**Chapter 4**

1. **INTRODUCTION**
2. A tissue is a group of...**similar cells that usually have a similar embryological origin and are specialized for a particular function.**
3. The nature of the extracellular material that surrounds the connections between the cells that compose the tissue influence **the structure and properties of a specific tissue.**
4. The science that deals with the study of tissues is called **histology**.
5. **Pathologists**, physicians who specialize in laboratory studies of cells and tissues, aid other physicians in making diagnoses; they also perform **autopsies**.
6. **TYPES OF TISSUES AND THEIR ORIGINS**
7. Depending on their function and structure, the various tissues of the body are classified into four principal types.

1. **Epithelial tissue covers body surfaces, lines hollow organs, body cavities, and**

**ducts; and forms glands.**

2. **Connective tissue protects and supports the body and its organs, binds**

**organs together, stores energy reserves as fat, and provides immunity.**

3. **Muscle tissue is responsible for movement and generation of force.**

4. **Nervous tissue initiates and transmits action potentials (nerve impulses)**

**that help coordinate body activities.**

1. All tissues and organs of the body develop from one or more of the three primary germ layers: **ectoderm, mesoderm and endoderm.**
2. Normally, **most cells within a tissue remain in place, anchored to other cells, basement membranes, or connective tissues. Exceptions include phagocytes and embryonic cells involved in differentiation and growth.**
3. In a **biopsy**, samples of living tissue removed for microscopic examination, is a chief responsibility of a pathologist.
4. **CELL JUNCTIONS**
5. Cell junctions are points of contact between ­**adjacent plasma membranes**.
6. Depending on their structure, cell junctions may serve one of three functions.
7. **Some cell junctions form fluid tight seals between cells.**
8. **Other cell junctions anchor cells together or to extracellular material.**
9. **Still others acty as channels, which allow ions and molecules to pass from cell**

**to cell within a tissue**

1. The five most important kinds of cell junctions are **tight junctions, adherens junctions, desmosomes, hemidesmosomes, and gap junctions.**
2. Tight junctions are formed by weblike strands of transmembrane proteins…**that hold adjacent plasma membranes together. They are common among epithelial cells that line the stomach, intestines, and urinary bladder.**
3. Adherens junctions are made of **plaque, actin microfilaments, and cadherins.**
4. Desmosomes are composed of **plaque** and are linked by transmembrane glycoproteins that extend across a gap between adjacent cell membranes and link the **cytoskeletons** of cells together. They are common in the cells of the **epidermis and between cardiac muscle fibers in the heart.**
5. Hemidesmosomes connect cells to **extracellular material** such as the basement membrane.
6. Gap junctions allow cells in a tissue to rapidly communicate through **connexons, transmembrane protein channels** that connect cells together.
7. **EPITHELIAL TISSUES**
8. General Features of Epithelial Tissues
9. Following are the general features of epithelial tissues.
10. **Epithelia cells are arranged in sheets, either in single or multiple layers.**
11. **Epithelium consists mostly of packed cells with little extracellular**

**material.**

1. **Many cell junctions are present, providing secure attachments**

**among cells,**

1. **An epithelial cell has an apical surface and a basal surface attached to**

**a base membrane.**

1. **Epithelia adhere firmly to nearby connective tissue via a thin**

**extracellular layer, the basement membrane.**

1. **Epithelial tissue is avascular, exchange of materials between epithelium**

**and adjacent connective tissue is by diffusion.**

1. **Epithelia have a nerve supply.**
2. **Epithelia have a high capacity for renewal (a high metabolic rate).**
3. Basement membranes can become thickened due to increased collagen and laminin production. In diabetes mellitus, the basement membrane of small blood vessels, especially those in the **retina and kidney**, thickens.
4. Functions of epithelia include...**protection, filtration, lubrication, secretion,**

**digestion, absorption, transportation, excretion, sensory, reception,**

**and reproduction**.

1. The subtypes of epithelium include **covering and lining epithelium and glandular epithelium.**
2. Covering and Lining Epithelium
3. Classification
4. The eight types of covering and lining epithelial tissue are classified according **to the way cells are arranged in layers**.
5. Epithelial tissue is also classified by the characteristic **shape of the cell**.
6. Layers are arranged as simple (**one layer**), stratified (**several layers**), and pseudostratified (**one layer that appears as several**).
7. Cell shapes include squamous (**flat**), cuboidal (**cube-like**), columnar (**rectangular**), and transitional (**variable**).
8. Covering and lining epithelia may be classified as a **combination of arrangement**

**of layers and shapes of the cells**. The name of the specific type of stratified epithelium depends on the shape of the surface cells.

