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المحاضرة الثالثة

Tissue: Structure, properties; classification and function(patr1)

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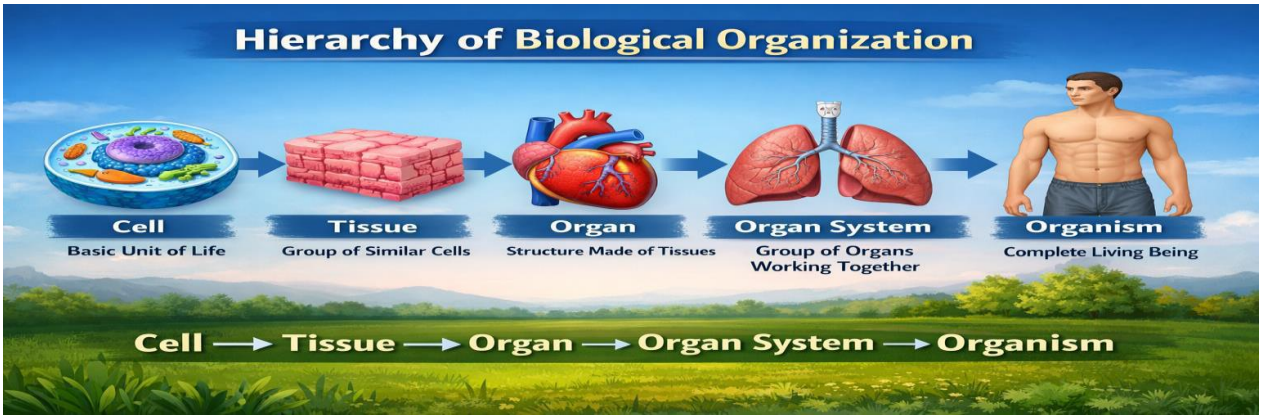
1. Introduction to Tissues

Tissues are **groups of similar cells that perform a specific function** in the body, along with their extracellular matrix (ECM). They are the **building blocks of organs** and organ systems.

Histology is the branch of biology that studies tissues in detail. Understanding tissue structure and function is essential for fields like anatomy, physiology, pathology, and medicine.

Organization Levels in the Human Body:

- Cells → Tissues → Organs → Organ Systems → Organism



Each level has increasing complexity: cells are the basic unit, while tissues are organized groups of cells performing similar functions.

Clinical Importance:
Abnormalities in tissue structure lead to diseases, e.g., fibrosis in connective tissue, epithelial cancers, muscle dystrophies, and neurodegenerative disorders.

2. Basic Components of Tissues

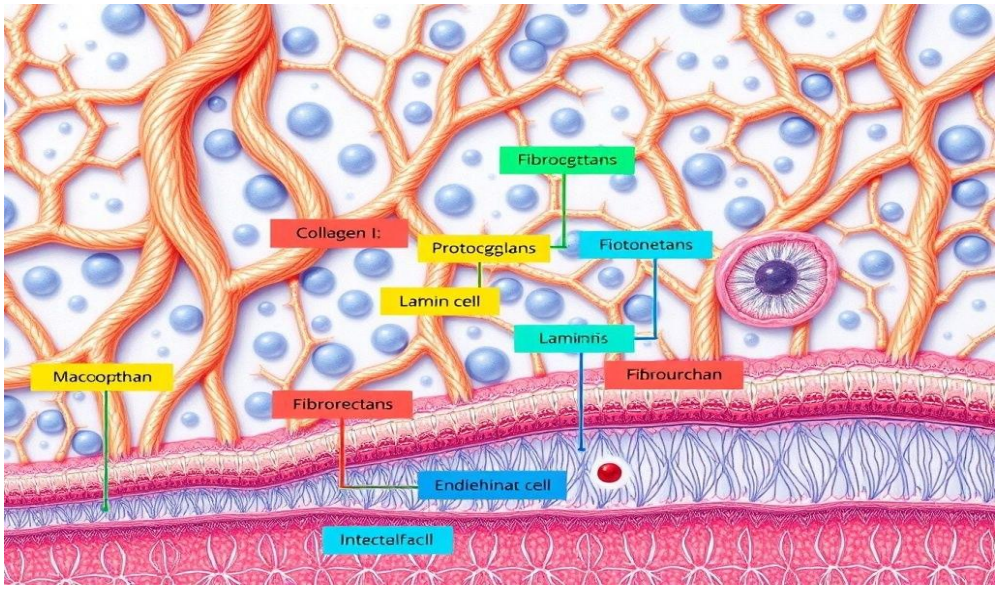
Every tissue has two main components:

2.1 Cells

- Functional units of the tissue.
- Specialized according to tissue type.
  Examples:
  - Muscle cells → contraction
  - Neurons → signal transmission
  - Epithelial cells → protection and secretion

2.2 Extracellular Matrix (ECM)

- Non-living substance between cells.
- Provides structural support and regulates cellular behavior.
- Composed of:
  - **Fibers**: Collagen (strength), Elastic (flexibility), Reticular (network support)
  - **Ground substance**: Water, glycoproteins, proteoglycans



3. Properties of Tissues

Tissues possess **unique properties** depending on their function:

1. **Irritability (Responsiveness)**
   Ability to respond to internal or external stimuli. Example: Nerve tissue reacts to touch or pain.
2. **Conductivity**
   Ability to transmit impulses. Example: Electrical signals in neurons.
3. **Contractility**
   Ability to shorten and generate force. Example: Muscle tissue contraction.
4. **Elasticity**
   Ability to return to original shape after stretching. Example: Skin and arteries.
5. **Extensibility**
   Ability to stretch without damage. Example: Smooth muscles in the stomach.

Table 1: Tissue Properties Overview

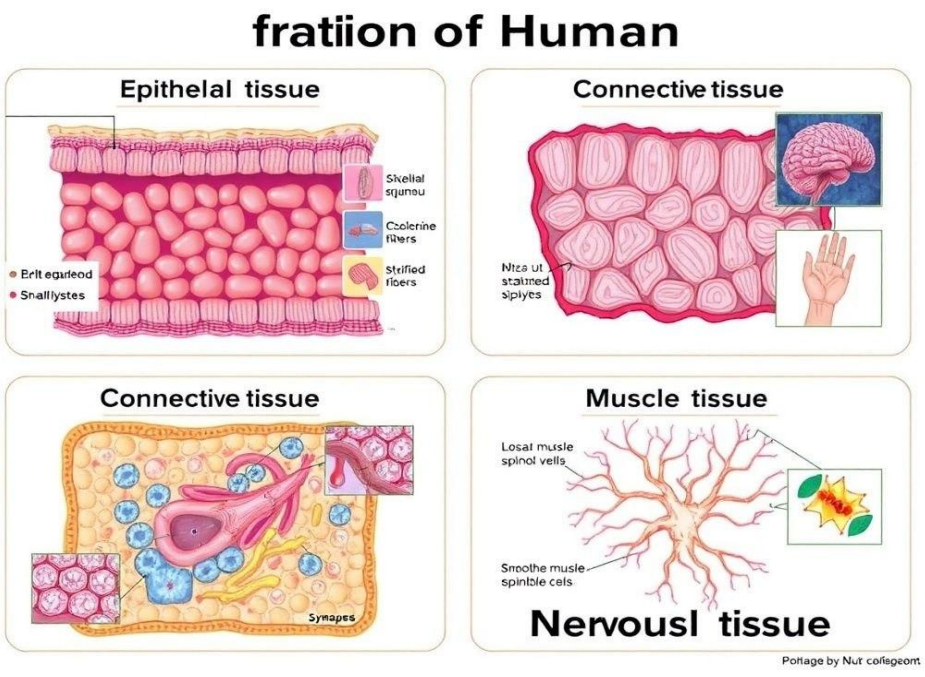
Tissue Type	Key Properties	Example Function
Epithelial	Protection, absorption	Skin, intestine
Connective	Strength, flexibility	Tendons, cartilage
Muscle	Contractility, extensibility	Heart, skeletal muscles
Nervous	Irritability, conductivity	Brain, spinal cord

