discuss the contraction mechanisms and functions of each muscle type.

Assessment:

- Provide diagrams and descriptions of the observed muscle tissue structures.
 - Compare the functions of striated and smooth muscles.
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Laboratory Class 15-16: Investigation of the Structure of Neurons and Neuroglia

Objective:

- To study the structure and functions of neurons and neuroglial cells in the nervous system.

Equipment and Materials:

- Prepared slides of nervous tissue, electron micrographs.
- Microscope, neuron models, neuroglial staining kits.

Procedure:

1. **Observation of Neurons:**
 - Examine neurons under the microscope, focusing on the soma, dendrites, axon, and synaptic terminals.
2. **Observation of Neuroglia:**
 - Study the structure of different types of neuroglial cells (astrocytes, oligodendrocytes, Schwann cells) and their roles in supporting neurons.

Assessment:

- Provide a detailed report on the structure of neurons and neuroglia.
- Discuss the functional roles of neurons and glial cells in the nervous system.