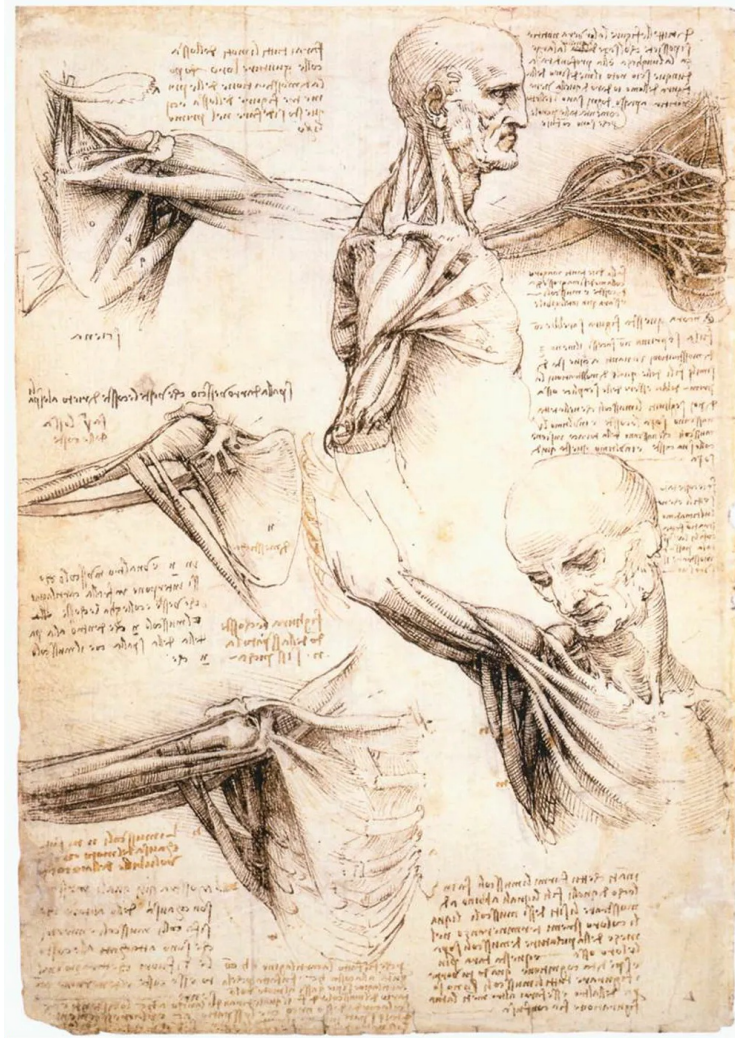


Study Guide

for

Human Anatomy 231

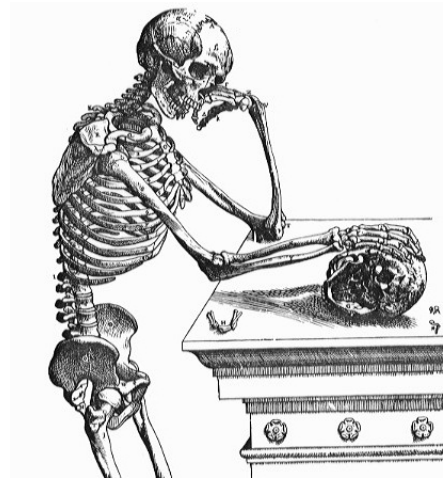


Da Vinci 1510

Jacob Sapiro, Ph.D.
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Andreas Vesalius, 1543

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 a list of street names will give you knowledge of how to get somewhere. 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 two hours 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.

I. How to Take Notes and Study Anatomy

Most people misunderstand the purpose of taking notes in class. **The purpose of taking notes is not to write down every word, but rather to write down what you will need to know.** If you try to write everything that is said in class, you will not be able to do it! Almost no one can write that fast. Just try to write down every word that is written on the board, what you think are the key concepts about each topic, and take pictures of all of the drawings on the board. That means that in order to get all of the information necessary, you will have to record the lectures.

Your actual study notes should be written at home. These notes should not be transcript of what I said in class, rather you should take what I said in class and use it to answer the questions below so that you synthesize the information. In that way you will understand the information and can use your knowledge to answer a variety of questions that might appear on the exam. It should take you at least 6 - 9 hours to write out your notes for each lecture. I know that seems like a lot, but in fact, this is your main study tool. When you are finished writing your notes, you are pretty much done studying. All that is left is to review for the test. If it takes you any less time than this, you are doing something wrong!

