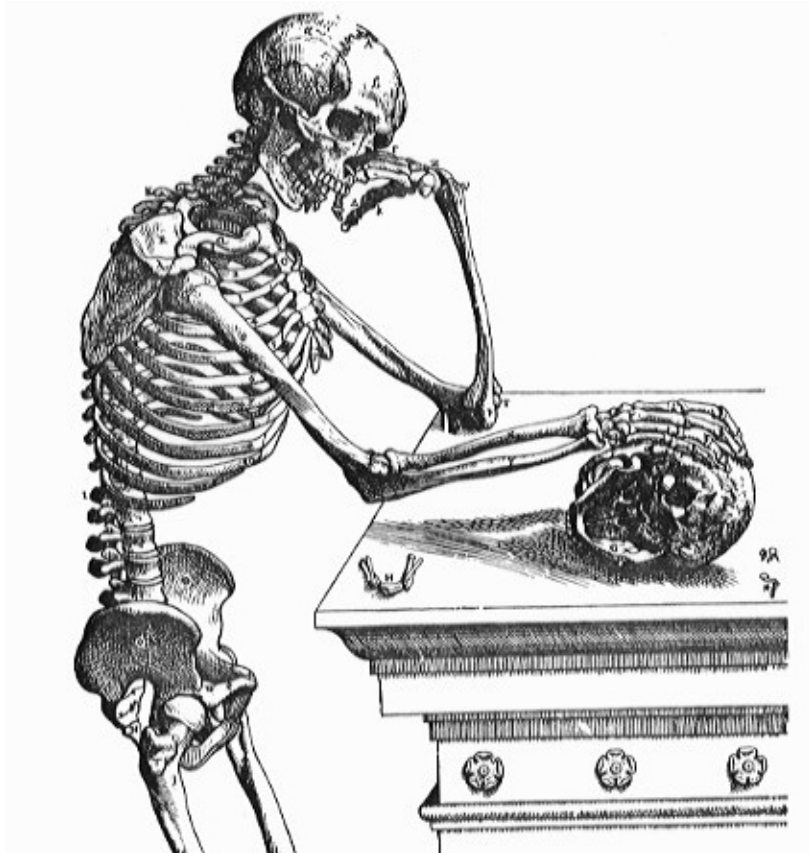


# Study Guide

for

# Human Anatomy 231



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## How to use this Study Guide

The purpose of this study guide is to facilitate your studying by giving you lists of many of the terms and structures that you will be responsible for knowing. This study guide is divided into two parts. The first part is intended primarily for use in lecture and the second part is intended primarily for use in lab. Probably the single most important section of this study guide is the lists of clinical terms and drawings in each review section. A significant portion of every lecture exam will ask you to explain the anatomical basis and clinical significance of these terms. Also every exam will ask you to draw and label specific structures. The lab portion of the study guide consists mostly of the terms you will be responsible for knowing on the lab exams. During the lab exams you will be expected to identify the various structures of the body and understand why they are important.

This study guide does not contain all of the information you will need to know for this class. There are many other terms and concepts that will be given to you in lecture and lab that you will be responsible for. I do not teach directly from the textbook. You do not need to read the textbook before you come to class. Your best sources for what you need to know are the lectures and lab sessions. Even though I do not test from the textbook, it is an important resource for helping you understand Anatomy. You will be expected to bring the textbook with you to every lab. By the time you take a test, there should be no doubt in your mind about what you need to know to get an A in the class. While I cannot guarantee that you will get an A, if you work hard enough, and if you know how to study, you will do well. Simply memorizing these terms will give you as much knowledge of Anatomy as memorizing the phone book will give you knowledge of the people listed therein. Anatomy is not about memorizing names; it is about understanding the structure of the human body. Your goals should be to understand the structural and functional importance of these terms. If you only memorize definitions, you will earn, at best, a C. Too many students assume that this course is like other classes where reading the notes three or four times before a test is sufficient to get a passing grade. Could you pass a math class by merely reading over your notes? In this class you will need to be able to do Anatomy, which takes understanding the principles and concepts, not just memorization.

As you look through this study guide, you will be overwhelmed by the number of terms and concepts you will need to learn for this class. Don't worry, students can, and do pass this course. The students who will pass this class are the ones who make a commitment of time and effort. This course should be one of the most important things in your life this semester. The only way to be able to learn this much material is to study at least an hour or two every single day for lecture and an additional hour or two every day for lab. If you start studying a week before the test, you will fail the test. If you fall behind, you will never be able to catch up.

At the end of each section in the study guide are sample questions that are similar to the questions on the exam. You can get help, if you are having trouble answering these questions, during office hours or review sessions. Understand that sample questions are there just to give you an idea of what might be on the exam; these questions may not appear on the exam. Also, in the review section are some drawing assignments. At least one drawing will be required on each exam. It is highly recommended that you practice these drawings at home and bring them in to be evaluated before the exam. Students have found these drawings extremely helpful, so if you put a little effort into doing them, you will be rewarded with better grades. In addition to this study guide, you will find copies of old exams on my website.

# Introduction to the Language of Anatomy

Anatomy is the language of health care. Learning Anatomy is like learning a new language. Anatomy has its own vocabulary, which is sometimes different from English – for example: there is no such thing as a “cheek bone” or “hip bone.” Likewise, words are sometimes used differently in Anatomy; the “arm” in Anatomy includes only the region from the shoulder to the elbow; it is not the entire limb.

When learning a new language, it is not enough to merely memorize definitions. One needs to learn how words are used. If you were given a French-English dictionary, would you be able to speak French? Likewise, in this class, you need to understand how words are used, you need to understand how to form plurals, you need to recognize the genitive forms of nouns, you need to be able to distinguish between adjectives and nouns, etc.

The number of new terms you will encounter this semester will depend on your language skills coming into the class. If you are fluent in English or Spanish (for example, if you scored above 750 in both the reading and writing portions of the SAT), you may only have 600 - 700 new terms to learn. If however, you are a more typical student, you may have more than 1,600 - 1,800 new terms to learn in this class. That comes out to more than 100 new terms per week for a full-length semester!

While there are many hundreds of new terms for you to learn in this class, that is not as onerous as it seems. The parts of the body are all named for where they are, what they look like, or what they do. Therefore, if you understand what the name means, you already understand some important fact about that structure. Most anatomical terms are based on just a few dozen prefixes, suffixes and roots. Almost all anatomical terms are either English words or words derived from Greek or Latin. If you learn the root of a word, you will have a much easier time. For example, the word “rectus” is Latin for “straight.” If you know that, then you will know that the rectus abdominis muscle is the straight muscle of the abdomen; the erector spinae muscle straightens the spine; the rectum of the large intestine is the straight portion of the large intestine, etc.

## Anatomy Course Objectives

This course is specifically designed for pre-health profession students. You will be learning the Anatomy you will need to know as a health care provider. By the end of the semester, you will be expected to:

1. Understand the concepts related to the organization and structure of the body
2. Know the language of health care
3. Be able to relate structure and function
4. Understand the anatomical basis of common diseases and conditions
5. Learn the study skills that will enable you to continue your studies toward a career in health care

## Forming Plurals

Singular ending	Plural ending	Examples
--a	--ae	fossa, fossae vertebra, vertebrae
--en	--ina	lumen, lumina foramen, foramina
--ex	--ices	cortex, cortices index, indices
--is	--es	diagnosis, diagnoses epiphysis, epiphyses
--ix	--ices	matrix, matrices appendix, appendices
--nx	--nges	phalanx, phalanges meninx, meninges
--um	--a	datum, data bacterium, bacteria
--us	--i	nucleus, nuclei stimulus, stimuli
--y	--ies	ovary, ovaries capillary, capillaries

## Genitive Terms

The word "genitive" means showing a possessive relationship. In English, we use an 's or the phrase "of the" to express this relationship. For example, the main artery in the arm is the "brachial artery" which translates to the "arm's artery", or the "artery of the arm". In anatomy, most genitive terms are modified nouns such as: "pelvic," which means "of the pelvis," or "abdominal" which means "of the abdomen." Some frequently used genitive terms are different from the commonly used nouns such as:

### of the...

arm	brachial
bladder	cystic
eyes	optic
head	cephalic
heart	cardiac
kidney	renal or nephric
liver	hepatic
lungs	pulmonary
mouth	oral
neck	cervical
organ	visceral
ribs	costal
skin	dermal
skull	cranial
stomach	gastric
thigh	femoral
underarm	axillary
wrist	carpal

## Common Prefixes

<b>Prefixes</b>	<b>Definition</b>	<b>Example</b>
a, an	without	anaerobic: without oxygen
ante	before	anterior: in front of (before) the body
anti	opposed to	antidepressant: a drug which fights depression
ecto, ex	outside	excrete: to remove from the body
endo	within	endocardium: layer on the inside of the heart
epi	above	epidermis: top-most layer of the skin
hyper	excess	hypertension: high blood pressure
hypo	below	hypodermis: layer below the dermis
inter	between	intercellular: between cells
intra	within	intracellular: within a cell
meta	beyond	metacarpal: beyond the wrist
para	next to	paranasal sinus: next to the nasal cavity
peri	around	perimeter: area around an object
sub	below	submarine: below the ocean

# Basic Anatomical Terms

Anatomical Position: upright with feet flat on floor, the arms are along the sides of the body with the palms forward.

## Planes of reference:

- sagittal plane
  - midsagittal
  - parasagittal
- coronal (frontal) plane
- transverse (cross-sectional) plane
- oblique plane
- longitudinal plane - used only in reference to tubes

## Directional terms:

- superior
- inferior
  
- anterior (ventral)
- posterior (dorsal)
  
- medial
- lateral
  
- deep (internal)
- superficial (external)
  
- proximal
- distal



# Review for Quiz I

**A. Know how to form singulars or plurals using the suffixes on page 4.**

**B. Know how to use all of the terms on pages 5 - 7.**

**C. Read and understand “How to use the study guide”**

## Sample questions:

1. What is the best grade you can hope to receive if you merely memorize all of the material?
2. Is it necessary to have your textbook with you in lecture? In lab?
3. Lecture exam questions are specifically based on material in the
  - a. textbook
  - b. study guide
  - c. lecture
4. Which of the following is a good study method for being successful in Anatomy?
  - a. start studying one week before the exam.
  - b. memorize the textbook and study guide.
  - c. do the review drawings and turn them in to be evaluated.
  - d. make sure you memorized the answers to the review questions.
5. About how many new terms will the average student need to learn each week in a 16 week class?  
A. 30 - 50                      B. 50 - 75                      C. 75 - 100                      D. 100 - 120
6. An intradermal injection is given where?
7. An epidural injection is given \_\_\_\_\_ the dura.
8. Where is the hypogastric region?
9. Is the word aquarium singular or plural? What is the other form?
10. The ankle is \_\_\_\_\_ to the knee.
11. Where is the antebrachial region?

# Cells and Tissues

## Cellular Structure

Organelles: membranous or membrane bound structures within a cell that carry out particular functions

Cytoplasm: everything in a cell except the nucleus

Cytosol: everything in a cell except the organelles. Mostly made of water with dissolved ions, nutrients, etc.

List of Organelles:

1. plasma membrane: the membrane that surrounds the cell. Its structure is identical to all cell membranes.

Function: controls what enters or leaves a cell, interaction with other cells and the environment.

Structure: phospholipid bilayer, cholesterol, proteins. The proteins carry out almost all of the transport and signaling functions of a cell.

2. nucleus: largest organelle, stores DNA and makes RNA (RNA is used to make proteins)

nucleolus: a region within the nucleus that makes ribosomes.

3. mitochondrion (pl. mitochondria): makes ATP (energy for the cell) from glucose and fats in the presence of oxygen.

4. rough endoplasmic reticulum: has ribosomes - makes proteins for membranes and export from the cell.

5. golgi complex: packages proteins into vesicles and sends them to the proper location.

6. lysosomes: vesicles containing digestive enzymes, digest old organelles etc.

7. smooth endoplasmic reticulum: metabolism of carbohydrates, lipids, stores calcium, detoxifies harmful substances (such as drugs, alcohol)

Other structures in cytosol

1. ribosomes: structures that are used to read RNA and make proteins

2. cytoskeleton: protein fibers that maintain cell shape and are responsible for all movement.