1. Simple Epithelium
2. Simple squamous epithelium consists of…**a single layer of flat, saclike cells,**
3. It is adapted for diffusion and filtration and is found in

**in lungs and kidneys**.

1. It is not found in parts of the body that are subject to **little wear**

**and tear.**

1. Endothelium lines the **heart and blood vessels**.
2. Mesothelium lines the...**thoracic and abdominopelvic cavities**

**and covers the organs within them.**

1. Simple cuboidal epithelium consists of a simple layer of cube-shaped cells and performs the functions of **secretion and absorption**.
2. Simple columnar epithelium consists of a single layer of rectangular cells and can exist in two forms: **nonciliated** simple columnar epithelium and **ciliated** simple columnar epithelium.
3. Nonciliated simple columnar epithelium contains microvilli...

**to increase surface area and the rateof absorption and goblet cells that secrete mucus.**

1. Ciliated simple columnar epithelium contains cells with cilia, motile, hair-like processes that...**help to move fluids or particles along a surface**.
2. Pseudostratified epithelium appears to have several layers because the nuclei are **at various levels**.
3. All cells are attached to the **basement membrane** but some do not reach the apical surface.
4. In pseudostratified ciliated columnar epithelium, the cells that reach the surface either **secrete mucus** (goblet cells) or bear cilia that **sweep away mucus and trapped foreign particles**.
5. Pseudostratified nonciliated columnar epithelium contains **no cilia or goblet cells**.
6. Stratified Epithelium
7. Epithelia have at least **2 layers** of cells.
8. This is a more **durable and protective** tissue.
9. The name of the specific kind of stratified epithelium depends on the **shape of the surface cells**.
10. Stratified squamous epithelium consists of several layers of cells in which the top layer of cells is **flat and the deeper layers of cells vary in shape from cuboidal to columnar.**
11. The basal cells replicate by...**mitosis and ultimately work their**

**way to the surface.**

1. In keratinized stratified squamous epithelium, a tough layer of keratin (**a protein resistant to friction and repels bacteria**) is deposited in the surface cells.
2. Nonkeratinized stratified squamous epithelium does not contain keratin and **remains moist**.
3. A Papanicolaou smear or **PAP smear** involves collecting samples of cells present in the secretions of the cervix and vagina for early detection of changes in the cells that might indicate **cancer or a precancerous condition**.
4. Stratified cuboidal epithelium is a rare tissue consisting of two or more layers of cube-shaped cells whose function is **mainly protective**.
5. Stratified columnar epithelium consists of several layers of cells of which only the top layer is columnar. It is somewhat **rare and functions in protection and secretion**.
6. Transitional epithelium consists of several layers of cells whose appearance is variable.
7. **It is capable of stretching and thus permits distention of**

**an organ.**

1. It lines the urinary bladder and portions of the ureters and the urethra.
2. Glandular Epithelium
3. A gland is a...**single cell or mass of epithelial cells adapted for secretion.**
4. Endocrine glands are **ductless**; their secretory products (hormones) enter the

**Extracellular fluid and diffuse into the blood.**

1. Exocrine glands (**sweat, oil, and digestive glands**) secrete their products into ducts

that empty at the surface of...**covering and lining epithelium or directly onto a**

**free surface.**

4. Structural Classification of Exocrine Glands

1. Unicellular glands are **single celled**, such as the goblet cell.
2. Multicellular glands are composed of cells that form a distinctive microscopic structure or macroscopic organ, such as...**sweat, oil, and salivary glands.**
3. They are classified by whether the ducts are branched (**compound**) or unbranched (**simple**).
4. They are also classified by the shape of the secretory portion: **tubular,**

