Connective Tissue

- Most ____________ and widely distributed tissue type
- Four classes
  - Connective tissue proper
  - Cartilage
  - Bone tissue
  - Blood

Table 4.1

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<td>Interstitial fluid</td>
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Major Functions of Connective Tissue

- Binding and ____________
- ____________
- ____________
- Transportation (blood)

Characteristics of Connective Tissue

- Connective tissues have:
  - Mesenchyme as their common tissue of origin
  - Varying degrees of ____________
  - Cells separated by ____________ (ground substance and fibers)

Table 4.1

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Ground substance
- Medium through which solutes diffuse between blood capillaries and cells
- Components:
  - Interstitial fluid
  - Adhesion proteins ("glue")
  - Proteoglycans
    - Protein core + large polysaccharides (chondroitin sulfate and hyaluronic acid)
    - Trap water in varying amounts, affecting the viscosity of the ground substance
Structural Elements of Connective Tissue

- Three types of fibers
  - __________ (white fibers)
  - Strongest and most abundant type
  - Provides high tensile strength
  - __________
    - Networks of long, thin, elastin fibers that allow for stretch
  - __________
    - Short, fine, highly branched collagenous fibers

- Cells
  - Mitotically active and secretory cells = "__________"
  - Mature cells = "__________"
  - Fibroblasts in connective tissue proper
  - Chondroblasts and chondrocytes in cartilage
  - Osteoblasts and osteocytes in bone
  - Hematopoietic stem cells in bone marrow
  - Fat cells, white blood cells, mast cells, and macrophages

Cell types

- Macrophage
- Fibroblast
- Lymphocyte
- Fat cell
- Mast cell
- Neutrophil

Connective Tissue: Embryonic

- __________—embryonic connective tissue
  - Gives rise to all other connective tissues
  - Gel-like ground substance with fibers and star-shaped mesenchymal cells

Overview of Connective Tissues

- For each of the following examples of connective tissue, note:
  - Description
  - Function
  - Location

Connective Tissue Proper

- Types:
  - __________ connective tissue
    - Areolar
    - Adipose
    - Reticular
  - __________ connective tissue
    - Dense regular
    - Dense irregular
    - Elastic
(a)  Connective tissue proper: loose connective tissue, areolar

Description: Soft connective tissue with all three fiber types: elastic, fibrous, and ground substance. This type of tissue serves all organs and is also present under epithelial lining in the body. It is a soft, flexible tissue that cushions and wraps organs, plays a role in inflammation, and helps hold and convey tissue fluid.

Function:
- Wraps and cushions organs
- Macrophages phagocytize bacteria
- Plays an important role in inflammation
- Holds and conveys tissue fluid

Location:
- Widely distributed under epithelia of the body
- Forms lamina propria of mucous membranes
- Packages organs
- Surrounds capillaries

Photomicrograph: Areolar connective tissue, a soft packaging tissue of the body (300x).

(b)  Connective tissue proper: loose connective tissue, adipose

Description: Matrix similar to areolar tissue, but with a higher density of adipocytes or fat cells. These cells have a large fat droplet and a pushed-to-the-side nucleus.

Function:
- Provides reserve food fuel
- Insulates against heat loss
- Supports and protects organs

Location:
- Under skin in the hypodermis
- Around kidneys and eyeballs
- Within abdomen
- In breasts

Photomicrograph: Adipose tissue from the subcutaneous layer under the skin (350x).

(c)  Connective tissue proper: loose connective tissue, reticular

Description: A network of reticular fibers in a loose ground substance. Reticular cells lie on the network.

Function:
- Fibers form a soft internal skeleton (stroma) that supports other cell types including white blood cells, mast cells, and macrophages.

Location:
- Lymphoid organs (lymph nodes, bone marrow, and spleen)

Photomicrograph: Dark-staining network of reticular connective tissue fibers forming the internal skeleton of the spleen (350x).

(d)  Connective tissue proper: dense connective tissue, dense regular

Description: Primarily parallel collagen fibers; a few elastic fibers; major cell type is the fibroblast.