A. microtubules: maintain the shape of the cell and allow organelles to move within the cell

B. microfilaments: provide physical strength to the cell. Made of keratin

C. intermediate filaments: allows a cell to move or change shape. Made of actin and myosin

# Tissues

## I. epithelia

### A. simple epithelia

1. simple squamous epithelium
2. simple cuboidal epithelium
3. simple columnar epithelium
4. pseudostratified epithelium

### B. stratified epithelia

1. stratified squamous epithelia
  - a. keratinized stratified squamous epithelium
  - b. nonkeratinized stratified squamous epithelium
2. stratified cuboidal epithelium
3. transitional epithelium

## II. fibrous (proper) connective tissues

### Components of fibrous connective tissues

Cells: fibroblasts

leukocytes (macrophages, mast cells)

adipocytes

Extracellular matrix: interstitial fluid  
collagen fibers  
elastic fibers  
reticular fibers

Blood vessels

Nerves

### Types of fibrous CT

- A. areolar tissue
- B. adipose tissue
- C. reticular connective tissue
- D. dense irregular fibrous connective tissue
- E. dense regular fibrous connective tissue

## III. special connective tissues

### A. cartilages

1. hyaline cartilage
2. fibrocartilage
3. elastic cartilage

### B. bone tissues

1. compact bone
2. spongy bone

### C. blood

## IV. muscle tissues

- A. skeletal (striated) muscle
- B. cardiac muscle
- C. smooth muscle

## V. nervous tissue

# Exocrine Glands

Exocrine glands are glands that secrete into ducts. There are many types of exocrine glands and they can be classified using a variety of criteria.

## I. Classification of glands based on the type of secretion

<u>type of gland</u>	<u>example</u>
A. <b>serous glands</b> (watery secretions)	sweat glands
B. <b>mucous glands</b> (secrete mucus) (note the spelling of mucus vs. mucous)	goblet cells
C. <b>mixed glands</b> (watery and mucous secretions)	salivary glands
D. <b>oil glands</b> (oily or waxy secretions)	sebaceous glands

## II. Classification of glands based on method of secretion

<u>type of gland</u>	<u>example</u>
A. <b>merocrine glands</b> (exocytosis)	most sweat glands, mucus glands
B. <b>apocrine glands</b> (breaking off of apical portion of cells)	mammary glands
C. <b>holocrine glands</b> (entire cells breaking off)	sebaceous glands

## III. Classification of glands based on structure

<u>type of gland</u>	<u>example</u>
A. <b>unicellular glands</b>	goblet cell
B. <b>multicellular glands</b>	
2. <b>tubular or alveolar (acinar) glands</b>	
a. <b>simple</b>	sweat glands (simple tubular glands)
b. <b>compound glands</b>	mammary glands (compound alveolar glands)

# Cells and Tissues Review

## A. Define each of the following terms and explain their anatomical basis.

apoptosis

benign tumor

biopsy

cancer

carcinoma

malignant tumor

metastasis

sarcoma

stem cells

tumor

## B. Draw each of the following. Label the parts and briefly explain their functions.

1. typical human cell including organelles and other structures.
2. A series of cross sections showing the different types of epithelia.
3. Areolar connective tissue including the cells and extracellular structures.

## C. Sample multiple choice questions. Choose the best answer.

1. Which type of tissue is avascular?  
A. stratified squamous epithelium      B. elastic cartilage      C. compact bone  
D. both A and B      E. all of the above
2. Cells that metastasize are different from normal cells in that they usually have  
A. a thicker plasma membrane      B. more lysosomes      C. more SER  
D. more mitochondria      E. none of the above
3. Salivary glands  
A. produce mucus      B. are merocrine glands      C. are multicellular glands  
D. both A and B      E. all of the above

# Integumentary System

## SKIN:

### A. epidermis - stratified squamous epithelium layers:

1. stratum basale
2. stratum spinosum
3. stratum granulosum
4. stratum lucidum (found only in palms and soles)
5. stratum corneum

### B. dermis - fibrous connective tissue

1. papillary layer - areolar CT
2. reticular layer - dense irregular CT

### C. hypodermis - adipose tissue

## Accessory Organs of the skin:

### A. hair

1. arrector pili
2. hair bulb
3. hair papilla
4. hair root
5. hair shaft
6. hair sheath
7. sebaceous gland

### B. nails

1. nail bed
2. nail root

### C. sense receptors

1. Touch receptors (3 types: light touch, vibration and skin stretching)
2. Pressure receptors
3. Temperature receptors (heat receptors and cold receptors)
4. Pain receptors, itch receptors

### D. glands

1. merocrine (eccrine) sweat glands
2. apocrine sweat glands
3. mammary glands (modified apocrine glands)
4. sebaceous glands
5. ceruminous glands

## Integumentary System Review

### A. Define each of the following terms and explain their anatomical basis.

abrasion

acne

aging of skin

blister

burns: first degree  
second degree  
third degree

callus

cellulite

cyanosis

decubitus ulcer

dermatitis

liposuction

psoriasis

scar

skin cancer: basal cell carcinoma  
melanoma  
squamous cell carcinoma

skin color

skin grafts

stretch marks

wound healing

### B. Draw each of the following. Label the parts and briefly explain their functions.

1. Cross section of skin including all of the layers of the epidermis, dermis and hypodermis.

2. Longitudinal section of a hair follicle including all of its associated structures (arrector pili, sebaceous glands, etc.)

**C. Sample multiple choice questions. Choose the best answer.**

1. The region of the skin which provides the greatest protection against abrasion is the
  - A. hypodermis
  - B. reticular layer
  - C. stratum basale
  - D. basement membrane
  - E. stratum corneum
  
2. When doing DNA fingerprinting for solving crimes, live cells must be used. Which region of a hair is used to identify a suspect?
  - A. hair bulb
  - B. hair root
  - C. hair papilla
  - D. hair shaft
  - E. hair follicle
  
3. Keratinocytes are found in which layer of the skin?
  - A. stratum basale
  - B. stratum granulosum
  - C. papillary layer
  - D. both A and B
  - E. all of the above



# Skeletal System

## Types of cartilage

1. hyaline cartilage: costal cartilage, trachea, joints
2. elastic cartilage: ears, nose
3. fibrocartilage: between vertebrae, pubic symphysis, knee

## Histology of bone

### bone cells

1. osteoblasts - lay down matrix
2. osteocytes - mature bone cells in lacunae
3. osteoclasts- demineralize matrix

### extracellular matrix

1. tricalcium phosphate (hydroxyapatite), calcium carbonate, and other minerals
2. reinforcing collagen fibers

## Types of bone tissue

### 1. compact bone

#### osteon

central canals

artery, vein, nerve, lymphatic vessel

perforating canals

canaliculi

lamellae

interstitial lamellae

osteocytes

lacunae

### 2. spongy bone

#### trabecula

osteocytes

lacunae

canaliculi

endosteum

## Structure of a long bone

diaphysis: compact bone  
medullary cavity

yellow marrow

epiphysis: spongy bone

red marrow

epiphyseal line

articular cartilage

nutrient foramina

periosteum

endosteum

## Skeletal System Review

### A. Define each of the following terms and explain their anatomical basis.

bone growth

bone remodeling

cartilage growth

fractures

closed (simple)

comminuted

compression

greenstick

hairline

open (compound)

spiral

stress

osteophytes (bone spurs)

osteoporosis

shin splints

### B. Draw each of the following. Label the parts and briefly explain their functions.

1. Cross section of an osteon.
2. Sagittal section of a typical long bone.
3. A series of illustrations showing endochondral ossification.

### C. Sample multiple choice questions. Choose the best answer.

1. In a five year old child, endochondral ossification is occurring in the  
A. epiphyseal plates                      B. sesamoid bones                      C. bones of the skull  
D. all of the above                      E. none of the above
2. The primary function of yellow bone marrow is:  
A. fat storage.                      B. blood cell formation.                      C. collagen production.  
D. to prevent collapse of trabeculae.                      E. to provide a blood supply to osteocytes in lacunae.
3. What happens when there is no blood flowing to a particular bone?  
A. nothing                      B. the body can not store fat                      C. the bone deteriorates  
D. the bone grows to compensate                      E. new vessels will grow from the red marrow

# Articulations

## Types of Joints

### A. Fibrous joint

1. suture: between bones of skull
2. syndesmosis: between radius and ulna

### B. Cartilaginous joint

1. synchondrosis: costal cartilage  
epiphyseal plate
2. symphysis: pubic symphysis  
intervertebral disc  
anulus fibrosus (annulus fibrosus)  
nucleus pulposus

### C. Synovial joint: most common joint

- examples:
1. hinge
  2. plane
  3. ball and socket

## Structure of a synovial joint

articular cartilage  
joint capsule: fibrous membrane, synovial membrane  
synovial fluid  
ligaments  
tendons  
meniscus - not associated with all synovial joints  
bursa- not associated with all synovial joints  
tendon sheath - - not associated with all synovial joints

## Articulations Review

### A. Define each of the following terms and explain their anatomical basis.

arthritis: gouty arthritis  
rheumatoid arthritis  
osteoarthritis

bursitis

"cracking" joints

herniated intervertebral disc

sprain

strain

tendinitis

torn cartilage

### B. Draw each of the following. Label the parts and briefly explain their functions.

1. Typical synovial joint
2. An intervertebral disc showing a herniation

### C. Sample multiple choice questions. Choose the best answer.

1. Which of the following statements is true about synovial fluid?  
A. It is derived from plasma.                      B. It nourishes the articular cartilage.  
C. It is made by the synovial membrane.        D. Both A and C.  
E. All of the above.
2. Which type of joint usually has the greatest number of ligaments compared to the others?  
A. plane joint                      B. ball and socket joint                      C. symphysis  
D. suture                      E. syndesmosis
3. Which of the following is true of osteoarthritis?  
A. it is caused by over use of a joint  
B. it is caused by putting pressure repeatedly on a joint  
C. it is an autoimmune disease  
D. it is characterized by the breakdown of articular cartilage  
E. it can be prevented by taking calcium supplements

# Muscular System

## Structure of skeletal muscle:

1. epimysium - dense regular CT
2. perimysium - dense CT
3. endomysium - very thin loose CT

## Types of skeletal muscles: based on fascicle arrangement

1. parallel
2. pennate
  - a. unipennate
  - b. bipennate
  - c. multipennate
3. convergent
4. circular (sphincter)

## Components of a skeletal muscle fiber (cell)

plasma membrane (sarcolemma)

many nuclei

mitochondria

myofibrils: actin and myosin organized into sarcomeres

T tubule

sarcoplasmic reticulum

## Smooth Muscle

- found around all internal organs
- single cells
- actin and myosin not organized
- not forceful contractions, but doesn't fatigue
- contraction due to nerve, hormones, change in environment e.g. oxygen, pH

## Cardiac Muscle

- single cells
- organized fibers
- gap junctions between cells
- intrinsic beat and neural control

## Muscular System Review

### A. Define each of the following terms and explain their anatomical basis.

atrophy

hypertrophy

muscle contraction

muscle regeneration

### B. Draw each of the following. Label the parts and briefly explain their functions.

1. Cross section of a muscle.
2. Different types of skeletal muscle fascicle arrangements.
3. Longitudinal section of a muscle fiber showing all organelles and structures.

### C. Sample multiple choice questions. Choose the best answer.

1. The epimysium is most similar in structure to
  - A. hypodermis
  - B. fibrocartilage
  - C. ligaments
  - D. synovial membranes
  - E. endomysium
2. Which of the following is true of myosin filaments?
  - A. they are only found in skeletal muscle
  - B. they are proteins
  - C. they shorten during contraction
  - D. both A and B
  - E. all of the above are true
3. Calcium is used in muscle contraction to
  - A. allow myosin to pull on actin
  - B. make ATP
  - C. make actin
  - D. produce an action potential
  - E. allow muscle to relax

## D. Lever System Problems

1. The gracilis muscle adducts the thigh (brings the thigh to the midline). It inserts on the tibia 40 cm. from the hip and 5 cm. distal to the knee. The center of weight of the lower limb is 30 cm. from the hip.
  - A. If the lower limb weighs 20 kg., how much force will the muscle need to move it?
  - B. If the muscle contracts 4 cm, how far will the knee move?
  - C. What type of lever system is this? What are the advantages and disadvantages of this lever system?
  
