Human Anatomy Lab Manual

HUMAN ANATOMY LAB MANUAL

MALGOSIA WILK-BLASZCZAK

KEVIN ALFORD, ANDREA CAMPO-VELEZ, AND VICTORIA DORCH

Mavs Open Press

Arlington

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ABOUT THIS PROJECT

OVERVIEW

This is a lab manual for a college-level human anatomy course (BIOL 3446 at UTA). Despite the abundance of information readily available via Google, the mastery of anatomy requires a fair amount of *memorization* for quick recall. The activities in this manual encourage students to engage with new vocabulary in many ways, including grouping key terms, matching terms to structures, recalling definitions, and written exercises.

As the majority of college campuses do not have easy access to a cadaver, most of the activities in this manual utilize anatomical models. Also included are several dissections of animal tissues, and a significant amount of histological examinations.

Each unit includes both pre- and post-lab questions and six lab exercises designed for a classroom where students move from station to station during a three-hour period. Effort was put into equalizing the time required to perform each lab exercise, to facilitate class flow. The vocabulary terms used in each unit are listed at the end of the manual and serve as a checklist for practicals.

CREATION PROCESS

When Malgosia Wilk-Blaszczak began teaching human anatomy at UTA she realized that while there are many commercially available manuals which incorporate a lot of human physiology, none of them focus solely on anatomy. She decided to create a manual for anatomy labs that could fill that void. The first version of this work was created and used in anatomy labs at UTA.

The idea of publishing the lab manual as an OER came to her courtesy of Michelle Reed, Open Education Librarian at UTA. To make this leap to an open platform, she enlisted the help of some of her best students. In Fall 2017, one year prior to the publication of this work, Wilk recruited a group of three excellent undergraduate teaching assistants. These students worked with UTA Libraries to identify openly licensed images and incorporate them into the text. Libraries' staff assisted in migrating the resource to Pressbooks, where it could be easily exported into a variety of formats. Furthermore, we conducted student surveys to gather feedback. Wilk's teaching assistants have always been an important part of her pedagogy. With their assistance, she was able to complete and openly publish this anatomy lab manual. The students put in the hard work to change all illustrations to Creative Commons licensed images and ensure proper attribution of all the images used. The student contributors, Kevin Alford, Andrea Compo-Valez, and Victoria Dorch, now alumni, reviewed and edited the resource, and are listed as co-authors of this manual.

Ultimately, open manuals reduce the cost to students while customizing the information and visuals required for class. In addition, the digital copy of the manual allows students to access homework and exercises wherever they are and is easily obtainable on the first day of class. Open

manuals are also dynamic works that can be adapted to suit the needs of other institutions or groups that wish to explore the topic but do not have a solid framework to do so. The resulting OER is being piloted in human anatomy labs in Fall 2018 and will be revised following the pilot period with input from current students and lab instructors. It is our hope that this extension of Wilk's class will open the door to connecting our courses to broader collaborations and student input.

ABOUT THE AUTHOR

Dr. Malgosia Wilk-Blaszczak has taught human anatomy and human physiology courses for 30 years to medical and nursing students, and currently to undergraduate students at University of Texas at Arlington. She holds an M.D. and a Ph.D. in Neuroscience from the Warsaw Medical University. Ever since she discovered her father's anatomical fold-out "manikin" as a child, Dr. Wilk has has been enamored by all aspects of the human body. In addition to teaching, she loves old medical illustration and never misses the chance to see them in museums when she travels.

In the International Museum of Surgical Science, Chicago, IL

ACKNOWLEDGMENTS

AUTHOR'S NOTE

I would like to dedicate this section to all my undergraduate teaching assistants, past and present. Every semester, I pick the most gifted students from previous semesters to serve as teaching assistants. I appreciate your commitment, passion, and hard work, but most of all, the amazing times we have had together. Special thanks to Clint Hassell and Natalie Winter who have served as my teaching assistants for many semesters, and have been good friends ever since. You have always done more than what was expected, and have given so much of your time and effort to support students to really grow and surprise us.

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Michelle Reed and Thomas Perappadan of UTA Libraries for assisting in the publication of this resource.

Jodi Wiley, B.S, UTA alumna, for creating and formatting class handouts that became the foundation for this OER.

Bradford Dimos, UTA graduate student, and Collin Funkhouser, UTA alumnus, for class-testing the previous version of this resource.

ABOUT THE COVER

Kyle Pinkos, UTA Libraries' Marketing Coordinator, designed the cover for this OER. The images used are in the public domain. Featured images, from *Ontleding Des Menschelyken Lichaams* by Govard Bidloo, are available from the U.S. National Library of Medicine.

LAB 1: ANATOMICAL LANGUAGE

LAB 1: ANATOMICAL LANGUAGE

MEASURABLE OUTCOMES

- Understand what the standard anatomical position is.
- Correctly identify a given plane by its correct name.
- Relate different structures of the body using the directional terms provided.
- Correctly identify the anatomical regions of the body.
- Demonstrate how to properly focus histology slides and identify key structures.
- Demonstrate an adequate understand of the material in this section.

BACKGROUND

A solid foundation is essential when learning any new skill. Understanding anatomical directions, articulations, planes, and regions are the foundation for learning anatomy.

The standard anatomical position of the human body is facing towards the observer, legs hip-width apart, feet facing forward, arms out slightly at either side with palms facing forward. When determining a structure's relative position, be sure to use this frame of reference. For example, it can be easy to confuse which side is the anterior aspect of the hands, therefore, one might incorrectly assume that the thumb is medial to the little finger. Remember, the anterior aspect of the hand is the palm, therefore the thumb is furthest from the center of the body and is lateral.

The archetypal body planes are frontal, sagittal and transverse planes. The frontal plane splits the body into anterior and posterior halves. The sagittal plane splits the body into left and right halves. The transverse plane splits the body into superior and inferior (top and bottom) halves. It is important to be able to identify a given plane so that you can orient yourself when a specimen, model or diagram is depicted a certain way. This same reasoning applies to the necessity of understanding directional terms such as anterior, inferior, distal and medial. It is recommended that you read the content prior to attending lab to make the most of your time.

Vocabulary for Anatomical Language on page(s) 160-161.

PRE-LAB 1

(5 points)

Last Name: _____ First Name: _____

INSTRUCTIONS:

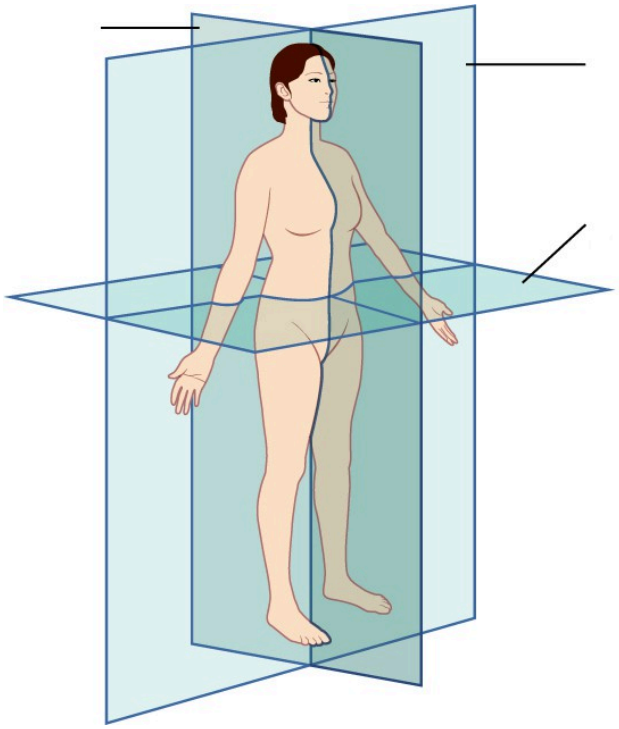
Fill in the table below with the appropriate terms. Note: For this lab only, you may use any anatomical structure of the human body to fill in the table.

For the remaining pages of the prelab, label the designated planes, regions, and directions.

(1 point)

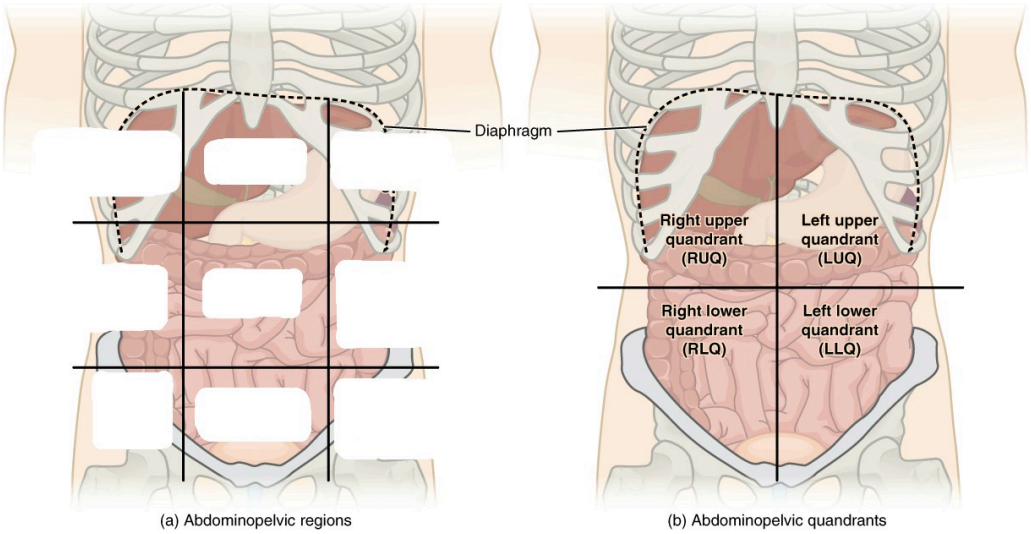
Name of a structure	is	directional term	to	Name of the second structure
forearm*	is	proximal	to	hand*
head	is	superior	to	
	is	inferior	to	tibia
breast	is	anterior	to	
	is	distal	to	upper arm
brain	is	medial	to	
	is	lateral	to	trunk

Label the planes of the body. (1 point)



Planes of Body

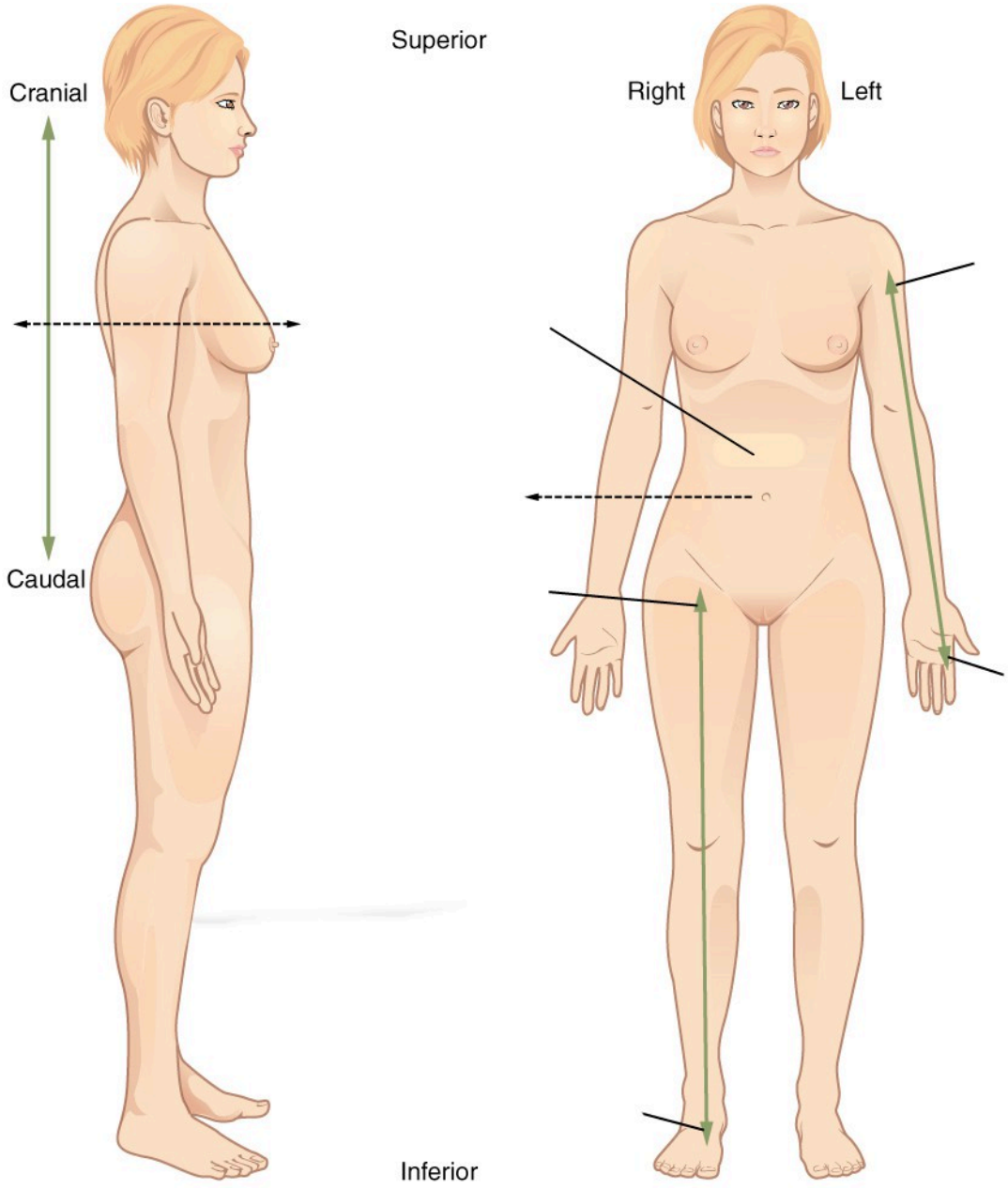
Label all nine regions of the abdomen. (1 point)



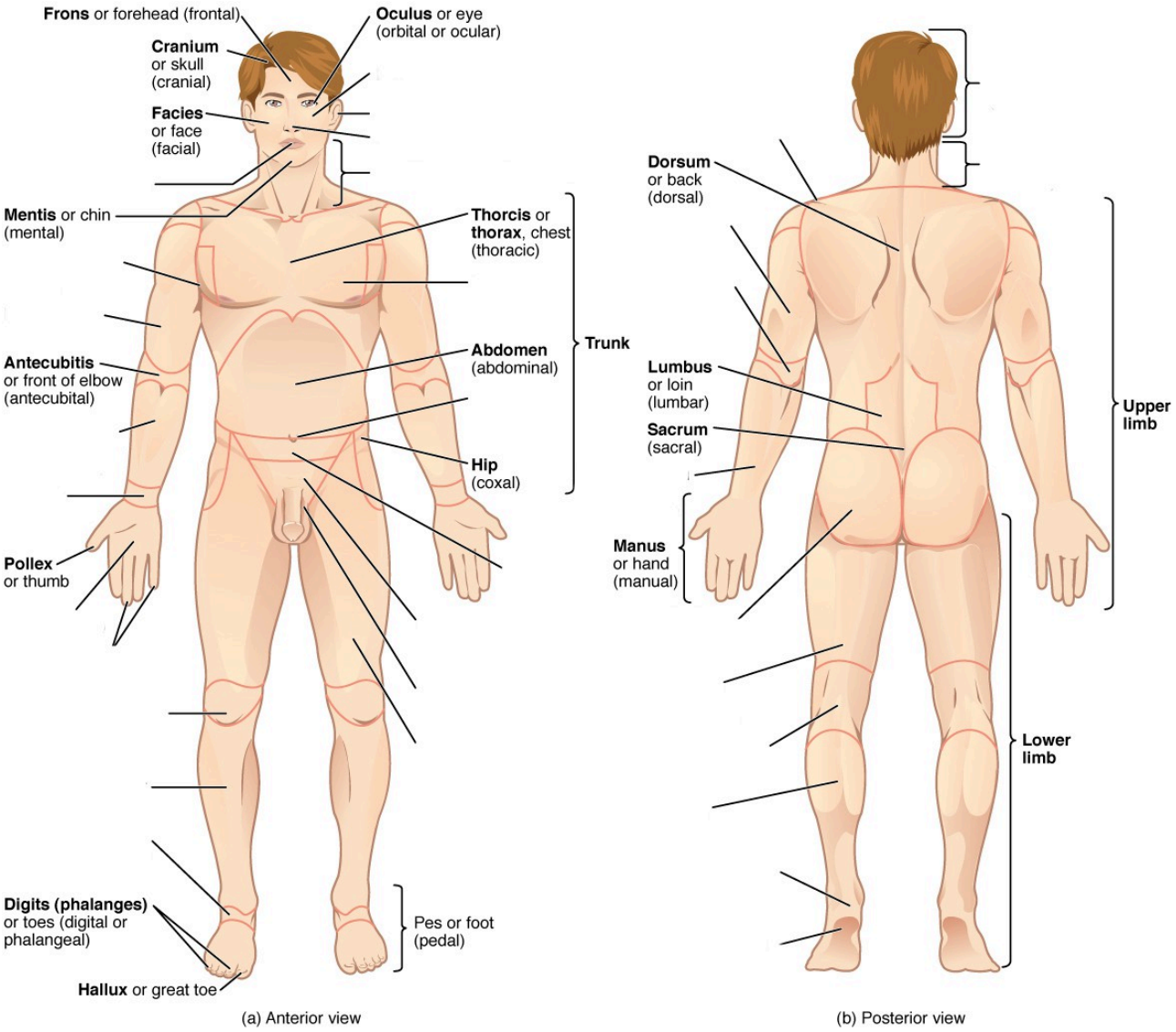
(a) Abdominopelvic regions

(b) Abdominopelvic quandrants

Label the anatomical directions designated by the lines and arrows. (1 point)



Label the regions of the body. (1 point)



LAB ACTIVITIES

For this lab only, there will be three stations for each group to cycle through, stations one, two and three; stations four, five and six will mirror these stations for this lab only. A list of words is provided below that you are expected to identify, learn, and label on the models provided. You must use all the words provided. Using the colored tape provided, write the number that corresponds to the organ/structure and place it on your model. When complete, notify your TA so they may check your work.
Note: Do not simply label the models, it is crucial that you understand how to apply all of these terms in each system, for the rest of the semester!
For each additional station, directions will be provided for the particular activity.

STATIONS ONE AND SIX: HISTOLOGY

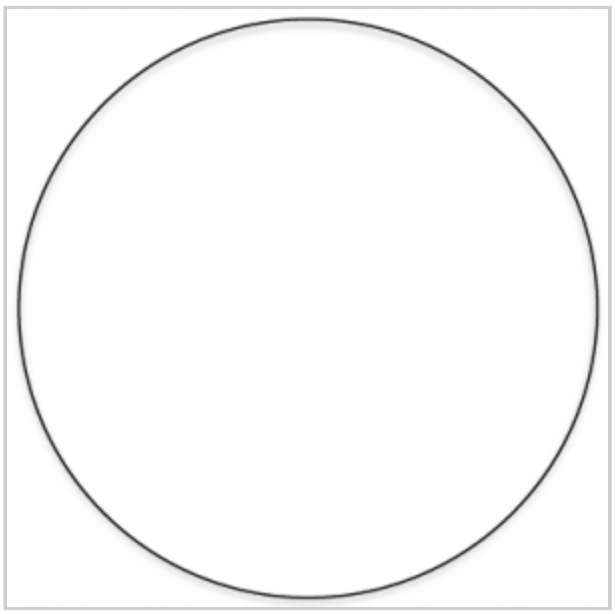
This is an advanced biology class, therefore you all likely have experience with microscopes. However, use these stations to refresh your memory of proper microscope etiquette, how to focus on a slide, and identify key features. For the remainder of this class, you will be expected to identify various tissues under the microscope. Be sure to ask your TA for assistance, and remember taking a picture of the slide to study later is not helpful if you don't take the time to study it in lab and understand which aspects are most important.

Basic instructions for use:

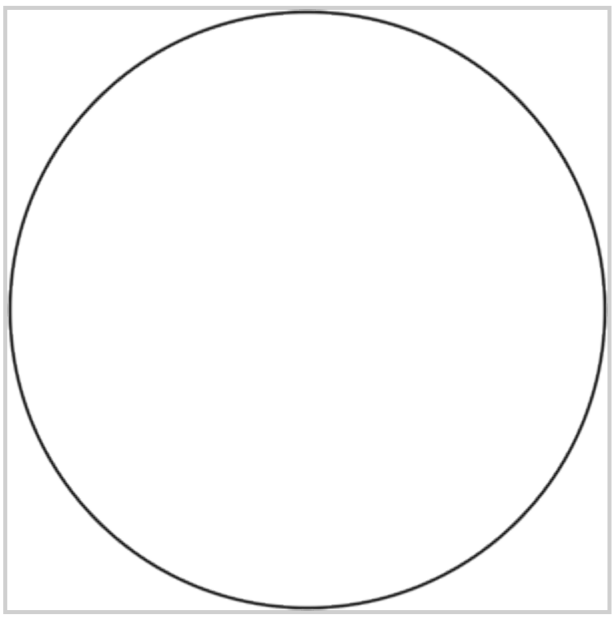
- Turn on the microscope. Move he stage down to its lowest setting and adjust the iris diaphragm until it allows the least amount of light in.
- Put the slide in position on the stage and be sure to start with the 5x objective to view it. While looking through the eyepiece, use the stage controls to move the specimen in line with the objective.
- Using the coarse adjustment knob, bring the stage up until you can see the specimen. Remember, it will not be in focus! If you bring the stage up too high, then switching to a higher objective, may touch the slide, scratch the lens, or even break the slide. Instead, use the fine adjustment knob to clarify the image and the iris diaphragm to allow as much light in as needed.
- Once the 5x is in focus, you can move to the next objective. Use the fine adjustment knob to focus before moving to the next objective. Do NOT touch the coarse adjustment knob.
- When you finish using the microscope, move the 5x objective to the start position and move the stage back down to its lowest position.

Sketch the slides available for today's lab and indicate the magnitude at which you are observing/

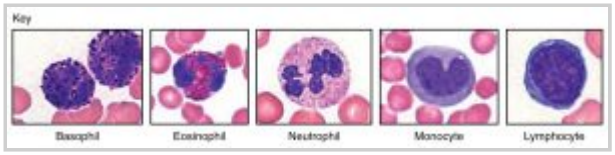
sketching. Be sure to identify, include, and label your sketch with the corresponding structures listed beneath each slide. Use the images provided to guide you through this process.

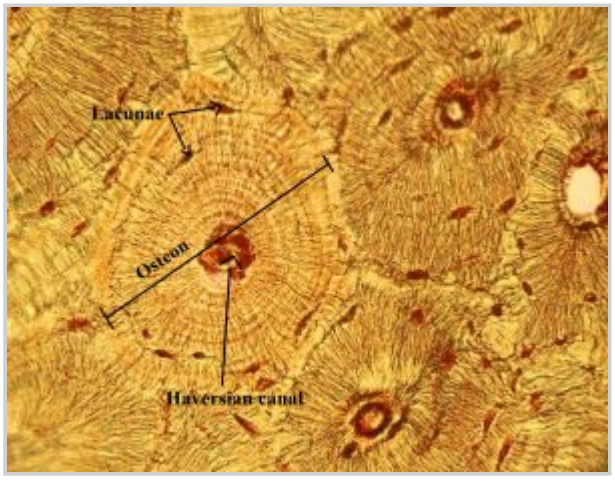


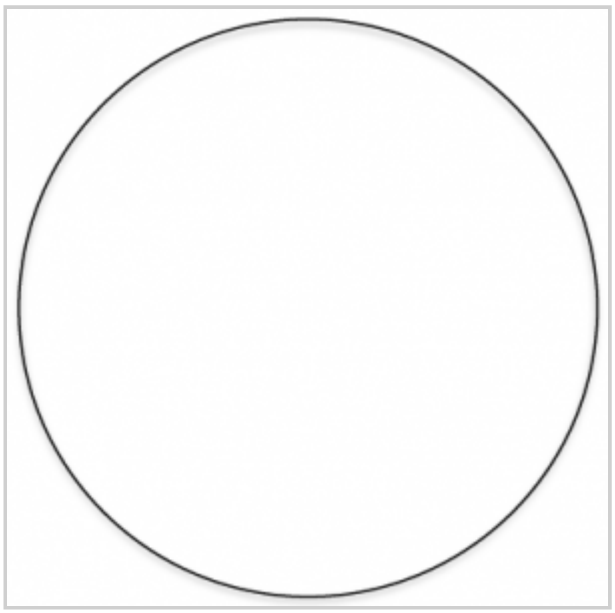
Spinal Cord



Kidney







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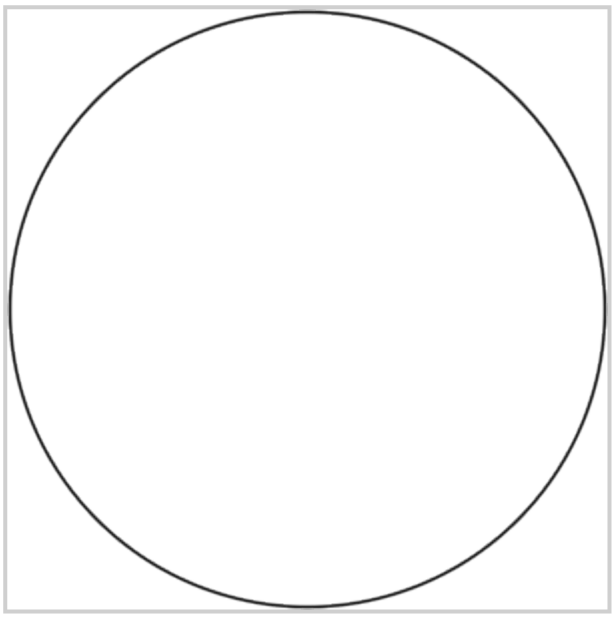
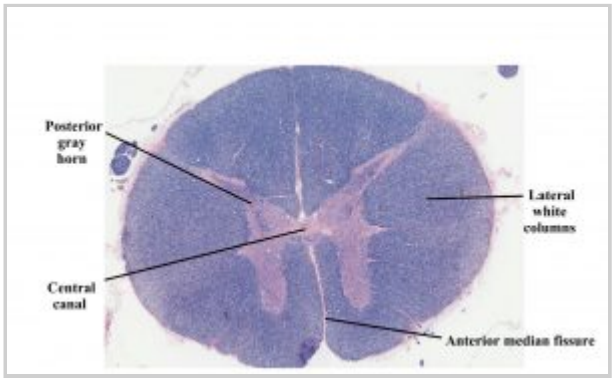
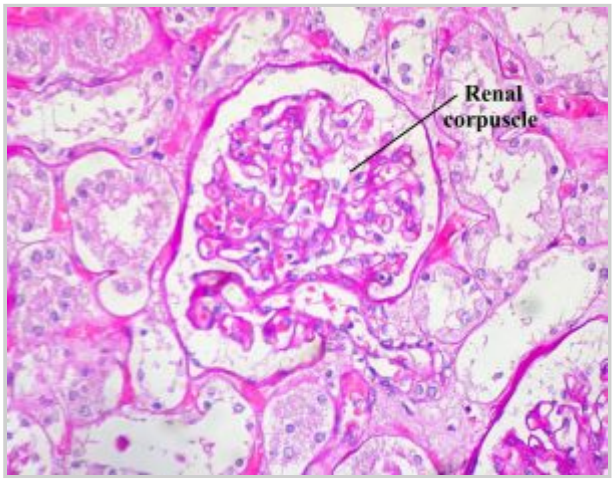
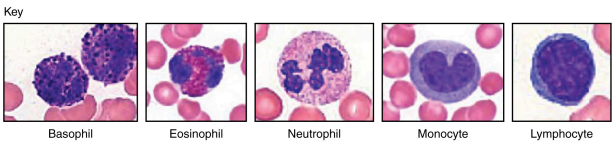


Kidney

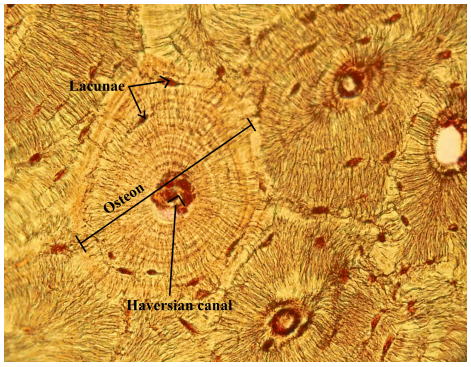




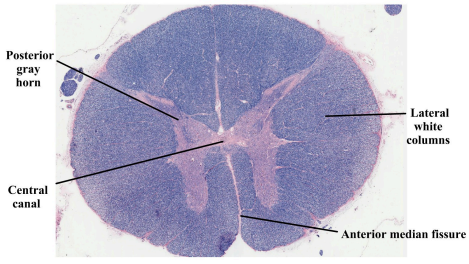
Monocyte



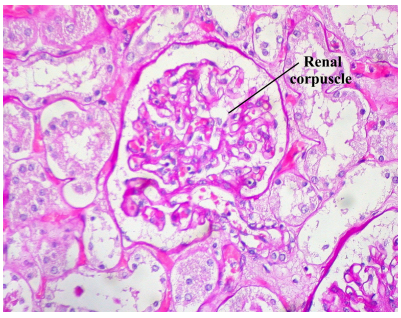
Compact Bone



Spinal Cord



Kidney



STATIONS TWO AND FIVE: THE BASICS

The terms in the following tables are important in understanding the relationship between different organs and structures of the body. Using the models and diagrams in your atlas, learn

how to identify the different body planes and the appropriate use of directional terms. When trying to understand body movements, it is helpful to act them out yourself.

Label the torso models of this station with the number that corresponds to the appropriate regions of the abdominal cavity using the colored tape. When you are finished, ask your TA to check your labeling. Before leaving the station, remove all of the labels you have placed on the model. Note the locus of each organ within each region.

Body Planes

#1 frontal	#2 transverse	#3 sagittal

Directional Terms

#4 anterior	#7 inferior	#10 proximal	#13 superficial
#5 posterior	#8 lateral	#11 distal	#14 parietal
#6 superior	#9 medial	#12 deep	#15 visceral

Abdominal Regions

#16 right hypochondriac region	#19 right lumbar region	#22 right iliac region
#17 epigastric region	#20 umbilical region	#23 hypogastric region
#18 left hypochondriac region	#21 left lumbar region	#24 left iliac region

STATIONS THREE AND FOUR: REGIONS OF THE BODY

Label the models of this station with the number that corresponds to the appropriate structure of the peripheral nervous system using the colored tape. When you are finished, ask your TA to check your labeling. Before leaving the station, remove all the labels you have placed on the model.

Anatomical Regions

#1 cephalic	#11 brachial	#21 abdominal	#31 femoral
#2 cranial	#12 cubital	#22 hepatic	#32 patellar
#3 ocular (orbital)	#13 antecubital	#23 renal	#33 popliteal
#4 auricular (otic)	#14 olecranal	#24 umbilical	#34 crural
#5 buccal	#15 antebrachial	#25 lumbar	#35 sural
#6 nasal	#16 carpal (carpus)	#26 pelvic	#36 tarsal (tarsus)
#7 oral	#17 palmar	#27 inguinal	#37 calcaneal
#8 cervical	#18 digital (phalangeal)	#28 pubic	#38 pedal
#9 acromial	#19 thoracic	#29 sacral	#39 plantar
#10 scapular	#20 mammary	#30 gluteal	

Common Anatomical Features

The following terms are useful to know and understand as they will reappear throughout this course.

#40 process	#45 sulcus	#50 facet	#54 septum
#41 tuberosity	#46 gyrus	#51 fossa	#55 raphe
#42 condyle	#47 foramen	#51 fundus	#56 ampulla
#43 epicondyle	#48 foramina	#52 hilum	
#44 fissure	#49 meatus	#53 isthmus	

POST-LAB 1 QUESTIONS

(2 points)

Last Name: _____ First Name: _____

1. Give the name of the anatomical region to which each of the following structures belongs. (0.5 points)
    a. Elbow
    b. Back of the knee
    c. Belly button
    d. Heel
    e. Back of the neck

2. Determine which body plane is described by each of the following scenarios. (0.5 points)
    a. If the human body were split into left and right halves.
    b. If the human body were split into anterior and posterior halves.
    c. If the human body were split into superior and inferior halves

3. There are nine abdominal regions. Name the three consecutive regions that run down the center of the abdomen. (0.5 points)

4. Fill in the blanks with the correct anatomical direction. (0.5 points)
    a. Phalanges (fingers) are _____ to the carpals (wrist).
    b. The tibia (medial bone of the lower leg) is _____ to the femur (large bone of the thigh).
    c. The sural region is _____ to the crural region.
    d. The left and right iliac regions are _____ to the hypogastric region of the abdominal cavity.
    e. The nose is _____ to the ears.
    f. The abdomen is _____ to the back.

LAB 2: BONES AND BONE MARKINGS

LAB 2: BONES AND BONE MARKINGS

MEASURABLE OUTCOMES

- Determine if a given bone is part of the axial or appendicular skeleton.
- Ascertain the major bones of the skull, as well as any markings or unique features, the regions of the vertebral column, parts of a typical vertebra, along with the other bones and features of the axial skeleton.
- Identify the bones of the appendicular skeleton and their unique features.
- Designate bones as either left or right when applicable. Examples include the ulna, humerus, femurs, scapulas, and clavicles.
- Understand how different bones fit together and articulate. Demonstrate this by assembling different regions of the body using the bones provided.
- Differentiate compact, spongy and dry bone histology slides. This includes identifying the unique characteristics of each.
- Demonstrate an adequate understand of the material in this section.

BACKGROUND

The skeletal system is the primary structural organ system of the body. Many people think of the skeletal system as being static in that it is unchanging, however, this is not the case. Bones, like other organ systems, have specialized cells which allow them to perform a variety of essential tasks. Osteoblast are responsible for secreting the bony matrix necessary for bone formation. Osteoclast, meanwhile, are large multinucleated cells responsible for the dissolution and reabsorption of bone. It is made mostly of collagen, which gives bone its soft framework, and calcium phosphate which adds strength and hardness to the structure. It is divided into the axial and the appendicular skeleton. The *axial skeleton* consists of the skull, hyoid bone, vertebral column, sternum, and ribs. Whereas the *appendicular skeleton* consists of the clavicle, scapula and the rest of the upper and lower limbs. Without the foundational structure of the skeletal system, there would be nothing to support the body and provide points of attachment for muscles. Bones function to protect internal organs, assist body movements, store and release calcium and phosphorous, participate in blood cell production and store fat in the yellow marrow. Bones also function to protect internal organs, assist body movements, and the storage and release of ions such as calcium and phosphorous. Furthermore, long bones contain both hemopoietic (red) and stromal (yellow) marrow which produce red blood cells and fat cells respectively. Each of these cells have specific functions that are key to the development and repair of a bone over time. The two types of bone tissue are compact and spongy bone. *Compact bone* is typically found along the perimeter of bones and makes up the majority of the diaphysis of long bones. It is stronger than spongy bone and provides more stability. Compact bone is made up of circular units called

osteons. Osteons are composed of rings called *lamellae* that spiral down into a central canal, known as the *Haversian canal*. This central canal is the passage for nerves, blood vessels, and lymphatics. *Spongy bone*, on the other hand, is typically the deepest layer of a bone's composition. It is made of trabeculae which give spongy bone its characteristic lighter weight. There are five classifications of bones based on their shape, long bones, short bones, flat bones, irregular bones and sesamoid bones. The shape and composition of each bone allow them to function as mentioned above.

Vocabulary for Bones and Bone Markings on page(s) 161-162.

PRE-LAB 2

(5 points)

Last Name: _____ First Name: _____

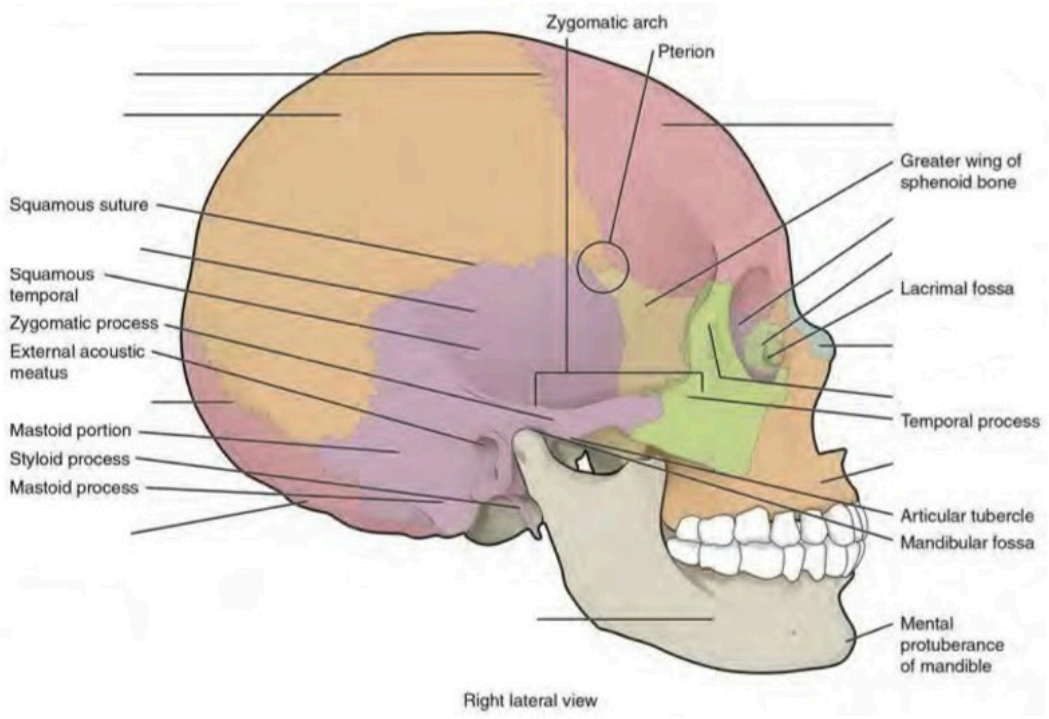
INSTRUCTIONS:

Fill in the table with the appropriate terms. For the remaining illustrations, label the structures indicated.

