Honors Anatomy Sept 8 ,2015

- SAP 1c: EXPLAIN THE ROLE OF HOMEOSTASIS AND ITS MECHANISMS AS THEY RELATE TO THE BODY AS A WHOLE
- WARM UP:

1. What are the 3 parts of the homeostatic control system?
2. What is the term for the dynamic equilibrium of the body?

- CLASSWORK: Tissue notes; Tissues Flashcards pg 91
- CLOSING: Picture Perfect

Body Tissues

- Tissues--groups of closely associated cells with similar structure and function
- Four primary tissue types
  1. Epithelial—protection
  2. Connective—support
  3. Nervous tissue—control
  4. Muscle—movement

Most organs contain several tissue types and the arrangement of tissues determines the structure and function of the organ.

1. Epithelial Tissue (epithelium)

- Found in different areas
  1. Body coverings & linings
  2. Glandular tissue
- Functions
  3. Protection
  4. Absorption
  5. Filtration
  6. Secretion

Areas where epithelium is found …

1. Covering & lining epithelium
   - Found on free surfaces of body such as outer layer of skin, dipping into and lining the open cavities of the digestive and respiratory systems, lines blood vessels and heart, and covers walls and organs of closed ventral cavity
   - Nearly all substances received or given off by the body must pass thru the epithelium

2. Glandular epithelium
   - Fashions (forms) the glands of the body

4 functions of the epithelium

1. **protection**—skin (protects mechanical/ chemical/ bacterial)
2. **Absorption**—digestive tract
3. **Filtration**—kidneys (also do protection and absorption)
4. **Secretion**—specialty of glands

excretion, sensory reception (other functions, but not primary functions)

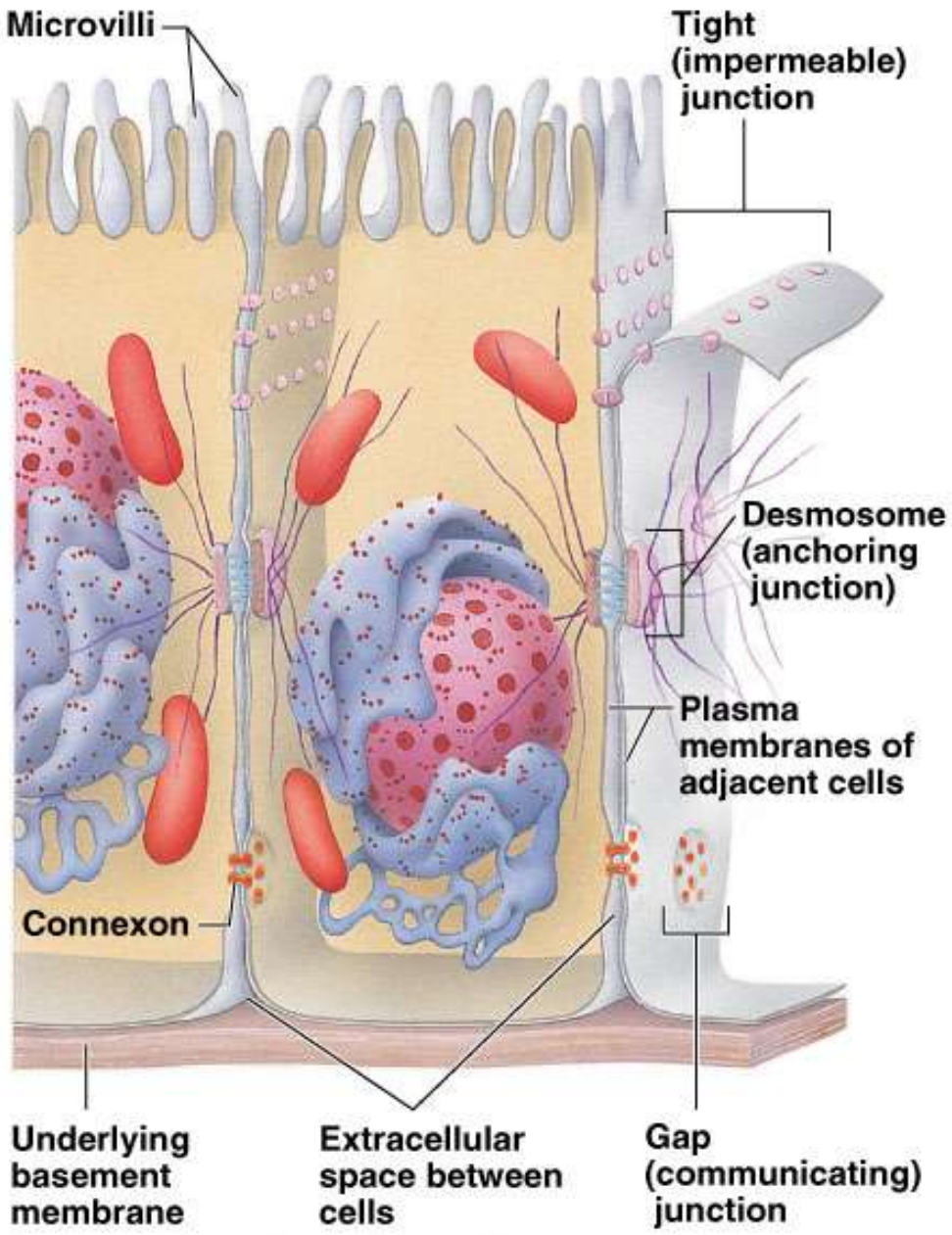
Epithelium Characteristics

1. Cellularity—
   - Composed almost entirely of cells
   - Epithelial cells fit closely together (in contrast, muscle & connective tissue cells are often widely separated)

Epithelium Characteristics cont.

2. Specialized contacts—form continuous sheet bound to adjacent cells by lateral contacts

   - **Tight junctions—when adjacent plasma membranes fuse together like a zipper**
   - **Desmosomes—anchoring junctions that prevent cells subjected to mechanical stress from being pulled apart**
   - **Gap junctions—allow communication b/w cells**


Microvilli
Tight (impermeable) junction
Desmosome (anchoring junction)
Plasma membranes of adjacent cells
Connexon
Underlying basement membrane
Extracellular space between cells
Gap (communicating) junction

Epithelium Characteristics cont.

3. Polarity—

- always has one free (apical) surface
- Some surfaces contain extensions
  - **microvilli—fingerlike extensions of the plasma membrane; increase surface area & are common in tissues that absorb & secrete substances (intestine & kidney)**
  - **cilia—hairlike projections commonly found in lining of trachea (& other internal tracts); propel substances along the epithelial surface**

Epithelium Characteristics cont.

4. **Avascularity (have no blood supply)**

Epithelium Characteristics cont.

5. Basement membrane—epithelial rest on thin supporting basal lamina which separates it from connective tissue

   - Basal lamina (epithelial)—nonliving, adhesive material formed by glycoproteins
   - Reticular lamina (connective)—extracellular material made up of fine collagenous or reticular fibers

   *these 2 lamina form the basement membrane

Epithelium Characteristics cont.

6. Regeneration
   - High capacity to regenerate
   - As long as the cells receive adequate nutrition, they can replace lost cells rapidly by cell division

Classification of Epithelium

- All epithelial cells are irregularly polyhedral (many-sided) in cross section, but differ in cell height.
- By height, there are 3 common shapes
  - Squamous – flattened & scalelike
  - Cuboidal – cube-shaped (as tall as they are wide)
  - Columnar – column-like (tall & column shaped)

In each, the shape of the nucleus conforms to that of the cell. Thus, nuclear shape can be very helpful when attempting to distinguish epithelial types