2. The quadriceps femoris inserts onto the tibial tuberosity 5 cm from the knee and is used to extend the knee. The center of weight of the leg is 15 cm from the knee. The foot is 30 cm from the knee.
  - A. If the leg weighs 6 kg, how much force will the muscle need to exert in order to move it?
  - B. If the muscle contracts 2 cm., how much will the foot move?
  - C. What type of lever system is this? What are the advantages and disadvantages of this type of lever system?
  
3. The triceps brachii muscle inserts onto the ulna 3 cm proximal to the elbow joint. The center of weight of the forearm is 6 cm distal to the joint. The hand is 30 cm from the elbow.
  - A. If the muscle exerts 20 kg. of force, how much force will be applied to the forearm?
  - B. If the muscle contracts 2 cm., how far will the hand move?
  - C. What type of lever system is this? What are the advantages and disadvantages of this type of lever system?
  
4. The coracobrachialis muscle is one of the flexors of the arm. It originates on the coracoid process of the scapula and inserts onto the middle of the humerus 15 cm from the shoulder joint. The center of weight of the arm is 10 cm from the shoulder joint.. The elbow is 20 cm from the shoulder.
  - A. If the muscle contracts 3 cm, how far will the elbow move?
  - B. If the arm weighs 10 kg, how much force will the muscle need to exert in order to move the arm?
  - C. What type of lever system is this? What are its advantages and disadvantages?
  
5. The masseter muscle inserts on the mandible 9 cm from the temporomandibular joint. The center of weight of the jaw is 12 cm from the joint. The molars are 3 cm. from the joint.
  - A. If you need 30 kg. of force in order to chew on some nuts, how much force will the muscle need to generate?
  - B. If the muscle contracts 2 cm, how many cm will the molars move?
  - C. What type of lever system is this? What are its advantages and disadvantages?

# Circulatory System

## Blood

### I. plasma

91.5% water

8.5% solutes

#### A. proteins

1. albumins

2. antibodies

3. clotting factors

4. lipoproteins - transport lipids HDL, LDL

#### B. nutrients

1. glucose

2. amino acids

#### C. wastes

urea

#### D. gasses

1. O<sub>2</sub>

2. CO<sub>2</sub>

3. N<sub>2</sub>

#### E. electrolytes (ions)

1. Na

2. K

3. Ca

4. Cl

### II. Cells

A. erythrocytes (red blood cells)

B. leukocytes (white blood cells)

C. platelets

## Heart

### I. Pericardium

A. parietal pericardium:

1. serous layer: simple squamous epithelium

2. fibrous layer: dense fibrous CT (often also has adipose tissue)

B. pericardial cavity: thin fluid filled cavity

C. visceral pericardium:

1. serous layer: simple squamous epithelium

2. fibrous layer: dense fibrous CT (often also has adipose tissue)

II. myocardium: cardiac muscle,

III. endocardium:

A. simple squamous epithelium

B. loose fibrous CT



### **Embryonic development of the heart**

day 21: two tubes form at ventral midline

day 23: heart tubes fuse and begin to contract

blood beginning to form and be pumped

day 23: atrium and ventricle develop

day 25: heart begins to twist moving atria anteriorly

day 28: atrial and ventricular septa begin to form

day 35: fetal heart development complete

## **Blood Vessels and Lymphatics**

### **Structure of blood vessels:**

#### I. tunica intima (t. interna)

A. endothelium - simple squamous epithelium

B. subendothelial layer - loose CT

#### II. tunica media

A. circularly arranged smooth muscle

B. elastic fibers (internal and external elastic laminae)

#### III. tunica adventitia (t. externa)

dense irregular CT which blends into the loose CT of the surrounding tissue

### **Types of vessels:**

#### I. arteries

A. elastic arteries

B. muscular arteries

C. arterioles

#### II. capillaries

A. continuous capillaries

B. fenestrated capillaries

C. discontinuous (sinusoid) capillaries

#### III. veins

A. venules

B. veins

#### IV. lymphatic vessels

A. lymphatic capillaries

B. lymphatic vessels

C. thoracic duct

#### V. lymphatic organs

A. lymph nodes

B. thymus

C. spleen

## **Circulatory System Review**

### **A. Define each of the following terms and explain their anatomical basis.**

anemia

aneurysm

angina

atherosclerosis

arteriosclerosis

bone marrow transplant

coronary bypass

deep vein thrombosis

edema

embolism

endocarditis

electrocardiogram

heart murmur

hemorrhoids

ischemia

leukemia

lymphoma

myeloma

myocardial infarction

patent ductus arteriosus

patent foramen ovale

pericarditis

phlebitis

prolapsed valve

splenectomy

stroke

systole and diastole

thrombosis

tonsilitis

varicose veins

**B. Draw each of the following. Label the parts and briefly explain their functions.**

1. Coronal section through the heart showing the chambers, valves, etc.

For drawings 2 through 6, draw them proportional to each other on a single sheet of paper, and label the layers and tissues.

2. Cross section of an elastic artery.

3. Cross section of a muscular artery

4. Cross section of an arteriole.

5. Cross section of a continuous capillary.

6. Cross section of a vein.

7. A typical capillary bed.

**C. Sample multiple choice questions. Choose the best answer.**

1. The first sound of a heartbeat is caused by the

- |  |  |
|--|--|
| A. contraction of the atria                | B. contraction of the ventricles           |
| C. opening of the atrio-ventricular valves | D. closing of the atrio-ventricular valves |
| E. closing of the semilunar valves         |  |

2. Which of the following is true of lymph nodes?

- |   |                                  |
|---|----------------------------------|
| A. they are found throughout the body   | B. they filter wastes from blood |
| C. they filter wastes from tissue fluid | D. they pump lymphatic fluid     |
| E. they serve no function               |                                  |

3. When taking a blood test, you have your finger poked. Which type of vessel is not severed?

- |                         |                          |                        |
|-------------------------|--------------------------|------------------------|
| A. arteriole            | B. venule                | C. lymphatic capillary |
| D. continuous capillary | E. fenestrated capillary |                        |

4. What is the function of the vasa vasorum?

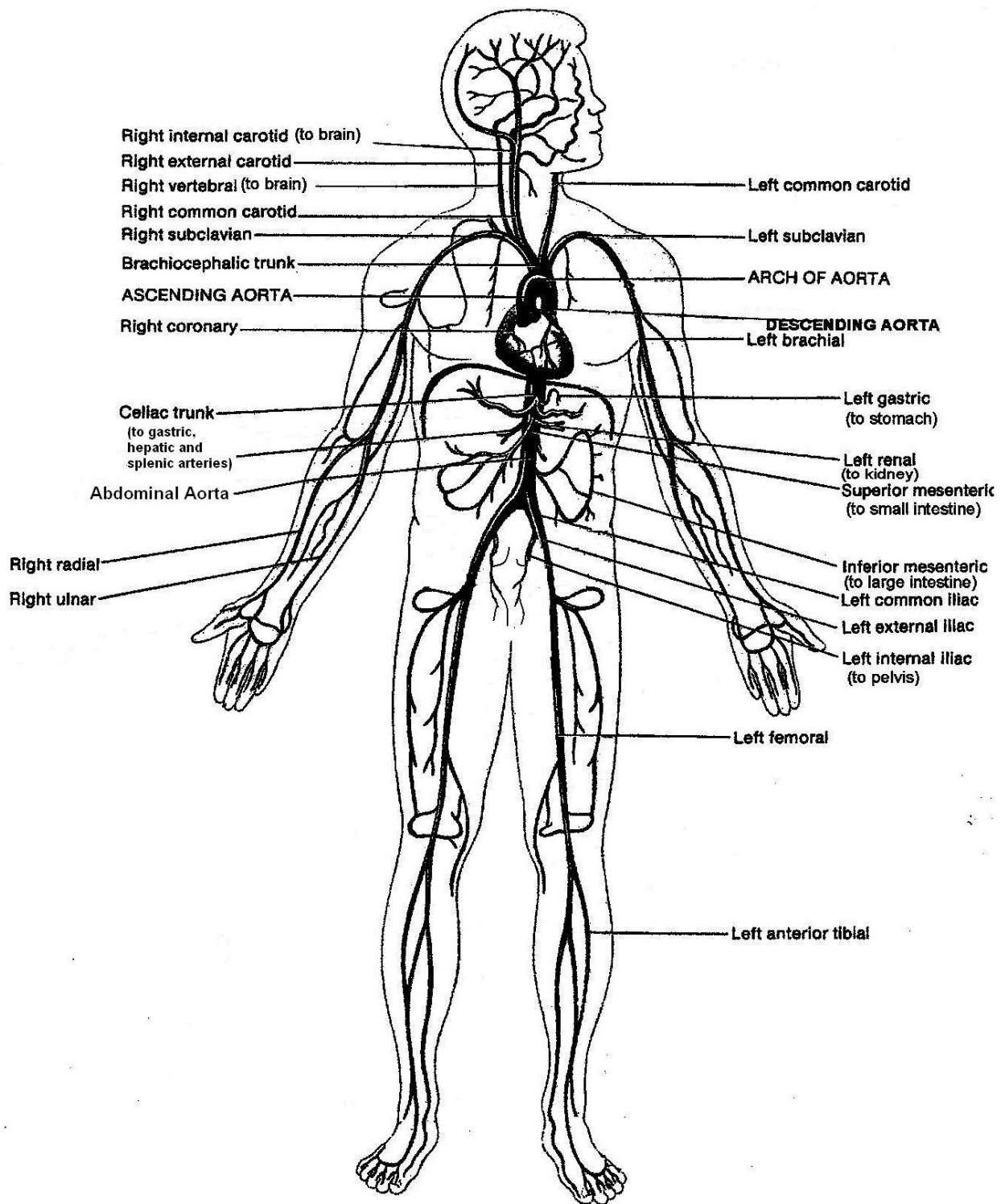
- |   |   |
|---|---|
| A. to supply the arterioles with nutrients        | B. to supply the tunica intima with nutrients |
| C. to supply the tunica adventitia with nutrients | D. both A and B                               |
| E. all of the above                               |   |

5. Lymphatic fluid contains all of the following except

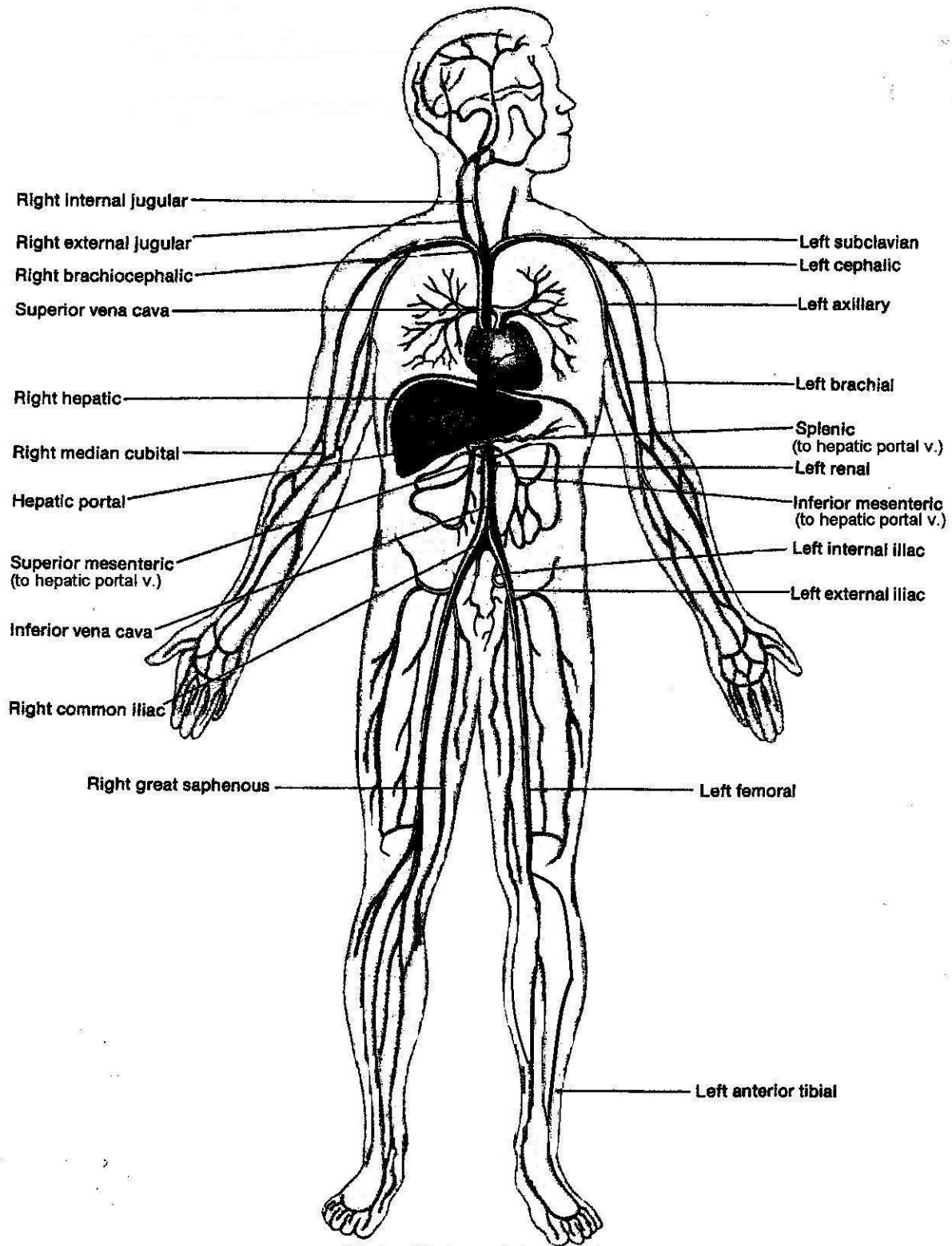
- |              |  |                 |
|--------------|--|-----------------|
| A. platelets | B. leukocytes                                    | C. erythrocytes |
| D. sodium    | E. both A and C are not found in lymphatic fluid |                 |