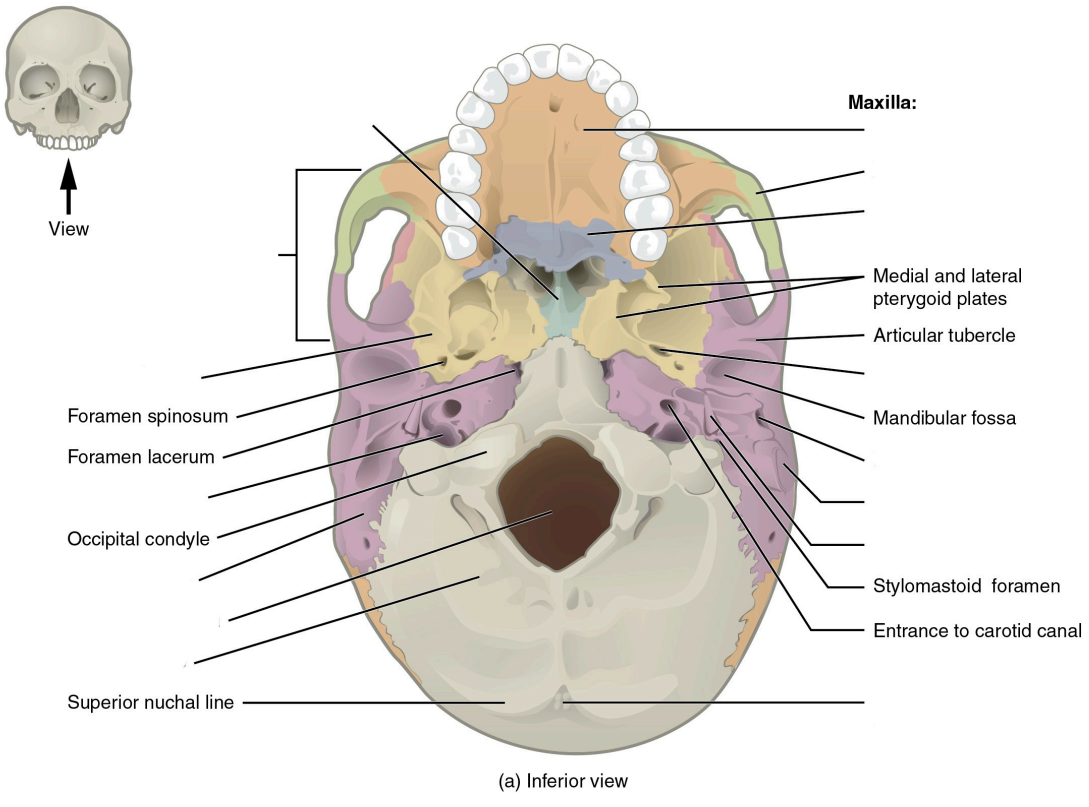
(1 point)

Name of a structure	is	directional term	to	Name of the second structure
radius*	is	proximal	to	ulna*
femur	is	superior	to	
	is	inferior	to	thoracic vertebrae
patella	is	anterior	to	
	is	distal	to	metacarpals
tibia	is	medial	to	
	is	lateral	to	sternum

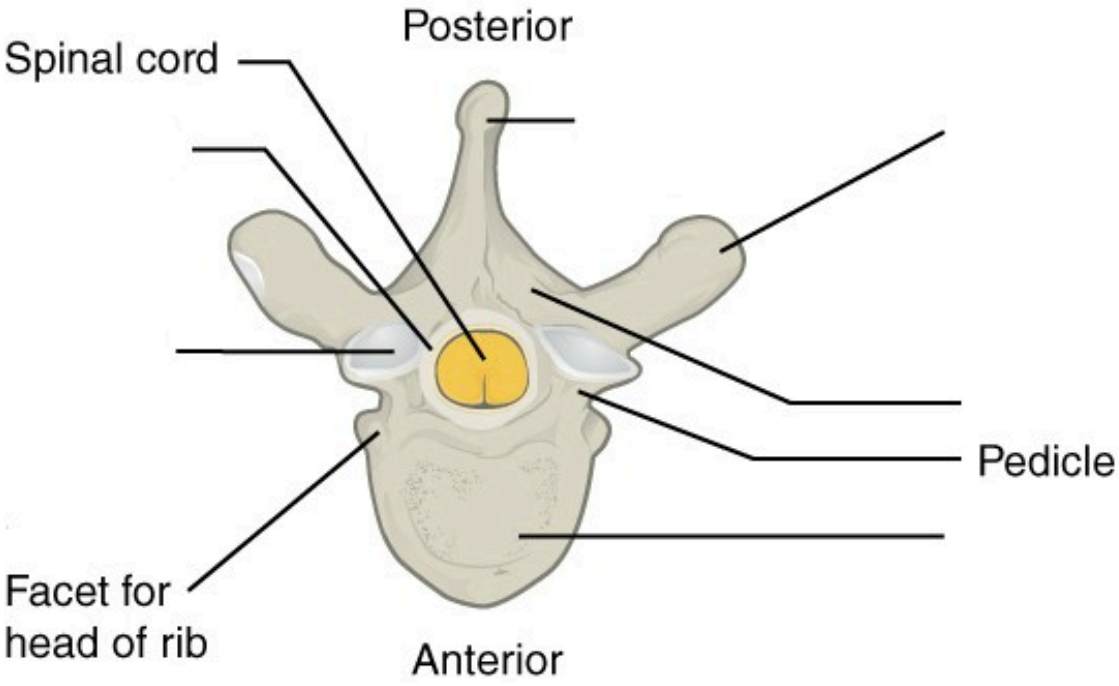
Label the cranial structures and bones. (0.5 points)



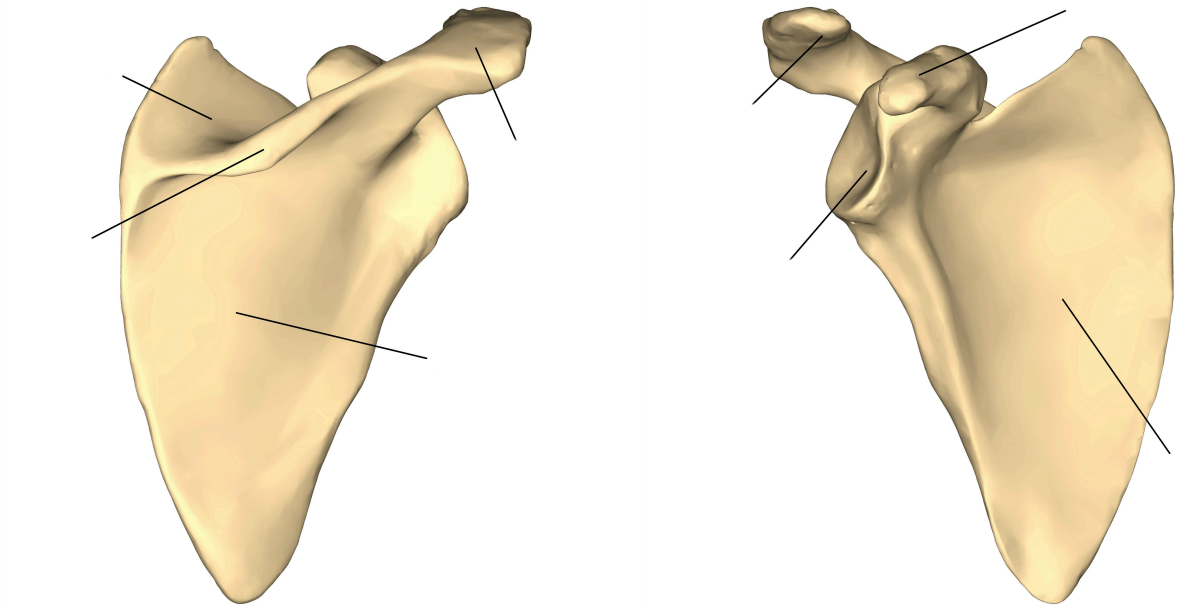
Label the cranial bones and special features. (0.5 points)



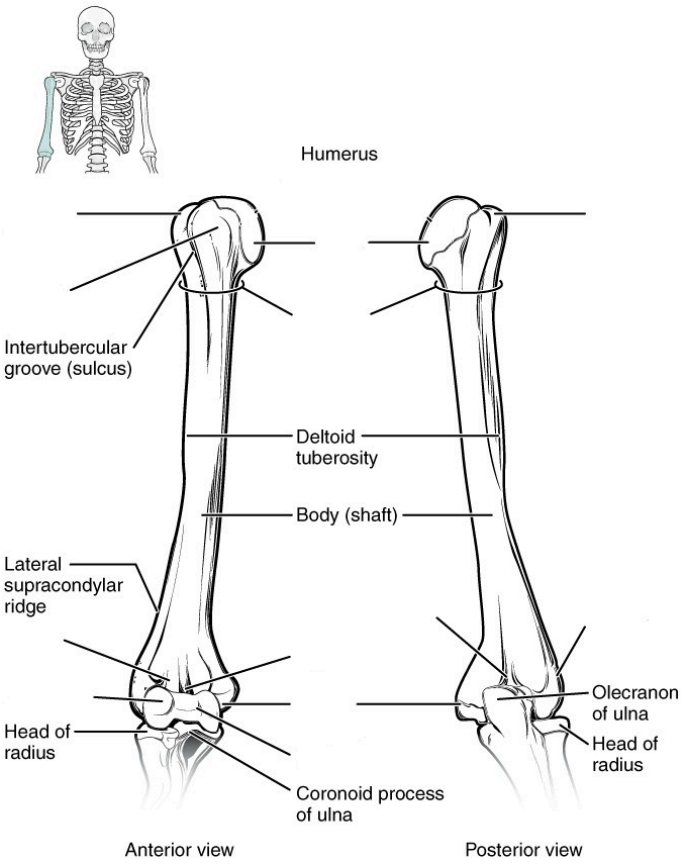
Label the distinctive parts of the vertebra. (0.5 points)



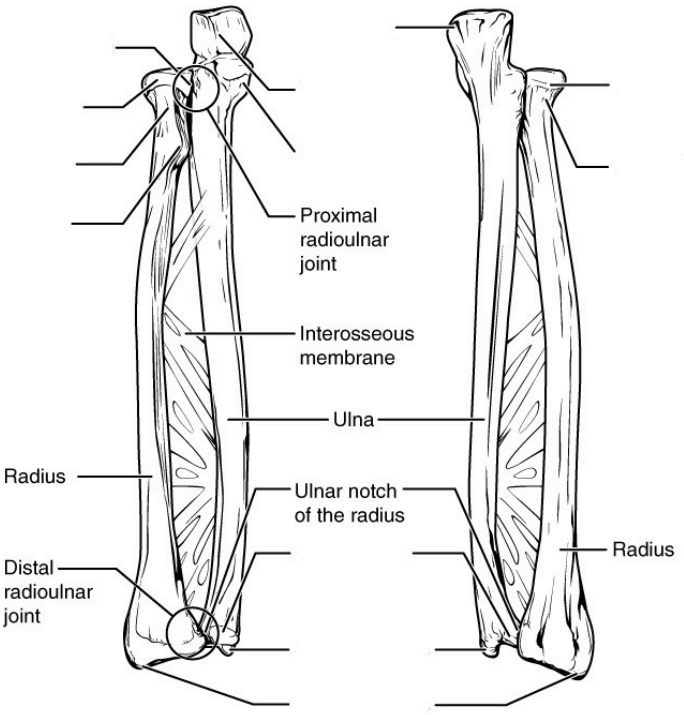
Label the features of the scapula. (0.5 point)



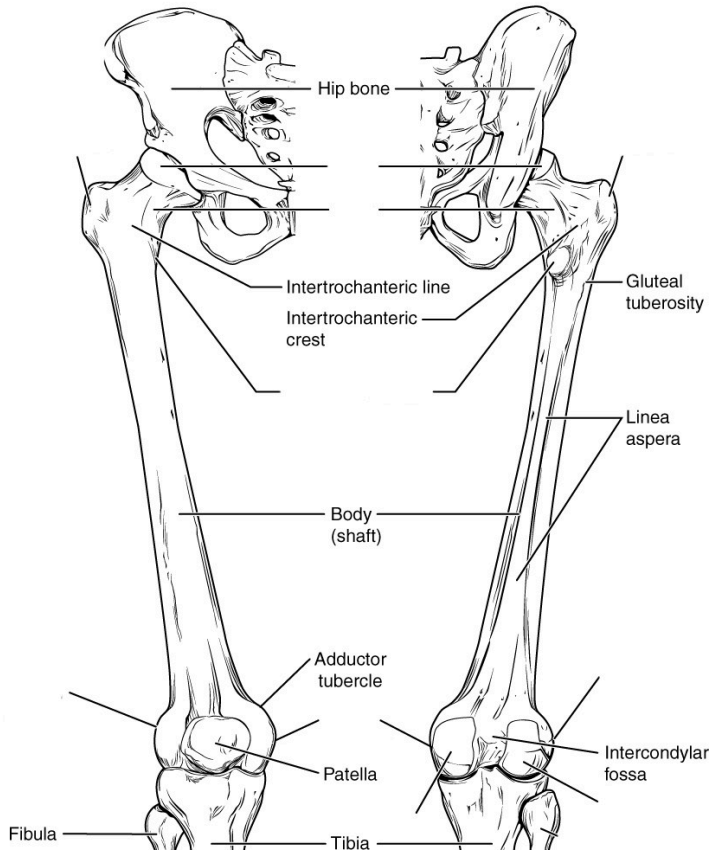
Label the features of the humerus. (0.5 points)



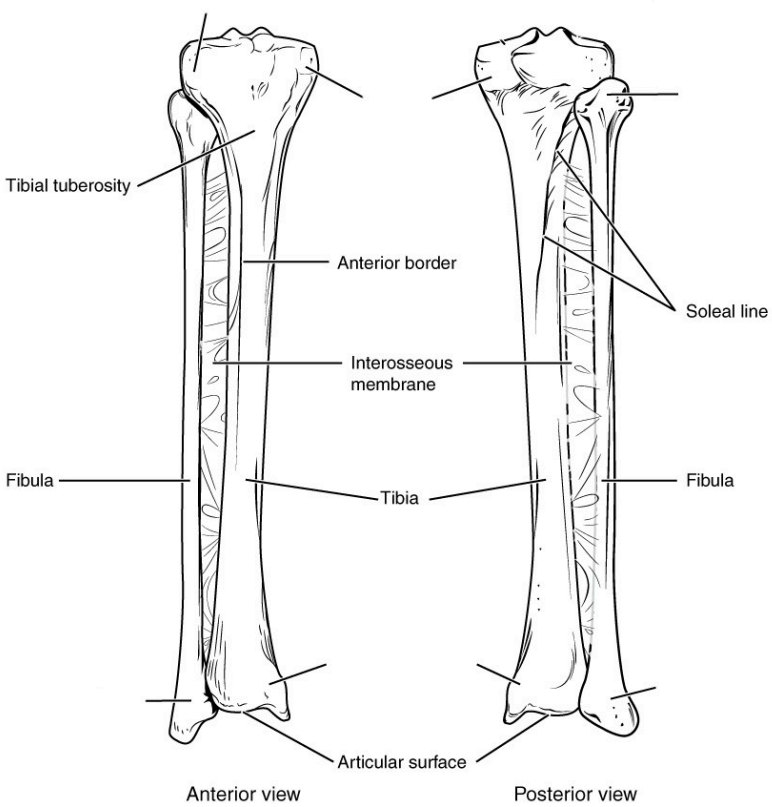
Label the features of the radius and ulna. (0.5 point)



Label the features of the femur. (0.5 points)



Label the features of the tibia and fibula. (0.5 points)



LAB ACTIVITIES

A list of words is provided below that you are expected to identify, learn, and label on the models provided. Note that not all models will have some of the organs/structures, so be sure to find them on an alternate model. You must use all the words provided. Using the colored tape provided, write the number that corresponds to the organ/structure and place them on your model. When complete, notify your TA so they may check your work.

For each additional station, directions will be provided for the activity.

STATION ONE: SKULL

Label the models of this station with the number that corresponds to the appropriate structure of the peripheral nervous system using the colored tape. When you are finished, ask your TA to check your labeling. Before leaving the station, remove all the labels you have placed on the model.

Note: For the following structures, be able to differentiate between left and right halves when applicable.

Bones of Skull

#1 frontal bone	#5 ethmoid bone	#9 zygomatic bone	#13 superior nasal conchae
#2 parietal bone	#6 sphenoid bone	#10 nasal bone	#14 middle nasal conchae
#3 temporal bone	#7 palatine bone	#11 vomer	#15 inferior nasal conchae
#4 occipital bone	#8 maxilla	#12 lacrimal bone	#16 mandible

Skull Bone Markings

#18 external auditory meatus	#20 styloid process	#22 cribriform plate of ethmoid bone	#24 zygomatic process of temporal bone
#19 mastoid process	#21 external occipital protuberance	#23 olfactory foramina	#25 temporal process of zygomatic bone

Special Features of Skull

#26 foramen magnum	#28 foramen ovale	#30 coronal suture	#32 lambdoid suture
#27 jugular foramen	#29 sella turcica	#31 sagittal suture	

STATION TWO: AXIAL SKELETON CONT.

Label the models of this station with the number that corresponds to the appropriate structure of the peripheral nervous system using the colored tape. When you are finished, ask your TA to check your labeling. Before leaving the station, remove all the labels you have placed on the model.

Note: For the following structures, be able to differentiate between left and right halves when applicable.

Vertebral Column

#1 hyoid Bone	#4 thoracic region	#7 coccyx
#2 vertebrae	#5 lumbar region	#8 intervertebral foramen
#3 cervical region	#6 sacrum	#9 intervertebral disc

Parts of Typical Vertebra

#10 body	#12 lamina	#14 transverse process	#16 inferior articular process	#18 facet of inferior articular process
#11 vertebral foramen	#13 spinous process	#15 superior articular process	#17 facet of superior articular process	

Unique Cervical Vertebrae and Characteristics

#19 bifid spinous process	#21 atlas	#23 dens
#20 transverse foramen	#22 axis	

Thoracic Cage

#24 sternum	#26 sternal body	#28 ribs
#25 manubrium	#27 xiphoid process	#29 costal cartilage

STATION THREE: LIMB ASSEMBLY

In this station, you will be given a bucket filled with random bones some of which you will use to assemble an arm and a leg. Note below which bucket you are working with. Your assignment is to lay out the bones of each limb in their correct positions relative to each other and determine which bones do not belong to either limb. Additionally, you will need to determine whether each limb is a right or left limb; circle your results below. When you are finished, ask your TA to check whether you have assembled and identified your limbs correctly.

Bucket # _____

Upper limb: Left / Right

Lower limb: Left / Right

STATION 4: HISTOLOGY

Sketch the slides available for today's lab and specify the magnitude at which you are observing/ sketching. Be sure to identify and label your sketch with the corresponding structures listed beneath each slide.

Compact Bone Osteon Lamellae, Lacunae, Volkmann's canals, Haversian canal	**Spongy Bone**

STATION FIVE: UPPER LIMBS

Label the models of this station with the number that corresponds to the appropriate structure of the peripheral nervous system using the colored tape. When you are finished, ask your TA to check your labeling. Before leaving the station, remove all the labels you have placed on the model.

Note: For the following structures, be able to differentiate between left and right halves when applicable.

Clavicle

#1 acromial end of clavicle	#2 sternal end of clavicle

Scapula

#3 glenoid cavity	#5 coracoid process	#7 supraspinous fossa	#9 subscapular fossa
#4 acromion	#6 spine of scapula	#8 infraspinous fossa	

Humerus

#10 head	#13 lesser tubercle	#16 coronoid fossa	#19 lateral epicondyle
#11 neck	#14 trochlea	#17 radial fossa	#20 olecranon fossa
#12 greater tubercle	#15 capitulum	#18 medial epicondyle	

Ulna

#21 head	#23 trochlear notch	#25 radial notch
#22 olecranon	#24 coronoid process	# 26 styloid process

Radius

#27 head	#29 radial tuberosity
#28 neck	#30 styloid process

Hand and Wrist

#31 carpals (8)	#33 phalanges	#35 middle phalanges
#32 metacarpals	#34 proximal phalanges	#36 distal phalanges

STATION SIX: LOWER LIMBS

Label the models of this station with the number that corresponds to the appropriate structure of the peripheral nervous system using the colored tape. When you are finished, ask your TA to check your labeling. Before leaving the station, remove all the labels you have placed on the model.

Note: For the following structures, be able to differentiate between left and right halves when applicable.

Pelvis

#1 ilium	#3 ischium	#5 pubis	#7 acetabulum
#2 iliac crest	#4 ischial spine	#6 pubic symphysis	

Femur

#8 head	#11 lesser trochanter	#14 medial condyle
#9 neck	#12 medial epicondyle	#15 lateral condyle
#10 greater trochanter	#13 lateral epicondyle	#16 intercondylar fossa

17 patella

Tibia

#18 lateral condyle	#19 medial condyle	#20 medial malleolus

Fibula

#21 head	#22 lateral malleolus

Foot and Ankle

#23 tarsals (7)	#25 metatarsals	#27 proximal phalanges	#29 distal phalanges
#24 calcaneus	#26 phalanges	#28 middle phalanges	

POST-LAB 2 QUESTIONS

(3 points)

Last Name: _____ First Name: _____

1. Replace the common name of following bones with their corresponding anatomical names. (0.5 points)
    a. Fingers
    b. Hip
    c. Head
    d. Bones of the lower arm
    e. Knee
    f. Ankle
    g. Bone of the thigh
    h. Upper jaw
    i. Lower jaw
    j. Shins
    k. Tailbone
    l. Toes
    m. Collarbone
    n. Shoulder blade

2. Name five bones of the axial and appendicular skeleton. (0.5 points)
    1.
    2.
    3.
    4.
    5.
    1.
    2.
    3.
    4.
    5.

3. What makes the atlas (C1) and axis (C2) different from the rest of the vertebrae? (0.5 points)

4. What is unique about the hyoid bone? (0.5 points)

5. When a person is seated on the floor "criss-cross" style, which bones are touching the ground? (0.5 points)

6. Name a bone that is inferior (1), superior (2) and medial (3) to the radius. (0.5 points)
    1.
    2.
    3.

LAB 3: SPINAL CORD AND SPINAL NERVES

LAB 3: SPINAL CORD AND SPINAL NERVES

MEASURABLE OUTCOMES

- Correctly identify the structures which constitute comprise the spinal cord and its extensions.
- Explain the differences between the meninges.
- Differentiate the spinal plexuses.
- Determine the origin, pathway and target organs of the spinal nerves.
- Classify the structures of the spinal cord on the given histology slides.
- Demonstrate an adequate understand of the material in this section.

BACKGROUND

The spinal cord is made of *white matter* encompassed by *gray matter* with a *central canal* running through it that serves as a path for *cerebrospinal fluid (CSF)*. The gray matter is divided into *posterior (dorsal) grey horns* which contain sensory neurons, and *lateral and anterior (ventral) horns* that contain the cell bodies of motor neurons. The surrounding white matter is divided into *anterior (ventral) white columns*, *lateral white columns*, and *posterior (dorsal) white columns*. The *grey commissure* is the gray matter posterior to the central canal where the neurons from either side of the spinal cord crossover. The same principle applies to the *white commissure* which lies anteriorly to the gray matter.

The spinal cord has several layers to protect it from damage. Beginning superficially and working our way deeper, the vertebral column encases the spinal cord and provides a hard shell for protection. Deep to the vertebrae are the meninges, consisting of the *dura mater*, *arachnoid mater,* and *pia mater*. Extensions from the pia mater, the denticulate ligaments, suspend the spinal cord in CSF and act as a shock absorber.

The spinal cord begins at the terminal end of the brain stem and extends to approximately the L1 vertebra adults and L2 vertebrae in children; it is located within the vertebral foramen and is divided into 4 distinct regions. The cervical segment extends from C1 to the C7 vertebrae. The thoracic segment extends from T1 to the T8 vertebrae. The lumbar segment corresponds with T9-T11 vertebrae. Finally, the sacral segment extends from T12 to L2. The *cervical enlargement,* C4-T1, is a bulbous structure from which many neurons of the upper extremities invaginate. Likewise, the *lumbar enlargement,* T9-T12, is a bulbous structure from which neurons that innervate the lower limbs originate.

Note: do not confuse the regions of the spine with the regions of the spinal cord, they are not the same.

There are 31 pairs of spinal nerves: 8 cervical pairs 12 thoracic pairs, 5 lumbar pairs, 5 sacral pairs and 1 coccygeal pair. However, nerves from every other area along the spinal cord do not do this; they first converge in a network called a plexus. With the exception of the thoracic region, nerves of the cervical, brachial, lumbar and sacral regions of the spinal cord branch from a network of nerves known as plexuses.

Vocabulary for Spinal Cord and Spinal Nerves can be found on page(s) 171-172.

PRE-LAB 3

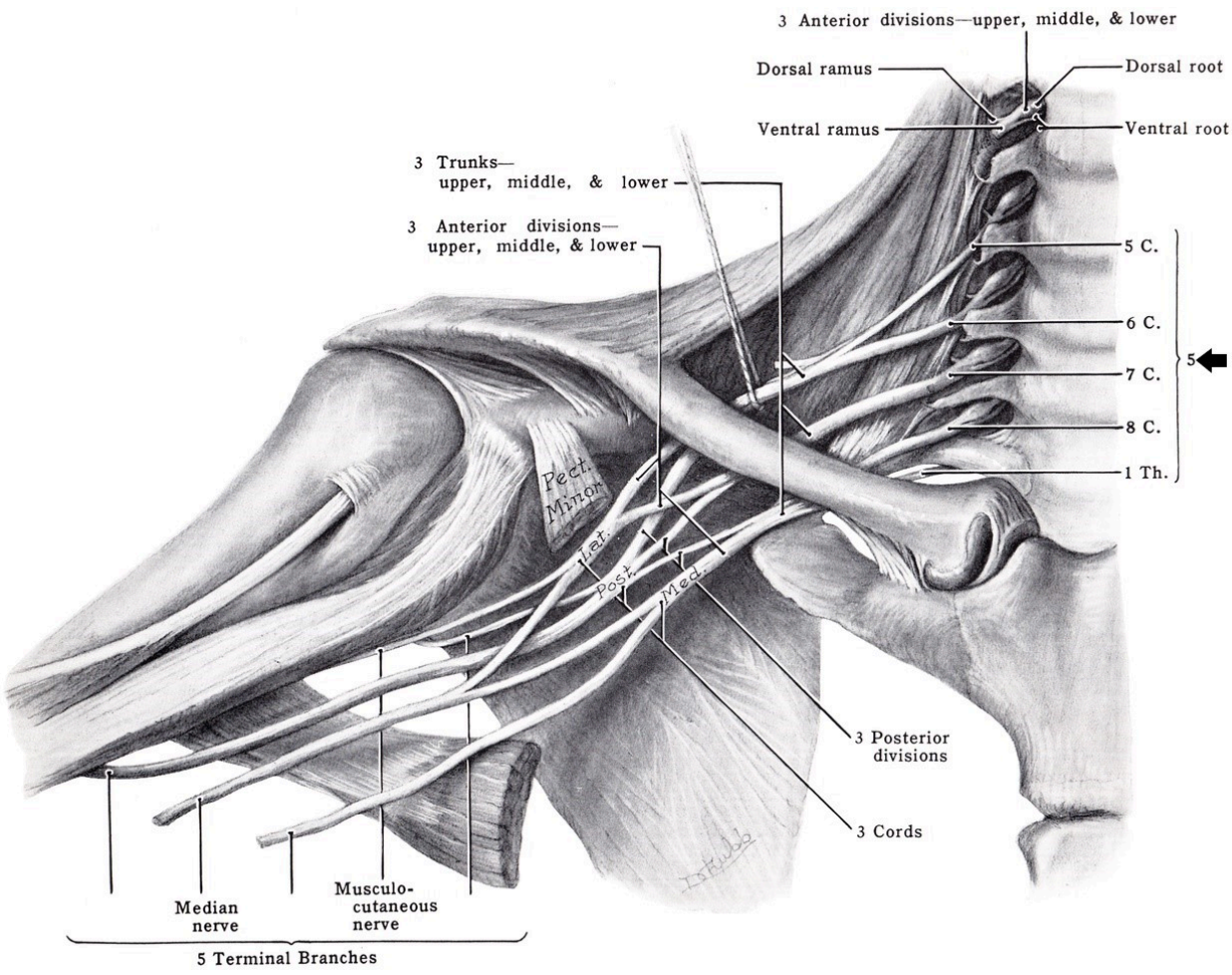
(5 points)

Last Name: _____ First Name: _____

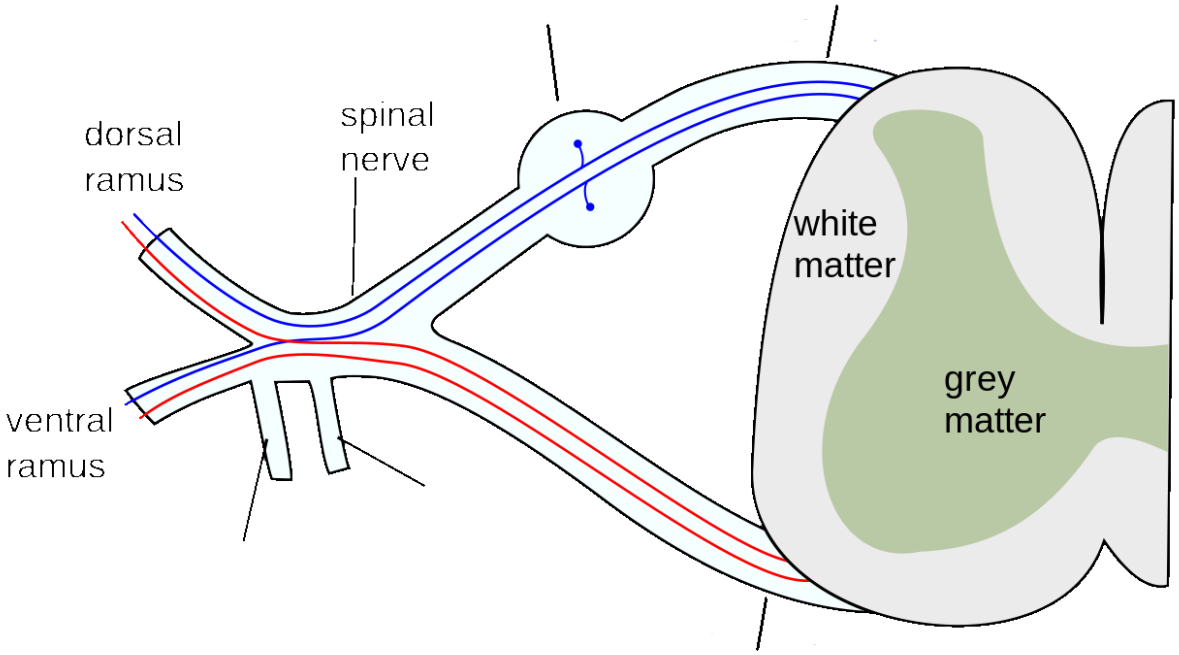
INSTRUCTIONS:

What region of the spinal cord lacks a nerve plexus? **(1 point)**

Label the structures of the brachial plexus? **(1 point)**

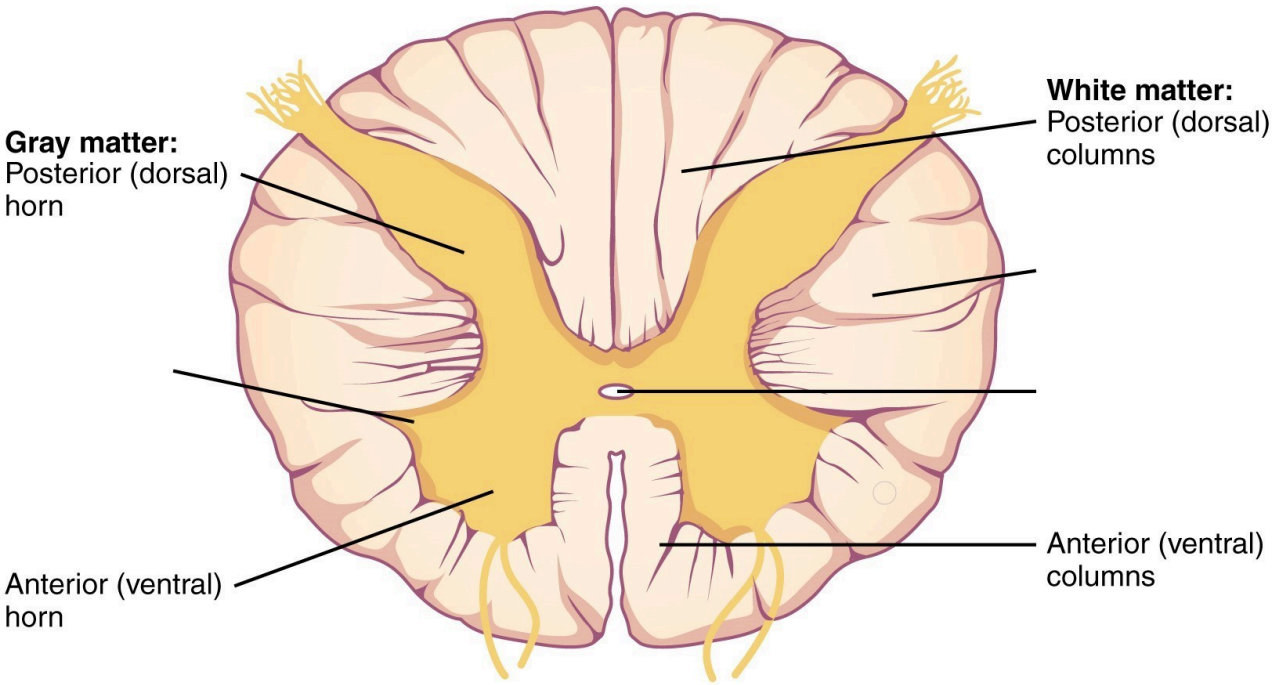


Label the structure of the spinal nerve. **(1 point)**



Which segment of the spinal cord has the highest white to grey matter ratio; which region has the highest grey matter to white matter? **(1 point)**

Label the following structures of the spinal cord. **(1 point)**


Gray matter:
Posterior (dorsal) horn
Anterior (ventral) horn
White matter:
Posterior (dorsal) columns
Anterior (ventral) columns

LAB ACTIVITIES

A list of words is provided below that you are expected to identify, learn, and label on the models provided. Note that not all models will have some of the organs/structures, so be sure to find them on an alternate model. You must use all the words provided. Using the colored tape provided, write the number that corresponds to the organ/structure and place them on your model. When complete, notify your TA so they may check your work.

For each additional station, directions will be provided for the activity.

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STATION ONE: SPINAL CORD

Label the models of this station with the # that corresponds to the appropriate structure of the spinal cord and its protective structures using the colored tape. When you have finished, have your TA check your labeling. Before leaving the station, remove all of the labels you have placed on the model.

Note: For the following structures, be able to differentiate left and right halves when applicable.

#1 vertebral column	#4 dura mater	#7 subarachnoid space	#10 denticulate ligaments	#13 filum terminale
#2 spinal meninges	#5 subdural space	#8 cerebrospinal fluid	#11 spinal cord	#14 cauda equina
#3 epidural space	#6 arachnoid mater	#9 pia mater	#12 conus medullaris	

Spinal Cord

#15 anterior median fissure	#19 posterior white columns	#23 anterior white commissure	#27 thoracic innervation segment	#31 lumbar enlargement
#16 posterior median sulcus	#20 anterior gray horns	#24 posterior gray commissure	#28 lumbar innervation segment	
#17 anterior white columns	#21 lateral gray horns	#25 central canal	#29 sacral innervation segment	
#18 lateral white columns	#22 posterior gray horns	#26 cervical innervation segment	#30 cervical enlargement	

STATION TWO: SPINAL NERVES AND CERVICAL PLEXUS

Label the models of this station with the number that corresponds to the appropriate structure of the peripheral nervous system using the colored tape. When you are finished, ask your TA to check your labeling. Before leaving the station, remove all the labels you have placed on the model.

Note: For the following structures, be able to differentiate between left and right halves when applicable.

Spinal Nerves

#1 cervical nerve one (C1)	#9 thoracic nerve one (T1)	#17 thoracic nerve nine (T9)	#25 lumbar nerve five (L5)
#2 cervical nerve two (C2)	#10 thoracic nerve two (T2)	#18 thoracic nerve ten (T10)	#26 sacral nerve one (S1)
#3 cervical nerve three (C3)	#11 thoracic nerve three (T3)	#19 thoracic nerve eleven (T11)	#27 sacral nerve two (S2)
#4 cervical nerve four (C4)	#12 thoracic nerve four (T4)	#20 thoracic nerve twelve (T12)	#28 sacral nerve three (S3)
#5 cervical nerve five (C5)	#13 thoracic nerve five (T5)	#21 lumbar nerve one (L1)	#29 sacral nerve four (S4)
#6 cervical nerve six (C6)	#14 thoracic nerve six (T6)	#22 lumbar nerve two (L2)	#30 sacral nerve five (S5)
#7 cervical nerve seven (C7)	#15 thoracic nerve seven (T7)	#23 lumbar nerve three (L3)	#31 coccygeal nerve one (Coc1)
#8 cervical nerve eight (C8)	#16 thoracic nerve eight (T8)	#24 lumbar nerve four (L4)	

Cervical plexus

Note: When labeling the nerves that exit the cervical plexus, focus on their location, the connections between the nerves of the plexus, and what they innervate. Also note any interesting characteristics you find, for example, which is the longest nerve? Make use of your textbook and atlas during this time.

#32 lesser occipital nerve	#34 transverse cervical nerve	#36 superior root of Ansa cervicalis nerve	#38 phrenic nerve
#33 great auricular nerve	#35 supraclavicular	#37 inferior root of Ansa cervicalis nerve	#39 segmental branches

STATION THREE: BRACHIAL PLEXUS

Label the models of this station with the number that corresponds to the appropriate structure of the peripheral nervous system using the colored tape. When you are finished, ask your TA to check your labeling. Before leaving the station, remove all the labels you have placed on the model.

Note: When labeling the nerves that exit the brachial plexus, focus on their location, the connections between the nerves of the plexus and what they innervate. Also note any interesting characteristics you find, for example, which is the longest nerve? Make use of your textbook and atlas during this time.

