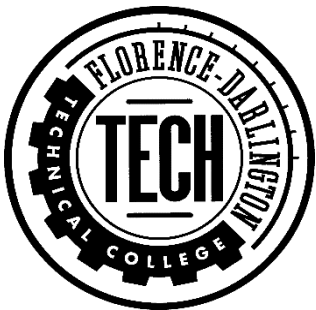
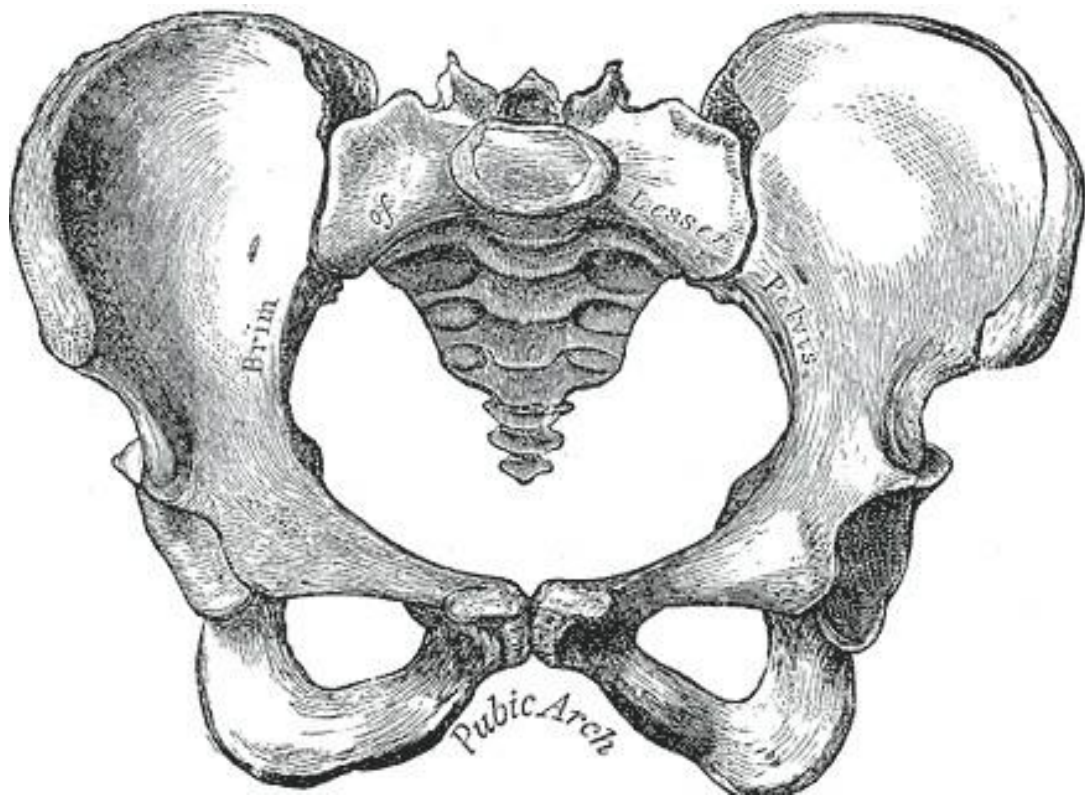


# Biology 210

## Human Anatomy & Physiology I

### Laboratory Coursepack

Last Updated August 2020  
Fall Semester 2020



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Natural Sciences Department  
Florence Darlington Technical College  
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## **Anatomy and Physiology Laboratory Safety Procedures and Protocol**

All students must read and understand the information in this document with regard to laboratory safety and emergency procedures prior to the first laboratory session. ***Your personal laboratory safety depends mostly on YOU.*** Effort has been made to address situations that may pose a hazard in the lab but the information and instructions provided cannot be considered all-inclusive. Students **must** adhere to written and verbal safety instructions throughout the academic term. Since additional instructions may be given at the beginning of laboratory sessions, ***it is important that all students arrive at each session on time.***

With good judgment, the chance of an accident in this course is very small. Nevertheless, research and teaching workplaces (labs, shops, etc.) are full of potential hazards that can cause serious injury and or damage to the equipment. Working alone and unsupervised in laboratories is forbidden if you are working with hazardous substances or equipment. With prior approval, at least two people should be present so that one can shut down equipment and call for help in the event of an emergency.

Safety training and/or information should be provided by a faculty member, teaching assistant, lab safety contact, or staff member at the beginning of a new assignment or when a new hazard is introduced into the workplace.

### **Common Sense**

Good common sense is needed for safety in a laboratory. It is expected that each student will work in a responsible manner and exercise good judgment and common sense. If at any time you are not sure how to handle a particular situation, ask your Instructor for advice.

Horseplay of any kind is ***not*** allowed in the laboratory and is cause for dismissal.

Following instructions is a ***major*** portion of lab. It is important that you listen, write down and follow directions every time. Failure to pay attention can result in improper lab technique and can compromise safety.

### **Emergency Response**

1. It is your responsibility to read safety and fire alarm posters and follow the instructions during an emergency.
2. Know the location of the fire extinguisher, eyewash, and safety shower in your lab and know how to use them.
3. Notify your instructor immediately after any injury, fire or explosion, or spill.
4. Know the building evacuation procedures.
5. First aid kits are available in every lab. Make sure that you know where they are in case of an emergency.
6. Call 911 and Security in case of an emergency. **Main Campus: (843)-661-8210**

# **Anatomy and Physiology Laboratory Safety Procedures and Protocol**

## **Personal and General Laboratory Safety**

1. **Never eat, drink, or vape while working in the laboratory.**
2. Do not use any equipment unless you are trained and approved as a user by your supervisor.
3. Clothing: Laboratory coats are required when working with biological/chemical materials. Safety glasses and gloves may be required on occasion. Your instructor should inform you of necessary PPE for the experiment.
4. If you have long hair or loose clothes, make sure it is tied back or confined.
5. Keep the work area clear of all materials except those needed for your work. Extra books, purses, etc. should be kept away from the work space.
6. Clean up your work area before leaving.
7. Wash hands before leaving the lab and before eating.

## **Additional Safety Guidelines**

- Keep your lab space clean and organized.
- Clean your lab bench and equipment, and push your chair under your desk before you leave. The lab should look just as good (or better) than when you entered.

*Approved March 2016 by Natural Sciences Department, Human Resources,*



## BIOLOGY 210 LAB SYLLABUS NATURAL SCIENCES DEPARTMENT FLORENCE DARLINGTON TECHNICAL COLLEGE

Course Information	
<b>Instructor's Name Contact Information</b>	
<b>Required Lab Materials</b>	1. Lab manual (Print from Desire2Learn). 2. Cell phones and smartwatches cannot be used as a source of the lab manual during lab sessions, laptops/tablets are allowed.
Course Policies	
<b>Attendance Policy for Face-to-Face Labs</b>	<p>According to the FDTC student handbook, it is the responsibility of the student to attend all scheduled classes and observe all participation requirements in each of the courses in which he/she is enrolled. If a student is absent or fails to participate in more than 10% of the total hours that a course usually meets in a semester, the student will be subject to a failing grade or withdrawal by the instructor. It is the student's responsibility to initiate a withdrawal if he/she is unable to complete course requirements. Exceptions to this policy can be made only by the appropriate Associate Vice President.</p> <p>Please note the particulars for this course:</p> <ul style="list-style-type: none"> <li>• <b>Tardies</b> (up to 15 minutes late) count as ½ of an absence. If you arrive late on days in which quizzes or tests are administered, <u>you will not receive additional time to complete the assessment</u>. If you arrive after the quiz/test has been collected, you will not be offered an opportunity to take the quiz/test. Instead, a grade of zero (0) will be recorded. If you are 15 minutes late or more, you may be counted absent for the entire lecture period.</li> <li>• <b>Leaving early</b> (up to 15 minutes early): You will be docked for a partial or whole absence. Lab instructors hold lab periods for the scheduled times.</li> </ul>
<b>Attendance Policy for Online Labs</b>	<p>Completion of assignments and assessments will be used to gauge your attendance online. If you fail to complete assignments or assessments for a period of two weeks or longer, you will be withdrawn from this course.</p> <ul style="list-style-type: none"> <li>• If your last date of participation is before the withdrawal deadline, you will be assigned a W for this course.</li> <li>• If your date of participating is after the withdrawal deadline, you'll be assigned an F for this course.</li> </ul>
<b>Academic Dishonesty Policy</b>	<p>According to the FDTC student handbook, all forms of academic dishonesty including, but not limited to, cheating on tests, plagiarism, collusion, and falsification of information will be subject to disciplinary action. Cheating is defined to include, but is not limited to the following:</p> <ul style="list-style-type: none"> <li>• Copying another student's work or test.</li> <li>• Using unauthorized materials during a test.</li> <li>• Collaborating with another during a test or on assignments.</li> <li>• Knowingly obtaining, using, buying selling, transporting, or soliciting in whole or in part contents of a test or other work.</li> <li>• Bribing another person to obtain tests or information about tests.</li> <li>• Substituting for another student or permitting another to substitute for oneself.</li> </ul> <p>Any proven cases of academic dishonesty will result in an "F" for the assigned work or test and may result in administrative withdrawal from the course, with a grade of "F" assigned after a disciplinary hearing. Additional sanctions, including disciplinary probation or suspension, appropriate to the incidents may be imposed pursuant to the Student Code and Grievance Procedures.</p> <p><b>Please note:</b> phones shall not be visible or heard at any time during assessments. Please store your phone, turned off, during quizzes and exams. Please take care of your personal needs prior to the start of the exam. Bathroom breaks will not be permitted during assessments. If you leave the room, you must forfeit your quiz/exam and will not be offered an opportunity to complete it upon re-entry.</p>

