Cell Biology: Histology

AI-Generated Study Guide

(Based on lectures delivered by Dr. Ty C.M. Hoffman)

I. Overview of Biological Organization and Tissue Types

- **Hierarchy of Biological Organization:** Understand the relationship between cells, tissues, organs, and organ systems.
- **Four Primary Tissue Types:**Epithelial Tissue
- Connective Tissue
- Muscle Tissue
- Nervous Tissue
- **Excitable Tissues:**Definition: Tissues capable of producing and transmitting action potentials (electrochemical signals).
- Examples: Muscle tissue and nervous tissue.
- Non-Excitable Tissues: Epithelial tissue and connective tissue.

II. Epithelial Tissue (Epithelium)

- **Key Functions:**Covering surfaces (e.g., epidermis, internal organs).
- Lining internal spaces of hollow structures (e.g., digestive tract).
- Forming glands (producing hormones, etc.).
- **Important Properties:Cellularity:** Composed almost entirely of cells with very little extracellular material. Cells are tightly packed.
- **Polarity:** Having two structurally and functionally different surfaces.
- **Apical Surface:** The free, unattached surface (e.g., outer skin, lining of gut lumen).
- **Basal Surface:** The attached surface, connected to a basement membrane (basal lamina).
- **Avascularity:** Lacks blood vessels within the tissue itself. Nutrients and waste exchange occur via diffusion from underlying connective tissue.
- **Regeneration:** High capacity for self-repair and rebuilding if damaged.
- **Classification of Epithelia:By Number of Cell Layers:Simple Epithelium:** Single layer of cells.
- **Stratified Epithelium:** Two or more layers of cells.
- **Pseudostratified Epithelium:** Appears stratified but is actually a single layer because all cells touch the basement membrane (cells have varying heights).

- **Transitional Epithelium:** Multiple layers that change shape when stretched (found in organs like the urinary bladder that need to stretch significantly).
- **By Cell Shape (specifically in the apical layer for stratified epithelia):Squamous:** Thin, flat, wider than thick (like floor tiles).
- **Cuboidal:** Cube-shaped, roughly equal in width and thickness.
- **Columnar:** Column-shaped, thicker than wide.
- **Combinations and Examples:Simple Squamous Epithelium:**Characteristics: Thinnest epithelium, very delicate.
- Function: Ideal for rapid diffusion.
- Location: Alveoli of lungs (gas exchange).
- **Simple Cuboidal Epithelium:**Characteristics: Cells with sufficient cytoplasm for protein synthesis.
- Function: Secretion and absorption (requires transport proteins).
- Location: Kidney tubules (reabsorption of good substances).
- **Simple Columnar Epithelium:**Characteristics: Tall, column-shaped cells with extensive transport proteins. Often features microvilli to increase surface area.
- Function: Absorption (highly efficient nutrient uptake).
- Location: Small intestine (digested food absorption).
- **Stratified Squamous Epithelium:**Characteristics: Many layers, apical cells are squamous; continuous cell loss and replacement from basal layer.
- Function: Protection against abrasion and external forces.
- Location: Epidermis of skin.
- **Stratified Cuboidal Epithelium:**Characteristics: Multiple layers, apical cells are cuboidal.
- Function: Secretion.
- Location: Glands (e.g., salivary glands).
- **Stratified Columnar Epithelium:**Characteristics: Multiple layers, apical cells are columnar.
- Function: Protection and secretion (less common).
- Location: Mammary gland ducts, larynx.
- **Pseudostratified Columnar Epithelium:**Characteristics: Appears multi-layered but all cells touch the basement membrane; often ciliated.
- Function: Secretion and movement of mucus/debris.
- Location: Trachea (sweeping debris from lungs).
- **Transitional Epithelium:**Characteristics: Layers of cells that change shape from columnar/cuboidal to more squamous when stretched.
- Function: Accommodates stretching.
- Location: Urinary bladder, ureters.

III. Connective Tissue

- **General Characteristics:**Most diverse tissue type (ranging from liquid blood to hard bone).