Function:
- Attaches muscles to bones or to muscles
- Attaches bones to bones
- Withstands great tensile stress when pulling force is applied in one direction

Location:
- Tendons
- Most ligaments
- Aponeuroses

Photomicrograph: Dense regular connective tissue from a tendon (500x).

(e)  Connective tissue proper: dense connective tissue, dense irregular

Description: Primarily irregularly arranged collagen fibers; some elastic fibers; major cell type is the fibroblast. Fibroblasts allow to withstand tension exerted in many directions, providing structural strength.

Function:
- Able to withstand tension exerted in many directions
- Provides structural strength

Location:
- Fibrous capsules of organs and joints
- Denies of the skin
- Submucosa of digestive tract

Photomicrograph: Dense irregular connective tissue from the dermis of the skin (500x).

(f)  Connective tissue proper: dense connective tissue, elastic

Description: Dense regular connective tissue containing a high proportion of elastic fibers.

Function:
- Allows recoil of tissues following stretching
- Maintains pulsatile flow of blood through arteries
- Aids passive recoil of lungs following inspiration

Location:
- Walls of large arteries
- Between ligaments associated with the vertebral column
- Within the walls of the bronchial tubes

Photomicrograph: Elastic connective tissue in the wall of the aorta (250x).
Connective Tissue: Cartilage

• Three types of cartilage:
  – __________ cartilage
  – __________ cartilage
  – Fibrocartilage
Nervous Tissue

- Nervous tissue (more detail with the Nervous System, Chapter 11)

Muscle Tissue

- Muscle tissue (more detail with the Muscular System, Chapter 10)

- Muscle tissue (more detail with the Cardiovascular System, Chapters 18 and 19)
Muscle Tissue

- Smooth muscle

Description: Spindle-shaped cells with central nuclei; no striations; cells arranged closely to form sheets.

Function: Propels substances or objects (foodstuffs, urine, a baby) along internal passageways; involuntary control. Locations: Mostly in the walls of hollow organs.

Photomicrograph: Sheet of smooth muscle (200×).

Epithelial Membranes

- Membrane (skin) (More detail with the Integumentary System, Chapter 5)

Epithelial Membranes

- Mucous membranes
  - Mucosae
    - Line body cavities open to the exterior (e.g., digestive and respiratory tracts)
Epithelial Membranes

- Membranes
  - Serosae—membranes (mesothelium + areolar tissue) in a closed ventral body cavity
  - Parietal serosa line internal body walls
  - Visceral serosa cover internal organs

Steps in Tissue Repair

- Release of inflammatory chemicals
- Dilation of __________________________
- Increase in vessel permeability
- ____________ occurs

Inflammation sets the stage:
- Severed blood vessels bleed and inflammatory chemicals are released.
- Local blood vessels become more permeable, allowing white blood cells, fluid, clotting proteins and other plasma proteins to seep into the injured area.
- Clotting occurs; surface dries and forms a scab.

Steps in Tissue Repair

- Organization and restored __________
  - The blood clot is replaced with granulation tissue
  - Epithelium begins to regenerate
  - Fibroblasts produce collagen fibers to bridge the gap
  - Debris is phagocytized

Organization restores the blood supply:
- The clot is replaced by granulation tissue, which restores the vascular supply.
- Fibroblasts produce collagen fibers that bridge the gap.
- Macrophages phagocytize cell debris.
- Surface epithelial cells multiply and migrate over the granulation tissue.
Steps in Tissue Repair

- __________________ and fibrosis
  - The scab detaches
  - Fibrous tissue matures; epithelium thickens and begins to resemble adjacent tissue
  - Results in a fully regenerated epithelium with underlying scar tissue

Developmental Aspects

- Primary germ layers: ____________, ____________, and ____________
  - Formed early in embryonic development
  - Specialize to form the four primary tissues
    - Nerve tissue arises from ectoderm
    - Muscle and connective tissues arise from mesoderm
    - Epithelial tissues arise from all three germ layers