The following are the steps for writing your notes at home:

1. Break up the lecture into about 4 - 6 distinct topics. Don't try to do an entire lecture in one sitting. The ideal study time is 45 minutes to 1 hour. If you spend more time you will start to lose focus and you will just be wasting your time. After about an hour, get up, take a break for about 20 - 30 minutes.
2. For each structure, answer the following questions *in writing*:
 - A. Why is this structure important? What does it do?
 - B. What are the parts that make up this structure?
 - C. Why is it constructed in this fashion? In other words, how do the parts contribute to the function?
 - D. How does this structure relate in terms of structure and function to other things we learned in class?
 - E. What would happen if something went wrong with this structure?
3. For each disease or condition, answer the following questions *in writing*:
 - A. What is going wrong? What are the signs and symptoms?
 - B. What specific problems or changes in the anatomical structure allowed this to happen?
 - C. How might this be treated?
4. For each structure, draw a simple diagram of the structure using colored pencils (not colored pens, not a drawing program on a computer.) You should be able to do this even though you might have no artistic talent. Each drawing should contain the following:
 - A. Each part should be distinctly labeled.
 - B. State the structure or tissue that makes up each part.
 - C. What is the function of each part?
 - D. Bring your completed drawings to class or office hours to be checked.

This must be done after each lecture. I know that if you have a lecture on Tuesday and another lecture on Thursday, it may be hard to find the time to do all of the above in that interval, but this must certainly be done before the following week. Otherwise you will quickly fall behind and you will never have the opportunity to

catch up. **If you only study for the test, you will fail the test. You need to study for the following week because each topic builds on the ones before.** Don't skip anything. The tests will cover all of the material, so you need to know all of the material. It is too tempting to say "This topic is hard, I will leave it for later." Yes, some topics are harder than others, but it is the harder topics that you need to spend the most time on.

As you write your answers to the above questions, you will realize that you do not know some answers to the above questions. Don't worry, that is the purpose of doing this. Look it up in the text book and **ask me**. If you do this in a timely manner, there is still plenty of time to learn the material before the exam.

II. How to Prepare for the Exam

Once you have done all of the above, you can start preparing for the exam. This should be done starting about two weeks before the exam. (If you haven't completed all of the assignments in Section I, then there is no point in going on to Section II. You will be wasting your time and the time of other students in the class.)

The hardest thing about preparing for an exam is "knowing what you don't know." How can you study something if you don't even know that it is something you need to study?

1. Practice at home

- A. Using a blank sheet of paper and not looking at your notes or the book can you draw and label the structures.
- B. Using a blank sheet of paper and not looking at your notes or the book can you explain the structure and function of each item we learned in class?
- C. Using a blank sheet of paper and not looking at your notes or the book can you describe the diseases or conditions we learned in class and explain their causes in terms of anatomy?
- D. Can you answer the questions in the study guide or the practice exam? Do you understand why the wrong answers are wrong? Remember that your exam, while it will covers the same material as a practice exam, will not be identical.

2. Studying with a study group

- A. Find study partners who are serious about doing well in the class.
- B. Understand the purpose of a study group is not for you to learn the material, but for you to test each other on the material. That is how you are going to know if you understand it.
- C. In order for you to be tested, your study partner needs to know the material well.
- D. In order for you to test your study partner, you need to know the material well.
- E. Meet with your study group long enough before the exam so that if you don't know something, you will have time to learn it.

3. Reviewing for the exam

- A. Once you are done studying, you will need to review to keep the material fresh in your mind.
- B. Briefly go over the notes and drawings you did after the lectures every week.
- C. The weekend before the exam, test yourself by seeing if you can rewrite your notes and drawings using no hints. If you can do this at home, you can do this on the test. If you can't do this at home, obviously you can't do this on the test.

III. How to Study for Lab

Lab is much easier to study for than lecture, so too many students spend too much time studying for lab relative to lecture. While lecture should take you about 12 - 18 hours of study per week, lab should only take about 9 - 12 hours per week of study.

1. There is a short lecture before each lab period. Make sure to take good notes (see Section I).
2. Spend as much time in lab as possible. The bone, models, cats, etc. are not available for you to study at home. Taking pictures of them to study at home is of very limited value. The lab is open to you at least 20 hours per week. Use that time! Most of your study time should be in lab.
3. Make **proper** flash cards. While flash cards are a waste of time for lecture, they do serve a purpose in lab if done correctly. The flash card should have a drawing or picture in the front, and the information you are responsible for on the back. For example, a picture of a bone on the front and the names of the parts of the bone and their functions on the back.
4. Form a study group and quiz each other (see Section II 2 above).

IV. What not to do

1. **Do not use flash cards for lecture.** Making flash cards will not help you on the lecture exam and will take precious time away from your studying.
2. **Do not simply reread your notes multiple times.** This will not help you understand the material and is a waste of time.
3. **Do not procrastinate.** Waiting to study until the week before the exam means you will fail the exam. There is too much material to learn in a short period of time.
4. **Do not feel intimidated.** This is a difficult class, but it is doable if you put in the necessary effort.

Good luck. This is a difficult class, but every semester there are many students who earn A's and B's. If you try for an A, and you don't make it, you will get a B - not bad. Earning a B in Anatomy will allow you to get into any program you want (e.g. Nursing, Physical Therapy, etc.). Just make sure you also earn some A's along the way. If you earn a C, don't feel bad. It still means you learned enough to progress to your other classes, but now you are under some pressure to do better next semester. **Be warned:** Some students think that they don't have to work hard in Anatomy because they are in programs where they only need to earn a C in this class (perhaps Athletic Training, Physical Therapy Assistant, etc.). Those students are almost guaranteed to fail Anatomy because even earning a C requires a lot of effort.