## BIOLOGY 210 LAB SYLLABUS

<b>Grading Scale</b>	
<b>A</b> <b>90 – 100</b> <b>B</b> <b>80 – 89</b> <b>C</b> <b>70 – 79</b> <b>D</b> 60 – 69 <b>F</b> 59 and below	1. A “passing” average in this course is 70 (C) or higher. 2. To continue on for enrollment in BIO 211, the end of course average in BIO 210 must be 70 (C) average or higher. 3. The BIO 210 lab grade counts 25% toward your overall BIO 210 grade.
<b>How to Calculate Your Grade</b>	
Lab exam 1 – 5 = 80% total; Quiz average = 20%	
<b>Exam and Quiz Information</b>	
<b>Lab Exams and Makeup Policy</b>	<p>Lab exams may involve identification of structures on specimens, microscopes, powerpoint slides, or models. Exams are entirely fill in the blank; no multiple choice questions. The exams are one hour and 15 minutes long during which time you may visit lab stations to answer questions. One person per station. Spelling counts on all exams and misspellings will be penalized.</p> <p><b>DROPPED EXAM AND EXAM MAKE-UP POLICY</b></p> <ul style="list-style-type: none"> <li>• <b>NO makeup lab exams will be provided!</b></li> <li>• A total of five lab exams will be given with the option to take a lab final exam.</li> <li>• In face-to-face labs, students will not be allowed to take a lab exam during another lab period if they miss an exam during their scheduled lab period. In other words, students may not attend a section for a lab exam other than the regularly scheduled lab time period.</li> <li>• An optional lab final exam will be administered at the end of the semester. This cumulative lab exam is multiple choice format (100 questions) and provided on D2L only. If you have been caught cheating on an exam, the lab final exam will <i>not</i> count in the place of an assigned zero.</li> <li>• If a student misses any regularly scheduled lab exam, <b><u>regardless of the reason</u></b>, the student must take this lab final exam to eliminate a zero for the missed exam (except for cases of cheating in which a zero is assigned).</li> <li>• Students who miss one lab exam will use the score from the lab final exam to automatically replace the missed grade. However, students who miss a second lab exam will receive a zero for that exam as the lab final exam will not count for two missed lab exam scores.</li> <li>• Those students who wish to take the lab final exam to improve upon a poor lab test grade may do so (provided all five lab exams have been taken). The lab final exam will replace one lowest lab exam score for those who do attempt the lab final exam. Students who are satisfied with their five lab exam scores may opt to exempt the lab final exam.</li> </ul>
<b>Quiz &amp; Drop Box information</b>	<p>Lab Instructor will provide specific information regarding quiz frequency, specific format, when they will open and close in D2L.</p> <ul style="list-style-type: none"> <li>• One lowest quiz will be dropped. The remaining quizzes will be averaged as a lab exam grade.</li> <li>• <b>No make-up quizzes are provided, <u>regardless of reason</u></b></li> </ul> <p><b>Quiz Format:</b> Quizzes may be fill-in-the-blank, short answer, and may require identification. Spelling counts unless otherwise noted. Prior lab material will also be tested on the quiz. For online labs, quizzes may be multiple choice and include images.</p>

## LAB 1: INTRODUCTION TO THE HUMAN BODY

### ***LAB OBJECTIVES***

*By the end of today's lab, you should be able to:*

- Describe anatomical position.
- Define directional terms.
- Define body regional terms.
- Utilize directional and regional terms in sentences.
- Identify the body regional terms (chart 1) on a picture or a mannequin.
- List the body planes or sections.
- Identify the body planes or sections on a picture.
- Identify body cavities on a picture or model.
- List the organs found in various body cavities.
- Explain the organization of the body's cavities.
- Name serous membranes using a model or picture
- Define homeostasis.
- Explain and provide examples for the two feedback mechanisms the body employs to maintain homeostasis.

### ***MATERIALS NEEDED***

- Torso models
- Mannequin

### ***USEFUL HINTS***

- On the lab exam, identify body regions on anatomical models using proper terminology. *Brachial* is correct while *arm* is incorrect. See Activity 2: Anatomical Landmarks
- Body regions don't mean naming the muscles in a given region. Example: a tag on the buttocks would be labeled "gluteal," not gluteus maximus.

# LAB 1: INTRODUCTION TO THE HUMAN BODY

## ACTIVITY: THE BASICS OF ANATOMY AND PHYSIOLOGY

Define anatomy. \_\_\_\_\_

Define physiology. \_\_\_\_\_

Describe the level of organization in the human body. \_\_\_\_\_

\_\_\_\_\_

Describe anatomical position:

1. \_\_\_\_\_

2. \_\_\_\_\_

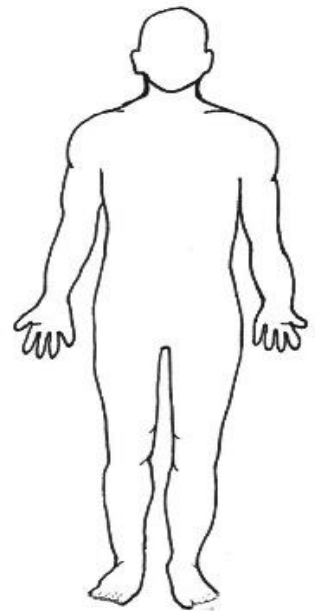
3. \_\_\_\_\_

Why is it used? \_\_\_\_\_

### Directional Terms

*Notice how each term is paired with a term of opposite meaning.*

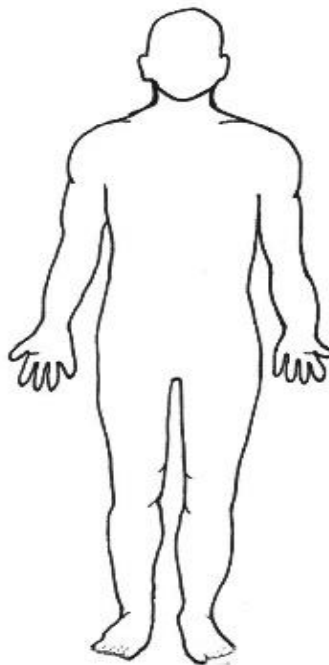
- **Superior** means toward the head
- **Inferior** means away from the head
- **Anterior** (or **ventral**) means toward the face, front, or belly side of the body.
- **Posterior** (or **dorsal**) means away from the face; toward the backside.
- **Medial** means toward the midline of the body.
- **Lateral** means away from the midline of the body.
- **Distal** means farther from the point of attachment of a limb.
- **Proximal** means closer to the point of attachment of a limb.
- **Deep** means toward the organs; farther from the surface.
- **Superficial** means toward the surface of the body or structure (like the skin).



**LAB 1: INTRODUCTION TO THE HUMAN BODY**  
**ACTIVITY: THE BASICS OF ANATOMY AND PHYSIOLOGY WORKSHEET**

*Fill in the blank with an appropriate directional term; in some cases there may be more than one correct answer.*

1. My wrist is \_\_\_\_\_ to my elbow.
2. My shoulder is \_\_\_\_\_ to my elbow.
3. The navel is \_\_\_\_\_ to the spine.
4. The breast bone is \_\_\_\_\_ to the shoulder socket.
5. The skin is \_\_\_\_\_ to the heart and lungs.
6. The head is \_\_\_\_\_ to the neck.
7. The mouth is \_\_\_\_\_ to the nose.
8. The spine is \_\_\_\_\_ to the breast bone.
9. The lungs are \_\_\_\_\_ to the ribcage.
10. The fingers are \_\_\_\_\_ to the wrist.
11. The eyes are \_\_\_\_\_ to the nose.
12. The ears are \_\_\_\_\_ to the mouth.
13. The ankle is \_\_\_\_\_ to the knee.
14. The waist is \_\_\_\_\_ to the neck.
15. The heart is \_\_\_\_\_ to the ribcage.



**LAB 1: INTRODUCTION TO THE HUMAN BODY**  
**ACTIVITY: ANATOMICAL REGIONAL TERMS**

**Body Regional Terms**

*Practice learning this list using the pictures on the next page and on your laboratory models.*

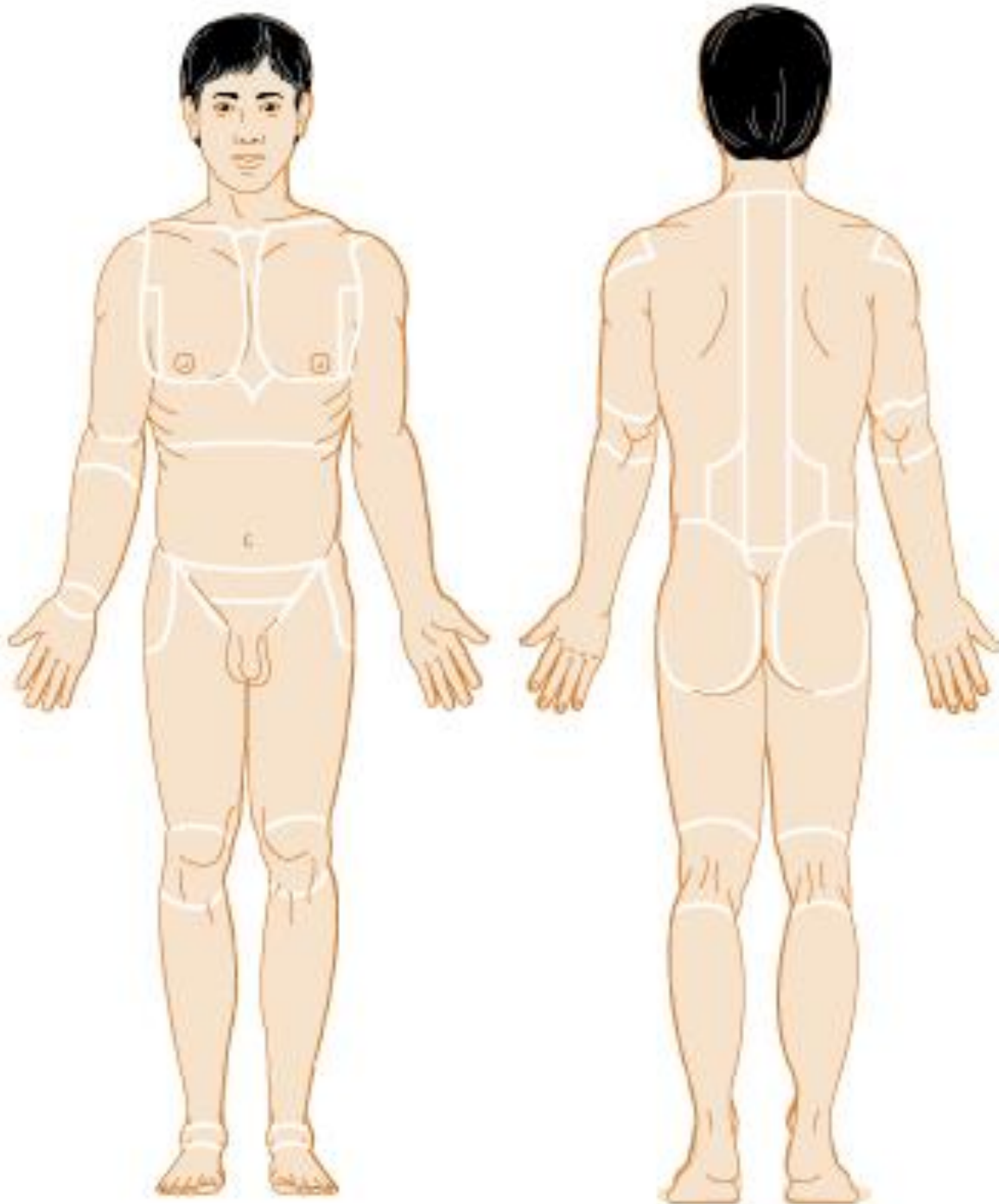
**Chart 1**

<i>Head and Neck</i>	<i>Trunk</i>	<i>Upper Limbs</i>	<i>Lower Limbs</i>
Cranial	Thoracic	Acromial	Gluteal
Frontal	Dorsal	Axillary	Femoral
Occipital	Vertebral	Brachial	Patellar
Ocular	Lumbar	Antecubital	Popliteal
Otic	Sacral	Olecranon	Tarsal
Nasal	Abdominal	Antebrachial	Pedal
Buccal	Pelvic	Carpal	Metatarsal
Oral	Inguinal	Manual	Digital
Mental	Pubic	Palmer	Plantar
Cervical		Metacarpal	
		Digital	

On the lab exam, models of the human body will be “tagged” and you must utilize these words to properly identify the region tagged. Please do not use the words in italics, as they are merely headers.