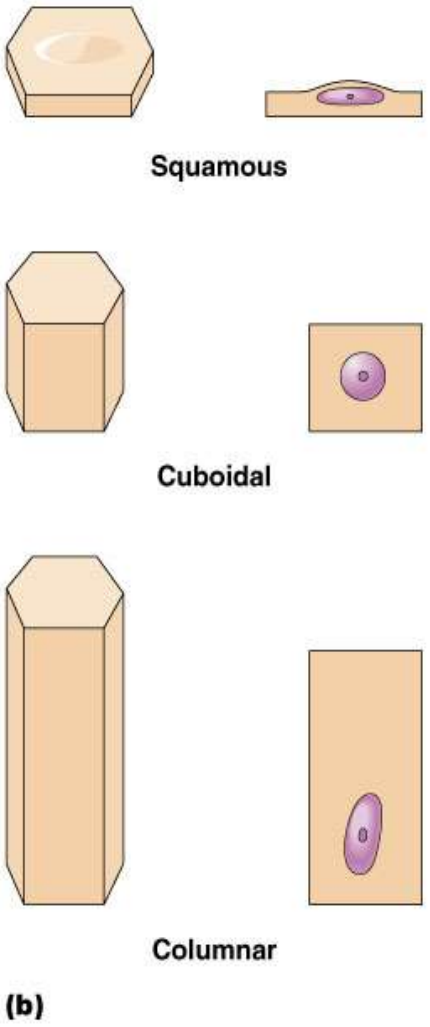


Figure 3.16b

Classification of Epithelium

- Cell arrangement (# of cell layers)
- 2 major types of epithelium
  1. Simple – one layer; typically found where absorption & filtration occur
  2. Stratified – more than one layer stacked on top of the other; typically found in high abrasion areas where protection is important (skin surface & lining of mouth)

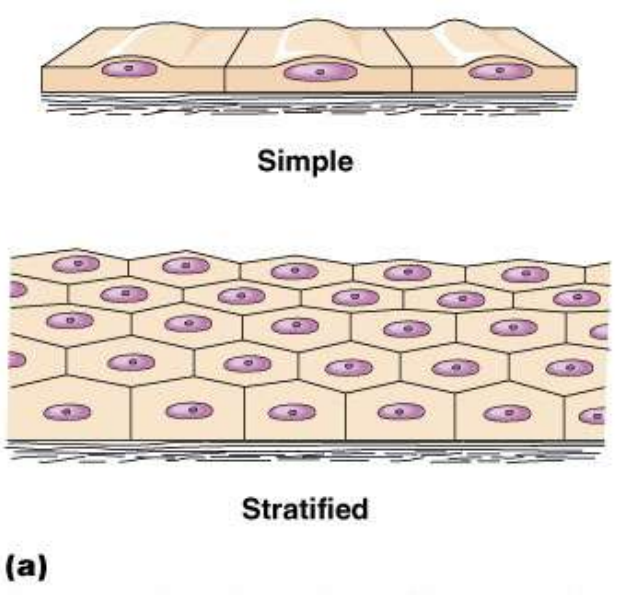
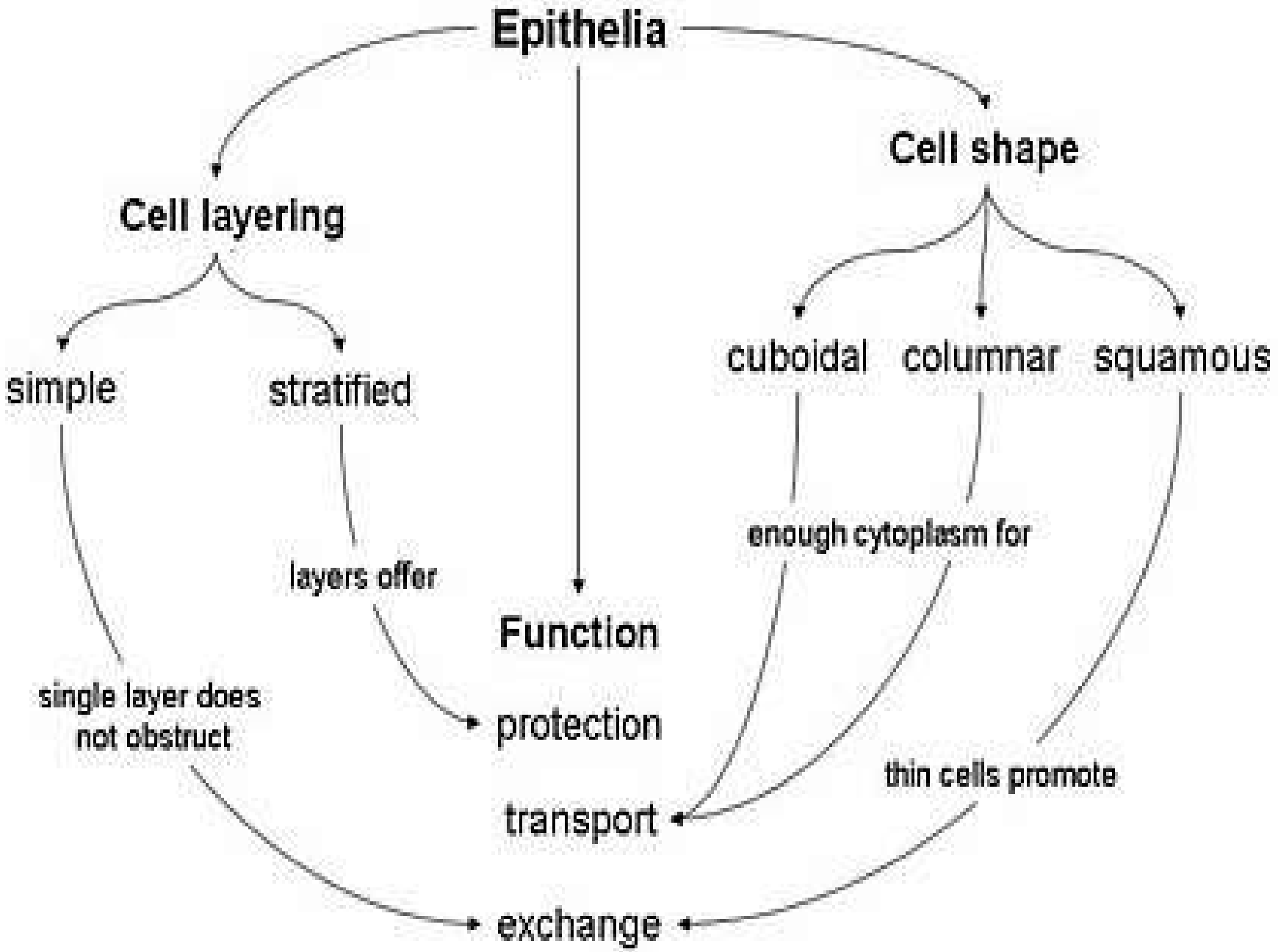
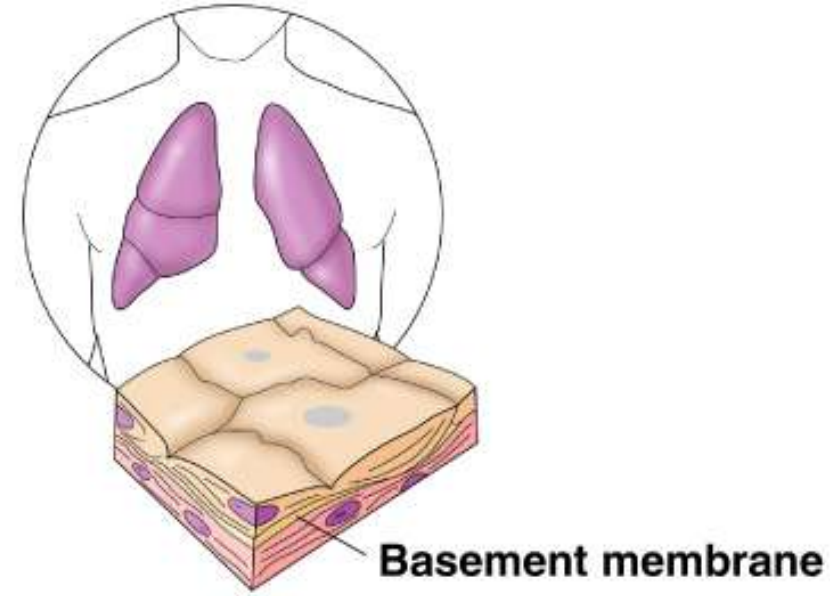


Figure 3.16a


Epithelia
Cell layering
Cell shape
simple
stratified
cuboidal
columnar
squamous
layers offer
enough cytoplasm for
Function
single layer does not obstruct
protection
transport
thin cells promote
exchange

Simple Epithelium

- Simple squamous
  - Single layer of flat cells
  - Usually forms membranes
    - Lines body cavities
    - Lines lungs and capillaries



(a) Simple squamous

Figure 3.17a

Simple Epithelium

- Simple cuboidal
  - Single layer of cube-like cells
  - Common in glands and their ducts
  - Forms walls of kidney tubules
  - Covers the ovaries