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 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 facts 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

Prefixes	Definition	Example
a, an	without	anaerobic: without oxygen
ante	before (in front of)	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:

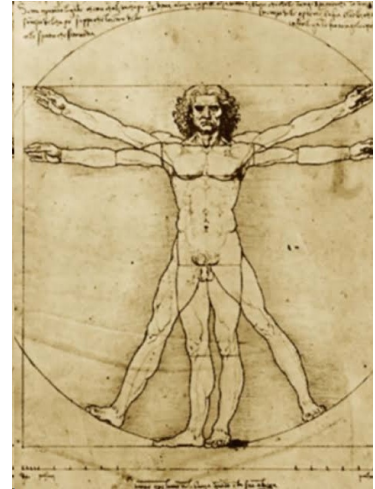
- superior
- inferior

- anterior (ventral)
- posterior (dorsal)

- medial
- lateral

- deep (internal)
- superficial (external)

- proximal
- distal



Vitruvian Man - Da Vinci, 1490

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?
12. Is the word labium singular or plural? What is the other form?

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 - separates the cell from the extracellular environment

cholesterol - ensures the membrane is stable and doesn't fall apart

proteins.- membrane proteins allow material to move in/out of the cell and allow for communication among cells

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. intermediate filaments: provide physical strength to the cell. Made of keratin

C. microfilaments: 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

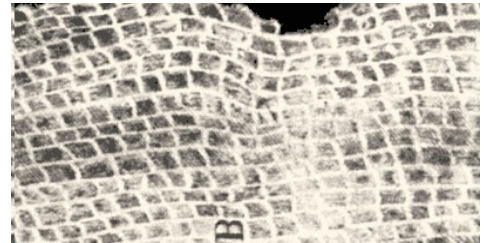
leukocytes (macrophages, mast cells)

adipocytes

Extracellular matrix: interstitial fluid
 collagen fibers
 elastic fibers
 reticular fibers

Blood vessels

Nerves



The first drawing showing “cells”. Robert Hooke, 1665

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. serous glands (watery secretions)	sweat glands
B. mucous glands (secrete mucus) (note the spelling of mucus vs. mucous)	goblet cells
C. mixed glands (serous and mucous secretions)	salivary glands
D. oil glands (oily or waxy secretions)	sebaceous glands

II. Classification of glands based on method of secretion

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

III. Classification of glands based on structure

<u>type of gland</u>	<u>example</u>
A. unicellular glands	goblet cell
B. multicellular glands	
2. tubular or alveolar (acinar) glands	
a. simple	sweat glands (simple tubular glands)
b. compound glands	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. A typical human cell including organelles and other structures.
2. A pseudostratified epithelium showing goblet cells, intercellular junctions, and basement membrane.
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

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. Which of the following is the most resistant to tearing?
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

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

1. Cross sections of compact bone and spongy bone.
2. Longitudinal 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: for example, 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

tendonitis

torn cartilage

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

1. A 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 of the following joints usually has the greatest number of ligaments?
 - 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 irregular CT
3. endomysium - areolar 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



Juan Valverde, 1560

Smooth Muscle

- found around almost 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. How do they differ in terms of strength of contraction and length of contraction?
3. Longitudinal section of a skeletal muscle fiber showing all organelles and structures. How does a muscle fiber contract?

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 triceps brachii muscle is the only extensor of the forearm. It inserts onto the ulna 2.5 cm proximal to the elbow joint. The center of weight of the forearm is 20 cm distal to the joint. The hand is 50 cm from the elbow.

 - A. If the muscle exerts 20 kg. of force, how much force will be applied to the center of the forearm?
 - B. If the muscle contracts 4 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?
2. The brachioradialis muscle is one of the flexors of the forearm. It originates on the humerus and inserts onto the styloid process of the radius 40 cm from the elbow. The hand is 50 cm from the elbow. The center of weight of the forearm is 20 cm from the elbow.

 - A. If the muscle contracts 4 cm, how far will the hand move?
 - B. If the forearm weighs 10 kg, how much force will the muscle need to exert in order to move it?
 - C. What type of lever system is this? What are its advantages and disadvantages?
3. The biceps brachii is one of the flexors of the forearm. It originates on the scapula and inserts on the radial tuberosity 5 cm from the elbow. The hand is 50 cm from the elbow.

 - A. If the muscle contracts 4 cm, how far will the hand move?
 - B. If the forearm weighs 10 kg, how much force will the muscle need to exert in order to move it?
 - C. What type of lever system is this? What are its advantages and disadvantages?
4. The brachialis is one of the flexors of the forearm. It originates on the humerus and inserts on ulna just distal to the coronoid process, 10 cm from the elbow. The hand is 50 cm from the elbow.