**D. Be able to trace the flow of blood between any two regions of the body. For example:**

1. arm to brain
2. small intestine to knee



Major Arteries of the Body



**Major Veins of the Body**

# Respiratory System

## Parts of the Respiratory System

### I. Nose

- A. nasal cartilages
- B. nasal cavity
  - connected to: sinuses, lacrimal duct, auditory tube

### II. Pharynx

- A. nasopharynx
- B. oropharynx
- C. laryngopharynx

### III. Larynx

- A. epiglottis
- B. thyroid cartilage
- C. vocal cords
- D. arytenoid cartilage
- E. cricoid cartilage

### IV. Trachea

#### **Histology of the trachea and bronchioles:**

- A. mucosa:
  - 1. ciliated pseudostratified epithelium with goblet cells
  - 2. lamina propria: loose fibrous CT with lots of elastic fibers
- B. submucosa: loose fibrous CT with seromucous glands
- C. adventitia: dense CT with hyaline cartilage

### V. Bronchi

### VI. Bronchioles

### VII. Alveoli

### VIII. Pleura

- A. parietal pleura
  - 1. simple squamous epithelium
  - 2. very thin loose CT
- B. pleural cavity
- C. visceral pleura
  - 1. simple squamous epithelium
  - 2. very thin loose CT

## Respiratory System Review

### A. Define each of the following terms and explain their anatomical basis.

asthma

bronchitis

chronic obstructive pulmonary disease

cough

chronic obstructive pulmonary disease (COPD)

emphysema

hiccup

laryngitis

lung cancer

pleurisy

pneumonia

pneumothorax

respiratory distress syndrome

sinusitis

tracheotomy

### B. Draw each of the following. Label the parts and briefly explain their functions.

1. A coronal section through the body showing all parts of the respiratory system including nasal cavity, larynx, bronchi, etc.

For drawings 2 and 3, draw them proportional to each other on a single sheet of paper, and label the layers and tissues

2. Cross section of the trachea or a bronchus.

3. Cross section of a bronchiole.

### C. Sample multiple choice questions. Choose the best answer.

1. Which of the following is not a function of mucus in the respiratory system?

- A. prevent the epithelium from drying out
- B. humidify the air
- C. clean the air
- D. nourish the cilia
- E. none of the above are functions of mucus

2. The parietal pleura is most similar in structure to the

- A. alveoli
- B. visceral pericardium
- C. tendons and ligaments
- D. papillary layer of the skin
- E. tunica adventitia

3. The nasal cavity is directly connected to the

- A. nasopharynx
- B. paranasal sinuses
- C. middle ear
- D. eye
- E. all of the above

# Nervous System

## Introduction to the nervous system

Parts of a neuron:

1. cell body
2. dendrites
3. axons
4. synapses
  - a. synaptic knobs
  - b. synaptic vesicles
  - c. synaptic cleft
  - d. post-synaptic cell

### Action potential:

1. Wave of depolarization - sodium enters neuron
2. Wave of repolarization - potassium leaves neuron

### Types of glia:

1. oligodendrocyte
2. Schwann cell
3. astrocytes
4. microglia

## Central Nervous System

### Brain

#### A. Cerebrum

- gyrus
  - sulcus
  - cerebral hemisphere
  - longitudinal fissure
  - commisure
  - contralateral innervation
1. frontal lobe
    - pre-central gyrus (primary motor cortex)
    - central sulcus
  2. parietal lobe
    - post-central gyrus (primary somatosensory cortex)
  3. temporal lobe
    - lateral sulcus
  4. occipital lobe
  5. basal ganglia



B. Cerebellum

C. Thalamus

D. Pineal gland

E. Limbic system

1. hippocampus
2. pre-frontal lobe
3. olfactory bulbs
4. hypothalamus

F. Brain stem

1. midbrain
2. pons
3. medulla

### **SPINAL CORD**

anterior median fissure

posterior median sulcus

central canal

gray matter: anterior horn, posterior horn

posterior root - sensory - posterior root ganglion

anterior root - motor

spinal nerve

### **Reflex arc**

sensory neuron

association neuron

motor neuron

### **Spinal tracts**

I. motor tracts

A. corticospinal tract - controls movement

B. vestibulospinal tract - maintains equilibrium

II. sensory tracts

A. dorsal column pathways - touch

B. spinocerebellar tract - proprioception

### **Meninges**

A. dura mater

1. periosteal layer
2. meningeal layer

B. arachnoid mater

C. pia mater

## **Ventricles**

- A. lateral ventricles
- B. third ventricle  
    cerebral aqueduct
- C. fourth ventricle
- D. central canal of spinal cord

## **Peripheral Nervous System**

### **Structure of a nerve:**

- A. epineurium
- B. perineurium
- C. endoneurium

## **AUTONOMIC NERVOUS SYSTEM**

### **A. Sympathetic (thoracolumbar) division**

Function: increase heart rate, dilation of bronchioles, increase metabolic activity, decrease digestion, increase sweat, dilation of pupils, constriction of blood vessels in skin, etc.

- Anatomy:
- 1. preganglionic axons exit spinal cord T1 - L2
  - 2. sympathetic trunk (chain) ganglia 22 - 24 ganglia on each side next to spinal cord
  - 3. short preganglionic axons, long postganglionic axons
  - 4. some preganglionic axons bypass sympathetic trunk and synapse in abdomen (solar plexus)

### **B. Parasympathetic (craniosacral) division**

Function: decrease heart rate, constriction of bronchioles, decrease metabolic activity, increase digestion, constriction of pupils, etc.

- Anatomy:
- 1. preganglionic axons exit from brain (cranial nerves) and from sacral region
  - 2. long preganglionic axons, short postganglionic axons
  - 3. ganglia in or near target organ
  - 4. does not innervate the skin

## CRANIAL NERVES

<u>Nerve</u>	<u>Name</u>	<u>Function</u>
I.	olfactory nerve	Sensory nerve for smell from nasal cavity
II.	optic nerve	Sensory nerve for vision from retina
III.	oculomotor nerve	Motor nerve* to 4 of the 6 extrinsic eye muscles Parasympathetic nerve to iris and ciliary muscles
IV.	trochlear nerve	Motor nerve* to 1 of the 6 extrinsic eye muscles
V.	trigeminal nerve	This nerve has three major divisions:
	V <sub>1</sub> ophthalmic division	Sensory nerve (touch, pain, etc.) from upper third of face
	V <sub>2</sub> maxillary division	Sensory nerve from middle third of face and upper teeth
	V <sub>3</sub> mandibular division	Sensory nerve from lower third of face and lower teeth Motor nerve* to muscles of mastication
VI.	abducens nerve	Motor nerve* to 1 of the 6 extrinsic eye muscles
VII.	facial nerve	Sensory nerve from taste buds Motor nerve* to muscles of facial expression Parasympathetic nerves to lacrimal, nasal, and most salivary glands
VIII.	vestibulocochlear nerve	Sensory nerve for hearing and balance from inner ear
IX.	glossopharyngeal nerve	Sensory nerve (touch, pain, etc.) from posterior tongue and pharynx and some taste buds Motor nerve* to muscles involved in swallowing Parasympathetic nerve to one salivary gland
X.	vagus nerve	Sensory nerve from thoracic and abdominal organs Parasympathetic nerve to thoracic and abdominal organs
XI.	accessory nerve	Motor nerve* to muscles of larynx and pharynx, trapezius and sternocleidomastoid muscles
XII.	hypoglossal nerve	Motor nerve* to muscles of tongue

\*All motor nerves also carry proprioceptive neurons which are sensory neurons.

## Nervous System Review

### A. Define each of the following terms and explain their anatomical basis.

gray matter

white matter

nerve

tract

nucleus

ganglion

nerve plexus

motor neuron (efferent neuron)

sensory neuron (afferent neuron)

association neuron (interneuron)

### Central Nervous System

Alzheimer's disease

blood-brain barrier

coma

dementia

encephalitis

epidural injection

hydrocephalus

Lewy body dementia

lumbar puncture

meningitis

multiple sclerosis

paralysis

subdural hemorrhage

transient ischemic attack

### Peripheral Nervous System

Bell's palsy

dermatomes

nerve regeneration

neuritis

pinched nerve

referred pain

shingles

trigeminal neuralgia

**B. Draw each of the following. Label the parts and briefly explain their functions.**

1. Myelinated neuron and synapse. Describe how an action potential travels down a neuron.
2. Lateral view of the brain showing the various regions of the brain including the lobes.
3. Cross section of a spinal cord showing a simple reflex arc.
4. Sagittal section of the head showing the ventricles and meninges. Describe how cerebrospinal fluid flows through the CNS.
5. Cross section of a nerve.
6. A view of the body showing parasympathetic and sympathetic nerves and ganglia.

**C. Sample multiple choice questions. Choose the best answer.**

1. Which of the following statements about dendrites is true?  
A. Dendrites are unmyelinated.                      B. Most neurons have only one or two dendrites.  
C. Dendrites manufacture neurotransmitter.      D. Dendrites are found in nerves.  
E. All of the above are true.
2. The cauda equina is:  
A. the roots of spinal nerves at the inferior end of the spinal cord within the vertebral column.  
B. the dermatomes that originate in the lower parts of the spinal cord.  
C. the tapered end of the spinal cord.  
D. an extension of the pia mater that anchors the spinal cord to the coccyx.  
E. where the cell bodies of sensory neurons are located.
3. Damage to the cerebellum would result in:  
A. loss of memory.                      B. uncoordinated movement.                      C. inability to dream.  
D. altered pituitary function.      E. uncontrollable body temperature.
4. If you want to test the cerebrospinal fluid, you take it from level L<sub>4</sub>. Why?  
A. The dura mater is very thin there.                      B. There are no spinal nerves there.  
C. That is where cerebrospinal fluid accumulates.      D. It is a painful place to draw the fluid.  
E. There is no spinal cord there.
5. Which of the following occurs during an action potential?  
A. sodium enters the neuron                      B. potassium enters the neuron  
C. sodium leaves the neuron                      D. both A and B  
E. both B and C
6. Which of the following is true of a reflex arc?  
A. It never involves the cranial nerves.                      B. It does not involve the anterior root.  
C. It does not usually involve more than three neurons.      D. It does not involve motor neurons.  
E. All of the above are true.

