HISTOLOGY MANUAL

2ND EDITION

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Preface

This revised edition of Histology Manual has been updated to include global scientific developments containing four chapters with detailed practical sessions on Microscopy, Epithelial Cells, Connective Tissues and Nervous System. In addition, there are practical sessions on the Digestive System, Urogenital System, Olfactory System, Respiratory System, Endocrine Glands, Lymphoid System, Circulatory System, Integumentary System, Photoreceptor and Audioreceptor System. A total of 55 histological slides of specimen are named in this manual, and are to be studied during the practical sessions as appropriate. Each Chapter contains expected goals and scientific knowledge that students are expected to meet and understand, along with Problem-Solving questions, in accordance with International Standard of Students-centred learning model which is a cornerstone of the philosophy of the College of Health Sciences of the University of Ilorin.

Schematic diagrams and models are provided to allow easy comprehension by students. Revised Notes are also provided as necessary to emphasize minimal facts that are expected to be understood by students. In addition to this Histology manual, students are expected to attend Practical Sessions with an approved Atlas of Histology and a Laboratory Practical Notebook.
Undoubtedly, this Manual is indispensable to students of Anatomy, Physiology, Medicine and Surgery, Dentistry, Nursing, Physiotherapy, Pharmacy, Optometry, Radiography, Biomedical Engineering and Allied Medically related Courses.

Professor A.S.ALABI B.Sc.,MBBS.,M.Sc.,Ph.D. ,FASN.
Professor of Anatomy
Head of Department
November, 2025.

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INTRODUCTORY NOTES TO STUDENTS

The Department of Anatomy is one of the foundation academic departments in the then Faculty of Health Sciences, University of Ilorin, Nigeria. The department, from its inception provided anatomical knowledge to undergraduate medical students but currently to undergraduate (B.Sc.) students of Anatomy, Physiology, Medicine and Surgery, Nursing, Physiotherapy, Pharmacy, Optometry and Vision Science, Radiography and Biomedical Engineering.

Our vision and mission, inter'alia**,** is to be an international centre of excellence for the study of contemporary anatomical sciences and to offer an outstanding and exceptional environment conducive to the acquisition of anatomical knowledge. In addition, the department earnestly desires to become a global leader in the teaching and research of anatomical sciences of Developmental Biology, Genetics and Molecular Biology, Gross Anatomy, Neurobiology, Histology, Physical Anthropology, Reproductive and Fertility Anatomy, Clinical and Radiological Anatomy, amongst other sub-specialties.

In pursuit of excellence, the Department of Anatomy has World-class facilities for teaching and research. Lectures are delivered with the aid of multimedia projection, Smart Screens, Computer aided Navigation facility and digital Anatomy facilities within the serene College of Health Sciences complex and related departments within the University of Ilorin. Facilities are available within the department for the dissection of cadaveric materials and visualizations of histological preparations using the compound optical microscopes. Our museum is well-stocked with carefully prosected anatomical specimen and osteological materials that aid the teaching and learning of the subject matter. In addition, the department has a Research Laboratory equipped with state-of-the-art facilities for cutting-edge research, with exceptional expertize in Cell and Developmental Biology, Endocrinology, Genetics and Molecular Biology, Neuroscience, Physical Anthropology and Reproductive Biology. The Department also has a Digital Anatomy Laboratory equipped with desktop computers to aid teaching and learning of gross anatomy and histological sections, using e-Resources.

Departmental academic staff includes erudite faculty members with vast teaching and research experience, many of whom hold the Doctor of Philosophy degree (Ph.D.) in Anatomy and a couple with Fellowships from related Clinical disciplines. In addition, the department has well trained technologists, technical and administrative staff who provide support for the academic team.

Academic programmes of the Department include undergraduate and postgraduate degree programmes. The undergraduate programmes domiciled in the department include:

1. Medical (MB;BS) programme: The Department of Anatomy participates in the teaching and training of future medical doctors in the MBBS programme. Medical students take courses in Genetics, Histology, Human Embryology, Gross Anatomy and Clinical Anatomy at 200 and 300 Levels.
2. Bachelor of Science (B.Sc.) degree in Anatomy: The department runs a 4-year programme leading to the award of the B.Sc. degree in Anatomy.

In addition, the Department of Anatomy makes substantial contribution to the teaching and training of undergraduate (B.Sc.) students of Physiology, Physiotherapy, Nursing, Optometry, Pharmacy, Radiography and Biomedical Engineering, amongst others.

The postgraduate programmes ran in the department include:

1. M.Sc. Anatomy: Holders of Bachelor's degrees in Anatomy, Medicine and Surgery, Dentistry, Zoology, Physiology, Physiotherapy and related disciplines are admitted into an 18-month programme. The graduation requirements include the submission and defense of a research dissertation.
2. Ph.D. Anatomy: This is essentially a research-based degree. Master's degree holders in Anatomy and related disciplines are admissible into this programme. The degree is awarded after substantial contribution to and advancement of research and knowledge in field of Anatomy. Submission and oral defense of a doctoral research thesis is major prerequisite.
   In addition, the Department of Anatomy contributes to postgraduate training in related departments of Biochemistry, Pharmacology, Physiology, Veterinary Anatomy and allied disciplines.

On behalf of the entire staff, I welcome you to the Department of Anatomy of the University of Ilorin.

Professor A.S.ALABI B.Sc.,MBBS.,M.Sc.,Ph.D. ,FASN.
Professor of Anatomy
Head of Department
November, 2025.

LIST OF CURRENT AND PAST ANATOMY HEADS OF DEPARTMENT

i. **Dr. P. Sengupta**, *MB;BS (Bihow), M.Sc. (New Delhi)* (Reader); 1981 - 1982
ii. **Dr. Nithilia Isaac**, BSc, MSc, (Madras), ChB, PhD (New Delhi) (Senior Lecturer); 1982 - 1984
iii. **Dr. H. S. Amono-Kuofi**, *MB;ChB (Ghana),* (Senior Lecturer); 1984 - 1986
iv. **Prof. S. A. Odekunle**, *MB;BS (Benin), Ph.D. (Sheffield),* 1986 – 1996
v. **Prof. C.O Bewaji** *B.Sc, M.Sc, Ph,D* (*Ibadan*) 1996 - 1997
vi. **Prof. A. O. Soladoye**, *MB;BS (Lagos), Ph.D. (Leeds)* 1997 - 2000
vii. **Dr. S. B. Agaja**, *MB;BS (Ibadan), FRCS, FWACS* (Senior Lecturer);2000 – 2004
viii. **Dr. O. R. Jimoh**, *MB;BS (Ilorin), FMCS* 2004 – 2010
ix. **Prof. S. B. Agaja**, *MB;BS (Ibadan), FRCS, FWACS* 2010 – 2013
x. **Dr. M. S. Ajao**, *MB;BS (ABU), M.Sc. (Lagos), Ph.D. (Wits)* (Senior Lecturer); 2013 – 2015
xi. **Dr. O. B. Akinola,** *B.Sc., M.Sc., Ph.D. (Ilorin)* (Reader); 2015-2017
xii. **Dr. A. O. Oyewopo**, *B.Sc., M.Sc. (LASU), Ph.D. (Lagos)* (Senior Lecturer); 2017-2019
xiii. **Dr. G. O. Omotoso**, *B.Sc., MB;BS, M.Sc., Ph.D. (Ilorin)* (Reader); 2019-2021
xiv. **Prof. B. U. Enaibe**, *B.Med Sc. (Port-Harcourt), M.Sc. (Calabar), Ph.D. (OAU)* 2021-2022
xv. **Prof. A. Olawepo**, *MBBS, MSc, FWACS, FMCS* 2022 - 2025
xvi. **Prof. A. S. Alabi** *B.Sc.,MBBS.,M.Sc.,Ph.D. ,FASN. 2025- date*