#1 dorsal scapular nerve	#5 musculocutaneous nerve	#9 lower subscapular nerve	#13 medial pectoral nerve
#2 long thoracic nerve	#6 lateral pectoral nerve	#10 axillary nerve	#14 medial cutaneous nerve of arm
#3 nerve to subclavius	#7 upper subscapular nerve	#11 median nerve	#15 medial cutaneous nerve of forearm
#4 suprascapular nerve	#8 thoracodorsal nerve	#12 radial nerve	#16 ulnar nerve

STATION 4: HISTOLOGY

Sketch the slides available for today's lab and specify the magnitude at which you are observing/sketching. Be sure to identify and label your sketch with the corresponding structures listed beneath each slide.

Spinal cord Anterior median fissure, Posterior median sulcus, Anterior white columns, Lateral white columns, Posterior white columns, Anterior gray horns, Lateral gray horns, Posterior gray horns, Anterior white horns, Posterior gray commissure, Central canal	**Sympathetic ganglion**

STATION FIVE: LUMBAR PLEXUS

Label the models of this station with the number that corresponds to the appropriate structure of the peripheral nervous system using the colored tape. When you are finished, ask your TA to check your labeling. Before leaving the station, remove all the labels you have placed on the model.

Note: When labeling the nerves that exit the lumbar plexus, focus on their location, the connections between the nerves of the plexus and what they innervate. Also note any interesting characteristics you find, for example, which is the longest nerve? Make use of your textbook and atlas during this time.

#1 iliohypogastric nerve	#3 genitofemoral nerve	#5 femoral nerve
#2 ilioinguinal nerve	#4 lateral cutaneous nerve of thigh	#6 obturator nerve

STATION SIX: SACRAL PLEXUS

Label the models of this station with the number that corresponds to the appropriate structure of the peripheral nervous system using the colored tape. When you are finished, ask your TA to check your labeling. Before leaving the station, remove all the labels you have placed on the model.

Note: When labeling the nerves that exit the sacral plexus, focus on their location, the connections between the nerves of the plexus and what they innervate. Also note any interesting characteristics you find, for example, which is the longest nerve? Make use of your textbook and atlas during this time.

#1 superior gluteal nerve	#4 nerve to quadratus	#7 posterior cutaneous nerve of thigh	#10 tibial median plantar nerve	#13 deep common fibular nerve
#2 inferior gluteal nerve	#5 nerve to obturator internus and superior gemellus	#8 pudenal nerve	#11 tibial lateral plantar nerve	
#3 nerve to piriformis	#6 perforating cutaneous nerve	#9 sciatic nerve	#12 superficial common fibular nerve	

POST-LAB 3 QUESTIONS

(2 points)

Last Name: _____ First Name: _____

1. What is the longest nerve in the body? (0.5 points)

2. In what region(s) of the spinal cord do the nerves which innervate the lower body originate? (0.5 points)

3. The spinal cord is divided into how many segments? List the number of segments in each portion of the spinal column. (0.5 points)

4. List the spinal meninges and the relevant spaces in between, as well as what occupies those spaces. (0.5 points)

LAB 4: BRAIN AND CRANIAL NERVES

LAB 4: BRAIN AND CRANIAL NERVES

MEASURABLE OUTCOMES

- Complete the dissection of the sheep brain and identify (with a pin) all of the structures of the brain using the corresponding vocabulary list.
- Locate structures of the brain and cranial nerves on the various models in the lab.
- Identify the 12 cranial nerves as well as their target organs.
- Determine the composition of the of the brain from dissections.
- Determine/trace the path of cerebrospinal fluid through the brain.
- Differentiate histology from different regions of the brain.
- Demonstrate an adequate understand of the material in this section.

BACKGROUND

The central nervous system entails all neurons of the brain and spinal cord. The brain is the central processing organ of the body and contains 100 billion neurons and a remarkable 1 trillion glial cells. It is estimated that cortical neurons alone consume around 5 billion ATP molecules per second. Whats more, some neurons can have axons that extend several feet. Unlike the spinal cord, the gray and white matter in the brain are arranged in three segments. From deep to superficial, the innermost region is made of gray matter which is surrounded by the myelinated axons of the white matter. The thin layer of the cerebral cortex responsible for higher order cognition is the outermost layer of gray matter. The brain is divided into four major regions, the brainstem, diencephalon, cerebellum, and cerebrum. The brainstem contains the medulla oblongata, pons, and midbrain (which houses the pineal gland). Caudal to the forebrain is the diencephalon, a region which contains the epithalamus, hypothalamus, thalamus and third ventricle.

There are four cavities in the brain called ventricles; here cerebrospinal fluid (CSF) is produced and circulated by ependymal cells and the choroid plexuses. The two largest ventricles lie within each cerebral hemispheres and are known as the lateral ventricles. Cerebrospinal fluid drains from the lateral ventricles, through the interventricular foramen and into the third ventricle. The third ventricle lies between the halves of the thalamus. From here, it flows through the cerebral aqueduct (aqueduct of sylvius) and into the fourth ventricle, which lies between the cerebellum and the pons. Cerebrospinal fluid drains from the fourth ventricle, into the lateral and median apertures and down through the central canal of the spinal cord. Cerebrospinal fluid leaks out through foramina into the subarachnoid space where it is reabsorbed by veins on the surface of the brain and spinal cord.

Like the spinal cord, the brain is protected by three meninx, the dura, arachnoid and pia mater.

Unlike the spinal meninges, the cranial dura mater is subdivided into two distinct layers; the periosteal layer, which is the superficial mot layer, and the inner meningeal dura mater. The two dural layers form the superior sagittal sinus which collectively channels venous blood from the brain. The falx cerebri divides the cerebrum into left and right hemispheres, the falx cerebelli divides the cerebellum into left and right hemispheres, and the tentorium cerebelli forms a physical barrier between the cerebrum and the cerebellum.

Vocabulary for the Brain and Cranial Nerves on page(s) 162-163.

PRE-LAB 4

(5 points)

Last Name: _____ First Name: _____

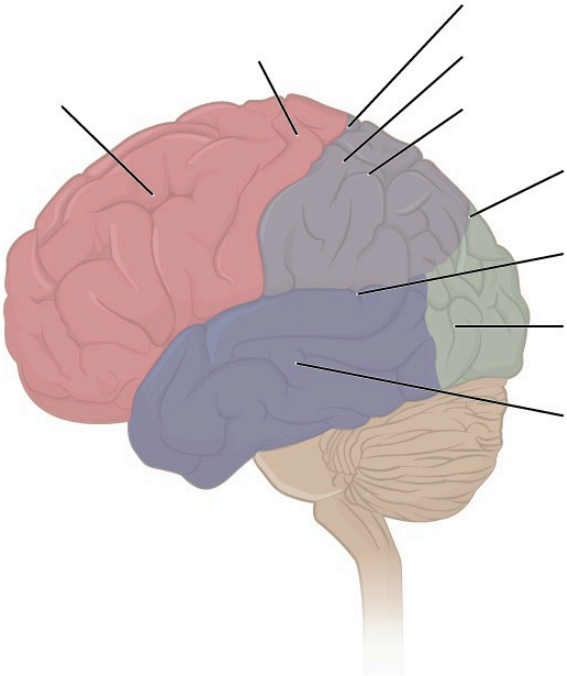
INSTRUCTIONS:

Fill in the table below with the appropriate terms. For the remaining exercises, label the designated structures.

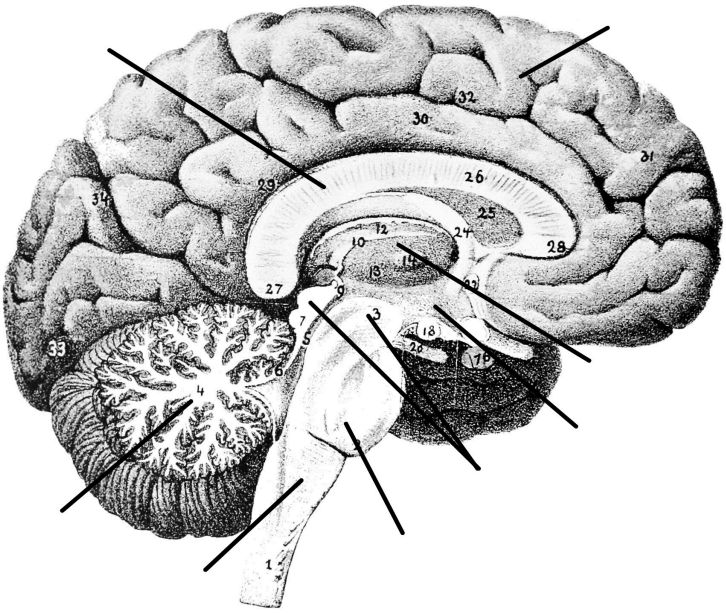
(1 point)

Name of a structure	is	directional term	to	Name of the second structure
pons*	is	anterior	to	cerebellum*
corpus callosum	is	superior	to	
	is	inferior	to	hypothalamus
precentral gyrus	is	anterior	to	
	is	superficial	to	diencephalon
interthalamic adhesion	is	medial	to	
	is	superior	to	pons

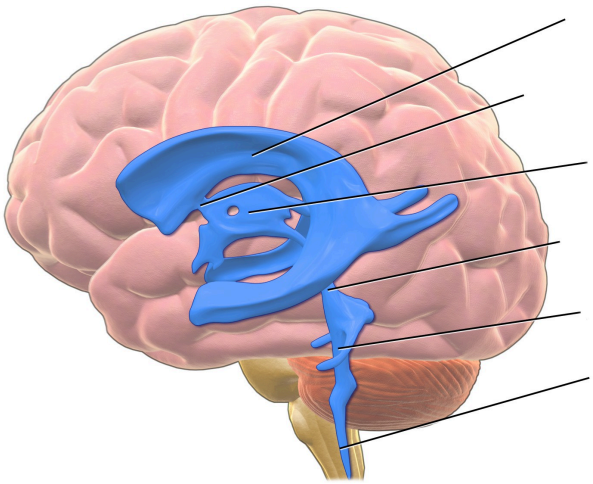
Label the sulci, gyri, and lobes of the cerebrum. (1 point)



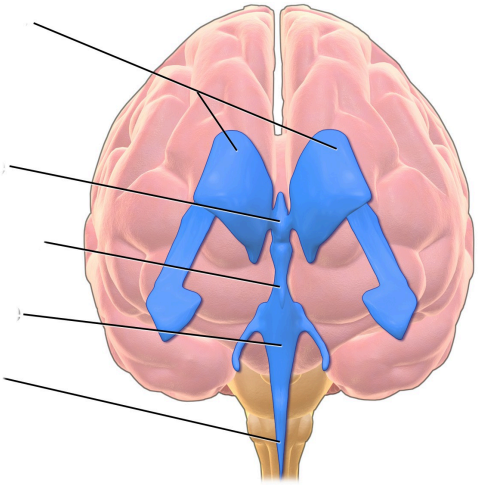
Label the major structures of the brain. (1 point)



Label the ventricles and passageway of CSF through the brain. (1 point)

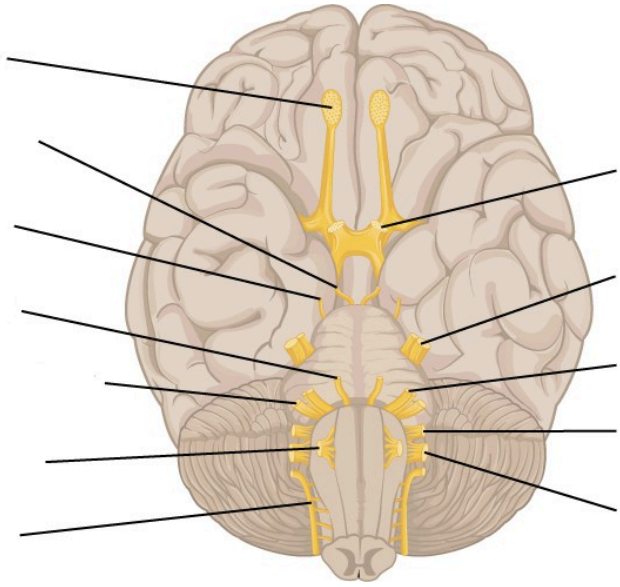


(lateral view)



(anterior view)

Label the cranial nerves. (1 point)



LAB ACTIVITIES

A list of words is provided below that you are expected to identify, learn, and label on the models provided. Note that not all models will have some of the organs/structures, so be sure to find them on an alternate model. You must use all the words provided. Using the colored tape provided, write the number that corresponds to the organ/structure and place them on your model. When complete, notify your TA so they may check your work.

For each additional station, directions will be provided for the activity.

STATION ONE: BRAIN

Label the models of this station with the number that corresponds to the appropriate structure of the peripheral nervous system using the colored tape. When you are finished, ask your TA to check your labeling. Before leaving the station, remove all the labels you have placed on the model.

Note: For the following structures, be able to differentiate between left and right halves when applicable.

Cerebrum

#1 cerebral cortex	#3 temporal lobes	#5 occipital lobe
#2 frontal lobe	#4 parietal lobes	#6 insula

Diencephalon

#7 thalamus	#9 mammillary bodies	#11 pineal glands
#8 hypothalamus	#10 epithalamus	

Brainstem

#12 midbrain	#14 superior colliculi	#16 cerebral peduncles	#18 medulla oblongata
#13 tectum (corpora quadrigemina)	#15 inferior colliculi	#17 pons	

Cerebellum

#19 arbor vitae	#21 vermis
#20 folia	#22 cerebellar peduncles

Other important structures

#23 basal nuclei	#25 fornix	#27 pituitary gland	#29 optic chiasm
#24 corpus callosum	#26 cingulate gyrus	#28 infundibulum	

STATION TWO: UNIQUE FEATURES AND PATHWAY OF CSF

Label the models of this station with the number that corresponds to the appropriate structure of the peripheral nervous system using the colored tape. When you are finished, ask your TA to check your labeling. Before leaving the station, remove all the labels you have placed on the model.

Note: For the following structures, be able to differentiate between left and right halves when applicable.

Composition of the Brain

#1 gray matter	#2 white matter

Superficial Characteristics of the Brain

#3 gyri (convulsions)	#5 sulci	#7 postcentral gyrus	#9 central sulcus	#11 transverse fissure
#4 fissures	#6 precentral gyrus	#8 lateral cerebral sulcus	#10 parieto-occiptal sulcus	#12 longitudinal fissure

Cranial Meninges

These features may not be shown on models, but it is important to be able to identify them in diagrams and on the brains that you will dissect.

#13 dura mater	#15 falx cerebelli	#17 arachnoid mater
#14 falx cerebri	#16 tentorium cerebelli	#18 pia mater

Ventricles and Associated Structures

Using the terms in the table below, determine the pathway of cerebrospinal fluid.

#19 lateral ventricles	#21 interventricular foramen	#23 cerebral aqueduct (aqueduct of midbrain)	#25 choroid plexuses
#20 septum pellucidum	#22 third ventricles	#24 fourth ventricles	#26 cerebrospinal fluid

STATION THREE: CRANIAL NERVES

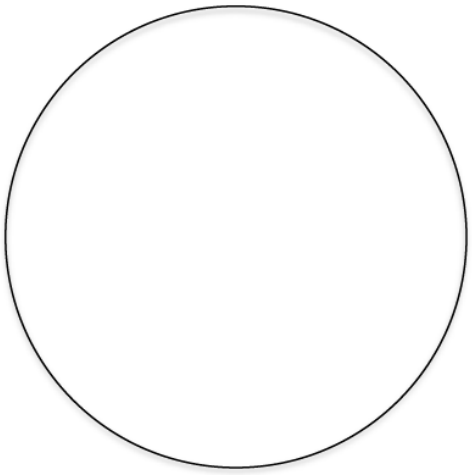
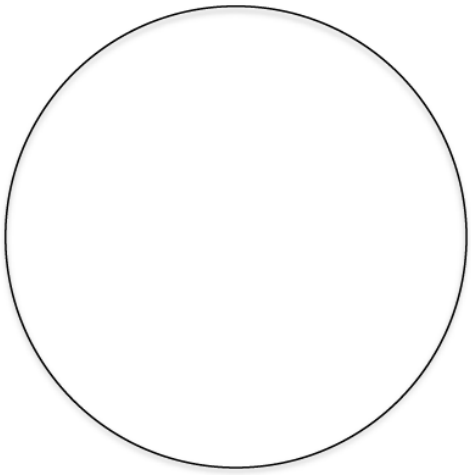
Label the models of this station with the number that corresponds to the appropriate structure of the peripheral nervous system using the colored tape. When you are finished, ask your TA to check your labeling. Before leaving the station, remove all the labels you have placed on the model.

While learning the names, corresponding numbers and location of each of the cranial nerves, be sure to connect these to their functions and the structures they innervate.

#1 olfactory nerve (I)	#4 trochlear nerve (IV)	#7 facial nerve (VII)	#10 vagus nerve (X)
#2 optic nerve (II)	#5 trigeminal nerve (V)	#8 vestibulocochlear/ acoustic nerve (VIII)	#11 Accessory/spinal nerve (XI)
#3 oculomotor nerve (III)	#6 abducens nerve (VI)	#9 glossopharyngeal nerve (IX)	#12 hypoglossal nerve (XII)

STATION 4: HISTOLOGY

Sketch the slides available for today's lab and specify the magnitude at which you are observing/ sketching. Be sure to identify and label your sketch with the corresponding structures listed beneath each slide.

	
Cerebrum	**Cerebellum**

STATION FIVE: BRAIN DISSECTION WITHOUT MENINGES

- Orientate the brain such that the posterior aspect containing the brain stem is facing you. Obtain the scalpel from your kit and place it on the anterior (farthest from you) portion of the longitudinal fissure. Using a scalpel, firmly press down on the brain while simultaneously bringing the scalpel carefully towards you; this makes a clean incision down the sagittal plane of the brain. (**DO NOT make sawing motions with the scalpel**.) Continue to make incisions until you have separated the brain into its two hemispheres.
- Obtain pins from the table and place them into as many structures as you can identify. Your lab TA will come around and ask you to identify the pins you have placed.

*If you are the last table to use this station, be sure to clean off the dissection kits in the lab sink.

STATION SIX: BRAIN DISSECTION WITH MENINGES

- The brain you will receive at this station will have the tough, fibrous meninges still surrounding it. Pinch this tissue between your fingers to separate it from the brain. Using the scissors in your dissection kit, carefully make an incision in the tissue until you have created a hole from which to cut. Cut the meninx, make sure that it comes away from the brain without pulling on the brain's outer cortex.
- Once the outermost meninx has been removed orientate the brain such that the posterior aspect containing the brain stem is facing you. Obtain the scalpel from your kit and place it on the anterior (farthest from you) portion of the longitudinal fissure of the brain. Using the scalpel, firmly press down on the brain while simultaneously bringing the scalpel carefully towards you; this makes a clean incision down the sagittal plane of the brain. (**DO NOT make sawing motions with the scalpel**.) Continue to make incisions until you have separated the brain into its two main hemispheres.
- Obtain pins from the table and place them on as many structures as you can identify. Your lab TA will come around and ask you to identify the pins you have placed.

*If you are the last table to use this station, be sure to clean off the dissection kits in the lab sink.

POST-LAB 4 QUESTIONS

(3 points)

Last Name: _____ First Name: _____

1. Which of the following structures are not part of the brainstem? (Circle the appropriate response(s)) (0.5 points)
    - Cerebral hemisphere
    - Cerebellum
    - Pons
    - Medulla oblongata
    - Midbrain
    - Diencephalon

2. What are the three primary parts of the diencephalon? (0.5 points)

3. Identify the meningeal (or associated) structures described below: (1 point)
    1. Outermost meninx that covers the brain and is composed of tough, fibrous connective tissue
    2. Location of CSF production
    3. Innermost meninx that covers the brain
    4. Structures instrumental in returning cerebrospinal fluid (CSF) to the venous blood in the dural venous sinuses
    5. A dural fold separating the cerebrum from the cerebellum

4. Provide the name and number of the cranial nerves involved in each of the following activities, sensations or disorders. (1 point)

    1. _____ Rotating the head
    2. _____ Smelling coffee
    3. _____ Elevating the eyelids; pupillary constriction
    4. _____ Slowing the heart; swallowing
    5. _____ Involved in Bell's palsy (facial paralysis); crying
    6. _____ Chewing food; feeling a toothache
    7. _____ Listening to music; seasickness
    8. _____ Secretion of saliva; tasting well-seasoned food
    9. _____ Involved in "rolling" the eyes (three nerves; provide numbers only)
    10. _____ Swallowing; speaking (motor only)
    11. _____ Seeing the PowerPoint during lecture

LAB 5: SPECIAL SENSES

LAB 5: SPECIAL SENSES

MEASURABLE OUTCOMES

- Explain the function of each special sense.
- Identify all of the provided anatomical structures of the special senses on available models.
- Determine the pathways of vision, hearing, balance, taste, and olfaction.
- Correctly identify the histology slides and the structures that can be differentiated on each.
- Determine the structures of the dissected eye.
- Demonstrate the ability to count the taste buds of a lab partner using the experiment provided.
- Demonstrate an adequate understand of the material in this section.

BACKGROUND

In anatomy, special senses are the senses that have organs specifically devoted to them such as vision, gustation, olfaction, audition, and equilibrioception. These senses have specialized organs that detect and process stimuli and send signals to the brain which lead to the perception of that stimulus. These specialized organs include the tongue, the nose, the eyes and the ears.

The *tongue* is a crucial organ in mechanical digestion and taste. Taste buds contain taste receptor cells which are the smallest functional unit in gustation. Taste buds can be found throughout the length of the upper digestive tract. On the surface of the tongue are protrusions called papillae. *Circumvallate papillae* are arranged in a v shape pattern on toward the base of the tongue, on the dorsal aspect, and contain more than 100 taste buds each. The *fungiform papillae* are found all over the dorsal aspect of the tongue and contain only about 5 taste buds each. The *foliate papillae* are found on the lateral aspects of the tongue and only contain taste buds during childhood. Finally, there are the *filiform papillae* which, like the fungiform papillae, are found all over the tongue, however, they do not contain taste buds. Instead, their barbed shape provides the friction for moving food around during mastication.

The olfactory epithelium is easily discernable on most models. Unlike any of the following special senses, neurons from the olfactory bulb bypass the thalamus and synapse directly with the olfactory cortex.

The ear is a complex organ which houses special structures that allow us to hear, balance and orientate ourselves. Sound waves are collected by the *auricle* and funneled into the external acoustic meatus. The ear is divided into three sections, the outer, middle, and inner ear. The outer ear consists of the *auricle* which extends through the *external auditory canal* and terminates at *t*he

tympanic membrane. The main structures of the middle ear are the *auditory ossicles*, Eustachian tube, oval window and round window. The auditory ossicles inward from the tympanic membrane, are the malleus, incus, and stapes. The base of the stapes covers the *oval window* which allows sound waves to pass from the tympanic membrane, into the cochlea of the inner ear. The inner ear is the innermost region of the ear where the *cochlea, vestibule*, and *semicircular canals* are. The cochlea, vestibule, and semicircular canals are responsible for hearing, static and dynamic equilibrium respectively. The vestibulocochlear nerve branches, into the cochlear branch, which innervates the cochlea, and the vestibular branch which innervates the vestibule and semicircular canals.

The eye is the specialized organ of sight which has three principal layers, the *fibrous tunic*, the *vascular tunic* and the *neural tunic*. Furthermore, there are two main chambers, the *anterior chamber*, containing *aqueous humor* and the *posterior chamber*, that contains *vitreous humor*. In the neural tunic of the retina, light propagates from the ganglionic cells through the bipolar cells to the rods and cons, which, somewhat paradoxically hyperpolarize opposite the direction of light.

The lacrimal apparatus frames the eye and coats the sclera and cornea in lacrimal fluid, a bacteriacide, which lubricates and protects them. The lacrimal apparatus is made of the *lacrimal gland, lacrimal canaliculi, lacrimal sac* and *nasolacrimal duct*. This network of structures allows tears produced by the *lacrimal gland* to cover the eye, drain through the lacrimal puncta into the lacrimal canaliculi, collect in the lacrimal sac, travel down the nasolacrimal duct and finally empty into the nose. This is why crying leads to a runny nose.

Vocabulary for Special Senses can be found on page(s) 169-171.

PRE-LAB 5

(5 points)

Last Name: _____ First Name: _____

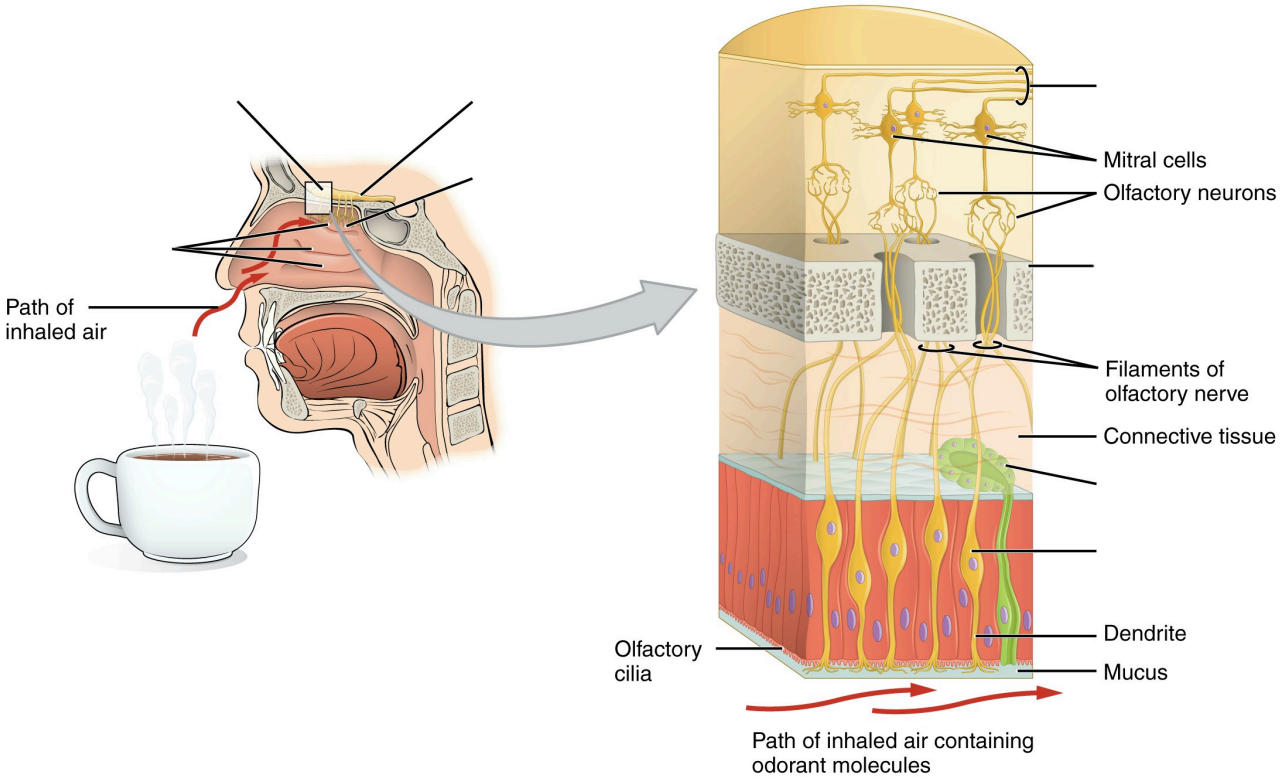
INSTRUCTIONS:

Fill in the table below with the appropriate terms. For the remaining exercises, label the structures accordingly.

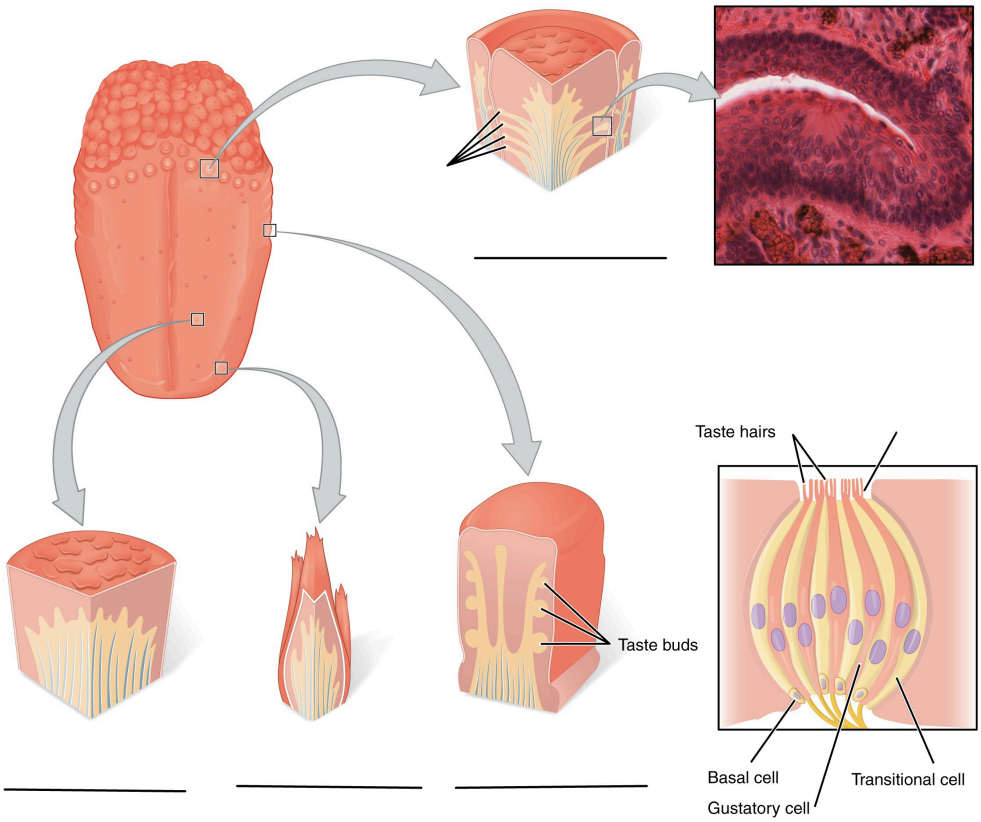
(1 point)

Name of a structure	is	directional term	to	Name of the second structure
retina*	is	posterior	to	lens*
middle nasal conchae	is	superior	to	
	is	inferior	to	cribriform plate
cornea	is	anterior	to	
	is	distal	to	tympanic membrane
medial rectus	is	medial	to	
	is	lateral	to	tongue

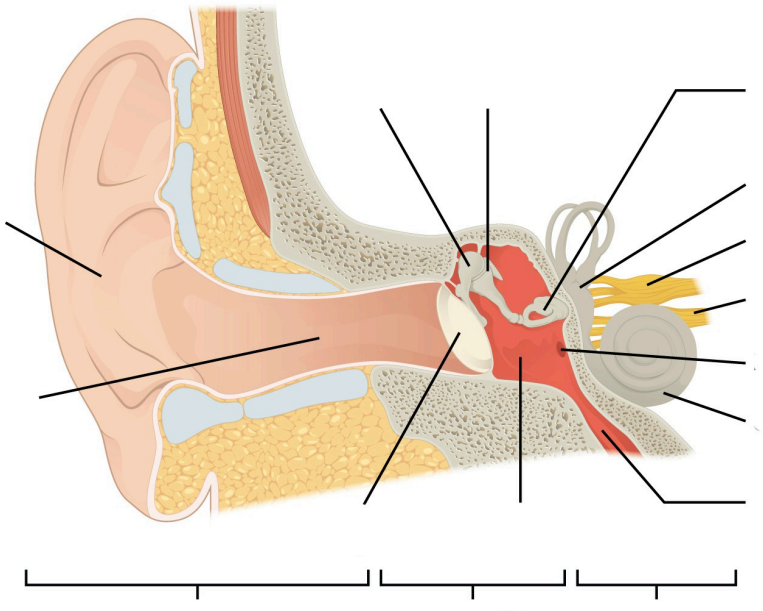
Label the structures of the olfactory epithelium and olfactory pathway. (1 point)



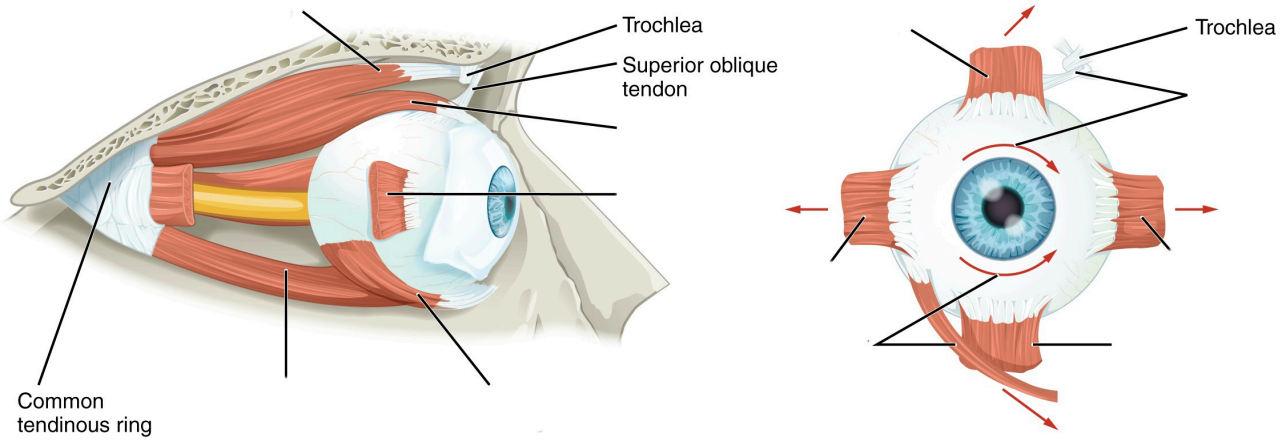
Label the types of papillae and parts of the taste buds. (1 point)



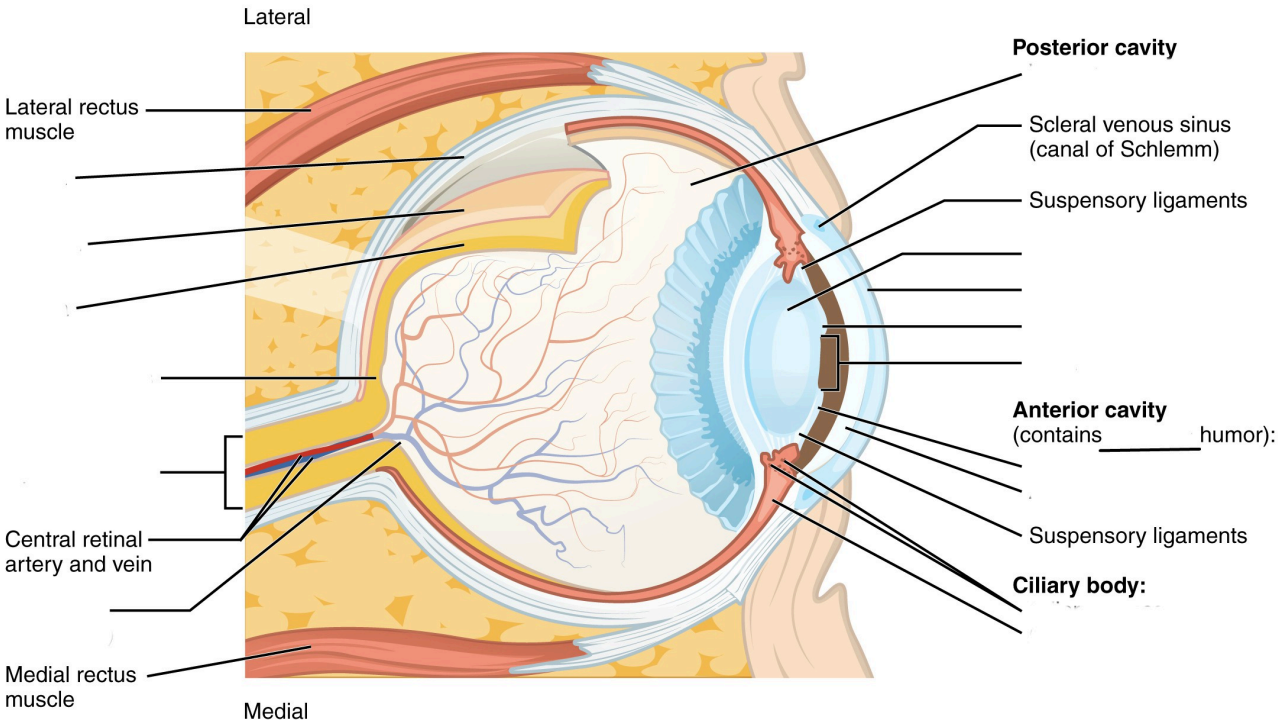
Label the regions and structures of the ear. (1 point)



Label the muscles of the eye. (0.5 points)



Label the structures and regions of the eye. (0.5 points)



LAB ACTIVITIES

A list of words is provided below that you are expected to identify, learn, and label on the models provided. Note that not all models will have some of the organs/structures, so be sure to find them on an alternate model. You must use all the words provided. Using the colored tape provided, write the number that corresponds to the organ/structure and place them on your model. When complete, notify your TA so they may check your work.

For each additional station, directions will be provided for the activity.

STATION ONE: ARE YOU A SUPER TASTER?

- For this exercise, it is recommended that you use dark food coloring for maximum effect
- Using the spoon, use a small amount of the food coloring or powder on the tongue. Do NOT use a full spoon or pour a mound on the subject's tongue!
- Paper squares will be provided which have a 1cm in diameter hole in them. Have the volunteer place the paper on their tongue and make sure that the hole aligns with the area highlighted by the food coloring.
- Use a camera phone (or other devices), to take a closeup still photo of the circle.
- The papilla will contrast against the color of the food coloring. Count the number of the papilla in the circle and record it below.
- If there are between 0 and 5 papilla, then the subject is a "hypo-taster". A hypo-taster is more tolerant of bitter tastes. If there are between 5 and 15 papillae, then the subject has average tasting capabilities. If there are more than 15 papillae found in this 1cm area, then the subject is a "hyper-taster". A hyper-taster is more sensitive to bitter tastes. Determine whether the subject is a hypo-taster, average taster or hyper-taster and record it below next to "Tasting abilities".
- Repeat with another group member.

Note: if your lab does not permit the use of food items in the lab, leave the room before conducting this experiment.

Subject #1: _____

Number of taste buds: _____

Tasting abilities: _____

Subject #2: _____

Number of taste buds: _____

Tasting abilities: _____

STATION TWO: TASTE AND SMELL

Label the models of this station with the number that corresponds to the appropriate structure of the peripheral nervous system using the colored tape. When you are finished, ask your TA to check your labeling. Before leaving the station, remove all the labels you have placed on the model.

