B. Connective Tissue

1. Location: the most abundant tissue in the body.
2. Functions:
    a. Support
    b. Attaches body parts together
    c. Protection
    d. Insulation
    e. Transport
    f. Storage: energy, calcium, etc.
3. Characteristics:
    a. Usually highly vascular (except for cartilage)
    b. Good nerve supply (except for cartilage)
    c. Can be a liquid, gel or hard (mineralized).
4. Tissue components: Composed of 2 basic components, **cells** and **extracellular matrix**.
    a. The extracellular matrix is all of the material outside of the cells. This consists of the **ground substance** and the **protein fibers**.
        i. The ground substance is composed of:
            (a) **interstitial fluid** (tissue fluid)
            (b) **adhesion proteins**: to help hold the tissue components together.
            (c) **proteoglycans:** (a protein and sugar molecule) such as hyaluronic acid or chondroitin sulfate. These molecules trap water within the tissue and affect the viscosity. The greater the amount of proteoglycans, the more viscous the tissue.
        ii. There are 3 types of protein fibers:
            (a) **Collagen fibers**: made of the protein collagen (the most abundant protein in the body) and are very strong. Appear as long, wavy, white bands.
            (b) **Elastic fibers**: made of the protein elastin and have great elasticity (can be bent and return to original shape). Are long, thin and branching in appearance.
            (c) **Reticular fibers**: also made of the protein collagen however these fibers are short and highly branching. Produces a netting to support soft tissues such as bone marrow, lymph nodes and glands.
    b. Cells
        i. Each tissue will have their own cells which produce and maintain the tissue.
        ii. White blood cells may also be present such as macrophages and mast cells to be covered later in the immune system.
5. Types of tissue:
    a. Loose connective tissues: fibers are loosely intertwined among the cells.
        i. **Areolar**:
            (a) unorganized sheets of filler tissue
            (b) contains all 3 fiber types
            (c) located in the subcutaneous layer deep to the skin; dermis; in certain membranes and surrounds blood vessels, nerves and body organs
        ii. Adipose
            (a) Cells (**adipocytes**) are specialized for storage of **triglycerides** (fats) and produce some hormones.

(b) Functions in insulation, energy storage and protection.

iii. Reticular

(a) Consists of reticular fibers that interlace together forming a network.

(b) Provides support for soft tissues such as glands, bone marrow and organs of the lymphatic system.

b. Dense connective tissues: contain more fibers and fewer cells.

i. Dense regular (white fibrous)

(a) Has collagenous fibers running in parallel bundles to provide strength.

(b) Forms tendons and ligaments.

ii. Dense irregular

(a) Has collagenous fibers arranged randomly throughout tissue. This allows for pull in multiple directions.

(b) Found in the dermis, also covers bones, cartilage and forms capsules around various organs.

iii. Elastic

(a) Dominated by elastic fibers which allow the tissue to stretch and recoil to original shape.

(b) Found in lungs, walls of arteries and vocal cords.

c. Cartilagenous tissue

i. general characteristics:

(a) **Chondroblasts** (fibroblasts the form cartilage) produce and surround themselves with extracellular matrix eventually enclosing themselves within a space known as **lacunae.**

(b) Once the chondroblast is completely enclosed within the space they are now referred to as **chondrocytes** (cartilage maintaining cells).

(c) The matrix consists of a firm ground substance containing chondroitin sulfate and networks of collagen and elastic fibers.

(d) Cartilage is surrounded by dense irregular connective tissue forming the **perichondrium** (peri= around; chondro=cartilage).

(e) Blood vessels and nerves are only found within the perichondrium. The cartilage is too dense for them to penetrate.

ii. Types of cartilage:

(a) **Hyaline cartilage**:

(1) The most abundant cartilage in the body.

(2) Contains very fine collagen fibers.

(3) Forms the fetal skeleton, supports respiratory passageways and covers articulating surface of bones.

(b) **Elastic cartilage**:

(1) Contains a network of elastic fibers within the matrix.

(2) Found in organs subjected to constant bending (epiglottis, ear, Eustachian tube).

(c) **Fibrocartilage**:

(1) Matrix contains bundles of collagen fibers allowing the cartilage to withstand a lot of pressure.

(2) Forms intervertebral disks, meniscus in knee and pubic symphysis.

d. Bone (osseous tissue)

i. Functions:
   (a) Support
   (b) Protection
   (c) Movement
   (d) Storage (calcium, phosphorus, bone marrow)

ii. General characteristics:
   (a) There are 2 types of bony tissue, **compact bone** and **spongy (cancellous) bone**
   (b) The ground substance of bone is hardened with the addition of mineral salts (calcium phosphate and calcium carbonate) known as **hydroxyapetite**.
   (c) The cells that build bone are known as **osteoblasts.**
   (d) The osteoblast builds bony tissue around itself enclosing the osteoblast within a space (**lacunae)**. The cell is now known as an **osteocyte** (a bone maintaining cell).
   (e) **Osteoclasts** are specialized white blood cells located in bony tissue that break down bone with HCL and proteases.
   (f) Blood vessels and nerves penetrate bone tissue through the **Haversian** and **Volkmann's canals**.

iii. Compact bone structure:
   (a) Composed of **osteons** which are concentric rings of bony tissue (like the trunk of a tree).
   (b) The layers of bone are known as **lamellae**.
   (c) The osteocytes reside in lacunae sandwiched between the lamellae.
   (d) Small canals (**canaliculi**) radiate from each lacunae to allow the transfer of nutrients and wastes between osteocytes.
   (e) A **Haversian (Central) canal** carries blood vessels and nerves through the center of the osteon. These canals run parallel to the surface of the bone.
   (f) **Volkmann's canals** run perpendicular to the surface of the bone and connect Haversian canals.

iv. Spongy (cancellous) bone structure:
   (a) Bone is formed of **trabeculae** (thin latticework).
   (b) Has large spaces filled with red bone marrow.

e. Blood tissue
   i. Has a liquid matrix known as **plasma**.
   ii. The fibers are normally dissolved within the plasma.
   iii. The cells found in blood tissue are formed from hematopoietic cells within red bone marrow. The cells include:
      (a) Erythrocytes (red blood cells)
      (b) Leukocytes (white blood cells)
         (i) Neutrophils
         (ii) Basophils
         (iii) Eosinophils
         (iv) Monocytes
         (v) Marcophages
         (vi) Lymphocytes
      (c) Megakaryoctes which give rise to platelets

iv. Blood will be detailed later.