LIST OF ANATOMY INSTRUCTORS AND ACADEMIC STAFF

	NAME	RANK	QUALIFICATIONS
1	**A. S Alabi**	Professor/ HOD	B.Sc. (Ilorin) 2001; MB;BS (Ilorin) 2009; M.Sc. (Ilorin), 2011; Ph.D. (Port-Harcourt) 2017
2	**O. B Akinola**	Professor	B.Sc. (Ilorin), 1998; M.Sc., (Lagos) 2001; Ph.D. (Ilorin) 2010
3	**M. S Ajao**	Professor	MB;BS (Zaria) 1998; M.Sc. (Lagos), 2003; Ph.D. (Johannesburg) 2011
4	**B. U Enaibe**	Professor	B.(Med.) Sc. (Port-Harcourt), 1985; M.Sc. (Calabar), 1991; Ph.D. (Ile-Ife) 2009
5	**A. Olawepo**	Professor	MB; BS (Ilorin), 1997; M.Sc. (Lagos), 2003; FMCS, 2011; FWACS 2011
6	**G. O Omotoso**	Professor	B.Sc. (Ilorin), 1999; MB; BS (Ilorin), 2006; M.Sc. (Ilorin), 2010; Ph.D. (Ilorin), 2015
7	**A. O Oyewopo**	Professor	B.Sc. (Ilorin), 1999; M.Sc. (Lagos), 2003; Ph.D. (LASU) 2014
8	**Risikat E. Kadir**	Professor	MB; BS (Zaria), 2004; M.Sc. (Ilorin), 2010; FMCOG, 2017; Ph.D. (Ilorin), 2021
9	**Misturah Y. Adana**	Professor	MB; BS (Ilorin), 2008; M.Sc. (Ilorin); Ph.D. (Durban), 2019
10	**A. Imam**	Senior Lecturer	B.Sc. (Ilorin), 2010; M.Sc. (Ilorin), 2013; Ph.D. (Johannesburg), 2019
11	**Suwebat B. Kareem**	Senior Lecturer	MB; BS (Ilorin), 2008; M.Sc. (Ilorin), 2016, Ph.D. (Ilorin), 2023
12	**Kehinde M. Ibiyeye**	Senior Lecturer	MB; BS (Ilorin), 2009; M.Sc. (Ilorin), 2015, Ph.D. (UPM), 2019
13	**Rukayah Jaji-Sulaimon**	Senior Lecturer	B.Sc. (Ilorin), 2009; M.Sc. (Ilorin), 2013; Ph.D. (Ilorin), 2021
14	**Folashade S. Lewu**	Senior Lecturer	B.Sc. (Ilorin), 2009; M.Sc. (Ilorin), 2015; Ph.D. (Ilorin), 2020
15	**Fatimoh A. Sulaimon**	Senior Lecturer	B.Sc. (Ilorin), 2014; M.Sc. (Ilorin), 2018, Ph.D. (Ilorin), 2023
16	**Adeola Alabi**	Lecturer I	MB; BS (Ilorin), 2010; M.Sc. (Ilorin), 2016, Ph.D. (Ilorin), 2023
17	**A.L Imam**	Lecturer II	B.Sc. (Ilorin), 2014; M.Sc. (Ilorin), 2018, Ph.D. (Ilorin), 2023

LIST OF TECHNICAL STAFF

	Name	Qualifications	Rank/Position
1	O.P Awolola	B.Sc. 1998, M.Sc. (Ilorin) 2010	Chief Technologist
2	Foyeke M. Adigun	B.Sc. (Port-Harcourt) 2011, M.Sc. (Ilorin) 2017	Principal Technologist
3	J. T. Adetoro	Intermed Diploma, 1996; HND, 2002	Senior Technologist
4	M. Adewole	SSCE, 2013; NECO, 2019	Senior Laboratory Supervisor

ADMINISTRATIVE STAFF

	Name	Qualifications	Rank/Position
1	Opeyemi D. Agbaje	Confidential Secretary II 2021, ND, 2014; Confidential Secretary III 2010, Dip. In Computer 2007, NECO, Confidential Secretary IV 1999, WAEC	Confidential Secretarial I
2	Simbiat O. Quadir	WAEC, NABTEB, B.ed (Ilorin)	Chief Clerical Officer

HISTOLOGY MANUAL REVIEW COMMITTEE

Names	Position
Prof. A. Olawepo	Chairman
Prof. M. S. Ajao	Member
Prof. O. B. Akinola	Member
Prof. A. O. Oyewopo	Member
Prof. A. S Alabi	Secretary

UNIVERSITY EXAMINATION REGULATIONS

Students are hereby advised to note the code of conduct on examination malpractices as contained on pages 72 and 73 of the University Academic Programmes (undergraduate and Sub-Degree 2009 – 2013) Rules and Regulations and Students Handbook of Information and Regulations, pages 19 – 23, which are reproduced below.

Candidates shall:

- Use or consult during an examination only such booklets, papers, instruments or other materials or aids as specifically permitted or provided by the Department in which the examination is being held;
- Not introduce or attempt to introduce into the examination venue: things such as handbags, books, notes, instruments (handsets, i-pod, Bluetooth, flash drives e.t.c) or other materials or aids that are not permitted;
- Not enter any examination venue with any inscription on any part of the body e.g. palm, arm, thigh e.t.c if such inscriptions bear any relevance to the examination;
- Not pass or attempt to pass any information from one person to another during an examination, neither act in collusion with any other candidate(s) or person(s) nor copy or attempt to copy from another candidate or engage in any similar activity;
- Not disturb or distract any other candidate(s) during the examination;
- Only use their matriculation number for examination, (no names should be written);
- Not be allowed to leave an examination venue until after 75% of the time allocated for that particular paper has expired;
- Use of mobile sets I-pods e.t.c are prohibited and any handset discovered in and around the examination hall would be impounded, irrespective of it being switched off.

Students will be required to present the following vital documents at the entrance of the examination hall before he/she would be allowed into the hall:

- Duly signed original course registration forms (not copies) and no course registration forms with any form of alteration without proper endorsement by the level adviser and faculty officer would be accepted;
- University identity card and evidence of payment of approved charges/levies.

It is advisable that students who have misplaced their I.D. cards should make request for a replacement through the Students Affairs Unit of the University of Ilorin.

CHAPTER ONE
LIGHT MICROSCOPY

A.O. Oyewopo, K M. Ibiyeye.
A. S. Alabi, A. Imam
S. B. Kareem ,B.U Enaibe, G.O Omotoso

Histology is studied using various types of microscopes, including light microscope, to visualize the structure of body tissues. Since structure is closely linked to function, a detailed examination of the components of cells and tissues can provide significant insights into their functional roles.

Light microscopy is used to make small structures and samples visible by providing a magnified image. For effective use of the microscope, it must be aligned correctly, handled carefully and kept clean at all times.

With regards to the microscope, the students should know and be able to do the following:

- Know the different components of the microscope;
- Understand the function of each component of the microscope;
- Insert and move a slide on the stage;
- Adjustment of the lighting mechanism of the microscope;
- Adjust the microscope to your eyes, including focus and inter-ocular distance;
- Recognise and understand different magnifications of an image;
- Understand and explain the pathway of light through the microscope; and
- Recognise tissue on the slides, identify and describe its cellular details.

