

## 4-4 Connective Tissue

- Characteristics of Connective Tissue
  1. Specialized cells
  2. Solid extracellular protein fibers
  3. Fluid extracellular **ground substance**
- The Extracellular Components of Connective Tissue (Fibers and Ground Substance)
  - Make up **the matrix**
    - Majority of tissue volume
    - Determines specialized function

## 4-4 Connective Tissue

- Functions of Connective Tissue
  - Establishing a structural framework for the body
  - Transporting fluids and dissolved materials
  - Protecting delicate organs
  - Supporting, surrounding, and interconnecting other types of tissue
  - Storing energy reserves, especially in the form of triglycerides
  - Defending the body from invading microorganisms

## 4-4 Connective Tissue

- Classification of Connective Tissues
  - 1. Connective tissue proper**
    - Connect and protect
  - 2. Fluid connective tissues**
    - Transport
  - 3. Supporting connective tissues**
    - Structural strength

## 4-4 Connective Tissue

- Categories of Connective Tissue Proper
  - *Loose connective tissue*
    - More ground substance, fewer fibers
    - For example, fat (*adipose tissue*)
  - *Dense connective tissue*
    - More fibers, less ground substance
    - For example, *tendons*

## 4-4 Connective Tissue

### Connective Tissue Proper Cell Populations

- Fibroblasts
- Fibrocytes
- Adipocytes
- Mesenchymal cells
- Macrophages
- Mast cells
- Lymphocytes
- Microphages
- Melanocytes

## 4-4 Connective Tissue

- **Fibroblasts**

- The most abundant cell type
  - Found in all connective tissue proper
  - Secrete proteins and hyaluronan (cellular cement)

- **Fibrocytes**

- The second most abundant cell type
  - Found in all connective tissue proper
  - Maintain the fibers of connective tissue proper

## 4-4 Connective Tissue

- **Adipocytes**

- Fat cells
  - Each cell stores a single, large fat droplet

- **Mesenchymal Cells**

- Stem cells that respond to injury or infection
  - Differentiate into fibroblasts, macrophages, etc.

## 4-4 Connective Tissue

- **Macrophages**

- Large, amoeba-like cells of the immune system
  - Eat pathogens and damaged cells
  - *Fixed macrophages* stay in tissue
  - *Free macrophages* migrate



## 4-4 Connective Tissue

- **Mast Cells**
  - Stimulate inflammation after injury or infection
    - Release **histamine** and **heparin**
  - *Basophils* are leukocytes (white blood cells) that also contain histamine and heparin

## 4-4 Connective Tissue

- **Lymphocytes**

- Specialized immune cells in lymphatic (lymphoid) system
  - For example, lymphocytes may develop into **plasma cells** (plasmocytes) that produce *antibodies*

## 4-4 Connective Tissue

- **Macrophages**

- Phagocytic blood cells
  - Respond to signals from macrophages and mast cells
  - For example, *neutrophils* and *eosinophils*

- **Melanocytes**

- Synthesize and store the brown pigment **melanin**

## 4-4 Connective Tissue

- **Connective Tissue Fibers**
  - 1. Collagen fibers**
  - 2. Reticular fibers**
  - 3. Elastic fibers**

## 4-4 Connective Tissue

- **Collagen Fibers**

- Most common fibers in connective tissue proper
- Long, straight, and unbranched
- Strong and flexible
- Resist force in one direction
- For example, *tendons* and *ligaments*

## 4-4 Connective Tissue

- **Reticular Fibers**
  - Network of interwoven fibers (stroma)
  - Strong and flexible
  - Resist force in many directions
  - Stabilize functional cells (**parenchyma**) and structures
  - For example, sheaths around organs

## 4-4 Connective Tissue

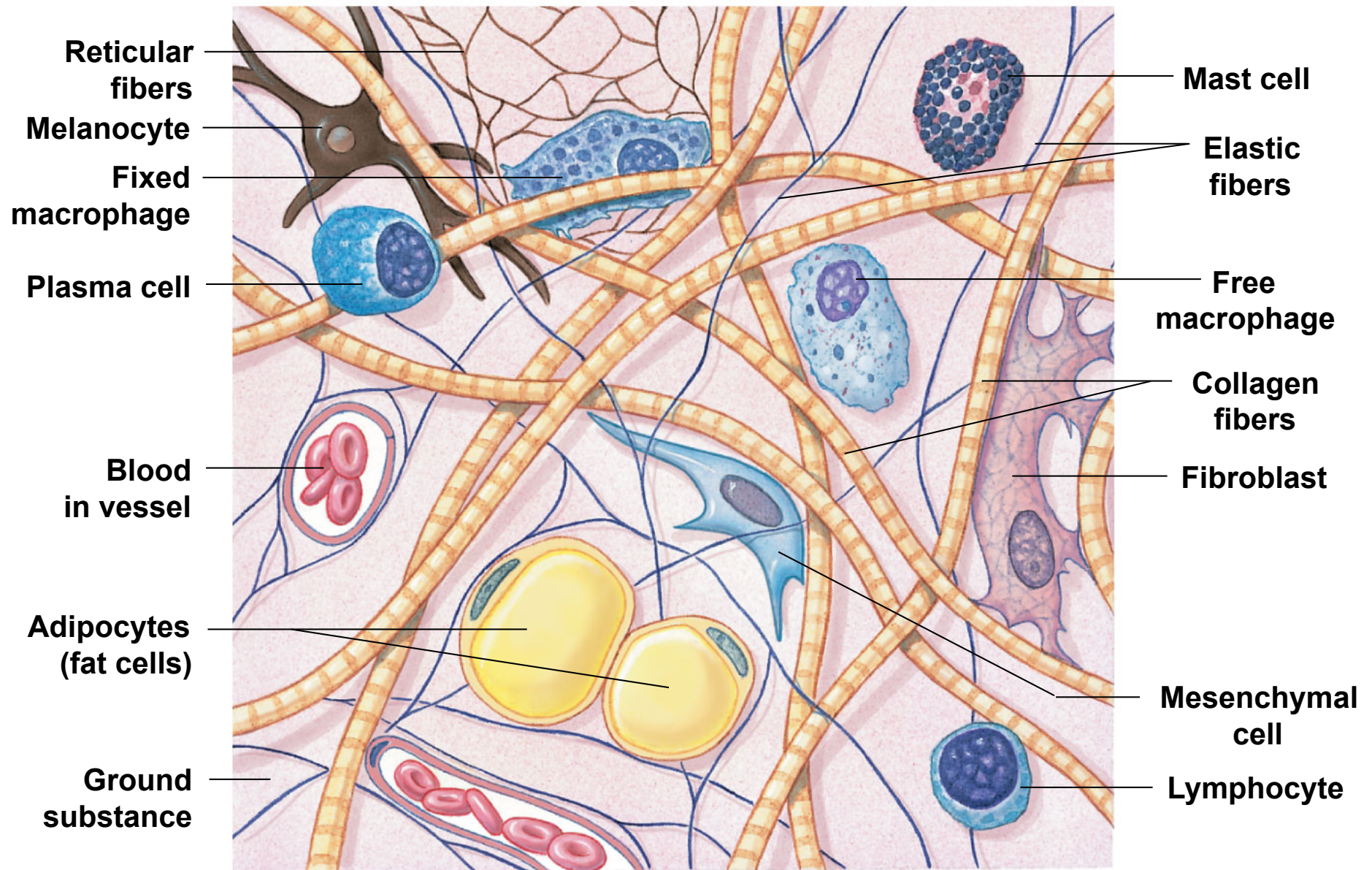
- **Elastic Fibers**
  - Contain *elastin*
  - Branched and wavy
  - Return to original length after stretching
  - For example, **elastic ligaments** of vertebrae

## 4-4 Connective Tissue

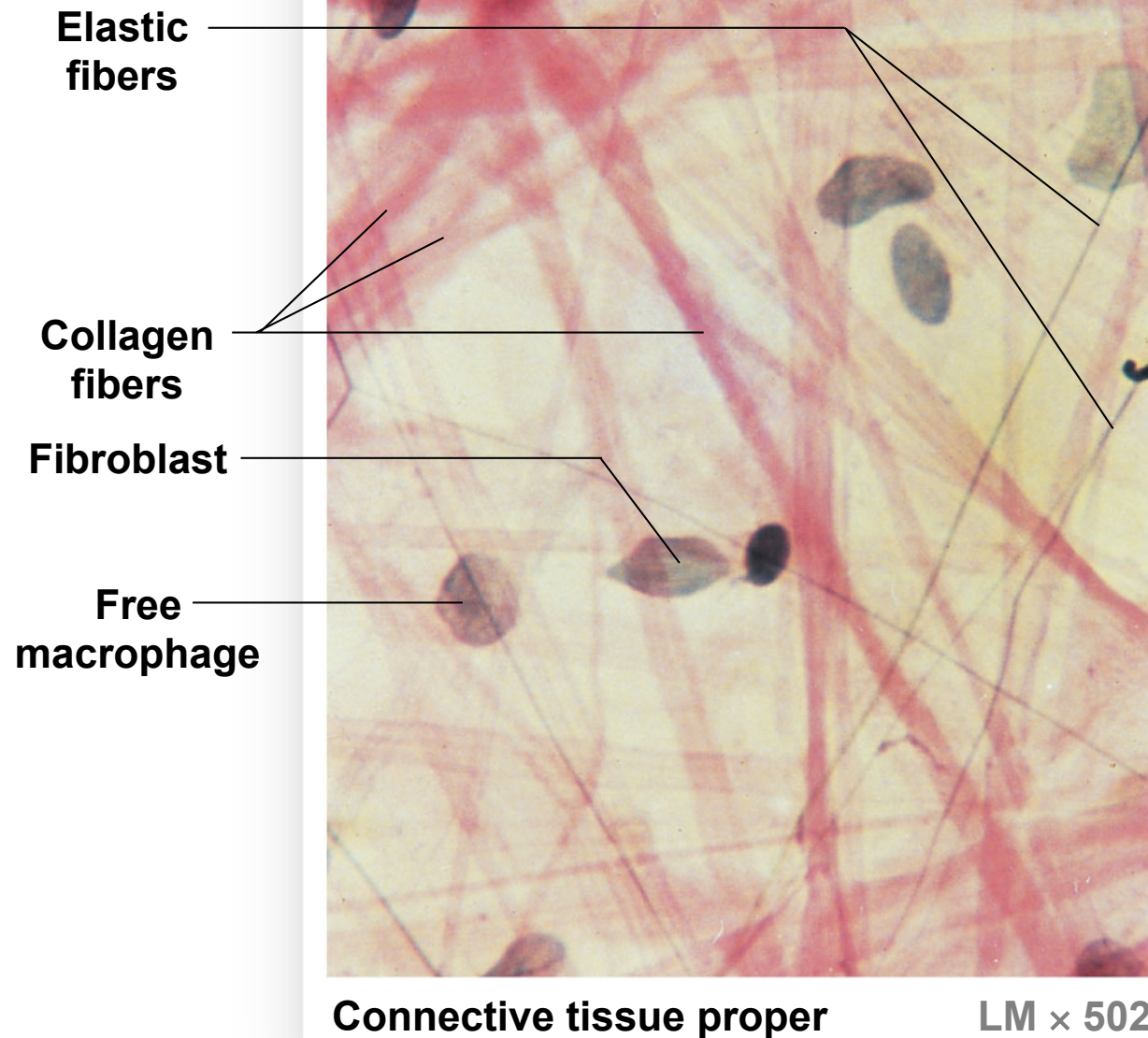
- Ground Substance
  - Is clear, colorless, and viscous
  - Fills spaces between cells and slows pathogen movement



**Figure 4-8 The Cells and Fibers of Connective Tissue Proper**



**Figure 4-8 The Cells and Fibers of Connective Tissue Proper**



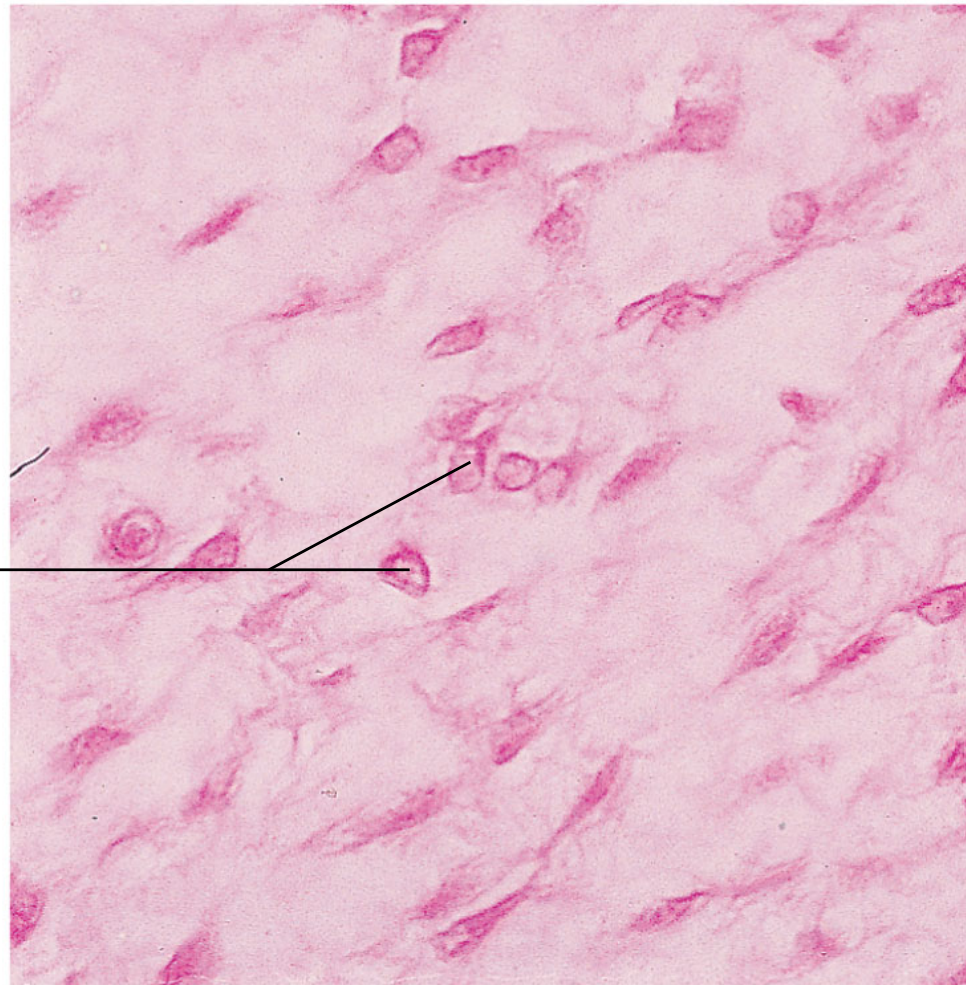
## 4-4 Connective Tissue

- Embryonic Connective Tissues
  - Are not found in adults
  - **Mesenchyme** (embryonic stem cells)
    - The first connective tissue in embryos
  - **Mucous connective tissue**
    - Loose embryonic connective tissue