 - A. If the muscle contracts 4 cm, how far will the hand move?
 - B. If the forearm weighs 10 kg, how much force will the muscle need to exert in order to move it?
 - C. What type of lever system is this? What are its advantages and disadvantages?
5. Why do we need three flexors of the forearm, whereas we have only one extensor?

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. O₂

2. CO₂

3. N₂

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

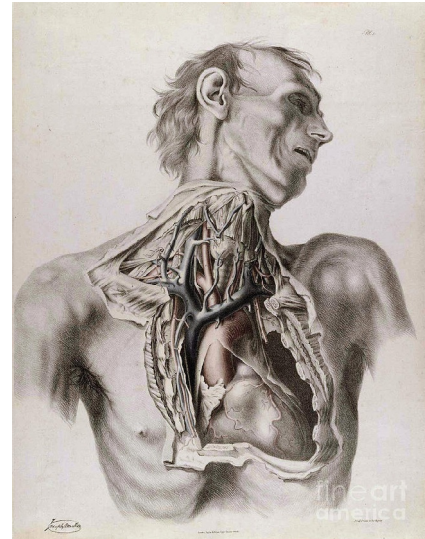
2. fibrous layer: dense fibrous CT (often also has adipose tissue)

II. myocardium: cardiac muscle,

III. endocardium:

A. simple squamous epithelium

B. loose fibrous CT



Richard Quain, 1844

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

atherosclerosis

arteriosclerosis

AV (arteriovenous) malformation

blood clot

bone marrow transplant

coronary bypass

deep vein thrombosis

diabetic angiopathy

edema

embolism

endocarditis

electrocardiogram

heart murmur

hemorrhoids

ischemia

myocardial infarction

patent ductus arteriosus

patent foramen ovale

prolapsed valve

splenectomy

stroke

systole and diastole

tonsillitis

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 in size to each other 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.

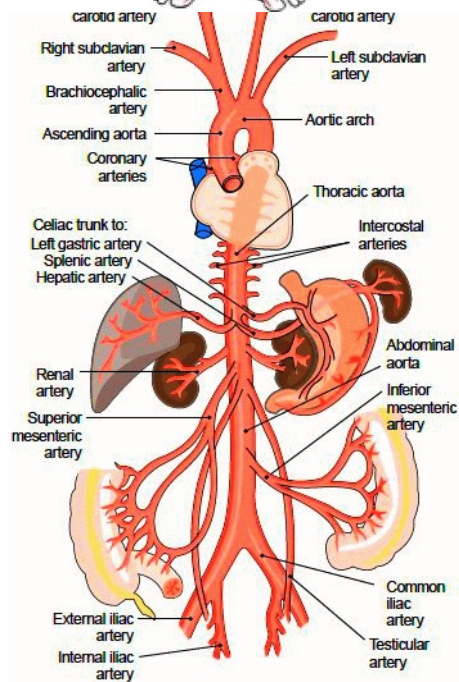
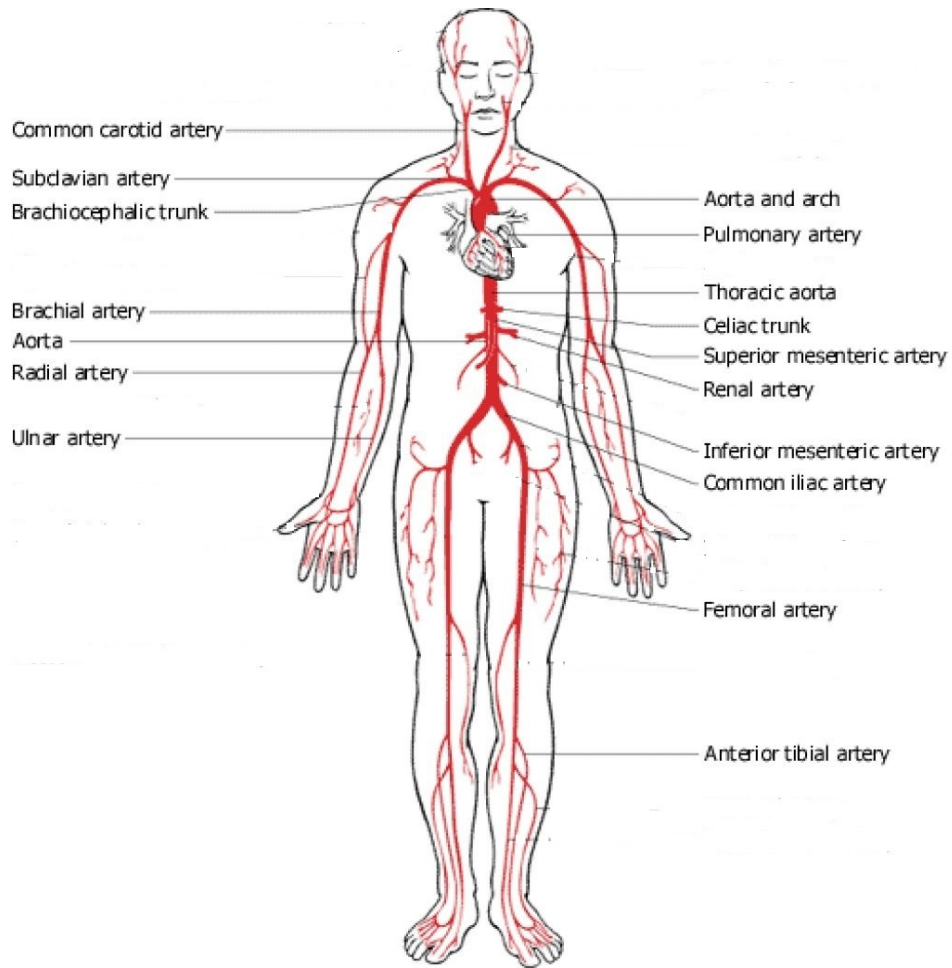
C. Sample multiple choice questions. Choose the best answer.