1.1. Identification and Functions of the Component Parts of a Microscope

Fundamentally, a microscope comprises

1. **Illumination system**: illuminate the sample. Most microscope use light bulbs, light-emitting diodes (LEDs) or lasers as light source.

2. **Imaging system**: produces a magnified image of the sample, which can be viewed by eye or a camera. The imaging system collects illuminating light that has interacted with the specimen and produces a magnified image. This is achieved by using the 2 main optical lens:

A. Objective lens collects as much light from the sample as possible.
B. Eyepiece lens relays the collected light to the observer's eye.

Part of a light microscope includes :

1. **Condenser** : focuses light from the source onto the tissue. It is placed below the stage of the microscope. It usually incorporates diaphragms to manage both quality and intensity of illumination.The diameter of the beam of light can be controlled via the diaphragm of the condenser. The more light on the specimen, the better the image resolution.

2. **The Mechanical Stage**: sits above the condenser. It supports the glass slide. The stage can moves in two directions; forward-backward and sideways using the stage control knob. The Vernier scales on the stage helps the operator to return to an exact position on the slide.

3. **Objective:** Usually but not restricted to 4X, 10X, 40X and 100X (oil immersion) magnification. The objective lenses receive light from the tissue on the slide and project an enlarged image in the direction of the ocular lens. Some types of objective lenses use oil or water placed on top the specimen or coverslip to obtain greater resolution at higher magnifications.

4. **Eyepiece**: The eyepiece or ocular lens further magnified and enhance the image from the objective and brings the image into focus for the eye. The final optical magnification of the specimen is the product of the magnification of the eyepiece and objective. The eyepiece often contains a diopter adjustment ring which can be used to adjust the focus for the user's own eyes.

5. **Coarse and Fine Focus Knobs**: They are adjustment wheels that move the stage or the microscope tube to focus the image seen at the eyepiece. At higher magnifications, only the fine focus knob should be used.

6. Others include: Light source, On/Off power switch, brightness control knob, stage control knob

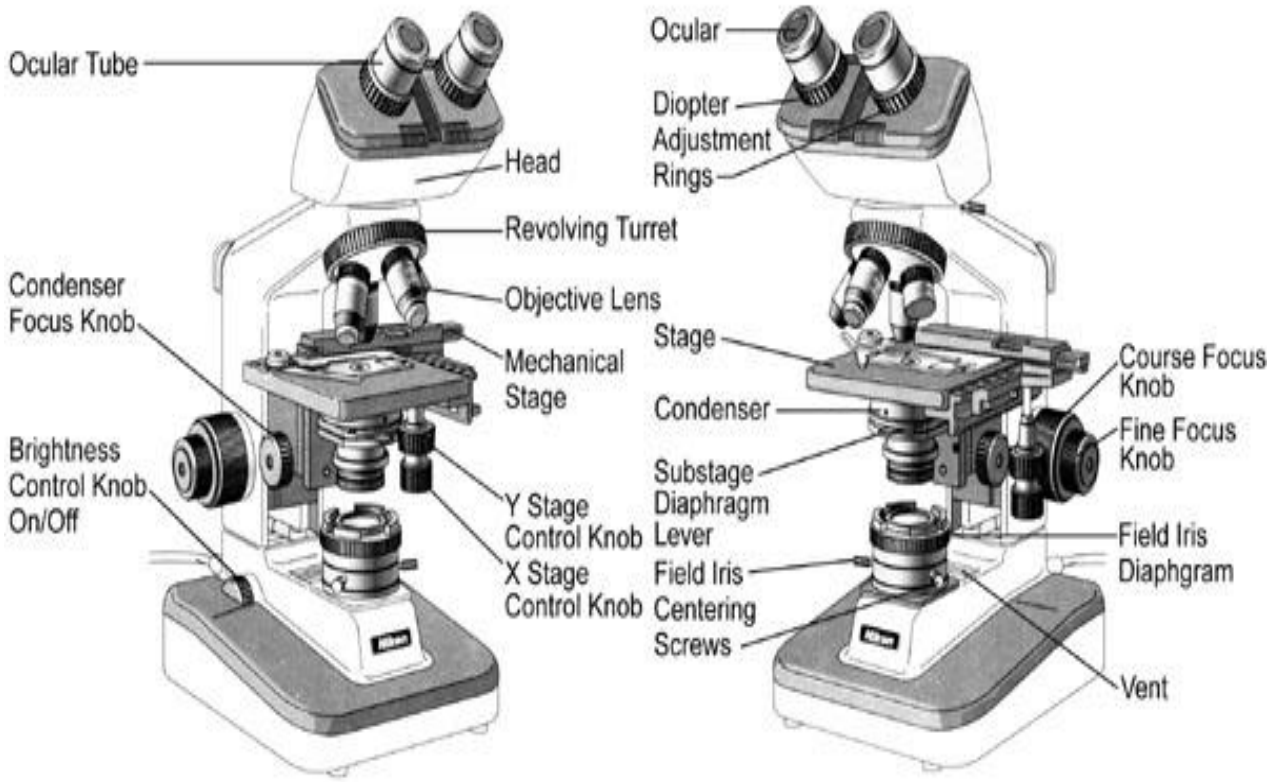


Figure 1: A Light Microscope.

Calculation of Total Magnification and Focal Length
Total Magnification = Power of the Objective Lens X Power of the Ocular Lens
Magnification (Objective) = Focal Length of Ocular Lens/Focal Length of the Objective Lens

1.2. *How to use the Light Microscope*

This is a very condensed version of the correct way to use a light microscope. Consult a manual or textbook if you plan to do serious work using a microscope.

However, you are expected to be able to:

- Focus and view slides effectively
- Know what objective lens to be use at a particular time when viewing the slide
- Know how and when to use the fine and coarse adjustment knob
- Know how to calculate the magnification of the specimen.

Using the microscope:

1. Handle the microscope by the stand only
2. Remove the microscope from its box beneath the table and place it on the desk
3. Ensure that there are no wires, books or pens under the base.
4. Open the diaphragm on the condenser all the way
5. Open the spring-loaded finger of the specimen holder on the mechanical stage and insert the slide. Ensure that the cover slip is facing up and the slide is at the center of the stage
6. Switch on the microscope
7. Adjust your chair until the level of your eyes is slightly higher than the level of the eyepiece.
8. Look through any of the two eyepiece and adjust the light (using brightness control knob) to a comfortable level (5-8)
9. Position your eyes approximately 2cm from the oculars
10. Slowly move the eyepiece closer to each other until you see two circles or two half circles
11. Then move the eyepiece slowly until you see only one circle
12. Close your right eye. Your left eye must see an image and vice versa.
13. Open both eyes. You should see one image with both eyes. If the ocular has a pointer, it should be visible with both eyes

14. If you see one image with both eyes, you can start focusing the image.
15. Ensure that the 4x objective is in position above the slide. This can be done by turning the nosepiece until the desired objective lens is in position (you will hear a click)
16. Turn the coarse focus adjustment knob and focus the image
17. Adjust the fine focus knob for a clearer image.
18. Focus the right image by turning the diopter adjustment ring
19. For a higher magnification, turn the nosepiece until the 10x objective clicks into place.
20. Focus the image only with fine focus knob for 10x, 40x and 100x objectives.
21. Turn the nosepiece until the 40x objective clicks into place
22. Focus the image only with fine focus knob
23. 100x objective is rarely used for histology slides. To view blood cells on peripheral blood film 100x objective is used but appropriate oil should be added onto the slide.