Note: For the following structures, be able to differentiate between left and right halves when applicable.

Tongue and Associated Structures

#1 lingual tonsils	#4 fungiform papillae	#7 circumvallate papillae
#2 palatine tonsils	#5 filiform papillae	#8 taste bud
#3 lingual papillae	#6 foliate papillae	#9 taste pore

Taste Pathway

#10 facial nerve (CN VII)	#12 vagus nerve (CN X)	#14 primary gustatory area
#11 glossopharyngeal nerve (CN IX)	#13 thalamus	

Nose

#15 superior nasal conchae	#19 middle nasal meatus	#23 cribriform plate of ethmoid bone
#16 middle nasal conchae	#20 inferior nasal meatus	#24 olfactory foramina
#17 inferior nasal conchae	#21 olfactory epithelium	
#18 superior nasal meatus	#22 olfactory glands	

Olfactory Pathway

#25 olfactory epithelium	#27 olfactory nerve (CN I)	#29 olfactory tract
#26 olfactory receptors	#28 olfactory bulb	#30 primary olfactory area of the cerebral cortex

STATION THREE: HEARING

Label the models of this station with the number that corresponds to the appropriate structure of the peripheral nervous system using the colored tape. When you are finished, ask your TA to check your labeling. Before leaving the station, remove all the labels you have placed on the model.

Note: For the following structures, be able to differentiate between left and right halves when applicable.

Outer Ear

#1 auricle (pinna)	#3 lobule	#5 external auditory canal	#7 tympanic membrane
#2 helix	#4 external auditory meatus	#6 ceruminous glands	

Middle Ear

#8 auditory ossicles	#10 incus	#12 Eustachian tube	#14 round window
#9 malleus	#11 stapes	#13 oval window	

Inner Ear

#15 bony labyrinth	#18 cochlea	#21 utricle
#16 semicircular canals	#19 membranous labyrinth	#22 saccule
#17 vestibule	#20 semicircular canals	#23 organ of corti

Auditory Pathway

#24 vestibulocochlear nerve (CN VIII)	#25 primary auditory area of the cerebral cortex

STATION FOUR: HISTOLOGY

Sketch the slides available for today's lab and specify the magnitude at which you are observing/sketching. Be sure to identify and label your sketch with the corresponding structures listed beneath each slide.

Retina Pigmented layer, Neural layer	**Tongue** Fungiform papillae, Filiform papillae

STATION FIVE: EYE DISSECTION

- First, determine the external surface features and structures of the cow eye. You should be able to identify: the *sclera*, or the white of the eye, the *cornea,* which is the semi-transparent layer covering the front part of the eye, and the *optic nerve* which protrudes from the posterior portion of the eye. There may be periorbital fat or external muscles still attached to the eye.
- Use dissecting scissors to cut away any fat or muscle attached to the eye.
- Using a scalpel, cut through the sclera along the frontal plane. When you remove the top of the eye, the part containing the cornea, what will remain is the lens sitting on top of a jelly-like mass known as the *vitreous humor*, it maintains the shape of the eye.
- Remove the lens and note how its composition is hard and similar to that of a marble. Next, remove the vitreous humor and take note of the shiny, blue layer along the inside of the back half of the eye, this is the retina.
- Moving back to the front half of the eye, depending on your initial halving of the eye, you can remove the iris from the cornea. Now lay out the contents of the cow eye from the most anterior through to the posterior portion of the eye and examine the structures.

*If you are the last table to use this station, be sure to clean off the dissection kits in the lab sink.

STATION SIX: VISION

Label the models of this station with the number that corresponds to the appropriate structure of the peripheral nervous system using the colored tape. When you are finished, ask your TA to check your labeling. Before leaving the station, remove all the labels you have placed on the model.

Fibrous Tunic

#1 sclera	#2 cornea

Vascular Tunic

#3 iris	#5 lens	#7 ciliary body
#4 pupil	#6 choroid	

Neural Tunic

#8 retina	#12 pigmented layer	#16 bipolar cells
#9 optic disc	#13 neural layer	#17 horizontal cells
#10 macula lutea	#14 rods	#18 ganglion cells
#11 fovea centralis	#15 cones	

Visual Pathway

#20 optic nerve	#22 optic tract
#21 optic chiasm	#23 primary visual area of the cerebral cortex

Eye Interior

#24 anterior chamber	#26 posterior chamber
#25 aqueous humor	#27 vitreous humor (body)

Muscles of the Eye

#28 levator palpebrae superioris	#30 inferior rectus	#32 medial rectus	#34 inferior oblique
#29 superior rectus	#31 lateral rectus	#33 superior oblique	

Lacrimal Apparatus

#35 lacrimal gland	#36 superior lacrimal canaliculi	#38 lacrimal sac
#36 lacrimal puncta	#37 inferior lacrimal canaliculi	#39 nasolacrimal duct

Conjunctiva

#40 palpebral conjunctiva	#41 bulbar conjunctiva

POST-LAB 5 QUESTIONS

(3 point)

Last Name: _____ First Name: _____

1. List the structures in each layer of the eye. (0.5 points)
    - Fibrous tunic:
    - Vascular tunic:
    - Neural tunic:

2. What is the olfactory pathway, starting from odorant to the primary olfactory area? How does this pathway differ from other sensory pathways? (0.5 points)

3. Match the following structures with their corresponding descriptions. (1 point)

Name of Structure	Descriptions	No. of Structure
1. Optic disc	an area where odorants bind to receptors to produce a sensation that will be perceived as smell	
2. Round window	contains approximately 100 taste buds	
3. Fungiform papillae	location of no visual activity, known as the "blind spot"	
4. Vitreous humor	contains the organs that sense dynamic equilibrium	
5. Olfactory epithelium	contains the organs that sense static equilibrium	
6. Filiform papillae	jelly-like mass that provides stability and structure to the eye	
7. Semicircular canals	provide friction, contains no taste buds	
8. Retina	contains approximately 5 taste buds	
9. Auditory ossicles (malleus, incus, and stapes)	the smallest bones in the body; transmits vibrations that are key to hearing	
10. Circumvallate papillae	possess the following layers to allow for the transmission of stimuli to the optic nerve; pigmented layer, photoreceptor layer, outer synaptic layer, bipolar cell layer, inner synaptic layer, ganglion layer	
11. Vestibule	membrane between the inner and middle ear to allow for pressure changes to equilibrate	

4. Describe the path of sound traveling through the ear to CN (VIII). (list structures)(0.5 points)

5. Describe the function of the following muscles. Do they assist in intorsion, extortion, abduction, adduction, elevation and/or depression of the eye? (0.5 points)

    1. Superior Rectus-
    2. Inferior Rectus-
    3. Medial Rectus-
    4. Lateral Rectus-
    5. Superior Oblique-
    6. Inferior Oblique-

LAB 6: RESPIRATORY SYSTEM

LAB 6: RESPIRATORY SYSTEM

MEASURABLE OUTCOMES

- Understand and identify the anatomical structures of the respiratory system on available models.
- Deduce the pathway of air through the respiratory system.
- Determine the pathway of pulmonary circulation.
- Identify the various muscles involved in respiration.
- Recognize the hallmarks of lung histology.
- Demonstrate an adequate understand of the material in this section.

BACKGROUND

The respiratory system is responsible for the gas exchange of oxygen and carbon dioxide. The main specialized organs of this process are the lungs which house clusters of sac-like structures known as *alveoli*. There are from 480 to 790 million alveoli which increase the efficiency of gas exchange by increasing surface area to around $118m^2$ in men and $91m^2$ in women. The respiratory system consists of the *nasal cavity, pharynx, larynx, trachea, lungs, bronchi, bronchioles*, and *alveoli*, along with their accessory structures. These structures are divided into the *upper and lower respiratory systems*, with the lower portion beginning at the larynx. The primary function of this system is to exchange oxygen and carbon dioxide between the body and the environment. Functionally, the respiratory system can be divided into the *conducting zone*, terminating at the terminal bronchioles; then air flows into the *respiratory zone,* where the actual gas exchange occurs.

Though we view each system individually in this lab, it is important to keep in mind that all organ systems overlap and work together in such a way that scientist are constantly discovering new connections. One such example is the *nose*. Not only is it the primary entrance and exit for respiration, but it also contains the olfactory epithelium, the primary structure of one of the special senses, olfaction. Likewise, the pharynx is a structure shared by both the respiratory and digestion systems.

Although both lungs functionally participate in respiration, they differ physically in various ways. The right lung is shorter and wider than the left lung, and the left lung occupies a smaller volume than the right. Another distinction between the two lungs is that the left lung contains the *cardiac notch*, which makes space for the heart. Furthermore, whereas the right lung has three lobes, the left lung has only two.

Though not visible on every model, each lung is surrounded by the pleura, which consists of two

layers called the visceral and parietal pleurae. They are important because they lubricate the lungs and reduce friction during inhalation and exhalation.

Vocabulary for Respiratory System can be found on page(s) 169.

PRE-LAB 6

(5 points)

Last Name: _____ First Name: _____

INSTRUCTIONS:

Fill in the table below with the appropriate terms. For the remaining exercises, label the designated structures.

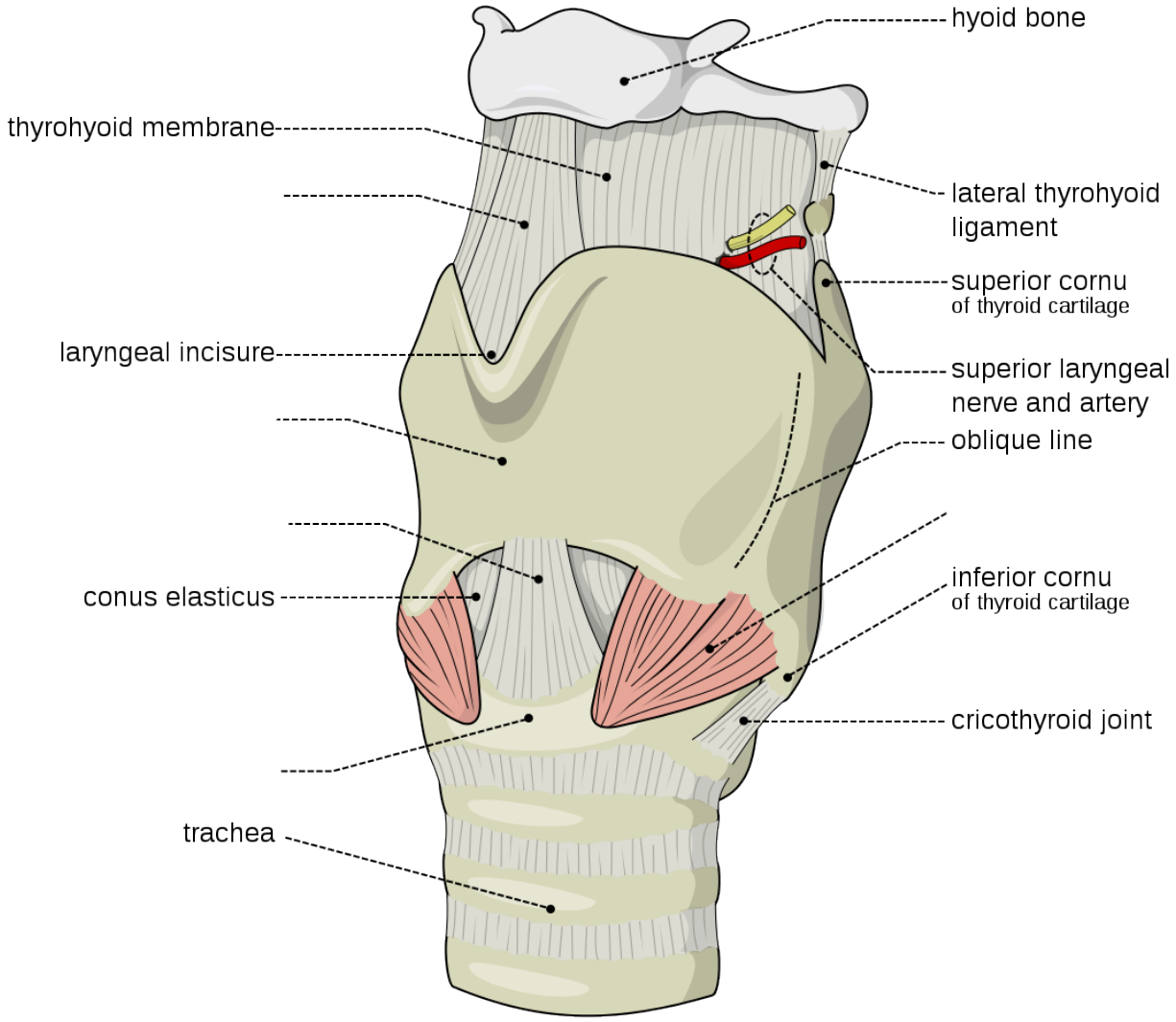
(1 point)

Name of a structure	is	directional term	to	Name of the second structureEpiglottis
Epiglottis*	is	Superior	to	Vocal cords*
Hyoid bone	is	Anterior	to	
	is	Inferior	to	Cricoid cartilage
Carina	is	Medial	to	
	is	Directly Superficial	to	Conus elasticus

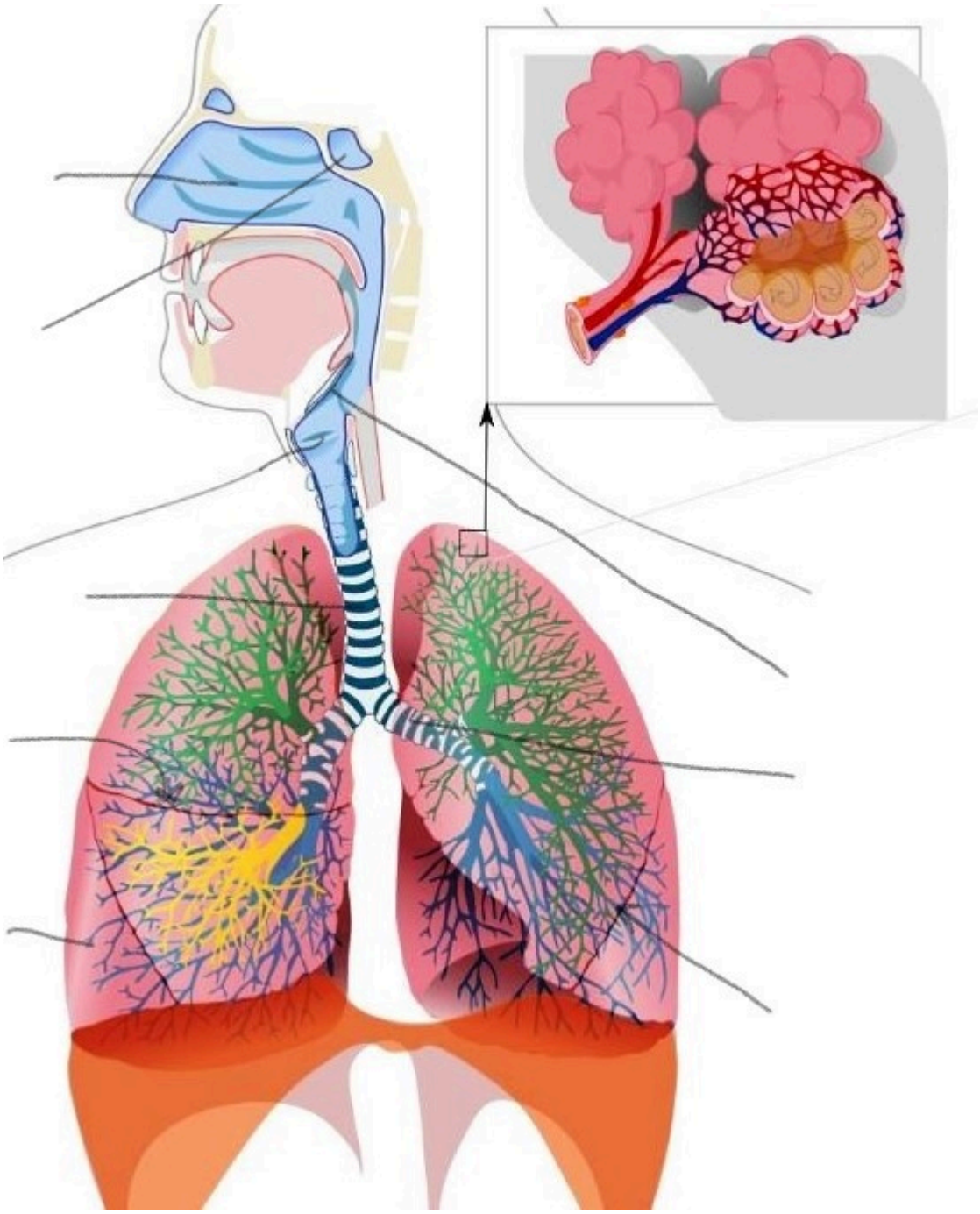
List two structures of the respiratory zone? **(0.5 points)**

List two structures of the conducting zone? **(0.5 points)**

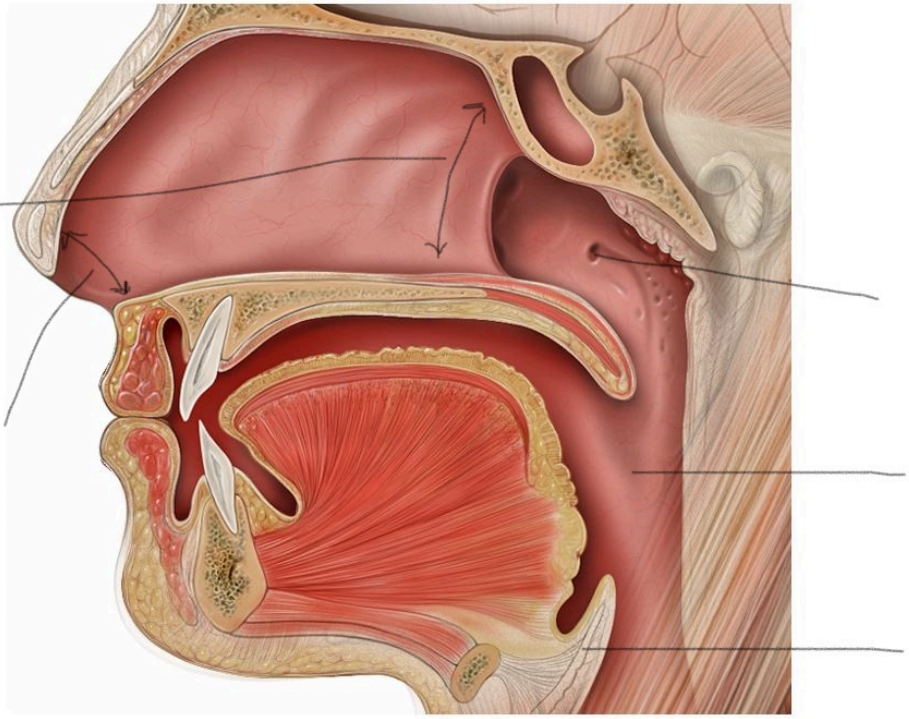
Label the following structures of the larynx. **(1 point)**



Label the following structures or the respiratory system. **(1 point)**



Label the following structures in the sagittal view of the upper respiratory system. (**1 point)**



LAB ACTIVITIES

A list of words is provided below that you are expected to learn and label on the models provided. Note that not all models will have some of the organs/structures, so be sure to find them on an alternate model. You must use all the words provided. Using the colored tape provided, write the number that corresponds to the organ/structure and place it on your model. When complete, notify your TA so they may check your work.

For each additional station, directions will be provided for the activity.

STATION ONE: UPPER RESPIRATORY

Label the models of this station with the number that corresponds to the appropriate structure of the peripheral nervous system using the colored tape. When you are finished, ask your TA to check your labeling. Before leaving the station, remove all the labels you have placed on the model.

#1 nose	#6 septal nasal cartilage	#12 nasal conchae*	#16 laryngopharynx	#21 soft palate
#2 root	#7 major alar cartilages	#12 nasal meatuses*	#17 lingual tonsils	#22 uvula
#3 bridge	#8 minor cartilages	#13 pharynx	#18 palatine tonsils	
#4 apex	#9 external naris	#14 nasopharynx	#19 pharyngeal tonsil (adenoid)	
#5 lateral nasal cartilages	#10 nasal cavity	#15 oropharynx	#20 hard palate	

*There are Superior, Middle, and Inferior parts to these structures.

STATION TWO: LOWER RESPIRATORY

Label the models of this station with the number that corresponds to the appropriate structure of the peripheral nervous system using the colored tape. When you are finished, ask your TA to check your labeling. Before leaving the station, remove all the labels you have placed on the model.

#1 larynx	#8 corniculate cartilages	#15 esophagus	#22 alveolar sacs	#29 middle lobe
#2 epiglottis	#9 cuneiform cartilage	#16 carina	#23 alveoli	#30 cardiac notch
#3 vestibular folds	#10 cricothyroid ligament	#17 primary (main) bronchi	#24 L/R lungs	#31 horizontal fissure
#4 vocal folds	#11 cricoid cartilage	#18 secondary (lobar) bronchi	#25 apex of lung	#32 oblique fissure
#5 thyrohyoid membrane	#12 cricotracheal ligament	#19 tertiary (segmental) bronchi	#26 base of lung	#33 hilum
#6 thyroid cartilage	#13 tracheal cartilages	#20 respiratory bronchioles	#27 superior lobe	
#7 arytenoid cartilages	#14 trachea	#21 alveolar ducts	#28 inferior lobe	

STATION THREE: MUSCLES OF RESPIRATION

Label the models of this station with the number that corresponds to the appropriate structure of the peripheral nervous system using the colored tape. When you are finished, ask your TA to check your labeling. Before leaving the station, remove all the labels you have placed on the model.

Muscles of Inspiration

#1 diaphragm	#2 external intercostals	#3 scalenes	#4 sternocleidomastoid

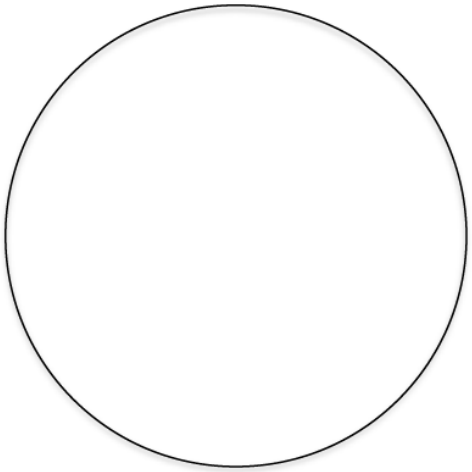
*Make note of which muscles are the primary muscles of inhalation, and which are the accessory muscles.

Muscles of Exhalation

#5 internal intercostals	#6 external oblique	#7 internal oblique	#8 transverse abdominis	#9 rectus abdominis

STATION FOUR: HISTOLOGY

Sketch the slides available for today's lab and specify the magnitude at which you are observing/sketching. Be sure to identify and label your sketch with the corresponding structures listed beneath each slide.



Lung

Terminal bronchioles, Respiratory bronchioles, Alveolar ducts, Alveolar sacs, Alveoli

STATION FIVE: LUNG DISSECTION

- First, identify the trachea and observe if it is flexible or stiff, does it collapse in on itself? Note the ringed structures along the trachea that support it and allow it to stay open. Identify any other structures along the outside of the lungs and trachea such as the pleural membrane or larynx if still attached.
- Lay the lungs where they both lay flat on the table. Using the dissecting scissors make a cut along the frontal plane beginning at the top of the trachea and working your way down to the branching of the primary bronchi.
- Cut along one of the bronchi, along the corresponding lung until you make a complete frontal plane cut.
- Use the pins provided and label as many structures as you can identify. Your TA will come around and ask you to identify the pins you have placed.
- Before leaving the station, remove all the pins you have placed.

*If you are the last table to use this station, be sure to clean off the dissection kits in the lab's sink.

STATION SIX: FLOW OF OXYGEN AND PULMONARY CIRCULATION

As a group, determine the path that oxygen travels starting from the nostrils to the alveoli. Be sure to identify where along that path each of the structures on the vocabulary list is located.

As a group, determine the route of pulmonary circulation. Be mindful of the fact that several structures are directly connected to the heart. Label the models/posters of this station with the # that corresponds to the appropriate vessels involved in pulmonary circulation using the colored tape. When you have finished, have your TA check your labeling. Before leaving the station, remove all of the labels you have placed on the models/posters.

#1 pulmonary trunk	#2 pulmonary arteries	#3 pulmonary capillaries	#4 pulmonary veins

POST-LAB 6 QUESTIONS

(2 points)

Last Name: _____ First Name: _____

1) Write a **C** if the listed structure is part of the conducting zone and an **R** if it is part of the respiratory zone. Also, label whether the structure is part of the upper respiratory (**U**) or lower respiratory system (**L**). (0.5 point)

Example: Larynx ___C___, ___L___

Alveoli _____

Trachea _____

Nasal cavity _____

Bronchi _____

Respiratory bronchioles _____

Pharynx _____

Alveolar ducts _____

Terminal bronchioles _____

2) Write the route that oxygen takes from when you inhale to the point of gas exchange with carbon dioxide. (0.5 point)

3) Give two unique characteristics of the pulmonary artery and vein. (0.5 point)

4) Describe the route of pulmonary circulation. (0.5 point)

LAB 7: THE CARDIOVASCULAR SYSTEM

LAB 7: THE CARDIOVASCULAR SYSTEM

MEASURABLE OUTCOMES

- Visually identify major components, vessels, and structures of a dissected heart.
- Determine the anatomical structures of the heart on available models.
- Determine the pathway of blood flow through the heart.
- List and accurately classify the distinct types of blood cells from histological slides.
- Recognize the features of cardiac tissue under a microscope.
- Identify the major blood vessels required for this lab.
- Distinguish between arterial and venous flow.

BACKGROUND

The cardiovascular system is responsible for the circulation of blood and transport of nutrients. Large multicellular organisms developed such a system as a means of actively transporting nutrients to the cells of the body. The *heart* is the organ of focus in this lab. It is divided into four distinct chambers, which in concert work to circulate blood. When the heart beats, it pumps blood into two different circuits: pulmonary and systemic. Pulmonary circulation carries blood from the right side of the heart to the alveoli of the lungs and back to the left side of the heart, while the systemic circulation carries blood from the left side of the heart to all the organs and tissues of the body, then back to the right side of the heart. If it were possible to stretch out all of the blood vessels in the body, they would measure 60,000 to 100,000 miles, enough circle the earth roughly four times. The heart is an incredible organ capable, on average, of circulating roughly 2,000 gallons worth of blood each day. Furthermore, the heart is one of the few organs capable of operating entirely apart from the central nervous system which makes it one of the hardest working organs.

Blood is classified as liquid connective tissue and is vital in its roles of transportation, regulation, and protection. It is made of distinct types of cells, mostly derived from bone marrow, and helps maintain homeostasis. Plasma and cellular elements are the two main components of blood, where plasma makes up 55% of blood and cellular elements make up 45%. Plasma is mostly water but contains proteins and other solutes as well. The vast majority of cell elements are *erythrocytes* with less than 1% comprising of *leukocytes* and *platelets*.

In this lab we will focus on the major blood vessels of the cardiovascular system. Arteries are blood vessels that always carry blood away from the heart; the blood they carry is oxygenated (exception: *pulmonary arteries*). They generally have thicker walls than veins, the other major blood vessels in the cardiovascular system. Veins carry blood toward the heart and carry deoxygenated blood

(exception: *pulmonary veins*). Both vessel types are formed by the tunica intima, tunica media, and tunica adventitia.

Vocabulary for the Cardiovascular System can be found on page(s) 163-165.

PRE-LAB 7

(5 points)

Last Name: _____ First Name: _____

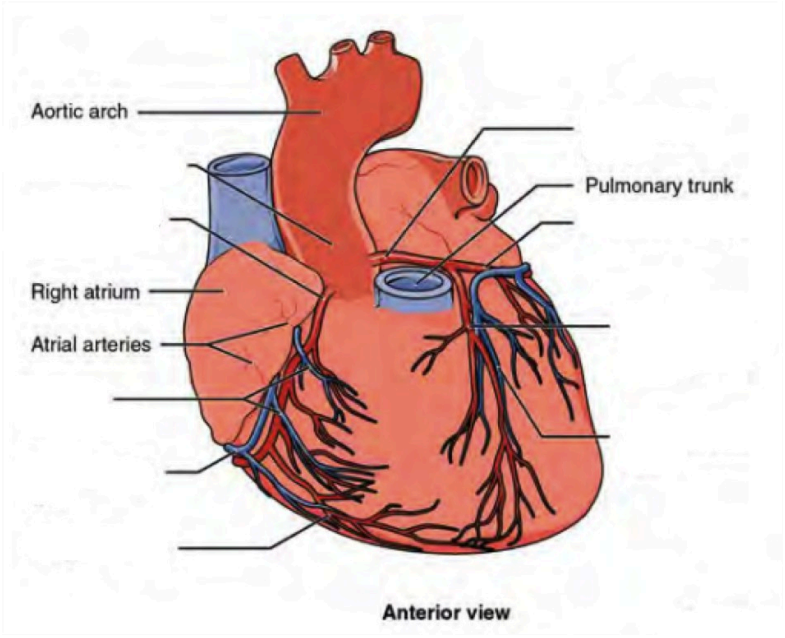
INSTRUCTIONS:

Fill in the table below with the appropriate terms. For the remaining exercises, label the structures accordingly.

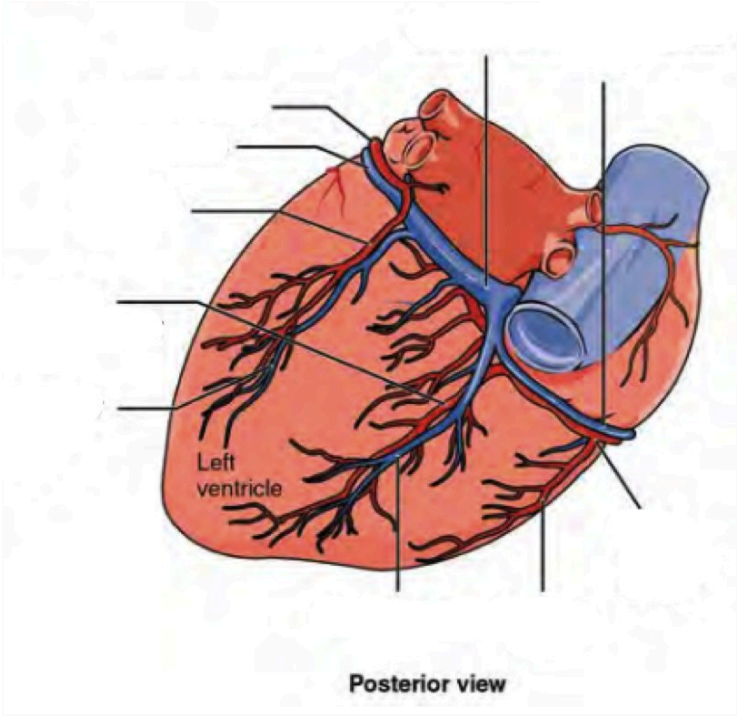
(1 point)

Name of a structure	is	directional term	to	Name of the second structure
pulmonary vein	is	proximal	to	right ventricle
auricle	is	superior	to	
	is	inferior	to	heart's base
anterior interventricular sulcus	is	anterior	to	
	is	distal	to	ascending aorta
heart	is	medial	to	
	is	lateral	to	left ventricle

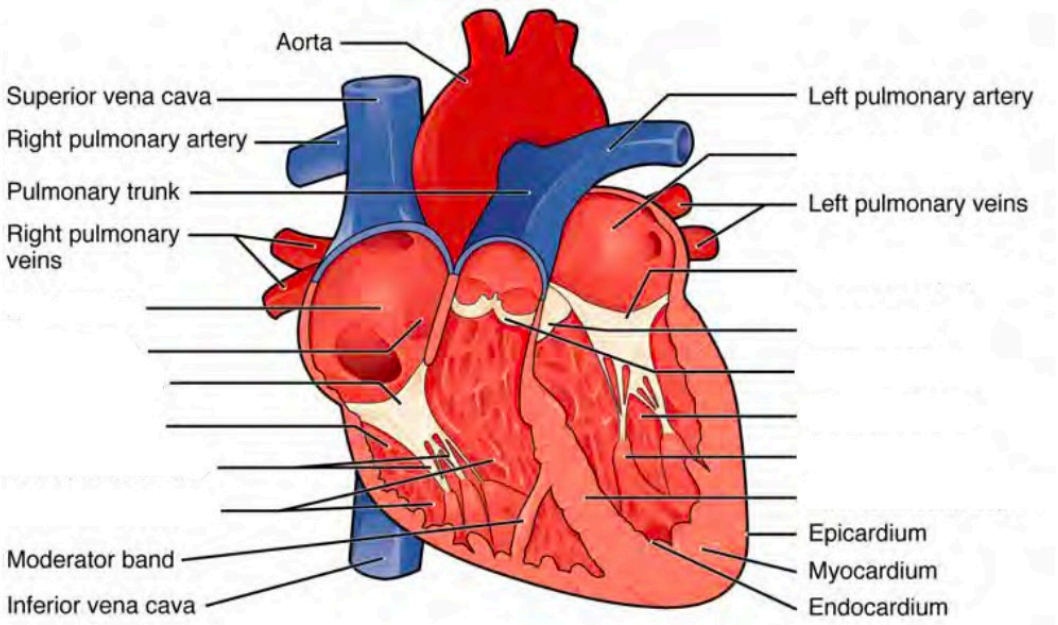
Label the prominent coronary surface vessels. (0.5 points)



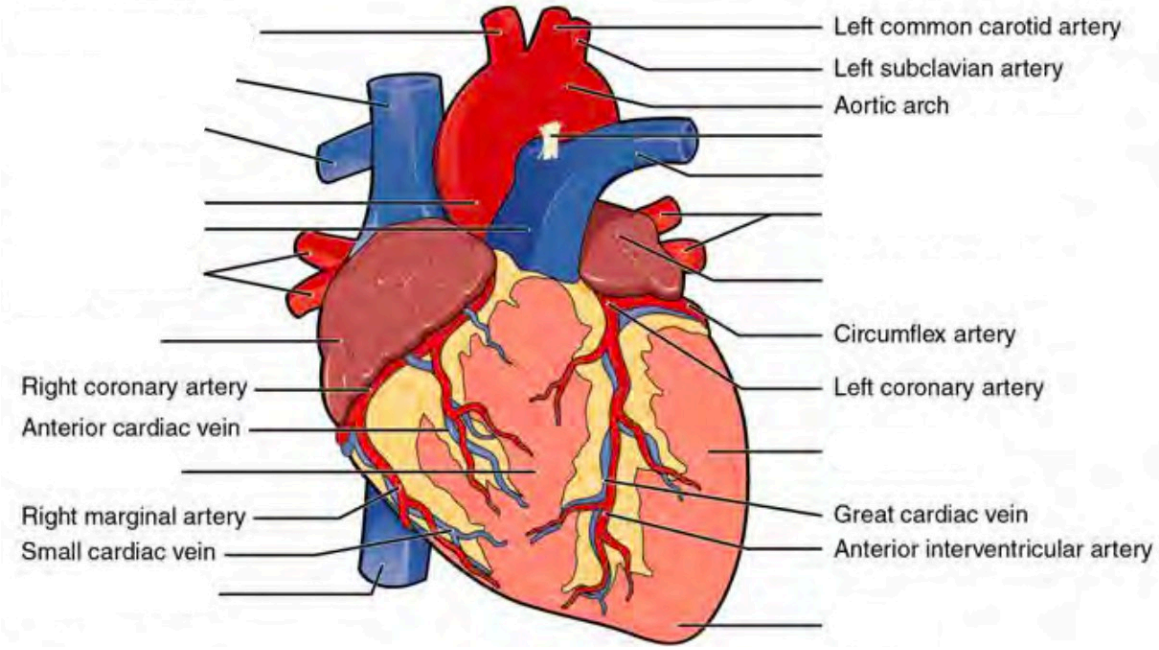
Label the prominent coronary surface vessels. (0.5 points)



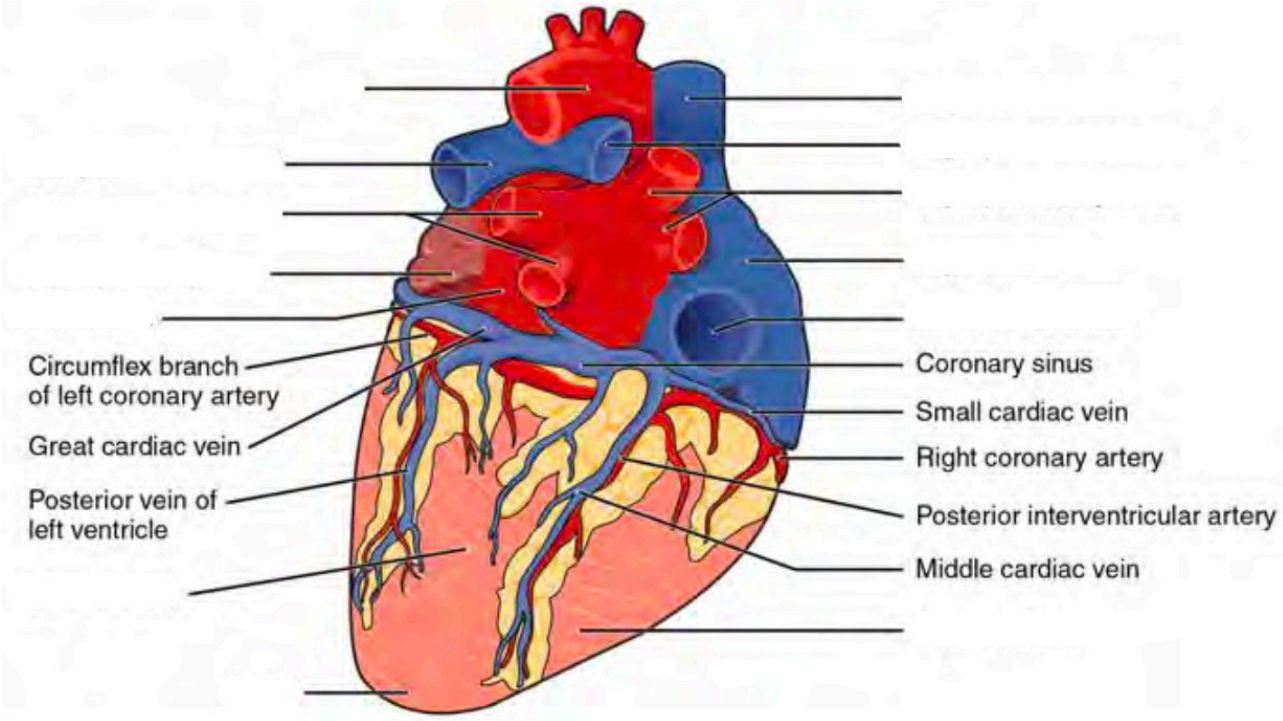
Label the internal formations of the heart. (1 point)



