

Histology Notes

Tissues are groups of cells that are similar in structure and perform a common or related function.

1. Epithelial tissues: forms boundaries between different environments, protects, secretes, absorbs, filters
 - a. Lining of digestive tract organs and other hollow organs
 - b. Skin surface (epidermis)
2. Nervous tissue: Internal communication
 - a. Brain
 - b. Spinal chord
 - c. Nerves
3. Muscle Tissue: Contracts to cause movement
 - a. Skeletal (muscles attached to bones)
 - b. Cardiac (muscles of heart)
 - c. Smooth (muscles of walls of hollow organs)
4. Connective tissue: supports, protects and binds other tissues together
 - a. Bones
 - b. Tendons
 - c. Fat and other soft padding tissue

TISSUE PREPARATION FOR LIGHT AND ELECTRON MICROSCOPES

Outline the steps used to prepare biological tissues used for microscopes

1. Fixation: preserves cellular structure and maintains the distribution of organelles. Cross-link amino acids to stabilise proteins via formaldehyde and glutaraldehyde; osmium tetroxide is used to preserve lipids; artifacts: forceps damage, biopsy, wrong concentration of fixator or incomplete fixation

2. Dehydration: removes water via graded alcohol; via a series of alcohols at increasing concentrations. The sample is then infiltrated with an intermediate solvent miscible with both alcohol and the embedding solution; artifacts: too long, too short or too rapid

3. Infiltration and Wax Embedding: makes the tissue solid to section; infiltrates dehydrated tissue with liquid wax at about 65 degrees in an oven which then solidifies; artifacts: heat causes tissue shrinkage or incomplete infiltration

4. Sectioning: cut thin enough to allow a beam of light or electrons to pass through; via a microtome with a sharp blade; artifacts: too thick, nick in the blade or chatter

- Light microscopy: 1–20 microns
- Electron microscopy: 60–100 nanometers
 - Cross-section (cs) or tranverse section (ts): perpendicular to the long axis of a structure
 - Longitudinal section (ls): parallel to the long axis of a structure
 - Oblique (tangential) section: any section other than the above

5. Staining: to visualise structures; commonly H&E staining which distinguishes elements based on charge; heavy metals like lead citrate (lead) and uranyl acetate (uranium) can be used to bind to areas of negative charge and block the passage of electrons in an electron microscope; histochemical staining localises chemical groups such as lipids and carbohydrates; artifacts: over staining, especially with eosin; stain precipitates

- Hematoxylin & Eosin Staining
 - Hematoxylin is basic
 - Binds to negatively charged acidic components (basophilic)
 - Purple/blue colour
 - Nucleic Acids, nucleus, rough endoplasmic reticulum
 - Eosin is acidic
 - Binds to positively charged basic components (acidophilic)
 - Pink colour
 - Collagen (extracellular matrix), protein (cytoplasm), mitochondria
 - H&E doesn't work on adipose tissue as it dissolves in alcohol and is a neutral tissue (90% of neurons, the Schwann cells, are lipids)

6. Mounting: sample is mounted on a slide for use in a microscope; artifacts: air bubbles, folds in tissue or contamination

→ **Artifact:** any feature of a tissue section that is present as a result of the tissue processing. These include tears and folds, shrinkage, spaces resulting from extracted cellular contents (e.g., lipid, precipitates), and redistributed organelles.

EPITHELIAL TISSUE

Identify the 2 major types of epithelial tissues and define their roles in the body

Epithelial tissues/epithelium is a sheet of cells that covers a body surface or lines a body cavity. They form the boundary between external environment and internal body tissues

- **Covering and lining epithelium:** forms the outer layer of the skin, lines open cavities of urogenital, digestive and respiratory systems and covers the walls and organs of the closed ventral body cavity, lines blood and lymph vessels
- **Glandular epithelium:** fashions the glands of the body

Roles:

1. Protection
2. Absorption
3. Filtration
4. Excretion
5. Secretion
6. Sensory reception

Describe the 5 main characteristics of epithelial tissue

Polarity

- 2 surfaces = “apical-basal polarity”
- Apical surface: upper free surface exposed to the body exterior/cavity of an internal organ;
 - Most have microvilli (non-motile projections from the apical surface: extensions of the plasma membrane) to increase SA for absorption or secretion. Collectively form a brush border
 - Some have cilia (tiny hairlike motile projections from the apical surface) that beat rhythmically to move material (e.g. mucus) along the surface. Found in the upper respiratory tract, Fallopian tube to propel substances along their surface
 - Stereocilia: long microvilli, non-motile projections from the apical surface of the cells of the epididymis that increase SA for absorption of water and concentration of sperm
- Basal surface: lower surface that contacts the basal lamina
- The basal lamina is a thin non-cellular, adhesive, supporting sheet adjacent to the basal surface
 - Consists largely of glycoproteins and some fine collagen fibres
- The basal lamina selectively filters molecules diffusing from underlying connective tissues
- It also acts as a scaffolding along which epithelial cells can migrate to repair a wound

Specialised contacts: Sparse intercellular matrix (cells close together without much between them)

- Epithelial tissues are **highly cellular**
- Cells fit closely together to form continuous sheets (except for glandular epithelia)
- Lateral surface: junctional complexes join adjacent cells, isolate apical from basolateral domains and allow communication between adjacent cells
- Lateral contacts bind together adjacent cells at many points for attachment and anchorage
 - Tight junctions
 - Desmosomes
- Keeps proteins in the apical region of the plasma membrane from diffusing into the basal region = maintains epithelial polarity

SIMPLE EPITHELIA

1. *Simple Squamous Epithelium*

- **Description:**
 - Single layer of cells
 - Flattened laterally
 - Disc-shaped central nuclei
 - Sparse cytoplasm
 - Thin
- **Function:**
 - Short distance for diffusion and filtration
 - Sites where protection is not important
 - Secretes lubricating substances in serosae
- **Examples:**
 - Kidney glomeruli
 - Air sacs of lungs
 - Lining of heart
 - Blood vessels
 - Lymphatic vessels
 - Lining of ventral body cavity (serosae)

2. *Simple Cuboidal Epithelium*

- **Description:**
 - Single layer
 - Cube-like
 - Large, spherical central nuclei (dark staining)
- **Function:**
 - Secretion and absorption
- **Location:**
 - Kidney tubules
 - Ducts and secretory portions of small glands
 - Ovary surface

3. *Simple columnar epithelium*

- **Description:**
 - Single layer
 - Tall cells
 - *Round to oval* nuclei
 - Some bear cilia
 - May contain goblet cells
- **Function:**
 - Absorption
 - Secretion of mucus
 - Enzymes and other substances
 - Ciliated type propels mucus by ciliary action
- **Location:**
 - Nonciliated: lines most of the digestive tract, gallbladder, excretory ducts of some glands
These have dense microvilli on the apical surface for absorption
 - Ciliated: lines small bronchi, uterine tubes, and some regions of the uterus