



Aakash



BYJU'S NOTES

Structural Organisation in Animals - I



Key Takeaways

Epithelial Tissue

1

Simple

Compound

Nervous Tissue

3

Muscular Tissue

4

Connective Tissue

Loose

Dense

Specialized

Skeletal

Fluid

Summary

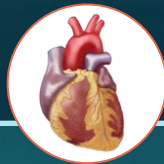


Level of Organisation



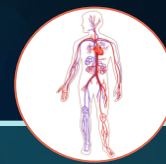
Tissue

A group of **similar cells** along with the **intercellular substances** that perform a **specific function** is known as **tissue**.



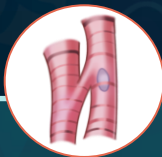
Organ

A **system of tissues** that work **together** on a larger scale to do certain jobs is an **organ**.



Organ system

A **group of organs** that work together to perform common bodily functions is an organ system.



Cell

Cell is the **fundamental** unit of **life**.

Levels of organisation

Organ systems come together to form a multicellular organism.



Organism

An **organism** is a recognisable and **self-contained individual**.



Animal Tissues



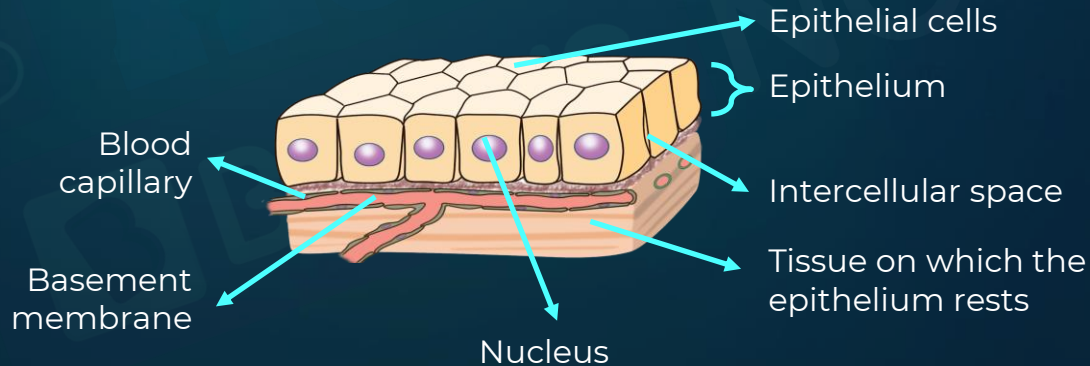
Animals with tissue systems or a higher level of organisation are all made up of the four basic types of tissues.

Epithelial tissue

Connective tissue

Nervous tissue

Muscular tissue



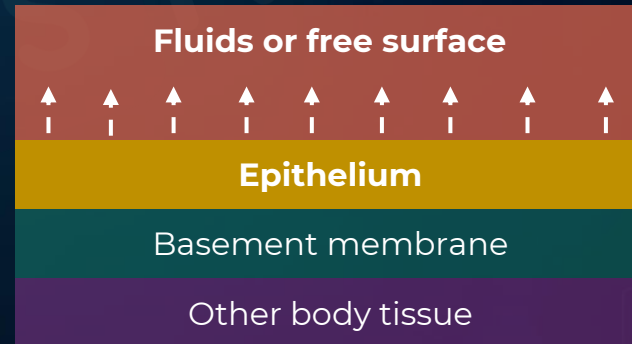
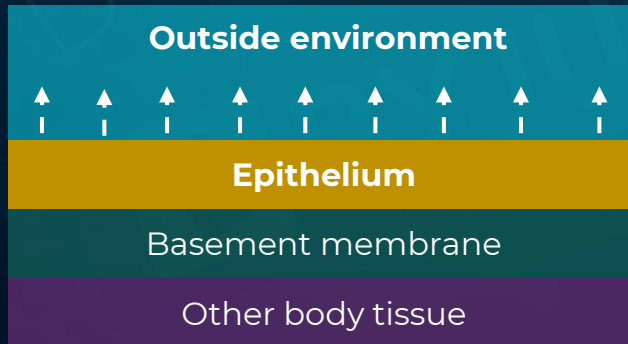


Epithelial Tissue



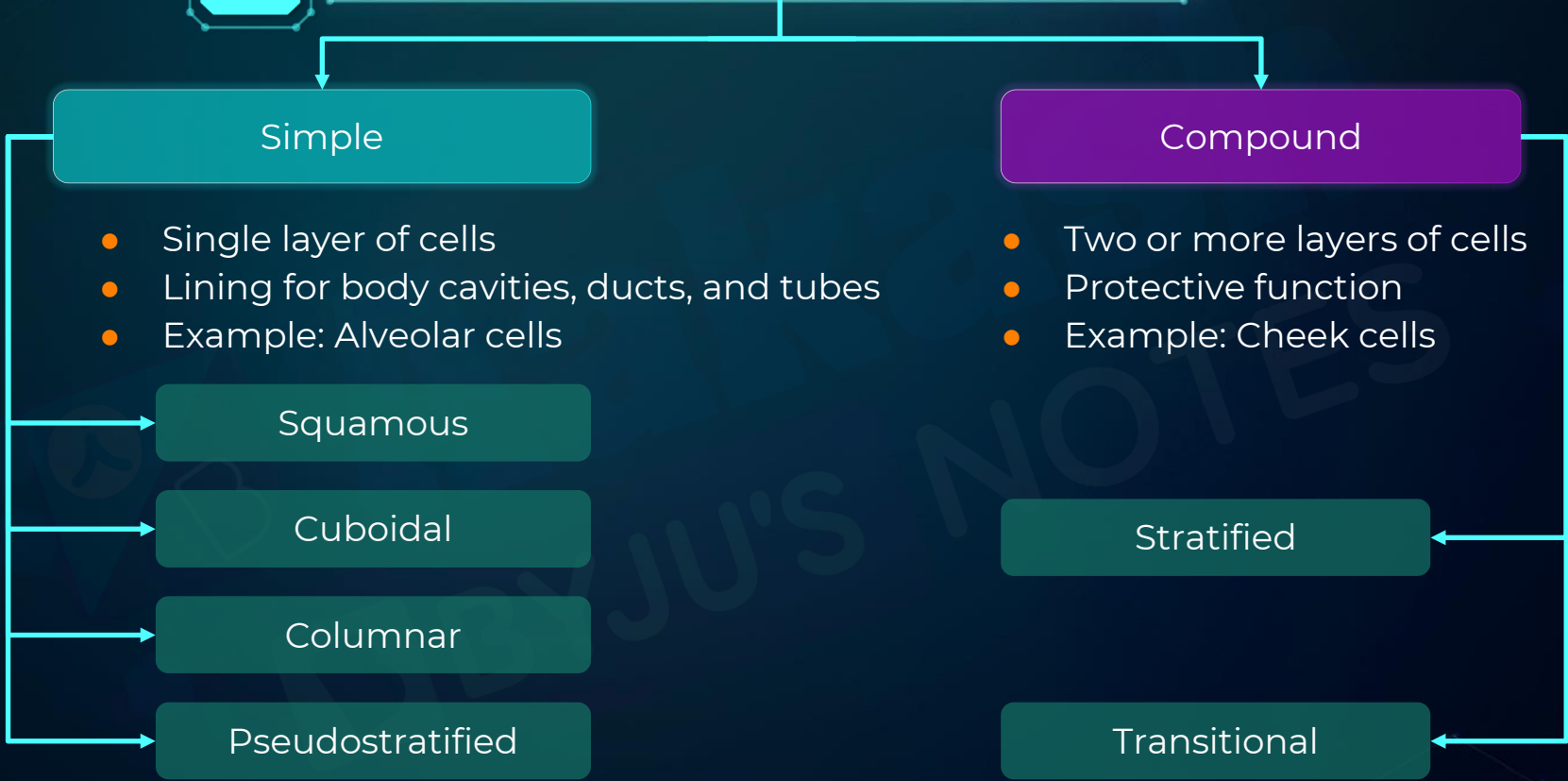
- It is commonly known as **epithelium**.
- It is a large sheet of cells that **forms the lining** of all the body surfaces.
- These cells rest on a non-cellular **basement membrane** which is made up of
 - **Basal lamina** - upper thin layer
 - **Reticular lamina** - lower thick fibrous layer

- It has a **free surface**.
- Epithelial cells are arranged compactly with little intercellular spaces.
- Generally, they are **avascular** and do not have blood vessels.