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

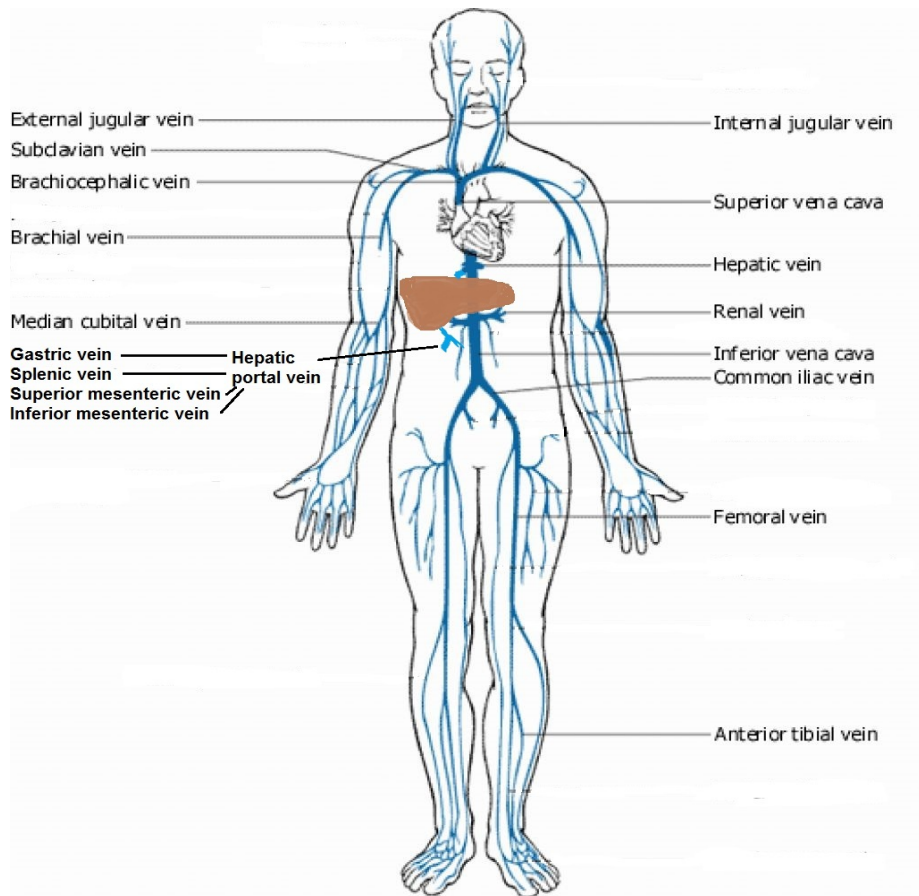
D. Be able to trace the flow of blood between any two regions of the body. For example:

1. arm to brain
2. small intestine to knee

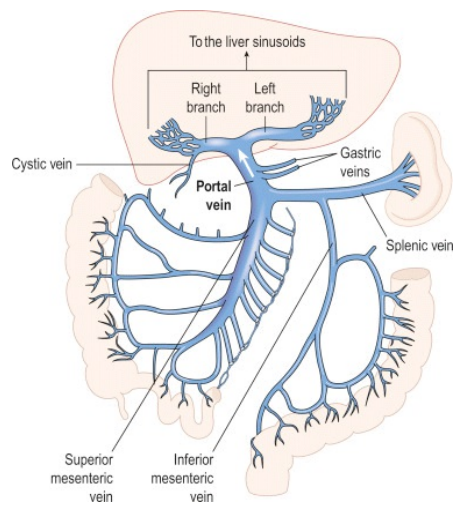
Major Arteries



Major Veins



Hepatic Portal System



Respiratory System

Parts of the Respiratory System

I. Nose and 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 bronchi:

- 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 (COPD)

cough

emphysema

laryngitis

lung cancer

pneumonia

pneumothorax

respiratory distress syndrome

snoring and sleep apnea

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

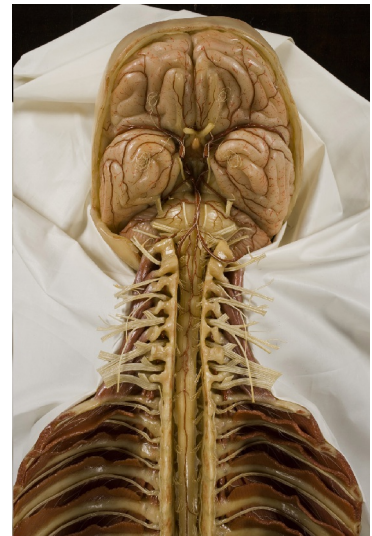
post-central gyrus (primary somatosensory cortex)