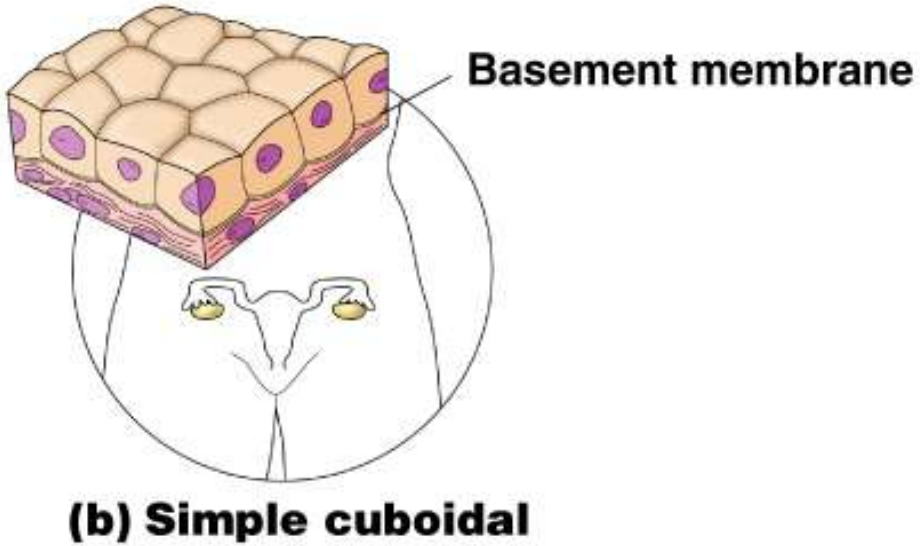


Figure 3.17b

Simple Epithelium

- Simple columnar
  - Single layer of tall cells
  - Often includes goblet cells, which produce mucous
  - Lines digestive tract

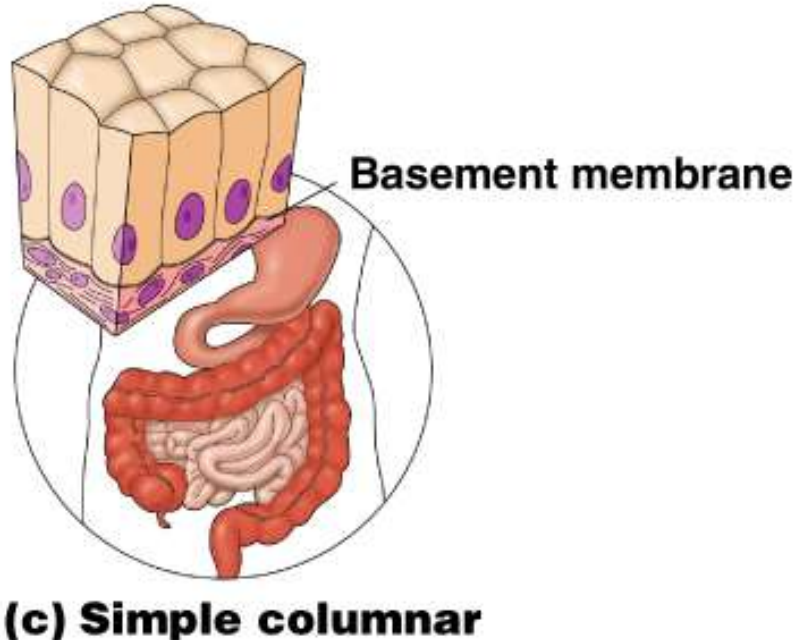


Figure 3.17c

Simple Epithelium

- Pseudostratified
  - Single layer, but some cells are shorter than others
  - Often looks like a double cell layer
  - Sometimes ciliated, such as in the respiratory tract
  - May function in absorption or secretion

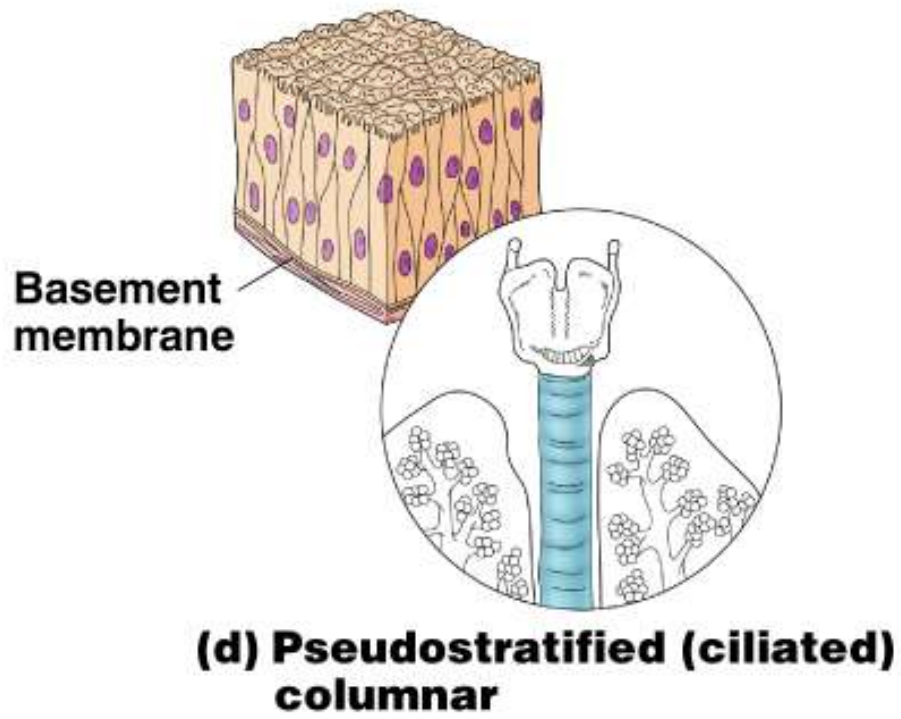


Figure 3.17d

Stratified Epithelium

- Stratified squamous
  - Cells at the free edge are flattened
  - Found as a protective covering where friction is common
  - Locations
    - Skin
    - Mouth
    - Esophagus

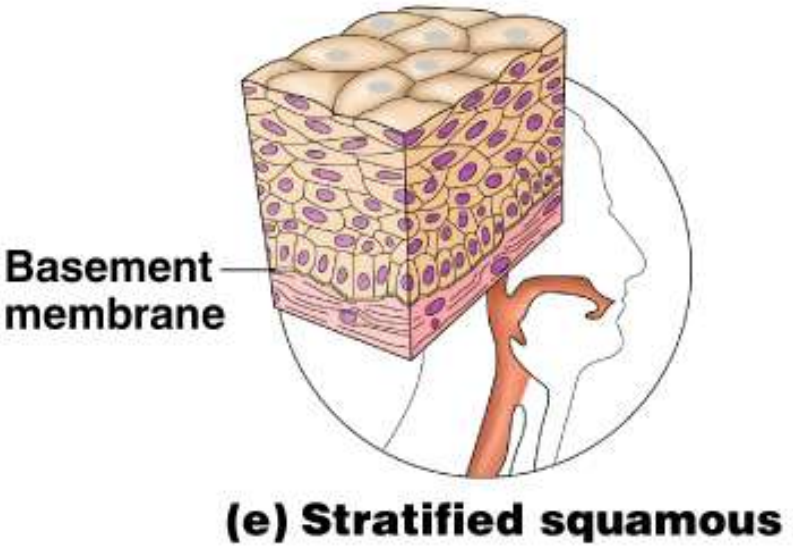


Figure 3.17e

Stratified Epithelium

- Stratified cuboidal
  - Two layers of cuboidal cells
- Stratified columnar
  - Surface cells are columnar, cells underneath vary in size and shape
- Both:
  - Rare in human body
  - Found mainly in ducts of large glands—function in protection

Stratified Epithelium

- Transitional epithelium
  - Shape of cells depends upon the amount of stretching
  - Lines organs of the urinary system