Epithelial Tissue





Simple Epithelial Tissue



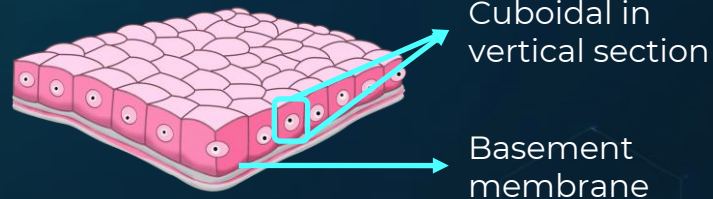
Squamous

- It is also known as **pavement epithelium**.
- It is the layer of thin flat cells with **prominent nuclei**.
- **It has flattened cells** with irregular boundaries.
- **It forms the diffusion boundary.**
- It occurs in the **alveoli of lungs, lining of the blood, and lymph vessels.**



Cuboidal

- It appears **cuboidal in vertical sections** and polygonal from the surface.
- It has **circular nuclei**.
- It participates in **secretion, absorption, and excretion.**
- It lines **small salivary and pancreatic ducts** with thyroid follicles.



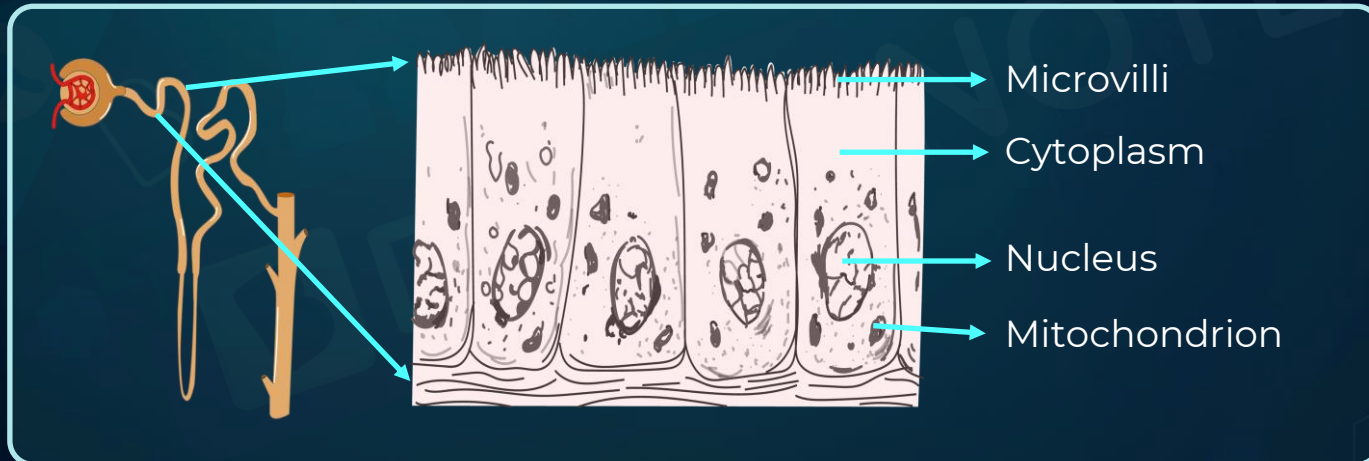


Simple Epithelial Tissue



Cuboidal

- Cuboidal epithelium bears **microvilli** in **absorptive regions** on their free ends.
- They give a brush-border appearance and hence called **brush-bordered epithelium**.
- They are found in **proximal tubules of kidney**.



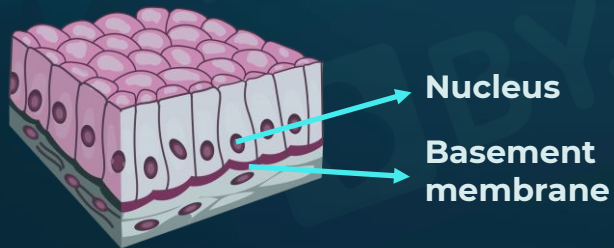


Simple Epithelial Tissue



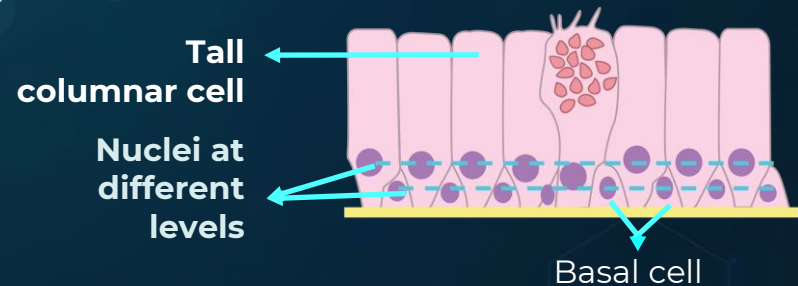
Columnar

- Appear column-like in vertical section.
- Nucleus usually located near the base.
- Lines the **stomach** and the **inner layer of small intestine**.
- Increases surface area for absorption.



Pseudostratified

- It is a **single layer** of columnar cells.
- It **appears to be double layered** due to different sizes of cells.
- Nuclei are present on different levels.
- **Shorter cells lack cilia** and secrete mucus.
- **Longer cells are ciliated** and propel the mucus and the particle towards the larynx.





Simple Epithelial Tissue



Cuboidal and columnar epithelium can specialize into 2 distinct types, besides their normal form

Ciliated

- Type of cuboidal or columnar epithelium **bearing cilia**
- Composed of a **single layer of cube-like cells**
- Commonly found in **inner surface of hollow organs like bronchioles and fallopian tubes.**
- **Main functions** is to move particles or mucus in a specific direction

Glandular

- Cuboidal or columnar cells
- **Specialised for secretion**
- They can be
 - **Unicellular:** Consisting of isolated glandular cells - **Goblet cells** of alimentary canal
 - **Multicellular:** Consisting of cluster of cells - **Salivary glands**