3. temporal lobe

lateral sulcus

4. occipital lobe

5. basal ganglia



Luigi Rolando, c. 1820

- 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

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 ₁ ophthalmic division	Sensory nerve (touch, pain, etc.) from upper third of face
	V ₂ maxillary division	Sensory nerve from middle third of face and upper teeth
	V ₃ 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

concussion

dementia

encephalitis

epidural injection

hydrocephalus

Lewy body dementia

lumbar puncture

meningitis

multiple sclerosis

subdural hemorrhage

transient ischemic attack

Peripheral Nervous System

Bell's palsy

dermatomes

diabetic neuropathy

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 L₄. 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. Smell

receptors in upper part of nasal cavity - chemoreceptors

V. Taste

taste buds located on dorsum of tongue, some on soft palate and oropharynx

Anatomy of taste buds

sensory 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

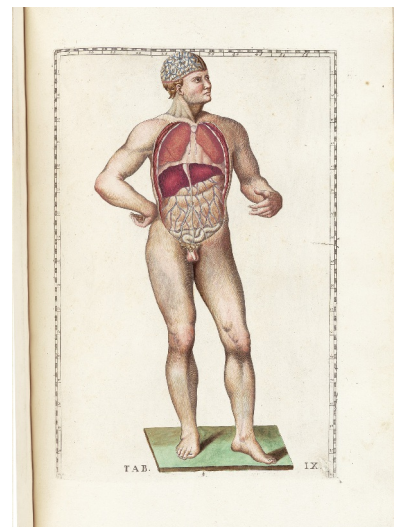
crown
root
enamel
dentin
pulp
gingiva
periodontal ligament

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



Bartholomeo Eustachi, 1783

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

internal and external anal sphincters

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.

- Which of the following is not a function of the liver?
A. make blood proteins B. make bile C. destroy old erythrocytes
D. store calcium E. regulate the amount of glucose in the blood
- Pancreatic islet cells are most similar to
A. seromucous gland cells B. trachea epithelial cells C. leukocytes
D. pituitary cells E. muscularis mucosae cells
- 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

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
 - transitional epithelium
 - lamina propria (lots of elastic fibers)
- B. muscularis - 2 layers not neatly organized as in GI tract
 - longitudinal layer
 - 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
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

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 (approximately 28 days)

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)
Step 7. decrease in estrogen and progesterone levels due to the death of the corpus luteum stimulates FSH release (Step 1)

II. Fallopian Tubes

function: move egg from ovary to uterus
site of fertilization
broad ligament - mesentery which attaches to fallopian tubes and uterus

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

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.

- Which of the following is a function of estrogen?
 - Inhibiting the growth of primary follicles
 - Stimulating the growth of the endometrium
 - Stimulating the development of breasts
 - Stimulating bone growth
 - All of the above
- The vaginal mucosa is lined by
 - ciliated columnar epithelium
 - simple squamous epithelium
 - stratified squamous epithelium
 - pseudostratified epithelium
 - transitional epithelium
- Sometimes, during childbirth, an episiotomy has to be performed in order to prevent tearing of the
 - placenta
 - myometrium
 - cervix
 - urethra
 - 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 and yolk sac

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



Adriaan van de Spiegel, 1626

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

Microscope



Objectives:

Scanning	1.25x	(silver)
Low power	4x	(red stripe)
Medium power	10x	(yellow stripe)
High power	40x	(light blue stripe)
Super high power	60x	(dark blue stripe)

Directions for using the microscope

1. Using two hands, bring your microscope to your station. Once the scope is in place, do not move it around.
2. Plug the microscope in. Do not let too much of the cord hang loose.
3. Turn on the light. Adjust the intensity of the light with the knob next to the light switch. The light intensity should be in the middle of the range.
4. Adjust the eyepieces by moving them up so that they are the proper distance apart for your eyes.
5. Place a slide on the stage and clip it into place. You can move the stage by using the knobs on the left of the stage. Looking at the slide (not into the microscope) move the slide so that the specimen is in the center of the viewing area (it is lit).
6. Make sure the low power objective is in place and focus the image using the course focus adjustment. If your eyes don't have the same focus, close your left eye and adjust the focus using the focus knob. Now close your right eye and adjust the focus using the knob on the eyepiece.
7. Rotate the nose piece to the scanning objective. Find the region you would like to examine in more detail. Use only the fine focus. If you cannot focus by turning the fine focus knob less than one circle, then go back to low power and refocus using the course focus knob. **Do not turn the fine focus knob more than one circle in either direction.**
8. Rotate the nose piece to the medium power objective. Flip the condenser up. Use only the fine focus. **Do not turn the fine focus knob more than one circle in either direction.**
9. If necessary, rotate the nose piece to one of the high power objectives. Use only the fine focus. **Do not turn the fine focus knob more than one circle in either direction.**
10. When you are done looking at the slide, rotate the nose piece back to low power. Flip the condenser down. Move the stage down using the course focus knob. Remove the slide and return it to the tray.
11. To put away the microscope: Turn off the power. Move the stage to the center. Wind the cord and clip the plug onto the cord. Move the eyepieces down. Use two hands to carry the microscope back to its cubby.