**acinar, or tubular**

1. Combining the shapes of the secretory portion with the degree of branching of the duct gives **the structural classification for multicellular glands.**
2. Functional classification of exocrine glands is based on whether...**a secretion is a product of a cell or consists of entire or partial glandular cells themselves.**
3. Merocrine glands form the secretory products and discharge it by ­­­­**excytosis**.
4. Apocrine glands accumulate their secretary product at the apical surface of the secreting cell; that portion then...**pinches off from the rest of the cellto form the secretion with the remaining part of the cell repairing itself and repeating the process.**
5. Holocrine glands accumulate the secretory product in the cytosol; when the cell dies,...**it and its products are discharged as the glandular secretion, with the discharges cell being displaced by a new one.**
6. **CONNECTIVE TISSUE**
7. Connective tissue is the **most abundant and widely distributed tissue in the body.**.
8. General features of connective tissue
9. Connective tissue consists of two basic elements: **cells and extracellular matrix**. Matrix consists of protein fibers and ground substance.
10. The matrix of a connective tissue, which may be...**fluid, semifluid, gelatinous, fibrous, or calcified, is usually secreted by the connective tissue cells and adjacent cells and determines the tissue’s qualities.**
11. Unlike epithelia, connective tissues do not occur on **free surfaces**.
12. Unlike epithelium, connective tissue is highly vascular (**except for cartilage and**