4. Classification of Tissues

Human tissues are classified into **four main types**:

1. **Epithelial Tissue** – Covers surfaces, lines cavities, forms glands.
2. **Connective Tissue** – Supports, protects, and binds other tissues.
3. **Muscle Tissue** – Specialized for movement.
4. **Nervous Tissue** – Specialized for communication.

Diagram: Classification of Human Tissues



5. pithelial Tissue

5.1 Definition

A sheet of **tightly packed cells** covering the body surfaces, lining cavities, and forming glands.

5.2 Characteristics

- Closely packed cells
- Minimal ECM
- Avascular (no blood vessels; nutrients diffuse from underlying connective tissue)
- Attached to a **basement membrane**
- High regenerative capacity

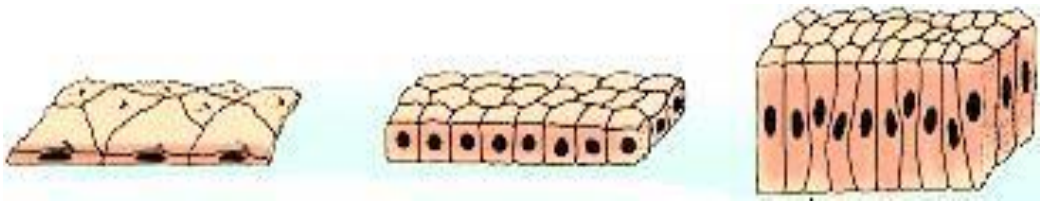
5.3 Functions

- **Protection**: Skin protects against pathogens and injury.
- **Absorption**: Intestines absorb nutrients.
- **Secretion**: Glands secrete enzymes, hormones, and sweat.
- **Filtration**: Kidneys filter blood.

5.4 Types of Epithelial Tissue

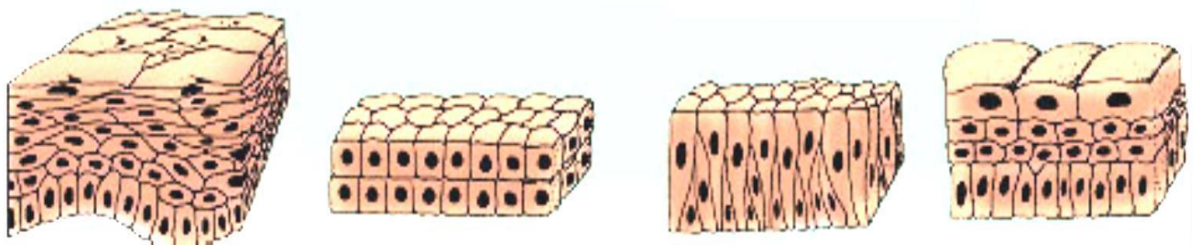
1. Simple Epithelium (single layer)

- Simple squamous → diffusion (lungs, blood vessels)
- Simple cuboidal → secretion/absorption (kidney tubules)
- Simple columnar → absorption and secretion (intestine)



2. Stratified Epithelium (multiple layers)

- Stratified squamous → protection (skin, mouth)
- Stratified cuboidal → secretion (sweat glands)

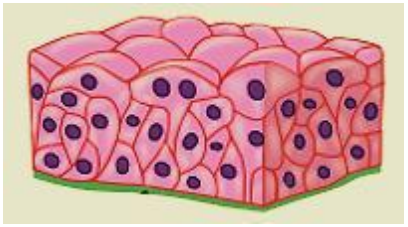


3. Pseudostratified Epithelium

- Appears layered but all cells touch basement membrane (respiratory tract)

4. Transitional Epithelium

- Specialized for stretching (urinary bladder)



6. Connective Tissue

6.1 Definition

Tissue that **connects, supports, and protects** other tissues and organs.