**Figure 4-9a Connective Tissues in Embryos**

**Mesenchymal  
cells**



**Mesenchyme**

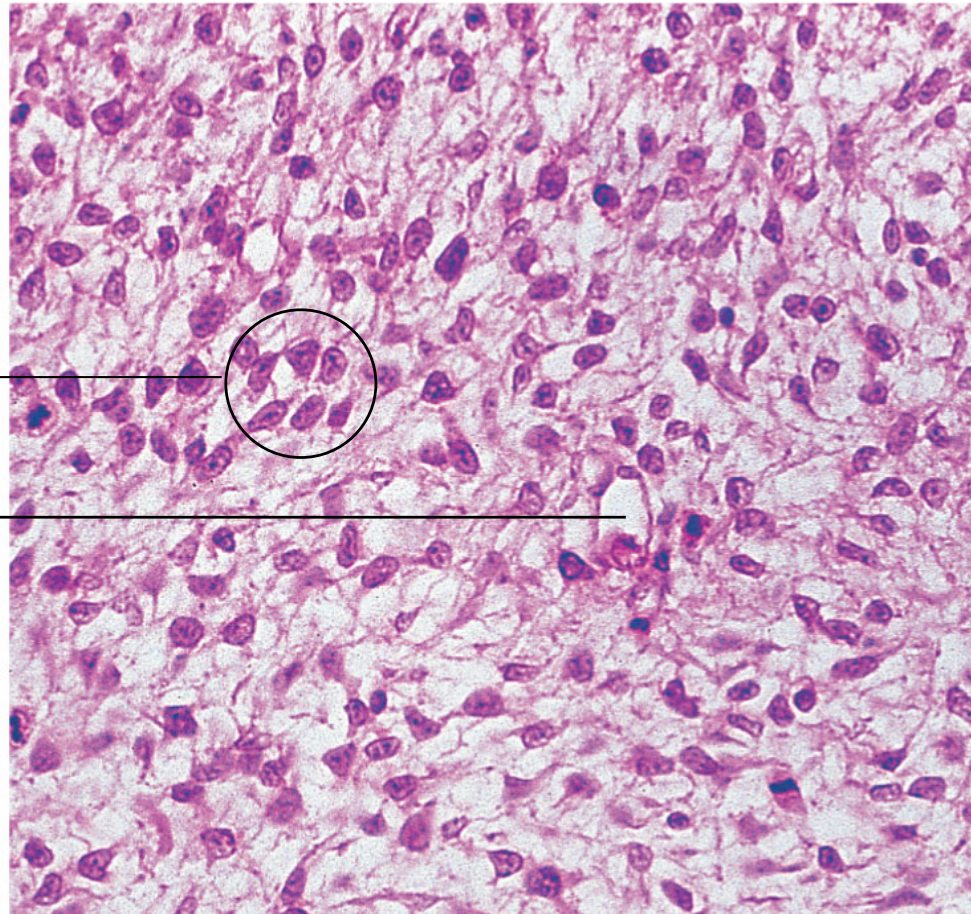
**LM × 136**

**a** This is the first connective tissue to appear in an embryo.

**Figure 4-9b Connective Tissues in Embryos**

**Mesenchymal  
cells**

**Blood vessel**



**Mucous connective tissue**      **LM × 136**  
**(Wharton's jelly)**

**b** This sample was taken from  
the umbilical cord of a fetus.

## 4-4 Connective Tissue

- **Loose Connective Tissues**
  - The “packing materials” of the body
  - Three types in adults
    1. **Areolar**
    2. **Adipose**
    3. **Reticular**

## 4-4 Connective Tissue

- **Areolar Tissue**
  - Least specialized
  - Open framework
  - Viscous ground substance
  - Elastic fibers
  - Holds blood vessels and capillary beds
    - For example, under skin (subcutaneous layer)

## 4-4 Connective Tissue

- **Adipose Tissue**
  - Contains many adipocytes (fat cells)
  - 2 types of adipose tissue
    1. **White fat**
    2. **Brown fat**



## 4-4 Connective Tissue

- **White fat**
  - Most common
  - Stores fat
  - Absorbs shocks
  - Slows heat loss (insulation)
- **Brown fat**
  - More vascularized
  - Adipocytes have many mitochondria
  - When stimulated by nervous system, fat breakdown accelerates, releasing energy
  - Absorbs energy from surrounding tissues

## 4-4 Connective Tissue

- Adipose Tissue
  - Adipose cells
    - Adipocytes in adults do not divide
      - Expand to store fat
      - Shrink as fats are released
  - Mesenchymal cells divide and differentiate
    - To produce more fat cells
    - When more storage is needed

## 4-4 Connective Tissue

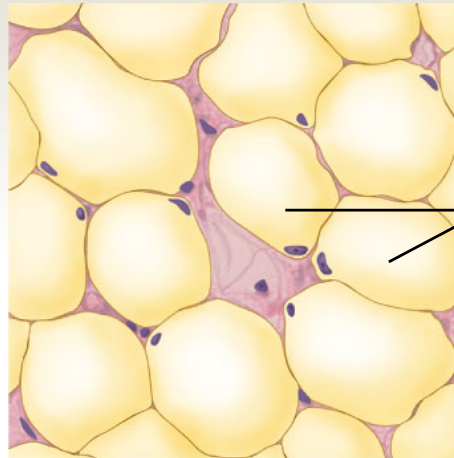
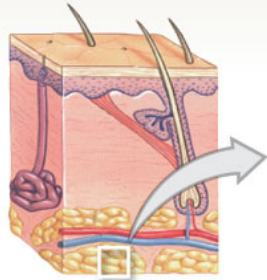
- **Reticular Tissue**
  - Provides support
  - Complex, three-dimensional network
  - Supportive fibers (stroma)
    - Support functional cells (parenchyma)
  - Reticular organs
    - Spleen, liver, lymph nodes, and bone marrow

**Figure 4-10a Adipose and Reticular Tissues**

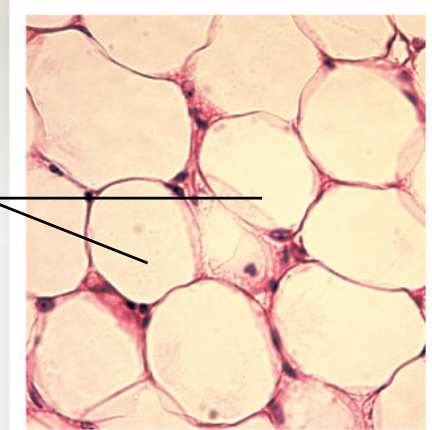
## Adipose Tissue

**LOCATIONS:** Deep to the skin, especially at sides, buttocks, breasts; padding around eyes and kidneys

**FUNCTIONS:** Provides padding and cushions shocks; insulates (reduces heat loss); stores energy



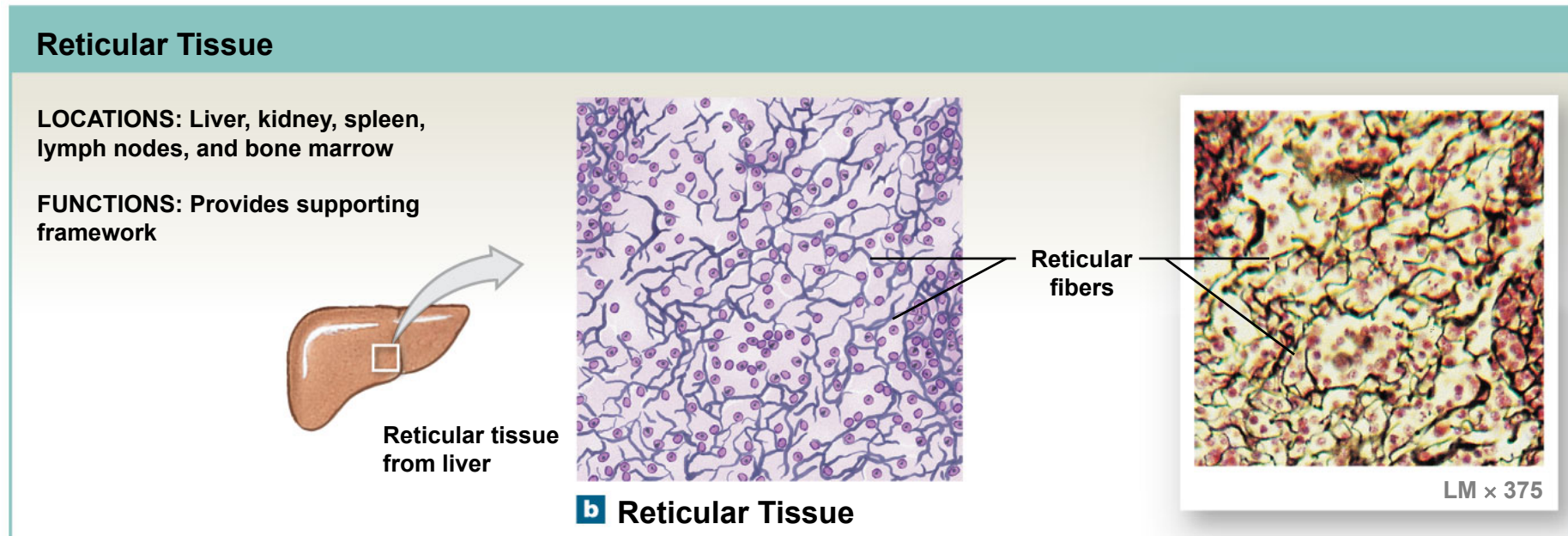
Adipocytes  
(white adipose cells)



LM × 300

**a** Adipose tissue

**Figure 4-10b Adipose and Reticular Tissues**



## 4-4 Connective Tissue

- **Dense Connective Tissues**
  - Connective tissues proper, tightly packed with high numbers of collagen or elastic fibers
    - **Dense regular connective tissue**
    - **Dense irregular connective tissue**
    - **Elastic tissue**

## 4-4 Connective Tissue

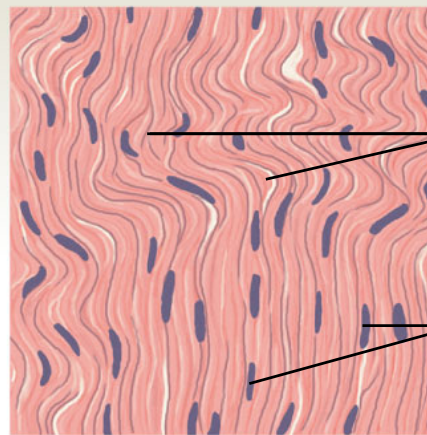
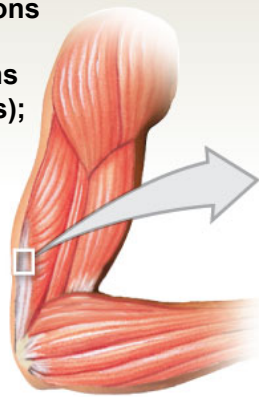
- **Dense Regular Connective Tissue**
  - Tightly packed, parallel collagen fibers
    - **Tendons** attach muscles to bones
    - **Ligaments** connect bone to bone and stabilize organs
    - **Aponeuroses** attach in sheets to large, flat muscles

**Figure 4-11a Dense Connective Tissues**

### Dense Regular Connective Tissue

**LOCATIONS:** Between skeletal muscles and skeleton (tendons and aponeuroses); between bones or stabilizing positions of internal organs (ligaments); covering skeletal muscles; deep fasciae