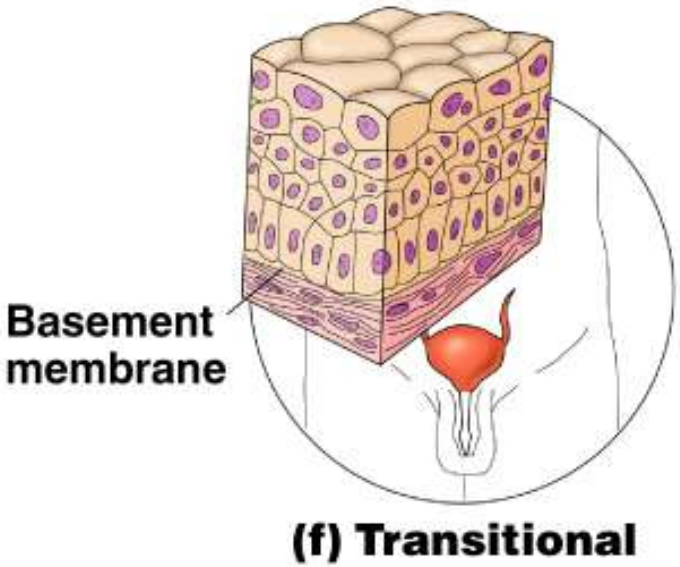


Figure 3.17f

Honors Anatomy Sept 9 ,2015

- SAP 1c: EXPLAIN THE ROLE OF HOMEOSTASIS AND ITS MECHANISMS AS THEY RELATE TO THE BODY AS A WHOLE
- WARM UP:

1. What are the 4 functions of epithelial tissue?
2. What are the 6 characteristics of epithelial tissue?

- CLASSWORK: Tissue notes; Tissues Worksheet
- CLOSING: Pictionary

3 types of Epithelial membranes

1. Mucous membranes (mucosae)
   - line body cavities **that are open to the exterior** (digestive, respiratory, & urogenital tracts)
   - “wet,” or moist, membranes; secretions

3 types of Epithelial membrane

2. Cutaneous membrane
   - SKIN
   - **keratinized** stratified squamous epithelium (**epidermis**) firmly attached to a thick connective tissue layer (**dermis**)
   - Uniquely different b/c it is exposed to air and is **a dry membrane**

3 types of Epithelial membrane

3. Serous membrane (serosae)
   - line the body cavities **that are not open to the exterior**
   - each serosa consists of **parietal** and **visceral** layers
   - Serosae are named according to **site** & **specific organ** association
     - Ex. Pleura—lining of thoracic wall & covering the lungs
       Pericardium—encloses the heart
       Peritoneum—abdominopelvic cavity

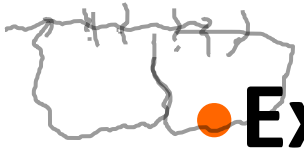
Glandular Epithelium

- Gland – one or more cells that produce & secrete an aqueous (water-based) fluid that typically contains proteins.
- Glands are classified as:
  - endocrine OR exocrine;

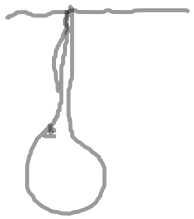
  and as

  unicellular OR multicellular

- **Endocrine gland**
  - Ductless
  - Secretions are hormones (regulatory chemicals)



- **Exocrine gland**



  - Empty through ducts to the epithelial surface
  - Include sweat and oil glands, salivary glands, liver, pancreas, mammary glands, mucous glands, etc.

- **Unicellular exocrine glands**
  - Ductless glands that produce **mucin**, a slimy coating (mucous) that protects and lubricates surfaces
  - Include the **goblet cells** of intestine and **respiratory mucosae**

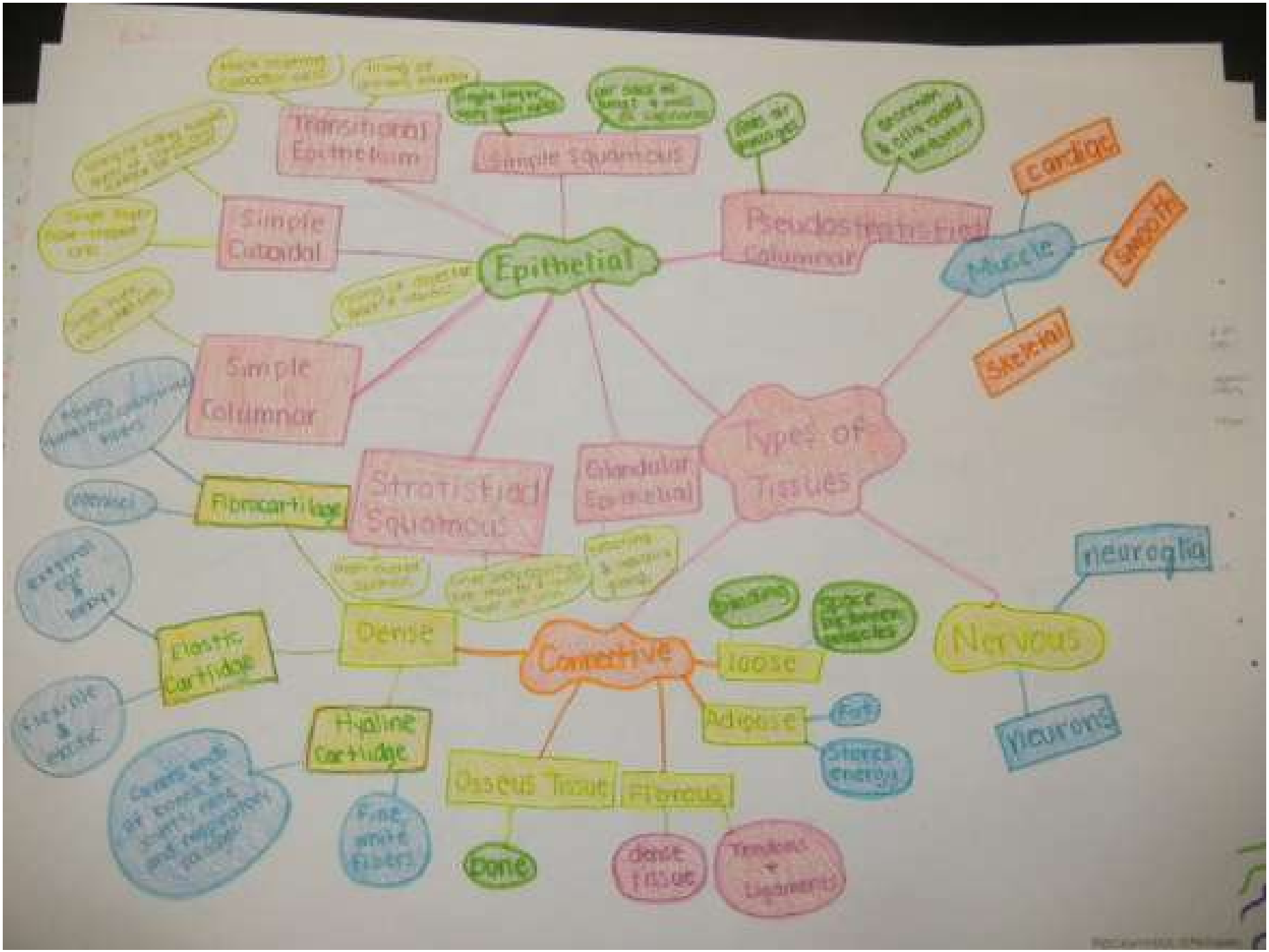
- **Multicellular exocrine glands**

1.Merocrine glands—secrete products by exocytosis (pancreas, sweat glands, salivary glands)

2.Holocrine glands—entire secretory cell ruptures, releasing secretions & dead cell fragments (sebaceous (oil) glands)

3.Apocrine glands—a less numerous type of sweat gland

http://www.lab.anhb.uwa.edu.au/mb140/CorePages/Epithelia/Epithel.htm#Secretory


Types of Tissues
Epithelial
Transitional Epithelium
Simple Squamous
Pseudostratified Columnar
Simple Cuboidal
Simple Columnar
Stratified Squamous
Glandular Epithelial
Muscle
Cardiac
Smooth
Skeletal
Fibrocartilage
Elastic Cartilage
Hyaline Cartilage
Dense
Connective
Loose
Adipose
Osseus Tissue
Fibrous
Bone
Nervous
neuroglia
Neurons


Types of Tissues
muscles
Skeletal muscles
voluntary
Skeletal
Pumps blood
Cardiac
wall of Heart
Involuntary
smooth
Stomach
connective
loose C.T
binds skin to organs throughout body
Space between muscles
Adipose tissue
fat
beneath skin
bones + joints
very fine, white fibers
Hyaline cartilage
Dense C.T
very thick + elastic
Elastic cartilage
external ear + larynx
Fibrocartilage
Very tough
intervertebral disks
dense tissue
Fibrous C.T
tendons + ligaments
connects muscles to bones
connects bones to bones
epithelial
bladder
Barrier
Transitional
Glandular
Exocrine
Endocrine
Simple
Columnar
Squamous
Flat
lungs
Cuboidal
Cube
OVARIES
Columns
Digestive Tract
Stratified
Pseudo
Trachea
Secretion
Cube
Squamous
mouth
Columnar
columns
Pharynx
Cuboidal
Pancreas
nervous
neurons
found in brain
Impulse Signals
neuroglia
protection
support

2. Connective Tissue

(2nd primary tissue type)

- Found everywhere in the body; but the amount varies greatly
- Includes the most abundant and widely distributed tissues

Connective Tissue cont.