Types of Glands



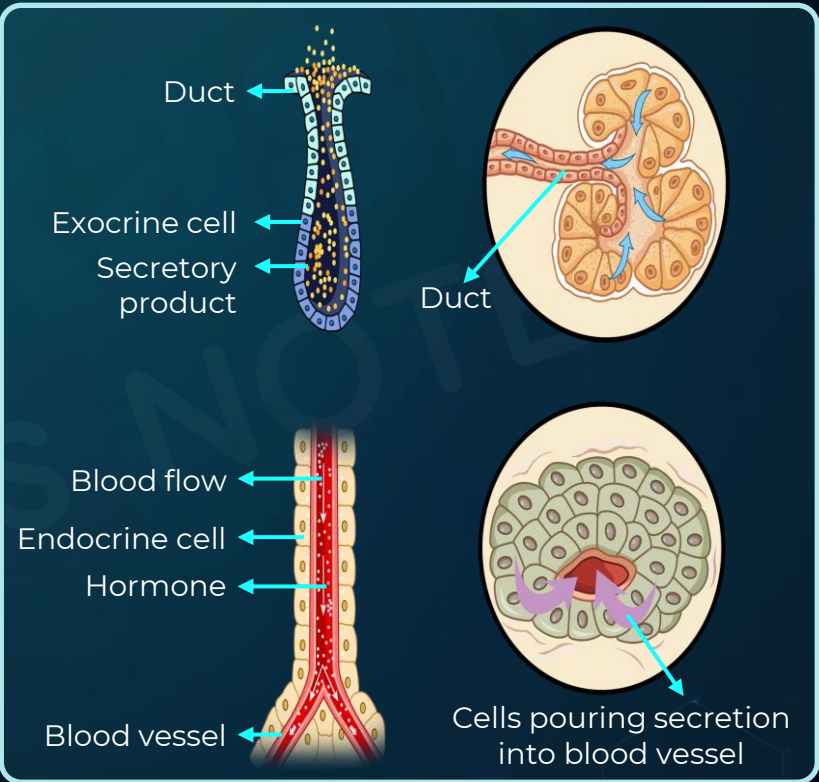
Types of glands

Exocrine

- Presence of **ducts**
- Secretes cell products like mucus, saliva, oil, milk, digestive enzymes
- Example: Salivary glands, mammary glands, sebaceous glands, etc.

Endocrine

- **Ductless**
- Secretes hormones
- Example: Testes, pancreas, pituitary glands, ovaries, etc.

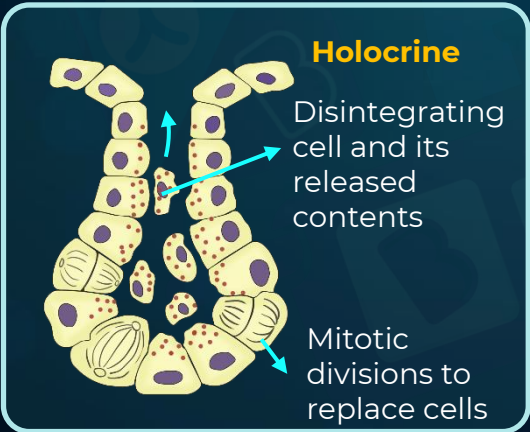




Types of Glands

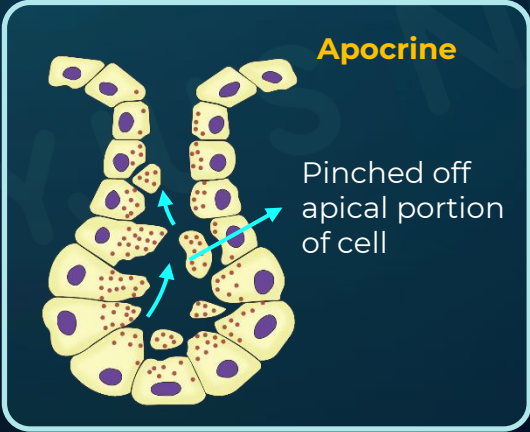
Holocrine

- Product of secretion is **shed with the whole cell** leading to its destruction
- E.g. - Sebaceous glands



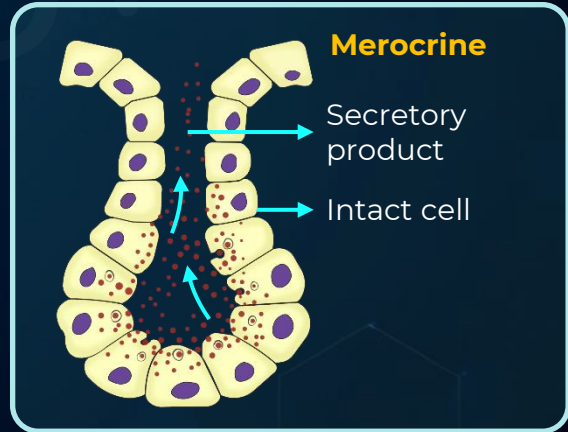
Apocrine

- Only the **apical portion of the cytoplasm is discharged** along with the secretory product
- E.g. - mammary glands



Merocrine

- Secretory cells leave the cell by exocytosis with **no loss of other cellular material**
- E.g. - the pancreas





Compound Epithelial Tissue



- This epithelial consists of **more than one layer** of cells.
- Only the **deepest layer rests** on the basement membrane.
- They **provide protection** to underlying tissues against mechanical, chemical, thermal or osmotic stresses.

Types

Stratified epithelial tissue

- 'Stratum' means layer.
- It consists of **more than one layer** of cells.
- It **provides protection** to underlying tissues under stress conditions.
- It is the **deepest layer** formed by **columnar cells**.
- The superficial cells can vary from squamous to cubicle.

Transitional epithelial tissue

- The cells are **thinner** and **more elastic** when compared to stratified epithelium cells.
- 4-6 Layer of cells
 - Innermost layer of cells - **cuboidal** or columnar
 - Middle layer of cells - **pear-shaped**
 - Surface cells are **large** and **oval-shaped**

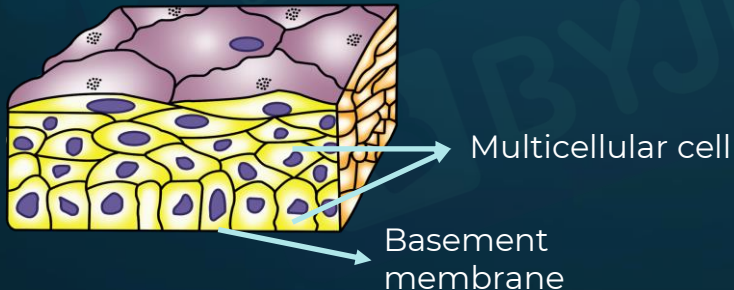


Compound Epithelial Tissue



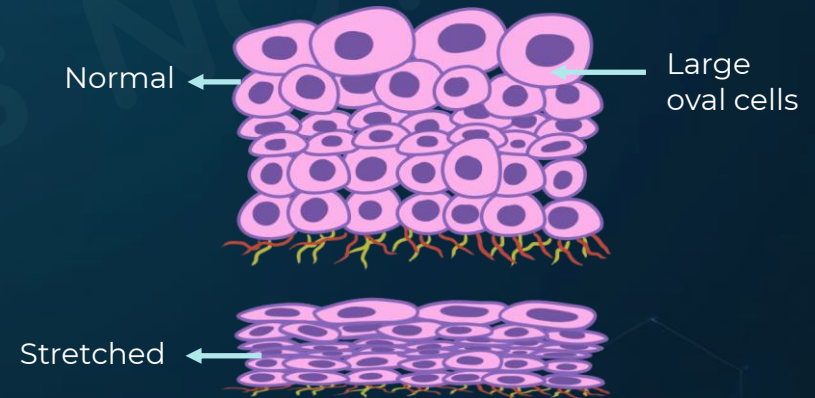
Stratified epithelial tissue

- Stratified **non-keratinised** squamous epithelium covers moist surfaces like **buccal cavity, pharynx** and **oesophagus**.
- Stratified **keratinised** squamous epithelium covers the **dry surface** of **skin**.
- In **keratinised epithelium**, heavy deposits of **keratin** (insoluble protein) in the dead superficial cells makes the epithelium **impervious to water**.



