

# I. ORGANIZATION OF THE BODY

## TISSUES: FIBROUS CONNECTIVE TISSUES

CN: Use yellow for C and C', and red I. (1) Begin with the illustration at middle left, and the related titles (A through K). The titles and borders of the microscopic sections of dense regular/irregular c.t. (F<sup>1</sup>, F<sup>2</sup>) receive the color of collagen (F) as that is the dominant structure in both tissues. (2) Do not color the matrix.

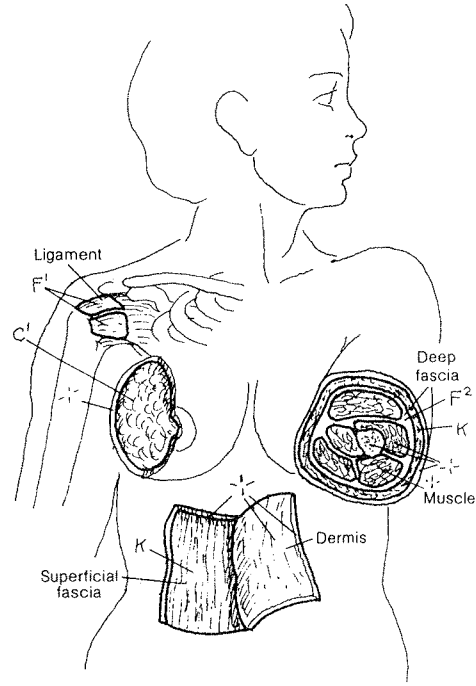
The connective tissues (c.t.) connect, bind, and support body structure. They consist of variable numbers of cells, fibers, and ground substance (fluid, viscous sol/gel, or mineralized). At the microscopic level (here illustrated at about 600 x magnification), connective tissues range from blood (cells/fluid), through the fibrous tissues (cells/fibers/variable matrix) to the more stiff supporting tissues (cells/fibers/dense matrix) of cartilage and mineralized bone. Connective tissue can be seen at visible levels of body organization as well, in fascial layers of the body wall, tendons, ligaments, bone, and so on. This plate introduces the fibrous connective tissues (c.t. proper).

### CELLS:\*

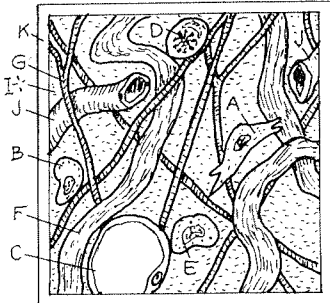
- FIBROBLAST<sub>A</sub>
- MACROPHAGE<sub>B</sub>
- FAT CELL<sub>C</sub>
- PLASMA CELL<sub>D</sub>
- MAST CELL<sub>E</sub>

### FIBERS:\*

- COLLAGEN<sub>F</sub>
- ELASTIC<sub>G</sub>
- RETICULAR<sub>H</sub>
- MATRIX, GROUND SUBSTANCE<sub>I, J</sub>
- CAPILLARY<sub>K</sub>



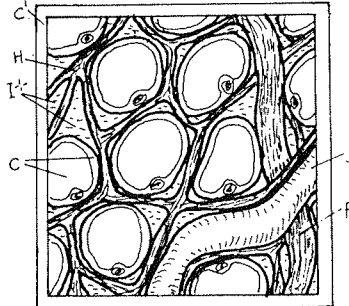
### LOOSE, AREOLAR C.T. K



Loose, areolar connective tissue is characterized by many cells, a loose, irregular arrangement of fibers, and a moderately viscous fluid matrix. Fibroblasts secrete the fibers and ground substance of this tissue. Mobile macrophages engulf cell debris, foreign matter, and microorganisms. Fat cells, storing lipids, may be seen in small numbers or large (adipose tissue). Plasma cells secrete antibodies in response to infection. Mast cells contain heparin and other secretory products, some of which initiate allergic reactions when released. Numerous other cells may transit