- Connects and supports other tissues.
- Characterized by a significant amount of **extracellular matrix** (ECM).
- **Two Major Components:Cells:Blasts:** Immature, actively dividing cells that produce extracellular matrix (e.g., chondroblasts, osteoblasts).
- **Cytes:** Mature cells that maintain the extracellular matrix (e.g., chondrocytes, osteocytes).
- **Clasts:** Cells that degrade or break down the extracellular matrix (e.g., osteoclasts).
- **Extracellular Matrix (ECM):Ground Substance:** The amorphous material that fills the space between cells and fibers. Its consistency varies (liquid, gel, solid).
- **Fibers (Proteins):Collagenous Fibers (Collagen):** Tough, rope-like, provide tensile strength, do not stretch.
- **Elastic Fibers (Elastin):** Delicate, flexible, able to stretch and recoil (like a rubber band).
- **Reticular Fibers:** Branched, form a delicate, net-like framework or web.
- **Classification of Connective Tissues:Embryonic Connective Tissue:Mesenchyme:** Undifferentiated tissue, precursor to all other connective tissues.
- **Mucous Connective Tissue:** Found in the embryo, produces mucus.
- **Adult Connective Tissue (Six Major Kinds):Loose Connective Tissue (Areolar Tissue):**Characteristics: Low density of fibers, abundant ground substance, not very strong.
- Function: Packing material, allows movement/gliding.
- Location: Deep in the skin, allows skin to glide over underlying structures.
- **Dense Connective Tissue:Dense Regular Collagenous:**Characteristics: High density of collagen fibers, arranged in parallel.
- Function: Strong in one direction.
- Location: Tendons (muscle to bone), Ligaments (bone to bone).
- **Dense Regular Elastic:**Characteristics: High density of elastic fibers, arranged in parallel.
- Function: Strong, but capable of stretching and recoiling.
- Location: Vocal folds.
- **Dense Irregular Collagenous:**Characteristics: High density of collagen fibers, arranged in irregular/all directions.
- Function: Strong in multiple directions.
- Location: Dermis of the skin.
- **Dense Irregular Elastic:**Characteristics: High density of elastic fibers, arranged irregularly.
- Function: Stretches and recoils in multiple directions.
- Location: Aorta (major artery).
- **Connective Tissues with Special Properties:Adipose Tissue:**Characteristics: Specialized for storing fat (lipids). Contains adipocytes.
- Function: Padding, thermal insulation, energy storage.
- Location: Throughout the body.
- **Reticular Tissue:**Characteristics: Abundant reticular fibers forming a net-like structure.
- Function: Forms a filter or sieve.
- Location: Lymph nodes (filtering invaders).

- **Cartilage:** (Avascular, slow to heal due to reliance on diffusion)
- **Hyaline Cartilage:**Characteristics: Most abundant, glassy appearance, low friction surface.
- Function: Reduces friction in joints, precursor to most bones during development.
- Location: Articular surfaces of highly movable joints, costal cartilages (ribs to sternum).
- **Fibrocartilage:**Characteristics: High density of collagen fibers, very tough.
- Function: Provides strong anchoring and shock absorption.
- Location: Intervertebral discs (between vertebrae).
- **Elastic Cartilage:**Characteristics: High density of elastic fibers, very flexible and resilient.
- Function: Maintains shape while allowing flexibility.
- Location: External ear (pinna).
- **Bone:** (Hardest connective tissue, vascular)
- **Compact Bone:**Characteristics: Very dense, forms outer surfaces of bones, arranged in osteons (haversian systems).
- Function: Provides strength and support, withstands direct forces.
- Microscopic Features:
- **Osteons:** Cylindrical units with a central canal.
- **Central Canal (Haversian Canal):** Contains blood vessels and nerves.
- **Lamellae:** Concentric layers of bone matrix.
- **Lacunae:** Small chambers within the matrix where osteocytes reside.
- **Canaliculi:** Tiny canals connecting lacunae, allowing nutrient/waste exchange between osteocytes.
- Cells: Osteoblasts (produce matrix), Osteocytes (maintain matrix), Osteoclasts (degrade matrix).
- **Cancellous Bone (Spongy Bone):**Characteristics: Porous, found in the interior of bones (especially flat bones and ends of long bones), filled with marrow.
- Function: Lighter weight, provides space for marrow.
- Microscopic Features: Composed of trabeculae (little rods/girders) forming a network.
- **Blood and Hemopoietic Tissue:Blood:**Characteristics: Liquid connective tissue.
- Components:
- **Cells:** Red Blood Cells (enucleated, carry hemoglobin for O2/CO2 transport), White Blood Cells (immune function), Platelets (cell fragments involved in clotting).
- **Extracellular Matrix:Plasma:** The liquid matrix of blood, contains dissolved proteins (fibers).
- **Serum:** Plasma with clotting proteins removed (ground substance only).
- Function: Transport of gases, nutrients, wastes, hormones, immune defense.
- **Hemopoietic Tissue:**Characteristics: Tissue responsible for producing blood cells. Contains stem cells.
- Location: Red marrow (found in tips of long bones and flat bones).
- Yellow Marrow: Primarily fat (adipocytes).