Transitional epithelial tissue

- It lines the surface of the **urinary bladder and ureters**.
- It allows **considerable extension** of these organs to accommodate urine.

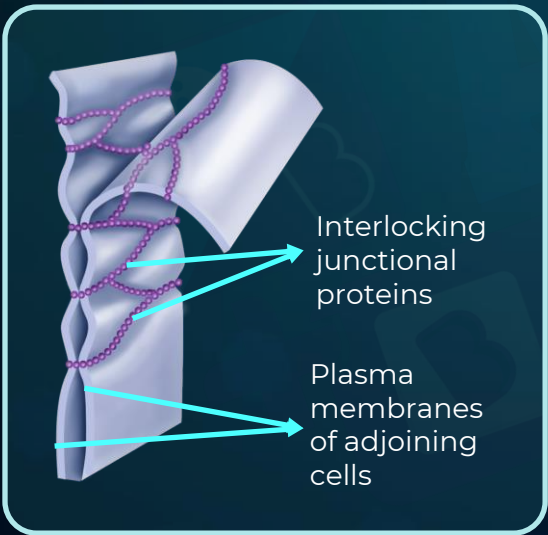




Intercellular Junctions

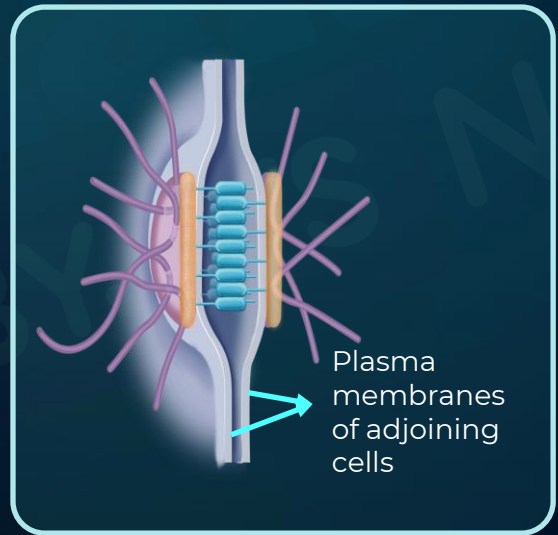
Tight (Zonula occludens)

Tight junctions stop substances from leaking across the tissue



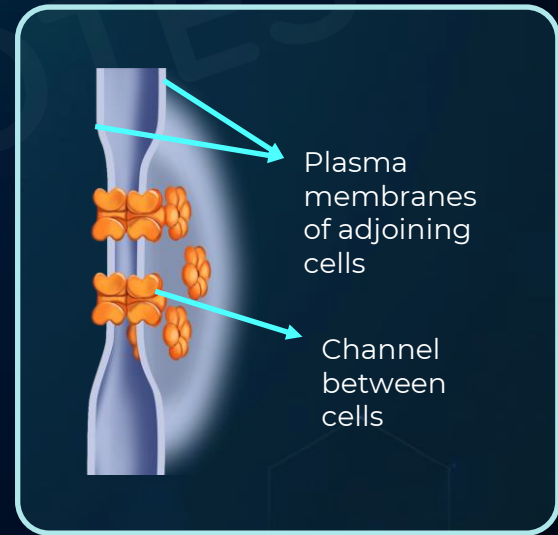
Adhering

Adhering junctions cement neighboring cells together



Gap (Macula adherens)

Gap junction facilitate cell communication by movement of ions and molecules between adjacent cells

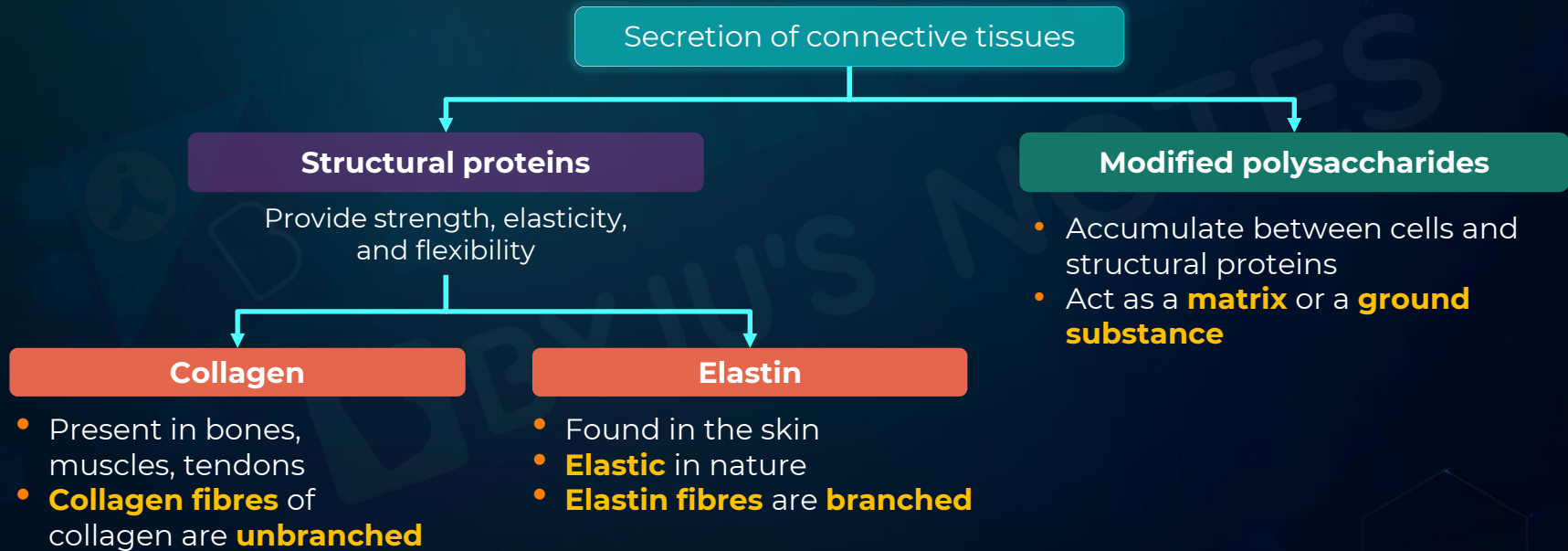




Connective Tissue



- They are the tissues that **link** and **support** different tissues and organs in the body.
- The **characteristics** of connective tissues are as follows:
 - They are the **most abundant** tissue of the body.
 - They are generally **vascular**.