**LAB 1: INTRODUCTION TO THE HUMAN BODY**  
**ACTIVITY: ANATOMICAL REGIONAL TERMS**

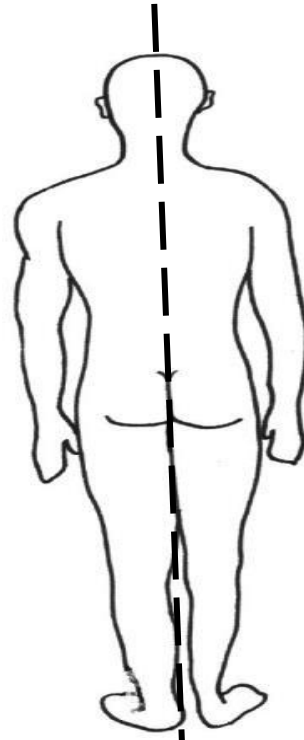
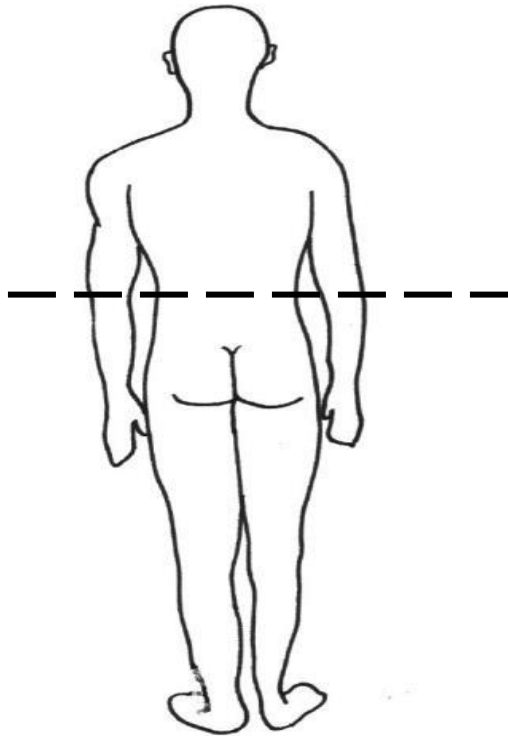
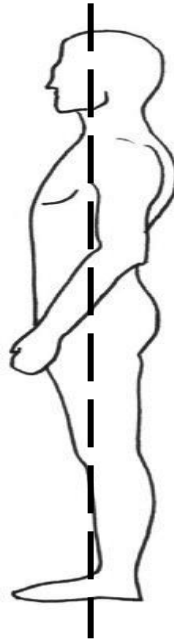
*Learn the anatomical regional terms on the previous page. Use the pictures as practice*



**LAB 1: INTRODUCTION TO THE HUMAN BODY**  
**ACTIVITY: PLANES AND SECTIONS & BODY CAVITIES**

- \_\_\_\_\_ 1. This type of body plane/section divides the body into left and right portions.
- \_\_\_\_\_ 2. This type of body plane/section divides the body into **equal** left & right halves.
- \_\_\_\_\_ 3. This type of body plane/section divides the body into superior & inferior portions.
- \_\_\_\_\_ 4. Divides the body into anterior and posterior portions.

*Label the following planes/sections on the person, below.*



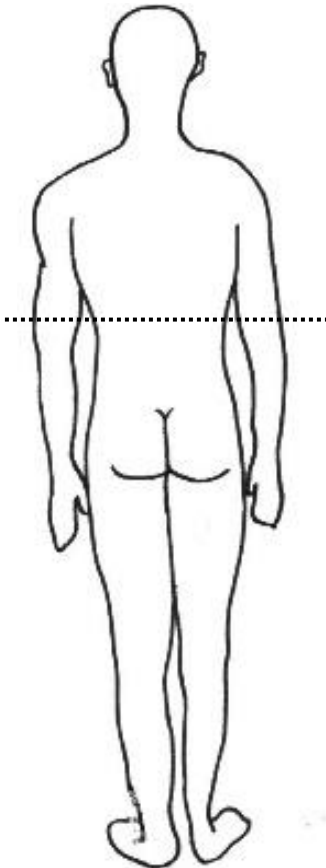
## LAB 1: INTRODUCTION TO THE HUMAN BODY

### ACTIVITY: PLANES AND SECTIONS WORKSHEET

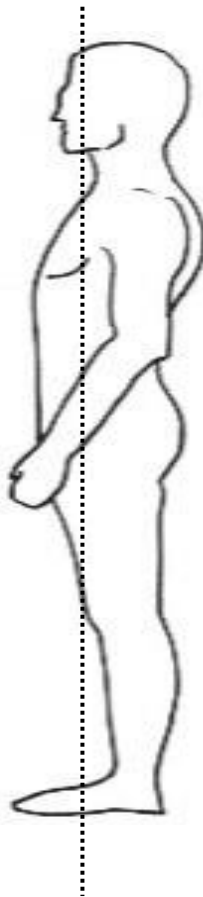
*Fill in the blank with an appropriate term. In some cases there may be more than one correct answer.*

1. To scan an image of the brain from the anterior to the posterior side, you would follow along a \_\_\_\_\_ plane.
2. To make an incision that transversely divides one vertebra from the next, you must be making a division between \_\_\_\_\_ and \_\_\_\_\_ portions.
3. Ron has diabetes and had his left leg amputated below the knee. The surgeons made a \_\_\_\_\_ section to remove the inferior portion of his leg.
4. “To cut your nose off in spite of your face” is an expression that means the nose would be removed along the \_\_\_\_\_ plane.
5. Van Gogh was an artist who removed his ear; he must have made a \_\_\_\_\_ section to remove it from the rest of his head.
6. The diaphragm rests beneath the lungs, making a \_\_\_\_\_ plane between thoracic and abdominopelvic cavities on the ventral side of the body.
7. Identify the plane or section each dotted line creates on each figure, below.

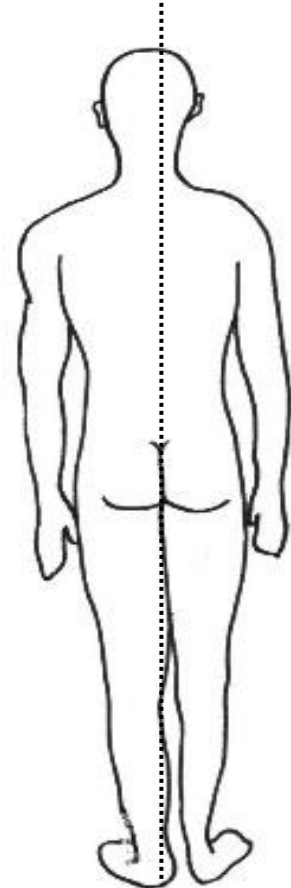
**A**



**B**



**C**



## LAB 1: INTRODUCTION TO THE HUMAN BODY ACTIVITY: PLANES AND SECTIONS & BODY CAVITIES

1. **Ventral Body Cavity** is found on the anterior side of the body. It contains two cavities:

a. **Thoracic Cavity:** contains the \_\_\_\_\_ organs and is formed by the ribcage. The \_\_\_\_\_ your breathing muscle, separates the thoracic from the abdominopelvic cavities. The middle area of the thoracic cavity where the heart is housed, esophagus and trachea are found is called the \_\_\_\_\_. The lungs are housed in \_\_\_\_\_ cavities while the heart is housed in a pericardial cavity; the pleural cavities are separated by the mediastinum.

b. **Abdominopelvic Cavity:** houses many organs. There aren't any bones protecting this area (except for the little protection from the pelvic bones). The \_\_\_\_\_ cavity contains the gastrointestinal (GI) systems while the \_\_\_\_\_ cavity contains the bladder, reproductive organs and some GI organs.

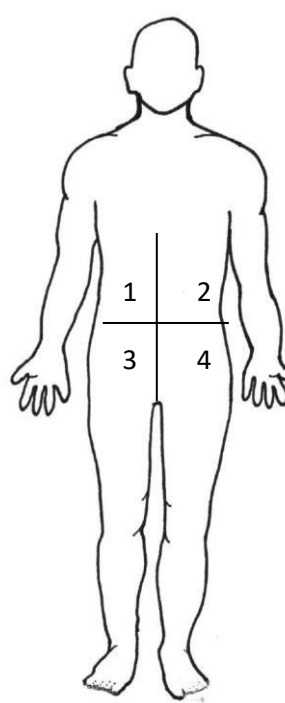
Use the torso models to locate the organs in this cavity.

The abdominopelvic cavity has 4 quadrants:

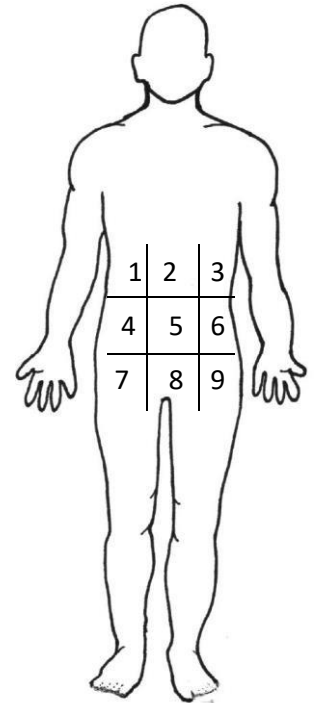
1. \_\_\_\_\_
2. \_\_\_\_\_
3. \_\_\_\_\_
4. \_\_\_\_\_

The abdominopelvic cavity has 9 regions:

1. \_\_\_\_\_
2. \_\_\_\_\_
3. \_\_\_\_\_
4. \_\_\_\_\_
5. \_\_\_\_\_
6. \_\_\_\_\_
7. \_\_\_\_\_
8. \_\_\_\_\_
9. \_\_\_\_\_



*Quadrants*



*Regions*

2. Two cavities are found in the dorsal region:

a. **Cranial Cavity:** which houses the \_\_\_\_\_. The skull forms the protection around this organ.

b. **Spinal or Vertebral Cavity:** which houses the \_\_\_\_\_. The vertebrae protect this organ.