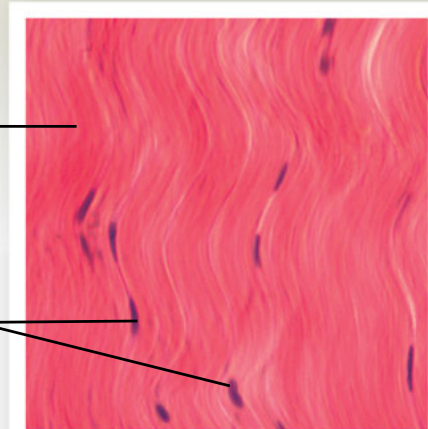
**FUNCTIONS:** Provides firm attachment; conducts pull of muscles; reduces friction between muscles; stabilizes relative positions of bones



Collagen fibers

Fibroblast nuclei

**a** Tendon



LM × 440



## 4-4 Connective Tissue

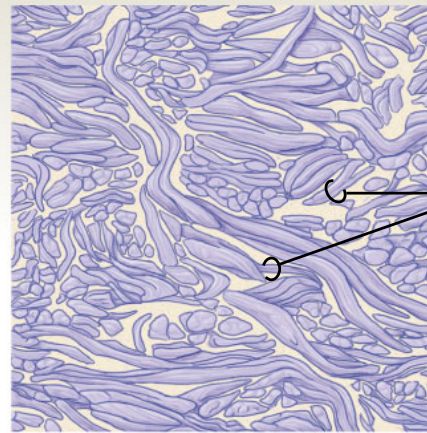
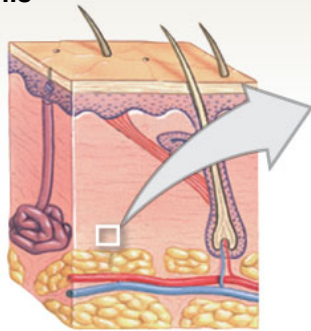
- **Dense Irregular Connective Tissue**
  - Interwoven networks of collagen fibers
    - Layered in skin
    - Around cartilages (*perichondrium*)
    - Around bones (*periosteum*)
    - Form **capsules** around some organs (e.g., liver, kidneys)

**Figure 4-11b Dense Connective Tissues**

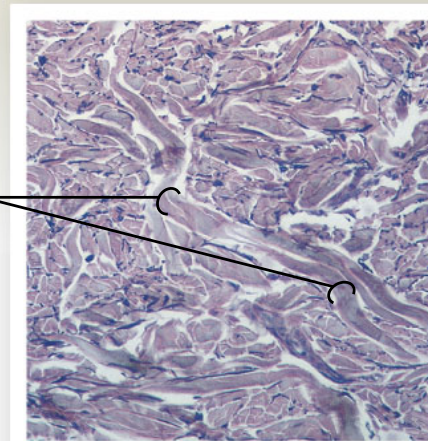
### Dense Irregular Connective Tissue

**LOCATIONS:** Capsules of visceral organs; periosteum and perichondria; nerve and muscle sheaths; dermis

**FUNCTIONS:** Provides strength to resist forces applied from many directions; helps prevent overexpansion of organs such as the urinary bladder



**b** Deep dermis



Collagen  
fiber  
bundles

LM × 111

## 4-4 Connective Tissue

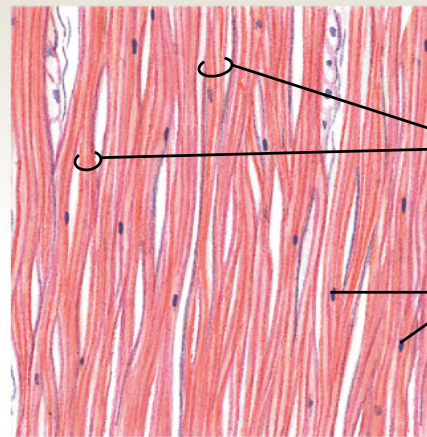
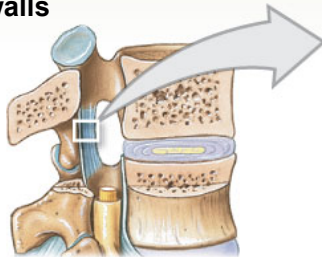
- **Elastic Tissue**
  - Made of elastic fibers
    - For example, elastic ligaments of spinal vertebrae

**Figure 4-11c Dense Connective Tissues**

### Elastic Tissue

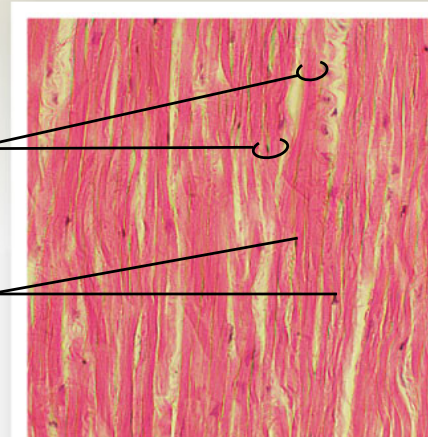
**LOCATIONS:** Between vertebrae of the spinal column (ligamentum flavum and ligamentum nuchae); ligaments supporting penis; ligaments supporting transitional epithelia; in blood vessel walls

**FUNCTIONS:** Stabilizes positions of vertebrae and penis; cushions shocks; permits expansion and contraction of organs



Elastic fibers

Fibroblast nuclei



LM × 887

**c Elastic ligament**

## 4-4 Connective Tissue

- Fluid Connective Tissues
  - *Blood and lymph*
  - Watery matrix of dissolved proteins
  - Carry specific cell types (*formed elements*)
    - Formed elements of blood
      - Red blood cells (erythrocytes)
      - White blood cells (leukocytes)
      - Platelets

## 4-4 Connective Tissue

- Fluid Elements of Connective Tissues
  - Extracellular
    - *Plasma*
    - *Interstitial fluid*
    - *Lymph*

**Figure 4-12 Formed Elements of the Blood**

### **Red blood cells**

**Red blood cells, or erythrocytes (e-RITH-rō-sīts), are responsible for the transport of oxygen (and, to a lesser degree, of carbon dioxide) in the blood.**



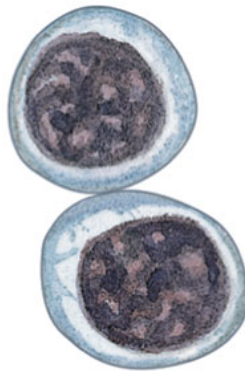
**Red blood cells account for roughly half the volume of whole blood and give blood its color.**

## White blood cells

White blood cells, or leukocytes (LOO-kō-sīts; *leuko-*, white), help defend the body from infection and disease.



**Monocytes** are phagocytes similar to the free macrophages in other tissues.

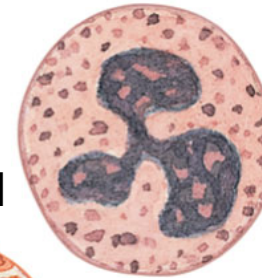


**Lymphocytes** are uncommon in the blood but they are the dominant cell type in lymph, the second type of fluid connective tissue.

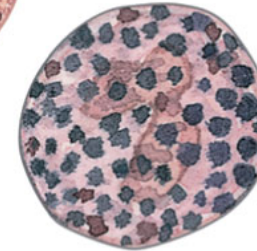
**Eosinophil**



**Neutrophil**



**Basophil**



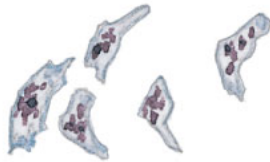
**Eosinophils and neutrophils** are phagocytes. **Basophils** promote inflammation much like mast cells in other connective tissues.



**Figure 4-12 Formed Elements of the Blood**

### **Platelets**

**Platelets are membrane-enclosed packets of cytoplasm that function in blood clotting.**



**These cell fragments are involved in the clotting response that seals leaks in damaged or broken blood vessels.**

## 4-4 Connective Tissue

- **Lymph**
  - Extracellular fluid
    - Collected from interstitial space
    - Monitored by immune system
    - Transported by lymphatic (lymphoid) system
    - Returned to venous system

## 4-4 Connective Tissue

- Fluid Tissue Transport Systems
  - Cardiovascular system (blood)
    - Arteries
    - Capillaries
    - Veins
  - Lymphatic (lymphoid) system (lymph)
    - Lymphatic vessels

## 4-5 Supporting Connective Tissues

- Support Soft Tissues and Body Weight
  - **Cartilage**
    - Gel-type ground substance
    - For shock absorption and protection
  - **Bone**
    - **Calcified** (made rigid by calcium salts, minerals)
    - For weight support

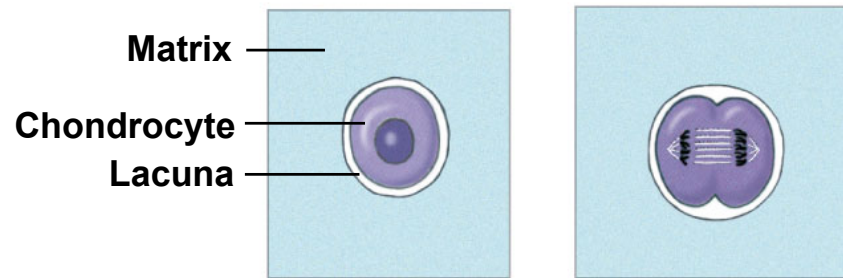
## 4-5 Supporting Connective Tissues

- Cartilage Matrix
  - Proteoglycans derived from chondroitin sulfates
  - Ground substance proteins
- **Chondrocytes** (cartilage cells) surrounded by **lacunae** (chambers)

## 4-5 Supporting Connective Tissues

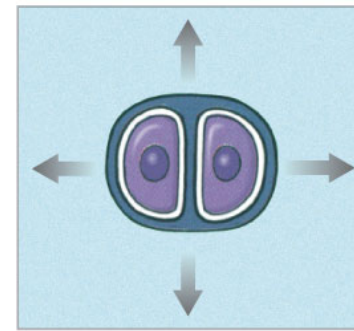
- Cartilage Structure
  - No blood vessels
    - Chondrocytes produce **antiangiogenesis factor**
- **Perichondrium**
  - Outer, fibrous layer (for strength)
  - Inner, cellular layer (for growth and maintenance)

**Figure 4-13a The Growth of Cartilage**

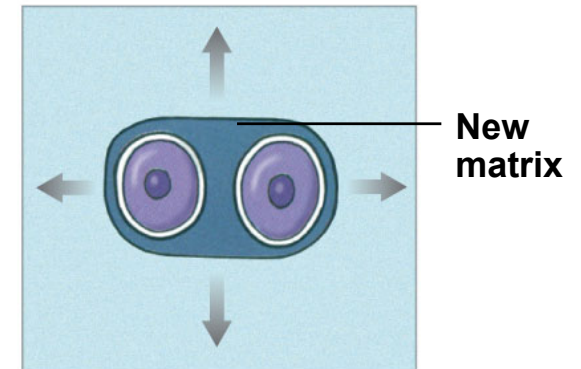


**Chondrocyte undergoes division within a lacuna surrounded by cartilage matrix.**

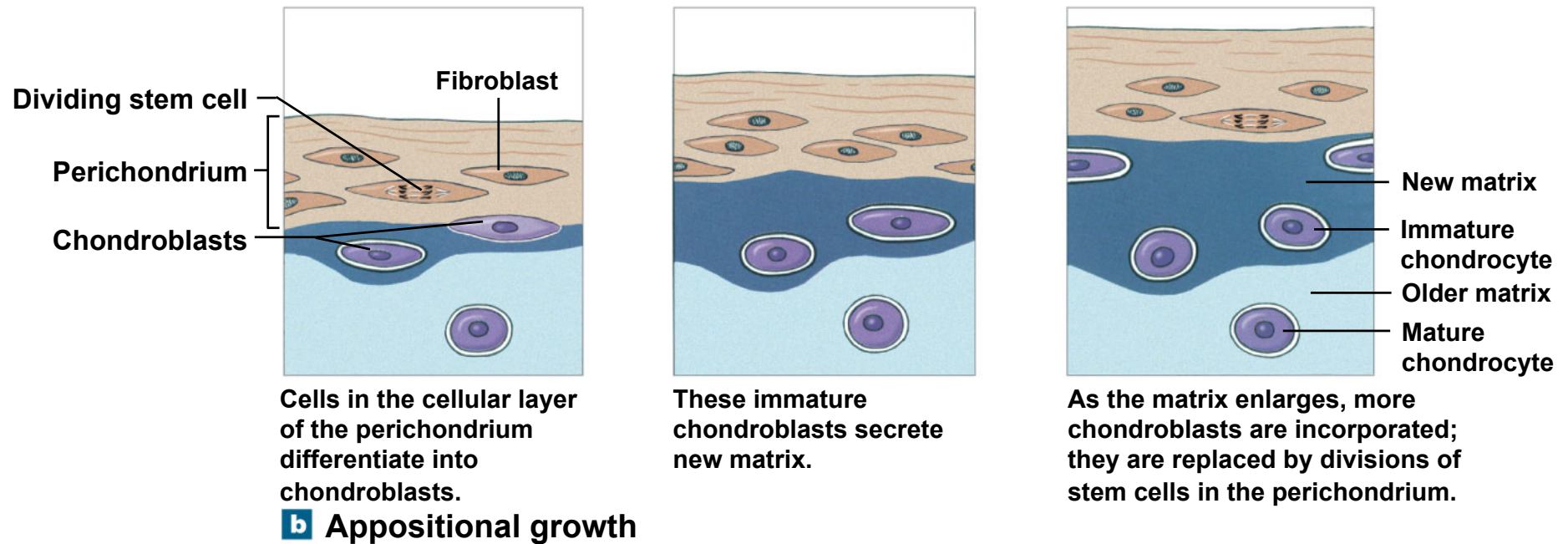
**a Interstitial growth**



**As daughter cells secrete additional matrix, they move apart, expanding the cartilage from within.**



**Figure 4-13b The Growth of Cartilage**





## 4-5 Supporting Connective Tissues

- Types of Cartilage
  1. Hyaline cartilage
  2. Elastic cartilage
  3. Fibrocartilage (fibrous cartilage)