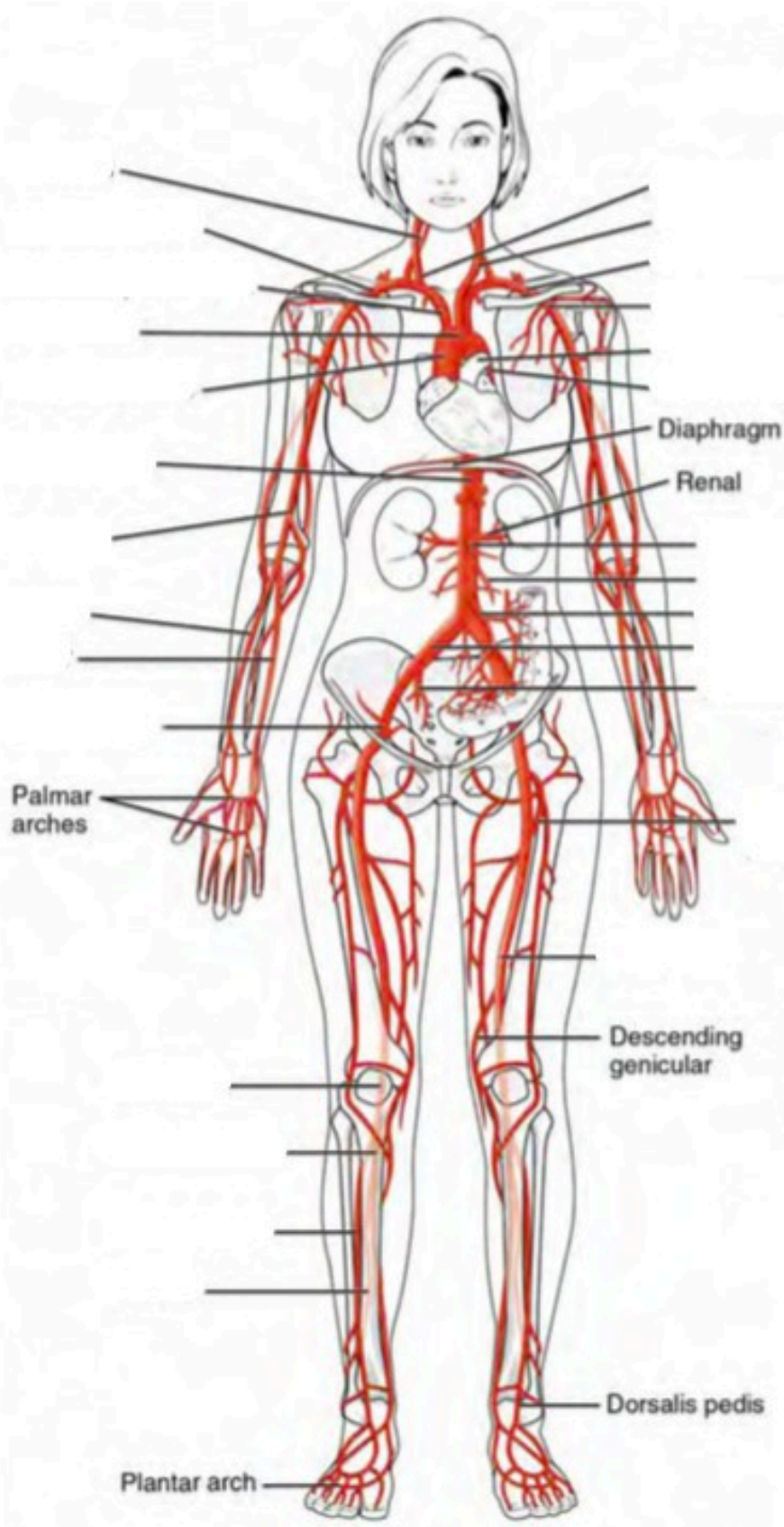
Label the surface features of the anterior aspect of the heart. (0.5 points)



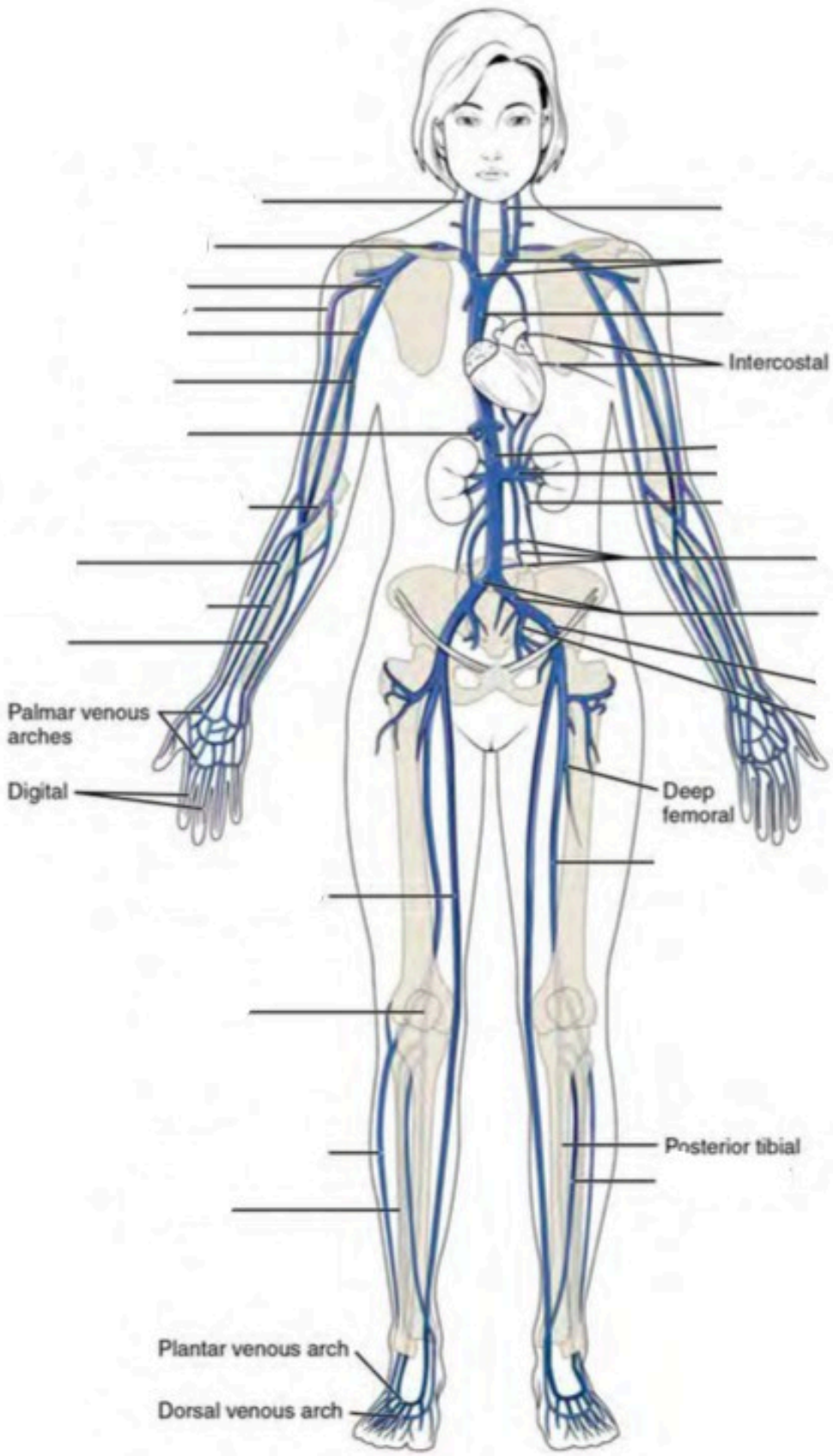
Label the surface features on the posterior aspect of the heart. (0.5 points)



Label the major systemic arteries of the body. (0.5 points)



Label the major systemic veins of the body. (0.5 points)



LAB ACTIVITIES

A list of words is provided below that you are expected to identify, learn, and label on the models provided. Note that not all models will have some of the organs/structures, so be sure to find them on an alternate model. You must use all the words provided. Using the colored tape provided, write the number that corresponds to the organ/structure and place them on your model. When complete, notify your TA so they may check your work.

For each additional station, directions will be provided for the activity.

STATION ONE: HEART

Label the models of this station with the number that corresponds to the appropriate structure of the peripheral nervous system using the colored tape. When you are finished, ask your TA to check your labeling. Before leaving the station, remove all the labels you have placed on the model.

Note: For the following structures, be able to differentiate between left and right halves when applicable.

Orientation

#1 apex	#2 base

Layers

#3 pericardium	#4 epicardium	#5 endocardium	#6 myocardium

Surface Features

#7 superior vena cava	#10 left pulmonary artery	#13 ascending aorta	#16 posterior interventricular sulcus
#8 right pulmonary artery	#11 coronary sulcus	#14 descending aorta	#17 epicardial fat
#9 inferior vena cava	#12 arch of aorta	#15 anterior interventricular sulcus	#18 auricles

Internal Structures

#19 papillary muscles	#23 tricuspid valve	#27 right atrium	#31 left ventricle
#20 pectinate muscles	#24 bicuspid valve	#28 left atrium	#32 interventricular septum
#21 chordae tendineae	#25 pulmonary valve	#29 interatrial septum	#33 right bundle branches
#22 trabeculae carneae	#26 aortic valve	#30 right ventricle	#34 left bundle branches

Coronary Circulation – Arteries

#35 coronary arteries	#37 posterior interventricular branch	#39 circumflex branch	#41 branch of left coronary artery
#36 marginal branches	#38 right pulmonary artery	#40 anterior interventricular branch	#42 middle cardiac

Coronary Circulation – Veins

#43 coronary sinus	#45 great cardiac	#47 left pulmonary
#44 anterior cardiac	#46 small cardiac	#48 right pulmonary

STATION TWO: MAJOR UPPER BODY VESSELS

Label the models of this station with the number that corresponds to the appropriate structure of the peripheral nervous system using the colored tape. When you are finished, ask your TA to check your labeling. Before leaving the station, remove all the labels you have placed on the model.

Note: For the following structures, be able to differentiate between left and right halves when applicable.

Arterial Circulation

#1 brachiocephalic trunk	#6 vertebral arteries	#11 anterior cerebral artery	#16 thoracic aorta
#2 common carotid arteries	#7 basilar artery	#12 anterior communicating artery	#17 abdominal aorta
#3 internal carotid arteries	#8 posterior cerebral artery	#13 axillary arteries	
#4 external carotid arteries	#9 posterior communicating artery	#14 radial arteries	
#5 subclavian arteries	#10 middle cerebral artery	#15 ulnar arteries	

Venous Circulation

#18 brachiocephalic veins	#22 axillary veins	#26 medial cubital veins	#30 azygos vein
#19 internal jugular veins	#23 brachial veins	#27 radial veins	#31 hemiazygos vein
#20 subclavian veins	#24 cephalic veins	#28 ulnar veins	#32 accessory hemiazygos vein
#21 external jugular veins	#25 basilic veins	#29 median antebrachial veins	

STATION THREE: MAJOR LOWER BODY VESSELS

Label the models of this station with the number that corresponds to the appropriate structure of the peripheral nervous system using the colored tape. When you are finished, ask your TA to check your labeling. Before leaving the station, remove all the labels you have placed on the model.

Note: For the following structures, be able to differentiate between left and right halves when applicable.

Arterial Circulation

#1 suprarenal arteries	#6 celiac trunk	#11 external iliac arteries	#16 anterior tibial arteries
#2 renal arteries	#7 common hepatic artery	#12 internal iliac arteries	#17 posterior tibial arteries
#3 gonadal arteries	#8 splenic artery	#13 femoral arteries	#18 fibular arteries
#4 inferior mesenteric artery	#9 lumbar arteries	#14 deep femoral arteries	
#5 superior mesenteric artery	#10 common iliac arteries	#15 popliteal arteries	

Venous Circulation

#19 ascending lumbar veins	#24 hepatic portal veins	#30 common iliac veins	#35 popliteal veins
#20 gonadal veins	#25 inferior mesenteric vein	#31 internal iliac veins	#36 small saphenous veins
#21 renal veins	#26 splenic vein	#32 external iliac veins	#37 anterior tibial veins
#22 suprarenal veins	#27 superior mesenteric vein	#33 femoral veins	#38 fibular veins
#23 hepatic veins	#28 inferior phrenic vein	#34 great saphenous veins	

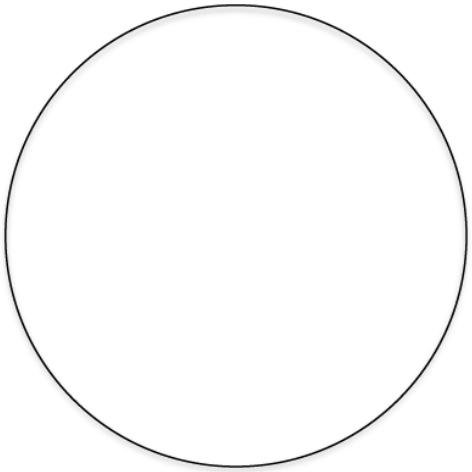
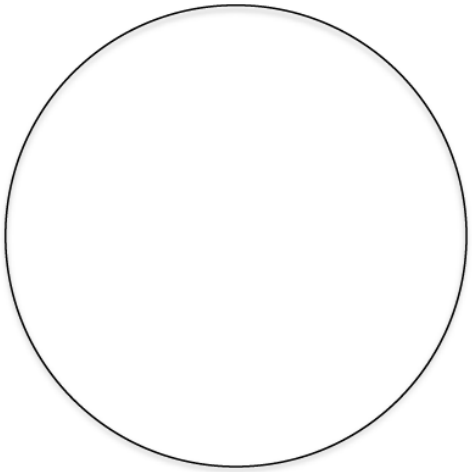
STATION FOUR: HISTOLOGY & DIFFERENTIAL BLOOD COUNT

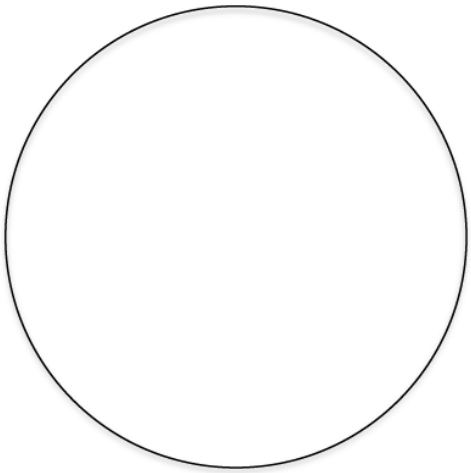
Sketch the slides available for today's lab and specify the magnitude at which you are observing/sketching. Be sure to identify and label your sketch with the corresponding structures listed beneath each slide.

Blood Vessels

Vein	**Artery**

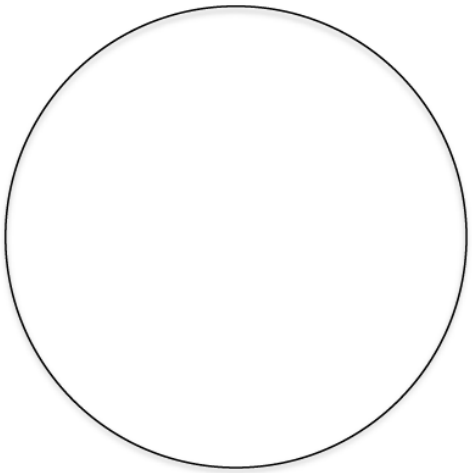
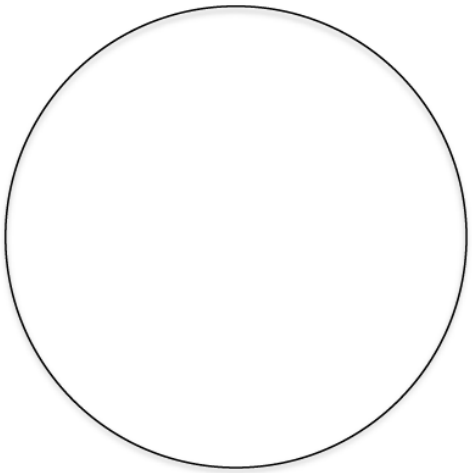
Blood Components

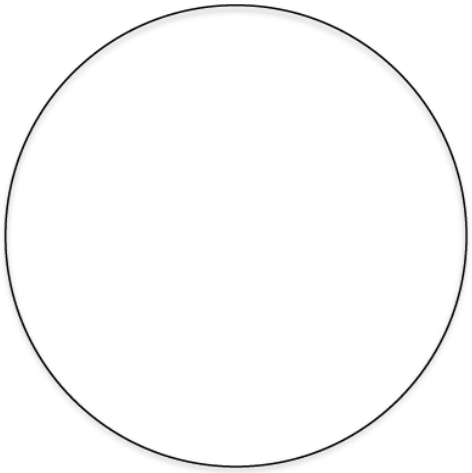
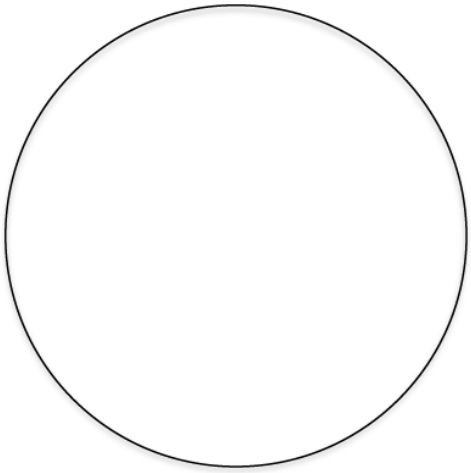
	
Leukocyte	**Thrombocyte**

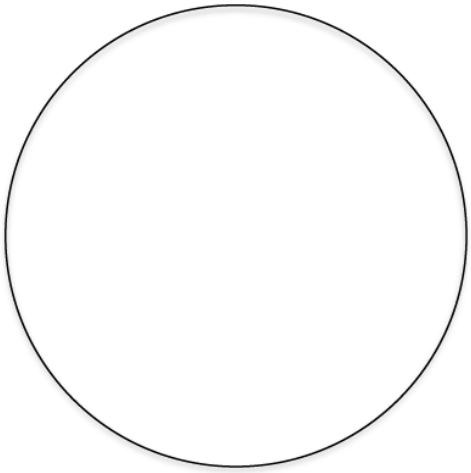


Erythrocyte

Leukocytes

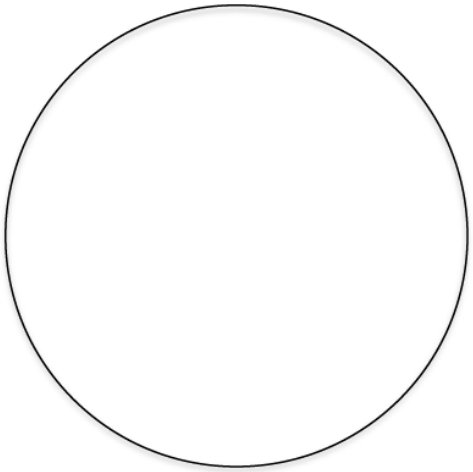
	
Basophil	**Eosinophil**

	
Neutrophil	**Lymphocyte**



Monocyte

Cardiac



Cardiac muscle

Differential Blood count

- Place the blood smear slide under the microscope and focus it to 70x magnification.

- Once you have isolated a portion of the smear, count the number of each type of blood cell. Record the numbers below

Note: Platlets may not be visible at this magnification

- RBC: _____Neutrophils: _____
- Basophils: _____Eosinophils: _____
- Monocytes: _____Lymphocytes: _____

STATION FIVE: HEART DISSECTION

- Observe and identify all the surface anatomy of the heart.
- Orientate the heart so that the ventral side is facing you. The base of the heart should be positioned right side up for dissection.
- Using your fingers or a probe, find the following at the base of the heart: pulmonary vein, aorta, vena cava, and pulmonary trunk.
- Using the superior vena cava and pulmonary vein as guides, make a coronal incision using the scapula.
- Observe and place pins on the following structures: R/L ventricles, R/L atriums, interventricular septum, the valves, tissue layers (cardiac muscle, papillary muscles). Your TA will come around and ask your goup to identify the pins you have placed.
- Before leaving the station, remove all the pins you have placed.

*If you are the last table to use this station, be sure to clean off the dissection kits in the lab's sink.

STATION SIX: FLOW OF BLOOD AND BLOOD TYPING

As a group, determine the flow of blood through the various structures and vessels of the heart. Be sure to identify where along that path each of the structures on the vocabulary list is located. Use the rest of this page to draw out the pathway.

As a group, determine the different blood type in this station. Follow the procedure below in order to do so.

- Obtain a blood-sampling tray and place two drops of the synthetic blood into the wells.
- Place two drops of the Anti-a "antibody" into the well labeled a. Using a toothpick, mix well and allow to sit undisturbed for one minute. Note any clotting that may occur.
- Place two drops of the Anti-B "antibody" into the well labeled B. Using a toothpick, mix well and allow to sit undisturbed for one minute. Note any clotting that may occur.
- Place two drops of the Anti-Rh "antibody" into the corresponding well. With a toothpick, mix well and allow to sit undisturbed for one minute. Note any clotting that may occur.
- Using your knowledge of the interaction between blood antigens and their corresponding

antibodies, determine the blood type. Remember that if an antibody finds its targeted antigens, it causes blood coagulation. If no coagulation occurs, this means that the blood does not contain any of the antigens.

POST-LAB 7 QUESTIONS

(3 points)

Last Name: _____ First Name: _____

1. List the function of each cardiac layer and number the order from most to least superficial. (0.5 point)
    - Pericardium:
    - Myocardium:
    - Endocardium:
    - Epicardium:

2. Explain why the left ventricle's walls are thicker than the right ventricle's. (0.5 point)

3. A child is stung by a bee and experiences an anaphylactic reaction. Upon observing the pathology, you notice a large increase in the number of very large granulocytic white blood cells whose granules obscure the nucleus. What type of cell did you observe? (0.5 point)

4. Correctly match the term with the correct order of blood flow through the heart. (0.5 point)

    Venous blood enters the _____ from the _____ and _____ as well as the coronary sinus, which converge into the the _____. From there blood passes the _____ valves and enters the _____. The venous blood passes through the _____ and from there branches off into the _____ and _____ before circulating through the _____. After

being oxygenatated, the blood re-enters the heart through the _____ which converge into the _____. Then the blood flows through the _____ into the _____. From here, blood is ejected through the _____ into the _____ before entering the _____ and finally systemic circulation.

1. Superior vena cava
2. Inferior vena cava
3. Right atrium
4. Left atrium
5. Lungs
6. Pulmonary veins
7. Left pulmonary artery
8. Right pulmonary artery
9. Right atrioventricular valve
10. Mitral valves
11. Ascending aorta
12. Arch of aorta
13. Aortic semilunar valve
14. Pulmonary semilunar valve
15. Left ventricle
16. Right ventricle
17. Heart

5. What is the anatomical significance of the pericardium and epicardial fat? The visceral layer of the pericardium is also known as the _____? (0.5 point)

6. An individual who cannot coagulate properly is at risk of bleeding out with any significant lesion. A reduction in what type of cell might cause this in such an individual? How does this affect the composition of their blood? (0.5 point)

LAB 8: DIGESTIVE SYSTEM

LAB 8: DIGESTIVE SYSTEM

MEASURABLE OUTCOMES

- Label the anatomical structures of the digestive system on available models.
- Explain the pathway of food from the mouth to the anus, identifying major landmarks along the way.
- Deduce the pathway of major arteries and veins that supply the organs of the digestive system.
- Identify the histology of the digestive organs on microscope slides.
- Demonstrate an adequate understand of the material in this section.

BACKGROUND

The digestive system consists of the gastrointestinal tract (also known as the alimentary canal), a hollow muscular tube extending from the mouth to the anus, and accessory organs, including the *liver* and *pancreas.* Technically, until food is absorbed in the intestines it is considered to be outside of the body. To promote absorption, the intestines have villi which contain hair-like structures called microvilli. Like the alveoli of the lungs, microvilli substantially increase the surface area of the intestines to between 180 to 300 m^2 (the size of the average American home). Major structures of the gastrointestinal tract include the *oral cavity, pharynx, esophagus, stomach, small intestine, large intestine, rectum*, and *anus*. These structures and organs form a hollow space from mouth to anus and function to chemically and mechanically catabolize and absorb nutrients. Along the way organs such as the *salivary glands, liver, gallbladder* and *pancreas* release enzymes to aid digestion and are known collectively as accessory structures.

The organs of the GI tract are made from four layers, the inner lining or *mucosa*, the *submucosa* containing blood vessels and lymphatics, the *muscularis* or smooth muscle layer, and the outermost layer or *serosa/adventitia*. Each layer plays a vital role in the digestive system ranging in their capacity to form a protective barrier from the highly acidic contents of the stomach to supplying hormones, producing muscle contractions and draining lymph. Furthermore, specialized cells such as the foveolar, chief cells of the stomach are supporting cells which produce a protective layer of mucus and gastric acid for digestion. Other supporting cells, such as the gastric parietal cells of the stomach and the ductal and acinar cells of the pancreas release zymogens, inactive forms of digestive enzymes.

The peritoneum is a large serous membrane which lines the abdominal cavity and coverers most of the digestive organs. some organs are only partially covered by the peritoneum while others are entirely uncovered. These organs are referred to as being retroperitoneal. Formed by the double folding of the peritoneum is a continuous set of tissues known as the mesentery. This organ

was relatively recently reclassified as an organ after discovering its complex constitution. The mesentery houses lymphatic vessels as well as providing a conduit for the blood vessels for the small and large intestines.

Vocabulary for Digestive System can be found on page(s) 165-166.

PRE-LAB 8

(5 points)

Last Name: _____ First Name: _____

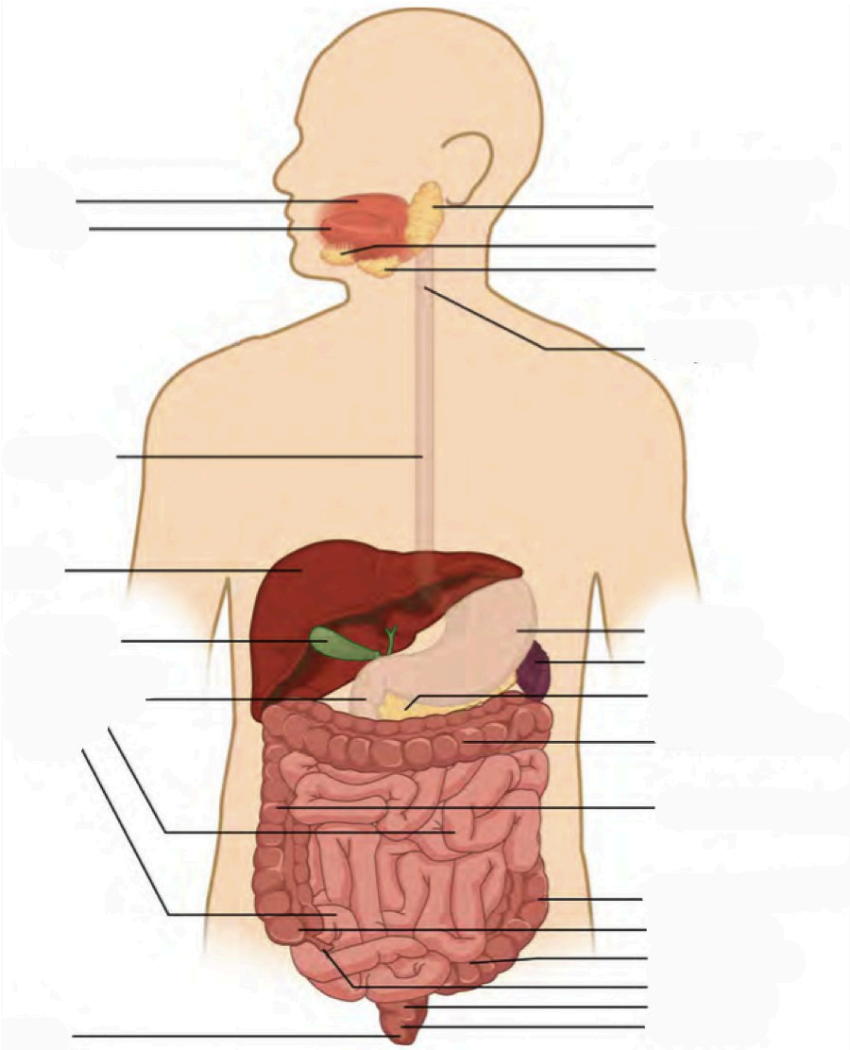
INSTRUCTIONS:

Fill in the table below with the appropriate terms. For the remaining exercises, label the structures accordingly.

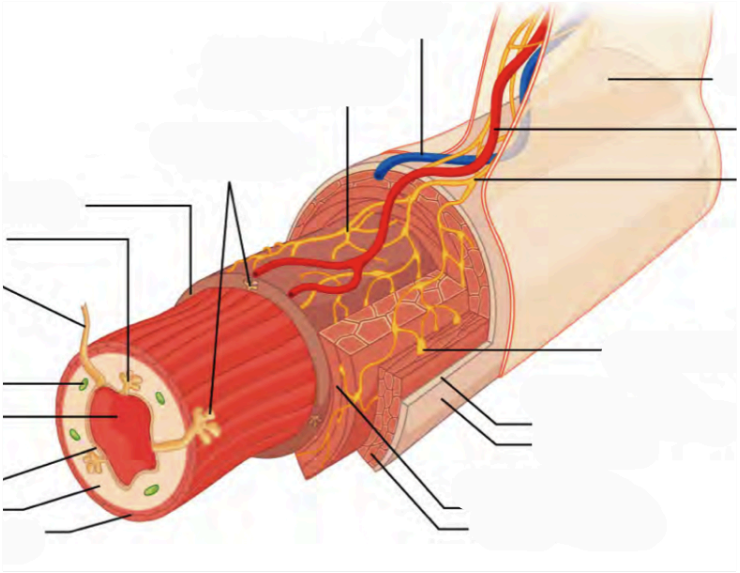
(1 point)

Name of a structure	is	directional term	to	Name of the second structure
gallbladder*	is	posterior	to	liver*
transverse colon	is	superior	to	
	is	inferior	to	small intestine
liver	is	anterior	to	
	is	distal	to	duodenum
jejunum	is	medial	to	
	is	lateral	to	left lobe of liver

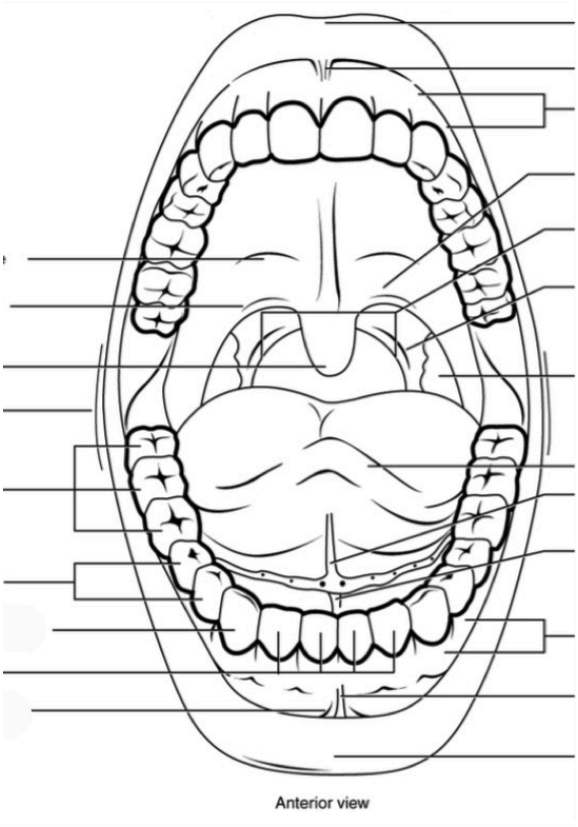
Label all digestive organs of the GI tract. (1 point)



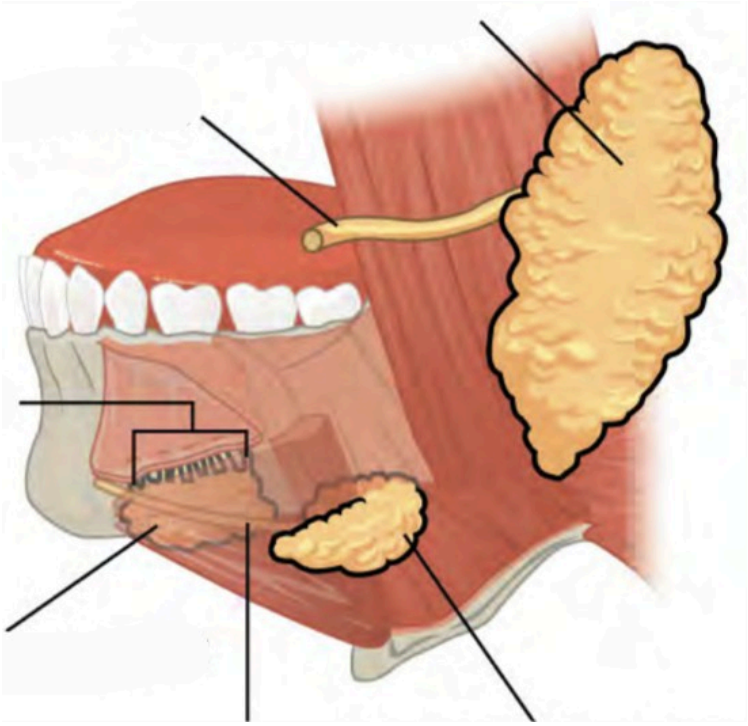
Label the elements of the alimentary canal. (0.5 points)



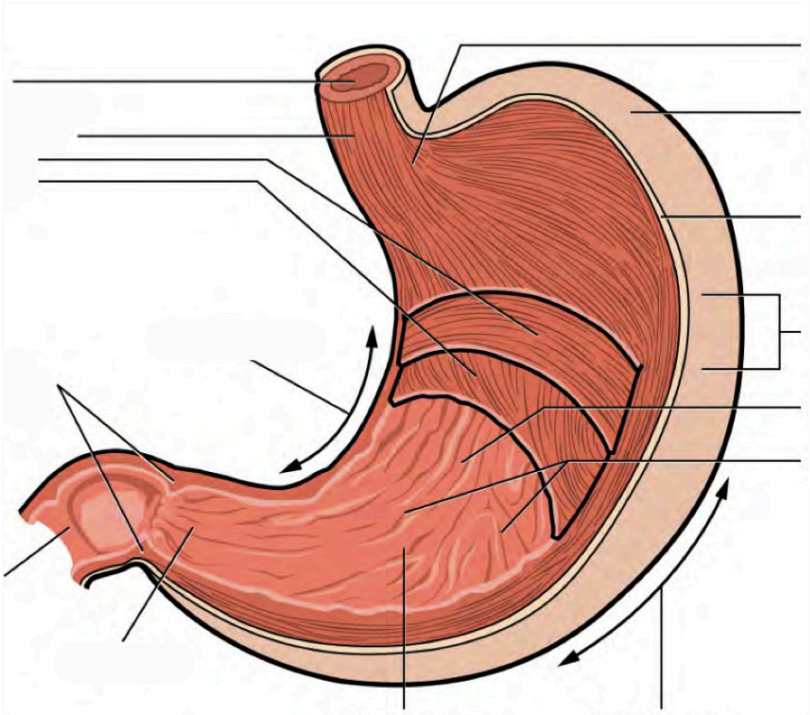
Label the different aspects of the mouth. (0.5 points)



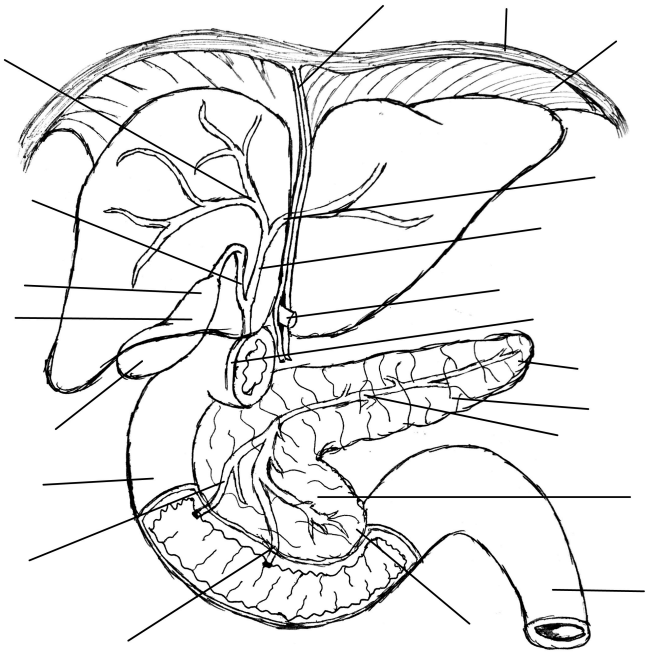
Label the major salivary glands and ducts. (0.5 points)



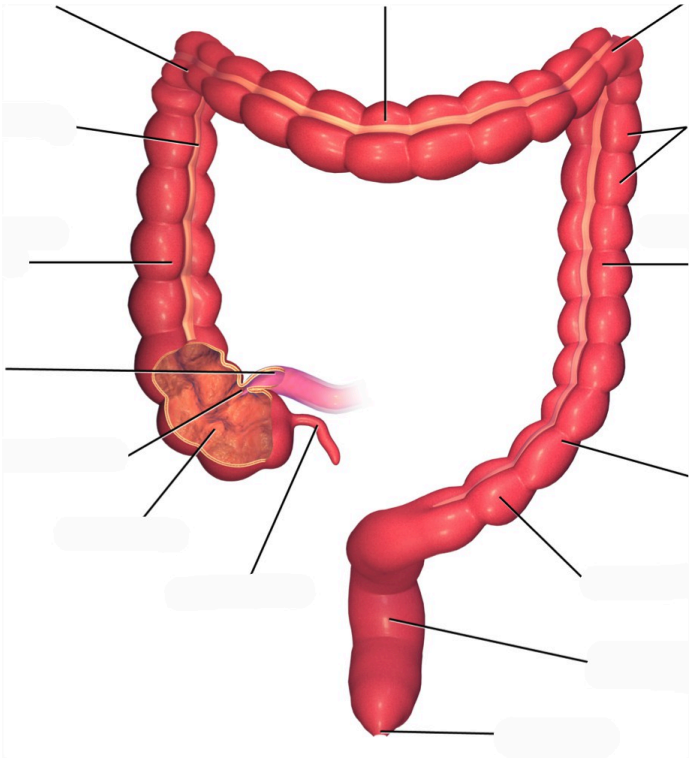
Label the aspects of the stomach accordingly. (0.5 points)



Label the accessory organs, structures, and ducts of the digestive system. (0.5 points)



Label the structures and features of the large intestine. (0.5 points)



LAB ACTIVITIES

A list of words is provided below that you are expected to identify, learn, and label on the models provided. Note that not all models will have some of the organs/structures, so be sure to find them on an alternate model. You must use all the words provided. Using the colored tape provided, write the number that corresponds to the organ/structure and place them on your model. When complete, notify your TA so they may check your work.