6.2 Characteristics

- Cells are widely spaced
- Abundant ECM
- Usually vascular (except cartilage)
- Contains specialized cells

6.3 Components

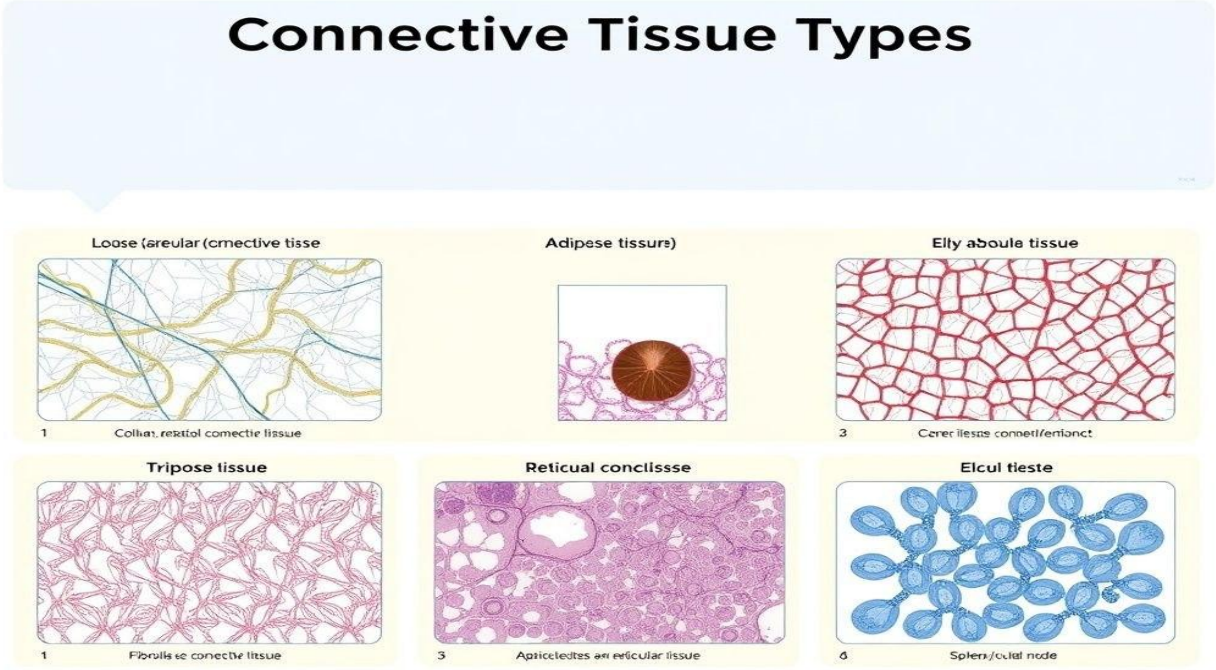
- **Cells**: Fibroblasts, adipocytes, macrophages
- **Fibers**: Collagen (strength), Elastic (stretch), Reticular (framework)
- **Ground substance**: Proteoglycans, glycoproteins

6.4 Functions

- Structural support (bone, cartilage)
- Transport of substances (blood)
- Protection and immunity (lymphoid tissue)
- Energy storage (adipose tissue)

6.5 Types

1. **Loose Connective Tissue** → beneath epithelium, flexible support
2. **Dense Connective Tissue** → tendons, ligaments
3. **Cartilage** → flexible support, no blood vessels
4. **Bone** → rigid support
5. **Blood** → transport and immunity



7. Muscle Tissue

7.1 Definition

Specialized tissue capable of **contraction**, allowing movement.