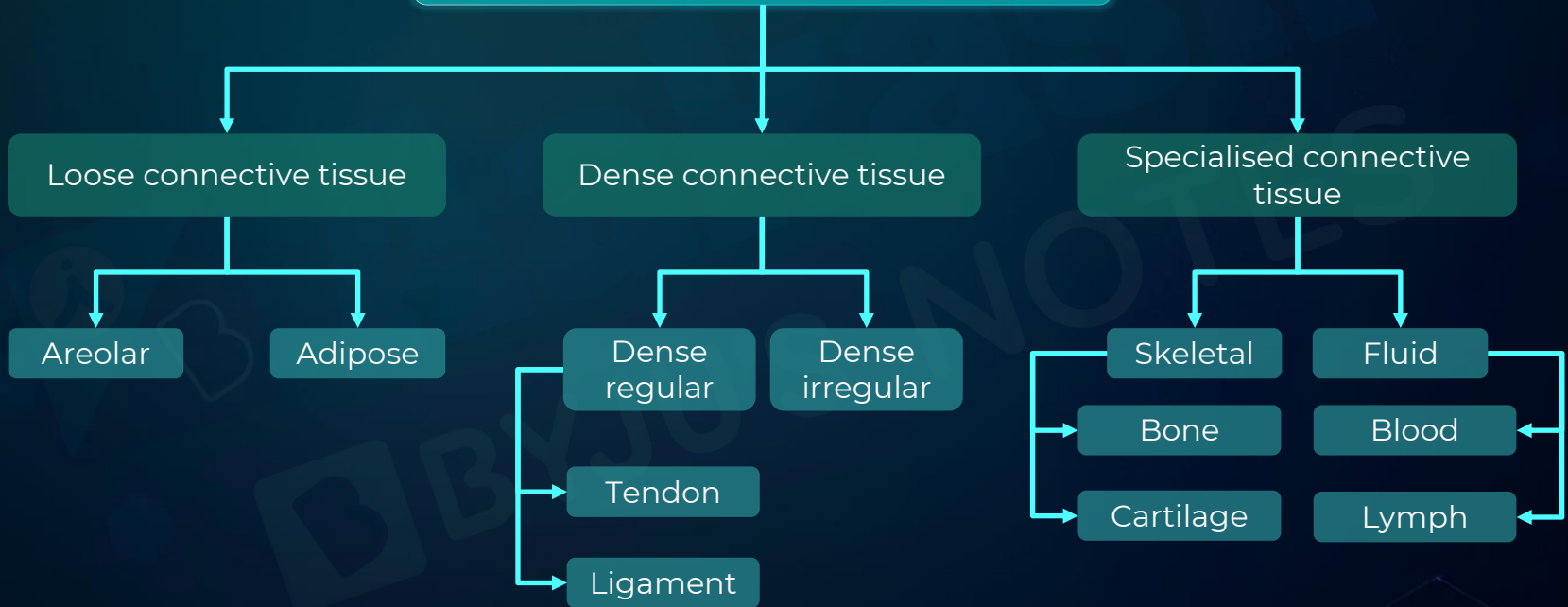




Connective Tissue



Types of connective tissues



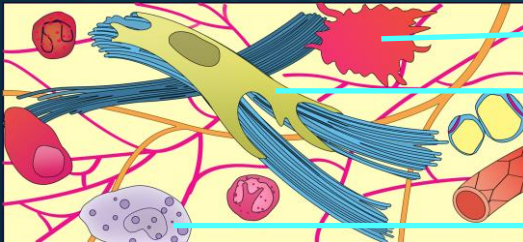


Loose Connective Tissue



- It is a **binding tissue** that holds organs and other tissues together.
- It consists of **loosely arranged cells and fibres.**
- The components are embedded in a **semifluid matrix.**

Areolar

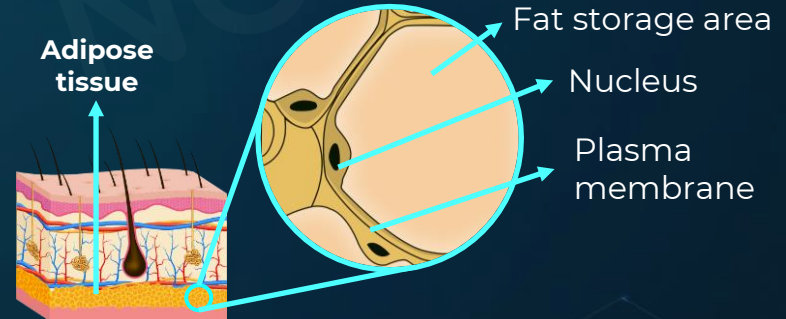


Macrophages

Fibroblasts

Mast cell

Adipose



Adipose
tissue

Fat storage area

Nucleus

Plasma
membrane

Layer of the skin



Loose Connective Tissue



Areolar

- Most widely distributed in animal body
- Present **beneath** the **skin**
- Joins skin to muscles
- Found around **muscles, blood vessels** and **nerves**
- Three types of cells:
 - **Fibroblasts** - principal cells, secrete major amount of matrix
 - **Macrophages/Histiocytes** - phagocytic in nature
 - **Mast cells/Mastocytes** - irregularly ovoid cells containing basophilic granules which contain histamine, heparin and serotonin

Adipose

- Contains large, spherical or oval cells called **fat cells** or **adipocytes**.
 - Cytoplasm and organelles in this are **pressed by fat** into a narrow annular layer just beneath plasma membrane
- Present **beneath skin**, around **kidneys, mesentery** and **bone marrow**
- **Synthesises, stores** and **metabolises fat**
 - Serves as fat reservoir, shock absorber and insulator



Dense Connective Tissue



- The cells and fibres of the dense connective tissue are **compactly arranged**.

Regular

- **Collagen fibres** are **present** in **rows** between many **parallel bundles** of **fibres**
- They form the principal components of **ligaments** and **tendons**.
 - Tendons consist of parallel bundles of collagen fibres
 - Ligaments consist of collagen fibres arranged in bundles with fibroblasts present in rows between bundles along with elastin fibres.

Irregular

- Fibroblasts and various types of fibres (mostly collagen) are **oriented irregularly**.
- This tissue is present in the **skin**.



Specialized Connective Tissue



Skeletal connective tissue

- Extracellular ground substance is solid
- Forms the endoskeleton of vertebrates which:
 - Supports the body
 - Protects various organs
 - Helps in locomotion

Cartilage

Bone

- **Flexible connective tissue**
- Keeps the **motion of the joint fluid**
- Helps in **maintaining the smoothness in movements of the joints** by **coating the surfaces** of the bones in our joints and by **cushioning bones** against impact.
- In vertebrates, most cartilages in the embryo stage are replaced by bones in the adult stages

- **Hard and non-pliable** connective tissue
- Ground substance is made up of **calcium salts** and **collagen fibres**
- 70% inorganic matter, 30% organic matter
- Decalcifies in HCL, unaffected in KOH



Skeletal Connective Tissue



Cartilage

Structure

- Matrix - **solid, pliable**, resists compression
 - Produced and maintained by cartilage cells
- **Fluid filled spaces** called **lacunae** are present
- Contain **cartilage-forming cells** called **chondrocytes**

Function

- Provides **support** and **flexibility** to body parts
- **Resists compression**
- Smoothens surface at joints
 - Hence, **prevents wear and tear of bones** due to friction

Location

- Nasal septum
- Epiglottis
- Tip of nose
- Outer ear joints
- Between adjacent bones of the vertebral column
- Limbs and hands in adults



Skeletal Connective Tissue



Bone

Structure

- Matrix - **very hard** and **non pliable**
 - Due to presence of **calcium phosphate, calcium carbonate** and salts like **ossein** and **collagen fibres**
 - Arranged in form of layers called lamellae
 - Ring shaped **fluid filled spaces** called **lacunae** present in them.
 - Lacunae contains **osteocytes**
- **Long bones** have **bone marrow cavity**
 - Filled with **soft** and semisolid fatty tissue - **bone marrow**
 - Site of production of **blood cells**

Function

- Provides **structural framework** to body
- **Supports and protects** tissues and organs such as brain, lungs etc.
- Provides surface for attachment of muscles
- Helps in **locomotion** and **movement**
- Storage site of **calcium** and **phosphate**

Location

- Endoskeleton of adults vertebrates



Skeletal Connective Tissue



Bone

Compact

- It forms the dense outer layer of the bones.
- It is composed of many longitudinal, column-like structures called **Haversian systems**.
 - Several concentric layers (lamellae) of bony matrix encircle a longitudinal central **Haversian canal**.
- Haversian canals are connected by **Volkman canals**.
- Marrow cavity of long bones **contain fatty yellow bone marrow** in adults.