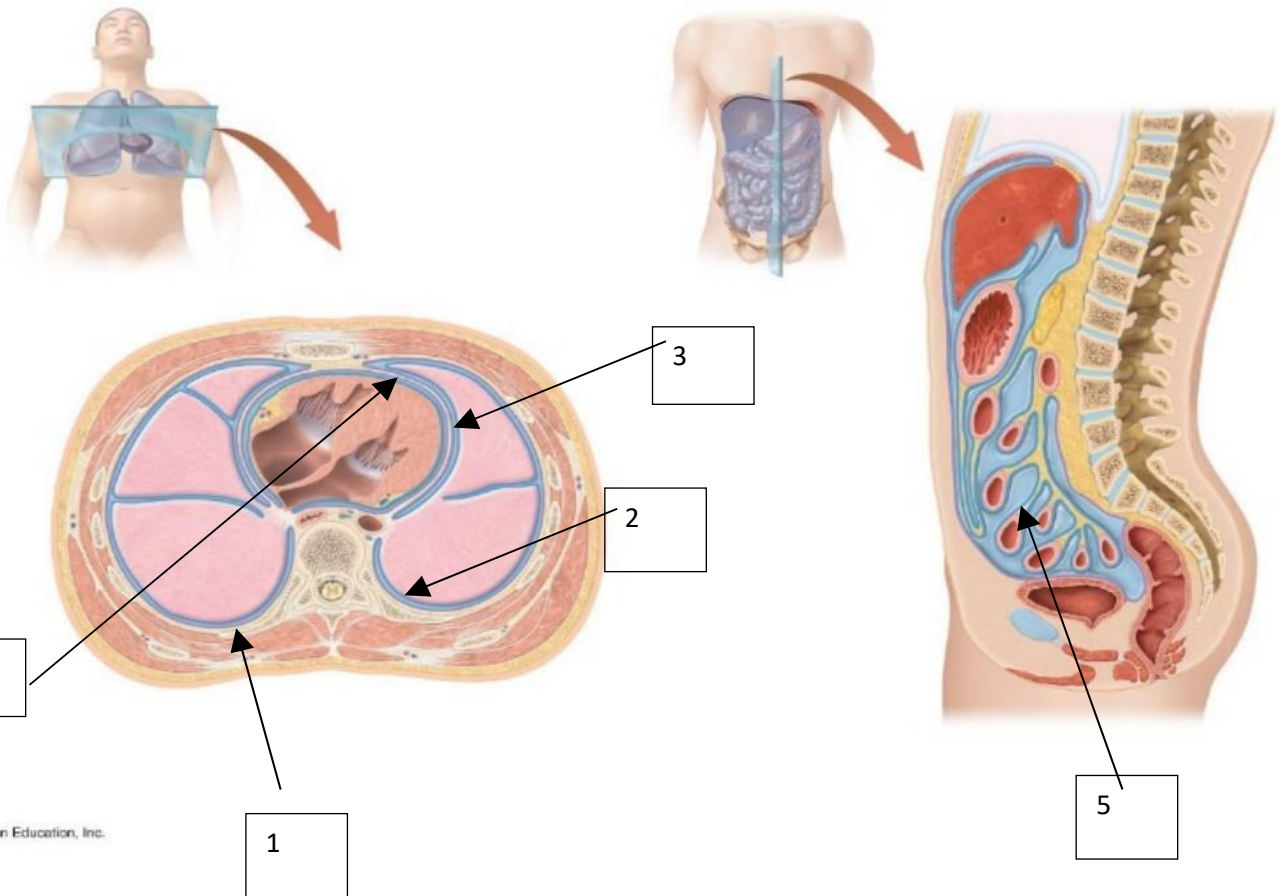
## LAB 1: INTRODUCTION TO THE HUMAN BODY ACTIVITY: BODY CAVITY WORKSHEET

*Complete these sentences with an appropriate directional term, organ, or cavity name.*

1. The umbilical region is \_\_\_\_\_ to the epigastric region.
2. The left hypochondriac region is \_\_\_\_\_ to the epigastric region.
3. The hypogastric region is \_\_\_\_\_ to the epigastric region.
4. The right iliac region is \_\_\_\_\_ to the right hypochondriac region.
5. The thoracic cavity contains these organs: \_\_\_\_\_
6. The diaphragm separates the \_\_\_\_\_ cavity from the \_\_\_\_\_ cavity.
7. The liver, stomach, pancreas, and intestines are in the \_\_\_\_\_ cavity of the \_\_\_\_\_ body cavity.

Correctly name the serous membrane:

- 1: \_\_\_\_\_
- 2: \_\_\_\_\_
- 3: \_\_\_\_\_
- 4: \_\_\_\_\_
- 5: \_\_\_\_\_



## LAB 1: INTRODUCTION TO THE HUMAN BODY

### ACTIVITY: HOMEOSTASIS

**Homeostasis** (“*same, standing still*”) is defined as the maintenance of a constant internal environment within the body; it’s a dynamic equilibrium or an attempt to maintain a balance. To maintain proper homeostasis we need:

- nutrients
- oxygen
- water
- body temperature of 98.6 ° F

**Define Negative Feedback Loop: Output** inhibits/stops/cancels **input**. The release of a product inhibits any further production to reach homeostasis. In other words, the role of the effector in negative feedback is to **cancel** the original stimulus (shut off the system).

#### Negative Feedback Mechanism

- **stimulus** (= input) can be either internal or external
- **sensory receptor** carries the message to the brain or spinal cord
- **regulatory center** (= brain) interprets the information and turns on an effector
- **motor output** (=motor neuron) sends signal to effector
- **effector** (= output) glands or organs bring about a response that cancels the original stimulus:

**Describe an example of a Negative Feedback Loop:**

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#### Other Examples:

- most hormones
- maintenance of body temperature, blood pressure

**Define Positive Feedback Loop: Output** enhances/increases/promotes **input**. The effects trigger more change until homeostasis is reached. The response intensifies or enhances the original stimulus; the feedback is “positive” since you get the same action as the original stimulus. Positive feedback does not attempt to restore homeostasis within a narrow range of values, as does negative feedback. Instead, the effector **enhances** the stimulus, not cancels it as in negative feedback, to restore homeostasis.

**Describe an example of a Positive Feedback Loop:**

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---



---

#### Other Examples:

- blood clotting using platelets
- chronic heart failure (CHF)
- oxytocin and labor/delivery

# LAB 1: INTRODUCTION TO THE HUMAN BODY

## ACTIVITY: HOMEOSTASIS WORKSHEET

### Exercises:

1. Describe how scratching an itch is an example of negative feedback using the mechanism provided on the previous page.

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2. Compare the role of the effector in the positive feedback mechanism to the negative feedback mechanism.

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3. Do you think the defecation reflex uses a type of *positive* or *negative* feedback mechanism? Explain to support your answer choice.

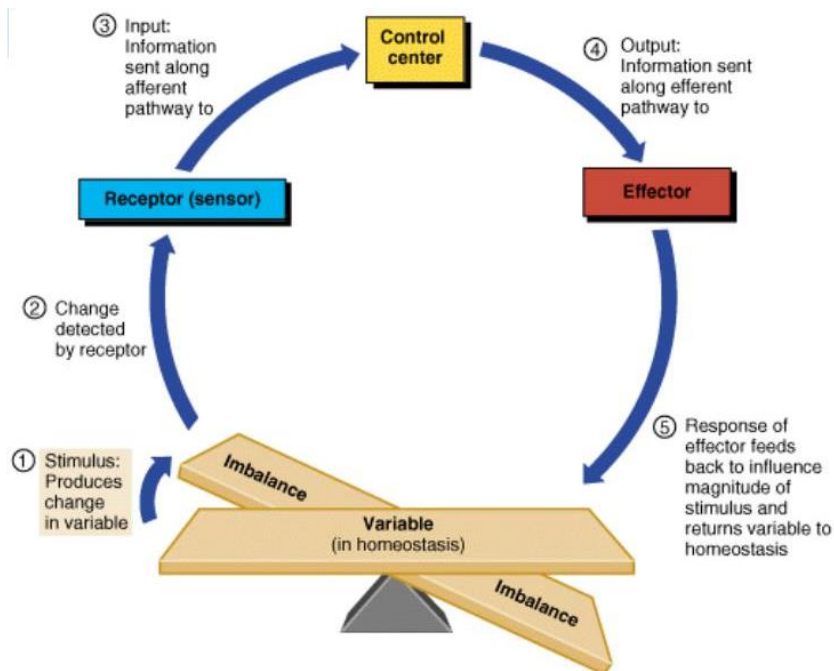
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## LAB 2: MICROSCOPY

### ***LAB OBJECTIVES***

*By the end of the lab, you should be able:*

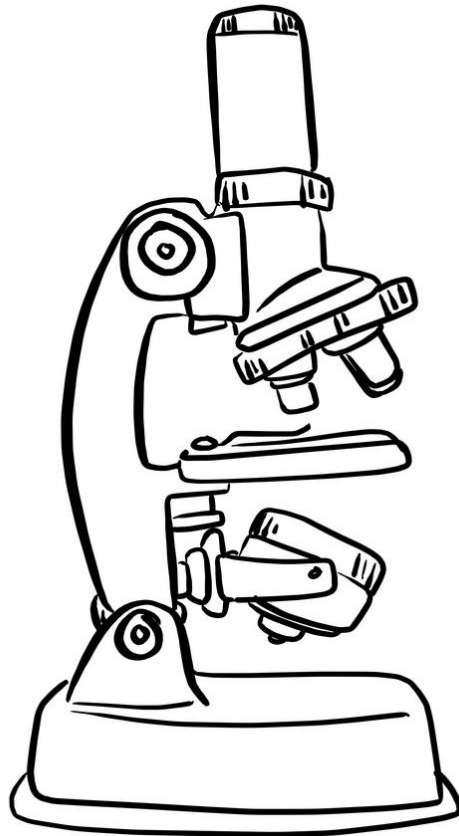
- Demonstrate proper microscope use.
- Identify the parts and functions of each part of a microscope.
- Troubleshoot problems with a microscope.
- Identify major cell structures on a cheek cell swab.
- Describe the events that occur in each stage of the cell cycle.
- Identify cells in each stage of the cell cycle using images or a mitosis model
- Identify selected cellular structures using models and know functions of each structure
- Identify selected structures on cells viewed in an image or a mitosis model