1.3. Identification of the Structural Components of the Epidermis

Slide 1: This is a hematoxylin-eosin slide of skin tissue. The skin has 3 layers: epidermis, dermis and the subcutaneous layer. The epidermis has pink flakes of keratin. Below the keratin are multiple layers (stratified) of squamous cells. Change the objective to 10x, and use the fine focus knob to focus the image. The squamous cells are polygonal in shape, have a central round purple (basophilic) nucleus and pink cytoplasm (eosinophilic). Change the objective to 40x to see a higher magnification of the nucleus and cytoplasm. Can you appreciate the granular cytoplasm? Do you notice that the pink cellular extension connecting the cells? That is the intercellular bridges. Move the stage control knob such that you move towards the keratin. Can you see that the cells and their nucleus are becoming smaller and the nucleus disappearing? The epidermis has 4/5 layers. Can you identify the layers?

At the end of this section, you should be able to identify:

- The shape of the cell and its nucleus
- The location of the nucleus in the cell i.e. central or eccentric
- The ratio of the size of the nucleus to the size of the cell
- The colour of the nucleus
- The colour of the cytoplasm

- Any granule within the cell

Reference

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CHAPTER TWO

EPITHELIAL CELLS

R. Jaji-Sulaimon, O. B. Akinola, B. U. Enaibe, A. Olawepo, M. Y. Adana
and A.L Imam

Epithelial cells are large sheets covering all surfaces of the body exposed to the external environment and lining internal body cavities. In addition, epithelial tissue forms majority of the glandular tissue in the human body. At the end of this section, the students are expected to be able to identify the different kinds of epithelial cells present in different body tissues based on the following:

* The type, size and form or shape of cell present i.e. squamous, cuboidal, columnar e.t.c.
* The number of cell layers i.e simple or stratified.
* Cell borders – visible or not.
* Position of the cells in relation to each other and the underlying basal lamina.
* Nature of the free or luminal surface i.e. ciliated, brush border etc.
* Presence of glands and hair.
* Types of glands present e.g. single cell, simple, tubular etc.
* The position of the nucleus in each of the cell.

2.1 *Lining Surface Epithelial Cells*

The aim of this practical session is to illustrate epithelial tissue. The type, cell form, examples of distribution and functions of lining epithelial cells are provided below.

Type of Epithelial Cells	Cell Form or Shape	Examples of Distribution	Main Function
Simple	Squamous	Lining of vessels (endothelium).	Facilitates the movement of the viscera (mesothelium), active transport by pinocytosis (mesothelium and endothelium), secretion of biologically active molecules (mesothelium).
		Serous lining of cavities; pericardium, pleura, peritoneum (mesothelium).	
	Cuboidal	Covering the ovary, thyroid.	Covering, secretion.

Type of Epithelial Cells	Cell Form or Shape	Examples of Distribution	Main Function
	Columnar	Lining of intestine, gallbladder.	Protection, lubrication, absorption, secretion.
Pseudostratified	Some columnar and some cuboidal	Lining of trachea, bronchi, nasal cavity.	Protection, secretion; cilia-mediated transport of particles trapped in mucus.
Stratified	Surface layer squamous keratinized (dry)	Epidermis.	Protection; prevents water loss.
	Surface layer squamous nonkeratinized (moist)	Mouth, esophagus, larynx, vagina, anal canal.	Protection, secretion; prevents water loss.
	Cuboidal	Sweat glands, developing ovarian follicles.	Protection, secretion.
	Transitional: domelike to flattened, depending on the functional state of the organ	Bladder, ureters, renal calyces.	Protection, distensibility.
	Columnar	Conjunctiva.	Protection.

Each specimen must be studied as follows:

1. **General structure**
   (a) The type, size and form or shape of cell present i.e. squamous, cuboidal, columnar e.t.c.
   (b) The number of cell layers, i.e. squamous or stratified.
   (c) Cell borders – visible or not.
   (d) Position of the cells in relation to each other and the underlying basal lamina.
   (e) Nature of the free or luminal surface e.g ciliated, brush border etc.
   (f) Presence of glands and hair.
   (g) Types of glands present e.g. single cell, simple, tubular e.t.c.
   (h) The position of the nucleus in each of the cell.

2. **Cell structure**
   a) Nucleus
      (i) Staining reaction and degree of granularity of chromatin.
      (ii) Position in the cell.
      (i) Shape and size.
      (ii) Shape and size in comparison to the shape and size of the cell.
   b) Cytoplasm
      (i) General appearance and texture.
      (ii) Staining reaction
      (i) Presence of inclusions such as prominent granules, vacuoles, pigments etc.

2.1.1. *Simple Squamous Epithelium (Mesothelium)*

Slide 2: This is a spread preparation of the mesenterium. The simple squamous epithelium is a thin serous membrane made up of only one cell layer such that every cell is in direct contact with the underlying basement membrane. It can be found in the peritoneal cavity of the abdomen, pleura and other flat surfaces where passive diffusion of gases occur. The mesenterium has two outer layers of mesothelium and an inner core of connective tissue. Because the specimen is a spread of the membrane on the slide and not a sectioned piece of tissue, the mesothelium is studied looking at the surface of the cells. This slide serves as an example of cells organized into a continuous layer with the cell borders clearly visible. By focusing up and down both mesothelial layers can be seen.

Identify:

(i) Cell borders
(ii) Shape of the cells.
(iii) Large lightly stained nuclei.

Note: Connective tissue cell nuclei are discussed later under connective tissue.

2.1.2. *Simple Squamous Epithelium (Endothelium*)

Slide 3: This specimen serves as an example of endothelium as seen in a section. Examples of specimen used here are sections through the section of the ileum. The specimens that are used are sections through the skin of the palm or a section through the ileum can also be used. The blood vessels can be found in the dermis/hypodermis of the skin or in the submucosa of the ileum. Simple squamous epithelium is a single thin layer of squamous cells that lines the interior surface of blood vessels and lymphatic vessels thereby forming an interphase between the circulating blood or lymph within the lumen.

Identify:

Macroscopic

Hold the slide against a white background and look at it with the naked eye. Identify the three coloured layers seen in the section:

(i) A dark pink to red scalloped area – the epidermis.
(ii) A central light pink area – dermis.
(iii) A thick very light pink area – the hypodermis.

The blood vessels can be found under low magnification in the dermis.

Microscopic

(i) Lumen of the blood vessel
(ii) Endothelial cells against the lumen
(iii) Nuclei of the endothelial cells
(iv) Cytoplasm
(v) Layers of the blood vessel wall

2.1.3. *Simple Cuboidal Epithelium*

Slide 4: This specimen is a section through the kidney.

Identify:

Macroscopic

(i) The mass of tissue forming the kidney.
(ii) The cortical and medullary areas of the kidney.

Macroscopic

(i) Simple cuboidal epithelium that lines certain of the tubules. These cells are as wide as they are high.

2.1.4. *Simple Columnar Epithelium*

Slide 5: This specimen is a section through the gallbladder.

Identify:

Microscopic
(i) Lumen of the gallbladder
(ii) Simple columnar epithelial cells

2.1.5. *Simple Ciliated Columnar Epithelium*

Slide 6: This specimen is a section through the uterine tube.
Identify:

Microscopic
(i) Lumen of the uterine tube.
(ii) Ciliated as well as non-ciliated columnar epithelial cells

2.1.6. *Pseudostratified Ciliated Columnar Epithelium*

Slide 7: This specimen is a section through the trachea.