- Main subgroups/types
  1. Connective tissue proper (dense & loose)
  2. Cartilage
  3. Bone
  4. Blood

Connective Tissue cont.

- Major functions are
  1. Binding—connective tissue
  2. Support—bone & cartilage
  3. Protection—bone, cartilage, & fat
  4. Insulation—fat
  5. Transportation—blood

3 Connective Tissue Characteristics

1. Common origin
   - all connective tissue forms from mesenchyme (embryonic tissue derived from the mesoderm germ layer)
2. Degrees of Vascularity
   - Cartilage is avascular
   - Dense connective tissue is poorly vascularized
   - Other types—rich blood supply

3 Connective Tissue Characteristics

3. Matrix
   - What is matrix?
     - Nonliving substance that surrounds living cells; typically includes ground substance (fluid to hard) & fibers (collagen, elastic, or reticular)
   - Why is matrix important?
     - Matrix is what enables connective tissue to bear weight, withstand great tension, & endure abuses such as physical trauma or abrasion

3 Structural Elements of Connective Tissue

- 3 main components of connective tissue

matrix

1. Ground substance
2. Fibers

3. Cells

3 Structural Elements of Connective Tissue

1. Ground Substance *(found in matrix)*

- Amorphous (unstructured) material that fills the space b/w cells and contains the fibers
- Made of interstitial fluid, glycoproteins, & glycosaminoglycans (GAGs)—GAGs coil, intertwine, & trap water forming fluid to semistiff gel.
- Functions as molecular "sieve" or medium thru which nutrients & other substances can diffuse b/w blood & cells

3 Structural Elements of Connective Tissue

2. Fibers: 3 types of fibers found in matrix

   A. Collagen

      - Extremely tough & provide high tensile strength (resist longitudinal stress)
      - Formed from protein collagen
      - Often called “white” fibers b/c of glistening white appearance

2. Fibers: 3 types of fibers found in matrix

B. Elastic

- Formed from protein elastin
- Coiled structure that allows it to stretch & recoil like a rubber band
  - Ex. Collagen fibers stretch a bit, then "lock" in full extension to limit the stretch & prevent tissue from tearing. Elastic fibers then snap the connective tissue back to its normal length when the tension lets up.
- Are found in areas where greater elasticity is needed (skin, lungs, & blood vessel walls)
- Often called "yellow" fibers due to yellow appearance

3 Structural Elements of Connective Tissue

2. Fibers: 3 types of fibers found in matrix

C. Reticular

- Fine collagen fibers
- Branch extensively, forming a netlike "reticulum" in the matrix.
- Construct a fine mesh around small blood vessels, support soft tissue of organs, and area found at junction b/w connective tissue & other tissue types.

3 Structural Elements of Connective Tissue

3. Cells

- Primary cell types are:
  1. Connective tissue proper → fibroblast
  2. Cartilage → chondroblast
  3. Bone → osteoblast
  4. Blood → hemocytoblast (always actively mitotic)
- Each cell type exists in immature & mature forms
  - These cells are actively mitotic when immature & less active when mature

"—blast" = immature cell "—cyte" = mature cell

Connective Tissue cont.

- Macrophages
  - Large, irregularly shaped cells that avidly phagocytize both foreign matter that has invaded the body & dead or dying tissue cells.
  - Also central actors in the immune system
  - Macrophages may be loose & migrate freely, or they may be fixed in matrix.
  - Ex. Histiocytes → loose connective tissue

    Kupffer cells → in the liver

    Microglial cells → brain

Connective Tissue cont.

Types of Connective Tissue

- All classes consist of living cells surrounded by a matrix
- Major differences reflect cell type, fiber type, & proportion of the matrix contributed by the fibers
  - Main subgroups/types
    1. Connective tissue proper (dense & loose)
    2. Cartilage
    3. Bone
    4. Blood

Connective Tissue cont.

Embryonic Connective Tissue

1. Mesenchyme (mesenchymal tissue)
2. Mucous connective tissue (Wharton's jelly, which supports umbilical cord)

Type: 1. Connective Tissue Proper

2 Classes—loose & dense

Loose

1. Areolar—packages organs & surrounds capillaries
2. Adipose—reserve E, insulation, support, & protection
3. Reticular—soft internal skeleton to support other cell types

Dense

4. Dense regular—attaches muscle to bone (tendons) or bone to bone (ligaments)
5. Dense irregular—provides structural strength (dermis)
6. Elastic—provides durability with stretch

Loose Connective Tissue Types

- Areolar
  - Most widely distributed connective tissue
  - Soft, pliable tissue
  - Contains all fiber types
  - Can soak up excess fluid
  - Wraps organs & holds them in position

Don't write this slide

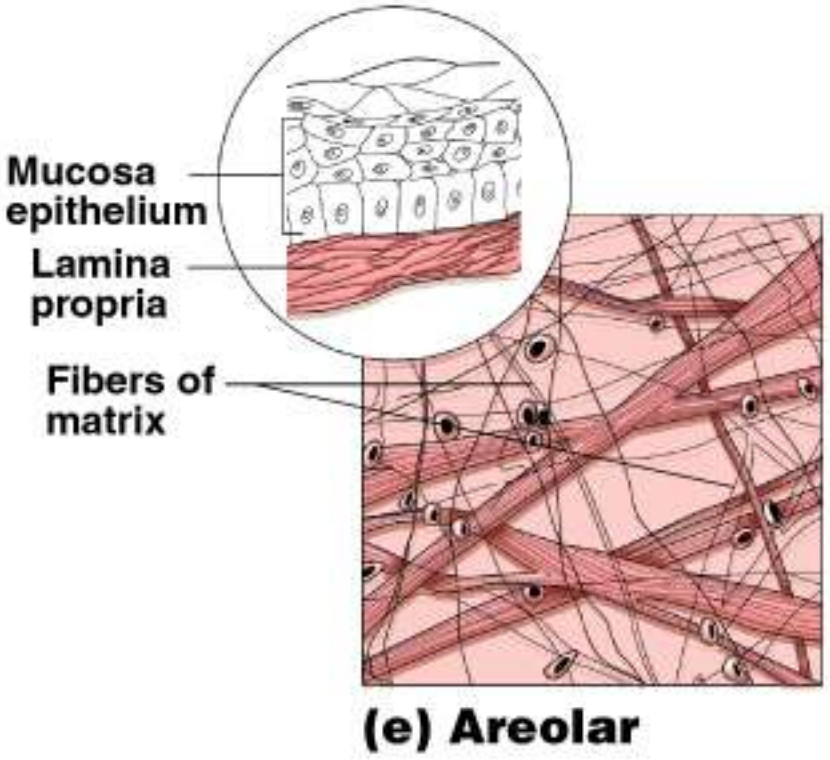


Figure 3.18e

Loose Connective Tissue Types

Don't write this slide

- Adipose
  - an areolar tissue in which fat cells predominate
  - Functions
    - Insulates the body
    - Protects some organs
    - Serves as a site of fuel storage—ex. hips and breasts serve as fat "depots"

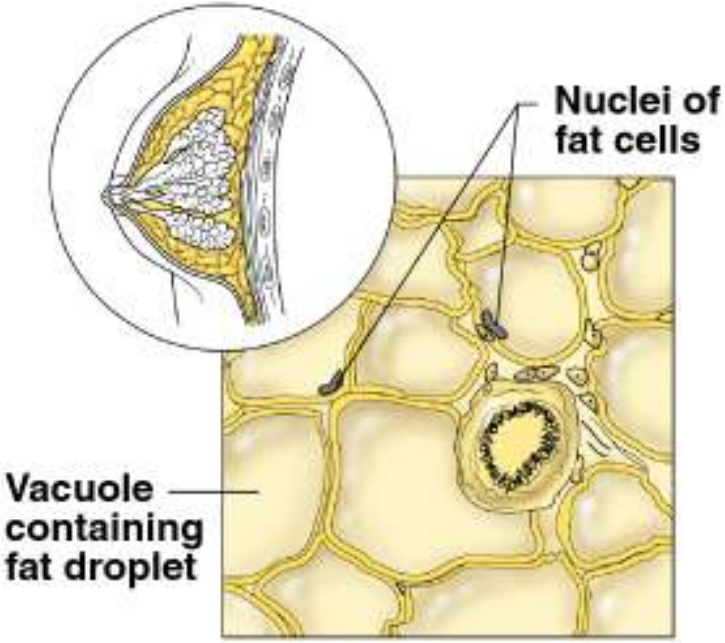


Figure 3.18f

Loose Connective Tissue Types

- Reticular connective tissue
  - Delicate network of interwoven fibers
  - Forms stroma (supporting framework) of lymphoid organs
  - Lymph nodes
    - Spleen
    - Bone marrow