### ***MATERIALS NEEDED***

- Microscope
- Lens cleaner and lens paper
- Slide with letters

### ***USEFUL HINTS***

- Master lab objectives and study guide topics 12-18 (located on page 32) before lab meets again



## LAB 2: MICROSCOPY

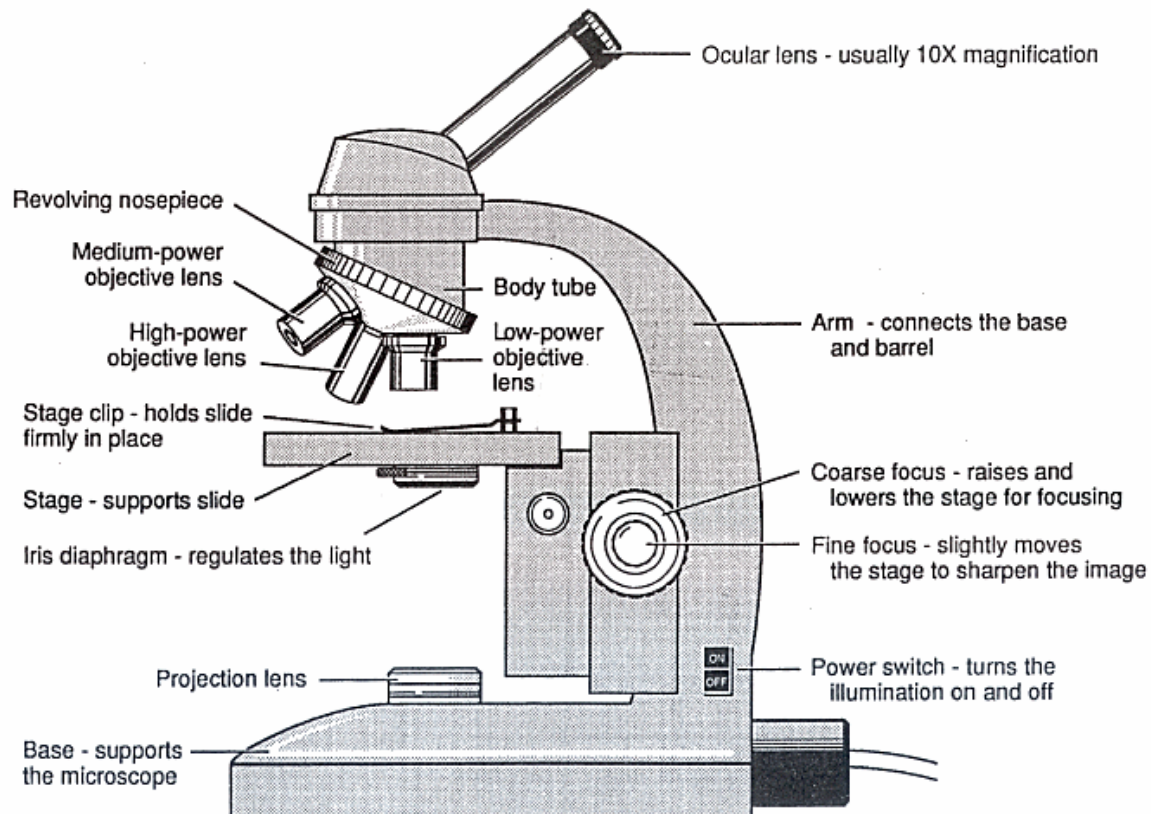
### ACTIVITY: THE COMPOUND LIGHT MICROSCOPE

#### Directions for Carrying the Microscope

- Always carry the microscope in an upright position, using both hands. Place one hand on the arm (part X) and another under the base (part A).
- Place the microscope in the center of the lab bench, not near the edge (to prevent it from falling off!)

#### Proper Microscope Use

- **Cleaning the Lens:** Use lens paper with cleaning fluid to clean the eyepieces and objectives.
- **Learning the Parts:** Your instructor will review the parts of the microscope and basic functions. If you're unsure of any function of the microscope, ask your instructor for help.
- **Viewing Slides on the Microscope:** To avoid breaking a slide and to bring it into focus, **always** start with the stage closest to the objective lens on the lowest power (4x objective). To bring the image on the slide into focus, start with the lowest power objective (4x) and move the stage away from the objective using the coarse focus first. Once the image is in view, adjust the image using the fine focus. If you wear glasses, remove them and focus the image for your eyes. If you look into your neighbor's microscope, be prepared to fine focus the image since our eyes focus differently.
- **Microscope Storage:** Place the lowest objective toward the stage (4x). Return the cord to its wrapped position around the base and place the microscope back on the shelf in its proper location



## LAB 2: MICROSCOPY

### ACTIVITY: BECOMING FAMILIAR WITH A COMPOUND LIGHT MICROSCOPE

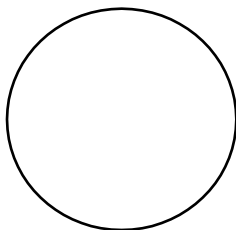
Since you do not have a microscope at home, please use this one: [NC Bionetwork Virtual Microscope \(ncbionetwork.org/iet/microscope\)](http://ncbionetwork.org/iet/microscope). Please check this great site out - and click on LEARN to see the name of each part and its function. Click on EXPLORE to see and use various microscope slides. The letter "e" is in the slide box under SAMPLE slides (assignment on page 20 of the Lab Manual deals with the appearance of the letter "e." I have left these steps, below, in the lab manual so you can read about the definitions (bold-faced terms).

**Step #1.** Obtain a slide of the letter "e" or "b".

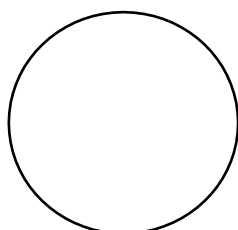
**Step #2.** Follow these directions to use the slide of the letter "e" on the microscope:

- Plug in your microscope and turn on the light source for the microscope.
- Rotate the nosepiece until the lowest power objective (4x) is in position.
- Using the coarse adjustment, position the body tube so that the objective clears the stage by about 1 inch.
- Place the slide next to the circle labeled 0x. Draw the letter "e" in the circle and try to draw it at about the size it appears to your unaided eye.
- Place your slide on the stage and use the clips to secure the slide. Do NOT "flip" or "turn around" the slide as you place it between the stage clips. Keep the letter "e" oriented as the letter "e" as it appears without using the microscope. We will study how the microscope impacts the orientation of the letter "e".
- As you look from the side of the stage (DON'T look through the ocular lens while you're doing this), bring the objective and stage close together using the coarse adjustment. Place the slide about ½" from the objective lens.
- Now, place both of your eyes so that you can see through the ocular lens. Move the stage down and away from the slide using the coarse adjustment knob.
- Move the stage left, right, up, and down to observe the direction in which the letter "e" moves. (**Inversion** results when the image is flipped both vertically and horizontally through the lens.)
- As the specimen comes into view, use the fine adjustment knob to bring the object into sharp focus.
- You should be able to change objectives and still view your specimen with fine focusing (**parfocal**).

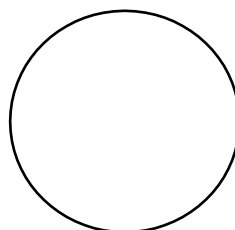
0x (Step 2)



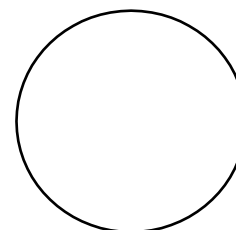
4x (Step 3)



10x (Step 4)



40x (Step 5)



**Step #3.** Center the letter "e" and then draw it in the 4x circle. Draw it to scale (almost like a photo). The key is to draw what you see, not what you think it should look like.

**Step #4.** Switch to the 10x objective, focus using the fine adjustment knob, re-center, and draw what you see in the 10x circle. Again, draw it to scale.

**Step #5.** Switch to the 40x objective, focus using the fine adjustment knob, re-center, and draw what you see in the 40x circle. Again, draw it to scale.

## LAB 2: MICROSCOPY

### ACTIVITY: ANATOMY & PHYSIOLOGY OF THE COMPOUND LIGHT MICROSCOPE

**Questions:**

1. Describe the size of the letter “e” on the microscope slide in comparison to what you see through the ocular lens.

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2. Describe the size of the letter “e” as you change from the 4x, to the 10x, and to the 40x objective.

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3. Describe the orientation of the letter “e” on the microscope stage in comparison to what you see through the ocular lens.

---

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4. What parts of the microscope control the amount of light?

---

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5. Why shouldn't the coarse adjustment knob be used with the 10x, 40x or 100x objectives?

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6. A microscope has a 5x ocular. It also has 10x, 20x, 30x, and 40x objectives. Calculate the highest total magnification and also calculate the lowest total magnification. Show all math work in doing these problems.

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7. As you view a wetmount of a paramecium, you notice that it is swimming to the left and towards you. Describe how you control the stage adjustment knobs to keep the paramecium centered?

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## LAB 2: CELLS

### ***LAB OBJECTIVES***

*By the end of the lab, you should be able:*

- Describe the events that occur in each stage of the cell cycle.
- Identify cells in each stage of the cell cycle using images or a mitosis model
- Identify structures on cells viewed in an image or a mitosis model
- Identify cellular structures using models and know functions of each structure

### ***MATERIALS NEEDED***

- Microscope
- Lens cleaner and lens paper
- Box of clean microscope slides
- Microscope cover slips
- Onion root tip mitosis slides
- Animal cell models
- Mitosis models

## LAB 2: CELLS

### ACTIVITY: THE CELL CYCLE

The **Cell Cycle** is a process by which eukaryotic cells (plants, animals, fungi, and protists) undergo. The cell cycle consists of two major phases: **interphase and mitosis**. Periods of interphase are punctuated by mitosis (cell division or reproduction), then the cell returns to interphase. Approximately 10% of a cell's life is spent in mitosis; 90% is spent in interphase. Cytokinesis (cell division) occurs in-between mitosis and interphase. The goal of mitosis is to replicate the nucleus. The goal of cytokinesis is to separate the two nuclei, cytoplasm, and other organelles into 2 separate cells.

*Please utilize your textbook to identify the following stages of mitosis, structures, and organelles on the models*

#### Lab 2: Chart 2 Stages of the Cell Cycle

Stage	Key events	How to identify stage
<b>Interphase</b>		Nucleus is present. Can't see chromosomes
• <b>G1</b>	Cell growth and normal cellular metabolism.	
• <b>S</b>	DNA synthesis.	
• <b>G2</b>	Additional cell growth and cellular metabolism.	
<b>Prophase</b>	Nucleus breaks apart. Chromatin condenses into chromosomes. Spindles form.	Nucleus is gone. Random chromosomes are present.
<b>Metaphase</b>	Spindles move chromosomes to equator of cell	Chromosomes lined up at cell's equator
<b>Anaphase</b>	Spindles separate sister chromatids	Sister chromatids are separated
<b>Telophase</b>	Essentially a reversal of prophase: nucleus reforms, chromosomes decondense, spindles disappear	Nucleus reforms, chromosomes disappear. Presence of cleavage furrow for animal cells or cell plate for plant cells.