**tendons**).

1. Except for cartilage, connective tissue, like epithelium, has a **nerve supply.**
2. Connective Tissue Cells
3. Cells in connective tissue are derived from mesenchyme.
4. **Immature cells** have names that end in -blast (e.g., fibroblast, chondroblast) while **mature** have names that end in -cyte (e.g., osteocyte).
5. Most mature cells have reduced capacity..**for cell division and matrix formation and are mostly involved in maintaining the matrix.**
6. Types of cells found in various connective tissues include
7. **Fibroblasts** (which secrete fibers and matrix)
8. **Macrophages** (or histiocytes, which develop from monocytes and are phagocytic),
9. **Plasma cells** (which develop into antibody-producing B lymphocytes, or B cells),
10. **Mast cells** (which are abundant alongside blood vessels and produce histamine),
11. **Adipocytes** (or fat cells, which store energy in the form of fat),
12. **White blood cells** (or leukocytes).
13. Extracellular Matrix
14. The ground substance and fibers, **deposited in the space in between the cells**, comprise the matrix of connective tissue.
15. Substances found in the ground substance include hyaluronic acid, chondroitin sulfate, dermatan sulfate, and keratan sulfate. Collectively they are called **glycosamino glycans** (GAG’s)
16. The function of ground substance is that it...**supports, binds and provides a medium for the exchange of materials between the blood and cells, and is active in influencing cell functions.**
17. Chondroitin sulfate and glucosamine are used as nutritional supplements to maintain **joint cartilage**.
18. Fibers
19. Fibers in the matrix provide **strength and support for tissues**.
20. Three types of fibers are embedded in the matrix between cells of connective tissues.
21. Collagen fibers, composed of the protein collagen, are very tough and resistant to stretching, yet allow some flexibility in tissue; they are found in **bone, cartilage, tendons, and ligaments**.
22. Elastic fibers, composed of the protein elastin surrounded by the glycoprotein fibrillin, they provide strength and stretching capacity and are found in **skin, blood vessels, and lungs**.
23. Reticular fibers, consisting of collagen and glycoprotein, provide support in the walls of blood vessels and form a strong, supporting network around **fat cells, nerve fibers, and skeletal snd smooth muscle fibers**.
24. Marfan Syndrome is caused by a defective fibrillin gene and results in **abnormal eleastic fibers**.
25. If a ligament is stressed beyond normal capacity it results in a **sprain** (**a stretched or torn ligamnet**). Because they are avascular, ligaments **heal slowly**.
26. Classification of Connective Tissue
27. Embryonic Connective Tissue
28. Connective tissue that is present primarily in the embryo or fetus is called **embryonic connective tissue**.
29. Mesenchyme, found almost exclusively in the embryo, is the tissue form from which **all other connective tissue eventually arises.**.
30. Mucous connective tissue (Wharton’s jelly) is found in the **umbilical cord of the fetus**.
31. Types of Mature Connective Tissue
32. Mature connective tissue exists in the newborn, has cells differentiated from mesenchyme, and does not change after birth. It is subdivided into several kinds: **connective tissue proper, cartilage, bone tissue, and blood**. Subtypes include **loose connective tissue, dense connective tissue, cartilage, bone, and blood.**
33. Loose connective tissue consists of all **three types of fibers, several types of cells, and a semifluid ground substance.**
34. Areolar connective tissue is a prime example of **loose connective tissue**. It shows all of the typical loose connective tissue features.
35. **Has several different kinds of cells and all three types of fibers.**
36. **It is found in ths subcutaneous layer.**
37. Adipose tissue consists of adipocytes which are specialized for storage of triglycerides.
38. **It is found wherever areolar tissue is located.**
39. **It reduces heat loss through the skin, serves as an energy reserve, supports, protects, and generates considerable heat to help maintain proper body temperature in newborns (brown fat).**
40. **Liposuction** involves sucking out small amounts of adipose tissue.
41. Reticular connective tissue consists of fine interlacing reticular fibers and reticular cells.
42. **It forms the stroma of certain organs.**
43. **It helps to bind together the cells of smooth muscle.**
44. Dense connective tissue contains more numerous, thicker, and dense fibers but considerably fewer cells than loose connective tissue.
45. **Dense regular connective tissue** consists of bundles of collagen fibers in a regular and orderly, parallel arrangement that confers great strength.
46. **Dense irregular connective tissue** contains collagen fibers that are irregularly arranged and is found in partsof the body where tensions are exerted in various directions.
47. **It usually occurs in sheets, such as the dermis in the skin.**
48. **It is also found in heart valves, the perichondrium, the tissue surrounding cartilage, and the periosteum.**
49. Elastic connective tissue consists of elastic fibers and fibroblasts.
50. It is quite **strong and can recoil back to its original shape after being stretched.**
51. It is found **it is found in lung tissue and elastic arteries.**
52. Cartilage consists of a dense network of collagen fibers and elastic fibers embedded in chondroitin sulfate.
53. **Its strength is due to its collegan fibers; its resilience, to the chondroitin sulfate.**
54. Chondrocytes occur with spaces called lacunae in the matrix.
55. It is surrounded by a dense irregular connective tissue membrane called the **perichondrium**.
56. Unlike other connective tissues, **cartilage has no blood vessels or nerves** (except in the perichondrium).
57. There are three major types of cartilage.
58. Hyaline cartilage is the most abundant but weakest type of cartilage and has fine collagen fibers embedded in a gel-type matrix. It affords…**flexibility and support and, at joints, it reduces friction and absorbs shock.**
59. Fibrocartilage contains bundles of collagen fibers in its matrix It does not have a perichondrium. Combining...**strength and rigidity, it is the strongest of the three types of cartilage.**
60. Elastic cartilage contains a threadlike network of elastic fibers within the matrix. A perichondrium is present. It provides...**strength and elasticity and maintains the shape of certain organs.**
61. The growth of cartilage is accomplished by interstitial (endogenous) growth (**endogeneous**) and appositional (exogenous) growth (**from without**).
62. Bone (osseous tissue) consists of a matrix containing **mineral salts and collagenous fibers** called osteocytes.
63. Bone is classified as either **compact or spongy**, depending on how the matrix and cells are organized.
64. The basic unit of compact bone is the **osteon or Haversian system**, consisting of four parts.
65. The lamella are concentric rings of matrix that consist of mineral salts that give bone...**its hardness and collegan fibers that give bone its strength.**
66. Lacunae are **small spaces** between lamellae that contain mature bone cells called **osteocytes**.
67. Canaliculi are minute canals containing processes of osteocytes that provide...**routes for nutrient and waste transport.**
68. A central (Haversian) canal contains **blood vessels and nerves.**
69. Spongy bone has trabeculae rather than osteons.
70. Bone...**supports, protects, helps provide movement, stores minerals, and houses blood-forming tissue.**
71. Liquid connective tissue
72. Blood (vascular tissue) consists of a...**liquid matrix called plasma and formed elements.**
73. Lymph is interstitial fluid flowing in **lymph vessels**.
74. Tissue engineering has allowed scientists to grow...**new tissues in the laboratoryfor the replacement of damaged tissues.**
75. **MEMBRANES**
76. Membranes are…**flat sheets of pliable tissue that cover or line a part of the body.**

Epithelial membranes consist of an epithelial layer and an underlying connective tissue layer and include **mucous membranes, serous membranes, and the cutaneous membrane (or skin).**