## 4-5 Supporting Connective Tissues

- **Hyaline Cartilage**

- Stiff, flexible support
- Reduces friction between bones
- Found in synovial joints, rib tips, sternum, and trachea

- **Elastic Cartilage**

- Supportive but bends easily
- Found in external ear and epiglottis

## 4-5 Supporting Connective Tissues

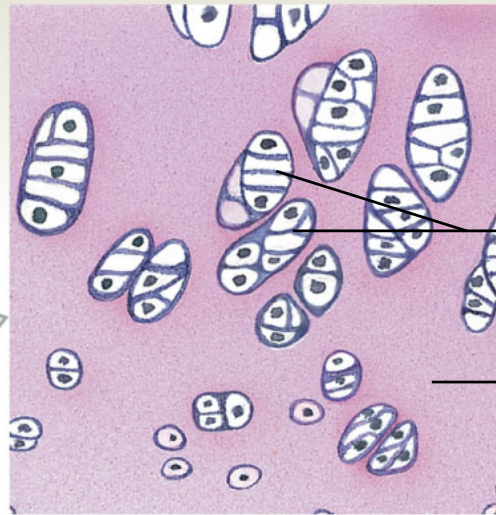
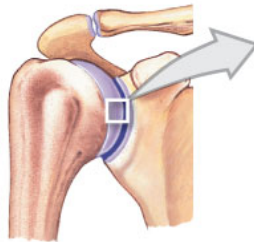
- **Fibrocartilage** (Fibrous Cartilage)
  - Limits movement
  - Prevents bone-to-bone contact
  - Pads knee joints
  - Found between pubic bones and intervertebral discs

Figure 4-14a Types of Cartilage

## Hyaline Cartilage

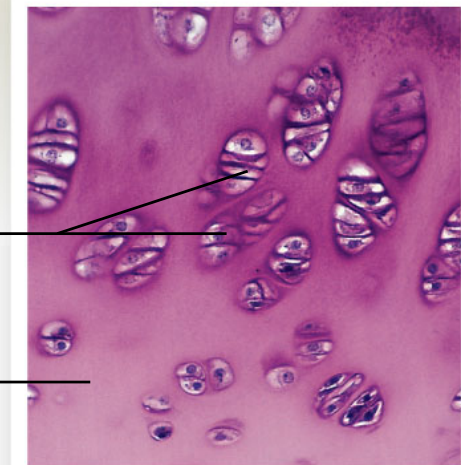
**LOCATIONS:** Between tips of ribs and bones of sternum; covering bone surfaces at synovial joints; supporting larynx (voice box), trachea, and bronchi; forming part of nasal septum

**FUNCTIONS:** Provides stiff but somewhat flexible support; reduces friction between bony surfaces



Chondrocytes  
in lacunae

Matrix



LM × 500

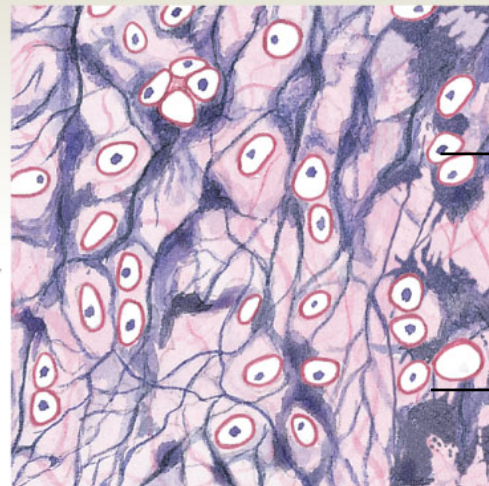
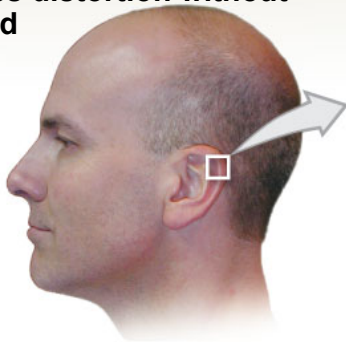
**a** Hyaline cartilage

**Figure 4-14b Types of Cartilage**

## Elastic Cartilage

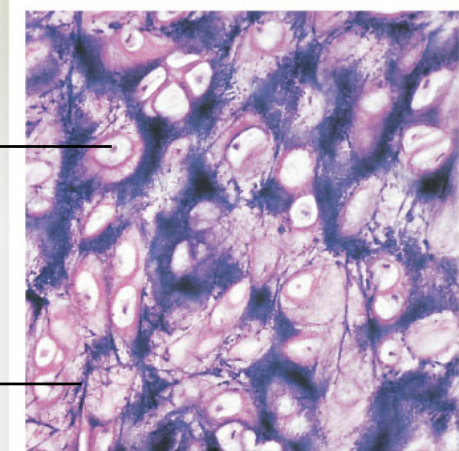
**LOCATIONS:** Auricle of external ear; epiglottis; auditory canal; cuneiform cartilages of larynx

**FUNCTIONS:** Provides support, but tolerates distortion without damage and returns to original shape



Chondrocyte  
in lacuna

Elastic fibers  
in matrix



LM × 358

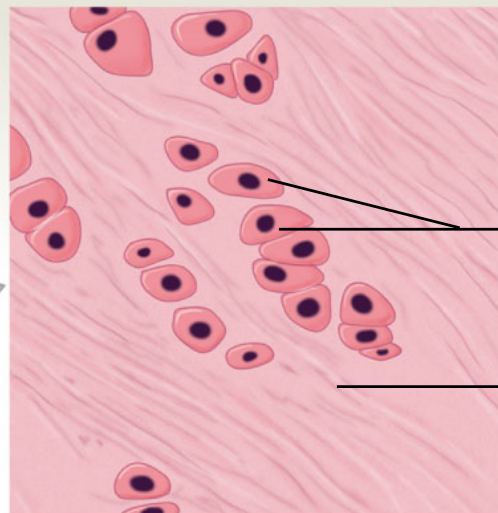
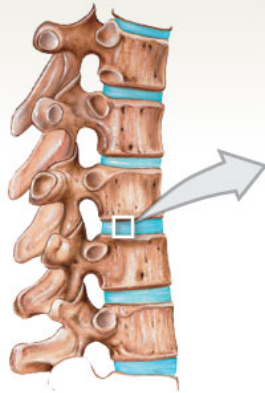
**b Elastic cartilage**

**Figure 4-14c Types of Cartilage**

## Fibrocartilage

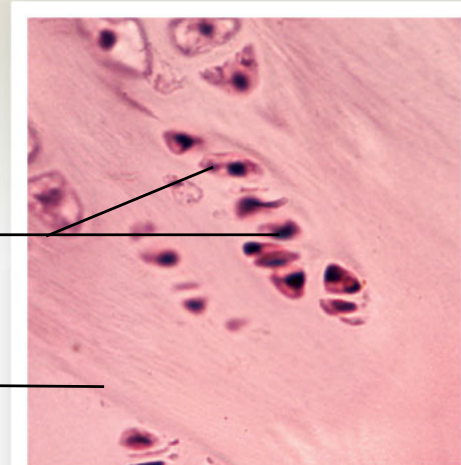
**LOCATIONS:** Pads within knee joint; between pubic bones of pelvis; intervertebral discs

**FUNCTIONS:**  
Resists compression; prevents bone-to-bone contact; limits movement



Chondrocytes  
in lacunae

Fibrous  
matrix



LM × 400

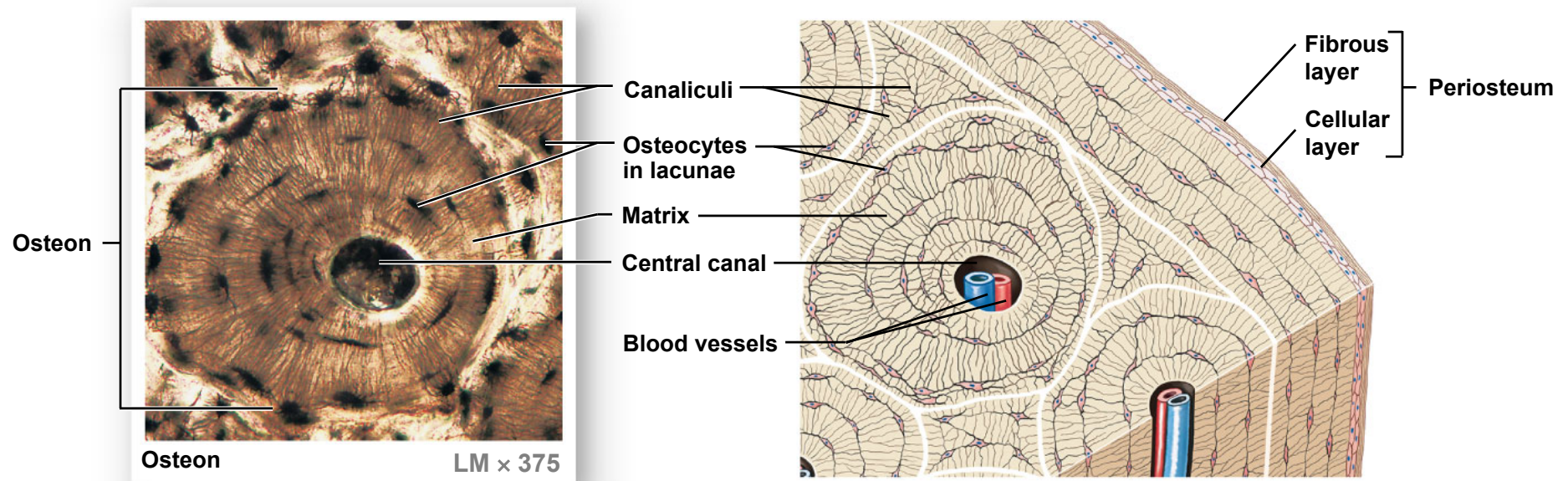
**c Fibrocartilage**

## 4-5 Supporting Connective Tissues

- **Bone or Osseous Tissue**
  - Strong (calcified calcium salt deposits)
  - Resists shattering (flexible collagen fibers)
- **Bone Cells or Osteocytes**
  - Arranged around **central canals** within matrix
  - Small channels through matrix (**canaliculi**) access blood supply
- **Periosteum**
  - Covers bone surfaces
  - Fibrous layer
  - Cellular layer



**Figure 4-15 Bone**





**Table 4-2 A Comparison of Cartilage and Bone**

<b>Table 4–2    A Comparison of Cartilage and Bone</b>		
<b>Characteristic</b>	<b>Cartilage</b>	<b>Bone</b>
<b>STRUCTURAL FEATURES</b>		
Cells	Chondrocytes in lacunae	Osteocytes in lacunae
Ground substance	Chondroitin sulfate (in proteoglycan) and water	A small volume of liquid surrounding insoluble crystals of calcium salts (calcium phosphate and calcium carbonate)
Fibers	Collagen, elastic, and reticular fibers (proportions vary)	Collagen fibers predominate
Vascularity	None	Extensive
Covering	Perichondrium (two layers)	Periosteum (two layers)
Strength	Limited: bends easily, but hard to break	Strong: resists distortion until breaking point
<b>METABOLIC FEATURES</b>		
Oxygen demands	Low	High
Nutrient delivery	By diffusion through matrix	By diffusion through cytoplasm and fluid in canaliculi
Growth	Interstitial and appositional	Appositional only
Repair capabilities	Limited	Extensive

## 4-6 Membranes

- Membranes
  - Physical barriers
  - Line or cover portions of the body
  - Consist of:
    - An epithelium
    - Supported by connective tissue

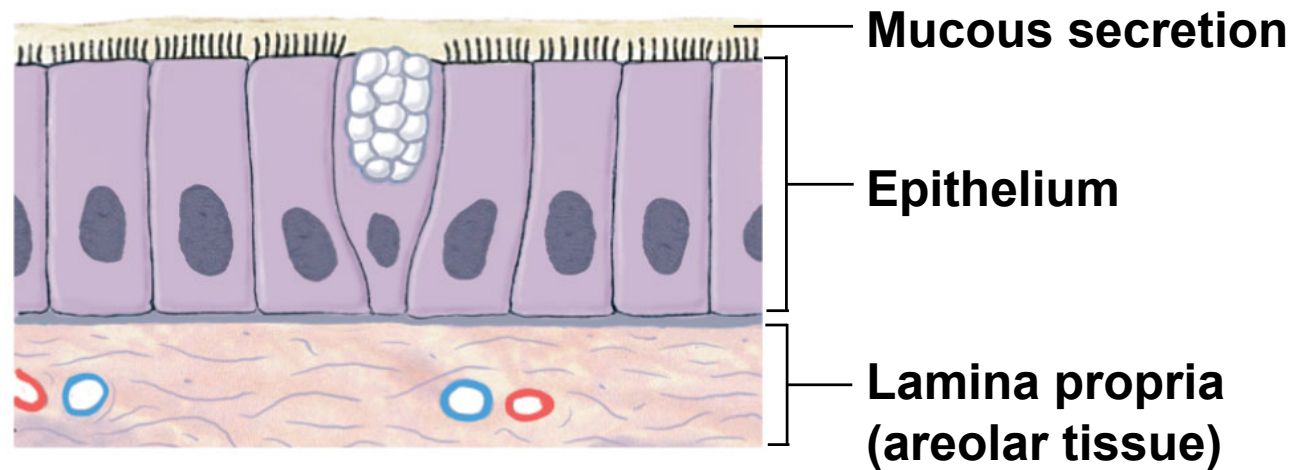
## 4-6 Membranes

- Four Types of Membranes
  1. Mucous membranes
  2. Serous membranes
  3. Cutaneous membrane
  4. Synovial membranes

## 4-6 Membranes

- **Mucous Membranes (Mucosae)**
  - Line passageways that have external connections
  - In digestive, respiratory, urinary, and reproductive tracts
  - Epithelial surfaces must be moist
    - To reduce friction
    - To facilitate absorption and excretion
  - Lamina propria
    - Is areolar tissue

**Figure 4-16a Membranes**



- a** Mucous membranes are coated with the secretions of mucous glands. These membranes line the digestive, respiratory, urinary, and reproductive tracts.