# Sense Organs

- I. Somatic senses: mostly in skin - touch, pressure, pain, heat, cold,
- II. Proprioceptors: - in muscles and joints - relay information to cerebellum about movement
- III. Visceral senses: - fullness - of bladder, stomach, blood pressure, internal pain, CO2 levels, etc
- IV. Olfactory senses: smell  
receptors in upper part of nasal cavity - chemoreceptors
- V. Gustatory sense: taste  
taste buds located on dorsum of tongue, some on soft palate and oropharynx

## Anatomy of taste buds

- gustatory cells - chemoreceptors
- supporting cells
- sensory neurons

## VI. Vision

### A. Anatomy of the exterior of the eye

- 1. orbit
- 2. extrinsic eye muscles
- 3. eyelids - cilia
- 4. glands
  - a. lacrimal glands
  - b. lacrimal caruncle
  - c. tarsal glands
  - d. ciliary sebaceous glands

### B. Anatomy of the eye

- 1. Conjunctiva
- 2. Fibrous tunic
  - a. sclera
  - b. cornea
- 3. Vascular tunic
  - a. choroid
  - b. ciliary body
  - c. lens
  - d. iris
- 4. Retina
  - a. pigment layer
  - b. photoreceptor layer - rods and cones
  - c. nervous layer
  - d. blood vessels

C. Cavities of the eye

1. Anterior cavity - filled with aqueous humor
2. Posterior cavity - filled with vitreous humor

VII. Hearing and balance

A. Outer ear

1. auricle (pinna)
2. external auditory canal
3. tympanic membrane

B. Middle ear

1. middle ear bones:- malleus (hammer), incus (anvil), stapes (stirrup)
2. stapedius muscle
3. auditory tube

C. Inner ear

1. bony labyrinth - perilymph
2. membranous labyrinth - endolymph
3. cochlea
  - a. hair cells
  - b. tectorial membrane
4. semicircular canals
5. vestibule

## Senses Review

### A. Define each of the following terms and explain their anatomical basis.

astigmatism  
cataract  
conduction deafness  
conjunctivitis  
detached retina  
epicanthic folds  
glaucoma  
macular degeneration  
middle ear infection  
myopia  
nerve deafness  
presbyopia  
vertigo

### B. Draw each of the following. Label the parts and briefly explain their functions.

1. Sagittal section through the eye.
2. A section through the ear showing the outer, middle and inner ear including the vestibular system.

### C. Sample multiple choice questions. Choose the best answer.

1. Which of the following statements is true?
  - A. the vestibule is filled with endolymph
  - B. the semicircular canals have hair cells
  - C. otoliths are used to determine the position of the head
  - D. the vestibular system is within the bony labyrinth of the temporal bone
  - E. all of the above
2. "Bloodshot eyes" are the result of dilation of blood vessels in the \_\_\_\_ and "pink eye" is due to dilation of blood vessels in the \_\_\_\_:
  - A. lens, sclera
  - B. cornea, retina
  - C. sclera, conjunctiva
  - B. conjunctiva, sclera
  - E. choroid, sclera
3. Which of the following structures is transparent?
  - A. cornea
  - B. lens
  - C. vitreous humor
  - D. both A and B
  - E. all of the above



# Endocrine System

- A. Hypothalamus
- B. Pituitary
  - 1. Adenohypophysis (anterior pituitary)  
Hypothalamo-hypophyseal portal system
  - 2. Neurohypophysis (posterior pituitary)
- C. Thyroid gland
- D. Parathyroid gland
- E. Adrenal glands
  - 1. adrenal cortex
  - 2. adrenal medulla
- E. Pancreas - pancreatic islets
- F. Every other organ in the body - stomach, liver, ovaries, heart, etc.

## Endocrine System Review

### A. Define each of the following terms and explain their anatomical basis.

diabetes mellitus

goiter

### B. Draw each of the following. Label the parts and briefly explain their functions.

1. Draw a sagittal section through the inferior portion of the brain showing the hypothalamus and pituitary including the portal system.

### C. Sample multiple choice questions. Choose the best answer.

- 1. Almost all the organs of the body are considered to be parts of the endocrine system because
  - A. they help move hormones around the body
  - B. they are affected by hormones
  - C. they make hormones
  - D. they are necessary for maintaining homeostasis, without which hormones will not be made
  - E. they are also exocrine glands
- 2. The neurohypophysis
  - A. controls the endocrine system
  - B. releases thyroid stimulating hormone
  - C. does not contain a portal system
  - D. secretes insulin
  - E. is not really a gland

# Digestive System

Functions:     ingestion  
                  digestion  
                    mechanical digestion  
                    chemical digestion  
                  absorption

## Gastrointestinal tract

### I. Mouth (oral cavity)

- A. lined by a non-keratinized stratified squamous epithelium
  
- B. tongue
  
- C. salivary glands
  - 1. small intrinsic salivary glands throughout the oral cavity
  - 2. extrinsic salivary glands
    - a. parotid glands
    - b. submandibular glands
    - c. sublingual glands
  
- D. palate
  - 1. hard palate
  - 2. soft palate
  
- E. Teeth - 32 adult teeth - 20 deciduous teeth
  - 8 incisors
  - 4 canine
  - 8 bicuspid (premolars)
  - 12 molars

### Structure of a tooth

crown  
root  
enamel  
dentin  
pulp  
gingiva  
periodontal ligament

### Structure of the GI tract

#### I. Mucosa

- A. lining epithelium - varies depending on region
- B. lamina propria - thin layer of loose connective tissue
- C. muscularis mucosae - thin layer of smooth muscle

II. Submucosa - moderate density CT. many elastic fibers. many glands

### III. Muscularis externa

A. inner circular layer

B. outer longitudinal layer

in some regions this layer is thickened to form a sphincter

Either

### IV. Serosa (around most of GI tract)

visceral peritoneum - simple squamous epithelium with underlying loose CT

or

### IV. Adventitia (around esophagus, duodenum, rectum)

dense irregular CT loosening as you go out

## II. Esophagus

mucosa - non-keratinized stratified squamous epithelium

muscularis externa:    upper 1/3 skeletal muscle  
                                 middle 1/3 combination  
                                 lower 1/3 smooth muscle

## III. Stomach

function:

1. store food so that it slowly enters small intestine
2. churn food (mechanical digestion) and mix it with gastric secretions (chyme)
3. destroy bacteria
4. a small amount of digestion of proteins
5. a small amount of absorption (water, electrolytes)

Anatomy:

fundus  
cardiac region  
cardiac sphincter  
esophageal hiatus  
body  
pyloric region  
pyloric sphincter  
rugae

Histology:

mucosa: simple columnar epithelium with large numbers of goblet cells  
          gastric pits  
          gastric glands

muscularis externa: 3 layers - oblique layer for churning

#### **IV. Small Intestine**

function: digestion and absorption

Increase surface area

1. plicae circularis - folds in mucosa
2. villi - folds in epithelium
3. microvilli - folds in plasma membrane

- A. duodenum
- B. jejunum
- C. ileum

Histology

mucosa: simple columnar epithelium with many goblet cells  
villi contain lacteals  
intestinal crypt - site of cell division and enzyme production

#### **V. Large Intestine**

function:

absorbs water and electrolytes  
stores feces  
contains bacteria

Histology

mucosa - lined by simple columnar epithelium with many goblet cells  
muscularis externa - relatively weak - especially in older people

Gross Anatomy

ileocecal valve  
cecum  
appendix  
ascending colon  
transverse colon  
descending colon  
sigmoid colon  
rectum  
anus  
levator ani

#### **VI. Mesenteries and Peritoneum**

function: physically support organs and allow blood vessels and nerves to reach organs

## Gastrointestinal Tract Review

### A. Define each of the following terms and explain their anatomical basis.

acid reflux  
appendicitis  
caries  
colitis  
colonoscopy  
colon cancer  
constipation  
cramps  
diarrhea  
diverticulitis  
gastric ulcer  
gingivitis  
hiatal hernia  
impacted wisdom teeth  
periodontitis  
peritonitis  
polyp  
root canal therapy

### B. Draw each of the following. Label the parts and briefly explain their functions.

1. Section through a tooth.
2. Cross section of the esophagus.
3. Cross section of the small intestine.
4. Coronal view of the abdomen showing the large intestine and its parts.

### C. Sample multiple choice questions. Choose the best answer.

1. The function of the appendix is to  
A. regulate digestion                      B. control defecation                      C. store *E. coli*. bacteria  
D. all of the above                      E. none of the above
2. Most of the absorption of nutrients takes place in the  
A. ileum                      B. duodenum                      C. large intestine  
D. rectum                      E. stomach
3. The esophagus is different from the rest of the G.I. tract because it has  
A. no submucosa                      B. skeletal muscle in the muscularis externa  
C. no mucosal epithelium                      D. cartilage in the tunica adventitia  
E. all of the above

# Accessory Organs of the Digestive System

## I. Liver

functions: over 500 biochemical functions  
makes blood proteins (clotting factors, etc.)  
makes bile (stored in gall bladder)  
helps to regulate blood glucose levels  
processes fats, amino acids, carbohydrates  
makes cholesterol  
breaks down various toxins and drugs

anatomy: 2 lobes - left and right  
blood supply - hepatic artery and hepatic portal vein

histology: liver lobule  
central vein  
sinusoid  
hepatic triad (portal triad):  
bile duct  
venule from hepatic portal vein  
arteriole from hepatic artery  
hepatocytes  
kupffer cell

## II. Gall bladder

function: stores and concentrates bile

hepatic ducts  
cystic duct  
common bile duct

## III. Pancreas

functions: produces many digestive enzymes  
produces bicarbonate to neutralize acidity of chyme  
islet cells make insulin and other hormones

pancreatic acini  
pancreatic duct

## Accessory Digestive Organs Review

### A. Define each of the following terms and explain their anatomical basis.

cirrhosis

gall stones

hepatitis

jaundice

pancreatic cancer

### B. Draw each of the following. Label the parts and briefly explain their functions.

1. Liver lobule.

2. A view of the gall bladder and pancreas showing their ducts.

### C. Sample multiple choice questions. Choose the best answer.

1. Which of the following is not a function of the liver?

A. make blood proteins  
D. store calcium

B. make bile

C. destroy old erythrocytes

E. regulate the amount of glucose in the blood

2. Pancreatic islet cells are most similar to

A. seromucous gland cells  
D. pituitary cells

B. trachea epithelial cells

C. leukocytes

E. muscularis mucosae cells

3. Blood entering the hepatic portal vein comes from the

A. stomach

B. small intestine

C. spleen

D. both A and B

E. all of the above

# Urinary System

## I. Kidney

functions:

- removal of metabolic wastes from blood
- regulation of ion concentration (Na, K)
- regulations of pH
- maintaining blood volume
- maintaining blood pressure

External anatomy:

- renal capsule - dense CT
- adipose capsule - adipose tissue
- renal fascia - moderate to loose CT

Internal anatomy:

- renal medulla
- renal pelvis
- renal cortex
- renal pyramids
- calyx
- ureter

Blood vessels:

- renal artery and vein
- interlobar artery and vein
- arcuate artery and vein
- interlobular artery and vein

Nephron

Glomerulus:

- glomerular capsule - simple squamous epithelium
- afferent arteriole
- glomerular capillaries - fenestrated capillaries
- efferent arteriole
- juxtaglomerular apparatus - secretes hormones
- proximal convoluted tubule - simple cuboidal epithelium with microvilli
- descending limb of loop of Henle - simple squamous epithelium
- ascending limb of loop of Henle - simple cuboidal epithelium
- distal convoluted tubule - simple cuboidal epithelium
- collecting duct - simple cuboidal epithelium
- peritubular capillaries
- vasa recta

## II. Ureters

histology:

- A. mucosa
  1. transitional epithelium



2. lamina propria (lots of elastic fibers)

B. muscularis - 2 layers not neatly organized as in GI tract

1. longitudinal layer

2. circular layer

C. adventitia - dense gradually changing to loose CT

### **III. Urinary Bladder**

histology:

similar to ureters

mucosa has rugae

muscularis - very thick to empty bladder - detrusor muscle

stimulated by stretching of bladder

### **IV. Urethra**

histology - similar to ureter

urethral sphincter - controls urination

internal urethral sphincter - formed from detrusor muscle

external urethral sphincter - skeletal (voluntary) muscle

## Urinary System Review

### A. Define each of the following terms and explain their anatomical basis.

bladder infection(cystitis)

catheterization

dialysis

kidney stones

lithotripsy

polycystic kidney disease

urinary tract infection

### B. Draw each of the following. Label the parts and briefly explain their functions.

1. Sagittal section of a kidney.
2. A view of a nephron and its associated blood vessels.
3. Cross section of the ureter.

