CHAPTER 4
The Tissue Level of Organization
The purpose of this chapter is to:

- Learn about the various types of tissues and their origins
- Discuss how cells of a tissue are held together
- Compare and contrast epithelial, connective, muscular, and nervous tissue
- Learn about the structure and function of membranes
- Understand tissue repair
The 4 Tissue Types

1. Epithelial
2. Connective
3. Muscular
4. Nervous
Cells can be held together in a number of ways. These points of contact between cells are called cell junctions.
Interactions Animation:

Intercellular Junctions

You must be connected to the Internet and in Slideshow Mode to run this animation.
Tight Junctions

- Adjacent plasma membranes
- Intercellular space
- Strands of transmembrane proteins

(a) Tight junctions
Adherens Junctions

(b) Adherens junction

Adjacent plasma membranes

Microfilament (actin)

Plaque

Transmembrane glycoprotein (cadherin)

Intercellular space

Adhesion belt
Desmosomes

- Adjacent plasma membranes
- Intercellular space
- Plaque
- Transmembrane glycoprotein (cadherin)
- Intermediate filament (keratin)

(c) Desmosome
Hemidesmosomes

Intermediate filament (keratin)

Plaque

Transmembrane glycoprotein (integrin) in extracellular space

(d) Hemidesmosome
Gap Junctions

(e) Gap junction

- Adjacent plasma membranes
- Connexons (composed of connexins)
- Gap between cells
Epithelial vs. Connective Tissue

What differences can you see?

(a) Epithelial tissue with many cells tightly packed together and little to no extracellular matrix

(b) Connective tissue with a few scattered cells surrounded by large amounts of extracellular matrix
Epithelial Tissue
General Features of Epithelial Tissue

- Cells are arranged in sheets
- Cells are densely packed
- Many cell junctions are present
- Epithelial cells attach to a basement membrane
- Epithelial tissue is avascular but does have a nerve supply
- Mitosis occurs frequently
Surfaces of Epithelial Cells and the Basement Membrane

- Apical (free) surface
- Lateral surfaces
- Basal surface
- Epithelium
- Basal lamina
- Reticular lamina
- Basement membrane
- Connective tissue
- Nerve
- Blood vessel
Classification of Epithelial Tissue

Covering and lining epithelia are classified according to the shape of the cells and how many layers thick they are.

**Arrangement of layers**
- Simple
- Pseudostratified
- Stratified

**Cell shape**
- Squamous
- Cuboidal
- Columnar
The name of the specific type of stratified epithelial tissue depends on the shape of the apical cells

- Table 4.1 in your textbook shows examples of each of the epithelial tissues – notice the similarities and differences!
Epithelial Tissue

Anatomy Overview:

Epithelial Tissues

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## Epithelial Tissue Naming Combinations

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<thead>
<tr>
<th></th>
<th>Squamous</th>
<th>Cuboidal</th>
<th>Columnar</th>
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<tbody>
<tr>
<td>Simple</td>
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<td>Pseudostratified</td>
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A gland is a single cell or a mass of epithelial cells adapted for secretion

- Endocrine vs. Exocrine Glands
Glandular Epithelium

A gland is a single cell or a mass of epithelial cells adapted for secretion

- Endocrine vs. Exocrine Glands
Structural Classification of Glandular Epithelium

- **Unicellular** – single cells
- **Multicellular** – composed of many cells that form a distinctive microscopic structure or macroscopic organ
  - Sweat glands
  - Oil glands
  - Salivary glands
Functional Classification of Glandular Epithelium

- Merocrine
- Apocrine
- Holocrine
General Features of Connective Tissue

- Consists of two basic elements
  - Cells
  - Extracellular matrix
- Cells do not cover or line (they do not have any free surfaces)
- Epithelial tissue is highly vascularized and has a nerve supply
  - Except tendon and cartilage
Connective Tissue Cells

**Reticular Fibers** are made of collagen and glycoproteins. They provide support in blood vessel walls and form branching networks around various cells (fat, smooth muscle, nerve).