Spongy

- Open lattice of bone present at the ends of the long bone (epiphysis)
 - Hence, also called **cancellous bones**
- **Contains red bone marrow where blood cells are formed**
- Consists of a network of many fine irregular bony plates or **trabeculae**



Skeletal Connective Tissue



Types of bones

Cartilage bones

- Also called **endochondral** or replacing bones
- Formed by replacement of cartilage by the bone
- **Chondroclasts dissolve cartilage** for replacement
- E.g. - Humerus, femur, vertebrae, ribs

Membrane bones

- Also called **dermal** or **investing** bone
- Formed in **dermis** of the skin
- E.g. - skull bones, clavicle

Sesamoid bones

- Formed by the **ossification** of the tendons
- E.g. - patella

Visceral bones

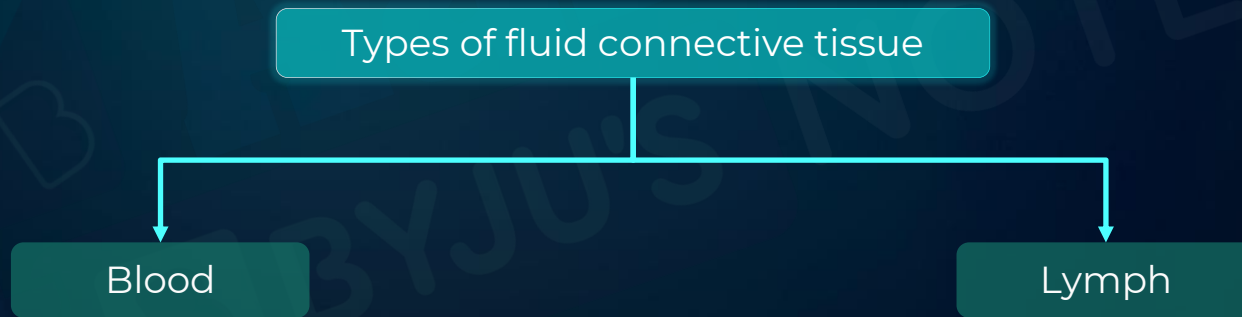
- Formed in **visceral/soft organs** in some species of animals
- E.g. - os cordis, os falciparum, os penis



Fluid Connective Tissue



- Made of
 - fibre free fluid matrix
 - specialised living cells
 - Can't divide or secrete matrix
- Help in transportation of nutritive elements, gases, excretory products, hormones





Fluid Connective Tissue



Components of blood

WBCs/Leukocytes

- Rounded or irregular in shape
- Able to change shape and amoeboid movement
- Capable of diapedesis

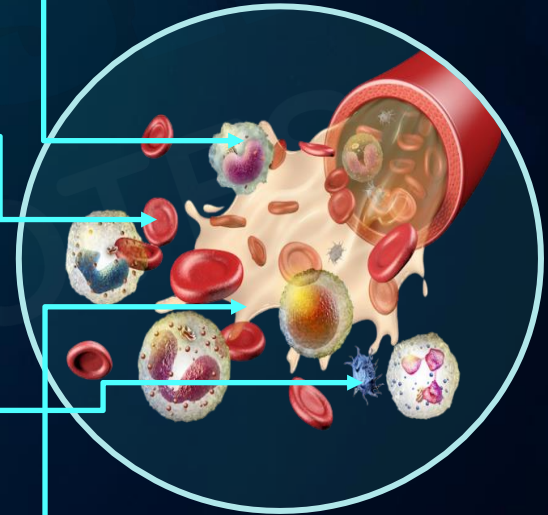
RBCs

- Oval shaped, biconcave, nucleated in most vertebrates
- In mammals, they are circular, biconcave, disc-like and lack nuclei

Platelets

- Also called thrombocytes
- Minute, non-nucleated, round or biconvex

Plasma





Nervous Tissue



- Develops from the **ectodermal** tissue.
- Conducts **nerve impulses** from one part to another part of the body
- Forms brain, spinal and nerves
- Controls all body activities
- Coordinates various body parts and functions

Types of nervous tissue

Neurons

- Basic structural and functional unit of neural tissue is neuron
- Excitable cells
- They are also known as **nerve cells**
- **Ganglions** are **group of neurons**
- Neurons are linked together

Neuroglial tissue

- Neuroglial cells **provide support** cells around brain, spinal cord, and ganglions
- *Glia* = glue
- Also known **glial cells**



Nervous Tissue



Parts of neurons

Cyton/Cell body

- Consists of a central nucleus and cytoplasm
- Contains characteristic **Nissl's granules** which stain deeply
- They are large, irregular masses of ribosomes and RER

Dendrites

- **Short and branched processes** arising from the cyton
- Carry impulses towards cyton

Axon

- Single cylindrical projection emerging from cyton
- Axon ends in **axon ending** (terminal arborizations)
- Carries message away from cyton
- Surrounded by a sheath (Neurilemma) of neuroglial cells called **myelin sheath**
- Myelin sheath is interrupted at **nodes of ranvier**

Synapse

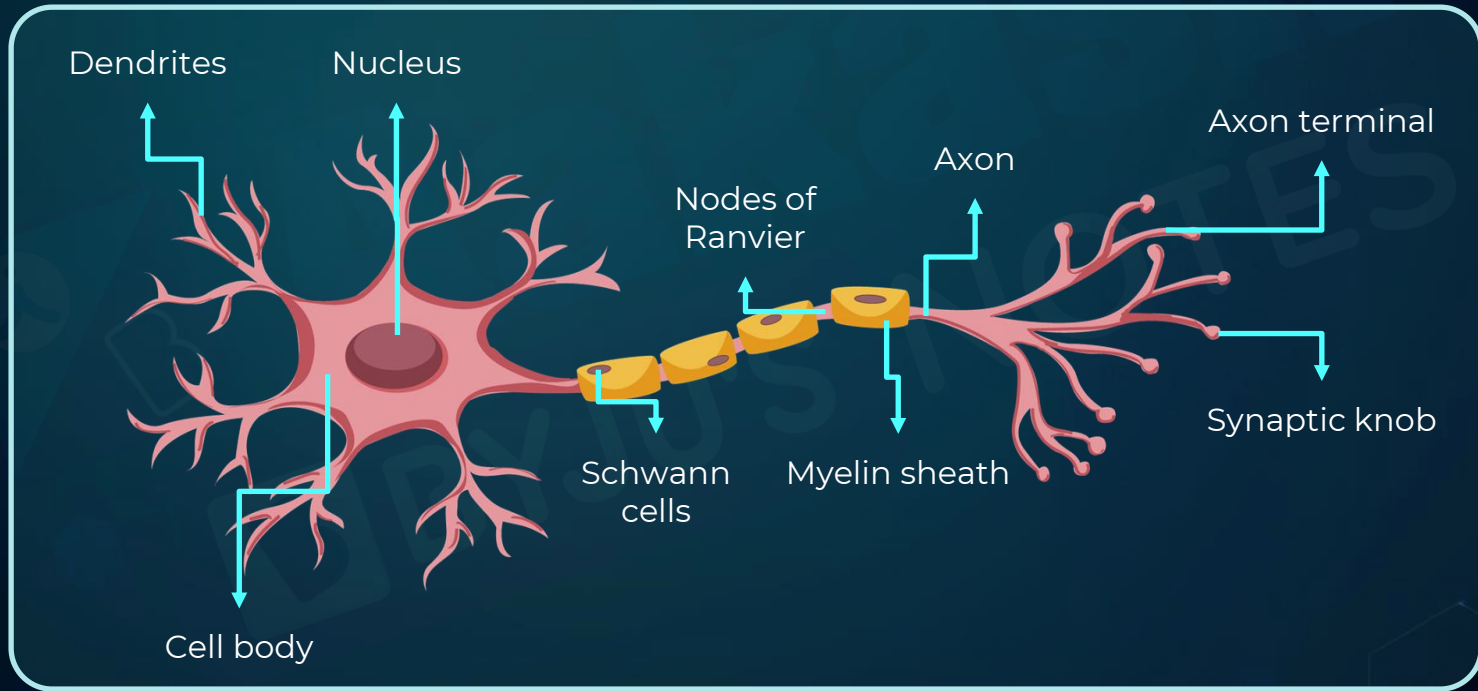
- Axon terminal is very closely placed to the dendrite of the other neuron to transfer impulses
- This zone is called **synapse**
- **Neurotransmitters** transfer signal at synapse