### C. Sample multiple choice questions. Choose the best answer.

1. Peristalsis occurs in which of the following?  
A. glomerular capillaries  
B. ureter  
C. nephron  
D. both A and B  
E. all of the above
2. Which of the following statements about the loops of Henle is true?  
A. they are located in the renal cortex  
B. they remove wastes from the nephron  
C. they allow water and ions to return to the blood  
D. they are where kidney stones first form  
E. all of the above are true
3. Which of the following is lined by a simple squamous epithelium?  
A. glomerular capillaries  
B. loops of Henle  
C. proximal convoluted tubules  
D. urethra  
E. both A and B

# Male Reproductive System

## I. Scrotum and Testes

function: regulates temperature of testes  
dartos muscle

**spermatic cord:** vas deferens  
spermatic artery  
spermatic vein  
nerves  
lymphatics  
cremaster muscle

**testes:** capsule  
septa  
lobules  
seminiferous tubules  
sustentacular (Sertoli) cells  
sperm  
acrosome  
head  
flagellum  
interstitial cells

## Epididymis:

function: stores sperm, allows sperm to mature

## II. Vas Deferens

function: carries sperm to urethra

## III. Seminal Vesicles

function: secretes 60% of semen fluid

## IV. Prostate gland

function: secretes 40% of semen fluid

## V. Bulbourethral glands

function: secrete mucus during erection - lubricates penile urethra for sperm

## VI. Penis

root - in perineum  
body  
glans  
prepuce (foreskin)  
3 cylinders of erectile tissue  
2 corpora cavernosa - posterior  
corpus spongiosum - contains urethra

## Male Reproductive System Review

### A. Define each of the following terms and explain their anatomical basis.

circumcision

enlarged prostate (prostatic hypertrophy)

inguinal hernia

prostate cancer

varicocele

vasectomy

testicular cancer

testicular torsion

undescended testes

### B. Draw the following. Label the parts and briefly explain their functions.

A midsagittal section showing the male reproductive system

### C. Sample multiple choice questions. Choose the best answer.

1. Which of the following statements is true?
  - A. The erectile tissue in the corpus spongiosum is not as rigid as in the corpora cavernosa
  - B. The corpus spongiosum is posterior to the corpora cavernosa
  - C. The bulb of the penis is within the perineum
  - D. Both A and C
  - E. All of the above
2. Inguinal hernias are
  - A. a result of the inguinal canal opening wider while straining the abdominal muscles.
  - B. a result of the inguinal canal opening wider during the descent of the testes.
  - C. much less common in women than in men
  - D. both A and B
  - E. all of the above
3. Prostatic hypertrophy is
  - A. a precancerous growth
  - B. almost never causes any problems
  - C. can be prevented by proper diet and exercise
  - D. all of the above are true
  - E. none of the above are true

# Female Reproductive System

## I. Ovaries

mesovarium - part of broad ligament

ovarian ligament - attaches ovary to uterus - continuous with the round ligament

layers: - superficial epithelium - visceral peritoneum

thin fibrous capsule

ovarian cortex - contains follicles (oocyte and follicular cells)

ovarian medulla - loose CT

## Menstrual Cycle (dates are approximate)

Day 1 - first day of menstruation

Day 7 - increase in estrogen -- build-up of stratum functionale of the uterus

Day 14 - large increase in estrogen and progesterone -- rapid build-up of stratum functionale

Day 28 - estrogen and progesterone levels drop – menstruation

## Ovarian Cycle (approximately 270 days)

Step 1. about 15 - 20 primary follicles begin to develop - due to hormone FSH

Step 2. secondary follicles form – begin secreting estrogen

Step 3. one graafian follicle matures – begins secreting large amounts of estrogen and progesterone

Step 4. (day 14 of menstrual cycle) graafian follicle forms blister on surface of ovary - ruptures releasing egg - ovulation

Step 5. remains of graafian follicle forms corpus luteum - secretes estrogen and progesterone which grows stratum functionale of the uterus

Step 6. if fertilization did not occur corpus luteum dies and becomes scar tissue (corpus albicans)

## II. Fallopian Tubes

function: move egg from ovary to uterus

site of fertilization

## III. Uterus

anatomy:

fundus

body

cervix

uterine wall

endometrium

stratum functionale

stratum basale

myometrium

perimetrium

## IV. Vagina

mucosa - rugae

non-keratinized stratified squamous epithelium.

lamina propria - lots of elastic fibers

muscularis

## **V. Vulva**

- mons pubis
- labia majora
- labia minora
- vestibule
  - vaginal orifice
  - urethral orifice
  - vestibular glands
- clitoris
- hymen

## **VI. Muscles of the pelvic floor**

- levator ani
- urogenital diaphragm
- central tendon of the perineum
- external anal sphincter
- external urethral sphincter
- bulbospongiosus

## Female Reproductive System Review

### A. Define each of the following terms and explain their anatomical basis.

cervical cancer

ectopic pregnancy

endometriosis

fibroids

menstrual cycle

pelvic inflammatory disease

prolapsed uterus

tubal ligation

urinary incontinence

uterine cancer

### B. Draw the following. Label the parts and briefly explain their functions.

A midsagittal section showing the female reproductive system

### C. Sample multiple choice questions. Choose the best answer.

1. Which of the following is a function of estrogen?

- A. Inhibiting the growth of primary follicles
- B. Stimulating the growth of the endometrium
- C. Stimulating the development of breasts
- D. Stimulating bone growth
- E. All of the above

2. The vaginal mucosa is lined by

- A. ciliated columnar epithelium
- B. simple squamous epithelium
- C. stratified squamous epithelium
- D. pseudostratified epithelium
- E. transitional epithelium

3. Sometimes, during childbirth, an episiotomy has to be performed in order to prevent tearing of the

- A. placenta
- B. myometrium
- C. cervix
- D. urethra
- E. external anal sphincter

# Development

Fertilization

Cleavages

Blastocyst

- inner cell mass
- trophoblast

Development of the placenta

- chorion
- chorionic villi
- umbilical cord
  - 2 umbilical arteries - from common iliac aa.
  - 1 umbilical vein - to hepatic v.

Development of the embryo

Gastrulation

- ectoderm - skin, nervous system
- mesoderm - muscle, bone, cardiovascular system, most connective tissues
- endoderm - GI tract and associated organs, lungs

Formation of amnion

**Organogenesis:**

- morphogenesis
- differentiation

Neurulation

- neural folds
- neural tubes
- neural crest

Somites

Limb Development

Development of GI tract, lungs

Facial Development

Development of external genitalia

Birth

Post-natal development



# Development Review

## A. Define each of the following terms and explain their anatomical basis.

amniocentesis

anencephaly

cleft lip and palate

cesarean section

conjoined twins

neonatal jaundice

placenta previa

situs inversus

spina bifida

## B. Draw each of the following. Label the parts and briefly explain their functions.

1. A cross section of an embryo just after neurulation.

2. A longitudinal section through an embryo just after neurulation.

## C. Sample multiple choice questions. Choose the best answer.

1. Which of the following are derived from the embryonic endoderm?

A. lungs

B. small intestine

C. heart

D. both A and B

E. all of the above

2. "Water breaking" during childbirth is

A. tearing of the placenta

B. tearing of the amnion

C. urination due increased abdominal pressure

D. the mucus plug popping out

E. secretions from the paraurethral glands

3. Which of the following continue to develop after birth?

A. skeletal system

B. nervous system

C. digestive system

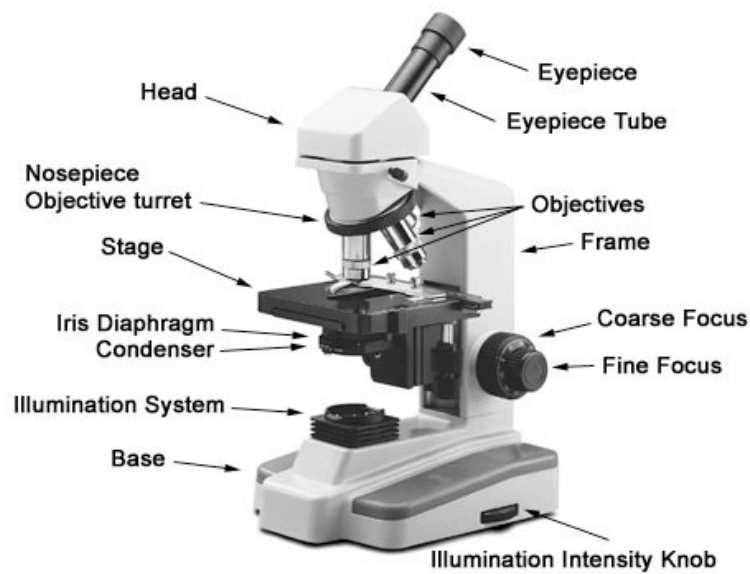
D. both A and B

E. all of the above

# Microscopy

Use and care of the microscope:

1. Always use two hands when carrying a microscope.
2. Once you set the microscope down on your table, do not move it. If you want to work with your lab partner, you move, not the microscope.
3. Always focus first on low power.
4. If you want to use medium or high power, only use the fine focus knob.
5. Move the stage down to change slides.
6. Put the microscope away as you found it and in its right place.



# Introduction to Histology

## Light vs. Electron Microscopy

light microscope resolution ~1  $\mu\text{m}$

electron microscope resolution ~ 1nm

scanning electron microscope

transmission electron microscope

## Slide preparation for light microscopy

A. obtaining a specimen (usually from biopsy or autopsy)

B. preserving the specimen

1. freezing

2. fixing in formaldehyde

C. hardening the specimen - replacing the water in the tissues with wax or plastic

D. sectioning (slicing) the specimen

Specimen needs to be sliced into sections that are 1 - 10  $\mu\text{m}$  thick.

E. placing the specimen on a slide

F. staining the specimen

Common stains:

1. hematoxylin: basic stain - blue - stains acids (DNA, etc.)

2. eosin: acidic stain - pink - stains proteins (collagen, cytosolic proteins)

# Skeletal System

## Types of bones:

long - bones of the limbs (clavicle is sometimes called a long bone, but it is an irregular bone)

flat - bones of the cranium, sternum

cuboidal (short) - carpal and tarsal bones

irregular - vertebrae, scapula, some bones of the skull, hyoid

sesamoid - patella, hand and foot sesamoid bones

## Parts of bones:

articular surface - the region where adjacent bones contact each other forming a joint

epiphysis - only on long bones - the ends of the bone

diaphysis - only on long bones - the shaft of the bone

process - a relatively large projection (part that sticks out) or prominent bump

tubercle/tuberosity - a projection or bump with a roughened surface

fossa - a smooth, shallow surface depression

condyle - a rounded articular process

epicondyle - a projection near a condyle but not part of the joint

spine - a relatively long, thin often pointy projection or bump

foramen - an opening through a bone

nutrient foramen - an opening to allow blood vessels and nerves to enter and exit a bone

ramus - a branch off the body of a bone that is at about a 90 degree angle to the rest of the bone

head - an enlargement of a bone at its proximal end

Note that whenever naming a part of a bone, the name of the entire bone name must be given. For example, “medial condyle of the humerus” or “ramus of the mandible.”