IV. Muscle Tissue

- **General Properties:Excitable:** Responds to stimuli by producing action potentials.
- **Contractility:** Ability to shorten or contract (pull, not push).
- **Extensibility:** Ability to be stretched.
- **Elasticity:** Ability to recoil to original length after stretching.
- **Three Major Types:Skeletal Muscle:**Location: Attached to bones, forms the bulk of muscles involved in movement.
- Cell Shape (Myofiber/Muscle Fiber): Long, cylindrical, unbranched.
- Nuclei: Multiple (multinucleated), peripherally located.
- Striations: Highly striated (ordered banding pattern).
- Control: Voluntary (conscious control).
- **Cardiac Muscle:**Location: Walls of the heart only.
- Cell Shape: Long, cylindrical, branched.
- Nuclei: Single nucleus, centrally located.
- Striations: Striated, but less orderly due to branching.
- Control: Involuntary (unconscious control).
- Special Feature: **Autorhythmicity** (contracts spontaneously), **Intercalated Discs** (specialized junctions allowing rapid electrical communication between cells for synchronized contraction).
- **Smooth Muscle:**Location: Walls of hollow organs (e.g., digestive tract, blood vessels).
- Cell Shape: Spindle-shaped (tapered ends).
- Nuclei: Single nucleus, centrally located.
- Striations: Non-striated.
- Control: Involuntary (unconscious control), autorhythmic (slower, prolonged contractions).

V. Nervous Tissue

- **Two Major Cell Classes:Neurons (Nerve Cells):**Characteristics: Excitable cells, specialized for receiving and transmitting electrochemical signals (action potentials). Very long, but thin.
- Parts:
- **Cell Body:** Contains the nucleus and most cytoplasm.
- **Dendrites:** Branching extensions that receive incoming stimuli/signals (inputs).
- **Axon:** A single, long extension that transmits signals away from the cell body (outputs). Can be myelinated for faster signal conduction.
- Function: Communication, information processing.
- **Neuroglia (Glial Cells):**Characteristics: Non-excitable supporting cells.
- Function: Support, protect, nourish neurons, and maintain the environment for neuronal function (e.g., myelination of axons).
- Location: Found throughout the nervous system (central and peripheral).

Histology Review Quiz

Instructions: Answer each question in 2-3 sentences.

1. Explain the concept of "excitable tissues" and provide two examples.
2. Describe the properties of "cellularity" and "avascularity" as they apply to epithelial tissue.
3. How is simple squamous epithelium ideally suited for its function in the lungs?
4. Differentiate between the apical and basal surfaces of an epithelium.
5. What are the three major types of cells found in connective tissue, and what is the primary role of each?
6. Compare and contrast dense regular collagenous connective tissue and dense irregular collagenous connective tissue in terms of fiber arrangement and strength.
7. Why is cartilage slow to heal compared to bone?
8. Describe the microscopic structure of compact bone, specifically mentioning osteons, central canals, and canaliculi.
9. What are the key differences in striation and control between skeletal muscle and cardiac muscle?
10. How do neurons and neuroglia contribute differently to the function of nervous tissue?