Identify:

Macroscopic
(i) The ring shaped trachea.
(ii) The horseshoe shaped hyaline cartilage.
Microscopic
(i) Lumen
(ii) The four types of cells that are found in this epithelium.

2.1.7. *Thin Stratified Squamous Non-keratinized Epithelium*

Slide 8: This specimen is a section through the eye. The thin stratified squamous non-keratinized epithelium is found on the outside of the cornea. Stratified epithelia occur where there are high levels of friction.

Identify:

Macroscopic

(i) The eyeball and the cornea situated interiorly.

Microscopic

(i) The different layers comprising the epithelium.

(ii) The shape of the cells in the different layers.

2.1.8. *Thick Stratified squamous Non-keratinized Epithelium*

Slide 9: This specimen is a section through the oesophagus.

Identify:

Macroscopic

(i) The circular oesophagus.

(ii) The lumen

Microscopic

(i) The different layers of the epithelium

(ii) The shape of the cells in the different layers

2.1.9. *Stratified Squamous Keratinizing Epithelium*

Slide 10: This specimen is a section through the skin of the palm of the hand.

Identify:

Macroscopic

Hold the slide against a white background and look at it with the naked eye. Identify three coloured layers seen in the section:

(i) A dark pink to red scalloped area – the epidermis

(ii) A central light pink area – the dermis

(iii) A thick but very light pin area – the hypodermis

Microscopic

(i) The different layers of the epithelium which form the epidermis

(ii) The shape of the cells in the different layers.

2.1.10. *Urothelium (Transitional)*

Slide 11: This specimen is a cross section through the ureter.

Identify:

Macroscopic

(i) The circular ureter

(ii) The lumen

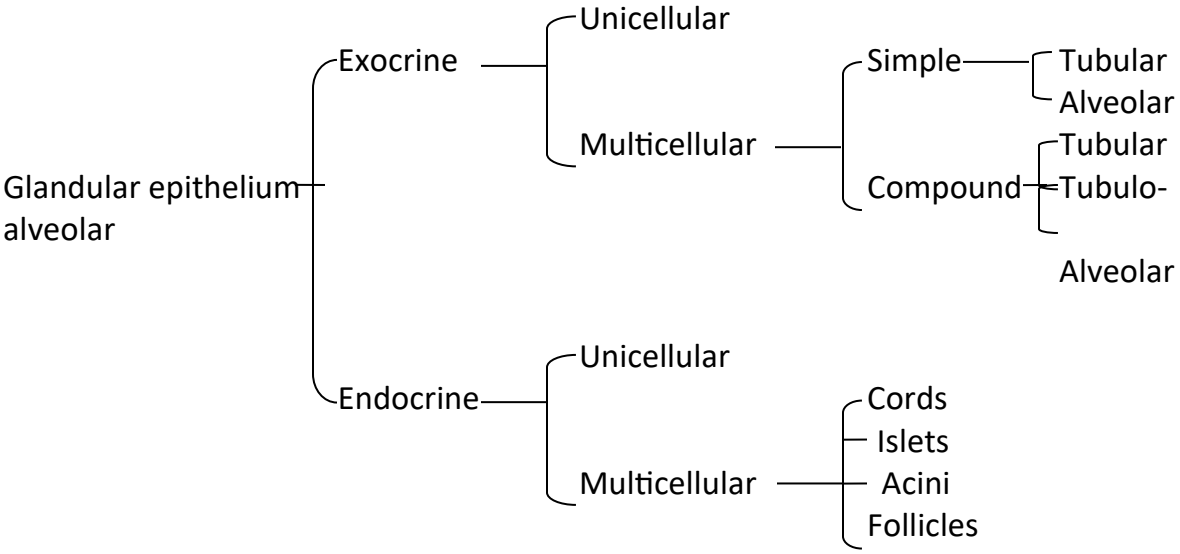
Microscopic

(i) The different layers of the epithelium

(ii) The shape of the cells in the different layers

2.2 Specialized or Glandular *Epithelial Cells*

The Specialized or Glandular epithelial cells will be studied according to the following scheme:



At the end of this sections, students are expected to know the concept of double glands i.e. pancreas, testes, ovary which have the ability to secrete both endo- and exocrine substances.

2.2.1. *Goblet Cells and Simple Tubular Glands*

Slide 12: This specimen is a longitudinal section through the large intestine.

Identify:

Macroscopic

(i) The longitudinally sectioned colon

(ii) The luminal surface

Microscopic

(i) Single cell gland or goblet cell (pale staining)

(ii) Simple tubular gland. Note that this gland is the whole test tube shaped structure and that it is lined with goblet cells and columnar epithelial cells.

2.2.2. Compound Tubulo-alveolar gland

Slide 13: This specimen is a section through the pancreas.

Identify:

Macroscopic

(i) The mass of pancreas tissue

Microscopic

(i) The round or elongated secretory units. These are groups of cells arranged around a central lumen.

2.2.3. *Secretory Units*

Slides 14 and 15: These specimen are sections through the pharyngeal tube and the tip of the tongue respectively, which are used as examples to study serous, mucinous and mixed secretory units.

Identify:

Macroscopic

Identify with the naked eye the J-shaped cartilage of the pharyngeal tube. The glandular tissue can be found on the inside of the J-shaped cartilage. The glandular tissue of the tongue can be found between the bundles of muscle fibers.

Microscopic

(i) Serous units
(ii) Mucinous units
(iii) Mixed units – serous demilunes

2.2.4. Islands

Slide 16: This specimen is a section through the pancreas to demonstrate the organization of endocrine glands.

Identify:

(i) The mass of pancreas tissue

Macroscopic

(i) An island among the exocrine glandular tissue
Look at the following slides to see the different ways cells in endocrine glands are organised:

Groups	-	hypophysis	-
Cords	-	adrenals	-
Follicles	-	thyroid	-

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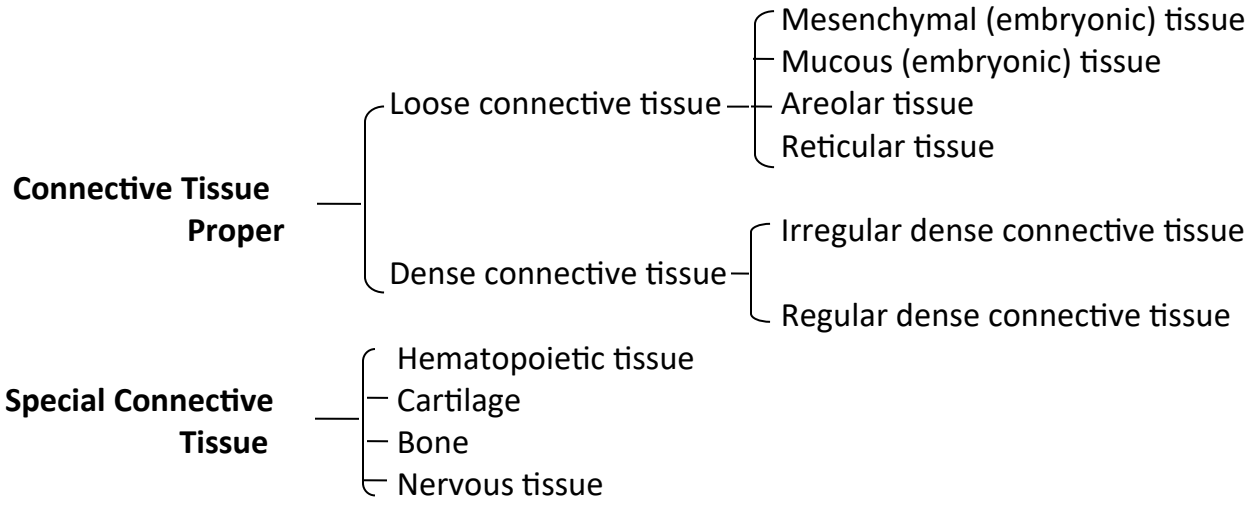
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CHAPTER THREE