For each additional station, directions will be provided for the activity.

STATION ONE: MOUTH

Label the models of this station with the number that corresponds to the appropriate structure of the peripheral nervous system using the colored tape. When you are finished, ask your TA to check your labeling. Before leaving the station, remove all the labels you have placed on the model.

Note: For the following structures, be able to differentiate between left and right halves when applicable.

Mouth

#1 labial frenulum	#3 hard palate	#5 uvula
#2 fauces	#4 soft palate	

Tongue

#6 tongue	#9 fungiform papillae	#11 circumvallate papillae	#13 taste pore
#7 lingual frenulum	#10 filiform papillae	#12 taste bud	#14 base
#8 apex			

Teeth

#15 incisor	#18 molar	#21 root	#24 pulp cavity	#27 cementum
#16 canine	#19 crown	#22 enamel	#25 pulp	#28 periodontal ligament
#17 premolar	#20 neck	#23 dentin	#26 apical foramen	#29 gingiva

Salivary Glands

#30 submandibular	#31 parotid	#32 sublingual

STATION TWO: ESOPHAGUS AND STOMACH

Label the models of this station with the number that corresponds to the appropriate structure of the peripheral nervous system using the colored tape. When you are finished, ask your TA to check your labeling. Before leaving the station, remove all the labels you have placed on the model.

Esophagus

#1 upper esophageal sphincter	#2 lower esophageal sphincter

Stomach

#3 gastric pits	#6 cardia	#9 pylorus	#12 circular muscle layer
#4 gastric glands	#7 gastric body	#10 pyloric sphincter	#13 oblique muscle layer
#5 fundus	#8 rugae	#11 longitudinal muscle layer	

STATION THREE: LIVER, GALLBLADDER AND PANCREAS

Label the models of this station with the number that corresponds to the appropriate structure of the peripheral nervous system using the colored tape. When you are finished, ask your TA to check your labeling. Before leaving the station, remove all the labels you have placed on the model.

Note: For the following structures, be able to differentiate between left and right halves when applicable.

Liver

#1 right lobe of liver	#3 right hepatic duct	#5 common hepatic duct	#7 hepatic canaliculi
#2 left lobe of liver	#4 left hepatic duct	#6 hepatic lobule	#8 falciform ligament

Gallbladder

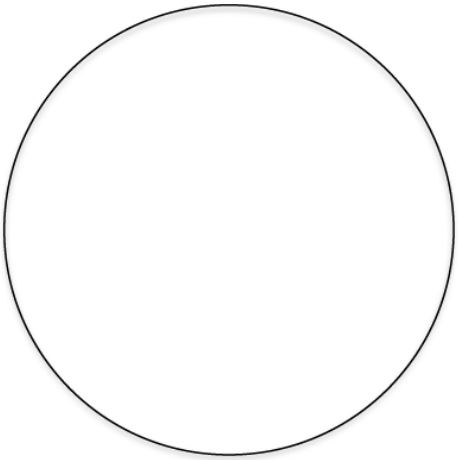
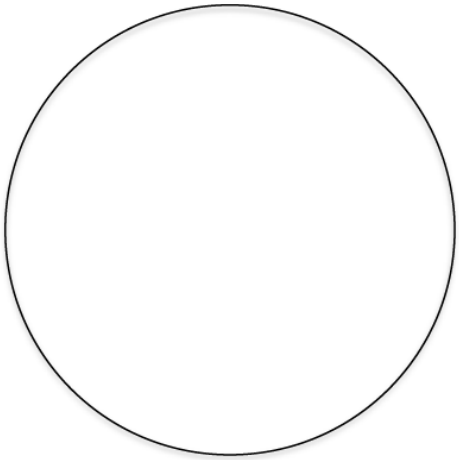
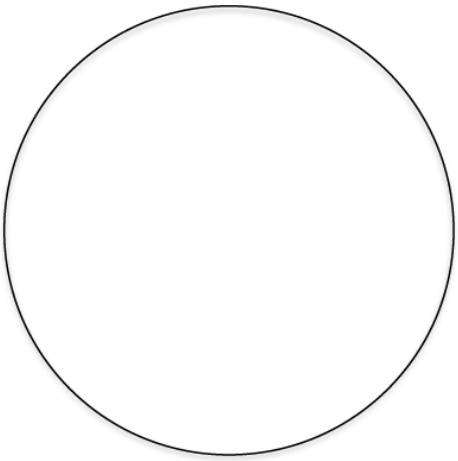
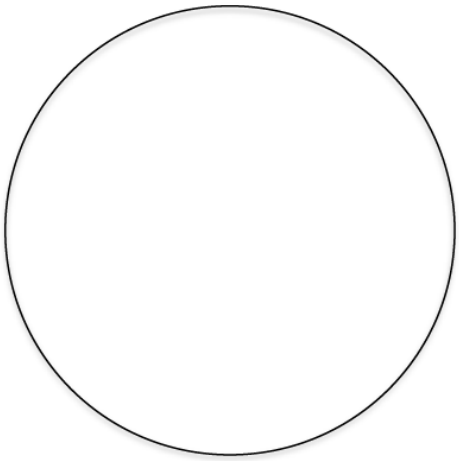
#9 fundus of gallbladder	#11 neck of gallbladder	#13 common bile duct
#10 body of gallbladder	#12 cystic duct	

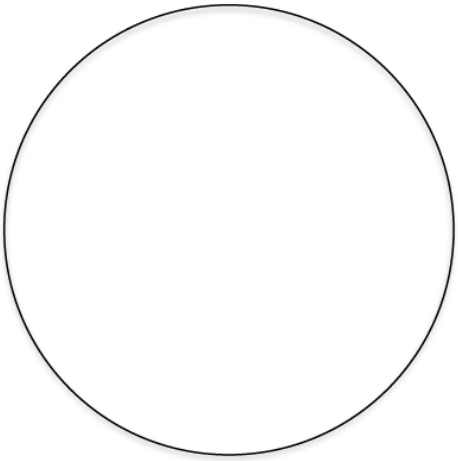
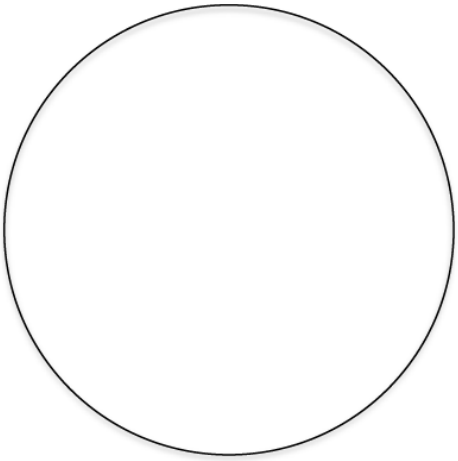
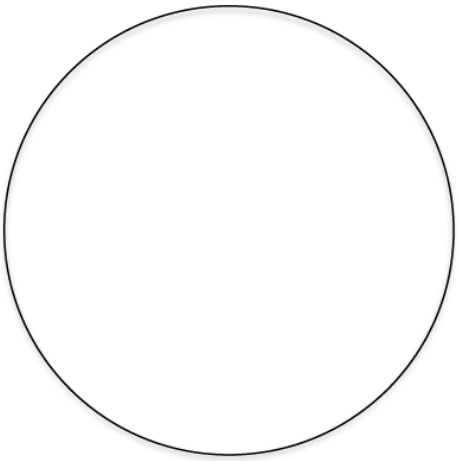
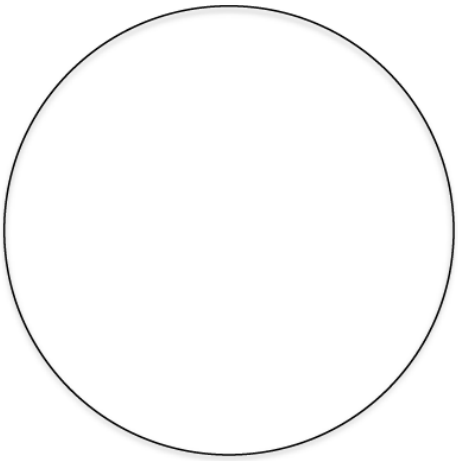
Pancreas

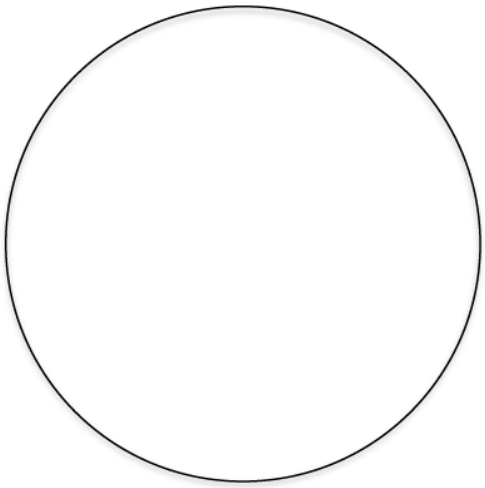
#14 acinar cells	#16 islets of Langerahans	#18 pancreatic head	#20 uncinate process	#22 pancreatic duct
#15 endocrine cells	#17 pancreatic tail	#19 pancreatic body	#21 accessory duct	

STATION FOUR: HISTOLOGY

Sketch the slides available for today's lab and specify the magnitude at which you are observing/sketching. Be sure to identify and label your sketch with the corresponding structures listed beneath each slide.

	
Tooth Enamel, Dentin, Pulp	**Parotid Gland**
	
Tongue Fungiform papillae, Filiform papillae, Circumvallate papillae, Taste bud, Taste pore	**Esophagus** Mucosa, Submucosa, Muscularis externa

	
Pancreas Acinar cells, Endocrine cells, Islets of Langerhans	**Liver** Hepatic lobules, Hepatic canaliculi
	
Duodenum Lumen, Villi, Mucosa, Submucsa, Muscularis, Externa Serosa	**Large Intestine** Lumen, Crypts of Lieberkühn, Mucosa, Submucosa, Muscularis externa, Serosa



Vermiform appendix

STATION FIVE: SMALL AND LARGE INTESTINES

Label the models of this station with the number that corresponds to the appropriate structure of the peripheral nervous system using the colored tape. When you are finished, ask your TA to check your labeling. Before leaving the station, remove all the labels you have placed on the model.

Note: For the following structures, be able to differentiate between left and right halves when applicable.

Small Intestine

#1 microvilli	#4 submucosa	#8 enterocytes	#11 ampulla of Vater	#14 ileum
#2 vili	#6 muscularis	#9 plicae circulares	#12 sphincter of Oddi	#15 ileocecal valve
#3 mucosa	#7 serosa	#10 duodenum	#13 jejunum	

Large Intestine

#16 crypts of Lieberkühn	#20 serosa	#24 right colic flexure	#28 sigmoid colon	#32 rectum
#17 mucosa	#21 cecum	#25 transverse colon	#29 teniae coli	#33 anal canal
#18 submucosa	#22 vermiform appendix	#26 left colic flexure	#30 haustra	#34 anal sphincter
#19 muscularis	#23 ascending colon	#27 descending colon	#31 epiploic appendices	#35 anus

Miscellaneous

#36 peritoneum	#38 greater omentum	#40 mesoappendix
#37 mesentery of transverse colon	#39 lesser omentum	

STATION SIX: FLOW OF GASTROINTESTINAL TRACT

As a group, determine the route boluses take through the various organs of the digestive tract. Be sure to identify the location of each structure on the vocabulary list of this lab section.

POST-LAB 8 QUESTIONS

(3 points)

Last Name: _____ First Name: _____

1. Describe the pathway food takes upon ingesting it, making sure to include all accessory structures. (0.5 point)

2. Explain the differences between the layers of the gastrointestinal tract. (0.5 points)

3. Match the terms with their corresponding descriptions. (0.5 points)

Name of Structure	Description	No. of Structure
1. Ileum	the largest salivary glands that produce approximately 25% of the saliva produced daily	
2. Gallbladder	passageway for liquids, foods, AND air	
3. Fauces	the modified muscularis of the large intestine	
4. Parotid glands	structures on the tongue that provide friction, allowing the tongue to move food in the oral cavity during mastication efficiently	
5. Filiform papillae	the terminal portion of the small intestine	
6. Pulp cavity	where bile made in the liver joins the bile stored in the gallbladder	
7. Pharynx	the opening between the oral cavity and the oropharynx	
8. Rugae	inner part of the tooth containing nerves and blood vessels	
9. Common bile duct	storage area for bile	
10. Teniae coli	folds of the inner wall of the stomach	

4. List each type of tooth. How do they function during mastication? (0.5)

5. List the accessory and primary structures of the GI tract. Why would accessory structures not be classified as primary organs/structures of the digestive system? (0.5 point)

6. A patient with cancerous growths in their salivary glands undergoes surgery to have them removed. How might this affect the digestive processes? (0.5 points)

LAB 9: URINARY AND REPRODUCTIVE SYSTEMS

LAB 9: URINARY AND REPRODUCTIVE SYSTEMS

MEASURABLE OUTCOMES

- Analyze reproductive and urinary organ tissues under the microscope.
- Complete the dissection of the kidney and accurately identify (with a pin) all structures of the kidney using the corresponding vocabulary list.
- Learn about the organs of the urinary system: kidney, ureter, urinary bladder and urethra, as well as the structural elements of the nephron and label on any available models.
- Compare and contrast the elements of the male and female reproductive systems and their associated accessory glands.
- Recognize homologous structures of the male and female reproductive systems.
- Demonstrate an adequate understand of the material in this section.

BACKGROUND

The urinary system is one of excretion, elimination and reabsorption. It is made from four organs, only one of which produces urine (the *kidney*). *Nephrons*, the smallest functional unit of the kidneys, are found in numbers of one to two million within the kidney and can filter up to 400 gallons of cycled blood, daily. The kidneys receive more blood than the heart, liver, or even the brain and have vital functions such as the regulation of pH, blood pressure, concentration of blood solutes and concentration of red blood cells. The remaining three organs (*ureters, urinary bladder*, and *urethra*) facilitate urine storage and secretion. Of these organs, only the urethra is anatomically distinct between males and females.

The reproductive system is designed to propagate a species and therefore has two primary functions: the production of gametes (*n*) and sex hormones. Male gametes are referred to as *sperm* cells, whereas female gametes are called *ova*. Reproduction is very metabolically taxing especially for the female. To illustrate, mature ovum can contain as many as 600,000 mitochondria; to reference, liver cells and cardiac muscles cells contain 2,000 and 5,000 mitochondria respectively. The role of the male reproductive system is to produce sperm and transfer them to the female reproductive tract. Although they originate from similar primordial tissues, the female and male reproductive systems differ in gonad type, ducts, accessory glands, and external genitalia. Male gonads are referred to as *testes* while the female gonads as *ovaries*; both are the sites of their respective gametogenesis. The hormones produced by the gonads are crucial to the reproductive system and sexual development, including primary and secondary sexual development, tissue regeneration, and production of gametes.

Humans are a sexually dimorphic species, which mean that there are distinguishing secondary sex characteristics. The hormones that influence male primary and secondary sexual development are

called androgens. The hormones that influence female primary secondary sexual development are called estrogens. In females, this entails the development of breasts which are specialized sweat glands. Males also have mammary tissue but their development is arrested early. Similarly, the thyroid cartilage is enlarged and commonly referred to as an Adam's apple in males but not so in females.

A developing fetus remains anatomically undifferentiated a will either develop characteristically male or female anatomy. At some point of gestation, the fetus will develop both Wolffian and Müllerian ducts, anlagen of the male and female reproductive systems. As a result, there are several elements of the male and female reproductive systems which are *homologous.* Such structures share developmental and evolutionary origins but are not necessarily similar in function. The following are the homologous structures of the male and female reproductive system: *labia majora* – male scrotum*; labia minora – shaft of penis*; *clitoris – glans penis*; paraurethral gland – *prostate gland*; greater vestibular gland – *bulbourethral gland.*

Vocabulary for the Urinary and Reproductive systems on page(s) 172 and 168.

PRE-LAB 9

(5 points)

Last Name: _____ First Name: _____

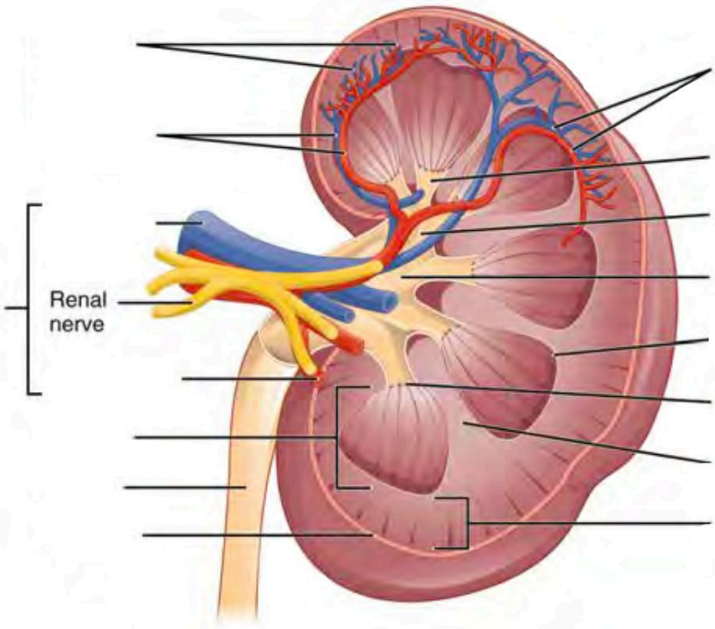
INSTRUCTIONS:

Fill in the table below with the appropriate terms. For the remaining exercises, label the structures accordingly.

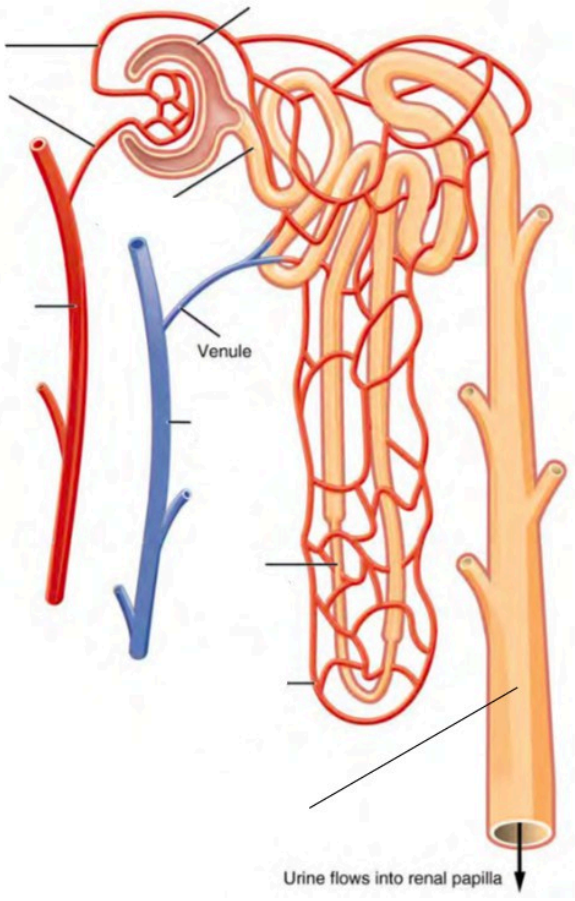
(1 point)

Name of a structure	is	directional term	to	Name of the second structure
scrotum*	is	posterior	to	penis*
kidneys	is	superior	to	
	is	inferior	to	urinary bladder
pubic symphysis	is	anterior	to	
	is	distal	to	prostate gland
uterus	is	medial	to	
	is	lateral	to	urethra

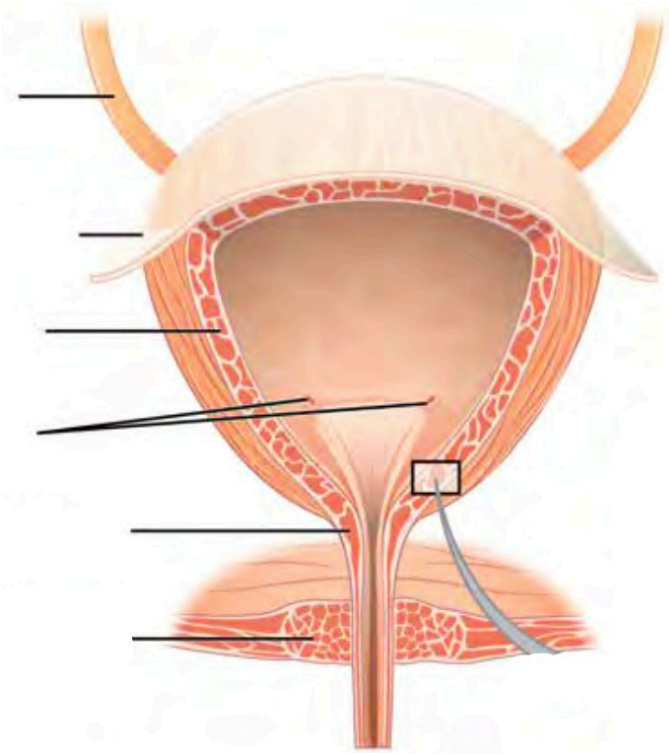
Label the structures and regions of the left kidney. (1 point)



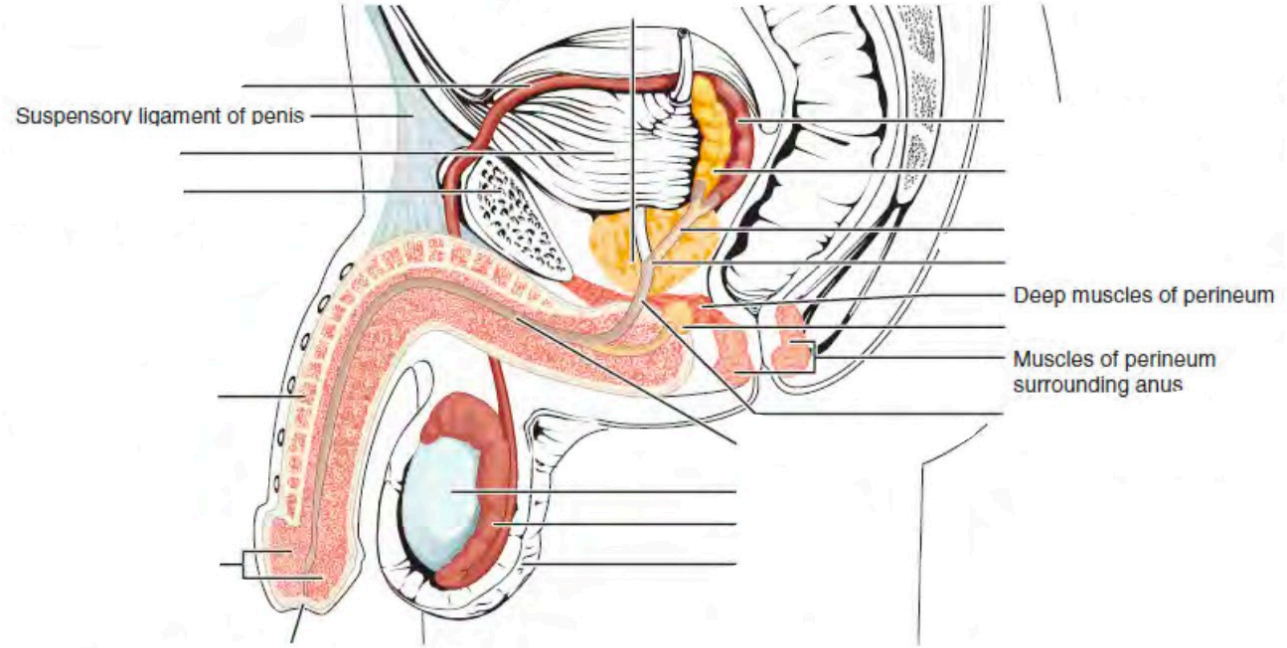
Label the structures of the nephron. (0.5 points)

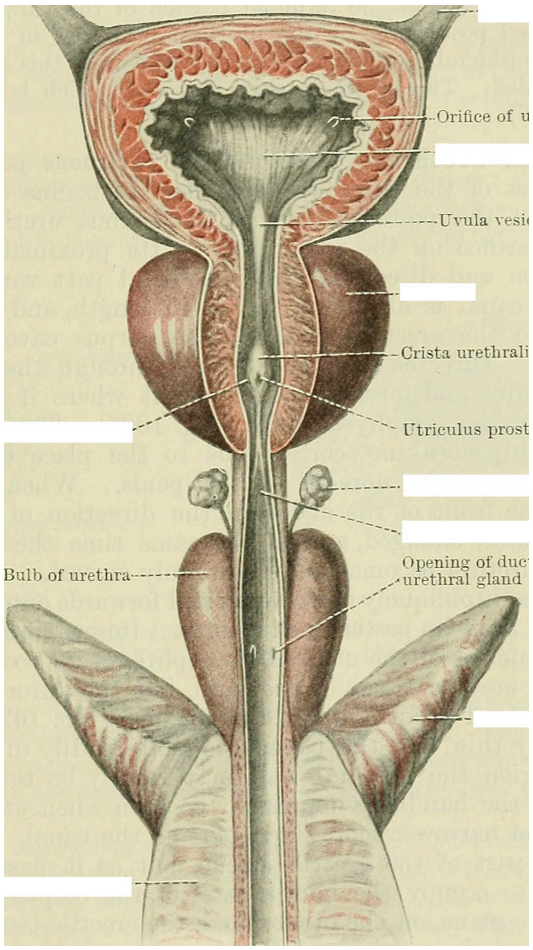
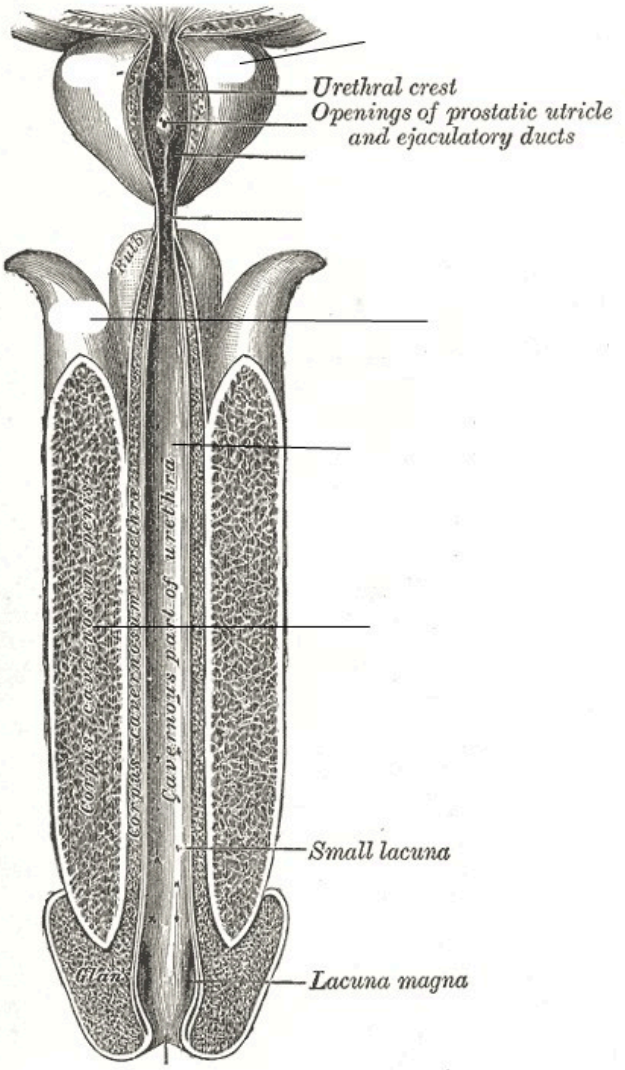


Label the structures of the bladder. (0.5 points)



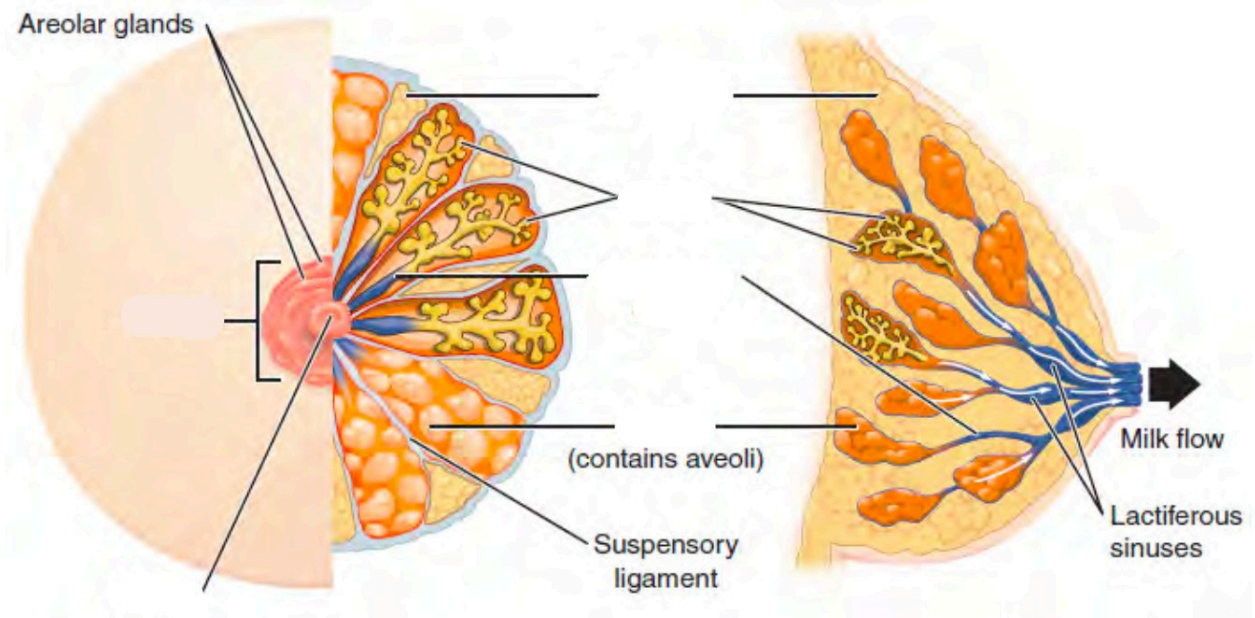
Label the parts of the male urinary/reproductive systems. (0.5 points)



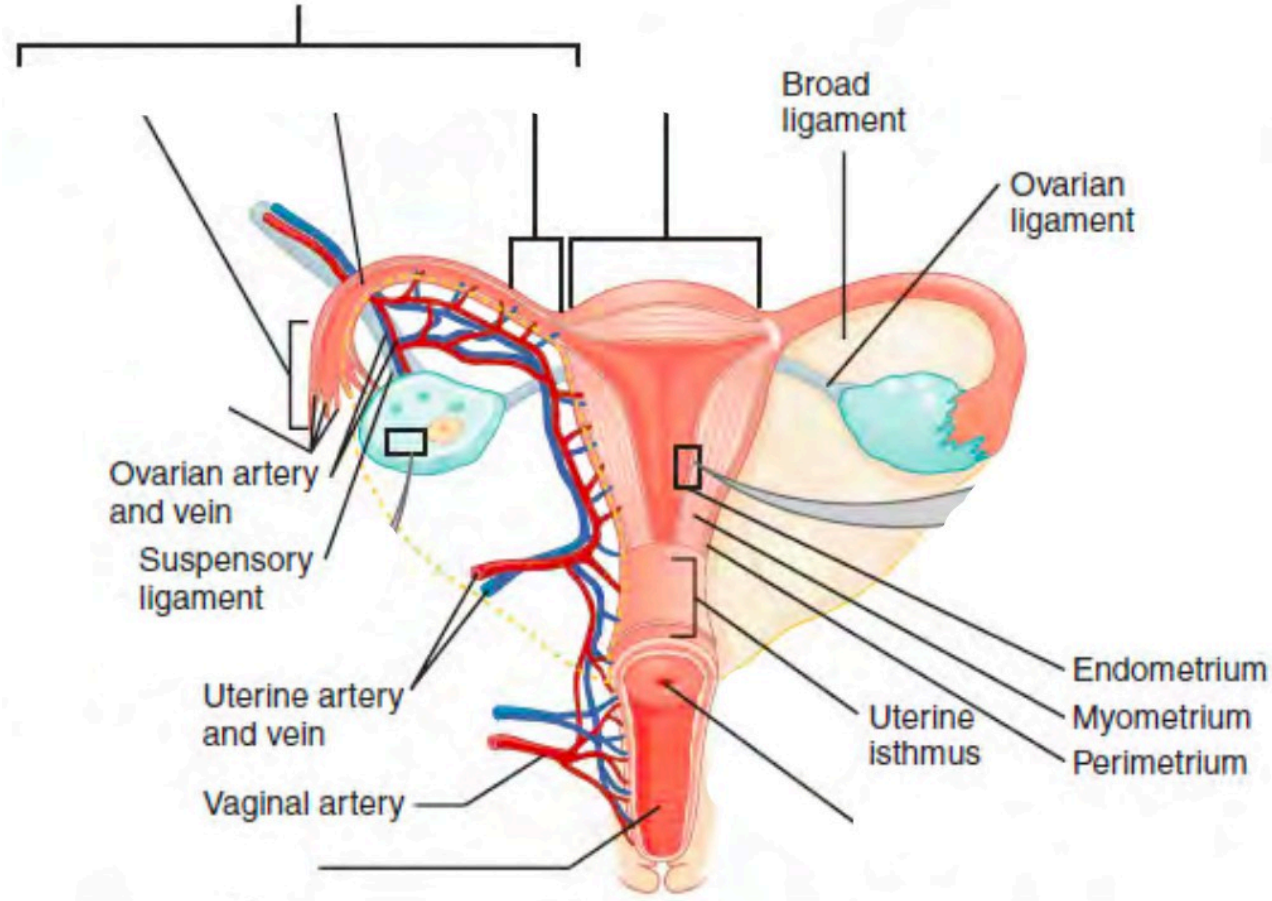
Label the structures of the male reproductive system. (0.25 points)	Label the structures of the male reproductive system. (0.25 points)
	

Label the parts of the female urinary/reproductive system. (0.5 points)

Label the structures of the breasts. (0.25 points)



Label the structures of the uterus. (0.25 points)



LAB ACTIVITIES

A list of words is provided below that you are expected to identify, learn, and label on the models provided. Note that not all models will have some of the organs/structures, so be sure to find them on an alternate model. You must use all the words provided. Using the colored tape provided, write the number that corresponds to the organ/structure and place them on your model. When complete, notify your TA so they may check your work.

For each additional station, directions will be provided for the activity.

STATION ONE: URINARY

Label the models of this station with the number that corresponds to the appropriate structure of the peripheral nervous system using the colored tape. When you are finished, ask your TA to check your labeling. Before leaving the station, remove all the labels you have placed on the model.

#1 renal fascia	#11 renal pelvis	#21 external urethral orifice	#31 proximal convoluted tubule
#2 adipose capsule	#12 renal hilum	#22 cortical nephron	#32 descending loop of Henle
#3 renal capsule	#13 ureter	#23 juxtamedullary nephron	#33 ascending loop of Henle
#4 renal cortex	#14 urinary bladder	#24 juxtaglomerular apparatus	#35 distal convoluted tubule
#5 renal medulla	#15 detrusor muscle	#25 renal corpuscle	#36 collecting duct
#6 renal lobe	#16 rugae	#26 glomerulus	#37 papillary duct
#7 renal pyramid	#17 urinary trigone	#27 podocyte	#38 minor calyx
#8 renal columns	#18 internal urethral sphincter	#28 bowman's capsule	#39 major calyx
#9 renal papilla	#19 external urethral sphincter	#29 capsular space	
#10 renal sinus	#20 urethra	#30 renal tubules	

Blood Vessels

#40 renal artery	#43 arcuate arteries	#46 glomerular capillaries	#49 cortical radiate veins	#52 renal vein
#41 segmental arteries	#44 cortical radiate arteries	#47 efferent arterioles	#50 arcuate veins	
#42 interlobar arteries	#45 afferent arterioles	#48 peritubular capillaries	#51 interlobar veins	

STATION TWO: REPRODUCTIVE – MALE

Label the models of this station with the number that corresponds to the appropriate structure of the peripheral nervous system using the colored tape. When you are finished, ask your TA to check your labeling. Before leaving the station, remove all the labels you have placed on the model.