Nervous Tissue



Diagram of a neuron





Nervous Tissue



Types of neurons

Unipolar

- **One** axon/dendrite
- Found in **early embryos**

Bipolar

- **One axon** and **one dendrite**
- Found in **olfactory epithelium** and **retina** of eye

Multipolar

- **One** long **axon** and **multiple dendrites**
- Very common
- Found in **brain** and **spinal cord**

Pseudounipolar

- **Bipolar** but appear unipolar
- Single process divides into dendrite and axon
- Found in **dorsal root ganglion** of the spinal nerve

Apolar

- Primitive neurons which first appeared in **cnidarians**
- **Undefined** polarity



Nervous Tissue



Types of glial cells

Astrocytes

- **Large in size** with number of protoplasmic processes
- Form **maximum number of glial cells**
- Help in nervous tissue repair
- Form blood-brain barrier

Oligodendrocytes

- Form an insulating layer called **myelin sheath** around axon of neurons in **CNS**
- Have few protoplasmic processes

Schwann cells

- Form an insulating layer called **myelin sheath** around axon of neurons in **PNS**
- Lipid rich layer

Microglial cells

- Mesodermal in origin
- Small in size
- Feathery-processes
- Help in **phagocytosis**



Muscular Tissue

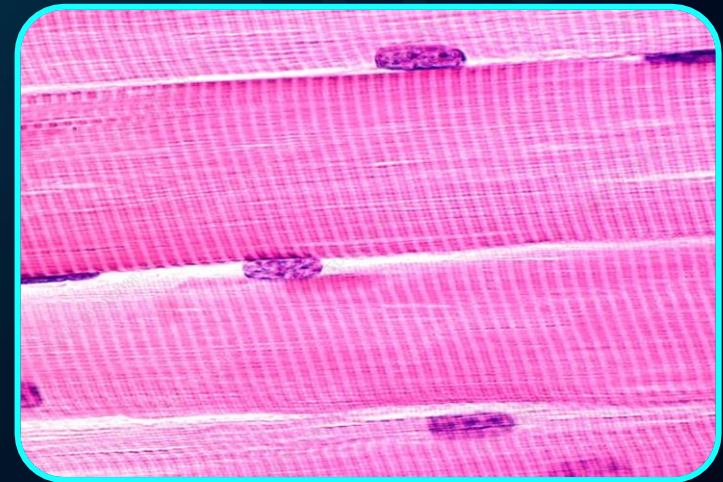


- Made up of long, **cylindrical fibres** arranged in a parallel fashion
- Muscle fibres consist of fine fibrils known as **myofibrils**
- Aid and **control movements**
- **Contract** and **relax** to **generate movement** in response to stimulus

Types of muscle tissues

Skeletal muscle tissue

- Closely attached to the skeletal bones
- Muscle fibres are **striated**
- Fibres are bundled together in a **parallel** fashion
- Sheath of tough connective tissue encloses several bundles of muscle fibre
- **Multinucleated, voluntary** in nature
- **Found between bones**



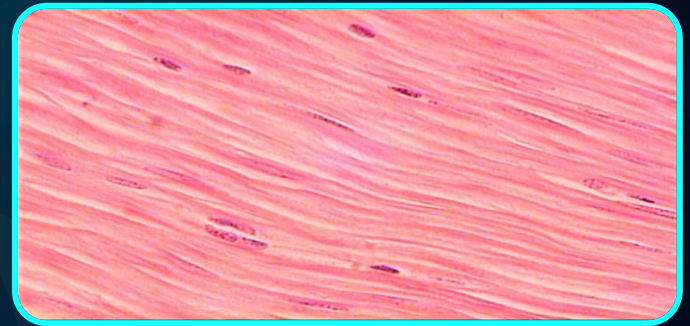


Muscular Tissue



Smooth muscle tissue

- **Striations are absent**
- Fibres tapers at both ends (**fusiform shape**)
- Cell junction holds cell together
- Fibres are bundled together in connective sheath
- **Uninucleated, involuntary** in nature
- Found in **stomach, intestine, uterus**, etc.



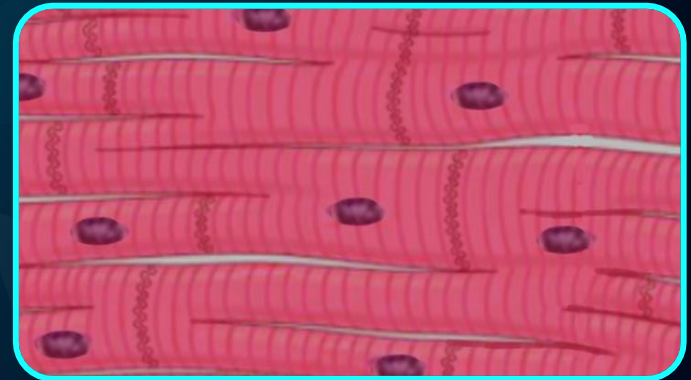


Muscular Tissue



Cardiac muscle tissue

- **Contractile tissue**
- Present **only in the heart**
- Cell junctions cause the fusion of plasma membrane of adjacent cells
- At some places, intercalated discs (communicated junctions) are formed at the **fusion points**
- Allows the cells to function in a coordinated manner
- **Unstriated, uninucleated** and **involuntary**





Summary



Epithelial tissue

Simple

- Single layer of cells
- Lining for body cavities, ducts, and tubes
- Example: Alveolar cells

Squamous

Cuboidal

Columnar

Pseudostratified

Compound

- Two or more layers of cells
- Protective function
- Example: Cheek cells

Stratified

Transitional



Summary



Types of glands

Exocrine

- Presence of **ducts**
- Secretes cell products like mucus, saliva, oil, milk, digestive enzymes
- Example: Salivary glands, mammary glands, sebaceous glands, etc.

Endocrine

- **Ductless**
- Secretes hormones
- Example: Testes, pancreas, pituitary glands, ovaries, etc.