## Appendicular Skeleton

### **Pectoral Girdle:**

**clavicle** (*L: little key*)

**scapula** (*L: blade*)

superior border (superior margin)

medial border (vertebral margin)

lateral border (axillary margin)

inferior angle

superior angle

scapular spine

acromion process (*G: akros = highest + omos = shoulder*)

coracoid process (*L: raven-like because it looks like a raven's beak*)

scapular notch (suprascapular notch)

glenoid cavity (glenoid fossa) (*G: socket-like*)

supraspinous fossa

infraspinous fossa

subscapular fossa

### **Upper Limb:**

**humerus** (*L: shoulder*)

head

greater tubercle

lesser tubercle

surgical neck

anatomical neck

intertubercular groove (bicipital groove, intertubercular sulcus)

deltoid tuberosity

nutrient foramen (pl. nutrient foramina)

lateral epicondyle

medial epicondyle

olecranon fossa

trochlea (medial condyle) (*L: pulley*)

capitulum (lateral condyle) (*L: little head*)

**ulna** (*L: elbow*)

olecranon process (*G: olen = elbow + kranion = head*)

coronoid process (*L: crown-like*)

radial notch

semilunar notch (trochlear notch) (*L: half moon*)

styloid process (*L: pen-like*)

**radius**

head

radial tuberosity

styloid process

**carpals** (8 bones)

**scaphoid** (navicular) (*G: ship-like*)

**lunate** (*L: moon-shaped*)

**metacarpals** (5 bones)

**phalanges** (*G: fingers*)

**proximal phalanx**

**middle phalanx**

**distal phalanx**

**Pelvic Girdle:**

**os coxa** (innominate bone, coxal bone) (*L: innominate = bone with no name*) (*L: coxa = hip*)  
acetabulum (*L: vinegar cup - finger bowl one uses to rinse one's hand after a meal*)

obturator foramen (*L: to occlude - because nothing goes through this foramen*)

pelvic inlet

pelvic outlet

**ilium** (*L: side*)

iliac crest

iliac fossa

anterior superior iliac spine

anterior inferior iliac spine

posterior superior iliac spine

posterior inferior iliac spine

greater sciatic notch (*G: sciatic = hip*)

**ischium** (*G: hip*)

ischial spine

ischial tuberosity

lesser sciatic notch

**pubis**

pubic symphysis

pubic arch

**Lower Limb****femur** (*L: thigh*)

head

neck

greater trochanter (*G: trochanter = runner - muscles for running attach here*)

lesser trochanter

gluteal tuberosity (*L: gluteus = buttock*)

linea aspera (*L: rough line*)

lateral condyle

medial condyle

lateral epicondyle

medial epicondyle

**patella** (*L: pan - it is shaped like a pan*)

**tibia** (*L: flute, in ancient times flutes were made of tibiae*)

lateral condyle

medial condyle

tibial tuberosity

medial malleolus (*L: little mallet*)

anterior crest (anterior border)

**fibula** (*L: pin, the fibula and tibia look like the pin of a brooch - or a modern safety pin*)

head

lateral malleolus

**tarsals** (7 bones)

**talus** (*L: die, these bones from animals were used to make dice*)

**calcaneus** (*L: chalk - either because it is shaped like a chalk or was used as chalk*)

**metatarsals** (5 bones)

**phalanges**

**proximal phalanx**

**middle phalanx**

**distal phalanx**



# Axial Skeleton

## SKULL

**Cranium** (calvarium: upper part of cranium)

### frontal bone

supraorbital foramen (supraorbital notch)

coronal suture (*L: coronal = like a crown*)

frontal sinuses (*L: sinus = hollow space*)

superior orbital fissure

### parietal bones

sagittal suture

squamous suture (squamosal suture) (*L: scale-like, flat*)

### occipital bone (*L: against the head*)

occipital condyles

### unconscious

foramen magnum (for spinal cord and vertebral arteries) (*L: magnum = big*)

hypoglossal canal (for hypoglossal nerve) (*G: hypo = below + glossus = tongue*)

lambdoidal suture (*G: shaped like the Greek letter λ lambda*)

### temporal bones (*L: temporal = relating to time - where time shows its effect, where hair first turn gray*)

external auditory meatus (external acoustic meatus) (*L: meatus = passage*)

mastoid process (*G: breast-like*)

mastoid sinuses (mastoid air cells)

styloid process

zygomatic process (*G: yoke*)

carotid canal (for carotid artery) (*G: carotid = to make unconscious - pressing on it makes on unconscious*)

petrous portion (*G: rocky*)

jugular foramen (for jugular vein) (*L: throat*)

internal auditory meatus (internal acoustic meatus) (for vestibulocochlear nerve)

**sphenoid bone** (*G: wedge-shaped*)

sella turcica (*L: Turkish seat or saddle*)

greater wings

lesser wings

pterygoid processes (*G: wing-like*)

optic canal (for optic nerve)

foramen ovale (for trigeminal nerve) (*L: oval hole*)

foramen rotundum (for trigeminal nerve) (*L: round hole*)

sphenoid sinuses

inferior orbital fissure

foramen lacerum (*L: lacerate = tear*)

**ethmoid bone** (*G: sieve-like*)

cribriform plate (for olfactory nerves) (*L: crib shaped - a crib is a basket with holes, sieve*)

crista galli (*L: rooster's crest*)

perpendicular plate

ethmoid sinuses

middle nasal conchae (*L: conch = seashell*)

**wormian bones (sutural bones)** (*Named for Anatomist Ole Worm (1588–1654)*)

**Facial bones**

orbit (parts of frontal, ethmoid, sphenoid, maxilla, lacrimal bones)

zygomatic arch (zygomatic process of maxilla, zygomatic bone, zygomatic process of temporal bone)

nasal septum (vomer and perpendicular plate of ethmoid) (*L: septum = partition*)

hard palate (palatine processes of maxilla and palatine bones)

paranasal sinuses (frontal sinus, ethmoid sinus, sphenoid sinus, maxillary sinus)

**mandible** (*L: jaw*)

ramus

coronoid process

mandibular condyle

**maxilla** (*L: upper jaw*)

palatine process

zygomatic process

maxillary sinuses

infraorbital foramen (for trigeminal nerve)

**zygomatic bones** (*G: yoke*)

**nasal bones**

**lacrima bones** (*L: tear*)

**palatine bones** (*L: roof of the mouth*)

**vomer bone** (*L: plow*)

**inferior nasal conchae**

**Fetal/Neonatal Skull**

Note that there are two frontal and mandible bones

anterior fontanelle (*L: little fountain - because you can feel the pulse*)

posterior fontanelle

anterolateral (sphenoid) fontanelles

posterolateral (mastoid) fontanelles

**hyoid bone** (not part of skull) (*G: shaped like the Greek letter v upsilon*)

**VERTEBRAL COLUMN:** 7 cervical vertebrae, 12 thoracic vertebrae, 5 lumbar vertebrae

**atlas** (*Named for the Greek Titan who holds up the world*)

**axis** (*L: axle*)

dens (odontoid process) (*L: tooth*)

**other vertebrae**

spinous process

transverse processes

lamina (*L: layer*)

body

pedicle (*L: little foot*)

vertebral foramen

intervertebral disc

intervertebral foramina

superior articular processes

inferior articular processes

6 articular facets for ribs on each thoracic vertebra (*L: facet = little face*)

pair of transverse foramina on each cervical vertebra

**sacrum** (*L: holy - probably a mistranslation of the Greek word for strong*)

sacral canal

dorsal (posterior) sacral foramina

ventral (anterior) sacral foramina

median sacral crest

**coccyx** (*G: cuckoo - because it resembles a cuckoo's beak*)

**ribs:** 7 pairs of true ribs, 5 pairs of false ribs (the inferior 2 pairs of false ribs are floating ribs)  
head

neck

facets for articulation

tubercle

costal cartilage

**sternum** (*G: chest, breast bone*)

manubrium (*L: handle - the sternum looks like a sword with the xiphoid as the blade*)

body

xiphoid (*G: sword*)

### **Clinical terms relating to the appendicular skeleton**

broken clavicle

dislocated shoulder

separated shoulder

dislocated elbow

broken wrist

broken scaphoid

broken hip

broken ankle

### **Clinical terms relating to the axial skeleton**

skull fractures

deviated septum

scoliosis (*G: twisting*)

kyphosis (*G: humpback*)

whiplash injuries (*the head snaps back like a whip*)

# Types of Movements

flexion

extension

hyperextension

abduction

adduction

rotation

circumduction

protraction

retraction

elevation

depression

pronation

supination

dorsiflexion

plantarflexion

inversion

eversion

## **Practice questions:**

1. If a patient is laying on her back with her lower limbs straight, her hips are \_\_\_\_\_.
2. A person kicks a soccer ball with the foot. What is the movement of the knee? \_\_\_\_\_
3. You are scratching you lower back. What is the position of the shoulder? \_\_\_\_\_

# Major Surface Landmarks

glabella (root of nose) (*L: bald - hairless region between the eyes*)

bridge of nose

dorsum of nose

ala of nose (*L: wing*)

nostrils

philtrum (*G: love potion - the upper lip was thought to be one of the most erotic parts of the body*)

auricle (pinna)

helix

tragus (*L: goat - old men often have hair on the tragus which looks like the beard of a goat*)

ear lobe

thyroid cartilage (Adam's apple) (*G: thyroid = shield shaped*)

jugular notch

nipple

areola (*L: small open space*)

costal margin

cubital region (*L: elbow*)

umbilicus (naval)

inguinal region (*L: groin*)

gluteal cleft (natal cleft)

perineum (*L: near the anus*)

popliteal region (*L: back of the knee*)

# Muscular System

## KEY:

H: know this muscle in the human.

C: know this muscle in the cat

C\*: the muscle in the cat is substantially different from that of the human

## Muscles of Facial Expression

frontalis (H)

o(origin): galea aponeurotica

i(insertion): skin of eyebrows

a(action): raises eyebrows; wrinkles forehead

orbicularis oculi (H) (*L: around the eye*)

o: frontal and maxillary bones

i: eyelid

a: closing eye; squinting

risorius (H) (*L: to laugh*)

o: fascia in cheek

i: corner of mouth

a: moves the corner of the mouth laterally

zygomaticus (H)

o: zygomatic bone

i: corner of mouth

a: raises corner of mouth in smiling

orbicularis oris (H) (*L: around the mouth*)

o, i: encircles mouth

a: closes lips; protrudes lips

platysma (H) (*G: flat*)

o: fascia of chest

i: lower margin of mandible

a: tenses skin of neck

## Muscles of Mastication

masseter (H) (*G: to chew*)

o: zygomatic arch

i: ramus of mandible

a: primary elevator of mandible

temporalis (H)

o: temporal and parietal bones

i: coronoid process of mandible

a: elevates mandible



### **Muscles of the Anterior Neck**

digastric (H,C) (*L: two stomachs - there are two muscle bellies*)

o: mastoid process of temporal bone

i: lower margin of mandible (via hyoid bone)

a: primary depressor of mandible; elevates hyoid during swallowing

mylohyoid (H,C) (*G: mylo = molar - the muscle extends from the sides of the mandible to the hyoid*)

o: medial surface of mandible

i: midline (where the two muscles meet) and hyoid

a: elevates floor of mouth

sternohyoid (H, C)

o: manubrium

i: hyoid

a: depresses hyoid

sternocleidomastoid (H,C\*) (*sternum and clavicle to the mastoid process of the temporal bone*)

o: manubrium and medial clavicle

i: mastoid process of temporal bone

a: flexes and rotates head

### **Muscles of the Pectoral Girdle**

trapezius (H,C) (*L: trapezoid shaped*)

o: thoracic and cervical vertebrae and occipital bone

i: spine of scapula and clavicle

a: rotates scapula; retracts scapula

rhomboideus major and minor (H,C\*) (*L: rhombus shaped*)

o: upper thoracic vertebrae

i: medial border of scapula

a: stabilizes scapula; retracts scapula

supraspinatus (H,C)

o: supraspinous fossa of scapula

i: greater tubercle of humerus

a: stabilizes humerus (as when carrying a suitcase)

infraspinatus (H,C)

o: infraspinous fossa of scapula

i: greater tubercle of humerus

a: stabilizes humerus (as when carrying a suitcase)

subscapularis (H,C)

o: subscapular fossa of scapula

i: lesser tubercle of humerus

a: rotates arm medially; stabilizes humerus (as when carrying a suitcase)

teres minor (H) (*L: round*)

o: lateral border of scapula

i: greater tubercle of humerus

a: rotates arm laterally and stabilizes humerus (as when carrying a suitcase)

teres major (H,C)

o: posterior surface of scapula

i: lesser tubercle of humerus

a: extends and adducts arm

pectoralis major (H,C\*) (*L: chest*)

o: sternum and upper costal cartilages

i: intertubercular groove of humerus

a: flexes and adducts arm

pectoralis minor (H)

o: ribs 3, 4, and 5

i: coracoid process of scapula

a: protracts and depresses scapula

serratus anterior (H,C) (*L: serrated*)

o: ribs 1 - 8

i: medial border of scapula

a: protracts scapula (used in pushing objects, punching)

latissimus dorsi (H,C) (*L: broadest muscle of the back*)

o: lower thoracic and lumbar vertebrae

i: intertubercular groove of humerus

a: primary extensor of arm (used in bringing arm down in swimming)

deltoid (H,C\*) (*L: triangle shaped*)

o: spine of scapula

i: deltoid tuberosity of humerus

a: primary abductor of arm

rotator cuff (H)