Answer Key

1. Excitable tissues are those capable of generating and transmitting electrochemical signals called action potentials. This property is crucial for rapid communication and movement in the body. Examples include muscle tissue, which contracts in response to these signals, and nervous tissue, which uses them for communication throughout the body.
2. Cellularity in epithelial tissue means it is composed almost entirely of cells packed tightly together with minimal extracellular material. Avascularity means that epithelial tissue lacks direct blood vessels; instead, nutrients and wastes must diffuse from nearby connective tissue due to its thinness.
3. Simple squamous epithelium is composed of a single, very thin layer of flat cells. This extreme thinness minimizes the distance for gas exchange, making it perfectly suited for efficient diffusion of oxygen and carbon dioxide in the alveoli of the lungs.
4. The apical surface of an epithelium is the "free" or unattached surface, exposed to an external environment or internal lumen, like the surface of the skin or the lining of the small intestine. The basal surface is the "attached" surface, connected to an underlying basement membrane, which typically anchors the epithelium to connective tissue.
5. The three major types of cells in connective tissue are blasts, cytes, and clasts. Blasts (e.g., fibroblasts, osteoblasts) are immature, actively synthesizing and secreting the extracellular matrix. Cytes (e.g., fibrocytes, osteocytes) are mature cells that primarily maintain the existing extracellular matrix. Clasts (e.g., osteoclasts) are responsible for degrading or breaking down the extracellular matrix.
6. Dense regular collagenous connective tissue has a high density of collagen fibers arranged in parallel, making it exceptionally strong in one specific direction of pull, as

seen in tendons. Dense irregular collagenous connective tissue also has a high density of collagen fibers, but they are arranged randomly in multiple directions, providing strength and resistance to forces from various orientations, like in the dermis of the skin.

7. Cartilage is slow to heal primarily because it is avascular, meaning it lacks direct blood supply. This forces its cells (chondrocytes) to rely on slow diffusion through a dense extracellular matrix for nutrient and waste exchange, severely limiting its repair capabilities compared to richly vascularized tissues like bone.
8. Compact bone is organized into repeating units called osteons (Haversian systems). Each osteon features a central canal containing blood vessels and nerves, surrounded by concentric layers of bone matrix called lamellae. Within these lamellae, small spaces called lacunae house osteocytes, which communicate with each other and the central canal via tiny channels called canaliculi, facilitating nutrient and waste transport through the solid matrix.
9. Skeletal muscle is highly striated due to the orderly arrangement of its contractile proteins and is under voluntary (conscious) control. Cardiac muscle is also striated, but its striations appear less orderly due to the branching nature of its cells; importantly, cardiac muscle is involuntary and exhibits autorhythmicity, meaning it can contract spontaneously without nervous system input.
10. Neurons are the excitable cells of nervous tissue, specialized for generating and transmitting electrochemical signals (action potentials) to communicate information throughout the body. Neuroglia, on the other hand, are non-excitable supporting cells that perform various functions to aid and protect neurons, such as providing nutrients, maintaining the extracellular environment, and forming myelin sheaths for faster signal conduction.

Essay Format Questions

1. Discuss the unique properties of epithelial tissue (cellularity, polarity, avascularity, and regeneration) and explain how each property contributes to its diverse functions in the human body. Provide specific examples for each property.
2. Choose two different types of simple epithelia (e.g., simple squamous, simple cuboidal, simple columnar) and two different types of stratified epithelia (e.g., stratified squamous, transitional). For each chosen type, describe its cellular characteristics, location in the body, and explain how its structure is perfectly adapted to its specific physiological function.
3. The extracellular matrix is a defining feature of connective tissue. Describe the two main components of the extracellular matrix (ground substance and fibers), detailing the three types of fibers found within it. Explain how the varying composition and arrangement of these components lead to the vast diversity and unique properties of different connective tissues, providing examples like loose, dense regular, and cartilage.
4. Compare and contrast the three types of muscle tissue (skeletal, cardiac, and smooth) across several characteristics, including cell shape, presence/absence of striations, number and location of nuclei, and type of nervous control (voluntary/involuntary).