## 4-6 Membranes

- **Serous Membranes**

- Line cavities not open to the outside
- Are thin but strong
- Have fluid transudate to reduce friction
- Have a parietal portion covering the cavity
- Have a visceral portion (**serosa**) covering the organs

## 4-6 Membranes

- Three Serous Membranes

- 1. Pleura**

- Lines pleural cavities
    - Covers lungs

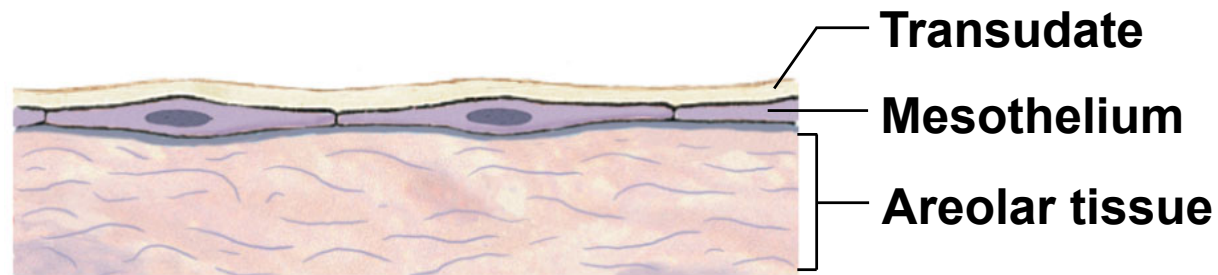
- 2. Peritoneum**

- Lines peritoneal cavity
    - Covers abdominal organs

- 3. Pericardium**

- Lines pericardial cavity
    - Covers heart

Figure 4-16b Membranes



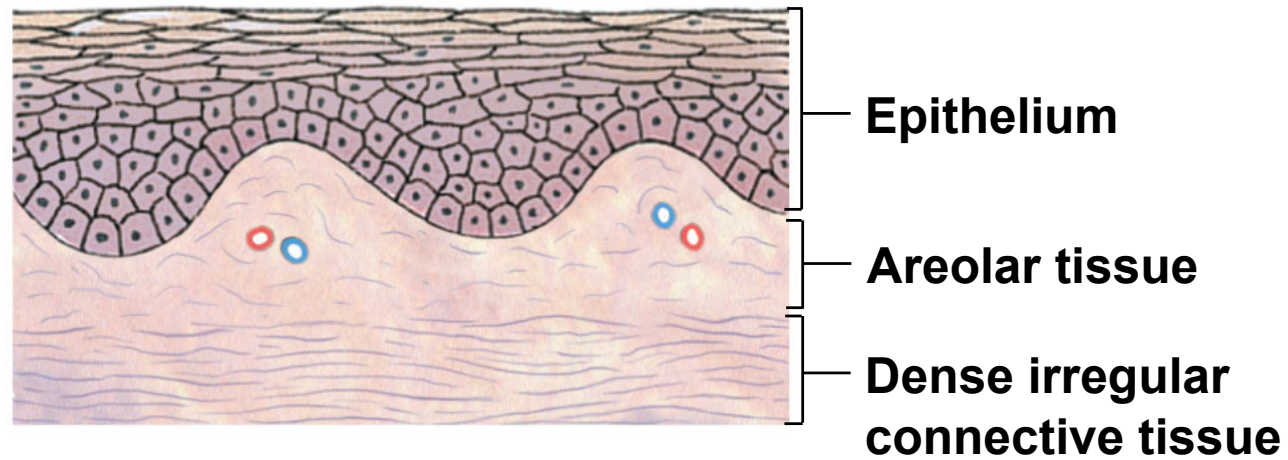
**b** Serous membranes line the ventral body cavities (the peritoneal, pleural, and pericardial cavities).



## 4-6 Membranes

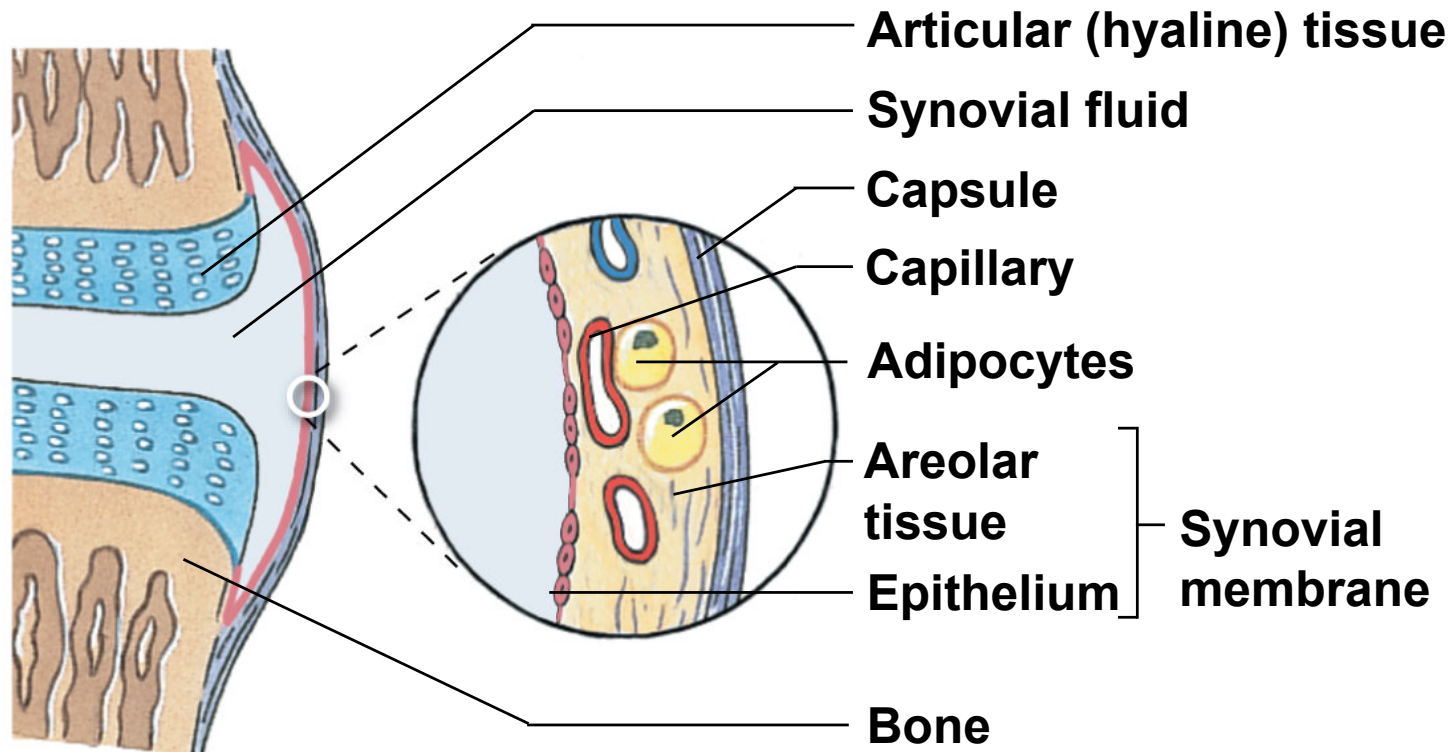
- **Cutaneous Membrane**
  - Is skin, surface of the body
  - Thick, waterproof, and dry
- **Synovial Membranes**
  - Line moving, articulating joint cavities
  - Produce **synovial fluid** (lubricant)
  - Protect the ends of bones
  - Lack a true epithelium

**Figure 4-16c Membranes**



**C** The cutaneous membrane, or skin, covers the outer surface of the body.

**Figure 4-16d Membranes**



**d** Synovial membranes line joint cavities and produce the fluid within the joint.

## 4-7 Internal Framework of the Body

- **Connective Tissues**

1. Provide strength and stability
2. Maintain positions of internal organs
3. Provide routes for blood vessels, lymphatic vessels, and nerves

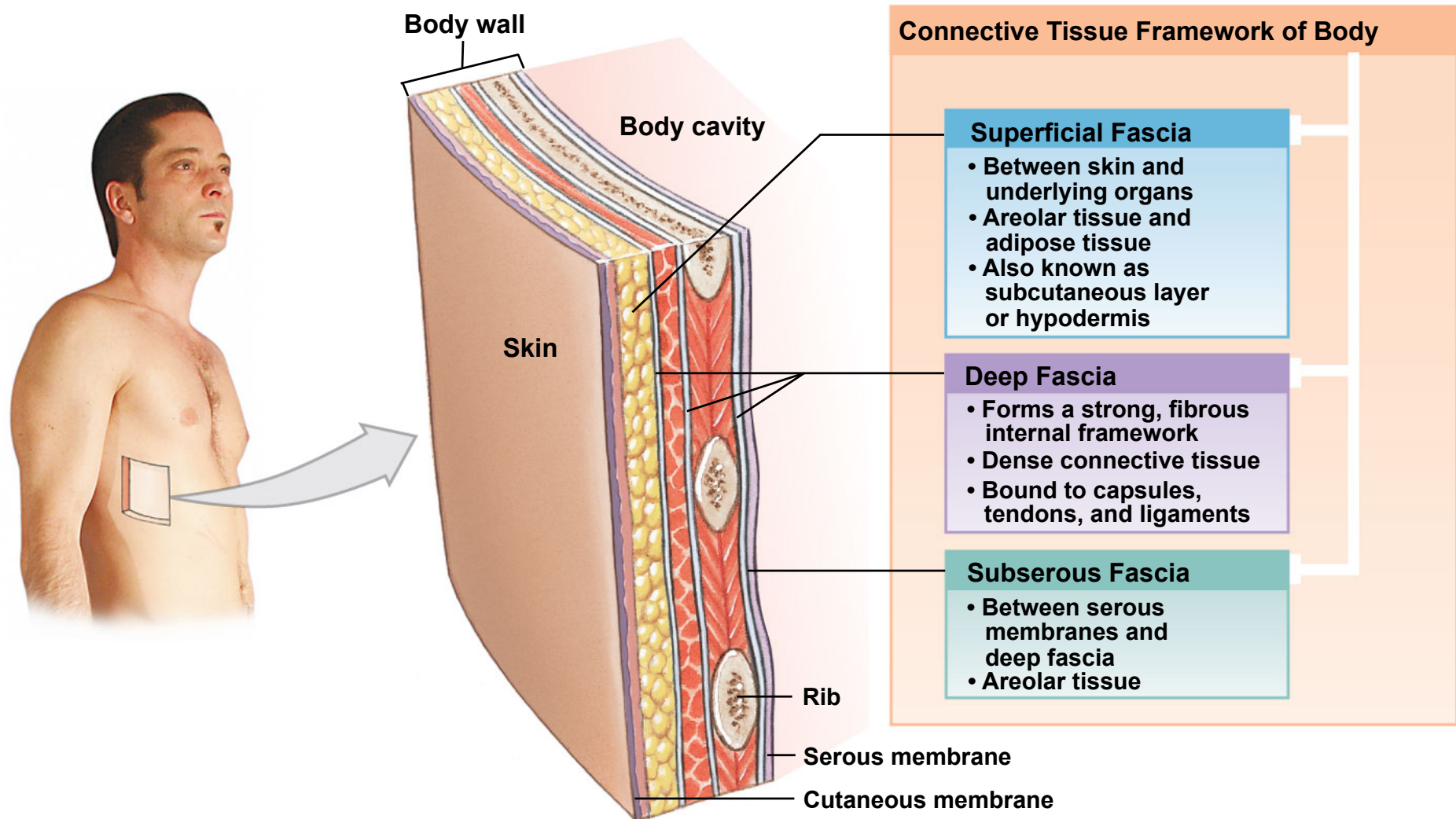
- **Fasciae**

- Singular form = **fascia**
  - The body's framework of connective tissue
  - Layers and wrappings that support or surround organs

## 4-7 Internal Framework of the Body

- Three Types of Fasciae
  1. **Superficial fascia**
  2. **Deep fascia**
  3. **Subserous fascia**