7.2 Types

1. **Skeletal Muscle**

- Voluntary, striated, attached to bones
- Multinucleated
- Function: Body movement

2. **Cardiac Muscle**

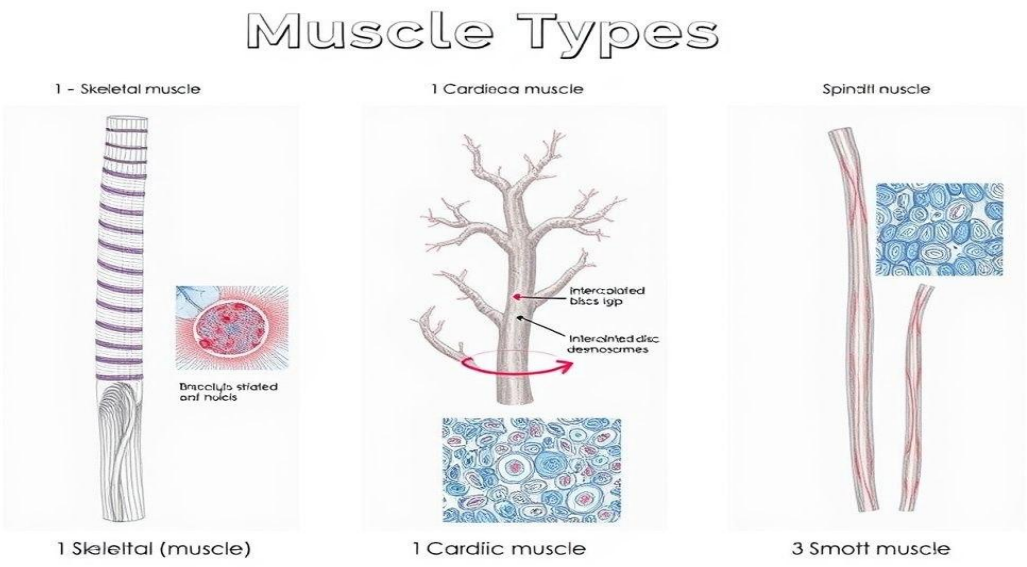
- Involuntary, striated, branched cells
- Found only in the heart
- Function: Pumps blood

3. **Smooth Muscle**

- Involuntary, non-striated
- Found in walls of organs
- Function: Movement of contents (digestive tract, blood vessels)