### **Muscles of the Arm**

triceps brachii (H,C) (*L: three headed muscle of the arm*)

o: proximal humerus; scapula

i: olecranon process of ulna

a: extensor of forearm

biceps brachii (H,C) (*L: two headed muscle of the arm*)

o: scapula

i: radial tuberosity

a: flexor of forearm

brachialis (H)

- o: anterior distal humerus
- i: coronoid process of ulna
- a: flexor of forearm

brachioradialis (H,C)

- o: distal end of humerus
- i: styloid process of radius
- a: flexes forearm

### **Muscles of the Forearm**

pronator teres (H,C)

- o: proximal end of ulna
- i: middle of radius
- a: pronates forearm

flexor carpi radialis (H,C)

- o: medial epicondyle of humerus
- i: base of metacarpals
- a: flexes and abducts wrist

palmaris longus (H,C\*)

- o: medial epicondyle of humerus
- i: palm aponeurosis
- a: flexor of wrist

flexor carpi ulnaris (H,C)

- o: medial epicondyle of humerus
- i: base of fifth metacarpal
- a: flexor and adductor of wrist

flexor digitorum superficialis (H,C)

- o: medial epicondyle of humerus
- i: middle phalanges of fingers
- a: flexes fingers

flexor digitorum profundus (H)

- o: anterior surface of ulna
- i: distal phalanges of fingers
- a: flexes fingers

extensor carpi radialis (longus and brevis) (H,C)

- o: lateral epicondyle of humerus
- i: base of second metacarpal
- a: extends and abducts wrist

extensor pollicis longus and brevis (H) (*L: pollex = thumb*)

- o: distal radius and ulna
- i: proximal and distal phalanges of thumb
- a: extend thumb

extensor digitorum (H,C)

- o: lateral epicondyle of humerus
- i: distal phalanges of fingers
- a: extends fingers

extensor carpi ulnaris (H,C)

- o: lateral epicondyle of humerus
- i: base of fifth metacarpal
- a: extends and adducts wrist

flexor retinaculum (H) (*L: retinaculum = a restraint - it holds the tendons in place*)

### **Muscles of the Palm**

thenar muscles (H) (*G: thumb*)

This is a group of 4 muscles that flex and adduct the thumb.

palmar muscles (H)

These are 3 groups of muscles that abduct, adduct, and flex the fingers.

### **Muscles of the Trunk**

external intercostals (H,C)

- o: inferior border of each rib
- i: superior border of rib below
- a: elevates ribs

internal intercostals (H)

- o: superior border of each rib
- i: inferior border of rib above
- a: depresses ribs

external oblique (H,C)

- o: distal margins of lower ribs
- i: linea alba, inguinal ligament
- a: flex abdomen; compress abdomen

internal oblique (H,C)

- o: iliac crest
- i: linea alba; inguinal ligament
- a: flex abdomen; compress abdomen

transverse abdominis (H,C)  
o: lumbar vertebrae  
i: linea alba; inguinal ligament  
a: flex abdomen; compress abdomen

rectus abdominis (H,C)  
o: pubic symphysis  
i: costal cartilages  
a: flex abdomen; compress abdomen

erector spinae (H) This is a group of muscles which run along the dorsal surfaces of the vertebrae and extends the back.

### **Muscles of the Pelvic Girdle**

sartorius (H,C) (*L: tailor - tailors used to sit cross legged as they sewed*)  
o: anterior superior iliac spine  
i: medial portion of proximal tibia  
a: flexes and laterally rotates thigh (crosses legs)

gluteus maximus (H,C)  
o: dorsal ilium and sacrum  
i: gluteal tuberosity of femur  
a. primary extensor of thigh when walking  
- note the sciatic nerve deep to the muscle

gluteus medius (H,C)  
o: lateral surface of ilium  
i: lateral portion of proximal femur  
a: abducts thigh

adductor magnus (H,C)  
o: pubis and ischial tuberosity  
i: medial portion of femur  
a: adducts thigh

gracilis (H,C) (*L: thin, graceful*)  
o: pubis  
i: medial surface of proximal tibia  
a: adducts thigh

### **Muscles of the Thigh**

quadriceps femoris (C): rectus femoris, vastus lateralis, vastus medialis, vastus intermedius (H)  
o: different origins along the femur for each muscle  
i: tibial tuberosity via patellar ligament  
a: extends knee especially when walking

hamstrings (C): biceps femoris, semitendinosus, semimembranosus (H)  
o: ischial tuberosity  
i: lateral condyle of tibia (biceps femoris)  
    medial condyle of tibia (semitendinosus, semimembranosus)  
a: flexes knee

### **Muscles of the Leg**

tibialis anterior (H,C)  
o: upper 2/3 of tibia  
i: first metatarsal  
a: dorsiflexion and inversion of foot

peroneus longus (fibularis longus) (H,C) (*G: peroneus = pin*)  
o: fibula  
i: first metatarsal  
a: plantar flexion and eversion of foot

gastrocnemius (H,C) (*G: calf - it is derived from "stomach of the leg"*)  
o: lateral and medial epicondyles of femur  
i: calcaneus via the tendocalcaneus (Achilles tendon)  
a: plantar flexion

soleus (H,C) (*L: flat - like the sole of a shoe*)  
o: superior tibia and fibula  
i: calcaneus via the tendocalcaneus (Achilles tendon)  
a: plantar flexion

### **Ligaments of the knee**

lateral (fibular) collateral ligament  
medial (tibial) collateral ligament  
anterior cruciate ligament (*L: cruciate = cross shaped*)  
posterior cruciate ligament  
patellar ligament

### **Clinical terms**

torn rotator cuff

carpal tunnel syndrome

knee injuries:   torn ACL  
                  torn cartilage

**Muscles within the Abdomen and Pelvis** (This group of muscles will be covered on the last exam.)

diaphragm (H,C)

- o: inferior border of thoracic cavity
- i: central tendon
- a: flattens when contracted causing air to enter lungs

levator ani (H)

- o: margin of pelvis
- i: opposite levator ani muscle
- a: supports pelvic organs, controls defecation

urogenital diaphragm (H)

- o: ischium
- i: muscle from opposite side
- a: supports pelvic organs, controls urination

bulbospongiosus (H)

- o: central tendon of perineum
- i: corpus spongiosum of penis or clitoris
- a: male: constricts urethra after urination and during ejaculation  
female: constricts vagina

external anal sphincter (H)

- o, i: central tendon of perineum
- a: keeps anal canal closed

# Cardiovascular System

## HEART

### KEY:

H: know this structure in the human.

S: know this structure in the sheep

anterior interventricular (descending) artery (H)

apex (H,S)

aorta (H,S)

aortic semilunar valve (S)

atrial septum (H,S)

circumflex artery (H)

chordae tendineae (S)

inferior vena cava (H)

left atrium (H,S)

left coronary artery (H)

left ventricle (H,S)

mitral valve (bicuspid valve) (H,S)

papillary muscles (S)

parietal pericardium (S)

pericardial cavity (S)

posterior interventricular artery (H)

pulmonary arteries (H)

pulmonary semilunar valve (H,S)

pulmonary trunk (H)

pulmonary vein (H)



right atrium (H,S)

right coronary artery (H)

right ventricle (H,S)

superior vena cava (H,S)

tricuspid valve (S)

ventricular septum (H,S)

visceral pericardium (S)

### **Blood Cells**

basophils (may be hard to find)

eosinophils

erythrocytes

monocytes

neutrophils

platelets

# Nervous System

## Brain

**KEY:** H: know this structure in the human.

S: know this structure in the sheep

arachnoid mater (S)

basal ganglia (H,S)

brain stem (H,S)

central sulcus (H)

cerebellum (H,S)

cerebral aqueduct (H,S)

cerebral hemispheres (H,S)

cerebrum (H,S)

corpora quadrigemina (H,S)

corpus callosum (H,S)

dura mater (S)

fornix (S)

fourth ventricle (H,S)

frontal lobe (H,S)

hypothalamus (H,S)

intermediate mass (H,S)

lateral ventricles (H,S)

longitudinal fissure (H,S)

medulla oblongata (H,S)

midbrain (H,S)

occipital lobe (H,S)

olfactory bulb (H,S)

optic chiasma (H,S)

optic tract (H,S)

parietal lobe (H,S)

pineal gland (H,S)

pituitary gland (H,S)

pons (H,S)

superior sagittal sinus (S)

temporal lobe (H,S)

thalamus (H,S)

third ventricle (H,S)

## **Arteries to the Brain**

### **Circle of Willis**

anterior cerebral arteries

anterior communicating arteries

basilar artery

internal carotid arteries

middle cerebral arteries

posterior cerebral arteries

posterior communicating arteries

vertebral arteries

## **Spinal Cord**

anterior horn (motor neuron cell bodies)

anterior median fissure

anterior root

central canal

grey matter

posterior horn

posterior median sulcus

posterior root

posterior root ganglion (sensory neuron cell bodies)

white matter

## **Eye**

choroid

ciliary body

cornea

iris

lens

optic nerve

retina: pigment layer  
photoreceptor layer  
nervous layer

sclera

# Thoracic Cavity

aorta (H,C)

axillary arteries (H,C)

axillary veins (H,C)

brachiocephalic artery (H,C)

brachial plexus (C)

common carotid arteries (H,C)

diaphragm (H,C)

esophagus (H,C)

heart (H,C)

hyoid bone (H,C)

jugular veins (H,C)

larynx: (H,C)

    cricoid cartilage (H,C)

    epiglottis (H)

    thyroid cartilage (H,C)

    vocal cords (H)

lungs (H,C)

parietal pericardium (C)

phrenic nerves (C)

subclavian artery (C)

subclavian vein (C)

superior vena cava (H,C)

thymus (H,C)

trachea (H,C)

vagus nerves (C)

# Abdominal Cavity

abdominal aorta (H,C)

colon: (H,C)

    ascending colon (H)

    appendix (H)

    cecum (H,C)

    transverse colon (H)

    descending colon (H)

    rectum (H,C)

common iliac arteries (H,C)

common iliac veins (H,C)

femoral artery, vein, nerve (H, C)

gall bladder (H,C)

    common bile duct (H)

    cystic duct (H)

    hepatic duct (H)

greater omentum (C)

hepatic portal veins (C)

inferior vena cava (H,C)

kidneys: (H,C)

    calyx (H,C)

    renal cortex (H,C)

    renal pyramids (H,C)

    renal arteries (H,C)

    renal veins (H,C)

large intestines (H,C)

liver (H,C)

mesentery (C)

mesenteric arteries (C)

pancreas (H,C)

parietal peritoneum (C)

peritoneal cavity (C)

small intestines (H,C)

spleen (H,C)

stomach (H,C)

ureters (H,C)

urinary bladder (H,C)

urethra (H)

visceral peritoneum (C)

# Reproductive System

## Male Reproductive System

body of penis (H)

bulb of penis (H)

corpus cavernosum (pl. corpora cavernosa)(H)

corpus spongiosum (H)

epididymis (H)

foreskin (prepuce) (H)

glans penis (H)

inguinal canal (H,C)

penile urethra (H)

prostate (H)

prostatic urethra (H)

scrotum (H,C)

seminal vesicle (H)

spermatic cord: (H,C)

    spermatic artery

    spermatic vein

    lymphatic vessels

    nerves

    cremaster muscle

    vas deferens

testis (H,C)

vas deferens (H,C)



## **Female Reproductive System**

broad ligament (H,C)

cervical canal (H)

cervix (H)

clitoris (H)

external urethral orifice (H)

fallopian tube (H,C\*)

fimbriae of fallopian tube (H)

fundus of uterus (H)

hymen (H)

labium majus (pl. labia majora) (H)

labium minus (pl. labia minora) (H)

ovary (H,C)

rectouterine pouch (pouch of Douglas) (H)

round ligament (H)

uterus (H,C\*)

vagina (H)

vestibule (H)

vulva (H)

# Embryonic Development

amnion

blastocyst

chorion

eye

branchial (gill) arches

heart

limb buds (leg buds, arm buds)

placenta

somites

tail

umbilical cord