**Figure 4-17 The Fasciae**



# 4-8 Muscle Tissue

- Muscle Tissue
  - Specialized for contraction
  - Produces all body movement
  - Three types of muscle tissue
    - 1. Skeletal muscle tissue**
      - Large body muscles responsible for movement
    - 2. Cardiac muscle tissue**
      - Found only in the heart
    - 3. Smooth muscle tissue**
      - Found in walls of hollow, contracting organs (blood vessels; urinary bladder; respiratory, digestive, and reproductive tracts)

## 4-8 Muscle Tissue

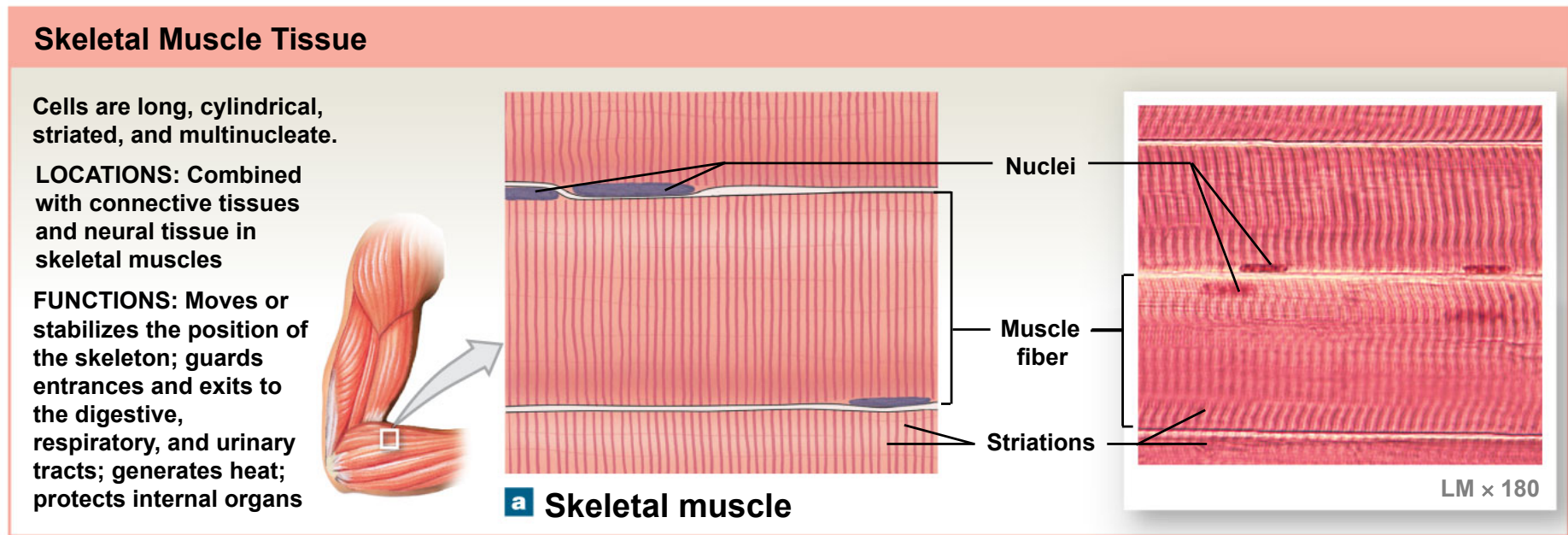
- Classification of Muscle Cells
  - **Striated** (muscle cells with a banded appearance)
  - **Nonstriated** (not banded; smooth)
  - Muscle cells can have a single nucleus
  - Muscle cells can be multinucleate
  - Muscle cells can be controlled **voluntarily** (consciously)
  - Muscle cells can be controlled **involuntarily** (automatically)



## 4-8 Muscle Tissue

- Skeletal Muscle Cells
  - Long and thin
  - Usually called **muscle fibers**
  - Do not divide
  - New fibers are produced by stem cells (**myosatellite cells**)

**Figure 4-18a Muscle Tissue**



## 4-8 Muscle Tissue

- Cardiac Muscle Cells
  - Called **cardiocytes**
  - Form branching networks connected at **intercalated discs**
  - Regulated by *pacemaker cells*
- Smooth Muscle Cells
  - Small and tapered
  - Can divide and regenerate

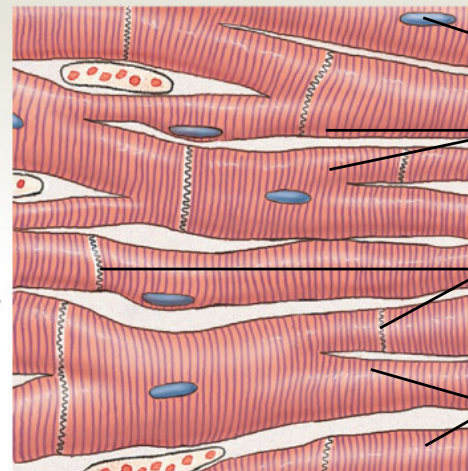
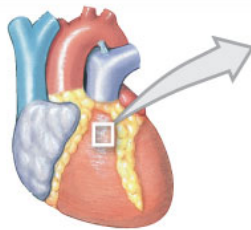
**Figure 4-18b Muscle Tissue**

### Cardiac Muscle Tissue

Cells are short, branched, and striated, usually with a single nucleus; cells are interconnected by intercalated discs.

**LOCATION:** Heart

**FUNCTIONS:**  
Circulates blood;  
maintains blood  
(hydrostatic) pressure

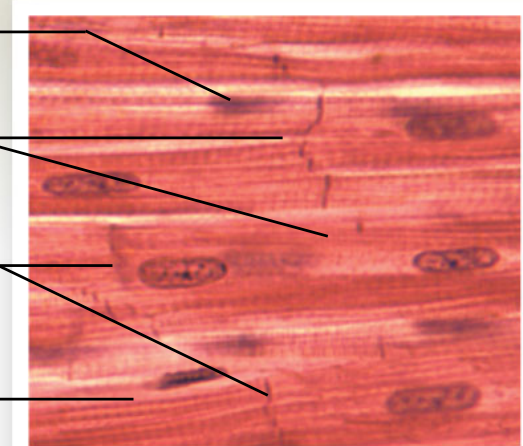


Nucleus

Cardiac  
muscle  
cells

Intercalated  
discs

Striations



LM × 450

**b Cardiac muscle**

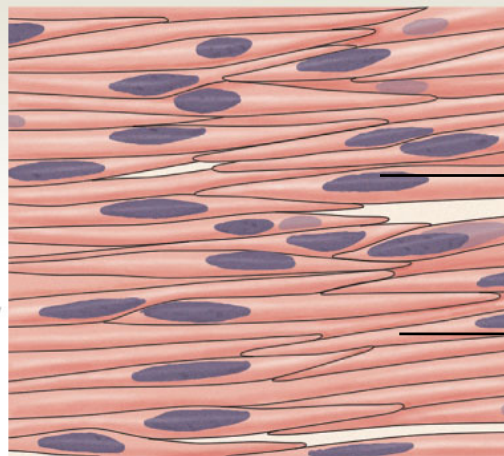
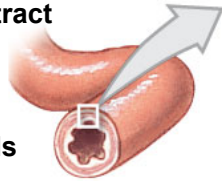
**Figure 4-18c Muscle Tissue**

### Smooth Muscle Tissue

Cells are short, spindle-shaped, and nonstriated, with a single, central nucleus.

**LOCATIONS:** Found in the walls of blood vessels and in digestive, respiratory, urinary, and reproductive organs

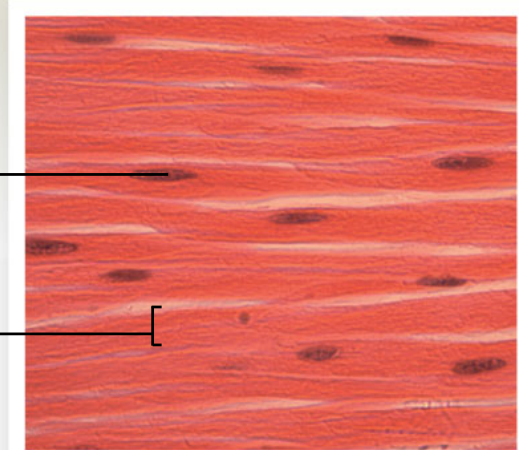
**FUNCTIONS:** Moves food, urine, and reproductive tract secretions; controls diameter of respiratory passageways; regulates diameter of blood vessels



**c Smooth muscle**

Nucleus

Smooth muscle cell



LM × 235

## 4-9 Neural Tissue

- Neural Tissue
  - Also called *nervous* or *nerve tissue*
    - Specialized for conducting electrical impulses
    - Rapidly senses internal or external environment
    - Processes information and controls responses
  - Neural tissue is concentrated in the central nervous system
    - Brain
    - Spinal cord

## 4-9 Neural Tissue

- Two Types of Neural Cells

- 1. Neurons**

- Nerve cells
    - Perform electrical communication

- 2. Neuroglia**

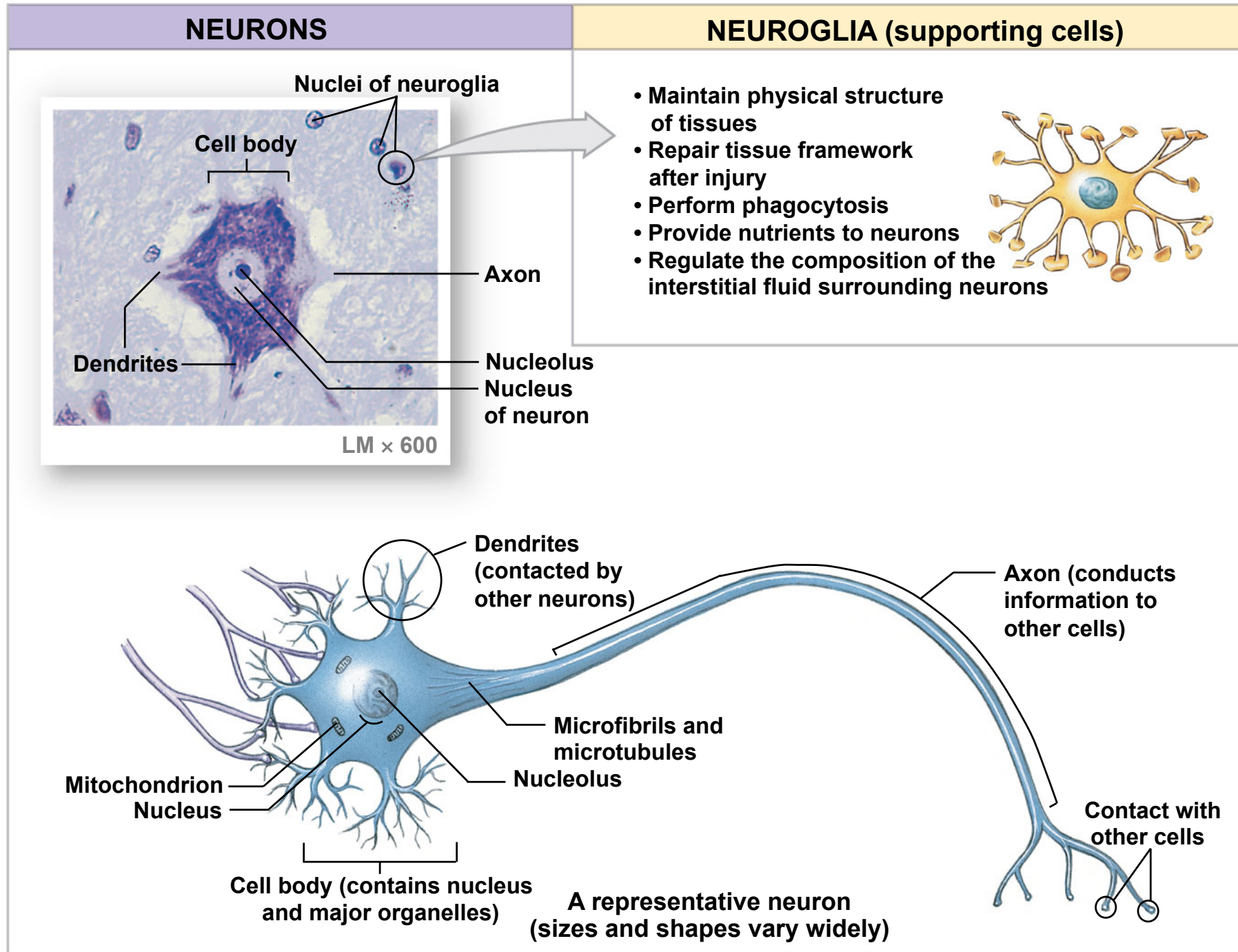
- Supporting cells
    - Repair and supply nutrients to neurons