Intercellular junctions

Tight
(Zonula occludens)

Adhering

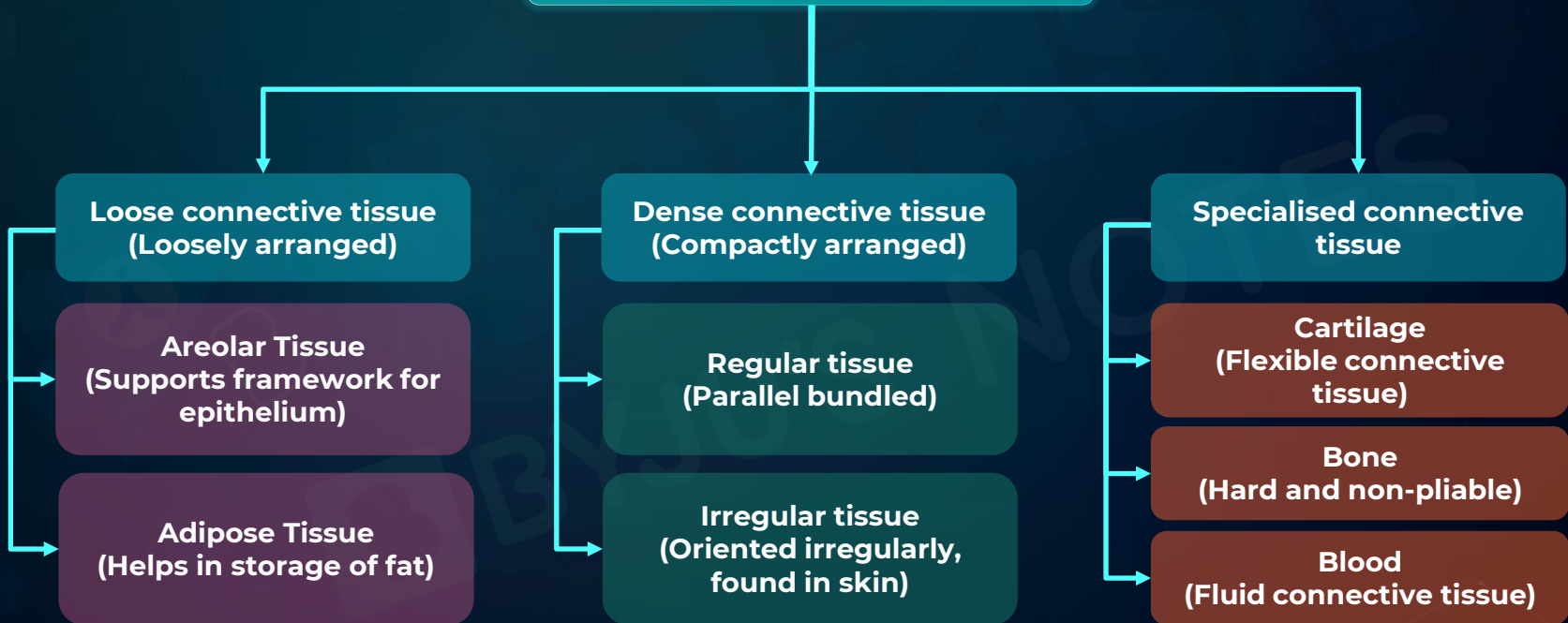
Gap
(Macula adherens)



Summary



Types of connective tissues





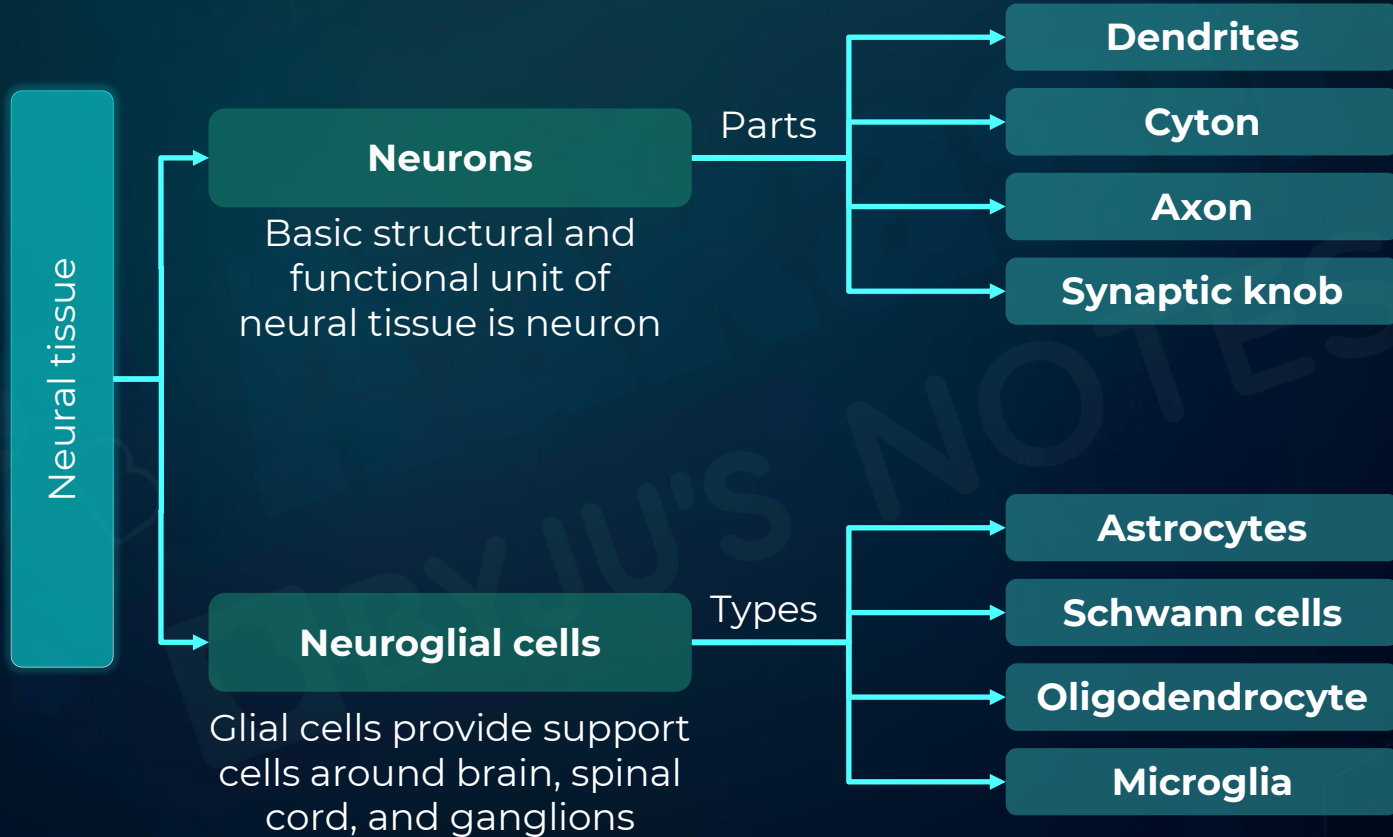
Summary



Bone	Cartilage
Composed of tough inflexible material called ossein	Composed of firm but flexible material called chondrin
Matrix occurs in concentric lamellae	Matrix occurs in homogeneous mass
Osteoblasts produce new osteocytes	Chondroblasts produce new chondrocytes
Osteocytes are present in the lacunae	Chondrocytes are present in the lacunae
Provides support and flexibility to body parts	Provides structural framework to body and protection to organs



Summary





Summary



Skeletal muscle	Smooth muscle	Cardiac muscle
Occur in the limbs, body wall, face, neck etc.	Occurs in the posterior part of oesophagus, urogenital tract, iris etc	Occurs in the walls of heart
Cylindrical in shape	Spindle shaped	Cylindrical in shape
Multinucleated	Uninucleated	Uninucleated
Voluntary in nature	Involuntary in nature	Involuntary in nature
Intercalated discs are absent	Intercalated discs are absent	Intercalated discs are present
Striated	Unstriated	Unstriated