1. Synovial membranes line joints and contain only connective tissue.
2. Epithelial Membranes
3. Mucous membranes (mucosae) line cavities that open to the exterior, such as the **gastrointestinal tract**.
4. The epithelial layer of a mucous membrane is an important aspect of the body’s **defense** mechanisms, acting as a **barrier to pathogens and a trapping surface for particles**.
5. The connective tissue layer of a mucous membrane is called the **lamina propria**.
6. A serous membrane, or serosa, lines a body cavity that does not **open directly to the exterior** and covers the organs that lie within the cavity. Examples include the **pleura, pericardium, an peritoneum**.
7. These membranes consist of parietal and visceral layers.
8. The epithelial layer secrets a lubricating serous fluid that reduces...**friction between organs and the walls of the cavities in which they nare located.**
9. Serous membrances may become inflammed with the buildup of **serous fluid** resulting in **pleurisy, pericarditis, or peritonitis**.
10. Cutaneous membranes cover body surfaces and consist of **epidermis and dermis.**
11. Synovial membranes line joint cavities, bursae, and tendon sheaths and do not contain epithelium; they also secrete a **lubricating synovial fluid**.

**VII. MUSCLE TISSUE**

1. Muscle tissue consists of fibers (cells) that are...**modified for contraction and thus provide motion, maintenance of posture, and heat production.**
2. It is subdivided into three types.
3. Skeletal muscle tissue is attached to **bones, is striated, and is voluntary**.
4. Cardiac muscle tissue forms most of the **heart wall, is striated, and is voluntary.**.
5. Smooth (visceral) muscle tissue is found in the walls of hollow internal structures (**blood vessels and viscera**), is nonstriated, and is usually **involuntary**. It provides motion – **constriction of blood vessels and airways, propulsion of foods through the gastrointestinal tract, and contraction of the urinary bladder and gall bladder.**
6. **NERVOUS TISSUE**
7. The nervous system is composed of only two principal kinds of cells: **neurons** (nerve cells), and **neuroglia** (protective and supporting cells).
8. Most neurons consist of a **cell body** and two types of processes called **dendrites and axons.**
9. Neurons are sensitive to...**stimuli, convert stimuli into nerve impulses, and conduct nerve impulses to other neurons, muscle fibers, or glands.**
10. Neuroglia **protect and support** neurons and are often the sites of **tumors of the nervous system**.
11. **EXCITABLE CELLS**
12. Neurons and muscle fibers are excitable cells because they **show electrical excitability.** (action potentials).
13. **TISSUE REPAIR: RESTORE HOMEOSTASIS**
14. Tissue repair is the process that replaces **worn out, damaged or dead cells**.
15. Each of the four classes of tissues has a **different capacity to replenish its parenchymal cells.**
16. Epithelial cells are replaced by the division of...**stem cells or by division of undifferentiated cells.**
17. Some connective tissues such as bone has a **continuous capacity for renewal** whereas cartilage replenishes cells **less rapidly**.
18. Muscle cells have a **poor capacity** for renewal.
19. Nervous tissue has the **poorest capacity**  for renewal
20. Fibrosis is the process of **scar formation**.
21. If the injury is extensive granulation tissue (**actively growing connective tissue**) is formed.
22. Adhesions, **which sometimes result from scar formation**, cause abnormal joining of adjacent tissues, particularly in the abdomen and sites of previous surgery. These can cause problems such as **intestinal obstruction**.
23. Conditions Affecting Repair
24. Nutrition is important to tissue repair. Various vitamins (**A, some B, D, C, E, and K**) and a **protein rich** diet are needed.
25. **Proper blood circulation is essential in tissue repair.**
26. **AGING AND TISSUES**
27. The tissues of young people **repair rapidly and efficiently**; the process **slows down with aging**.
28. The younger body is generally in a better **nutritional**  state, its tissues have a better **blood supply**, and its cells have a **faster metabolic rate.**.
29. **DISORDERS: HOMEOSTATIC IMBALANCES**
30. Disorders of epithelial tissues are mainly specific to individual organs, such as **skin cancer,** which involves the epidermis or peptic ulcer disease which involves **the epithelial lining of the stomach or small intestine**.
31. The most prevalent disorders of connective tissue are **autoimmune disorders** which are diseases in which antibodies produced by the immune system fail to distinguish what is foreign from what is self and **attacks the body’s own tissues**.
32. Sjogren’s syndrome causes inflammation and destruction of **exocrine** glands.
33. Systemic lupus erythematosus is a chronic inflammatory disease of **connective tissue**.