#1 pubic symphysis	#11 head of sperm	#21 seminal vesicles	#31 prepuce of penis
#2 dartos muscle	#12 midpiece of sperm	#22 bulbourethral (Cowper's) glands	#32 external urethral orifice
#3 cremaster muscle	#13 tail of sperm	#23 ejaculatory ducts	#33 root of penis
#4 scrotum	#14 seminiferous tubules	#24 prostatic urethra	#34 bulb of penis
#5 scrotal septum	#15 straight tubule	#25 intermediate urethra	#35 crus of penis
#6 testis	#16 rete testis	#26 spongy urethra	#36 suspensory ligament of penis
#7 lobules	#17 epididymis	#27 penis	#37 spermatic cord
#8 leydig cells	#18 ductus (vas) deferens	#28 corpus cavernosum	#38 deep muscle of perineum
#9 sertoli cells	#19 ampulla of ductus deferens	#29 corpus spongiosum	
#10 sperm	#20 prostate glands	#30 glans penis	

STATION THREE: REPRODUCTIVE – FEMALE

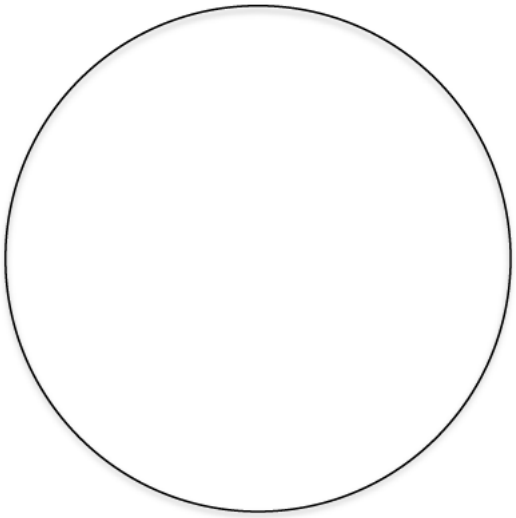
Label the models of this station with the number that corresponds to the appropriate structure of the peripheral nervous system using the colored tape. When you are finished, ask your TA to check your labeling. Before leaving the station, remove all the labels you have placed on the model.

#1 pubic symphysis	#10 isthmus of uterine tube	#19 fundus of uterus	#28 vaginal orifice	#37 breast
#2 placenta	#11 broad ligament	#20 body of uterus	#29 mons pubis	#36 areola
#3 ovary	#12 round ligament	#21 isthmus	#30 vulva	#39 nipple
#4 ova	#13 uterosacral ligament	#22 cervix	#31 labia majora	#40 mammary glands
#5 ovarian ligament	#14 uterus	#23 external os	#32 labia minora	#41 lobule
#6 uterine (Fallopian) tube	#15 endometrium	#24 internal os	#33 vestibule	#42 lactiferous ducts
#7 fimbriae of uterine tube	#16 myometrium	#25 vagina	#34 clitoris	#43 lactiferous sinus
#8 infundibulum of uterine tube	#17 perimetrium	#26 fornix	#35 external urethral orifice	#44 mammary ducts
#9 ampulla of uterine tube	#18 uterine cavity	#27 rugae	#36 vestibular glands	#45 mammary alveoli

STATION FOUR: HISTOLOGY

Sketch the slides available for today's lab and specify the magnitude at which you are observing/sketching. Be sure to identify and label your sketch with the corresponding structures listed beneath each slide.

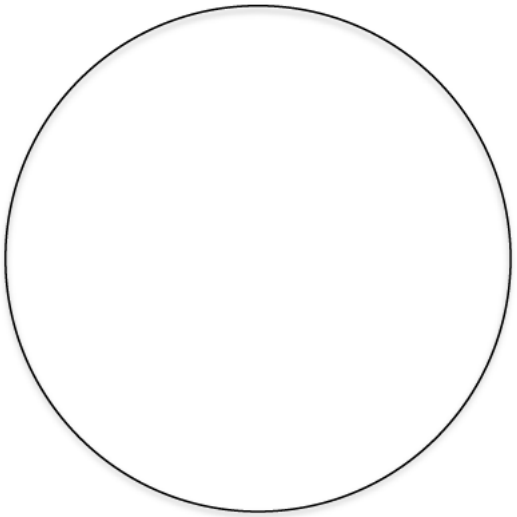
Urinary



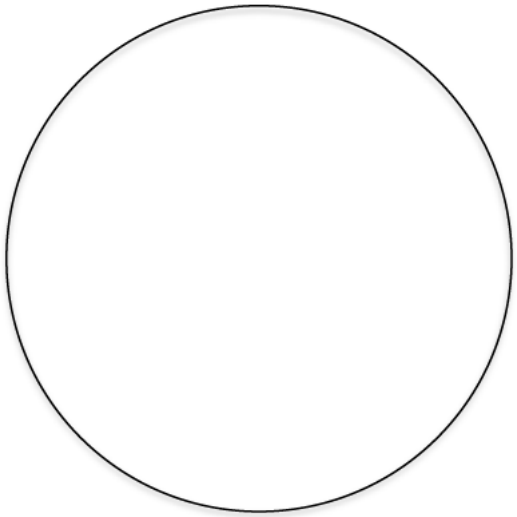
Kidney

Bowman's capsule (renal corpuscle), Glomerulus

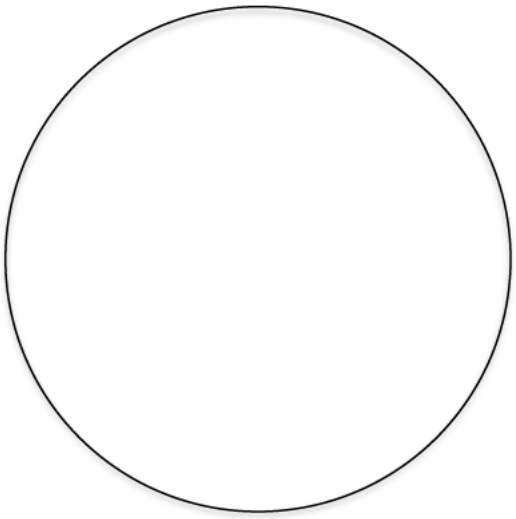
Male Reproductive



Testis
Seminiferous tubules, Lobules

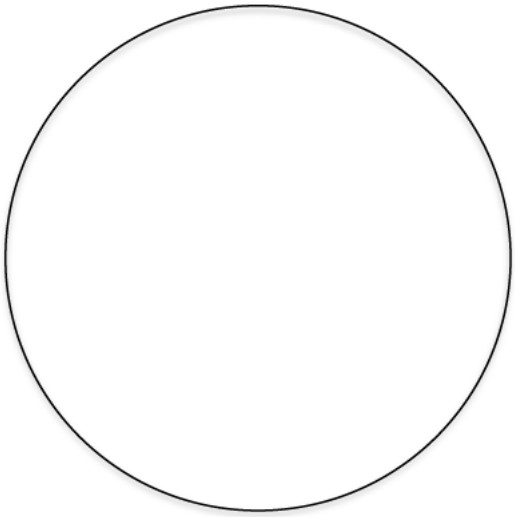
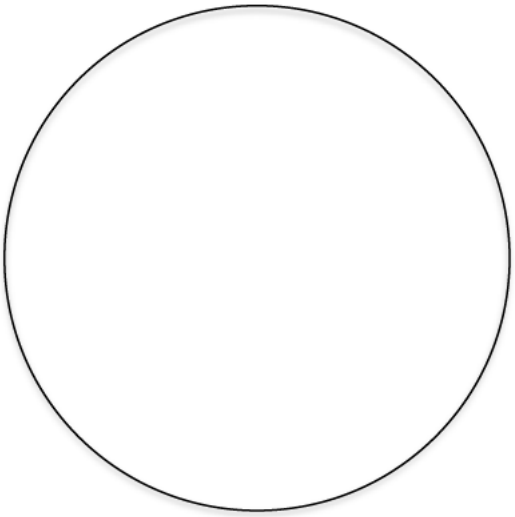
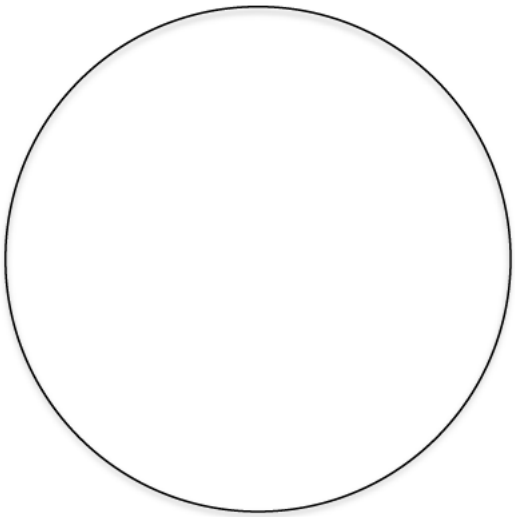
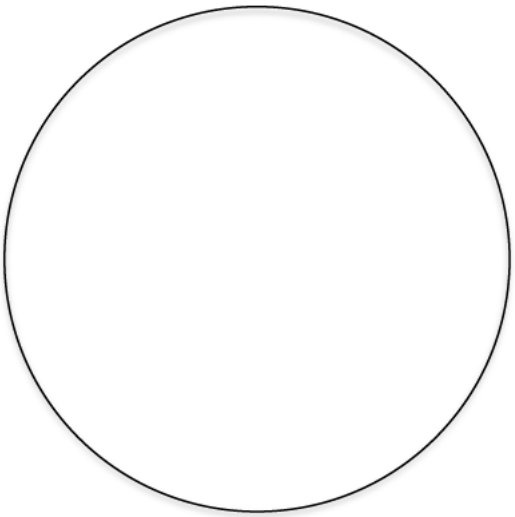


Epididymis



Human Sperm
Head, Midpiece, Tail

Female Reproductive

	
Mammary gland Mammary alveoli, Lobule, Ducts	**Uterus** Endometrium, Myometrium, Perimetrium
	
Placenta	**Ovary** Mature (Graafian) follicle

STATION FIVE: KIDNEY DISSECTION

- Upon receiving your kidney, identify the renal hilum, from which the renal artery, renal vein, and ureter protrude (it is also the indented portion of the kidney).
- Now lay the kidney on its broadest most flat portion, with the renal hilum facing opposite your dominant hand (if you are right-handed, the hilum should be facing left).
- Using the scalpel from your dissection kit, cut the kidney in half lengthwise from the side, meaning, your scalpel should begin at the anterior, medial section of the kidney and work its way down to the posterior medial section. (**DO NOT make sawing motions with the scalpel**.) Continue making these incisions with your scalpel until you have separated the halves of a kidney
- Obtain pins from the table and place them on as many structures as you can identify. Your lab TA will come around and ask you to identify the pins you have placed.
- Before leaving the station, remove all the pins you have placed.

*If you are the last table to use this station, be sure to clean off the dissection kits in the lab's sink.

STATION SIX: FILTRATE PATH AND BLOOD FLOW THROUGH KIDNEY

As a group, determine the route of urine through the various ducts of the kidney, originating at the glomerulus and ending with the urethra. Be sure to identify where along that path each of the structures on the vocabulary list is located.

As a group, determine the course of blood through the vessels of the kidney.

Note: The following three pages are left blank for the purpose of drawing out these two pathways.

POST-LAB 9 QUESTIONS

(2 points)

Last Name: _____ First Name: _____

1. Match the structure with the corresponding description. (0.5 point)

Name of Structure	Description	No. of structure
1. ureters	Area where renal vessels and ureters converge	
2. kidney	urination	
3. renal capsule	nephrons located deep in the renal medullas	
4. micturition	smooth muscle of the bladder	
5. rugae of the mucosa	organ of urine production	
6. hilum	includes Bowman's capsule and glomerulus	
7. collecting duct	folds in the bladder when empty	
8. detrusor	a structure where nephrons drain urine into	
9. renal capsule	collagen membrane around the kidney	
10. juxtamedullary nephrons	tubules that conduct urine from the kidney to bladder	

2. Write down the path of urine from the point of origin to secretion. (0.5 point)

3. Match the structure with the corresponding description. (0.5 point)

Name of Structure	Description	No. of structure
1. Ductus- vas-deferens	produce sperm and testosterone	
2. Areola	small convoluted tubules and site of spermatogenesis	
3. Testes	conduct sperm to the urethra during ejaculation	
4. Mammary gland	produces an ovum, estrogen, and progesterone	
5. Fimbriae	a gland in mammals that produces milk	
6. Corpus cavernosum and spongiosum	ducts that carry milk from the mammary glands to the nipple	
7. Labia major	pigmented area around the nipple	
8. Seminiferous tubules	the larger outer folds of the vulva surrounding the inner folds; contain adipose tissue and hair	
9. Ovaries	erectile tissues that form the bulk of the penis	
10. Lactiferous ducts	small fingerlike projections at the end of the fallopian tubes	

4. What is unique about the location/position of the kidneys? (0.5 point)

LAB 10: THE MUSCULAR AND INTEGUMENTARY SYSTEMS

LAB 10: THE MUSCULAR AND INTEGUMENTARY SYSTEMS

MEASURABLE OUTCOMES

- Name the anatomical structures of integumentary and muscular systems on available models.
- Distinguish between the types of muscular tissue from histology slides.
- Determine the layers of the integument from histology slides.
- Demonstrate an adequate understand of the material in this section.

BACKGROUND

The body's first line of defense against pathogens and other microbes is the skin. The skin is multi-layered and it functions to maintain homeostasis, retain water, synthesize vitamin D and regulate body temperature (thermoregulation). It is made of two chief layers: the *epidermis*, made of closely packed epithelial cells, and the *dermis*, made of dense, irregular connective tissue which houses blood vessels, *hair follicles*, *sweat glands*, and other structures. Beneath the *dermis* lies the *hypodermis*, which is composed mainly of loose connective and fatty tissues. One of skin's accessory structures, *nails*, are considered to be specialized structures of the epidermis found at the tips of fingers and toes. Other accessory structures, *sudoriferous glands*, produce sweat which cools the body by evaporation. Skin is the largest continuous organ of the body, encompassing approximately 16 percent of our body weight.

The muscular system is an intricate network of contractile tissue which works antagonistically in order to move the body. The action of walking requires roughly 200 different muscles alone. Besides skeletal muscles, there are also cardiac muscle and smooth muscle. Cardiac muscle is found uniquely in the heart and is responsible for pumping blood through the circulatory system. Smooth muscle is the type of muscle involved in involuntary movements such as peristalsis which propel boluses through the GI tract. Skeletal muscle is also known as striated muscle, as is cardiac muscle. As you approach the muscles in this lab, make note of which muscles may be named after their shape and which ones may be named after their location or their attachments to the skeleton. Individually, all cells, with the exception of sperm, are unable to move on their own. Nevertheless, with bones as there scaffold, muscles are able to produce movent through a complex series of metabolic reactions.

Vocabulary for Muscles and Integumentary systems can be found on page(s) 166-167 and 166.

PRE-LAB 10

(5 points)

Last Name: _____ First Name: _____

INSTRUCTIONS:

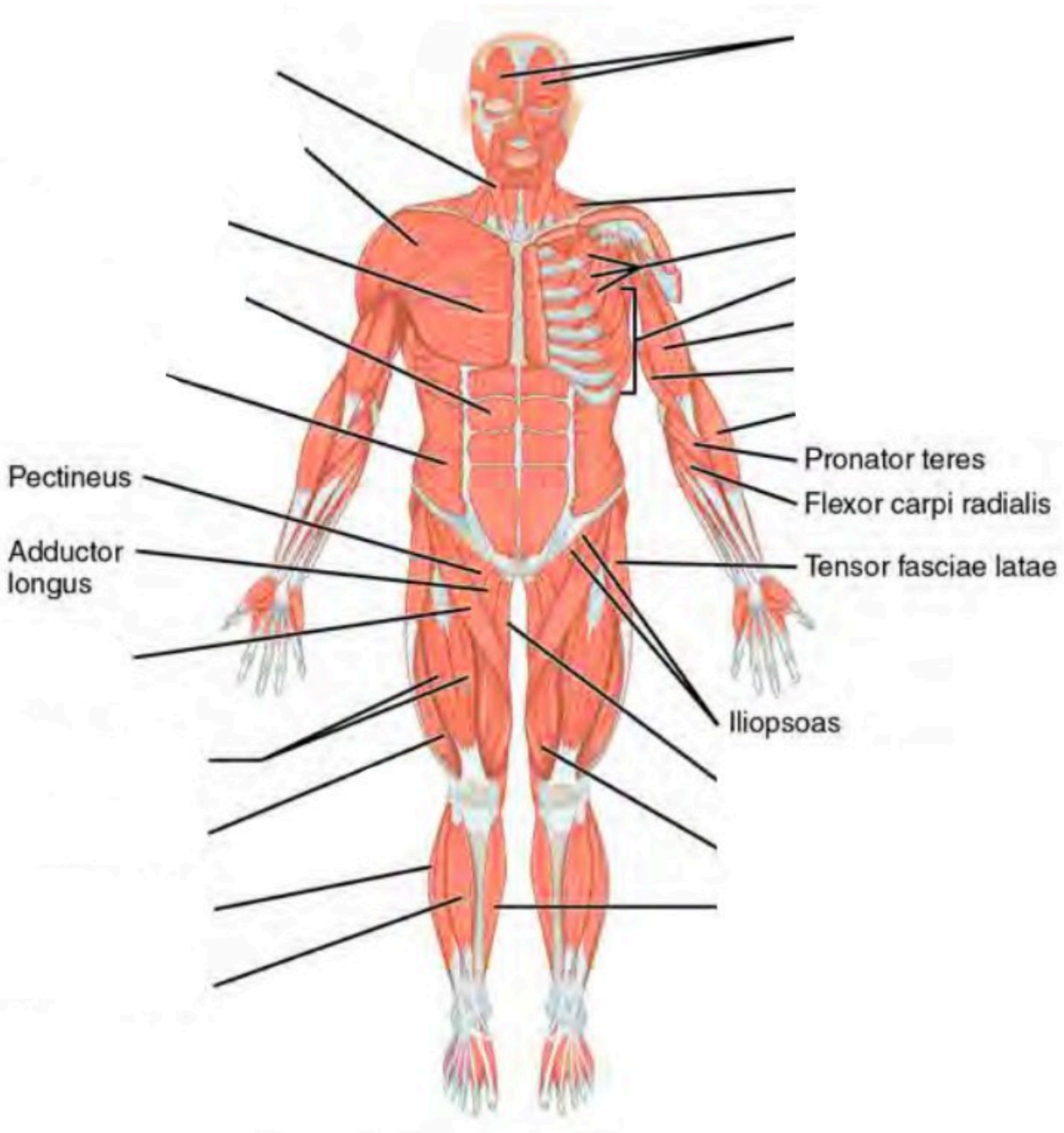
Fill in the table below with the appropriate terms. For the remaining exercises, label the structures accordingly.

(1 point)

Name of a structure	is	directional term	to	Name of the second structure
trapezius*	is	proximal	to	pectoralis major*
diaphragm	is	superior	to	
	is	inferior	to	scalenes
rectus abdominis	is	anterior	to	
	is	distal	to	biceps femoris
pectoralis minor	is	medial	to	
	is	lateral	to	external oblique

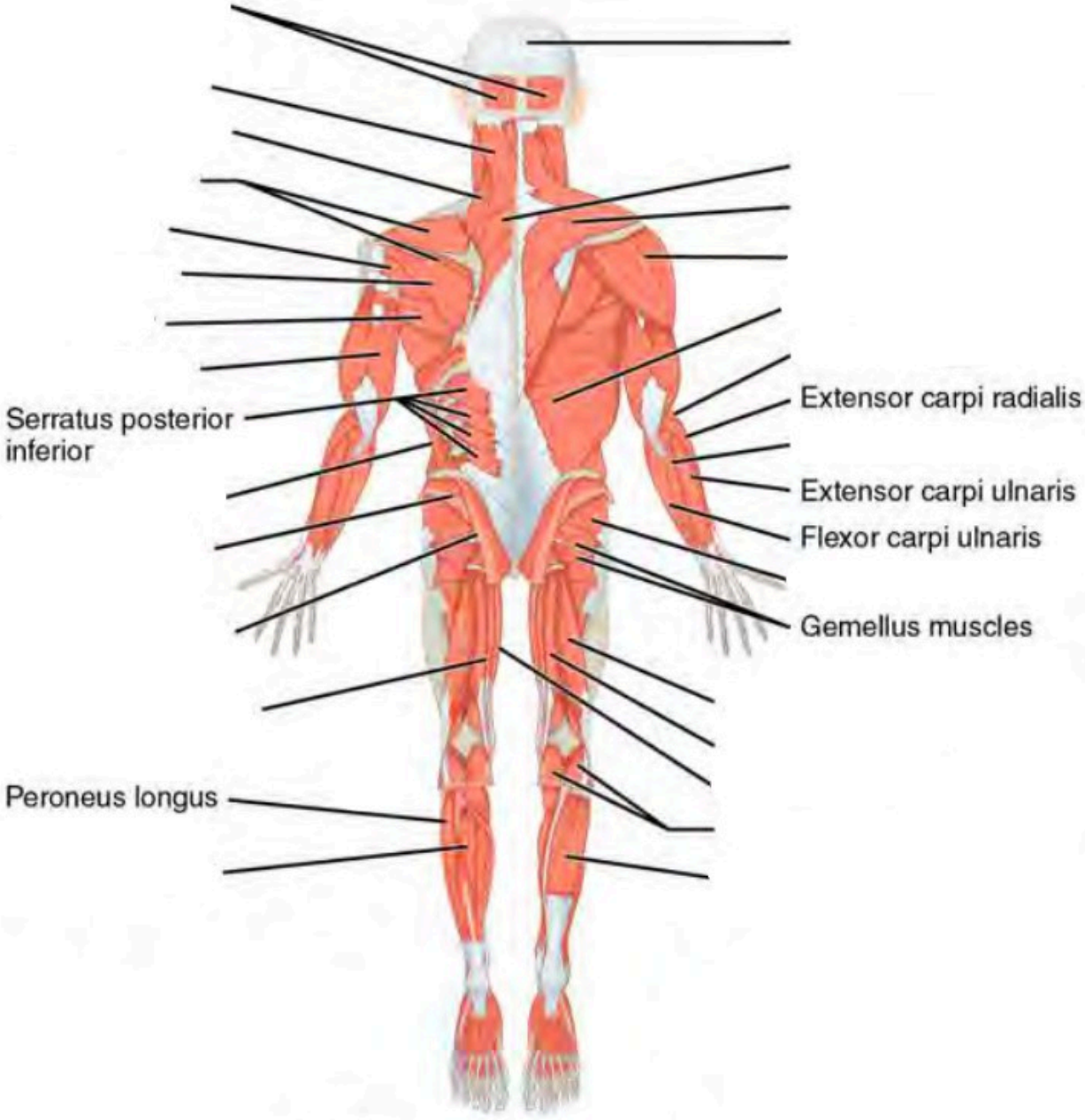
Label the major muscles. (0.5 points)

This is the (ventral /dorsal) aspect of the body. (circle one)

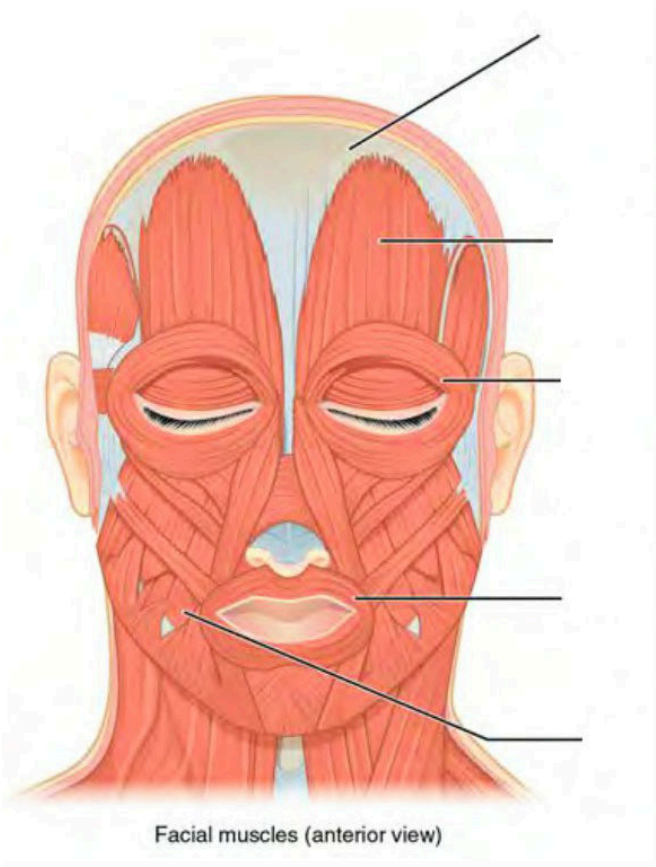


Label the major muscles of the body. (0.5 points)

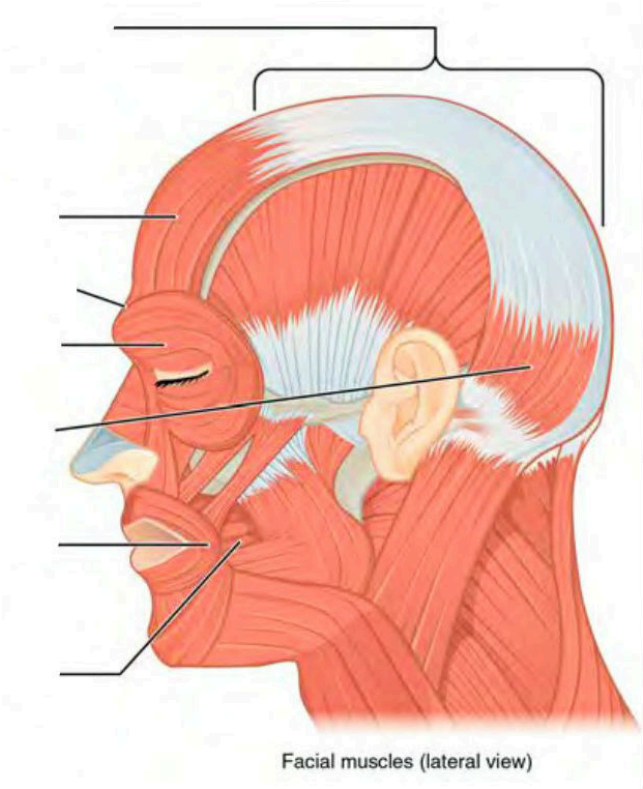
This is the (ventral /dorsal) aspect of the body. (circle one)



Label the muscles of the head. (0.25 points)

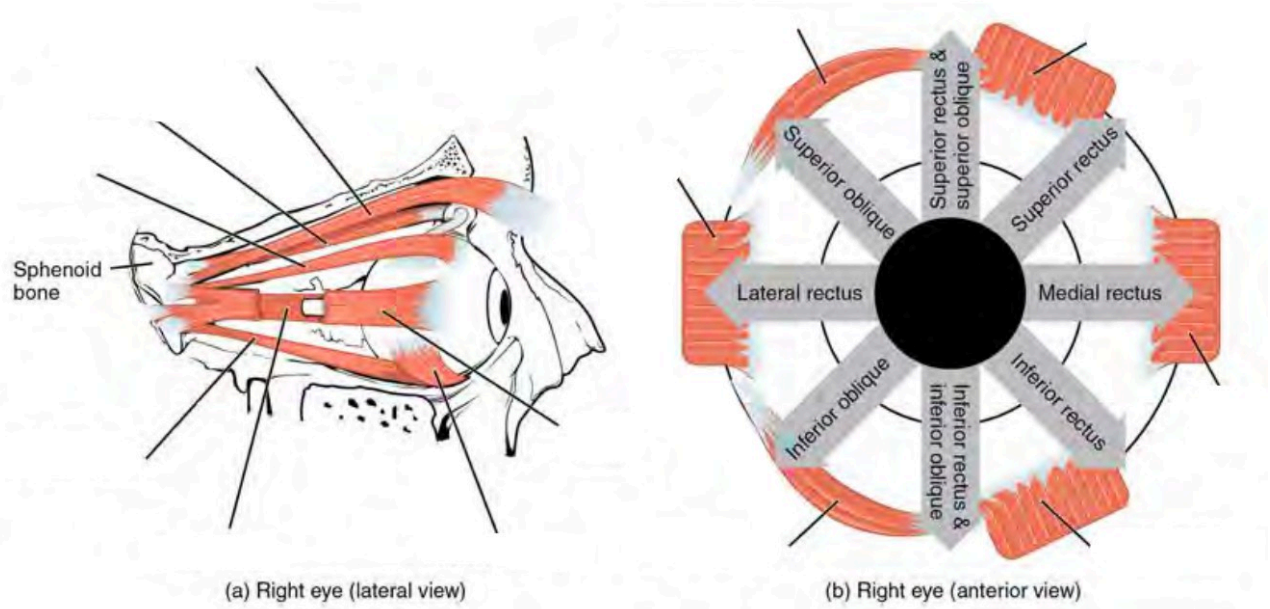


Facial muscles (anterior view)



Facial muscles (lateral view)

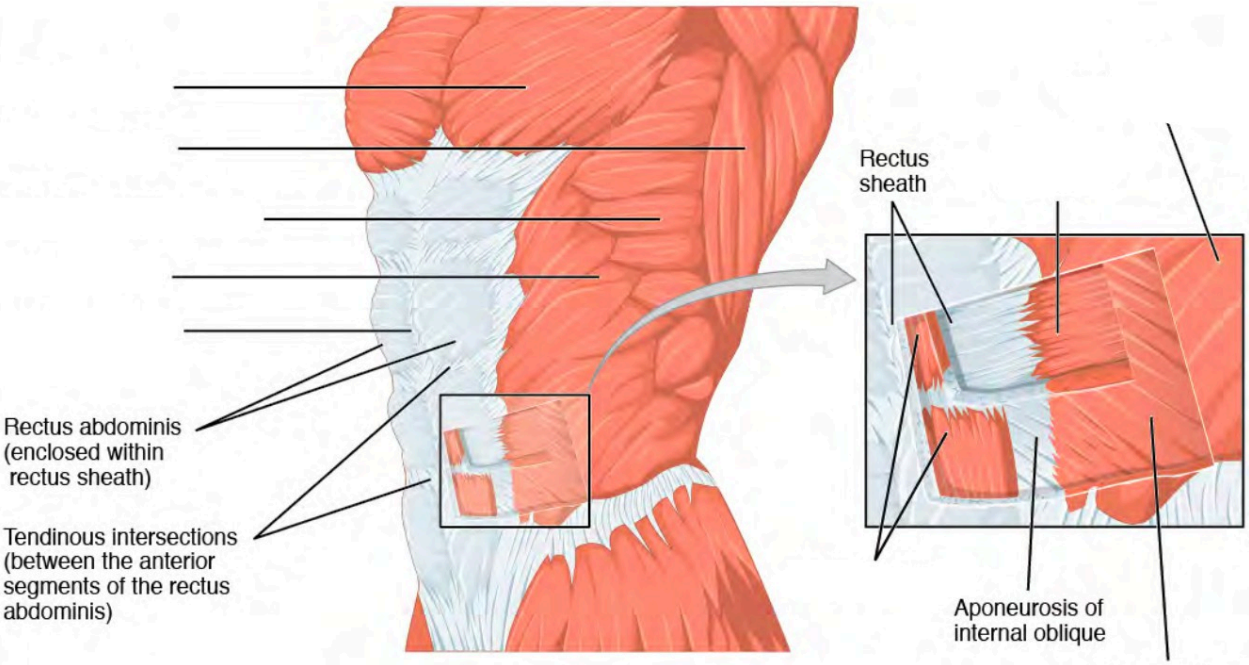
Label the muscles of the eye. (0.25 points)



(a) Right eye (lateral view)

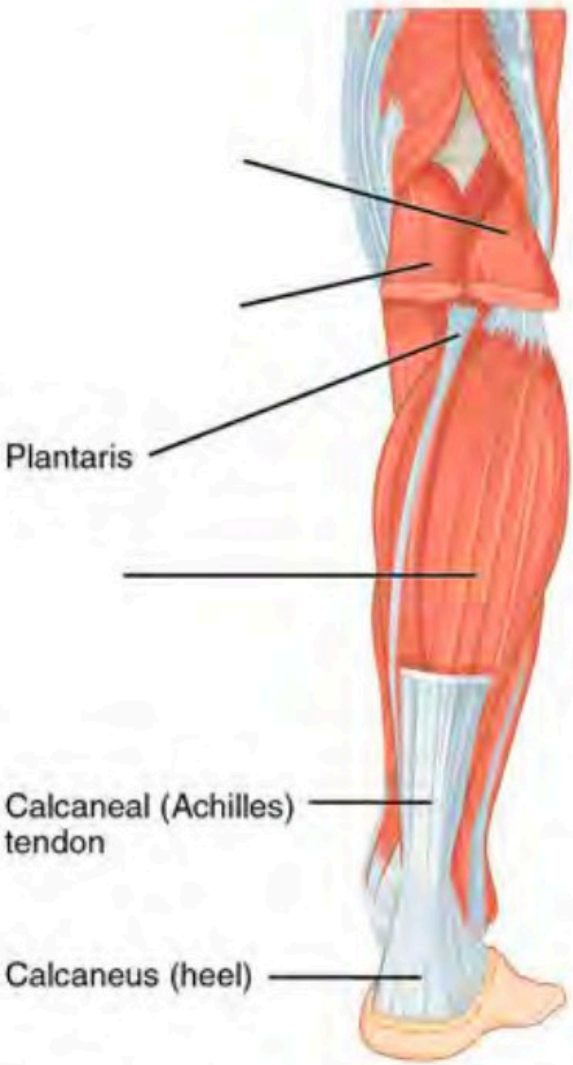
(b) Right eye (anterior view)

Label the major abdominal muscles. (0.25 points)

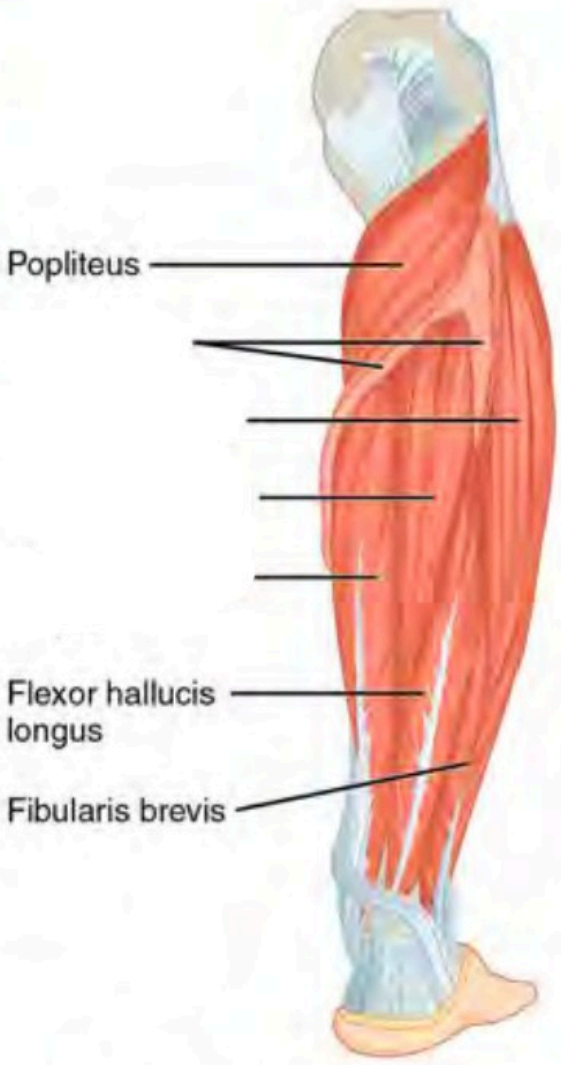


(a) Superficial and deep abdominal muscles (anterior lateral view)

Label the major muscles of the lower leg. (0.25 points)

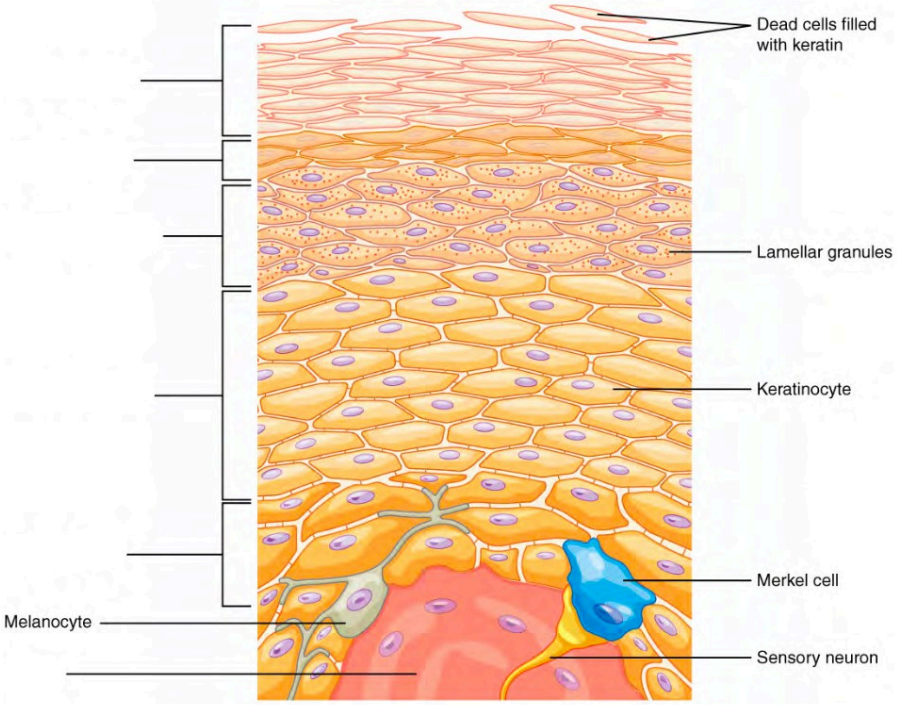


Superficial muscles of the right lower leg (posterior view)

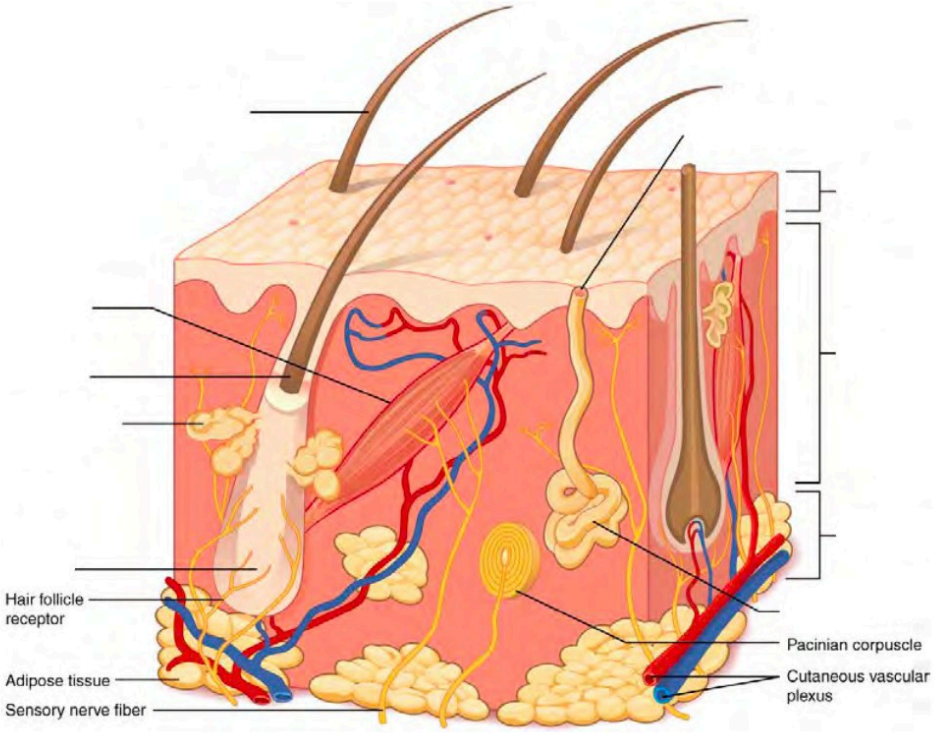


Deep muscles of the right lower leg (posterior view)

Label the layers of the epidermis. (0.5 points)



Label the layers of integument and accessory structures. (0.5 points)



LAB ACTIVITIES

A list of words is provided below that you are expected to identify, learn, and label on the models provided. Note that not all models will have some of the organs/structures, so be sure to find them on an alternate model. You must use all the words provided. Using the colored tape provided, write the number that corresponds to the organ/structure and place them on your model. When complete, notify your TA so they may check your work.