Discuss how these structural differences relate to their distinct functional roles in the body.

5. Explain the functional relationship between neurons and neuroglia within nervous tissue. Detail the primary role of neurons in communication, including their major anatomical parts and how they transmit signals. Then, describe the general supportive functions of neuroglia, providing an example of how a neuroglial cell directly aids neuronal function.

Glossary of Key Terms

- **Action Potential:** An electrochemical signal produced and transmitted by excitable tissues (muscle and nervous tissue).
- **Adipocyte:** A cell specialized for storing fat, found in adipose tissue.
- **Adipose Tissue:** A type of connective tissue specialized for fat storage, providing padding, insulation, and energy reserves.
- **Alveoli:** Tiny air sacs in the lungs lined by simple squamous epithelium, specialized for gas exchange via diffusion.
- **Apical Surface:** The free, unattached surface of an epithelial layer, exposed to either the external environment or an internal lumen.
- **Areolar Tissue:** Another name for loose connective tissue, characterized by few fibers and abundant ground substance.
- **Avascularity:** The property of a tissue lacking its own blood vessels, relying on diffusion for nutrient and waste exchange (e.g., epithelia, cartilage).
- **Axon:** The long, slender projection of a neuron that conducts electrical impulses away from the cell body.
- **Basal Lamina (Basement Membrane):** A thin, extracellular layer that anchors the basal surface of an epithelium to underlying connective tissue.
- **Basal Surface:** The attached surface of an epithelial layer, connected to the basement membrane.
- **Blast:** An immature, actively synthesizing cell type found in connective tissues, responsible for producing the extracellular matrix (e.g., osteoblast, chondroblast).
- **Canaliculi:** Tiny canals within the bone matrix that connect lacunae, allowing osteocytes to communicate and exchange nutrients/wastes.
- **Cancellous Bone (Spongy Bone):** Porous bone tissue found in the interior of bones, characterized by a network of trabeculae and spaces filled with marrow.
- **Cardiac Muscle:** Striated, involuntary muscle tissue found only in the heart; characterized by branched cells and intercalated discs.
- **Cartilage:** A type of connective tissue that is tough, flexible, and avascular; includes hyaline, fibrocartilage, and elastic types.
- **Cell Body (Soma):** The main part of a neuron containing the nucleus and most of the cytoplasm.
- **Cellularity:** The property of a tissue being composed primarily of closely packed cells with minimal extracellular material (characteristic of epithelia).