## 4-9 Neural Tissue

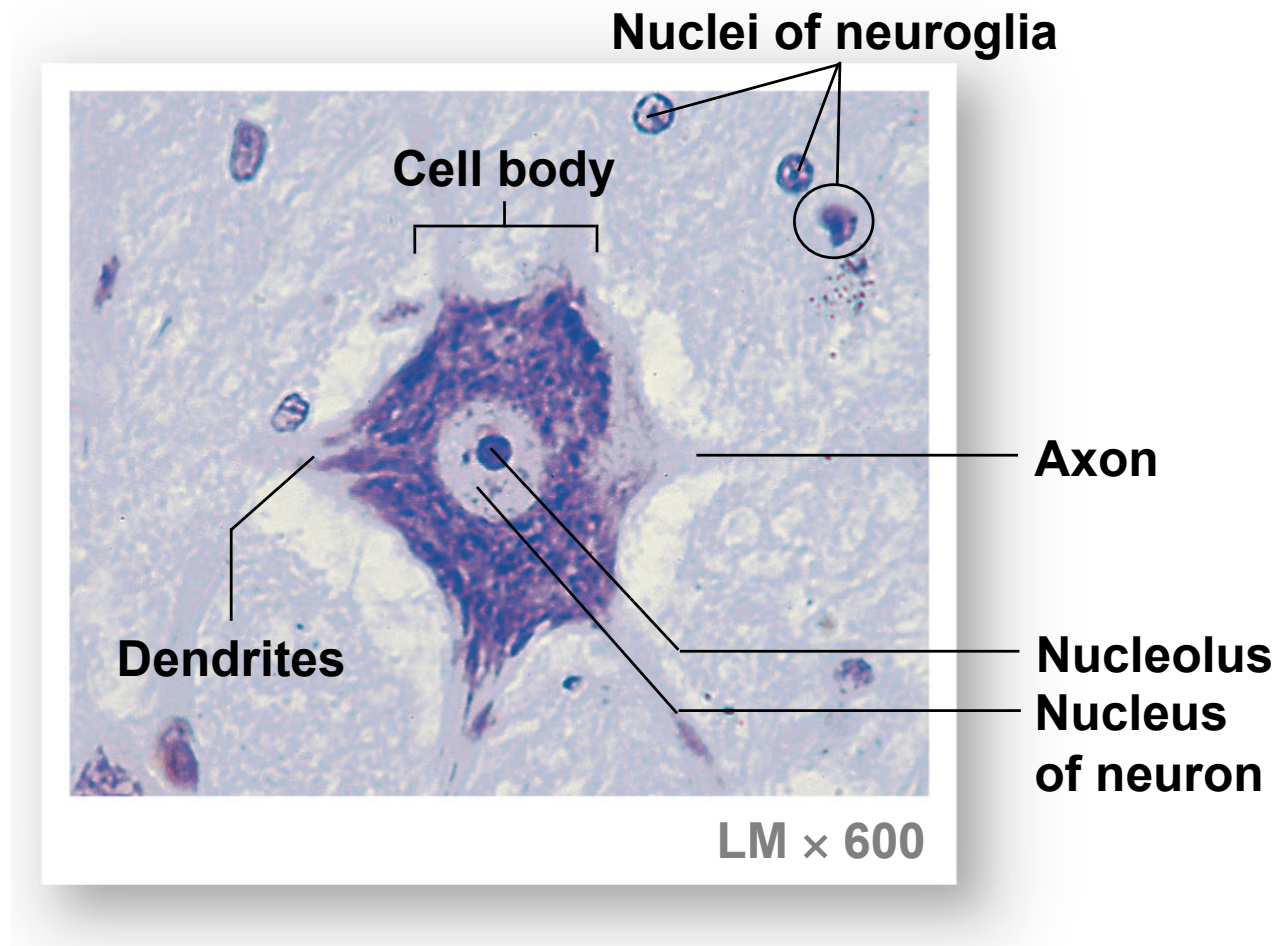
- Cell Parts of a Neuron
  - **Cell body**
    - Contains the nucleus and nucleolus
  - **Dendrites**
    - Short branches extending from the cell body
    - Receive incoming signals
  - **Axon (nerve fiber)**
    - Long, thin extension of the cell body
    - Carries outgoing electrical signals to their destination



Figure 4-19 Neural Tissue

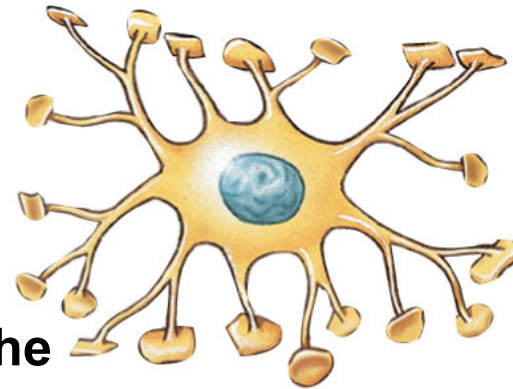


**Figure 4-19 Neural Tissue**

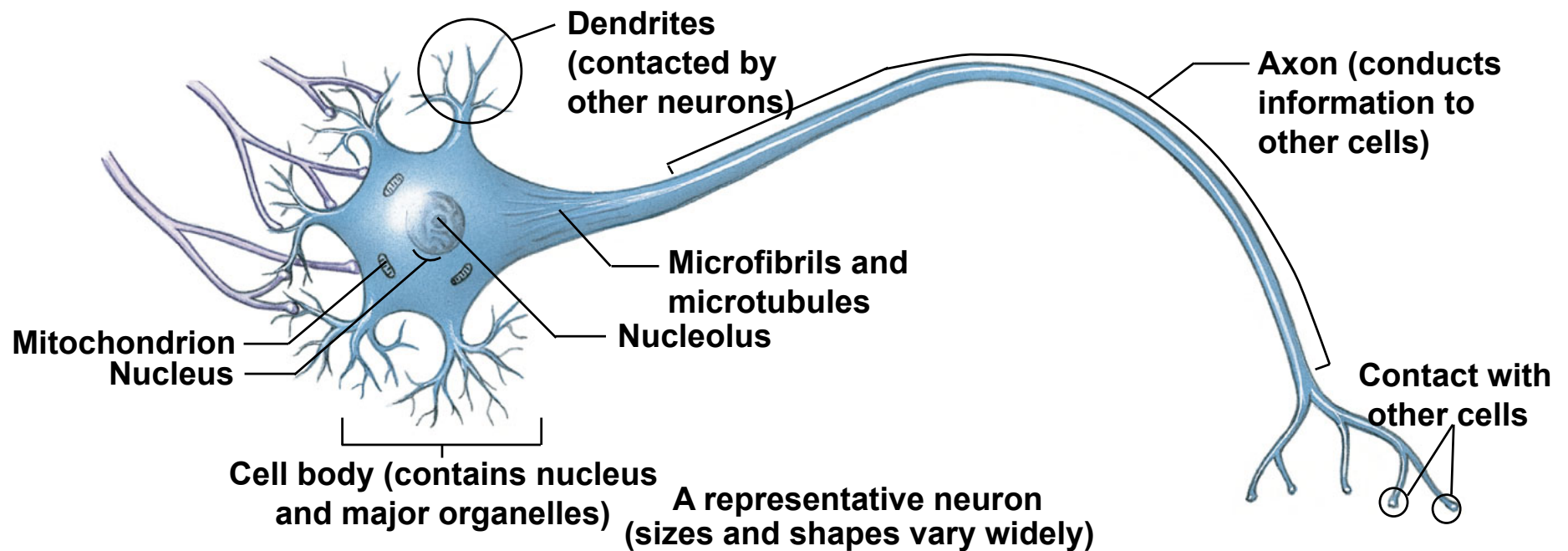


## NEUROGLIA (supporting cells)

- **Maintain physical structure of tissues**
- **Repair tissue framework after injury**
- **Perform phagocytosis**
- **Provide nutrients to neurons**
- **Regulate the composition of the interstitial fluid surrounding neurons**



**Figure 4-19 Neural Tissue**



## 4-10 Tissue Injuries and Repair

- Tissues Respond to Injuries
  - To maintain homeostasis
    - Cells restore homeostasis with two processes
      - 1. Inflammation**
      - 2. Regeneration**

## 4-10 Tissue Injuries and Repair

- Inflammation = Inflammatory Response
  - The tissue's first response to injury
- Signs and symptoms of the inflammatory response include:
  - Swelling
  - Redness
  - Heat
  - Pain

## 4-10 Tissue Injuries and Repair

- Inflammatory Response
  - Can be triggered by:
    - Trauma (physical injury)
    - Infection (the presence of harmful pathogens)

## 4-10 Tissue Injuries and Repair

- The Process of Inflammation
  - Damaged cells release chemical signals into the surrounding interstitial fluid
    - **Prostaglandins**
    - **Proteins**
    - **Potassium ions**



## 4-10 Tissue Injuries and Repair

- The Process of Inflammation
  - As cells break down:
    - Lysosomes release enzymes that destroy the injured cell and attack surrounding tissues
    - Tissue destruction is called **necrosis**

## 4-10 Tissue Injuries and Repair

- The Process of Inflammation
  - Necrotic tissues and cellular debris (**pus**) accumulate in the wound
    - Abscess – pus trapped in an enclosed area
  - Injury stimulates mast cells to release:
    - **Histamine**
    - **Heparin**
    - **Prostaglandins**

## 4-10 Tissue Injuries and Repair

- The Process of Inflammation
  - Dilation of blood vessels
    - Increases blood circulation in the area
    - Causes warmth and redness
    - Brings more nutrients and oxygen to the area
    - Removes wastes

## 4-10 Tissue Injuries and Repair

- The Process of Inflammation
  - Plasma diffuses into the area
    - Causes swelling and pain
  - Phagocytic white blood cells
    - Clean up the area

# 4-10 Tissue Injuries and Repair

- **Regeneration**

- When the injury or infection is cleaned up
  - Healing (regeneration) begins

- **The Process of Regeneration**

- Fibrocytes move into necrotic area
  - Lay down collagen fibers
  - To bind the area together (scar tissue)

## 4-10 Tissue Injuries and Repair

- The Process of Regeneration
  - New cells migrate into area
    - Or are produced by mesenchymal stem cells
  - Not all tissues can regenerate
    - Epithelia and connective tissues regenerate well
    - Cardiac cells and neurons do not regenerate (or regenerate poorly)

