

## INTRODUCTION

Anatomy has many applications

### I. Basic concepts of anatomy

- a. All living organisms are made of cells.
- b. Similar cell types --> tissue.
  - How many types of tissues are there?
    - °Epithelium
    - °Connective tissue
    - °Muscle
    - °?
- c. Different tissues combine to form an organ.
- d. Different organs combine to form an organ system.

### II. Cellular Structure (Chapter 2)

- a. Functional requirements
- b. Size
- c. Anatomy of a cell

Note: Much variation! Analogy: person or corporation.

#### i. Plasma membrane

#### ii. Cytoplasm

##### A. Cytosol

B. Organelles: beginning with those that are membrane-bound:

- Endoplasmic reticulum (ER)
  - \* Rough ER
  - \* Smooth ER
- Golgi body
- Lysosomes
- Mitochondria
- Cytoskeleton -- not membrane-bound. Three parts:
  - \* Microtubules
  - \* Microfilaments
  - \* Intermediate filaments

#### iii. Nucleus

#### d. Specialized cell contacts (cell junctions)

- Tight junctions
- Desmosomes
- Gap junctions

# TISSUES

Histology = the study of tissues

## I. Epithelium

### a. Introduction

Definition of epithelium: Tissue that:

- (1) covers or lines surfaces and cavities of the body,
- or
- (2) forms glands (= secretory structures)

### b. General characteristics

Cellularity: composed almost entirely of cells

Make specialized contacts

Display polarity (sidedness)

Basement membrane (anchors epithelium to the underlying connective tissue)

Ability to regenerate quickly

Avascular (no blood vessels)

Innervated

### c. Function

Absorption and secretion

Diffusion and Filtration

Propulsion

Protection

### d. Classification

By layering: simple or stratified

By shape: squamous, cuboidal, or columnar

#### A. Simple epithelium

1. Simple squamous -- thinnest kind

2. Simple cuboidal

3. Simple columnar

Nonciliated

Ciliated

Can have other modifications:

-Microvilli

-Goblet cells

4. Pseudostratified columnar

#### B. Stratified epithelium

1. Stratified squamous -- thickest

2. Stratified cuboidal -- rare

3. Stratified columnar -- very rare

4. Transitional (changes shape)

### e. Glands

#### 1. Exocrine

Unicellular

Multicellular

## 2. Endocrine

### II. Connective tissue

#### a. Important characteristics

Relatively few cells

Large amount of nonliving substance (extracellular matrix)

Vascularized (except cartilage)

#### b. Functions

#### c. Structure

##### 1. Cells:

- Derived from mesenchyme

- A characteristic type of cell for each kind of CT

- Cells secrete extracellular matrix

##### 2. Matrix

###### A. Fibers

\* Collagen fibers

\* Elastic fibers

\* Reticular fibers

###### B. Ground substance

\* Proteoglycans

\* Interstitial fluid

\* Additional components (e.g. calcium salts in bone)

(Note: Integrins = cell adhesion proteins -- glue cells to matrix)

#### d. Categories of CT (connective tissue)

##### 1. Connective tissue proper

Introduction

###### A. Loose connective tissue

Areolar

Adipose

Reticular

###### B. Dense connective tissue

Dense regular

Dense irregular

Elastic

##### 2. Cartilage

Properties of cartilage vs. bone

\* Ground substance is unique - acts like "water bed"

\* Fibers

\* Cells

\* Avascular

\* Not innervated

A. Hyaline cartilage

B. Elastic cartilage

### C. Fibrocartilage

#### 3. Bone

- \* Ground substance = calcium salts

- \* Fibers = lots of collagen

- \* Cells:

#### 4. Blood

- \* Why is blood a connective tissue?

## MEMBRANES AND INTEGUMENTARY SYSTEM

### I. Covering and lining membranes

#### a. Function

#### b. Composition

#### c. Types of membrane

- Mucous membrane

- Serous membrane

- Cutaneous membrane

### II. Integumentary system (skin and its appendages)

#### a. The skin: largest organ in the body

#### b. Structure of the skin

Two parts: Epidermis + dermis

##### \* Epidermis

Layers:

1. Stratum germinativum (stratum basale)

2. Stratum spinosum

3. Stratum granulosum

4. Stratum lucidum

5. Stratum corneum

Other cell types in epidermis

- Melanocytes

- Merkel cell

- Langerhans cell

##### \* Dermis

- Papillary layer

Blisters

- Reticular layer

Structures in dermis

- \* Hypodermis: Not a part of the skin, but usually discussed with it

#### c. Appendages of the skin

##### 1. Hairs

Shaft

Root

Bulb

Follicle

Arrector pili muscle

Cuticle  
Medulla  
Cortex  
Curliness & color  
Male pattern baldness

2. Glands

Sebaceous glands  
Sudoriferous (sweat) glands  
-Eccrine glands  
-Apocrine glands  
Modified sweat glands - e.g. mammary glands

d. Burns: Consequences and treatment

## BONE

### I. Introduction

- a. Extremes
- b. Bones are organs
- c. Functions of bones / bone tissue
- d. Classes of bones
  - \* Long bones
  - \* Short bones
  - \* Flat bones
  - \* Irregular bones

### II. Gross structure of a long bone

- \* Diaphysis
- \* Epiphyses
- \* Epiphyseal line
- \* Periosteum
- \* Articular cartilage
- \* Medullary cavity
- \* Endosteum
- \* Blood vessels
- \* Compact bone
- \* Spongy bone

### III. Histology of bone tissue

#### a. General

##### Cell types

- Osteoblasts
- Osteoclasts
- Osteocytes

##### Matrix

- Organic: called osteoid
  - Inorganic: called hydroxyapatite
- Fibers vs. ground substance?  
Secretion?

- Osteoblasts secrete:

- \* Osteoid
- \* Enzymes

b. Compact bone

- \* Osteon
- \* Lamellae
- \* Central (Haversian) canal
- \* Perforating (Volkmann's) canals
- \* Arteries, veins, nerves
- \* Osteocytes trapped within lacunae
- \* Canaliculi

c. Spongy bone

- \* Made of?
- \* Osteocytes?
- \* Canaliculi?

IV. Bone formation

a. Intramembranous bone formation

1. Formation of ossification center
2. Osteoblasts secrete osteoid
3. Formation of woven bone
4. Formation of mature bone tissue

b. Endochondral bone formation

1. Cartilage model grows a periosteum
2. Chondrocytes in center of diaphysis signal matrix to calcify
3. Periosteal bud invades diaphysis
4. Steps 2 & 3 occur in the epiphyses as well
5. Remodeling produces mature spongy & compact bone

\* Note: Cartilage remains at:

Photos of bone formation in the fetus

V. Bone growth

- a. Longitudinal bone growth
- b. Appositional bone growth

VI. Bone disorders

- a. Achondroplasia
  - Distraction osteogenesis
- b. Osteoporosis
- c. Osteomalacia
- d. Paget's disease

JOINTS

I. Introduction

a. Definition

\* Joints = articulations = points where bones meet and connect

b. Basic directional terms

- Planes or sections:
  - \* Sagittal
  - \* Frontal (coronal)
  - \* Transverse
- Other directional terms:
  - \* Superior / inferior
  - \* Anterior / posterior
  - \* Medial / lateral
  - \* Dorsal / ventral
  - \* Proximal / distal
  - \* Superficial / deep

c. Degrees of mobility

- \* Diarthrotic
- \* Amphiarthrotic
- \* Synarthrotic

d. Joints can change with age

- \* Synostosis

II. Joint classification

a. Fibrous joints

1. Suture
2. Syndesmosis
3. Gomphosis

b. Cartilaginous joints

1. Synchondrosis
2. Symphysis

c. Synovial joints

III. Anatomy of synovial joints

a. Structures of the joint itself

- \* Articular capsule
- \* Reinforcing ligaments
  - Capsular
  - Extracapsular
  - Intracapsular
 Reconstructing the ACL
- \* Articular disc (meniscus)

b. Structures often associated with synovial joints

1. Bursa
2. Tendon sheath

IV. Movements of joints

a. Non-angular (translational) movements

Specific directions:

- Elevation
- Depression
- Protraction

- Retraction

b. Angular movements

1. Change angle between two bones

- Flexion / Extension
- Abduction / Adduction
- Circumduction

Special movements of the feet:

- Dorsiflexion / Plantar flexion
- Inversion / Eversion

2. Rotate about bone's long axis

- Left rotation / Right rotation
- Medial rotation / Lateral rotation

Special movements of the forearm:

- Pronation / Supination

V. Synovial joints classified by shape

1. Plane joint (gliding joint)
2. Hinge joint
3. Pivot joint
4. Condyloid joint
5. Saddle joint
6. Ball-and-socket joint

VI. Joint health & pathology

a. Joint stability

\* Factors affecting stability:

- Shape of articular surface
- Ligaments
- Muscles

b. Injuries

- \* Dislocation
- \* Sprain
- \* Cartilage injury

c. Diseases

- \* Arthritis
  - Osteoarthritis
  - Rheumatoid arthritis
  - Gouty arthritis (gout)

## MUSCLE

I. Introduction to muscle

- a. Functions
- b. Special features of muscle tissue
- c. Muscle tissue types

II. Skeletal muscle

- a. Basic anatomy
  - \* Epimysium

- \* Perimysium
- \* Endomysium
- \* Tendon

b. Microscopic anatomy

- Muscle fibers
  - \* Myofibrils
  - \* Actin
  - \* Myosin
  - \* Striations
  - \* Sarcomere
  - \* What determines strength?
- Satellite cells
- Myostatin (clinical example)
- Nerve cells

c. Mechanism of contraction

d. Muscle length & contraction

e. Muscles in context

1. Attachments

- \* Origin
- \* Insertion

Example: Brachialis

2. Actions - general points

3. Muscles working together

- Prime mover (agonist)
- Antagonist
- Synergist
- Fixator

III. Cardiac muscle

- \* General features
- \* Intercalated discs
  - Gap junctions
  - Fasciae adherens
- \* Other features
- \* Stimulation of contraction

IV. Smooth muscle

- \* General features
- \* Organization
  - Dense bodies
  - Gap junctions
  - Loose organization allows...
  - Circular layer
  - Longitudinal layer
- \* Stimulation of contraction

What do all 3 muscle tissue types have in common?

# DIGESTIVE SYSTEM

## I. Introduction

- a. Function
- b. Components
  - Organs of the gastrointestinal tract (alimentary canal)
  - Accessory digestive organs
- c. Internal and external lining of the GI tract
  - \* Mucosa
  - \* Serosa (called peritoneum in the abdominopelvic cavity)
    - Inner lining =
    - Outer lining =
    - Mesentery
  - Volvulus (clinical example)
  - \* Secondarily retroperitoneal organs
  - \* Intraperitoneal organs

## II. Structure of the GI tract wall

- a. Mucosa
  - \* Epithelium
  - \* Lamina propria
  - \* Muscularis mucosae
- b. Submucosa
- c. Muscularis externa
- d. Serosa

## III. Steps in food processing

- a. Ingestion
- b. Mechanical breakdown
- c. Secretion
- d. Chemical digestion
- e. Absorption
- f. Propulsion
- g. Defecation

## IV. Organs of the gastrointestinal tract

- a. Mouth (oral cavity)
  - Salivary glands (NOTE: these are actually accessory digestive organs, not part of GI tract)
    - Mucous cells
    - Serous cells
- b. Pharynx
  - \* Oropharynx
  - \* Laryngopharynx
- c. Esophagus
  - 1. Function
  - 2. Location
  - 3. Characteristics

- \* Cardiac sphincter
- \* Clinical highlight: Hiatal hernia
- \* Clinical highlight: GERD
- \* Epithelium

d. Stomach

1. Functions
2. Gross anatomy
  - Regions
  - Pyloric sphincter
  - Lesser curvature
  - Greater curvature
  - Oblique muscle layer
  - Rugae
3. Microscopic anatomy
  - \* Clinical highlight: Peptic ulcer

e. Small intestine

1. Functions
2. Gross anatomy
  - \* Duodenum
  - \* Jejunum
  - \* Ileum

Clinical highlight: Diverticulum
3. Wall of the small intestine
  - \* Plicae circulares
  - \* Villi
  - \* Microvilli
  - \* Intestinal crypts
  - \* Goblet cells

f. Large intestine

1. Function
2. Gross anatomy
  - \* Cecum
  - \* Vermiform appendix

Clinical highlight: Appendicitis

  - \* Colon
  - \* Rectum
  - \* Anal canal
3. Wall of the large intestine
  - \* Taeniae coli
  - \* Haustra
  - \* Epiploic appendages
  - \* MALT?
  - \* Intestinal crypts
  - \* Epithelium type:

## V. Accessory digestive organs

### a. Liver

1. Functions
2. Gross anatomy
  - \* Lobes
  - \* Hepatic veins
  - \* Porta hepatis - contains:
    - Common hepatic duct
    - Hepatic arteries
    - Hepatic portal vein
3. Microscopic anatomy
  - \* Liver lobule
  - \* Hepatocyte
  - \* Central vein
  - \* Portal triad:
    - Portal arteriole
    - Portal venule
    - Bile duct
  - \* Liver sinusoids
  - \* Kupffer cells
  - \* Bile canaliculi
4. Pathway of blood flow