CONNECTIVE TISSUES

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Connective tissues are a group of tissues that provide the matrix that connects and binds the cells and organs. Connective tissues are of different types, and are functionally responsible for providing and maintaining form in the body. Other functions includes provision of structural frame work, protection against disease and storage of energy. Connective tissues comprises a number of three main components (Cells, Fibres and Amorphous ground substance), whose arrangements and abundance determine the type of connective tissue. The connective tissues will be studied according to the following scheme:



At the end of this section, students should be able to classify any connective tissue. Hence, students should do the following:

- Identify the different types of connective tissues and where they can be found
- Identify the various components of the connective tissues and their locations within the specimen
- Observe and take note of the staining reaction of the amorphous ground substance, cells and fibres.
- Observe and take note of the relative ratio of the amorphous ground substance, cells and fibres to one another.
- Observe and take note of the distribution of the cells in relation to the fibres.

- Take note of the relative ratio of cells and fibres to one another.
- Observe and take note of the relative ratio of the different types of fibres.
- Identify sections of tissues i.e. either transverse or longitudinal.
- Make a table for each type of connective tissue, describing and comparing each of the three components.

3.1 Connective Tissue Proper

3.1.1. *Basal Lamina*

Slide 17: This specimen of the kidney is stained with silver to demonstrate the basal lamina. The purpose of this practical session is to illustrate the basement membrane and general connective tissue.

Identify:

Macroscopic

(i) The outline of the kidney.
(ii) The cortex and medulla regions.

Microscopic

(i) The kidney tubules in the cortex.
(ii) The brown coloured basal lamina.

3.1.2. *Connective Tissue Cells*

Slide 18: This specimen is a section through the colon and is a good example of the different types of connective tissue cells.
Identify:

Macroscopic

(i) A thin dark pink coloured line, the mucosa.
(ii) A central light pink coloured area fine pink coloured structures, the submucosa.
(iii) An outer pink coloured irregular area, the out muscle layer.

Microscopic

In the lamina propria of the mucosa, which comprises an epithelial layer and a loose connective tissue layer, the lamina propria, the following cells must be identified:

(i) Fibroblasts
(ii) Plasma cells
(v) Eosinophils
(vi) Lymphocytes

(iii) Macrophages
(iv) Mast cells
(vii) Smooth muscle fibers

3.1.3. Mucous or *Gelatinous Connective Tissue*

Slide 19: This specimen is a cross section through the umbilical cord.

Identify:

Macroscopic
The three large blood vessels of the umbilical cord.

Microscopic
In the tissue and between the blood vessels the following:
(i) Fibroblasts
(ii) Collagen fibres
(iii) Amorphous ground substance

3.1.4. *Loose Connective Tissue (Collagen Fibres)*

Slide 20: This specimen is a spread of the mesenterium, stained to show collagen fibers and connective tissue nuclei.

Identify:

Macroscopic
(i) Spread of the mesenterium

Microscopic
(i) Nuclei of the connective tissue cells
(ii) Collagen fibers

3.1.5. *Loose Connective Tissue (Elastic Fibres)*

Slide 21: This specimen is a spread of the mesenterium that is stained for elastic fibres.

Identify:

Microscopic

(i) Elastic fibres
(ii) Mast cell granules

3.1.6. *Reticular Fibres*

Slide 22: This is a section through the liver to demonstrate reticular fibres.

Identify:

Macroscopic

(i) The mass of liver tissue

Microscopic

(i) Reticular fibres
(ii) Outlines of liver cells

3.1.7. *Loose Connective Tissue* (Sectioned)

Slide 23: This is a section of thin skin to demonstrate sectioned loose connective tissue.

Identify:

Macroscopic

(i) A fine dark area, the epidermis
(ii) A thick lighter eosinophilic area, the dermis.
(iii) A very thick light area with a fine eosinophilic line running through, the hypodermis.

Microscopic

The dermis is that part of the skin just beneath the epidermis (epithelium). It is divided into two parts, namely the papillary and reticular layers. The papillary layer

is situated directly beneath the epidermis and consists of loose connective tissue. The reticular part is composed of dense irregular connective tissue.

(i) Collagen fibres sectioned in different planes
(ii) Nuclei of the connective tissue cells

3.1.8. Dense Irregular Connective Tissue

Slide 24: This specimen is a section through the thin skin of the thigh to demonstrate dense irregular connective tissue in the dermis.

Identify:

Macroscopic

(i) The different staining layers of thin skin.

Microscopic

(i) Dense irregular connective tissue [is present in the reticular part i.e. the deeper part of the dermis]
(ii) Fibroblast nuclei.

3.1.9. Dense Regular Connective Tissue

Slide 25: This specimen demonstrates a cross and longitudinal section of the tendon.

Identify:

Macroscopic

(i) The cross and longitudinal sections of the tendon.

Microscopic

(i) Dense regular connective tissue.
(ii) Tendon cell nuclei.
(iii) Loose connective tissue.

3.1.10. *Adipose Tissue*

Adipose tissue is a special type of connective tissue in which adipose or fat cells (**adipocytes**) predominate. Fat cells can either be found isolated or in small groups within

the connective tissue itself. Adipose tissues are either **Unilocular** (common, or yellow) or **Multilocular** (or brown) **adipose tissue**. The two known types differ with respect to their different locations, structures, colors, and pathological characteristics. **Unilocular adipose tissue** comprises of cells which when completely developed, contain one large central droplet of yellow fat in their cytoplasm, while Multilocular adipose tissue comprises of cells that contain numerous lipid droplets and abundant brown mitochondria.

Slide 26: This is a specimen of the mesenterium stained to demonstrate fat cells and their nuclei.

Identify:

Macroscopic

(i) Spread of the mesenterium

Microscopic

(i) Fat cell nuclei
(ii) Lipid filled cytoplasm
(iii) Connective tissue septa

Slide 27: This is a section through the hypodermis of thick skin to demonstrate fatty connective tissue.

Identify:

Macroscopic

(i) The different textures and intensity of stained layers of thick skin.

Microscopic

(i) Fat cells
(ii) Connective tissue septa.

3.2 *Cartilage*

The purpose of this practical session is to demonstrate cartilage as a specialized connective tissue.

1.2.1. Hyaline Cartilage

Slide 28: This is a cross section through the trachea to demonstrate hyaline cartilage.

Identify:

Macroscopic

(i) The C-shape cartilage rings in the centre of the trachea

Microscopic

(i) Lacunae
(ii) Chondrocytes
(iii) Matrix
(iv) Perichondrium

1.2.2. Elastic Cartilage

Slide 29: This is a section through the pinna of the ear to demonstrate elastic cartilage.

Identify:

Macroscopic

(i) The dark purple stained elastic cartilage in the centre of the tissue.

Microscopic

(i) Lacunae
(ii) Chondrocytes
(iii) Matrix
(iv) Perichondrium

1.2.3. Fibrocartilage (Fibrous)

Slide 30: This is a cross and longitudinal section of tendon just prior to its attachment to bone.