Please identify the following structures on mitosis models or images:

1. Chromosomes
2. Spindle fibers
3. Sister chromatids
4. Cleavage furrow
5. Nucleus

### ACTIVITY: CELLULAR ORGANELLES

#### Lab 2 Chart 3

	Organelle	Function
1	Cell membrane	Controls passage of materials into and out of the cell
2	Cytoplasm	Contains organelles and dissolved solutes
3	Nucleus	Contains DNA. Involved with mitosis. Control center of cell.
	A. Nucleolus	Manufactures ribosomes
	B. Nuclear Envelope	Controls materials entering/exiting nucleus
4	Rough endoplasmic reticulum (RER)	Produces proteins that will be secreted from the cell
5	Smooth endoplasmic reticulum (SER)	Involved with detoxification and production of membranes
6	Golgi apparatus	Modifies proteins and package them for export out of the cell
7	Mitochondria	Involved with aerobic respiration
8	Centrioles	Forms spindle

**STUDY GUIDE FOR LAB EXAM 1 (covers Labs 1-2)**

*Misspellings count at least a 0.25 point deduction.*

**For Questions 1-40 (worth 2 pts each)**, you will view either microscopes, printed images, or anatomical models. For online labs: all of these will be presented via images. These questions include identification of *structures and cells* associated with mitosis. Images can also include identification of types of anatomical sections used (ex. transverse, sagittal, or frontal). Models can test regional terms, body cavities, serous membranes, etc.

All images found in D2L (lab power points and self-quizzes) are fair game. Please study those images.

Remaining questions are short answer questions totaling 20 pts. The following objectives will help guide your studying:

1. Describe anatomical position.
2. Define directional terms.
3. Define body regional terms.
4. Utilize directional and regional terms in sentences.
5. Identify the body regional terms on a picture or model (review Lab 1 Chart 1)
6. List the body planes or sections.
7. Identify the body planes or sections on a picture.
8. Identify body cavities on a picture and list the organs found in various body cavities.
9. Name serous membranes associated with various organs and body cavities.
10. Explain the organization of the body's cavities.
11. Be able to identify and correctly name serous membranes
12. Identify which level of hierarchical organization a body structure (cell, tissue, organ, etc.) fits into.
13. Define homeostasis.
14. Identify the different components of a feedback loop. Know their functions and examples of each.
15. Explain and provide examples for the two feedback mechanisms the body employs to maintain homeostasis.
16. Explain, in words, proper microscope use.
17. Demonstrate competence of various microscope parts. Know their functions, how to use them, and what happens if they don't work (review lab 2 chart 1)
18. Be able to calculate total magnification
19. Describe and define the terms associated with concepts of microscopy.
20. Describe the events that occur in each stage of the cell cycle.
21. Identify plant and animal cells in each stage of the cell cycle.
22. Identify the following structures and applicable functions for lab 2 charts 2 and 3.

**LAB EXAM 1**  
**GRADING RUBRIC FOR INSTRUCTORS**

**How to properly answer short answer questions:**

1. *Always be specific.* If asked for a difference between items, always state what you are referring to.

*Example: What is a difference between an ionic and a covalent bond?* Don't state one involves the sharing of electrons. State "*covalent bonds* involve the sharing of electrons while *ionic bonds* involve the transfer of electrons."

2. *Be complete.* If asked for 2 differences, then 4 things should be stated.

*Example: State 2 differences between protons and electrons.* Do not just state that protons are positively charged while electrons are negatively charged as this is just one difference. Also state that protons are found in the nucleus while electrons are found in orbitals.

## LAB 3: HISTOLOGY

### ***LAB OBJECTIVES***

*By the end of the lab, you should be able:*

- Define histology and tissue.
- Identify and name tissues to general and specific categories.
- Identify and name various specific types of epithelial, connective, and muscle tissues.
- Identify and name structures, cells, fibers, etc., associated with a particular tissue.
- Provide the structure, location and one function for the specific tissue types.

### ***MATERIALS NEEDED***

- Microscope
- Box of tissue slides (epithelial, connective, muscle, nervous)

### ***USEFUL HINTS***

- Note that certain slides (*example*: trachea, arteries, and skin) have multiple tissues on them (such as connective, epithelial, and muscular). Use a low power objective to scan the slide to find the tissue of interest.
- Spelling: You must properly spell the general tissue correctly once and then you can use the following allowed abbreviations. Not spelling it correctly or just using the abbreviations will result in a one-time 0.25 point spelling deduction per general tissue.
  - ET for epithelial
  - CT for connective tissue
  - MT for muscle tissue
  - NT for neural tissue

## LAB 3: HISTOLOGY

### ACTIVITY: IDENTIFYING EPITHELIAL, CONNECTIVE, MUSCLE & NERVOUS TISSUES

For each of these specific tissue types listed on the next two pages:

- Be able to provide two locations and functions.
- Distinguish among the general types and specific types of tissue.

#### Exam Hints:

- Be able to provide the proper general and specific names.

*Correct naming process:*

General tissue type: epithelial tissue

Specific tissue type: simple squamous

*Incorrect naming process:*

General tissue type: simple squamous

Specific tissue type: epithelial

- Provide the full specific name.

*Correct naming process:* loose adipose connective tissue

*Incorrect naming process:* adipose

- Be able to provide a minimum of two (2) specific functions/locations/structures for each tissue type (if provided). Try using one set of flash cards with the name of the tissue and its locations/functions on the back. Use a second set of flash cards with a picture of the tissue and its general and specific names on the back.
- Structures or cells associated with each tissue type are listed below the tissue name.

#### Key to Classifying Tissues

A. **Epithelial** – Cells along a surface. *If not, go to B.*

**1. What shape are the cells?**

- a) flat (wider than long) – squamous
- b) equal sides – cuboidal
- c) tall (longer than wide) – columnar

**2. How many layers are there?**

- a) one – simple
- b) more than one – stratified
- c) one made up of short and tall cells – pseudostratified

B. **Connective** – Cells are separated with a matrix between them and cells are not branched. *If not, go to C.*

**1. Matrix is made of only fibers – CT proper (fibrous)**

- a) thick fibers, many wavy – collagenous
  - i. long – dense regular
  - ii. combination of long & short – dense irregular
- b) shorter, thinner fibers – dense elastic
- c) branching fibers that appear curly – loose reticular
- d) combination of thick and thin in all directions – loose areolar
- e) no fibers, but look like empty balloons next to each other – loose adipose

**2. Cells in pockets and the matrix between may have fibers – cartilage**

- a) matrix is smooth – hyaline cartilage
- b) matrix has thick, wavy fibers – fibrocartilage
- c) matrix has thinner, shorter fibers – elastic cartilage

**3. Cells in rings with a white matrix between – compact bone (osseous)**

**4. Cells have no visible matrix between them – blood**

C. **Nervous** – Cells are mostly separate, but have branches that connect each other. *If not, go to D.*

D. **Muscle** – Cells are next to each other within an organ.

**1. Look like parallel tubes with stripes – skeletal**

**2. Tubes can be branched, with darker stripes between the other stripes – cardiac**

**3. Thin tubes with no stripes – smooth**

## LAB 3: HISTOLOGY

### ACTIVITY: IDENTIFYING EPITHELIAL, CONNECTIVE, MUSCLE & NERVOUS TISSUES

*Identify these tissues on your microscopes using the provided box of slides.*

**Lab 3 Chart 4**

	Location	Function	Recommended Objectives
<b>Epithelial Tissue (ET)</b>			
• <b>simple squamous</b>	lung alveoli, serous membranes, and capillaries	diffusion, secretion, reduces friction	lung alveoli: 10x or 40x
• <b>stratified squamous</b>	epidermis, lining of: mouth, esophagus, vagina, and anal canal	protection from abrasion, pathogens, or chemical attack	*skin or scalp: 4x to 40x
• <b>simple cuboidal</b>	kidney tubules and glands	secretion, absorption	mammal: 40x
• <b>simple columnar</b>	lining of digestive tract (from stomach to rectum)	secretion, absorption	human: 40x
• <b>pseudostratified columnar</b> ○ cilia ○ goblet cells	lining of nasal cavity, trachea, and bronchi	secrete and propel mucus	*trachea: 40x (use 4x to find the inner surface of the “ring” then work your way to the 40x.
• <b>transitional</b>	lining of ureters and urinary bladder	distension/stretching	*4x or 10x
<b>Connective Tissue (CT)</b>			
<b>Fibrous CT (CT Proper)</b>			
<i>(loose &amp; dense only)</i>			
• <b>loose areolar</b> ○ fibroblasts ○ collagen fibers	deep to epithelial tissues	wrap/cushion organs	40x
• <b>loose adipose</b> ○ adipocytes	hypodermis, abdomen, and breasts	insulation, cushion, and energy storage	*trachea, skin, artery, or transitional slide: 10x or 40x). Use 4x for large clear areas, then proceed to 10x, 40x.
• <b>dense regular</b> ○ fibroblasts ○ collagen fibers	tendons and ligaments	strong attachment of body parts in <i>one</i> direction	tendon: 10x or 40x Look at the edge. Don't confuse with smooth muscle. Manipulate fine focus to see the tissue.
• <b>dense irregular</b> ○ fibroblasts ○ collagen fibers	dermis of skin	strong attachments of body parts in <i>different</i> directions	*skin or scalp: 4x to 40x