7.3 Functions

- Locomotion
- Circulation of blood
- Movement of food and waste in organs



8. Nervous Tissue

8.1 Definition

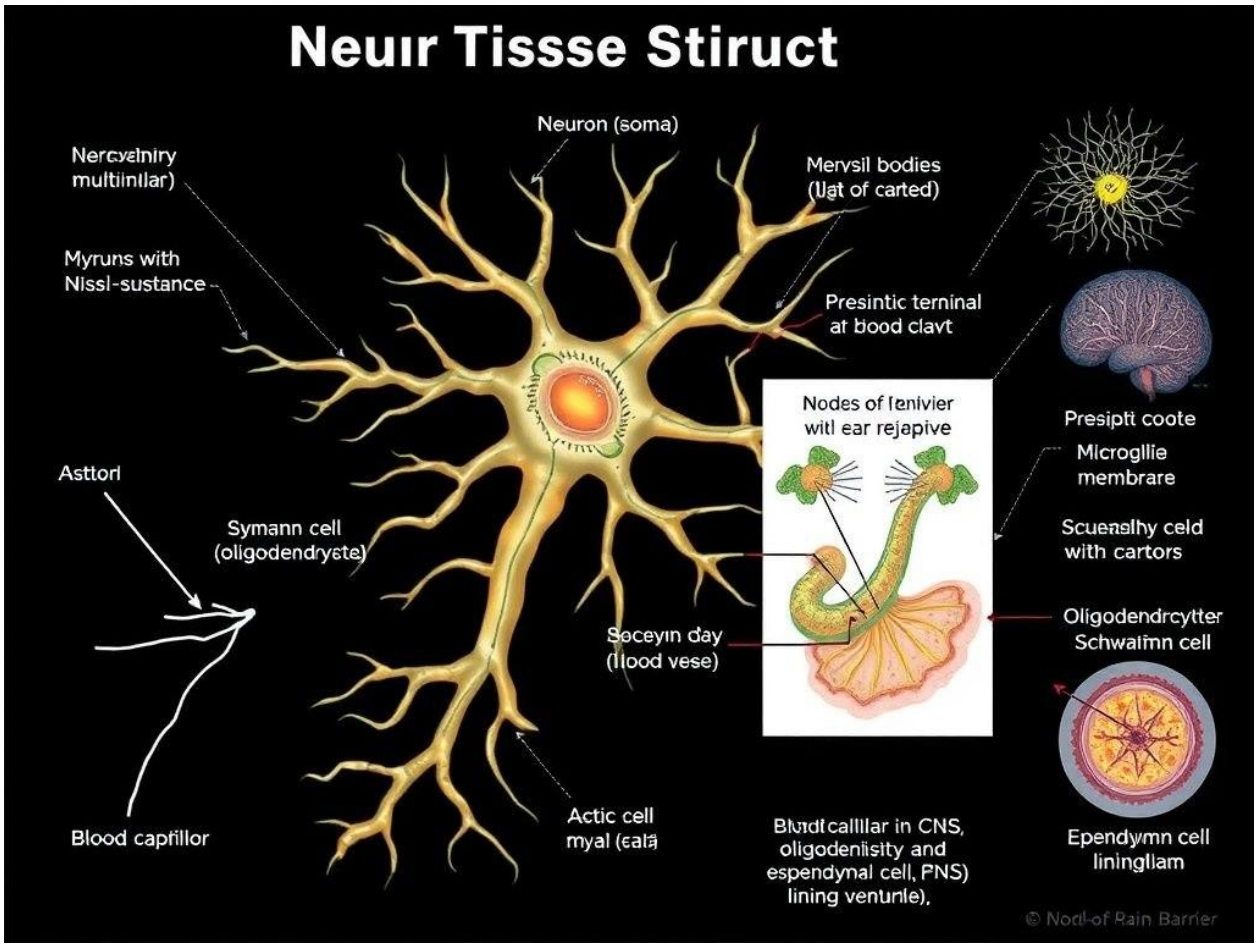
Tissue specialized for **communication and control** of body functions.

8.2 Components

- **Neurons** → transmit signals
- **Neuroglia** → support and protect neurons

8.3 Functions

- Receive stimuli from environment
- Process and integrate information
- Transmit impulses to effectors (muscles/glands)



9. Comparative Table of Tissue Types

Tissue Type	Structure Characteristics	Main Function	Examples
Epithelial	Tightly packed, avascular, regenerates	Protection, absorption, secretion	Skin, intestine
Connective	Cells spaced, abundant ECM	Support, transport, protection	Bone, cartilage, blood
Muscle	Contractile cells	Movement	Skeletal, heart, smooth
Nervous	Neurons + neuroglia	Communication	Brain, spinal cord

10. Clinical Significance

- **Epithelial tissue**: Carcinomas (skin, lung)
- **Connective tissue**: Osteoporosis (bone), arthritis (cartilage)
- **Muscle tissue**: Muscular dystrophy, myocardial infarction
- **Nervous tissue**: Alzheimer's, multiple sclerosis

11. Summary and Conclusion

Tissues are **fundamental units of multicellular life**. Each tissue type has distinct **structure, properties, and function**, forming the foundation for organs and systems. Understanding tissues is crucial in medicine, biology, and pathology.

- Epithelial → covers and protects
- Connective → supports and binds
- Muscle → moves and contracts
- Nervous → communicates and controls