Identify:

(i) Chondrocytes
(ii) Collagen fibres
(iii) Matrix

1.3. Contractile Cells

The purpose of this practical session is to demonstrate muscular tissue. There are basically three muscle types namely: skeletal, cardiac and smooth muscles.

The important differences between the 3 muscle types are summarized below:

	Skeletal	**Cardiac**	**Smooth**
Cells	Elongated	Branching	Spindle-shaped
Nucleus	Multiple peripheral	Single, large, oval and centrally placed	Single, central
Striations	Cross-striated	Cross-striated and intercalated disk at branching	None
Motor control	Voluntary	Involuntary	Involuntary

3.3.1. Smooth Muscle

Slide 31: This is a cross section through the umbilical cord. The three large blood vessels are used as examples of smooth muscle.

Identify:

Macroscopic

The orientation of the blood vessels in the umbilical cord.

Microscopic

(i) Longitudinally sectioned smooth muscle fibres.
(ii) Cross sectioned smooth muscle fibres.

3.3.2. Skeletal Muscle (Striated)

Slide 32: This specimen contains a longitudinal and cross section of skeletal muscle.
Slide 33: This is a section through the tip of the tongue in which the skeletal muscle is sectioned longitudinally, obliquely and crosswise.

To view the striations of skeletal muscle in the H/E specimen, the condenser of the microscope must be turned down to obtain as much contrast as possible. (Remember to turn the condenser back to its original position after you have finished).

Identify:

Microscopic

a) Longitudinal section
   (i) Skeletal muscle fibres
   (ii) Nuclei of the skeletal muscle fibres and connective tissue
   (iii) Cross striations
   (iv) Connective tissue
b) Cross section
   (i) Skeletal muscle fibres arranged in bundles
   (ii) Size, shape and diameter of the muscle bundles
   (iii) Nuclei of the skeletal muscle fibres Myofibrils
   (iv) Connective tissue

3.3.3. Skeletal Muscle (Striated)

Slide 34: This is a section through the tip of the tongue stained to show the cross striations.

Identify:

Microscopic:

(i) Longitudinal section of skeletal muscle
(ii) The different bands in the longitudinal section that form the cross striations
(iii) Nuclei of the skeletal muscle and connective tissue.

3.3.4. Heart Muscle (Longitudinal Section)

Slide 35: This is a longitudinal section through heart muscle. To view the cross striations, the condenser of the microscope must be turn downward to produce contrast.

Identify:

Microscopic

(i) Muscle fibres and branching
(ii) Nuclei of the heart muscle fibres and connective tissue
(iii) Intercalated discs and cross striations
(iv) Connective tissue

3.3.5. Heart Muscle (Longitudinal Section – Cross Striations)

Slide 36: This is a longitudinal section through heart muscle, stained to show the cross striations clearly.

Identify:

Microscopic

(i) Muscle fibres
(ii) Nuclei of the heart muscle fibres
(iii) Intercalary discs and cross striations
(iv) Connective tissue

3.3.6. Heart Muscle (Transverse Section)

Slide 37: This is a specimen of a cross section of the heart/cardiac muscle.

Identify:

Microscopic

(i) Muscle fibres
(ii) Nuclei of the heart muscle fibres
(iii) Connective tissue

3.4. *Musculoskeletal System: Bone*

The purpose of this practical session is to demonstrate bone as a specialized connective tissue.

1.4.1. Bone

Slide 38: This is a cross section through decalcified bone. There are two ways to study bone histology. Dry bone is cut and polished before mounting on a slide. **Bone decalcification** is the removal of the **mineral** component using an acid, leaving the bone soft and easy to cut. In dry ground bone, the organic material is removed. In contrast, in decalcified slides the relationship between the living components of bone is retained.

Identify:

Macroscopic

(i) Compact decalcified stained bone

Microscopic

(i) Haversian and Volkmann's canals
(ii) Lacunae
(iii) Bone matrix
(iv) Periosteum
(v) Fat cells of the bone marrow

3.4.2 Ground Bone Longitudinal Section)

Slide 39: This is a longitudinal ground section of macerated bone.

Identify:

Macroscopic

(i) The unstained white-yellow compact bone.

Microscopic

(i) Haversian and Volkmann's canals
(ii) Lamellae, lacunae and canaliculi

3.4.3. Ground Bone (Transverse Section)

Slide 40: This is a cross ground section of macerated bone.

Identify:

Macroscopic

(i) Haversian system
(ii) Haversian and Volkmann's canals
(iii) Lacunae and Lamellae
(iv) Canaliculi
(v) Interstitial lamellar systems
(vi) Circumferential lamellar systems

3.4.4. Bone Development

Slide 41: This specimen is a longitudinal section through the head of a rabbit's femur.

Identify:

Macroscopic

(i) The orientation of the head of the femur, the epiphysial plate and the shaft of the femur.

Microscopic

(i) The different zones of endochondral bone development
(ii) Osteoblasts and osteoclasts
(ii) Bone marrow

3.5. *Blood Cells*

The purpose of this practical session is to demonstrate the different blood cells and to do a differential white blood cell count.

3.5.1 Blood Smear

Slide 42: This is a blood smear to demonstrate red and white blood cells.

Identify:

Microscopic

(i) Erythrocytes
(ii) Neutrophils
(iii) Eosinophils
(iv) Basophils
(v) Lymphoocytes
(vi) Monocytes

3.5.2. Differential White Blood Cell Count

To do a differential white blood cell count a blood smear must be made and stained as follows:

Procedure:

1. Sterilize a fingertip with alcohol and let dry completely since alcohol haemolizes blood.
2. Prick the fingertip with a blood lancet deep enough to produce a drop of blood.
3. Carefully touch the drop of blood with one side of a clean glass slide.
4. Take a second glass slide and place the one side against the drop of blood so that the blood spreads along the edge.
5. With this second slide kept at an angle of 450 push the slide against the other slide to produce a blood smear. Do not use too large a drop of blood and do not make the angel of the slide too large as this will produce a thick unusable blood smear.
6. Let the smear dry.
7. Place the slide with the smear on a rack over a basin.
8. Draw 1ml Wrights staining fluid into a pipette and cover the blood smear carefully with the staining fluid. Be careful that the fluid does not run over the sides of the slide.

9. Stain the slide for 45 seconds.
10. Draw 1ml buffer into a pipette and add very carefully to the staining fluid on the slide.
11. Leave the slide to stain for 7 minutes.
12. Rinse quickly with tap water and carefully blot the slide dry. Do not wipe the slide as this will rub the blood smear off.
13. Let the slide dry well.

Results

Nuclei of leucocytes	-	dark and blue to purple
Eosinophilic granules	-	red to orange
Basophilic granules	-	dark purple to black
Lymphocytes	-	dark purple nuclei with light blue cytoplasm
Platelets	-	Violet to purple

3.5.3. Differential Counting

Counting takes place systematically, field after field, from left to right. If 200 cells have not been counted the first time across the slide, move the slide one field down and work across the slide this time from right to left. Continue in this way until 200 leucocytes have been counted.

All the different types of leucocytes must be counted and written down until 200 have been counted. The results are then given as a percentage of the total leucocytes counted.

Table I: Normal Differential Count in Adults

Type of cell	Total/mm	% of total leucocytes
Neutrophils	2500 – 7500	40 - 75
Eosinophils	40 – 440	1 - 6
Basophils	0 – 100	0 - 1
Lymphocytes	1500 – 3500	20 - 45
Monocytes	200 – 800	

Table II: Own Count

Type of cell	Total/mm	% of total leucocytes
Neutrophils		
Eosinophils		

Basophils
Lymphocytes
Monocytes

3.5.4. Bone Marrow

Slide 43: This is a section through bone to demonstrate bone marrow.