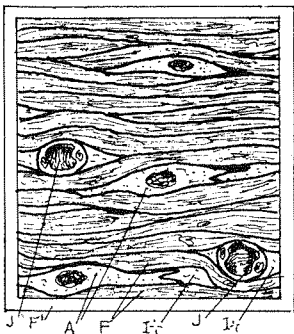
the loose fibrous tissues, including white blood cells (leukocytes). Collagen (linkages of protein exhibiting great tensile strength) and elastic fibers (made of the protein elastin) are the fibrous support elements in this tissue. Reticular tissue is a smaller form of collagen, forming supporting networks around cell groups of the blood-forming tissues, the lymphoid tissues, and adipose tissue. The matrix (consisting largely of water with glycoproteins and glycosaminoglycans in solution) is the intercellular ground substance in which all of the above function; it is fluid-like in the fibrous tissue. Numerous capillaries roam throughout this tissue. Loose connective tissue found deep to the skin is called superficial fascia, subcutaneous tissue, or hypodermis. It is found deep to the epithelial tissues of mucous and serous membranes of hollow organs.

### ADIPOSE C.T. C'



Aggregations of fat cells, supported by reticular and collagenous fibers, and closely associated with both blood and lymph capillaries, constitute adipose tissue. The storage/release of fat in/from adipose tissue is regulated by hormones (including nutritional factors) and nervous stimuli. It is a source of fuel, an insulator, mechanical padding, and stores fat-soluble vitamins. Adipose tissue is located primarily in the superficial fasciae (largely breast, buttock, anterior abdominal wall, arm, and thigh), yellow marrow, and the surface of serous membranes.

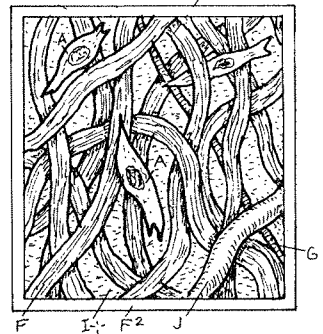
### DENSE REGULAR C.T. F<sup>1</sup>



Dense, parallel-arranged, masses of collagenous/elastic fibers form ligaments and tendons that are powerfully resistant to axially loaded tension forces, yet permitting some stretch. Tendons/ligaments contain few cells; largely fibroblasts. Elastic, dense regular ligaments are found in the posterior neck and between vertebrae; the tendocalcaneus is the largest elastic structure (tendon or ligament) in the body, storing energy used in gait.

Dense, irregularly arranged masses of interwoven collagenous (and some elastic) fibers in a viscous matrix form capsules of joints, envelop muscle tissue (deep fasciae), encapsulate certain visceral organs (liver, spleen, and others) and largely make up the dermis of the skin. It is impact resistant (bearing stress omnidirectionally), contains few cells, and is minimally vascularized.

### DENSE IRREGULAR C.T.



# 1. ORGANIZATION OF THE BODY

## TISSUES: SUPPORTING CONNECTIVE TISSUES

CN: Use the same colors as used on the previous plate for collagen Use light colors for A, B, G, I, and M. Complete the upper material (D) and elastic (E) fibers. Use a light tan or yellow for F and red for L. before coloring the bone section.

**CARTILAGE:**  
**CHONDROCYTE**<sub>A</sub>  
**LACUNA**<sub>B</sub>  
**MATRIX**<sub>C</sub>  
**COLLAGEN FIBER**<sub>D</sub>  
**ELASTIC FIBER**<sub>E</sub>

The supporting connective tissues consist of cartilage and/or bone. Microscopic sections of cartilage tissue reveal cells (*chondrocytes*) in small cavities (*lacunae*) surrounded by a specialized, hard but flexible *matrix* consisting of water electrochemically bound to proteoglycans and very fine *collagen fibers*. Cartilage is avascular; it receives its nutrition by diffusion. It generally does not repair well after injury but does replace itself with wear, as on joint surfaces.

Bone is unique for its mineralized matrix (average bone is 65% mineral, 35% organic tissue by weight). Bone forms the skeleton of the body; it is a reservoir of calcium; it acts as an anchor for muscles, tendons, and ligaments; it harbors many internal viscera, including the central nervous system; it assists in the mechanism of respiration, and is a center of blood-forming (hemopoietic) activity and fat storage.