- **Central Canal (Haversian Canal):** The central channel within an osteon of compact bone, containing blood vessels and nerves.
- **Chondroblast:** A blast cell found in cartilage, responsible for producing cartilage matrix.
- **Chondroclast:** A cell responsible for degrading cartilage matrix.
- **Chondrocyte:** A mature cartilage cell (cyte) that maintains the cartilage matrix, often trapped within lacunae.
- **Clast:** A cell type found in connective tissues whose job it is to degrade the extracellular matrix (e.g., osteoclast, chondroclast).
- **Collagenous Fibers:** Tough, rope-like protein fibers (collagen) in the extracellular matrix of connective tissue, providing tensile strength.
- **Columnar:** A cell shape, thicker than it is wide, resembling a column (e.g., simple columnar epithelium).
- **Compact Bone:** Dense, solid bone tissue that forms the outer layer of most bones, arranged in osteons, providing maximum strength.
- **Connective Tissue:** One of the four primary tissue types, characterized by abundant extracellular matrix and diverse functions, including support, connection, and protection.
- **Contractility:** The ability of muscle tissue to shorten or contract.
- **Cuboidal:** A cell shape that is roughly cube-like, with equal width and thickness (e.g., simple cuboidal epithelium).
- **Cyte:** A mature cell type found in connective tissues, responsible for maintaining the extracellular matrix (e.g., osteocyte, fibrocyte).
- **Dendrites:** Branching extensions of a neuron that receive incoming electrochemical signals (inputs) from other cells.
- **Dense Connective Tissue:** Connective tissue characterized by a high density of protein fibers, providing significant strength (e.g., tendons, ligaments, dermis).
- **Dermis:** The deeper layer of the skin, primarily composed of dense irregular collagenous connective tissue.
- **Diffusion:** The net movement of particles from an area of higher concentration to an area of lower concentration, crucial for nutrient/waste exchange in avascular tissues.
- **Elastic Cartilage:** A type of cartilage characterized by abundant elastic fibers, providing flexibility and the ability to recoil (e.g., external ear).
- **Elastic Fibers:** Flexible protein fibers (elastin) in the extracellular matrix of connective tissue that can stretch and recoil.
- **Elasticity:** The ability of muscle tissue to return to its original length after being stretched.
- **Embryonic Connective Tissue:** Connective tissue found only in the embryo, which develops into all other connective tissue types (e.g., mesenchyme).
- **Epidermis:** The outermost layer of the skin, composed of stratified squamous epithelium.
- **Epithelial Tissue (Epithelium):** One of the four primary tissue types, specialized for covering surfaces, lining cavities, and forming glands.
- **Excitable Tissue:** Tissues capable of producing and transmitting action potentials; includes muscle and nervous tissue.
- **Extensibility:** The ability of muscle tissue to be stretched or extended.

- **Extracellular Matrix (ECM):** The non-cellular component of connective tissue, located between cells, consisting of ground substance and protein fibers.
- **Fibroblast:** A blast cell found in fibrous connective tissues, responsible for producing collagen and other extracellular matrix components.
- **Fibrocartilage:** A type of cartilage with a high density of collagen fibers, providing great tensile strength and shock absorption (e.g., intervertebral discs).
- **Glands:** Structures formed by epithelial tissue that produce and secrete substances (e.g., hormones, saliva).
- **Ground Substance:** The amorphous component of the extracellular matrix, filling the space between cells and fibers, varying in consistency.
- **Hemoglobin:** A complex protein found in red blood cells that binds and transports oxygen and carbon dioxide.
- **Hemopoesis:** The process of producing blood cells.
- **Hemopoietic Tissue:** Tissue responsible for producing all types of blood cells, found primarily in red bone marrow.
- **Hyaline Cartilage:** The most abundant type of cartilage, with a glassy appearance, providing smooth, low-friction surfaces in joints and forming the precursor to most bones.
- **Hydroxyapatite:** A mineral composed mostly of calcium phosphate, which gives bone its hardness.
- **Involuntary Control:** Muscle contraction that is not under conscious control (e.g., cardiac muscle, smooth muscle).
- **Intercalated Discs:** Specialized junctions between adjacent cardiac muscle cells that allow for rapid and synchronized electrical communication, enabling the heart to pump efficiently.
- **Lacuna:** A small, hollow space or chamber within the extracellular matrix, often where cells like osteocytes or chondrocytes reside.
- **Lamellae:** Concentric layers of bone matrix found within osteons of compact bone.
- **Ligament:** A band of dense regular collagenous connective tissue that connects bones to other bones.
- **Loose Connective Tissue:** Connective tissue with a relatively low number of fibers and abundant ground substance, used as packing material and allowing for movement.
- **Lymph Nodes:** Structures in the lymphatic system containing reticular tissue, which act as filters to trap invaders and present them to immune cells.
- **Marrow (Red/Yellow):** Tissue found within bones. Red marrow is hemopoietic tissue (produces blood cells), while yellow marrow is primarily adipose tissue (fat).
- **Mesenchyme:** An embryonic connective tissue that serves as the precursor for all adult connective tissues.
- **Microvilli:** Finger-like projections on the apical surface of some epithelial cells (e.g., in the small intestine) that significantly increase surface area for absorption.
- **Muscle Fiber (Myofiber):** An individual muscle cell.
- **Muscle Tissue:** One of the four primary tissue types, specialized for contraction and movement; includes skeletal, cardiac, and smooth types.
- **Myelination:** The process of coating an axon with a myelin sheath (formed by neuroglial cells) to electrically insulate it and increase the speed of action potential conduction.