Introduction to Histology

Light vs. Electron Microscopy

- light microscope resolution $\sim 1 \mu\text{m}$
- electron microscope resolution $\sim 1\text{nm}$
 - 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 μm thick.

- E. placing the specimen on a slide

- F. staining the specimen
 - Common stains:
 - 1. hematoxylin: basic stain - blue - stains acids like DNA (nuclei)
 - 2. eosin: acidic stain - pink - stains bases like 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."

To help you understand the various terms given, the Latin (L) or Greek (G) meanings of the words are given to you.

Appendicular Skeleton

The Greek (G) or Latin (L) origin of the names are given in italics.

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*)

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

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

lacrimal 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. The position of the shoulder is _____ and _____ relative to anatomical position.

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*: this muscle is substantially different from that of the human

The Greek (G) or Latin (L) origin of the names are given in italics.

Muscles of Facial Expression

frontalis (epicranius) (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 Hyoid

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 of sternum
- i: hyoid
- a: depresses hyoid

sternothyroid (H,C)

- o: manubrium of sternum
- i: thyroid cartilage
- a: depress thyroid cartilage

thyrohyoid (H,C)

- o: thyroid cartilage
- i: manubrium of sternum (lateral margin)
- a: depress hyoid, rotate hyoid if only one thyrohyoid is active

Muscles that Move the Head and Neck

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 head, rotates head if only one sternocleidomastoid is active

scalenes (H)

- o: transverse processes of cervical vertebrae
- i: first two ribs
- a: flex and rotate neck, elevate first two ribs

splenius capitus (H) (*G: splenius: bandage + capitus: head*)

- o: spinous processes of upper thoracic vertebrae
- i: mastoid process of temporal bone
- a: extension and rotation of head

Muscles that Move 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

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)

Muscles that Move the Arm

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

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 that Move the Forearm

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 when forearm is supinated

brachialis (H)
o: anterior distal humerus
i: coronoid process of ulna
a: primary flexor of forearm

brachioradialis (H,C)
o: distal end of humerus
i: styloid process of radius
a: flexor of forearm when forearm is pronated

pronator teres (H,C)
o: proximal end of ulna
i: middle of radius
a: pronates forearm

Muscles that Move the Wrist and Hand

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*) Carpal tunnel syndrome

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 when inhaling

internal intercostals (H)

o: superior border of each rib
i: inferior border of rib above
a: depress ribs when exhaling

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 that Move the Thigh

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

iliopsoas (H,C) (psoas = G: muscle of the loin) (combination of iliacus and psoas muscles)

- o: iliac fossa and vertebrae T₁₂ - L₃
- i: lesser trochanter of femur
- a: flex thigh

tensor fasciae latae

- o: iliac crest
- i: iliotibial tract (iliotibial band)
- a: stabilizes and abducts thigh

Muscles that Move the Leg

quadriceps femoris (H,C):

- rectus femoris (H)
 - o: anterior inferior iliac spine
 - i: tibial tuberosity via patellar ligament
 - a: extends knee especially when walking
- vastus lateralis (H)
 - o: greater trochanter of femur
 - i: tibial tuberosity via patellar ligament
 - a: extends knee especially when walking
- vastus medialis (H)
 - o: medial side of femur
 - i: tibial tuberosity via patellar ligament
 - a: extends knee especially when walking
- vastus intermedius (H)
 - o: anterior, proximal femur
 - i: tibial tuberosity via patellar ligament
 - a: extends knee especially when walking

hamstrings (C):

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

Muscles that Move the Ankle and Foot

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

extensor digitorum longus (H,C)

- o: lateral condyle of tibia and proximal fibula
- i: middle and distal phalanges of toes II - V
- a: extends toes

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

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: pelvic margin
- 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) - become mast cells - secrete histamine

eosinophils - fight parasitic infections

erythrocytes - contain hemoglobin - carry oxygen

lymphocytes - make antibodies

monocytes - become macrophages - phagocytosis

neutrophils - phagocytosis

platelets - help clot blood

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) - help coordinate muscles so they work together

brain stem (H,S) - midbrain, pons, and medulla

central sulcus (H) - separates frontal and parietal lobes - sheep do not have a central sulcus

cerebellum (H,S) - coordinates movement with sensory stimuli

cerebral aqueduct (H,S) - connects third and fourth ventricles

cerebral hemispheres (H,S)

cerebrum (H,S)

corpora quadrigemina (H,S) - part of the midbrain - responsible for visual and auditory reflexes