\*multiple tissue types present

## LAB 3: HISTOLOGY

### ACTIVITY: IDENTIFYING EPITHELIAL, CONNECTIVE, MUSCLE & NERVOUS TISSUES

	Location	Function	Recommended Objectives
<b>Connective Tissue (CT)</b>			
<ul style="list-style-type: none"> <li>• <b>dense elastic</b> <ul style="list-style-type: none"> <li>○ elastic fibers</li> </ul> </li> </ul>	vocal cords and wall of aorta	recoil	*artery and aorta: start 4x and go to 40x
<ul style="list-style-type: none"> <li>• <b>hyaline cartilage</b> <ul style="list-style-type: none"> <li>○ lacunae**</li> <li>○ chondrocytes</li> </ul> </li> </ul>	ends of long bones, embryonic skeleton, nose, and trachea	flexible support, reduces friction between bony surfaces	*trachea: 40x (find inner layer of ring first then move to a more superficial layer where you'll find the hyaline cartilage)
<ul style="list-style-type: none"> <li>• <b>fibrocartilage</b> <ul style="list-style-type: none"> <li>○ lacunae**</li> <li>○ chondrocytes</li> </ul> </li> </ul>	intervertebral discs, pubic symphysis, menisci of knee	shock absorber, prevents bone-to-bone contact	40x (find lacuna with "wavy" irregular matrix)
<ul style="list-style-type: none"> <li>• <b>osseous tissue</b> <ul style="list-style-type: none"> <li>○ lacunae with osteocytes</li> <li>○ central canal</li> <li>○ osteon</li> </ul> </li> </ul>	axial and appendicular skeleton	protection, support, movement with aid of muscles, blood cell formation (hematopoiesis)	10x or 40x
<ul style="list-style-type: none"> <li>• <b>blood</b> <ul style="list-style-type: none"> <li>○ leukocytes (WBC)</li> <li>○ erythrocytes (RBC)</li> <li>○ platelets</li> </ul> </li> </ul>	cardiovascular system	transport of nutrients and wastes, and immunity	40x
<b>Muscle Tissue (MT)</b>			
<ul style="list-style-type: none"> <li>• <b>smooth</b></li> </ul>	walls of hollow organs (stomach, intestines), arteries and veins	involuntary contractions for peristalsis	*View transitional slide: note layer in between the adipose and transitional epithelium. 40x
<ul style="list-style-type: none"> <li>• <b>cardiac</b> <ul style="list-style-type: none"> <li>○ intercalated disks</li> </ul> </li> </ul>	heart	involuntary contractions to pump blood	Intercalated discs 40x
<ul style="list-style-type: none"> <li>• <b>skeletal</b></li> </ul>	attached to skeleton and facial tissue	voluntary contractions, thermoregulation, involuntary shivering	40x
<b>Nervous Tissue (NT)</b>			
	brain, spinal cord, nerves	sense stimuli, control effectors	mammal spinal cord: start with 10x and locate the center; then proceed to 40x and look for orange neurons.
<b>Find the:</b> neuroglia, neuron (body)			

\*multiple tissue types present

\*\*lacunae = plural, while lacuna = singular

## LAB 4: INTEGUMENTARY SYSTEM

### LAB OBJECTIVES

By the end of today's lab, you should be able to:

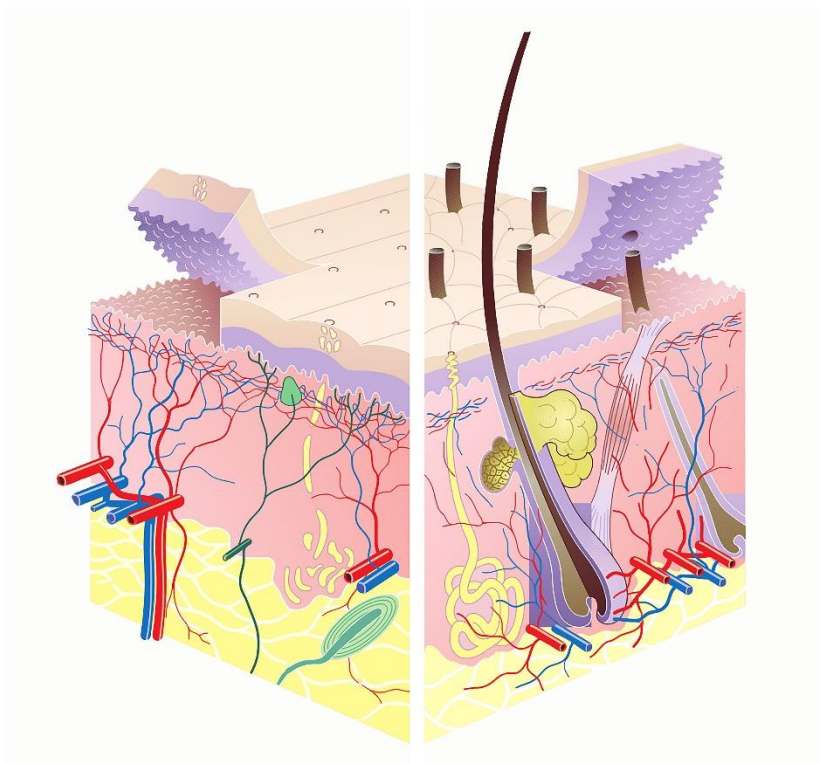
- Identify layers of skin and tissue type in each layer.
- Identify the layers of the epidermis
- Identify accessory structures of the skin

### MATERIALS NEEDED

- Skin models

On the skin model, identify the following:

1. **Epidermis** (tissue type: keratinized stratified squamous ET)
  - 1a. Stratum corneum
  - 1b. Stratum lucidum
  - 1c. Stratum granulosum
  - 1d. Stratum spinosum
  - 1e. Stratum basale
2. **Dermis** (tissue type: dense irregular CT)
  - 2a. Dermal papilla
3. **Hypodermis** (tissue type: loose adipose CT)
4. **Arrector pili muscle**
5. **Sebaceous gland**
6. **Eccrine sweat gland (Sudoriferous gland)**
7. **Hair shaft**
8. **Dermal papilla**



## STUDY GUIDE FOR LAB EXAM 2 (covers Labs 3-4)

*Misspellings count at least a 0.25 point deduction.*

**For Questions 1-40 (worth 2 pt each)**, you will view either microscopes, printed images, or anatomical models. For online labs: all of these will be presented via images. These questions include identification of *structures and cells* associated with tissues, as referred by the “open” bullets of testable structures (Lab 4 chart). All images found in D2L (lab power points and self-quizzes) are fair game. Please study those images.

Remaining questions are short answer questions totaling 20 pts. The following objectives will help guide your studying:

1. Define histology and tissue.
2. Identify and name tissues to general and specific categories.
3. Identify and name various specific types of epithelial, connective, and muscle tissues.
4. Identify and name structures, cells, fibers, etc., associated with a particular tissue.
5. Provide the structure, location and one function for the specific tissue types. For each specific tissue type listed in the lab 3 Chart 4, provide **two** functions and **two** locations.
6. Identify layers and structures associated with the integumentary system.

### GRADING RUBRIC FOR INSTRUCTORS

#### ***Error Type 1: Flip-flopping general and specific tissue types***

Example 1: General tissue type: simple squamous Specific tissue type: epithelial

**Grading: credit** will be deducted since the general and specific types were switched.

#### ***Error Type 2: Providing incomplete/incorrect information***

Example 1: General tissue type: connective Specific tissue type: cartilage

**Grading: credit** will be deducted since the specific cartilage type was not stated

Example 2: General tissue type: connective Specific tissue type: hyaline cartilage (but the image was fibrocartilage)

**Grading: credit** will be deducted since the incorrect cartilage type was stated

Example 3: General tissue type: epithelial Specific tissue type: stratified cuboidal (but image was simple cuboidal)

**Grading: credit** will be deducted since the incorrect epithelial type was stated

Example 4: General tissue type: epithelial Specific tissue type: cuboidal

**Credit** will be deducted since the specific type of was not fully stated (simple)

#### ***Error Type 3: Students will lose credit for not stating loose or dense when it comes to naming specific types of connective tissue proper. However full credit will be lost if the wrong type of tissue is named.***

Example 1: General tissue type: connective Specific tissue type: loose areolar (but tissue is loose adipose)

**Grading: no credit** since the wrong type of tissue was named.

### **Complete naming of location and function of each tissue is required to receive full credit.**

*Example 1:*

**Question:** Image of transitional epithelium is provided: Where is it found

**Answer:** lining of ureters or urinary bladder.

**Grading:** Half credit will be lost if the word “lining” isn’t included since that is the actual location of this tissue.

*Example 2:*

**Question:** Image of dense regular C is provided. What is its function?

**Answer:** strong attachment of body parts

**Grading:** Half credit will be lost since the answer did not state that the strong attachment of body parts occurs in one direction.

**Important note: The student MUST correctly identify the tissue in order to get credit for the function/location.**

Example: An image of smooth muscle is provided, but the student identifies it as dense regular. The next question asks where is this tissue found. The student must start walls of hollow organs. No credit will be given for tendons or ligaments.

**How to properly answer short answer questions:**

3. *Always be specific.* If asked for a difference between items, always state what you are referring to.

*Example: What is a difference between an ionic and a covalent bond?* Don't state one involves the sharing of electrons. State "*covalent bonds* involve the sharing of electrons while *ionic bonds* involve the transfer of electrons."

4. *Be complete.* If asked for 2 differences, then 4 things should be stated.

*Example: State 2 differences between protons and electrons.* Do not just state that protons are positively charged while electrons are negatively charged as this is just one difference. Also state that protons are found in the nucleus while electrons are found in orbitals.

## LAB 5: SKELETAL SYSTEM

### ***LAB OBJECTIVES***

*By the end of the lab, you should be able:*

- Describe and give examples of long, short, flat, irregular, sutural, and sesamoid bones.
- Differentiate between the axial and appendicular divisions of the skeletal system and identify to which division a bone belongs.
- Name and describe common bone markings.
- Name and identify the bones and bone markings for the axial skeleton and appendicular skeleton.
- Describe the major differences between male and female skeletons.

### ***MATERIALS NEEDED***

- Articulated skeleton
- Disarticulated head
- Boxes of bones
- Box of bones
- Sticks used to point at structures (no pens or pencils, please!)

### ***USEFUL HINTS***

- Learning bones using pictures is different than learning them using actual bone models.

The following is for face to face labs

- **Plan on spending extra time outside lab studying bones.** Hands-on learning is KEY for mastering the bones. Studying pictures has limited use.
  - Satellite campuses have bags of bones – ask your instructor or the site director (not for check out)
  - The Success Center is in the 300 building – they also have bags of bones to study (not for check out). Take a study group with you to study!
  - The Project RUSH BIO Hub is located in Room 5423. When the Academic Coach or Tutor is present, you may make use of the room and their models. You may need to join Project RUSH to use their models.
  - The main campus library has limited numbers of bags of bones for check

## LAB 5: SKELETAL SYSTEM ACTIVITY: BONE CLASSIFICATION

### Sizes and Shapes of Bones

All bones have a smooth outer surface of compact bone (osseous tissue) and a spongy internal framework of spongy (cancellous) bone.

1. **Long bones:** longer than wider. Mostly compact bone on the shaft while spongy is found concentrated at the ends.

**Example(s):** \_\_\_\_\_

2. **Short bones:** cube-shaped and contain mostly spongy bone.

**Example(s):** \_\_\_\_\_

3. **Flat bones:** thin, flattened, and usually curved. Two thin layers of compact bone sandwiching a layer of spongy bone between them.