**Figure 4-20 Tissue Repair**

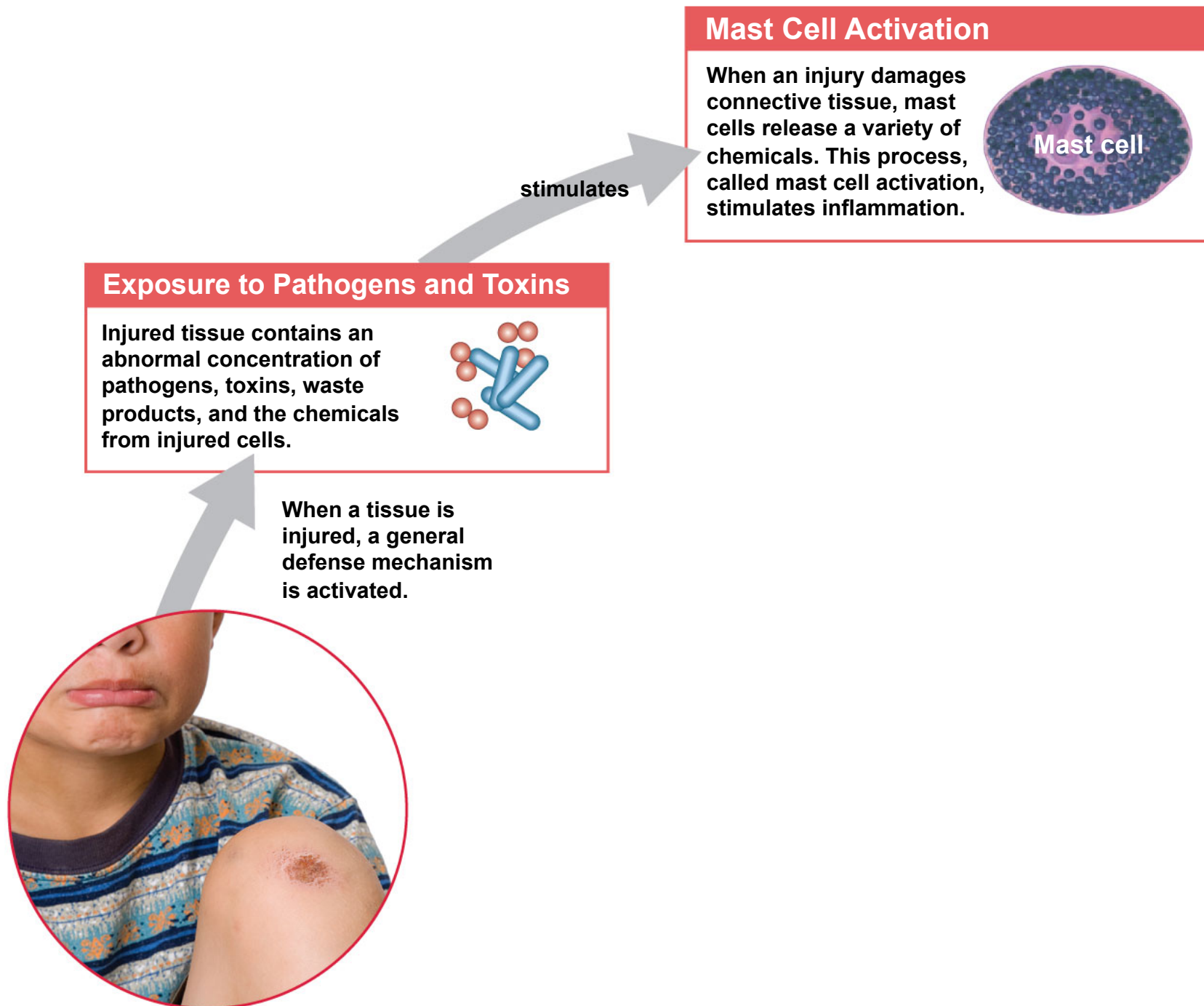


Figure 4-20 Tissue Repair

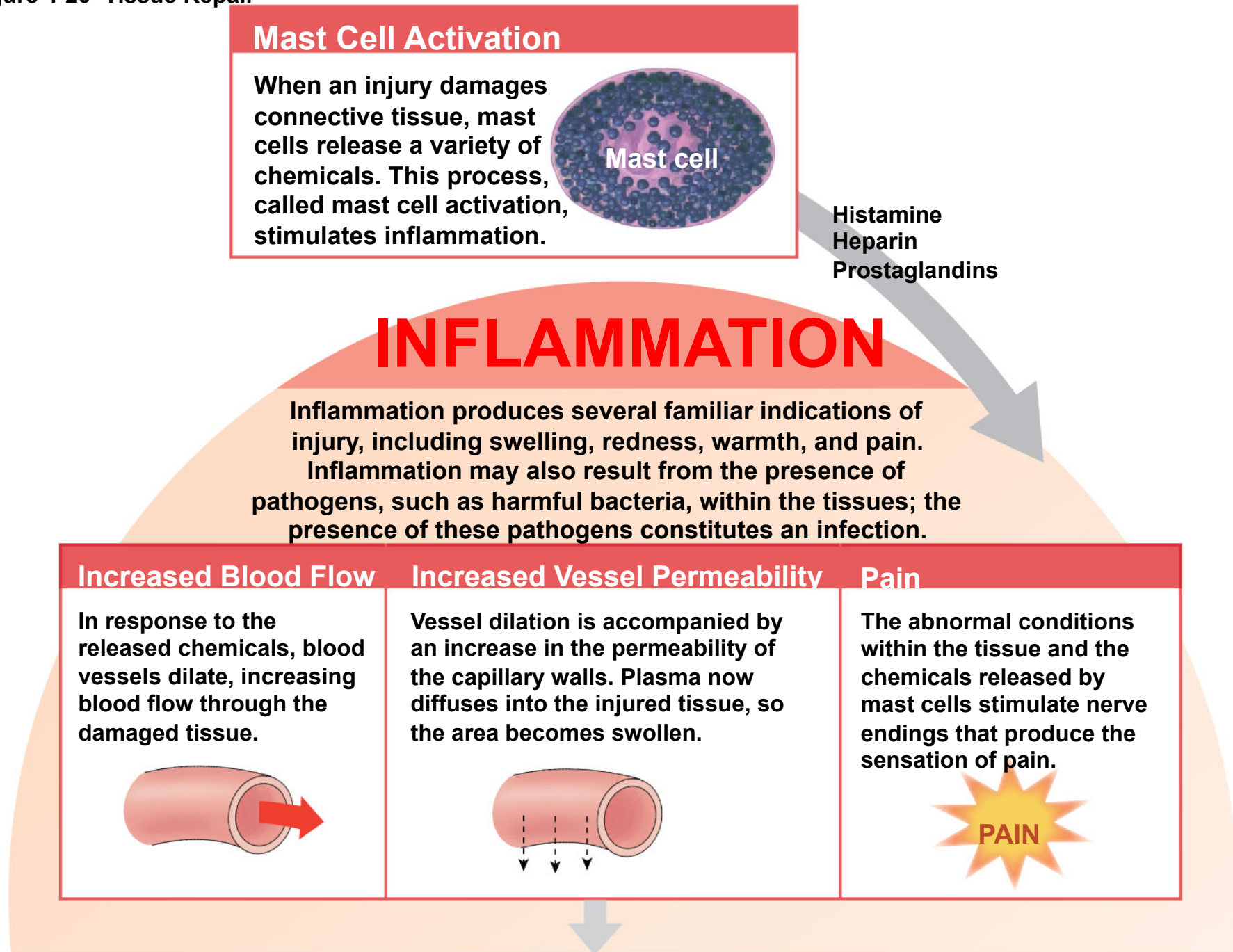
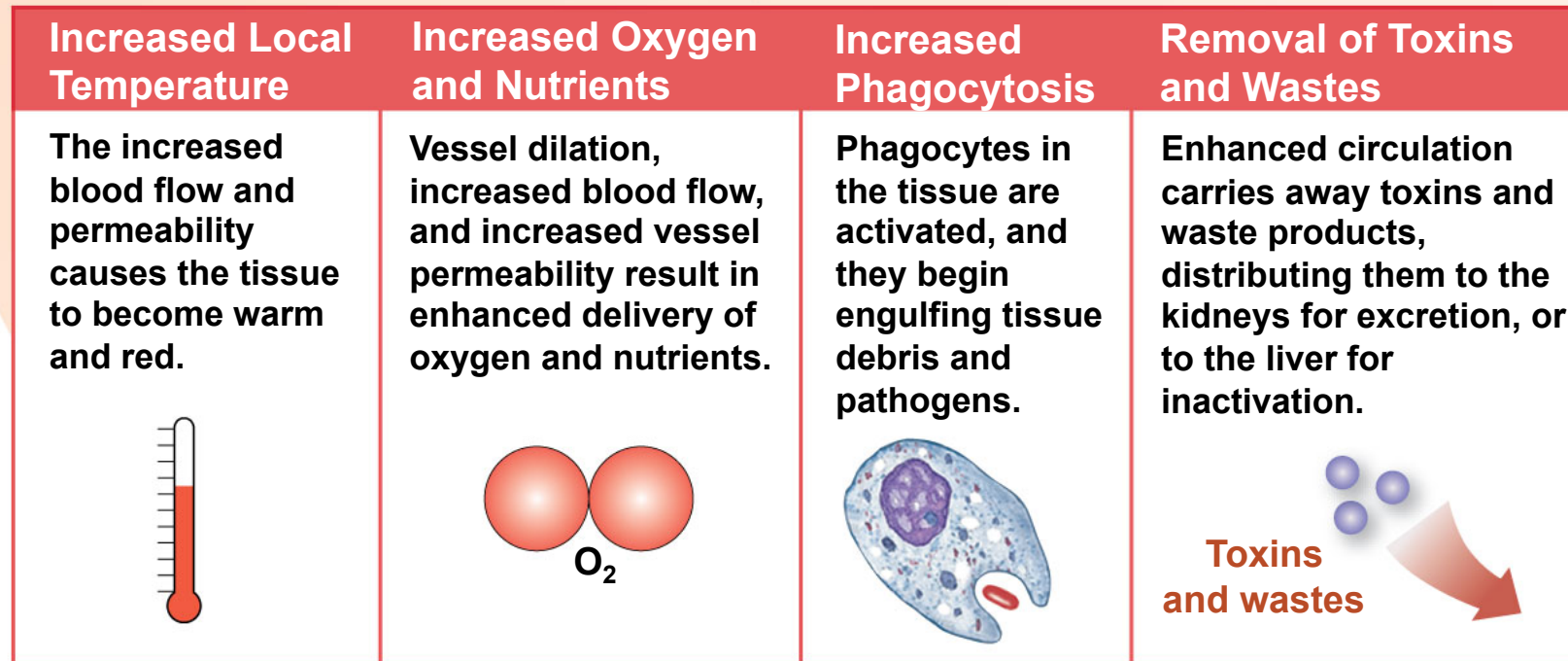




Figure 4-20 Tissue Repair



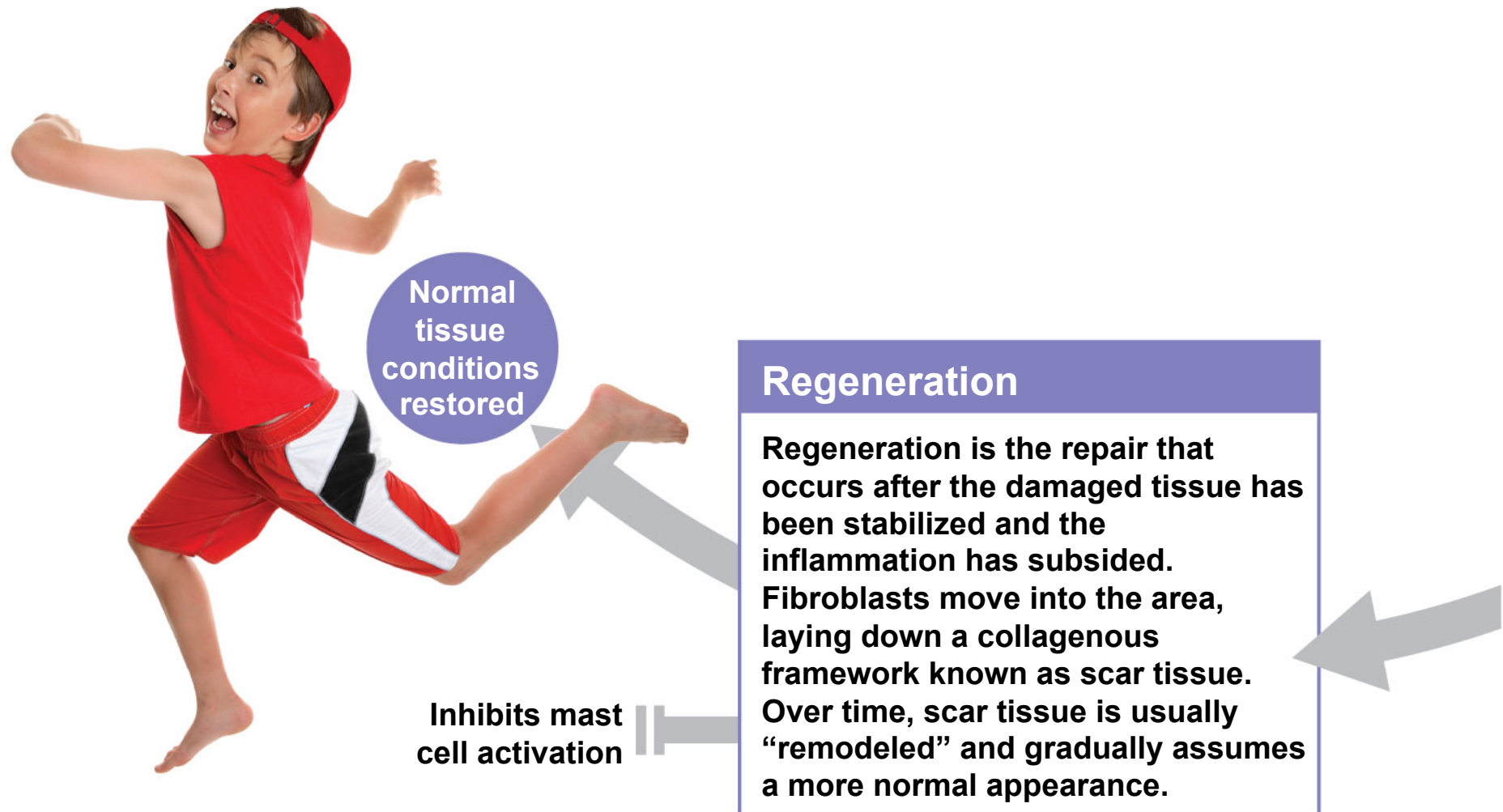
## Regeneration

Regeneration is the repair that occurs after the damaged tissue has been stabilized and the inflammation has subsided. Fibroblasts move into the area, laying down a collagenous framework known as scar tissue. Over time, scar tissue is usually “remodeled” and gradually assumes a more normal appearance.

## Inflammation Subsides

Over a period of hours to days, the cleanup process generally succeeds in eliminating the inflammatory stimuli.

**Figure 4-20 Tissue Repair**



## 4-11 Aging and Tissue

- Aging and Tissue Structure
  - Speed and efficiency of tissue repair decrease with age, due to:
    - Slower rate of energy consumption (metabolism)
    - Hormonal alterations
    - Reduced physical activity

## 4-11 Aging and Tissue

- Effects of Aging
  - Chemical and structural tissue changes
    - Thinning epithelia and connective tissues
    - Increased bruising and bone brittleness
    - Joint pain and broken bones
    - Cardiovascular disease
    - Mental deterioration

## 4-11 Aging and Tissue

- Aging and Cancer Incidence
  - Cancer rates increase with age
    - 25% of all people in the United States develop cancer
    - Cancer is the #2 cause of death in the United States
    - Environmental chemicals and cigarette smoke cause cancer

# An Introduction to Tissues

- Learning Outcomes
  - **4-1** Identify the four major types of tissues in the body and describe their roles.
  - **4-2** Discuss the types and functions of epithelial tissue.
  - **4-3** Describe the relationship between form and function for each type of epithelium.

# An Introduction to Tissues

- Learning Outcomes
  - **4-4** Compare the structures and functions of the various types of connective tissues.
  - **4-5** Describe how cartilage and bone function as a supporting connective tissue.
  - **4-6** Explain how epithelial and connective tissues combine to form four types of tissue membranes, and specify the functions of each.
  - **4-7** Describe how connective tissue establishes the framework of the body.

# An Introduction to Tissues

- Learning Outcomes
  - **4-8** Describe the three types of muscle tissue and the special structural features of each type.
  - **4-9** Discuss the basic structure and role of neural tissue
  - **4-10** Describe how injuries affect the tissues of the body.
  - **4-11** Describe how aging affects the tissues of the body.