- **Nerve Cell:** Another name for a neuron.
- **Nervous Tissue:** One of the four primary tissue types, specialized for communication and information processing; composed of neurons and neuroglia.
- **Neuroglia (Glial Cells):** Non-excitable supporting cells in nervous tissue that provide structural, metabolic, and protective support to neurons.
- **Neuron:** The excitable cell type in nervous tissue, specialized for receiving, processing, and transmitting electrochemical signals.
- **Oocyte:** In the context of bone, likely a misspelling or mispronunciation of Osteocyte.
- **Osteoblast:** A blast cell found in bone, responsible for synthesizing and secreting the organic components of the bone matrix.
- **Osteoclast:** A large cell that resorbs (breaks down) bone matrix.
- **Osteocyte:** A mature bone cell (cyte) that maintains the bone matrix, located within lacunae.
- **Osteon (Haversian System):** The fundamental structural unit of compact bone, consisting of concentric lamellae around a central canal.
- **Plasma:** The extracellular matrix of blood, a fluid containing dissolved proteins (fibers) and ground substance.
- **Platelets:** Small cell fragments in blood involved in clotting.
- **Polarity:** The property of an epithelial cell or tissue having distinct structural and functional differences between its apical and basal surfaces.
- **Pseudostratified Epithelium:** An epithelium that appears to have multiple layers due to varying cell heights, but all cells are in contact with the basement membrane (e.g., in the trachea).
- **Regeneration:** The ability of a tissue to repair itself and grow back after damage (e.g., epithelia).
- **Reticular Fibers:** Branched, delicate protein fibers that form a net-like framework in the extracellular matrix, often found in filtering organs.
- **Reticular Tissue:** A type of connective tissue characterized by abundant reticular fibers, forming a supportive network or filter.
- **Red Blood Cells:** Biconcave, enucleated cells in blood that contain hemoglobin and are specialized for oxygen and carbon dioxide transport.
- **Serum:** The fluid portion of blood plasma after clotting proteins (fibers) have been removed; essentially the ground substance of blood.
- **Simple Epithelium:** An epithelial tissue consisting of a single layer of cells.
- **Skeletal Muscle:** Striated, voluntary muscle tissue attached to bones, responsible for body movement.
- **Smooth Muscle:** Non-striated, involuntary muscle tissue found in the walls of hollow internal organs (e.g., digestive tract, blood vessels).
- **Squamous:** A cell shape that is thin and flattened, wider than thick (e.g., simple squamous epithelium).
- **Stem Cell:** An undifferentiated cell that has the ability to develop into various specialized cell types.
- **Stratified Epithelium:** An epithelial tissue consisting of two or more layers of cells.

- **Striations:** The banding pattern (alternating light and dark bands) visible in skeletal and cardiac muscle under a microscope, caused by the organized arrangement of contractile proteins.
- **Tendons:** Bands of dense regular collagenous connective tissue that connect muscles to bones.
- **Tissue:** A group of similar cells that work together to perform a specific function.
- **Trabeculae:** Little rods or plates of bone that form the network in cancellous (spongy) bone.
- **Transitional Epithelium:** A specialized stratified epithelium found in organs that undergo significant stretching (e.g., urinary bladder), allowing its cell layers to change shape.
- **Vascular:** Pertaining to or containing blood vessels.
- **Voluntary Control:** Muscle contraction that is under conscious control (e.g., skeletal muscle).
- **White Blood Cells:** Immune cells in the blood that protect the body against infection and disease.