### b. Gallbladder

1. General features
2. Pathway of bile flow

### c. Pancreas

1. Gross anatomy
2. Functions
  - \* Exocrine secretions
  - \* Endocrine secretions
3. Microscopic anatomy
  - \* Acinar cells
  - \* Epithelium of small ducts
  - \* Pancreatic islets
4. Pathways of flow

## RESPIRATORY SYSTEM

### I. Introduction

- a. Function
- b. Introduction to structures
  - \* Conducting zone
  - \* Respiratory zone
- c. Respiratory mucosa & epithelium
  - \* Respiratory zone
  - \* Conducting zone

- Clinical highlight: Cystic fibrosis

## II. Structures of the respiratory system

- a. External nose
- b. Nasal cavity
- c. Paranasal sinuses
- d. Pharynx
  - 1. Nasopharynx
  - 2. Oropharynx
  - 3. Laryngopharynx
- e. Larynx
  - \* Thyroid cartilage
  - \* Cricoid cartilage
  - \* Arytenoid cartilage
  - \* Epiglottis
  - \* Vocal folds
  - \* Vestibular folds
  - Epithelium
  - Cricothyrotomy (clinical item)
- f. Trachea
- g. Primary bronchi
- h. Lungs
  - 1. Gross anatomy
    - A. Regions & divisions
    - B. Pleurae
  - 2. Bronchial tree
    - Tissues
  - 3. Respiratory zone
    - Pulmonary alveoli
    - Types of alveolar cells
      - \* Type I cells
      - \* Type II cells
    - Role of surfactant
    - Respiratory Distress Syndrome (clinical highlight)

## II. Ventilation

- 1. Inspiration
- 2. Expiration
- Pneumothorax (clinical highlight)
- Mechanical ventilators (clinical highlight)

## CARDIOVASCULAR SYSTEM

### I. Introduction to the cardiovascular system

- a. Function
- b. Circulatory routes
  - \* Pulmonary circuit

- \* Systemic circuit
- c. General circulatory principles
  - \* Capillary beds
  - \* Arteries
  - \* Veins
    - Portal veins

## II. The heart

- a. Introduction
- b. Coverings
- c. Wall of the heart
- d. Chambers and vessels
  - 1. Atria
    - Right atrium
    - Left atrium
  - 2. Ventricles
    - Right ventricle
    - Left ventricle
- e. Valves
  - 1. Atrioventricular valves
    - Tricuspid valve
    - Bicuspid valve
    - Chordae tendineae
    - Papillary muscles
  - 2. Semilunar valves
    - Aortic semilunar valve
    - Pulmonary semilunar valve
    - Heart sounds
  - 3. Pathology of valves
- f. Pathway of blood flow
- g. Coronary artery disease
- h. Conduction system
  - 1. Introduction
  - 2. Sequence of conduction
    - Sinoatrial node
    - Atrioventricular node
    - Bundle of His
    - Bundle branches
    - Purkinje fibers
  - 3. Disorders of conduction system
    - \* Heart block

## III. Blood vessels

- a. Introduction
  - 1. Function
  - 2. Components of blood

- b. General structure of blood vessel wall
  - 1. Tunica interna (intima)
  - 2. Tunica media
  - 3. Tunica externa
- c. Arteries
  - 1. Structure
  - 2. Types of arteries
    - \* Elastic arteries
      - Aortic dissection (clinical highlight)
    - \* Muscular arteries
    - \* Arterioles
- d. Capillaries
  - 1. Structure
  - 2. Capillary beds
  - 3. Types of capillaries
    - Continuous capillaries
      - (in most organs)
      - (in brain) -- blood-brain barrier
    - Fenestrated capillaries
    - Discontinuous capillaries (sinusoids)
- e. Veins
  - 1. Structure
  - 2. Types of veins
    - Venules
    - Veins
      - \* Portal veins
  - 3. Mechanisms for enhancing venous return
    - Respiratory pump
    - Muscular pump
    - Swinging limbs

## NERVOUS SYSTEM

### I. Introduction

- a. Function
- b. Organization
  - \* Central nervous system
  - \* Peripheral nervous system
    - Anatomical divisions:
      - Spinal nerves
      - Cranial nerves
    - Functional divisions:
      - Afferent (sensory)
        - ~~ Somatic sensory
        - ~~ Visceral sensory
      - Efferent (motor)