Don't write this slide

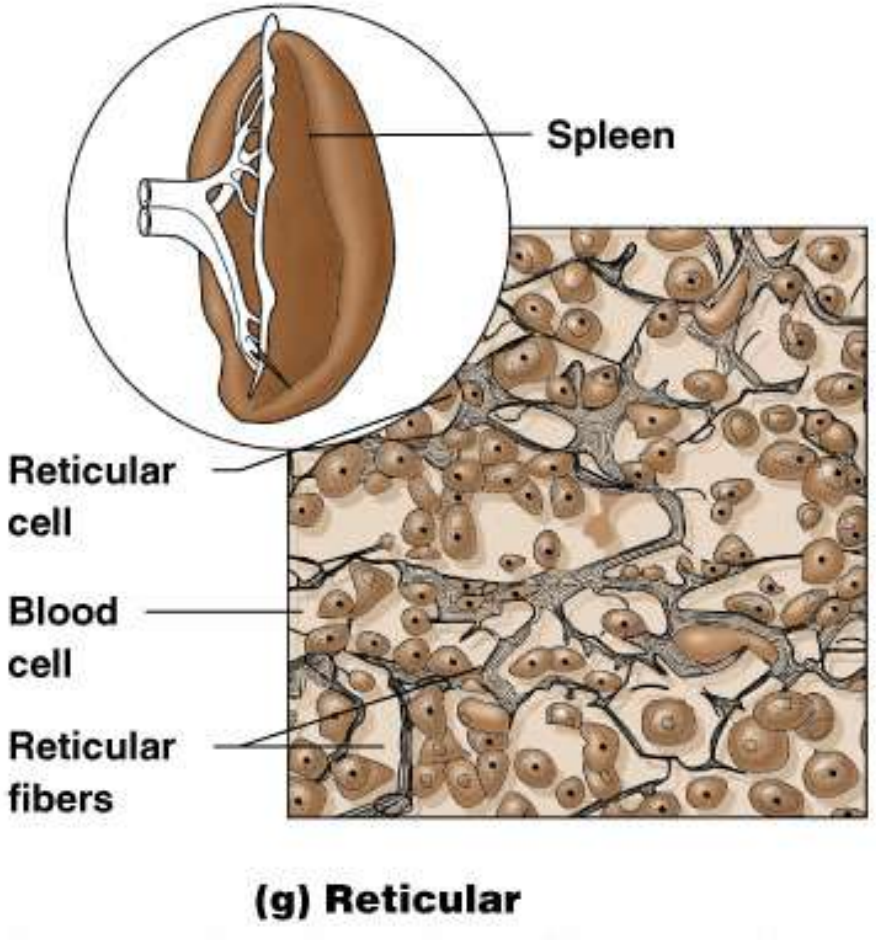


Figure 3.18g

Connective Tissue Types

Don't write this slide

- Dense connective tissue
  - Main matrix element is collagen fibers
  - Cells are fibroblasts
  - Examples
    - Tendon – attach muscle to bone
    - Ligaments – attach bone to bone

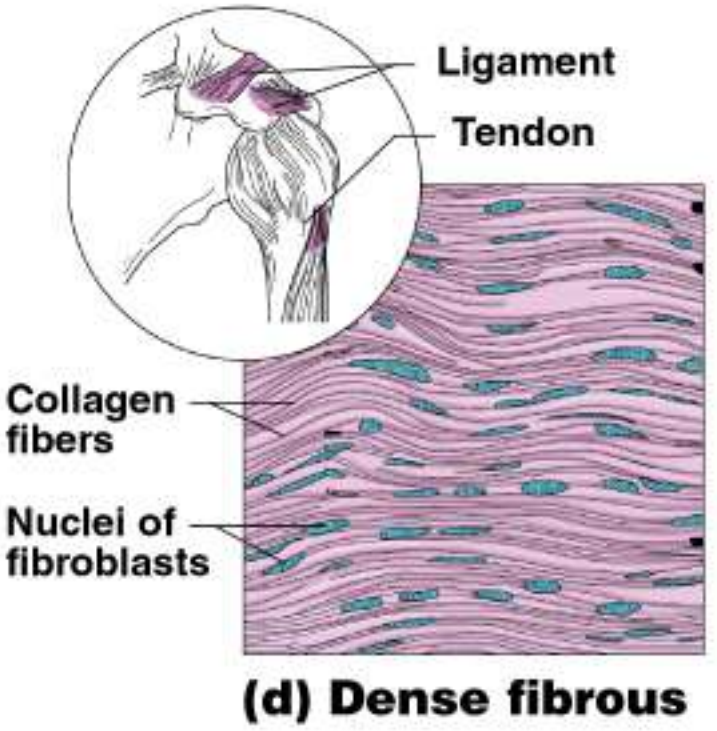


Figure 3.18d

Connective Tissue Types--
2. Cartilage

- Stands up to both tension and compression
- Tough, but flexible (charac. of dense connective tissue & bone)
- Avascular and lacks nerve fibers
- Made of almost 80% water
- Mvmt of tissue fluid w/n matrix enables cartilage to rebound after being compressed

- Chondroblasts—immature cartilage cells
- Chondrocytes—mature cartilage cells

Connective Tissue Types--

2. Cartilage

3 Varieties of Cartilage

1. Hyaline cartilage
   - Most common/abundant cartilage
   - Supports & reinforces
   - Resiliant cushioning properties
   - Resists compressive stress

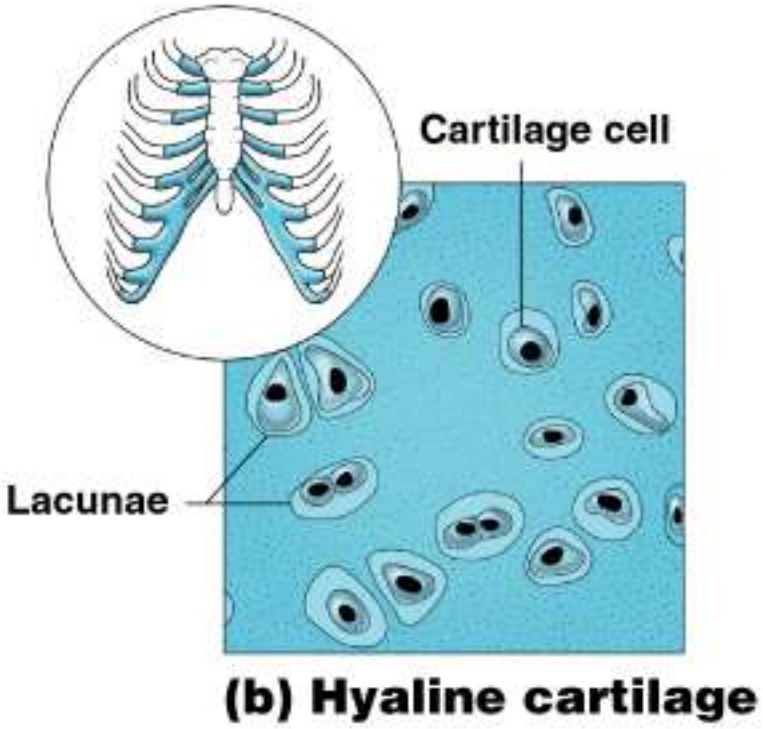


Figure 3.18b

Hyaline cartilage cont.

- Entire fetal skeleton is hyaline cartilage.
- Hyaline cartilage remains during childhood as epiphyseal plates (active growing regions near the end of long bones)
- Covers the ends of long bones as articular cartilage (helps to absorb compression at joints)

Connective Tissue Types--
3 varieties of cartilage cont.

2. Elastic cartilage
   - maintains shape of a structure while allowing great flexibility/elasticity
   - Contains more elastin fibers than hyaline cartilage does
   - Located primarily in areas were strength & exceptional stretchability are needed
   - Example: supports the external ear & found in epiglottis

Connective Tissue Types--

3 varieties of cartilage cont.