corpus callosum (H,S) - commissure which connects the two cerebral hemispheres

dura mater (S)

fornix (S) - connects hippocampus to the hypothalamus

fourth ventricle (H,S)

frontal lobe (H,S)

hypothalamus (H,S)

intermediate mass (H,S) - commissure which connects the two thalami

lateral ventricles (H,S)

longitudinal fissure (H,S) - separates the two cerebral hemispheres

medulla oblongata (H,S)

midbrain (H,S)

occipital lobe (H,S)

olfactory bulb (H,S)

optic chiasma (H,S) - where the two optic nerves cross to go to the contralateral sides of the brain

parietal lobe (H,S)

pineal gland (H,S) - maintains the circadian rhythms

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 root

central canal

grey matter

posterior horn

posterior root

posterior root ganglion (sensory neuron cell bodies)

white matter

Eye

choroid - thick pigmented region

ciliary body

cornea

iris

lens - often broken in the slide

optic nerve

retina: pigment layer
photoreceptor layer
nervous layer

sclera

Thoracic Cavity

aorta (H,C) - *Locate it posterior to the heart*

axillary artery and vein (H,C)

brachiocephalic artery (H,C)

brachial plexus (C)

common carotid arteries (H,C)

diaphragm (H,C)

esophagus (H,C) - *Locate it posterior to the trachea.*

heart (H,C)

hyoid bone (H,C) - *You should have felt the hyoid bone when you were dissecting the neck muscles.*

jugular veins (H,C)

larynx: (H,C)

 cricoid cartilage (H,C)

 epiglottis (H)

 thyroid cartilage (H,C)

 vocal cords (H)

lungs (H,C) - *Note how small the cat lungs are relative to human lungs. Cats are not built for long-distance running.*

parietal pericardium (C)

phrenic nerves (C) - *Nerves go from the neck to the diaphragm. only visible just above the diaphragm.*

subclavian artery and vein (C)

superior vena cava (H,C)

thymus (H,C) - *located anterior to the superior vena cava.*

trachea (H,C)

vagus nerves (C) - *locate them along the carotid arteries*

Abdominal Cavity

abdominal aorta and inferior vena cava (H,C) - *locate these vessels retroperitoneally in the upper portion of the abdominal cavity. follow them until they split into the common iliac vessels.*

colon (large intestine): (H,C)
 ascending colon (H)

 appendix (H)

 cecum (H,C)

 transverse colon (H)

 descending colon (H)

 sigmoid colon (H)

 rectum (H,C)

common iliac arteries (H,C)

common iliac veins (H,C)

femoral artery, vein, nerve (H, C) - *locate them between the gracilis and sartorius muscles.* Because the femoral vein is a very large vein near the surface, it is used when one needs to do a medical procedure which involves entering a vein.

gall bladder (H,C) - *find it between the right and middle lobe of the cat liver*

 common bile duct (H)

 cystic duct (H)

 hepatic ducts (H)

greater omentum (C)

kidneys: (H,C)

 calyx (H,C)

 renal cortex (H,C)

 renal pyramids (H,C)

 renal arteries (H,C)

renal veins (H,C)

liver (H,C) - note that the cat liver has more lobes than the human liver

mesentery (C)

pancreas (H,C) - *to find it in the cat, lift the greater omentum and observe the pancreas at the origin of the greater omentum*

parietal peritoneum (C) - lines the abdominal cavity

peritoneal cavity (C)

small intestines (H,C)

spleen (H,C)

stomach (H,C)

superior mesenteric arteries and veins (C)

ureters (H,C) - *separate the ureter and follow it from the kidney to the urinary bladder*

urinary bladder (H,C)

urethra (H)

visceral peritoneum (C)

Reproductive System

Male Reproductive System

body of penis (H)

bulb of penis (H) - erectile tissue within the perineum

corpus cavernosum (pl. corpora cavernosa)(H)

corpus spongiosum (H)

epididymis (H)

foreskin (prepuce) (H)

glans penis (H)

inguinal canal (H,C) - opening through the abdominal wall

penile urethra (H)

prostate (H) - makes seminal fluid

prostatic urethra (H)

scrotum (H,C)

seminal vesicle (H) - makes seminal fluid

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) - mesentery which attaches to the fallopian tubes

cervix (H)

clitoris (H)

external urethral orifice (H)

fallopian tube (H,C*)

fundus of uterus (H)

labium majus (pl. labia majora) (H)

labium minus (pl. labia minora) (H)

ovary (H,C)

round ligament (H) - from uterus to the perineum - homologous to the gubernaculum

uterus (H,C*)

vagina (H)

vestibule (H) - the space between the labia minora

vulva (H) - the term for the external genitalia of a female

Embryonic Development

amnion - sac which surrounds the fetus.

Functions: cushions and protects the fetus.

allows the fetus to float

chorion - embryonic form of the placenta

eye

branchial arches - vestige of gills

heart

limb buds (leg buds, arm buds)

placenta

somites - will form skeletal muscle and bone

tail

umbilical cord