- ~~ Somatic motor (voluntary)
- ~~ Visceral motor (involuntary) =  
autonomic nervous system
  - Sympathetic (fight or flight)
  - Parasympathetic (rest and  
digest)

## II. Histology of nervous tissue

### a. Neurons

1. Introduction
2. Anatomy of "typical" (multipolar) neuron
  - Cell body
  - Dendrite
  - Axon
  - Synapse
3. Types of neurons
  - Functional classification
    - \* Sensory neurons
    - \* Motor neurons
    - \* Interneurons
  - Structural classification
    - \* Multipolar
    - \* Bipolar
    - \* Unipolar

### b. Support cells (neuroglia)

- Oligodendrocytes
- Microglia
- Astrocytes
- Ependymal cells
- Schwann cells
- Satellite cells

### c. Introduction to gross anatomy

- Nerves
- Ganglia
- Gray vs. white matter
- Tracts
- Nuclei

## III. Brain

### a. Introduction

1. Complexity
2. Development
  - \* Neural tube
  - \* Primary brain vesicles
    - Prosencephalon
    - Mesencephalon

- Rhombencephalon
- \* Secondary brain vesicles
  - (From prosencephalon:)
    - \* Telencephalon
    - \* Diencephalon
  - (From mesencephalon:)
    - \* Mesencephalon
  - (From rhombencephalon:)
    - \* Metencephalon
    - \* Myelencephalon
- \* Adult brain structures
  - \* Cerebral hemispheres
  - \* Diencephalon
  - \* Midbrain
  - \* Pons
  - \* Cerebellum
  - \* Medulla oblongata

NOTE: Brain stem = midbrain, pons, medulla oblongata
- \* Ventricles
  - \* Lateral ventricles
  - \* Third ventricle
  - \* Cerebral aqueduct (not a ventricle)
  - \* Fourth ventricle
- 3. Cerebrospinal fluid
  - \* Choroid plexus
  - \* Circulation of CSF
- 4. Meninges
  - \* Function
  - \* Dura mater
  - \* Arachnoid mater
  - \* Pia mater
  - Role of meninges in circulation of CSF
  - Hydrocephalus (clinical highlight)
- b. Telencephalon
  1. Overview
    - \* Gyri
    - \* Sulci
    - \* Lobes
    - \* Layers
  2. Cerebral cortex
    - A. Introduction
    - B. Frontal lobe
      - Primary motor cortex

- Premotor cortex
- Prefrontal cortex

Clinical examples

- \* Phineas Gage
- \* Prefrontal lobotomy

C. Parietal lobe

- Integrates sensory information
  - Somatosensory cortex
- Alzheimer's Disease (clinical highlight)

D. Occipital lobe

- Primary visual cortex
- Visual association area

E. Temporal lobe

- Auditory cortex
- Olfactory cortex

F. Insula

- Sense of balance
- Taste, visceral senses, balance
- Integrate sensory information
- Emotion

3. White matter

- \* Commissural fibers
  - Split-brain experiments (clinical highlight)
- \* Association fibers
- \* Projection fibers

4. Deep gray matter of cerebrum

- \* Basal ganglia
  - Deep brain stimulation (clinical highlight)
- \* Basal forebrain nuclei

c. Diencephalon

1. Thalamus

2. Hypothalamus

- \* Center of homeostasis
- \* Biological clock

3. Epithalamus

- \* Pineal gland

d. Mesencephalon

1. Corpora quadrigemina

- \* Superior colliculi
- \* Inferior colliculi

2. Substantia nigra

e. Metencephalon

1. Pons

2. Cerebellum

- f. Myelencephalon
  - 1. Medulla oblongata
- g. Functional brain systems
  - 1. Reticular formation
    - \* Reticular activating system
  - 2. Limbic system
    - \* Amygdala
    - \* Cingulate gyrus
    - \* Hippocampus

#### IV. Spinal cord

- a. Function
- b. Anatomy
  - 1. Gray matter
    - Dorsal horns
    - Ventral horns
    - Lateral horns
  - 2. White matter
  - 3. Meninges
    - \* Dura mater
    - \* Arachnoid mater
    - \* Pia mater