For each additional station, directions will be provided for the activity.

STATION ONE: MUSCLES OF THE UPPER BODY

Label the models of this station with the number that corresponds to the appropriate structure of the peripheral nervous system using the colored tape. When you are finished, ask your TA to check your labeling. Before leaving the station, remove all the labels you have placed on the model.

Note: For the following structures, be able to differentiate between left and right halves when applicable.

Muscles of the Head and Neck

#1 epicranial aponeurosis	#7 nasalis	#13 zygomaticus minor	#19 sternocleidomastoid
#2 front belly of occipitofrontalis	#8 orbicularis oculi	#14 zygomaticus major	#20 platysma
#3 occipital belly of occipitofrontalis	#9 levator labii superioris	#15 buccinator	#21 sternohyoid
#4 temporalis	#10 levator anguli oris	#16 risorius	#22 scalenes
#5 auricularis superior	#11 depressor anguli oris	#17 orbicularis oris	
#6 procerus	#12 depressor labii inferioris	#18 mentalis	

Muscles of the Eye

#23 levator palpebrae superioris	#25 medial rectus	#27 inferior recuts	#29 superior oblique
#24 lateral recuts	#26 superior rectus	#28 inferior oblique	#30 trochlea

Muscles of the Arms

#31 deltoid	#33 clavicular part of deltoid	#35 coracobrachialis	#37 biceps brachii	#39 brachioradialis
#32 acromial part of deltoid	#34 spinal part of deltoid	#36 triceps brachii	#38 brachialis	#40 extensor digitorum

STATION TWO: MUSCLES OF THE BACK AND ABDOMEN

Label the models of this station with the number that corresponds to the appropriate structure of the peripheral nervous system using the colored tape. When you are finished, ask your TA to check your labeling. Before leaving the station, remove all the labels you have placed on the model.

Note: For the following structures, be able to differentiate between left and right halves when applicable.

#1 trapezius	#7 teres major	#13 pectoralis minor	#19 internal intercostals
#2 levator scapulae	#8 teres minor	#14 serratus anterior	#20 external intercostals
#3 splenius capitis	#9 rhomboid major	#15 recuts abdominis	#21 diaphragm
#4 supraspinatus	#10 rhomboid minor	#16 external oblique	
#5 infraspinatus	#11 latissimus dorsi	#17 internal oblique	
#6 subscapularis	#12 pectoralis major	#18 transversus abdominis	

STATION THREE: MUSCLES OF THE LOWER BODY

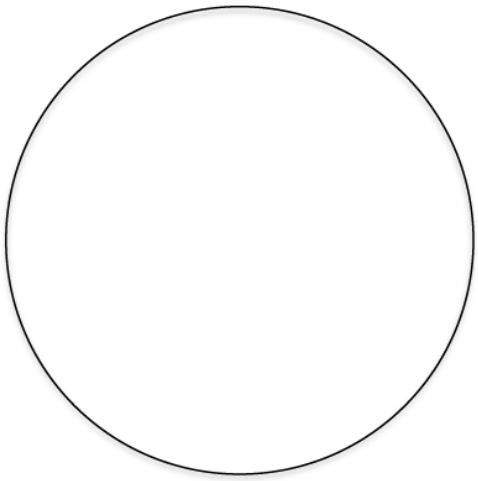
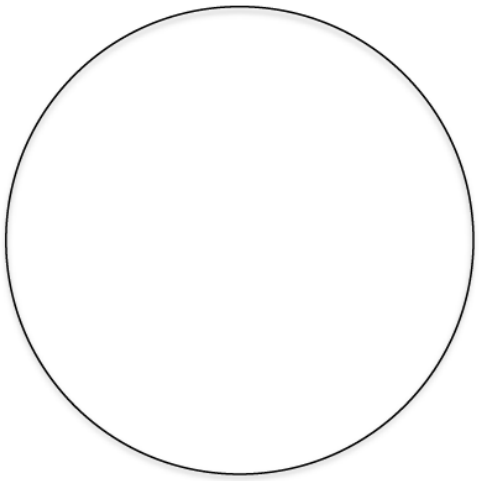
Label the models of this station with the number that corresponds to the appropriate structure of the peripheral nervous system using the colored tape. When you are finished, ask your TA to check your labeling. Before leaving the station, remove all the labels you have placed on the model.

Note: For the following structures, be able to differentiate between left and right halves when applicable.

#1 gluteus maximus	#7 vastus lateralis	#13 gracilis	#19 extensor digitorum longus
#2 gluteus medius	#8 vastus intermedius	#14 adductor longus	#20 fibularis longus
#3 gluteus minimus	#9 hamstrings	#15 pectineus	#21 tibialis anterior
#4 quadriceps	#10 biceps femoris	#16 sartorius	#22 flexor digitorum longus
#5 rectus femoris	#11 semitendionosus	#17 gastrocnemius	#23 tibialis posterior
#6 vastus medialis	#12 semimembranosus	#18 soleus	

STATION FOUR: HISTOLOGY – MUSCLE

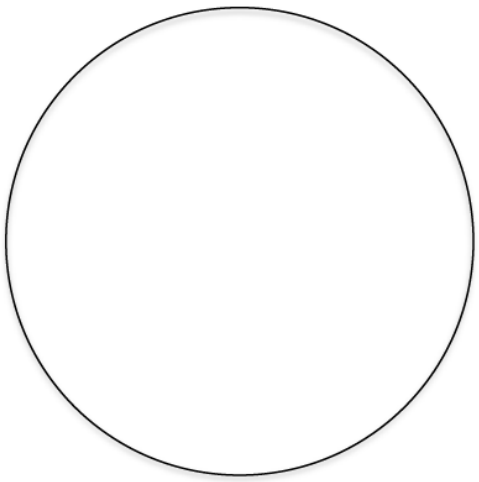
Sketch the slides available for today's lab and specify the magnitude at which you are observing/sketching. Be sure to identify and label your sketch with the corresponding structures listed beneath each slide.

	
Striated muscle	**Cardiac muscle** Intercalated discs

STATION FIVE: HISTOLOGY – INTEGUMENTARY

Sketch the slides available for today's lab and specify the magnitude at which you are observing/ sketching. Be sure to identify and label your sketch with the corresponding structures listed beneath each slide.

Skin of palm Epidermis, Dermis, Papillary layer, Reticular layer	**Human scalp w/hair follicle** Epidermis, Dermis, Arrecotr pili muscle, Sebaceous gland, Dermal papilla, Hair follicle, Hair bulb



Squamous epithelium

STATION SIX: INTEGUMENTARY

Label the models of this station with the number that corresponds to the appropriate structure of the peripheral nervous system using the colored tape. When you are finished, ask your TA to check your labeling. Before leaving the station, remove all the labels you have placed on the model.

SKIN

#1 epidermis	#5 stratum spinosum	#9 papillary layer	#13 hypodermis superficial fascia
#2 stratum corneum	#6 stratum basale	#10 reticular layer	#14 lamellated corpuscles
#3 stratum lucidum	#7 epidermal ridges	#11 dermal papillae	#15 thin (hairy) skin
#4 stratum granulosum	#8 dermis	#12 subcutaneous layer (Hypodermis)	#16 thick (hairless) skin

#17 squamous epithelium

Hair

#18 pili	#20 hair root	#22 bulb
#19 hair shaft	#21 hair follicle	#23 arrector pili muscles

Glands

#24 sebaceous	#26 eccrine sweat	#28 ceruminous
#25 sudoriferous	#27 aprocrine	

Nail

#29 nail body (nail plate)	#31 lunula	#33 nail bed
#30 free edge	#32 eponychium (cuticle)	

POST-LAB 10 QUESTIONS

(2 points)

Last Name: _____ First Name: _____

1. What muscles, in the dermis are responsible for erecting hair follicles? (0.5 points)

2. While examining a patient's eye, a doctor instructs them to move their right eye upward, to the left. Which muscles of the eye were utilized to perform this task? (0.5 points)

3. What muscle of the cervical region has two origins? (0.5 points)

4. What is the primary muscle used for normal breathing? Which additional muscles are utilized to increase inspiration and expiration during strenuous exercise? (0.5 points)

VOCABULARY

VOCABULARY

ANATOMICAL LANGUAGE

Body Planes

Frontal (Coronal)

Transverse

Sagittal

Directional terms

Anterior (Ventral)

Posterior (Dorsal)

Proximal

Distal

Superior

Inferior

Lateral

Medial

Deep

Superficial

Parietal

Visceral

Abdominal regions

Right hypochondriac

Epigastric

Left hypochondriac

Right lumbar

Umbilical

Left lumbar

Right iliac

Hypogastric (Pelvic)

Left iliac

Anatomical regions

Cephalic

Ocular

Auricular (Otic)

Buccal

Nasal

Oral

Axillary

Cubital

Antecubital

Carpal (Carpus)

Palmar

Thoracic

Abdominal Umbilical

Lumbar

Inguinal

Pubic

Gluteal

Patellar

Popliteal

Crural

Sural

Tarsal (Tarsus)

Pedal

Planter

TISSUES

Basic tissue types

Epithelial

Connective

Muscle

Nervous

Epithelial Tissues

Classification of Epithelial tissue:

Based on arrangement of layers

Simple

Pseudostratified

Stratified

Based on cell shapes

Squamous

Cuboidal

Columnar

Based on function

Covering and lining

Glandular

- Endocrine glands
- Exocrine glands

Absorptive

Transitional epithelium

Connective tissues

Connective tissue cells:

Fibroblasts

Macrophages

Plasma cells

Mast cells

Adipocytes

Connective tissue fibers:

Collagen fibers

Elastic fibers

Reticular fibers

Extracellular matrix:

BONES AND BONE MARKINGS

Classification of the bones	**Axial skeleton skull**
Long bone	Frontal bone
Short bone	Parietal bone
Flat bone	Temporal bone
Irregular bone	
Sesamoid bone	
Bone histology and formation	Occipital bone
Intramembranous ossification	
Endochondral ossification	Foramen Magnum
Osteoprogenitor cells	Ethmoid bone
Osteoblasts	
Osteocytes	
Osteoclasts	
Spongy Bone	Sphenoid bone
Trabeculae	Sella turcica
Compact bone	Zygomatic bone
Osteon	Mandible
Lamellae	Maxilla
Lacunae	Palatine bone
	Nasal bone
Parts of the bone	Vomer
Epiphysis	Lacrimal bone
Metaphysis	Hyoid bone
Epiphyseal Line/ Plate	
Articular cartilage	
Periosteum	
Endosteum	
Medullary cavity (marrow cavity)	
Red bone marrow	
Yellow bone marrow	

Special features of the skull

Zygomatic arch

- Zygomatic process of temporal bone
- Temporal process of zygomatic bone

Sutures

- Coronal sutures
- Sagittal sutures

Vertebral column

Parts of the typical vertebra

Body of the vertebrae

Vertebral foramen

Lamina

Spinous process

Transverse process

Regions of the vertebral column

Cervical region (recognize atlas and axis vertebral)

Transverse foramen (in cervical vertebrae only)

Atlas (C1)

Axis (C2)

Dens of axis

Thoracic region

Lumbar region

Sacrum

Coccyx

Intervertebral foramen

Intervertebral disc

Thoracic Cage

Sternum

Ribs

Clavicle

Scapula

Acromion

Glenoid cavity

Coracoid process

Supraspinous fossa

Infraspinous fossa

Humerus

Head

Trochlea

Capitulum

Medial epicondyle

Lateral epicondyle

Coronoid fossa

Olecranon fossa

Ulna	**Femur**
Olecranon (Olecranon process)	Head of femur
Coronoid process	Neck of femur
Trochlear notch	Greater trochanter
Head	Lesser trochanter
	Lateral condyle
Radius	Medial condyle
Head	
Styloid process	**Patella**
Carpals	**Tibia**
Metacarpals	Medial malleolus
Phalanges	
	Fibula
Hip bones	Head
Ilium	Lateral malleolus
Ischium	**Tarsals**
	Metatarsals
Pubic arch	**Phalanges**
Pubic symphysis	
Acetabulum	**Blood Supply**
	Periosteal arteries/veins
	Nutrient artery/veins

SPINAL CORD AND PERIPHERAL NERVES

Coverings of the spinal cord

Vertebral column

Spinal meninges

- Dura mater
- Arachnoid mater
  - Subarachnoid space

Pia mater

Cerebrospinal fluid (CSF)

Epidural space

Spinal cord

Spinal cord segments

- Cervical segments
- Thoracic segment
- Lumbar segment:
- Sacral segment

Cervical enlargement

Lumbar enlargement

Conus medullaris

Filum terminale

Cauda equina

External anatomy of the spinal cord

Anterior (ventral) median fissure

Posterior (dorsal) median sulcus

Cross section of the spinal cord

Grey matter

Posterior (dorsal) gray horn

Anterior (ventral) gray horn

Lateral gray horn

White matter

Posterior (dorsal) white columns

Lateral white columns

Anterior (ventral) white columns

Central canal

Plexuses and peripheral nerves

Cervical plexus

- C1-C5
- Phrenic nerve

Brachial Plexus

- C5-C8, T1
- Median nerve
- Radial nerve
- Ulnar nerve

Lumbar plexus

- L1-L4

Sacral plexus

- L4-L5, S1-S4
- Sciatic nerve
- Tibial nerve
- Common fibular nerve

Dermatomes

Spinal nerves

Anterior (ventral) root

Posterior (dorsal) root

Posterior (dorsal) root ganglion

Spinal nerve

Rami communicantes

Number of spinal nerves

Cervical nerves (8)

Thoracic nerves (12)

Lumbar nerves (5)

Sacral nerves (5)

Coccygeal nerves (1)

BRAIN AND CRANIAL NERVES

Nervous system divisions

Central nervous system

Peripheral nervous system

Somatic nervous system

Autonomic nervous system

Sympathetic

Parasympathetic

Sensory = afferent

Motor = efferent

Grey matter

White matter

Gyrus pl. gyri

Central sulcus

Meninges

Dura mater

Falx cerebri

Arachnoid mater

Pia mater

Ventricles

Lateral ventricles (2)

Interventricular foramen

Third ventricle

Cerebral aqueduct (aqueduct of midbrain)

Fourth ventricle

Cerebrospinal fluid (CSF)

Choroid plexuses

Brain Anatomy

Cerebrum

- Frontal lobe
- Temporal lobe
- Parietal lobe
- Occipital lobe

Insula

Corpus callosum

Basal Nuclei

Limbic System

- Amygdala
- Hippocampus
- Cingulate gyrus

Cerebellum

Cerebellar hemispheres

Vermis

Folia

Arbor vitae

Diencephalon

Hypothalamus

Thalamus

Epithalamus

Pineal gland

- Pituitary gland

Infundibulum

Medial eminence

Brain stem

Medulla oblongata

Pons

Midbrain

- Cerebral peduncles
- Tectum
- Corpora quadrigemina
- Superior and inferior colliculi
- Reticular formation

Cerebral Cortex Organization

Primary sensory cortex – postcentral gyrus

Primary motor cortex – precentral gyrus

Primary visual cortex – occipital lobe

Primary auditory cortex – temporal lobe

Broca's speech area – for making speech

Wernicke's area – for understanding speech

Cranial Nerves and their function

I. Olfactory – sensory

II. Optic- sensory

III. Occulomotor- motor + parasympathetic

IV. Trochlear- motor

V. Trigeminal – motor + sensory, mostly sensory

VI. Abducens- motor

VII. Facial – motor + sensory + parasympathetic, mostly motor

VIII. Vestibulocochlear (acoustic)- sensory

IX. Glossopharyngeal- motor + sensory + parasympathetic

X. Vagus- motor + sensory + parasympathetic, mostly parasympathetic

XI. Spinal accessory – motor

XII. Hypoglossal- motor

SOMATIC NERVOUS SYSTEM

Sensation

Perception

Sensory modality

Medial-lateral rule

Somatic Sensory Pathways

First order neurons

Second order neurons

Third order neurons

Dorsal root ganglion

Posterior gray horns

Thalamus

Primary somatosensory area

Sensory homunculus

Conscious motor tracts

Corticospinal tract (pyramidal tract)

Lateral corticospinal tract

Anterior corticospinal tract

Corticobulbar tracts

Upper motor neurons

- Pyramidal cells in precentral gyrus (primary motor cortex)
- Pyramids of medulla

Decussation of pyramids (most fibers cross to the other side)

1st synapse in spinal cord at the level of exit

Lower motor neurons

Motor homunculus

Internal capsule

Subconscious motor tracts

Rubrospinal tract

Somatic motor pathways (to voluntary muscles)

2-neuron pathway

Sensory tracts

Posterior (dorsal) columns (fine touch and vibration)

First synapse in the medulla oblongata

Crosses to the other side in the medulla

Gracile fasciculus

Cuneate fasciculus

Spinothalamic tracts

First synapse in the spinal cord at the level of entry

Crosses to the other side at the level of entry

Lateral spinothalamic tract (pain and temperature)

Anterior spinothalamic tract (crude touch)

Spinocerebellar tracts (unconscious)

Posterior spinocerebellar tract

Anterior spinocerebellar tract

Tectospinal tract

Vestibulospinal tract

Reticulospinal tract

AUTONOMIC NERVOUS SYSTEM WORD LIST

Preganglionic neuron	**Sympathetic division**
Autonomic ganglion	Lateral horns T1 to L2
Postganglionic neuron	Sympathetic ganglia
Preganglionic vs postganglionic fibers	Sympathetic trunk
Dual innervation	Prevertebral ganglia
	Adrenal Medulla
Autonomic Plexuses	
Cardiac plexus	**Parasympathetic (cranio-sacral) division**
Celiac (solar) plexus	Vagus nerve
Superior mesenteric plexus	Sacral parasympathetic neurons
Inferior mesenteric plexus	Parasympathetic ganglia in the walls of the target organs
Renal plexus	
Hypogastric plexus	

SPECIAL SENSES

Eyeball

Anterior cavity (has 2 chambers)

Aqueous humor

Posterior cavity (not chamber! See powerpoint.)

Vitreous humor

Lens

Fibrous Tunic

Sclera

Cornea

Vascular Tunic

Iris

Pupil

Ciliary bodies

Choroid

Neural Tunic

Retina

Macula lutea

Fovea centralis

Optic disc (blind spot)

Layers of the retina from outside of the eyeball to the inside)

Photoreceptors: Rods and Cones

Bipolar cells

Ganglion cells

Axons form optic nerve (CN II)

Horizontal cells

Amacrine cells

Inner ear- bony labyrinth

Semicircular canals

Vestibule

Cochlea

Perilymph

Inner ear- membranous labyrinth

Semicircular canals

Ampulla

Cupula

Urticle

Saccule

Cochlea

Endolymph

Maculae

Otoliths

Muscles of the eye

Superior rectus

Inferior rectus

Lateral rectus

Medial rectus

Superior oblique

Inferior oblique

Palpabrae

Conjunctiva

Lacrimal glands

Ear

External (outer) ear

Middle ear

Inner ear

External ear

Auricle

External auditory (acoustic) meatus (canal)

Tympanic membrane

Ceruminous glands

Middle Ear

Auditory ossicles

Stapes

Incus

Malleus

Oval window

Auditory (Eustachian) tube

Olfaction

Olfactory epithelium

Olfactory receptor cells

Olfactory nerve CN I

Cribriform plate of the ethmoid bone

Olfactory foramina

Olfactory bulb

Olfactory tract

Taste

5 primary tastes: sour, sweet, bitter, salt, umami

Taste buds

Lingual papillae on the tongue, soft palate, pharynx, epiglottis

Filiform papillae

Fungiform papillae

Circumvallate papillae

Scala media	Innervated by
Scala tympani	CN VII
Organ of Corti	CN IX
	CN X

RESPIRATORY SYSTEM WORD LIST

Upper respiratory system

Nose

Root

Bridge

Apex

naris (narises)

Nasal Cavity

Nasal Conchae (superior, middle, inferior)

Nasal meatuses (superior, middle, inferior)

Pharynx

Nasopharynx

Oropharynx

Laryngopharynx

Pharyngeal tonsil (adenoid)

Lower respiratory system

Larynx

Epiglottis

Vocal cords

Glottis

Larynx cartilages

Thyroid cartilage

Cricoid cartilage

Cuneiform cartilage

Corniculate cartilage

Arytenoid cartilage

Coverings of lungs

Parietal pleura

Visceral pleura

Pleural cavity

Primary muscles of inhalation

Diaphragm

External intercostal muscles

Accessory Muscles of Inhalation

Scalenes

Sternocleidomastoid

Coverings of lungs

Parietal pleura

Visceral pleura

Pleural cavity

Trachea and bronchial tree

Tracheal cartilages

Carina

Primary (main) bronchi (L/R)

Secondary (lobar) bronchi

Tertiary (segmental) bronchi

Bronchioles

Terminal bronchioles

Respiratory bronchioles

Alveolar ducts

Alveolar sacs

Alveoli

Type I Alveolar Cells

Type II Alveolar Cells

Surfactant

Lung external features

Superior Lobe

Inferior Lobe

Middle Lobe

Cardiac Notch

Horizontal fissure

Oblique fissure

Apex of lung

Base of lung

Hilum

Muscles of Exhalation

Internal Intercostal Muscles

External oblique

Internal oblique

Transverse abdominis

Rectus abdominis

Blood Supply to respiratory system

**Note the difference between pulmonary circulation and systemic circulation **

Systemic circulation

Bronchial arteries

Bronchial veins

Pulmonary circulation

Pulmonary trunk

Pulmonary artery

Pulmonary veins

BLOOD COMPONENTS

Blood components
Blood plasma
Plasma proteins
- Albumins
- Globulins
- Fibrinogen

Serum
Formed elements
- Erythrocytes

Leukocytes
Platelets

Blood Cell Formation
Hemopoiesis (Hematopoiesis)
Red bone marrow
Pluripotent stem cells

Erythrocytes (Red blood cells)
Erythropoiesis
Reticulocytes
Hemoglobin
ABO blood group system
Rh blood group system

Thrombocytes (Platelets)
Thrombopoiesis
Myeloid stem cell
Megakaryocyte

Leukocytes (White blood cells)
Myeloid stem cell line
- Granular leukocytes
  - Neutrophils
  - Eosinophils
  - Basophils
- Agranular leukocytes
  - Monocytes
  - Macrophages

Lymphoid stem cell line
- Lymphocytes
  - T cells
  - B cells
  - Natural killer cells

BLOOD VESSELS

Blood circuits

Pulmonary circulation

Systemic circulation

Coronary circulation

Hepatic portal circulation

Anastomoses (collateral arteries)

Arterio-arterial (2 or more arteries supplying blood to the same capillary bed)

Arterial-venous (bypassing capillary beds)

Layers of blood vessel walls

Tunica interna (intima)

Tunica media

Tunica externa (adventitia)

Vasa vasorum

Types of blood vessels

Know difference between arteries and veins

Arteries

Elastic arteries (conducting arteries)

Muscular arteries (distributing arteries)

Arterioles (resistance vessels)

Capillaries

- Continuous capillaries
- Fenestrated capillaries
- Sinusoid capillaries

Veins

- Venules

Major blood vessels of pulmonary circulation

Pulmonary trunk

Pulmonary arteries

Pulmonary capillaries

Pulmonary veins

Major arteries of systemic circulation

Make note of the paired branches vs unpaired arteries and veins

Aorta

Ascending aorta

Arch of the Aorta

Descending aorta

Brachiocephalic trunk

Common carotid artery

Internal carotid artery

External carotid artery

Carotid sinus

Common iliac artery

Blood flow to the brain

Aorta

Right/left common carotid artery

Right/left internal carotid arteries

Vertebral arteries

Basilar artery

Circle of Willis (cerebral arterial circle)

Left/Right middle cerebral arteries

Left/Right ophthalmic arteries

Arteries of the upper limbs

Left/Right subclavian arteries (note the differences in their origins)

Left/Right axillary arteries

Left/Right brachial arteries

Left/Right radial arteries

Left/Right ulnar arteries

Arteries of abdominal cavity	**Veins of the upper limbs**
Celiac trunk	Left/Right radial vein
Superior mesenteric artery	Left/Right ulnar vein
Inferior mesenteric artery	Left/Right median cubital vein
	Left/Right brachial vein
Arteries of the lower limbs	Left/Right axillary vein
Left/Right common iliac arteries	Left/Right cephalic vein
Left/Right femoral arteries	Left/Right subclavian vein
Left/Right popliteal arteries	Left/Right brachiocephalic veins
Left/Right anterior tibial arteries	Superior vena cava
Left/Right posterior tibial arteries	
Left/Right fibular (peroneal) arteries	**Hepatic portal circulation**
	Hepatic artery
Veins	Portal vein
Superior vena cava	Hepatic veins
Inferior vena cava	**Veins of the lower limbs**
	Left/Right fibular (peroneal) veins
Veins of the neck and head	Left/Right posterior tibial veins
Left/Right internal jugular	Left/Right anterior tibial veins
Left/Right external jugular	Left/Right popliteal veins
Left/Right subclavian vein	Left/Right great saphenous veins
Left/Right brachiocephalic veins	Left/Right femoral veins
	Left/Right common iliac veins
	Inferior vena cava

HEART

Cardiac muscle histology

Cardiac myocytes

Striated

Mononucleated

Intercalated discs

External features of the heart

Base

Apex

Auricles

Coronary sulcus

Anterior interventricular sulcus

Posterior interventricular sulcus

Positioning of the heart

Mediastinum

Behind the sternum

Rotated to the left

*Make sure you know what parts of the heart form anterior, posterior, inferior, right and left surfaces

Layers of the heart wall

Pericardium

Visceral layer (a.k.a. epicardium)

Epicardium (same as visceral layer of pericardium)

Myocardium

Endocardium

Internal heart anatomy

Right/Left atria

Pectinate muscles

Interatrial septum

Foramen ovale

Right/Left ventricles

Interventricular septum

Fibrous skeleton

Heart valves and associated structures

Cusps (leaflets)

Right atrioventricular valve – tricuspid valve

Left atrioventricular valve – bicuspid (mitral valve)

Chordae tendineae

Papillary muscles

Pulmonary semilunar valve

Aortic semilunar valve

Cardiac conduction system

Sinoatrial (SA) node

Atrioventricular (AV) node

Atrioventricular bundle (bundle of His)

Left and right bundle branches

Purkinje fibers

Coronary Circulation

Left coronary artery

Anterior interventricular branch

Circumflex branch

Right coronary artery

Posterior interventricular branch

Marginal branch

Great cardiac vein

Middle cardiac vein

Small cardiac vein

Anterior cardiac veins

Coronary sinus

LYMPHATIC SYSTEM

Main Four Elements of the System	**Lymphatic organs**
Lymph	Red bone marrow
Lymphocytes	Thymus
Lymphatic vessels	Lymph nodes
Lymphatic organs and tissues	Afferent lymphatic vessels
	Efferent lymphatic vessels
Lymphatic vessels and circulation	Spleen
Lymphatic capillaries	White pulp
Lacteals	Red pulp
Lymphatic vessels (lymphatics)	
Lymph trunks	**Lymphatic tissues**
Intestinal trunk	Mucosa-associated lymphatic tissue (MALT)
Bronchomediastinal trunks	Aggregated lymphatic follicles (Peyer's Patches)
Subclavian trunks	Tonsils
Jugular trunks	Pharyngeal tonsil (adenoid)
	Palatine tonsils
Thoracic duct (left lymphatic duct)	Lingual tonsils
Right Lymphatic duct	

DIGESTIVE SYSTEM

Parts of the digestive tract (top-down)	**Layers of the GI tract (from deep to superficial)**
Oral cavity (mouth)	Mucosa (digestive epithelium)
Esophagus	Submucosa
Stomach	Muscularis
Duodenum	Serosa/adventitia
Liver	*Innervation of the gut *
Pancreas	Submucosal plexus (plexus of Meissner)
Gallbladder	Myenteric plexus (plexus of Auerbach)
Jejunum	
Ileum	**Peritoneum**
Colon	Parietal layer
Cecum	Visceral layer
Appendix	Peritoneal cavity
Ascending colon	Greater omentum
Transverse colon	Lesser omentum
Descending colon	Mesentery
Sigmoid colon	Intraperitoneal organs
Rectum	Retroperitoneal organs
Anal canal	
Anus	

Parts of digestive tract in detail	**Teeth (denten)**
Mouth	Crown
Buccal (oral) cavity	Neck
Lips (labia)	Root
Uvula	Enamel
Hard palate	Dentin
Soft palate	Pulp cavity
Palatoglossal arch Palatopharyngeal arch	Root canal
Tonsils	Apical foramen
Salivary Glands	Incisors
Parotid glands	Canines
Submandibular glands	Premolars (Bicuspids)
Sublingual glands	Molars (Tricuspids)
Saliva	
Tongue	**Pharynx**
Papillae	Deglutition (swallowing)
Fungiform papillae	**Esophagus**
Circumvallate (vallate) papillae	Lower esophageal sphincter (lower esophageal valve) (LES)
Filiform papillae	
Lingual frenulum	

Stomach	**Pancreas**
Rugae	Pancreatic duct
Lesser curvature	Hepatopancreatic ampulla (ampulla of Vater)
Greater curvature	Sphincter of Oddi
	Acini (exocrine cells)
Fundus	Pancreatic islets (islets of Langerhans) (endocrine cells)
Body	
Pylorus	**Liver**
Pyloric sphincter	Right lobe
	Left lobe
Mucosa of the stomach	Quadrate lobe
Gastric glands	Caudate lobe
Gastric pits	Hepatocytes
Parietal cells	
Chief cells	
G cells	

Bile ducts

Right and left hepatic duct

Common hepatic duct

Common bile duct

Portal triad of liver lobules

Hepatic artery

Hepatic portal vein

Central vein

Hepatic veins

Gallbladder

Cystic duct

Small intestine

Circular folds (plicae circulares)

Villi

Lacteals

Duodenum

Jejunum

Ileum

Ileocecal sphincter (ileocecal valve)

Large intestine

Teniae coli

Haustra

Appendix

Cecum

Ileocecal sphincter (Ileocecal valve)

Colon

Ascending colon

Transverse colon

Descending colon

Sigmoid colon

Rectum

Anal canal

Anus

Blood supply of GI Tract

Sinusoid capillaries

URINARY

Kidneys	**Filtrate pathway (Nephron)**
Ureters	Cortical nephron
Urinary bladder	Juxtamedullary nephron
Urethra	Renal corpuscle
Kidney	
Fibrous capsule	
Perinephric fat	Afferent arteriole
Renal fascia	Efferent arteriole
Renal cortex	Proximal convoluted tubule
Renal medulla	Nephron loop (Loop of Henle)
Renal pyramids	
Renal papilla	
Renal columns	Distal convoluted tubule
Renal sinus	Collecting duct
Minor calyx	Papillary duct
Major calyx	
Renal pelvis	
Renal hilum	
Renal artery	
Renal vein	

Urinary bladder

Detrusor muscle

Trigone

Internal urethral sphincter

External urethral sphincter

Blood flow through kidney

Renal artery

Segmental arteries

Interlobar arteries

Arcuate arteries

Cortical radiate arteries

Afferent arterioles

Glomerular capillaries

Efferent arteriole

Peritubular/vasa recta capillaries

Interlobular veins

Arcuate veins

Interlobar veins

Renal vein

Inferior vena cava

MUSCULAR SYSTEM

Muscle cell (Myofibers)	**Muscles of the head and neck**
Sarcolemma	Mouth movement:
Sarcoplasm	Orbicularis oris
Sarcoplasmic reticulum	Zygomaticus major and minor
	Risorius
Connective tissues of the muscle	Mentalis
Endomysium	Depressor labii inferioris
Perimysium	Depressor anguli oris
Epimysium	Levator anguli oris
Muscle fascicles	Buccinator
Tendons	Depressor labii superioris
Aponeuroses	
	Eye movement:
Organization of fascicles	Corrugator supercilii
Parallel muscle fibers	Levator palpebrae superioris
Triangular muscle fibers	Orbicularis oculi
Pennate muscle fibers	
Unipennate muscle fibers	
Bipennate muscle fibers	
Multipennate muscle fibers	
Circular muscle fibers	

Muscles of the eyes and their action
Superior rectus- moves eyeballs superiorly (elevation) and medially (adduction), and rotates them medially (intorsion)
Superior oblique- moves eyeballs inferiorly (depression) and laterally (abduction), and rotates them medially (intorsion)
Levator palpebrae superioris- elevates upper eyelids (opens eyes)
Inferior oblique- moves eyeballs superiorly (elevation) and laterally (abduction) and rotates them laterally (extorsion)
Inferior rectus- moves eyeballs inferiorly (depression) and medially (adduction), and rotates them laterally (extorsion)
Lateral rectus- moves eyeballs laterally (abduction)
Medial rectus- moves eyeballs medially (adduction)

Muscles of respiration

External intercostals

Diaphragm

Scalenes*

Sternocleidomastoid*

Internal intercostals

Rectus abdominis

Internal oblique

External oblique

Transverse abdominis

Biceps Brachii (long and short head)

Triceps Brachii (medial, lateral, and long head)

Brachialis

Brachioradialis

Rotator Cuff Muscle (SITS)

Supraspinatus*

Infraspinatus*

Teres minor*

Subscapularis*

Teres major*

Coracobrachialis

Muscles of upper limb

Deltoid

JOINTS AND ARTICULATIONS

Joints (Arthroses)

Fibrous joints

Sutures

Syndesmoses

Gomphosis

Interosseous membranes

Cartilaginous joints

Synchondroses

Symphyses

Pubic symphysis

Epiphyseal cartilages

Synovial joints

Synovial cavity

Synovial membrane

Synovial fluid

Articular cartilage

Articular capsule (joint capsule)

Accessory structures

- Ligaments
- Tendons
- Bursae

Tendon sheaths

- Menisci

Classification of joints based on range of motion

Synarthrosis

Amphiarthrosis

Diarthroses

Classification based on mechanics of movement

Plane joints

Hinge joints

Pivot joints

Intervertebral articulations and ligaments

Intervertebral discs

Nucleus pulposus

Anulus fibrosus

Supraspinous ligament

Interspinous ligament

Anterior longitudinal ligament

Posterior longitudinal ligament

INTEGUMENTARY SYSTEM

Skin (Cutaneous membrane)
Epidermis
Dermis
Hypodermis- Subcutaneous (subQ) layer
Thin (hairy) skin
Thick (hairless) skin

Pigmentation of skin
Melanin
- Eumelanin
- Pheomelanin

Layers of epidermis
Stratum basale (germinativum)
Epidermal ridges
Stratum germinativum
Stratum spinosum
Stratum granulosum
Stratum lucidum
Stratum corneum

Cells of epidermis
Keratinocytes
Melanocytes
Intraepidermal macrophages (Langerhans cells)
Tactile epithelial cells (Merkel cells)

Dermis
Papillary region
Areolar tissue
Dermal papillae
Reticular region
Tension lines (lines of cleavage)

Accessory structures of the skin

Hairs
Shaft
Hair follicle
Hair matrix
Papilla of the hair
Bulb
Hair root plexus
Arrector pili muscle

Skin Glands
Sebaceous (oil) glands
Sebum
Sudoriferous (sweat) glands
Eccrine (merocrine) sweat glands
Apocrine sweat glands
Ceruminous glands
Cerumen

Nails
Nail body (plate)
Free edge
Nail root
Lunula
Hyponychium
Nail bed
Eponychium (cuticle)
Nail matrix

ENDOCRINE SYSTEM

Hypothalamus
"short" vs "long" axons
Supraoptic nucleus
Paraventricular nucleus

Pituitary gland *(Hypophysis)*
Sella turcica of sphenoid bone
Infundibulum
Medial eminence
Anterior pituitary (Adenohypophysis)
Posterior Pituitary (Neurohypophysis)
Pituicytes
Herring's bodies

Blood supply
Hypophyseal portal circulation
Superior hypophyseal artery
Fenestrated capillaries
Hypophyseal veins
Inferior hypophyseal artery

Thyroid Gland
Left and right lateral lobes
Isthmus
Follicles
Follicular cells – cuboidal epithelium
Thyroglobulin
Parafollicular cells

Parathyroid Glands
Chief cells- PTH
Oxyphils

Adrenal (Suprarenal) Glands
Adrenal cortex

Zona reticularis- gonadal steroids
Adrenal medulla
Chromaffin cells- epinephrine

Pancreas
Islets of Langerhans (pancreatic islets)
- Alpha cells- glucagon
- Beta cells- insulin
- Delta cells- somatostatin
- F cells- pancreatic peptide (PP)

Acinar cells, acini (exocrine)

Pineal Gland
Pinealocytes- melatonin
Calcifications

Other endocrine organs
Thymus
Skin
Vitamin D
Kidneys
Calcitriol
Testes
Interstitial cells- testosterone

Ovaries
Follicular cells– estrogens

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