3. Fibrocartilage

- Highly compressible & resists tension
- Found where hyaline cartilage meets a true ligament or tendon; where strong support & ability to withstand heavy pressure are required
- Example: forms cushion-like discs between vertebrae & spongy cartilage of knees

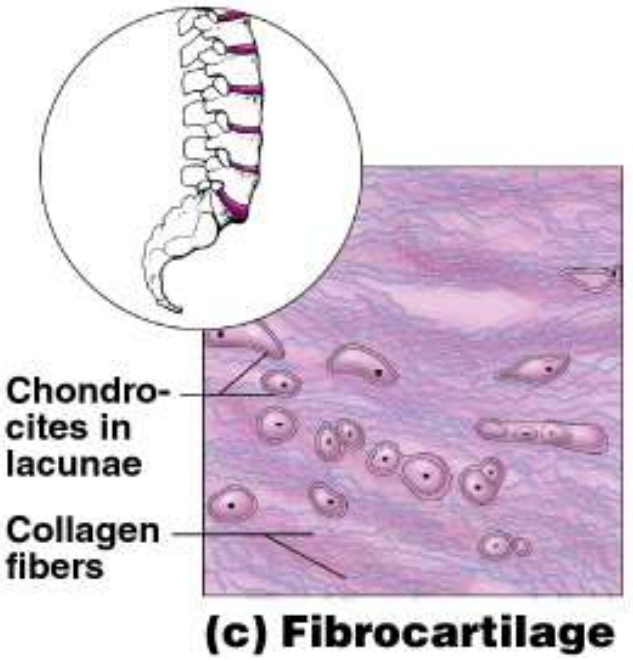


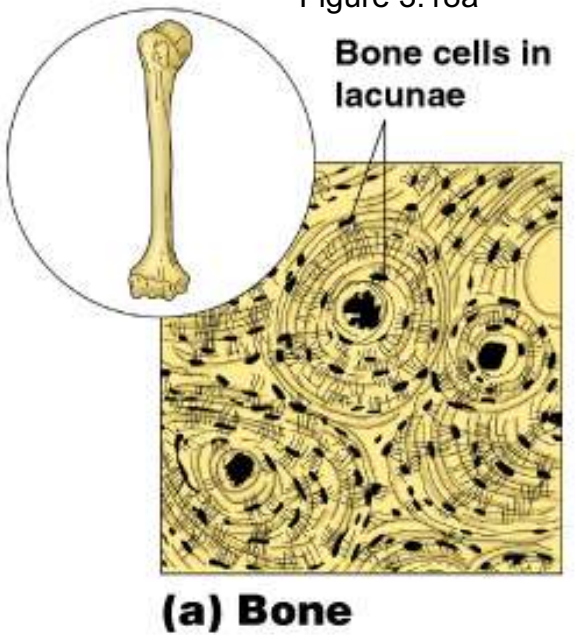
Figure 3.18c

Connective Tissue Types—

3. Bone (osseous)

- Used to protect and support & protect the body
- Provides cavities for fat storage & synthesis of blood cells
- Composed of:
  - Bone cells in lacunae (cavities)
  - Hard matrix of calcium salts (bone salts)
  - Large numbers of collagen fibers

Figure 3.18a



b/c of these 2, bone matrix is harder & more rigid than cartilage matrix

Bone cont.

Osteoblasts—produce the organic portion of the matrix; the bone salts are deposited on & b/w the fibers

Osteocytes—mature bone cells; found in the lacunae w/n the matrix

Lacunae—small space, cavity, or depression; in bone or cartilage this space is occupied by cells

*unlike cartilage, bone is very well supplied by blood vessels

Connective Tissue Types—

4. Blood

- Most atypical connective tissue
- Does NOT connect things or give mechanical support
- Classified as connective tissue b/c it develops from mesenchyme & consists of blood cells surrounded by a nonliving fluid matrix called blood plasma

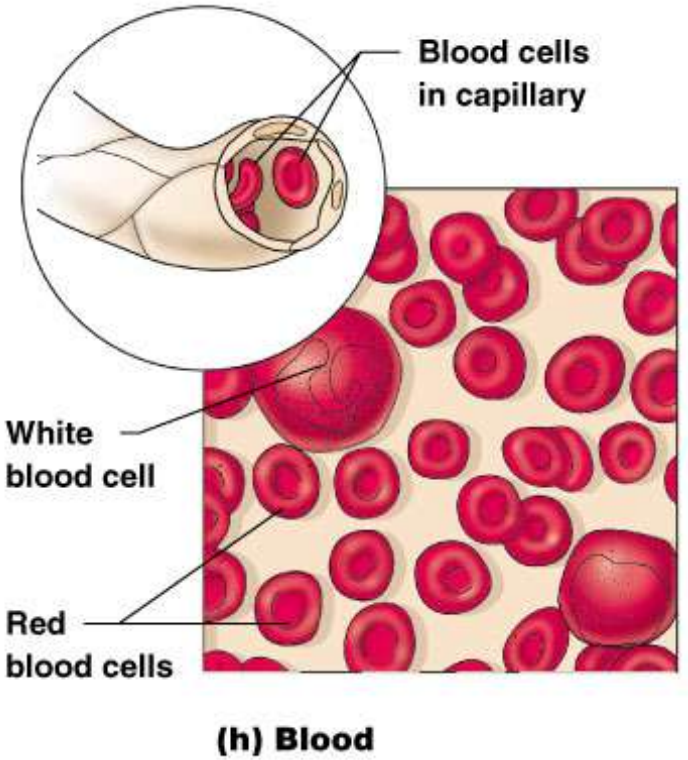


Figure 3.18h

Connective Tissue Types—

4. Blood cont.

- Fibers are soluble protein molecules visible only during clotting
- Functions --transport vehicle for materials for CV system, carries nutrients, wastes, respiratory gases, & other substances

Magic School Bus Blood Cells & Throat Tissue.asf

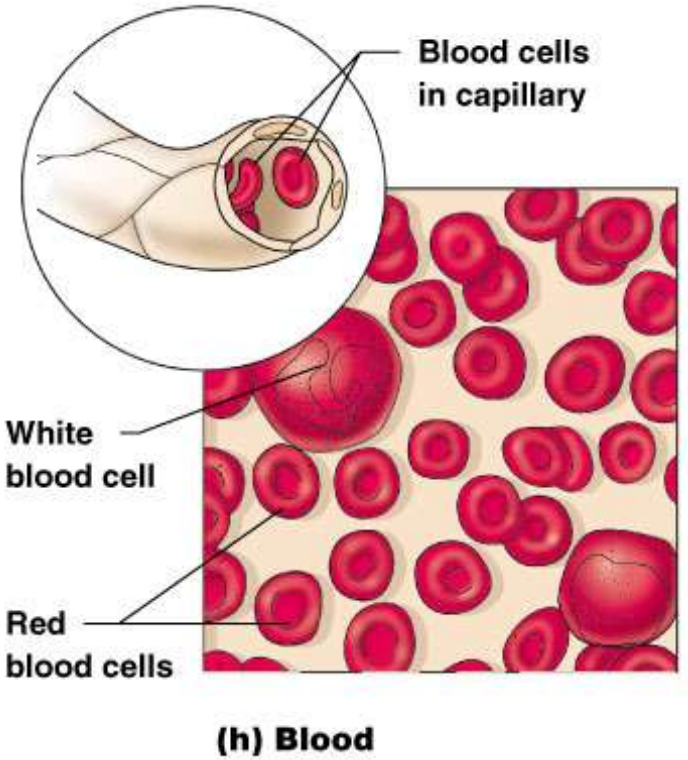


Figure 3.18h

3. Nervous Tissue

(3rd primary tissue type)

- Found in brain, spinal cord, & nerves
- Functions in regulation & control of body functions