#### V. Peripheral nervous system

- a. Introduction
- b. Nerves
  - 1. Cranial nerves
    - \* Pure sensory
    - \* Pure motor
    - \* Both motor and sensory
    - Bell's palsy (clinical highlight)
  - 2. Spinal nerves
    - A. General anatomy
      - \* Dorsal root ganglion
      - \* Dorsal root
      - \* Ventral root
      - \* Spinal nerve
      - \* Dorsal ramus
      - \* Ventral ramus
      - \* Dermatome
      - Shingles (clinical highlight)
      - Leprosy (clinical highlight)
    - B. Plexuses
      - \* Cervical plexus
      - \* Brachial plexus

- \* Lumbar plexus

- \* Sacral plexus

c. Autonomic nervous system

1. Introduction

2. Sympathetic nervous system

- A. General features

- B. Gross anatomy

- C. Neurotransmitters

- D. Physiological responses

- E. Adrenal medulla

- Epi pen (clinical highlight)

3. Parasympathetic nervous system

- A. General features

- B. Gross anatomy

- C. Neurotransmitters

- D. Physiological responses

d. Sensory system

1. Introduction

2. General senses

- A. General features

- B. Types of general senses

- \* Mechanoreceptors

- \* Thermoreceptors

- \* Nociceptors

- Structural types of receptors

- \* Free nerve endings

- \* Encapsulated nerve endings

3. Special senses

- \* Chemoreception

- \* Hearing

- \* Equilibrium (balance)

- \* Vision

- Structural types:

VI. Special senses (in detail)

a. Hearing and equilibrium

1. External ear

- \* Auricle

- \* External acoustic meatus

- \* Tympanic membrane

2. Middle ear

- Ossicles:

- \* Malleus

- \* Incus

- \* Stapes

- Oval window
- Round window
- Pharyngotympanic tube
- Clinical notes

### 3. Internal ear

#### A. Bony labyrinth

- \* Semicircular canal
- \* Vestibule
- \* Cochlea

#### B. Membranous labyrinth

- \* Semicircular ducts
- \* Sacculle and utricle
- \* Cochlear duct

#### C. Semicircular ducts

#### D. Sacculle and utricle

Sensory pathways from maculae and cristae ampullares:

#### E. Anatomy of cochlea

- \* Scala vestibuli
- \* Scala tympani
- \* Cochlear duct
  - Basilar membrane
  - Spiral organ of Corti

#### F. Pathway of sound sensation

- Pathway of sound vibrations
- Tonotopy

#### G. Clinical notes on sound

- \* Conductive deafness
- \* Sensorineural deafness
- \* Cochlear implant

### b. Vision

#### 1. Layers of the eye

##### A. Fibrous layer

- \* Sclera
- \* Cornea

##### B. Vascular layer

- \* Choroid
- \* Ciliary body
  - Accommodation
- \* Lens
- \* Iris

Uveal melanoma (clinical highlight)

##### C. Inner layer (sensory tunic)

- \* Pigmented layer

Retinal detachment (clinical highlight)

\* Neural layer

- Photoreceptors

Rods

Cones

Fovea centralis

- Other cells

Bipolar cells

Ganglion cells

Optic disc

2. Segments of the eye

\* Anterior segment

\* Posterior segment

3. Neural pathway

## LYMPHATIC AND IMMUNE SYSTEMS

I. Lymphatic system

a. Function

b. Pathway of flow

c. Structures

\* Lymphatic capillaries

- Endothelium

- Minivalves

\* Larger lymph vessels

- Valves

\* Lymph nodes

d. Pathology

\* Lymphedema

- Elephantiasis (clinical highlight)

II. Immune system

a. Cells

- Leukocytes

\* Macrophages

\* Lymphocytes

b. Tissues and organs

\* Lymphoid tissue

\* Lymphoid organs

- Primary lymphoid organs:

-- Thymus

-- Red bone marrow

- Secondary lymphoid organs:

-- Lymph nodes

-- Spleen

-- Tonsils

-- Peyer's patches

-- Appendix

## URINARY SYSTEM

### I. Introduction

- a. Function
- b. Components

### II. Kidney

- a. Gross anatomy
  - \* Cortex
  - \* Medulla

- b. Microscopic anatomy

- 1. Introduction

- A. Basic structure

- B. Function

- \* 3 processes:

- Filtration

- Resorption

- Secretion

- \* Resulting fluid = urine

- 2. Renal corpuscle

- Glomerulus

- Glomerular capsule

- 3. Proximal convoluted tubule

- Example: Diabetes mellitus

- 4. Loop of Henle

- Thin segment

- Thick segment

- The ability to concentrate urine

- 5. Distal convoluted tubule

- Example: Caffeine

- 6. Collecting duct

- Example: Alcohol