### HYALINE CARTILAGE<sub>A</sub>

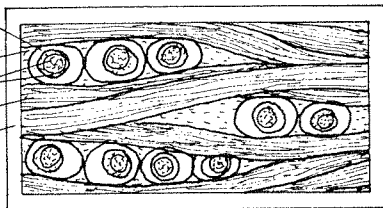
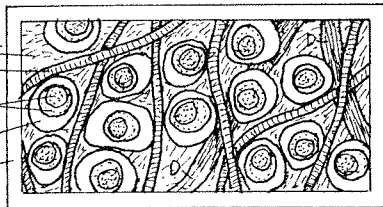
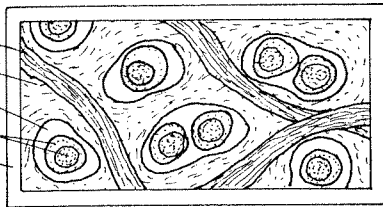
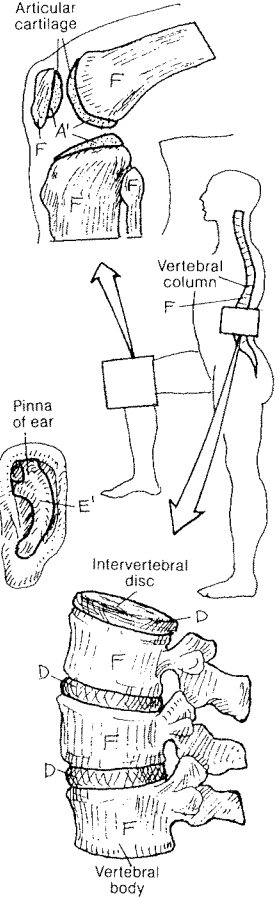
*Hyaline cartilage* is a flexible, avascular, insensitive, compressible cartilage, characterized by tiny pores. Its major significance is covering bone ends at synovial joints (articular cartilage). Joint movement enhances nutrition of the 1-3 mm thick articular cartilage, by pushing synovial fluid through the pores. Hyaline cartilage also supports the nose, contributes to the nasal septum, and is the main structural support of the larynx and lower respiratory tract. It forms the cartilage model for some bones in embryonic/fetal development; it is often a part of the intermediate framework (callus) in the healing process of fractured bone. Non-articular cartilage is generally ensheathed by perichondrium, a vascular fibrous tissue.

### ELASTIC CARTILAGE<sub>E</sub>

*Elastic cartilage* is essentially hyaline cartilage with elastic fibers and a slightly different type of collagen. It supports the external ear and contributes to the support of the larynx (epiglottis). It is remarkably flexible; test it on your external ear.

### FIBROCARTILAGE<sub>D</sub>

*Fibrocartilage* is dense fibrous tissue interspersed with chondrocytes in a reduced amount of intercellular matrix. It is found in intervertebral discs, the sacroiliac joint, pubic symphysis, and in several sites of ligamentous attachment to bone. Fibrocartilage enhances resistance to tensile and impact forces.



### BONE<sub>F</sub>

**PERIOSTEUM**<sub>F</sub>  
**COMPACT BONE**<sub>G</sub>  
**HAVERSIAN SYS.**<sub>G, D, K</sub>  
**HAV. CANAL**<sub>H</sub>  
**LAMELLAE**<sub>G'</sub>  
**OSTEOCYTE**<sub>I</sub>  
**LACUNA**<sub>B</sub>  
**CANALICULI**<sub>J</sub>  
**VOLKMANN CANAL**<sub>K</sub>  
**BLOOD VESSEL**<sub>L</sub>  
**SPONGY BONE**<sub>M</sub>

Microscopic sections of *bone* consist of *osteocytes* in *lacunae*, supported by collagen fibers in a mineralized (calcium hydroxyapatite) matrix. Other bone cells (not shown) include bone forming cells (osteoprogenitor cells, osteoblasts) and bone-absorbing cells (osteoclasts). *Compact bone* is the outer, impact-resistant, weight-bearing shell of bone. It is surrounded on its outer surface by a fibrous, vascular, cellular *periosteum*. The matrix of compact bone occurs in two patterns: concentric layers (*lamellae*) with a central canal (*haversian system/canal*) arranged in columns; and layers between and around haversian systems (circumferential system). The canals are interconnected by *volkmann canals*; both conduct *blood vessels*. The bone internal to compact bone is trabecular, characterized by irregular and interwoven bony beams (*spongy bone*). These beams are constantly reorienting in response to the stress imposed on them. Unlike cartilage, bone is well-vascularized; bone cells reach for vascular nutrition by multiple long cellular processes threading through small canals (*canaliculi*), giving the cells an insect-like appearance.