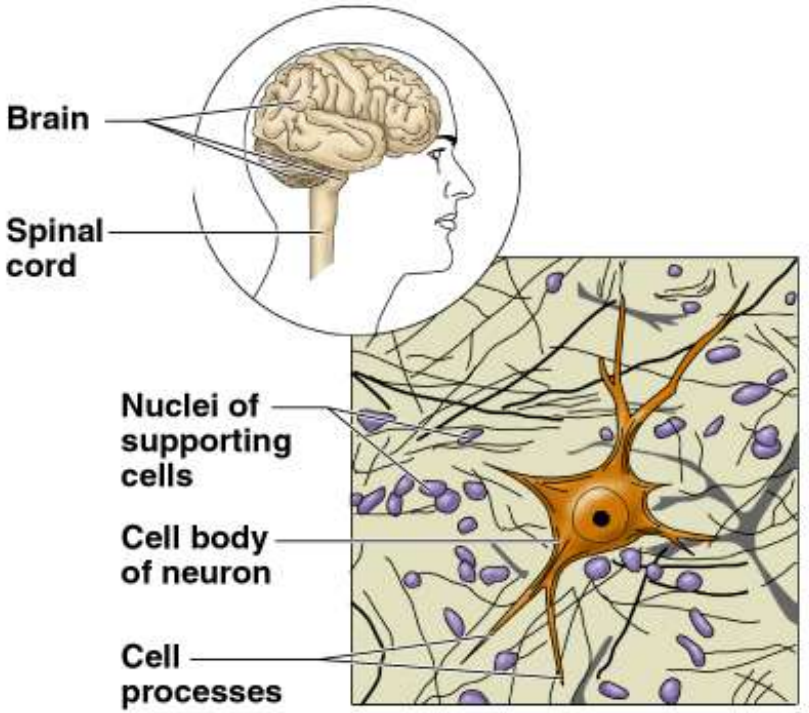


Figure 3.20

Nervous Tissue cont.

2 major cell types

1. Neuron
   - Highly specialized nerve cells that generate & conduct nerve impulses
   - Branching cells
   - The presence of cytoplasmic extensions, or processes, allow them to transmit electrical impulses over substantial distances w/n the body
2. Supporting cells
   - Nonconducting cells that support, insulate, and protect the delicate neurons.
   - Ex. Myelin sheath—fatty, whitish material that insulates long nerve fibers & increases transmission rate of nerve impulses

4. Muscle Tissue

(4th primary tissue type)

- Highly cellular, well-vascularized tissues
- Function is to produce body mvmts
- Muscle cells are composed of myofilaments
  - 2 types of myofilaments:
    1. Actin
    2. Myosin

Work together to bring about contraction of muscles

3 Types Muscle Tissue

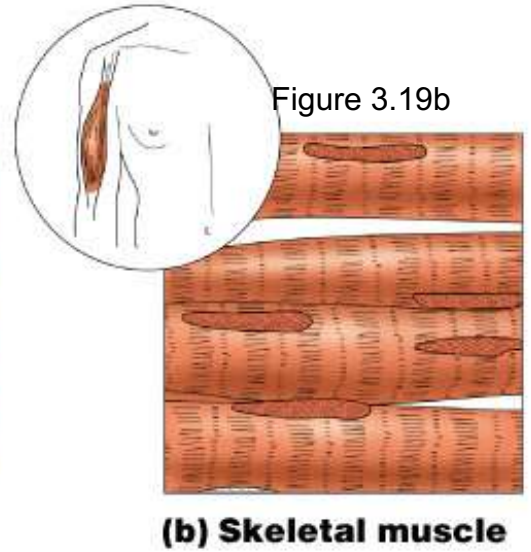


Figure 3.19b

(b) Skeletal muscle

1. Skeletal

- Packaged by connective tissue
- Form the flesh of the body
- As they contract , they pull on bones or skin causing body mvmts
- Can be controlled voluntarily
- Cells are long, cylindrical, and striated/banded which shows precise alignment of myofilaments
- Cells have many nuclei (multinucleate)

3 Types Muscle Tissue

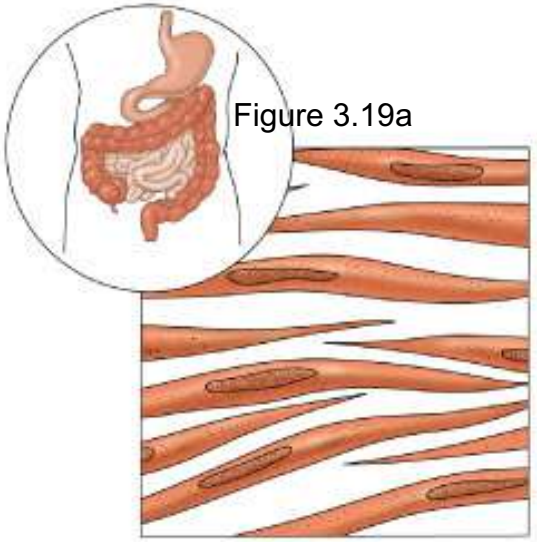


Figure 3.19a
(a) Smooth muscle

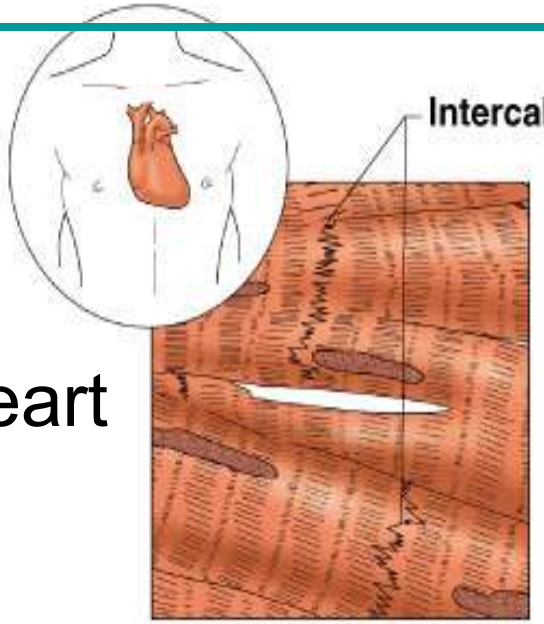
2. Smooth muscle

- No visible striations
- Involuntary muscle
- Individual cells are spindle shaped & contain one centrally located nucleus
- Found in walls of hollow organs (except heart); digestive & urinary tract organs, uterus, & blood vessels
- Functions to squeeze substances thru organs by alternately contracting & relaxing (peristalsis)

3 Types Muscle Tissue

3. Cardiac muscle

- Found only in the wall of the heart
- Function is to pump blood (involuntary) thru vessels to all parts of body
- Cells are striated, like skeletal, but there are structural differences:
  - Branching cells that fit together tightly at unique junctions called intercalated disks
  - One nucleus per cell (uninucleate)



(c) Cardiac muscle

Figure 3.19c

Muscle Tissue cont.

*b/c skeletal muscle is under our control, it is often called voluntary muscle

* Cardiac and smooth are called involuntary muscle

Tissue Repair (aka wound healing)

Body has many ways to protect itself:

1. Mechanical barriers—skin & mucosae and ciliary action
2. Chemical barriers—strong acid produced by stomach glands

If barriers are penetrated, the body initiates inflammatory & immune responses (mainly w/n connective tissues)

Tissue Repair cont.

Inflammatory Response

- Nonspecific reaction that develops quickly & occurs whenever/wherever tissues are injured
- Purpose:
  1. Get rid of the harmful agent
  2. Prevent further injury
  3. Restore tissue to a healthy condition

Tissue Repair cont.

Immune Response

- Extremely specific response, takes longer to activate
- Immune cells attack the specific recognized invader directly or by releasing antibodies into the blood.

What is required for Tissue Repair?

- Required that cells divide & crawl (migrate).
- This is initiated by growth factors (wound hormones) released by injured cells

How does Tissue Repair Occur?

1. regeneration—replacement of destroyed tissue with same kind of tissue
2. fibrosis—formation of fibrous connective tissue, called scar tissue

Which will occur? Depends on…

1. Type of injury (severity)
2. Type of tissue damaged

3 Steps to Repair

1. Inflammation
2. Restoration of blood supply thru organization (clotting proteins permeate capillaries & construct a clot; clot is exposed to air forming a scab; granulation tissue then forms—bleeds freely if scab is picked)
3. Regeneration & fibrosis result in permanent repair

Regeneration of Tissues

- Tissues that regenerate easily
  - Epithelial tissue
  - Fibrous connective tissue and bone
- Tissues that regenerate poorly
  - Skeletal muscle
- Tissues that are replaced largely with scar tissue
  - Cardiac muscle
  - Nervous tissue within the brain and spinal cord

Development of Tissues

During embryonic development, the formation of 3 primary germ layers occurs.

1. Ectoderm
2. Mesoderm
3. Endoderm

These primary germ layers specialize to form the four primary tissues from which all body organs are derived:

Epithelial tissues—form from all 3 germ layers

Muscle & Connective tissues—mostly from mesoderm

Nervous—from ectoderm