**Macrophages** develop from monocytes and destroy bacteria and cell debris by phagocytosis.

**Elastic Fibers** are stretchable but strong fibers made of proteins, elastin, and fibrillin. They are found in skin, blood vessels, and lung tissue.

**Adipocytes** or fat cells store fats. They are found below the skin and around organs (heart, kidney).

**Fibroblasts** are large, flat cells that move through connective tissue and secrete fibers and ground substance.

**Collagen Fibers** are strong, flexible bundles of the protein collagen, the most abundant protein in your body.

** Mast Cells** are abundant along blood vessels. They produce histamine, which dilates small blood vessels during inflammation and kills bacteria.

**Plasma Cells** develop from B lymphocytes. They secrete antibodies that attack and neutralize foreign substances.

**Ground Substance** is the material between cells and fibers. It is made of water and organic molecules (hyaluronic acid, chondroitin sulfate, glucosamine). It supports cells and fibers, binds them together, and provides a medium for exchanging substances between blood and cells.

**Eosinophils** are white blood cells that migrate to sites of parasitic infection and allergic responses.

**Neutrophils** are white blood cells that migrate to sites of infection and destroy microbes by phagocytosis.
Connective Tissue Extracellular Matrix

- Extracellular matrix is located in the spaces between connective tissue cells
- Extracellular matrix is composed of:
  - Fibers
  - Ground substance
Fibers in the extracellular matrix provide strength and support to a tissue

- Collagen fibers
- Elastic fibers
- Reticular fibers
Classification of Connective Tissue

- Embryonic
  - Mesenchyme
  - Mucous
Classification of Connective Tissue

- Mature
  - Loose
  - Dense
  - Cartilage
  - Bone
  - Blood
Connective Tissue

Anatomy Overview:

Connective Tissues

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Membranes

Membranes are flat sheets of pliable tissue that cover or line a part of the body.

2 types of membranes

1. Epithelial membranes
   - Mucous membranes
   - Serous membranes
   - Cutaneous membranes

2. Synovial membranes
(a) Mucous membrane

Mucous membranes line body cavities that open to the outside.

Lamina propria (areolar connective tissue)

(b) Serous membrane

Serous membranes line cavities that do not open directly to the outside.

Serous fluid

Mesothelium

Areolar connective tissue

Parietal pleura

Visceral pleura

Small intestine (inner lining)

Goblet cell

Mucus
Skin covers the surface of the body.

(c) Skin (cutaneous membrane)

(d) Synovial membrane

Articulating bone
Synovial (joint) cavity (contains synovial fluid)
Articulating bone

Synoviocytes
Synovial membrane (secretes synovial fluid)
Collagen fiber
Areolar connective tissue
Adipocytes

Synovial membranes line joints.
Muscle Tissue
General Characteristics of Muscular Tissue

- Muscle tissue consists of fibers that provide motion, maintain posture, and produce heat
- 3 types of muscle tissue
  1. Skeletal muscle
  2. Cardiac muscle
  3. Smooth muscle
Muscle Tissue

Anatomy Overview:

Muscle Tissue

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Nervous Tissue
Two kinds of cells:

1. Neurons
2. Neuroglia

Most neurons have a cell body, dendrites, and axons. They carry sensory and motor information and perform integrative functions.

Neuroglia protect and support neurons.
Anatomy Overview:

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Tissue Repair

- Tissue repair is the process that replaces worn out, damaged, or dead cells.
  - Epithelial cells are replaced by the division of stem cells or undifferentiated cells
  - Not all connective tissue cells have the ability to repair
  - Muscle cells can perform limited repair
  - Some nervous cells can perform limited repair, others cannot
- Fibrosis is the formation of scar tissue
Aging

- Younger bodies generally experience:
  - A better nutritional state
  - A better blood supply to tissues
  - A faster metabolic rate

- Aging slows the process of tissue repair
Disorders

- Disorders of epithelial tissues tend to be specific to individual organs
  - Skin cancer
- Disorders of connective tissues tend to be autoimmune in nature
  - Lupus
- Disorders of muscular and nervous tissues will be discussed in later chapters
End of Chapter 4

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