Identify:

Microscopic

(i) Bone
(ii) Fat Cells
(iii) Developing red and white blood cells
(iv) Megakaryocytes, mature red blood cells, mature white blood cells

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CHAPTER FOUR

NERVOUS TISSUE

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The human nervous system is the most complex system in the human body. It comprises billions of nerve cells (neurons), with support from numerous **glial cells**. Functionally, neurons are grouped as **circuits**, which is a set of coordinated processes intended to produce a definite result. A number of elementary circuits may be combined to form higher-order systems. The nerve tissue is distributed throughout the body as an integrated communications network. The nervous system can be broadly divided into the **central nervous system (CNS),** comprising of the brain and the spinal cord, and the **peripheral nervous system (PNS),** comprising cranial nerves emanating from the brain, spinal nerves emanating from the spinal cord, and their associated small aggregates of nerve cells called **nerve ganglia**. In addition to neurons, the nervous system contains numerous other cells, collectively called **neuroglial cells,** which do not receive or transmit impulses, but support neurons in various ways.

Some neurons have **receptors,** elaborated on their terminals, which are specialized for receiving different types of stimuli (such as, mechanical, chemical, thermal) and transducing them into nerve impulses which may eventually be conducted to nerve centers. These impulses are then transferred to other neurons for processing and transmission to higher centers for perceiving sensations or for initiating motor responses.

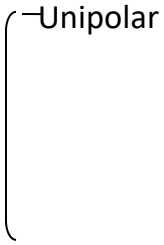
The PNS can functionally be divided into a **sensory (afferent) component,** which receives and transmits impulses to the CNS for processing, and a **motor (efferent) component,** which originates in the CNS and transmits impulses to effector organs of the body systems. The motor component is further subdivided as follows:

- **Somatic system**: Impulses originating in the CNS are transmitted directly, via a single neuron, to skeletal muscles.
- A**utonomic system**: Impulses from the CNS are transmitted to an autonomic **ganglion** via one neuron, afterwards a second neuron originating in the autonomic ganglion transmits the impulses to smooth muscles, cardiac muscles, or glands.

The purpose of this practical session is to demonstrate nervous tissue and nerve endings. Nervous tissue is studied according to the following scheme, hence at the end of this section students should be able to:

(a) identify, differentiate and draw Neurons and Neuroglia;
(b) identify, differentiate and draw different types of neuronal cell bodies and neuroglia;
(c) identify, differentiate and draw axons, dendrites, myelinated and non-myelnated axons;
(d) identify, differentiate and draw nerve endings, motor muscle end plate, Pacinian corpuscle and Meissner's corpuscle;
(e) understand the structural classification of neurons; and
(f) understand the functional classification of neurons;

Category	**Neurons**	**Neuroglia**
Cell Bodies	• Multipolar • Pseudo-unipolar	• Astrocytes • Ependymal cells • Microglia • Oligodendrocytes (CNS) • Schwann cells (PNS) • Satellite cells
Processes	• Dendrites • Axons (Myelinated and Non-myelinated)	• Extensions (e.g., glial processes)
Nerve Endings		
Central Nervous System (CNS)	• Synapses • Axon terminals	• Astrocyte end-feet (blood-brain barrier) • Ependymal lining (ventricles)
Peripheral Nervous System (PNS)		
Motor Units	• Motor muscle end plate	
Sensory Endings	• Pacinian corpuscle (deep pressure) • Meissner's corpuscle (light touch)	



Structural Classification of Neurons
- Bipolar
- Multipolar
- Pseudo-unipolar
- Golgi Type I
- Golgi Type II

Functional Classification of Neurons
- Sensory Neuron
- Motor Neuron
- Multipolar
- Sensory-Motor Neuron
- Interneuron
- Specialized Neuron

1.1. Multipolar Neurons

Slide 44: This is a cross-section through the spinal cord and spinal ganglion. Some spinal cord neurons serve as an example of multipolar neuron cell bodies.

Identify:

Macroscopic

The orientation of the spinal cord and the H-shaped grey matter, the white matter and the spinal ganglion,

Microscopic

The multipolar neuron cell bodies in the grey matter,

(i) Cell body.
(ii) Nucleus
(iii) Nissl substance
(iv) Neurofibrils
(v) Meshwork
(vi) Axon hillock
(vii) Nuclei of the neuroglia

4.2. *Pseudo-Unipolar Neurons*

Slide 45: This is a cross-section through the spinal cord ganglion. The spinal ganglion is used as an example to demonstrate pseudo-unipolar neuron cell bodies.

Identify:

Macroscopic

The orientation of the spinal ganglion identifying the spinal ganglion next to the spinal cord. The pseudo-unipolar neurons are found in the spinal ganglion.

Microscopic

(i) Cell bodies
(ii) Nuclei
(iii) Nissl-substance

4.3. *Myelinated Fibres*

Slide 46: This is a cross-section through a peripheral nerve.

Identify:

Microscopic

(i) Epineurium, perineurium and endoneurium
(ii) Axon
(iii) Neurilemma
(iv) Schwann cell nuclei

4.4. Myelinated Fibres

Slide 47: This is a cross-section through a peripheral nerve that has been stained for myelin.

Identify:

Microscopic

(i) Myelin sheath
(ii) Axon

4.5. *Motor End Plates*

Slide 48: This is a slide of separated skeletal muscle fibres illustrating the motor end plates of the peripheral nervous system.

Identify:

Microscopic

(i) Separated skeletal muscle fibres
(ii) Nerve fibres
(iii) Motor end plates

4.6. *Astrocytes*

Slide 49: This is a section through the cerebrum illustrating neuroglia of the central nervous system.

Microscopic

(i) Astrocytes
(ii) Blood vessels

4.7. *Ependyma*

Slide 50: This is a section through the choroid plexus illustrating neuroglia of the central nervous system.

Identify:

Microscopic

(i) Ependyma
(ii) Connective tissue and blood vessels

4.8. *Cerebrum*

Slide 51: This slide is a section through the cerebrum.

Identify:

Macroscopic

The white and grey matter

Microscopic

(i) The different layers of the cerebral cortex.
(ii) White matter

4.9. *Cerebellum*

Slide 52: This slide is a sagittal section through the cerebellum.

Identify:

Macroscopic

The grey and white matter

Microscopic

(I) The different layers of the cerebellar cortex
(II) White matter

1.10. *Synapse*

Slide 53: This is a cross-section through the spinal cord showing the nerve ends (synapses) of the central nervous system, which are situated on the neuron cell bodies of the large anterior horn of the spinal cord.

Identify:

Microscopic

(i) Neuron bodies
(ii) End plates

1.11. Pacinian Corpuscle

Slide 54: This is a section through the skin from the palm, illustrating the sensory nerve ending of the peripheral nervous system.

Identify:

Macroscopic

Orientate yourself with regard to the three visible primary layers of the skin of the palm. Look for the Pacinian corpuscles which are found in the subcutaneous fat tissue.

Microscopic

(i) Adipose tissue

(ii) Pacinian corpuscles

Meissner's Corpuscle

Slide 55: This is a section through skin from the palm, illustrating sensory nerve endings of the peripheral nervous system.

Identify:

Macroscopic

Orientate yourself with regard to the three layers of the skin. Look for Meissner's corpuscles in the papillary layer of the dermis

Microscopic

(i) Stratified squamous keratinized epithelium
(ii) Loose connective tissue
(iii) Meissner's corpuscles

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