**Example(s):** \_\_\_\_\_

4. **Irregular bones:** do not fit into one of the other categories due to their irregular shape.

**Example(s):** \_\_\_\_\_

5. **Sutural (Wormian) bones:** bones present as part of a suture.

6. **Sesamoid bones:** somewhat flat bones; develop inside tendons and located at joints (such as hands, knee, feet).

**Example(s):** \_\_\_\_\_

### Appendicular and Axial Skeletons

- **Axial skeleton:** \_\_\_\_\_

- Name some bones found in the axial skeleton: \_\_\_\_\_

\_\_\_\_\_

- **Appendicular skeleton:** \_\_\_\_\_

- Name some bones found in the appendicular skeleton: \_\_\_\_\_

\_\_\_\_\_



## LAB 5: SKELETAL SYSTEM

### ACTIVITY: BONES AND BONE MARKINGS OF THE AXIAL SKELETON

For the following lists of bones, you must know the following:

- Name of the bone (words in CAPITAL LETTERS)
- All bone markings as listed (words beneath each bone name)
- Common names
- All articulations (the names of bones that connect together at joints)

**Exam hints:**

- Name **all** parts of the bone marking: *foramen ovale* is correct; *ovale* is incorrect.
- Be careful to write your answers on the correct line on the answer sheet to ensure you receive all points.
- Study with a buddy. Take turns quizzing your study partner and try to cover as many different bones and markings as possible. Any marking or bone from the list can appear on the test.

### Common Bone Markings

#### **Projections that form Joints**

- Condyle = large, rounded knob or projection
- Head = round, bony expansion carried on a narrow neck; found on the proximal end of an articulating bone

#### **Projections for Muscle Attachment**

*Many of the processes, or parts of the bones that stick out, begin with a "T"*

- Crest = narrow, ridge-like projection
- Spine = sharp, slender, often pointed projection
- Trochanter = a very large, blunt, irregularly shaped process (only found on femur)
- Tubercle = small rounded projection or process (found only on the humerus) Tuberosity = a large rounded, roughened projection

#### **Depressions**

*Many of the depressions begin with an "F"*

- Foramen = round or oval hole through a bone
- Fossa = shallow, basin-like depression in a bone
- Meatus = tube-like passageway through a bone
- Sinus = cavity or hollow space in a bone

## LAB 5: SKELETAL SYSTEM

### ACTIVITY: BONES AND BONE MARKINGS OF THE AXIAL SKELETON

An \* indicates that you should be able to identify a bone as *left* or *right*.

#### **BONES OF THE SKULL (CRANIAL BONES)**

##### **FRONTAL BONE**

- supraorbital foramen (notch)

##### **PARIETAL BONE**

##### **TEMPORAL BONE\***

- external auditory/acoustic meatus
- mastoid process
- carotid canal
- zygomatic process
- jugular foramen
- mandibular fossa
- styloid process

##### **OCCIPITAL BONE**

- occipital condyle
- foramen magnum
- external occipital protuberance

##### **SPHENOID BONE**

- greater wings
- foramen **r**otundum {*hint ROS*}
- foramen **o**vale
- foramen **s**pinosum
- lesser wings
- sella turcica
- optic foramen (canal)
- pterygoid processes

##### **ETHMOID BONE**

- crista galli
- cribriform plate

**LAB 5: SKELETAL SYSTEM**  
**ACTIVITY: BONES AND BONE MARKINGS OF THE AXIAL SKELETON**

**BONES OF THE SKULL (FACIAL BONES)**

**MAXILLA BONE\***

- alveolar process/margin
- infraorbital foramen
- palatine process {*roof of mouth*}
- incisive fossa/canal {*depression posterior to the incisors*}
- medial palatine suture {*separates the L/R palatine processes*}

**PALATINE BONES**

**ZYGOMATIC BONES**

**NASAL BONES**

**MANDIBLE**

- mandibular notch
- mental foramen
- mandibular foramen
- ramus of mandible
- mandibular condyle/condylar process
- mandibular angle
- coronoid process
- alveolar process/margin

*Skull sutures*

- coronal suture
- sagittal suture
- lambdoid suture
- squamous suture

***FYI: The hyoid bone is the only bone with no articulations to other bones***

**LAB 5: SKELETAL SYSTEM**  
**ACTIVITY: BONES & BONE MARKINGS OF THE AXIAL SKELETON**

**BONES OF THE SPINAL COLUMN**

**CERVICAL VERTEBRAE (C<sub>1</sub> - C<sub>7</sub>)**

**ATLAS (C<sub>1</sub>)**

**AXIS (C<sub>2</sub>)**

- dens (odontoid process)

**THORACIC VERTEBRAE (T<sub>1</sub> - T<sub>12</sub>) LUMBAR VERTEBRAE (L<sub>1</sub> - L<sub>5</sub>)**

**SACRUM** – *formed from 5 fused vertebrae*

- median sacral crest
- sacral foramina

**COCCYX** – *formed from roughly 4 fused vertebrae*

*Hint for distinguishing among these three types of vertebrae:*

Presence or absence of transverse foramen? Transverse foramen are only present on cervical vertebrae.

Is there a facet for tubercle of rib? Facets for ribs are only found on thoracic vertebrae.

**Bone markings for cervical, thoracic, and lumbar vertebrae**

- transverse foramen {*cervical only*}
- body
- pedicle
- lamina
- transverse process
- spinous process
- superior articular facets
- inferior articular facets
- vertebral foramen

**BONES OF THE RIBCAGE**

**STERNUM**

- manubrium
- body
- xiphoid process

**TRUE RIBS (1 - 7)**

**FALSE RIBS (8 - 12)**

**FLOATING RIBS (11, 12)**

## **LAB 5: SKELETAL SYSTEM**

### **ACTIVITY: BONES & BONE MARKINGS OF THE APPENDICULAR SKELETON**

#### **BONES OF THE PECTORAL GIRDLE**

##### **SCAPULA \***

- vertebral (medial) border
- axillary (lateral) border
- acromion (process)
- glenoid cavity (fossa)
- spine
- coracoid process
- supraspinous fossa
- infraspinous fossa
- subscapular fossa

##### **CLAVICLE**

#### **BONES OF THE ARM**

##### **HUMERUS \***

- head
- trochlea
- greater and lesser tubercle; intertubercular groove
- deltoid tuberosity
- lateral epicondyle
- medial epicondyle
- olecranon fossa
- radial fossa
- capitulum
- coronoid fossa

##### **ULNA**

- olecranon process
- trochlear (semilunar) notch
- styloid process
- head
- coronoid process
- radial notch

##### **RADIUS**

- radial tuberosity
- head
- styloid process

#### **BONES OF THE HAND**

**-CARPALS**

**-METACARPALS**

**-PHALANGES**

## LAB 5: SKELETAL SYSTEM

### ACTIVITY: BONES AND BONE MARKINGS OF THE APPENDICULAR SKELETON

#### BONES OF THE PELVIC GIRDLE

##### COXAL BONE \*

- acetabulum
- obturator foramen

##### PUBIS

- pubic symphysis

##### ISCHIUM

- ischial tuberosity
- ischial spine

##### ILIUM

- sacroiliac joint
- greater sciatic notch

#### BONES OF THE LEG

##### FEMUR \*

- head
- neck
- greater trochanter
- lesser trochanter
- gluteal tuberosity
- linea aspera
- lateral condyle

##### FEMUR (CONT'D)

- medial condyle
- intercondylar notch (fossa)
- patellar surface
- fovea capitis
- intertrochanteric crest
- medial epicondyle
- lateral epicondyle

##### PATELLA

##### TIBIA \*

- lateral condyle
- medial condyle
- medial malleolus
- tibial tuberosity
- intercondylar eminence

##### FIBULA

- lateral malleolus

#### BONES OF THE FOOT

-TARSALS (CALCANEUS, TALUS, *other tarsal bones just identify as tarsals*)

-METATARSALS

-PHALANGES

## STUDY GUIDE FOR LAB EXAM 3 (covers Lab 5)

*Misspellings count at least a 0.25 point deduction.*

Questions are grouped by stations. If, you have any questions about a station, please ask for clarification. All questions are 2 points each, except the two extra credit questions which are worth 1 point each.

***To be well-prepared for the lab exam, you should be able to:***

1. Identify layers and structures associated with the integumentary system.
2. Describe and give examples of long, short, flat, irregular, sutural, and sesamoid bones.
3. Differentiate between the axial and appendicular divisions of the skeletal system and identify to which division a bone belongs.
4. Name and describe common bone markings.
5. Name and identify the bones and bone markings for the axial skeleton and appendicular skeletons.  
Be prepared to correctly identify the **type of isolated vertebra (cervical, thoracic, lumbar)** bone that is present at a station.
6. Identify selected bones as right or left.
7. Provide the bone or bone markings that a bone articulates with at a joint.

### GRADING RUBRIC FOR INSTRUCTORS

1. No partial credit will be given for naming the incorrect bone.
2. It is critical to learn the bone markings and be able to name them fully and correctly, hence no partial credit for naming any part of the bone marking incorrectly. Credit will be deducted for incorrect answers such as these:  
lateral *condyle* confused with lateral *epicondyle*; lateral condyle confused with *medial* condyle

**\*Misspelling:** Note that the misspelling of **fibula, tibia, & ilium** or **coronoid & coracoid** can result in a more severe or total point loss.

*Example:* spelling *tibia* as *tibula* or *fibula* as *fibia* will result in no credit.

## LAB 6: ARTICULATIONS & KINESIOLOGY

### ***LAB OBJECTIVES***

*By the end of the lab, you should be able:*

- Define articulation.
- Describe the types of various types of movements in joints; identify them on pictures.
- Identify structures located on selected joints.
- Be able to classify joints by their function.
- Be able to determine the action, origin, and insertion of selected muscles.

### ***MATERIALS NEEDED***

- Joint models
- Modified and unmodified whole skeleton models
- Sticks used to point at structures (no pens or pencils, please!)

### ***USEFUL HINTS***

- Learning joints using pictures is different than learning them using actual bone models.

The following is for face to face labs:

- **Plan on spending extra time studying outside of your lab.** Hands-on learning is KEY for mastering articulations. Studying pictures has limited use.
  - The Success Center is in the 300 building has joint models to study (not for check out). Take a study group with you to study!
  - The Project RUSH BIO Hub is located in Room 5423. When the Academic Coach or Tutor is present, you may make use of the room and their models.
  - The main campus library has limited numbers of models for check out.

## LAB 6: ARTICULATIONS & KINESIOLOGY

### ACTIVITY: SELECTED JOINTS AND JOINT CLASSIFICATION

*Locate these structures on the joint models.*

#### SHOULDER JOINT

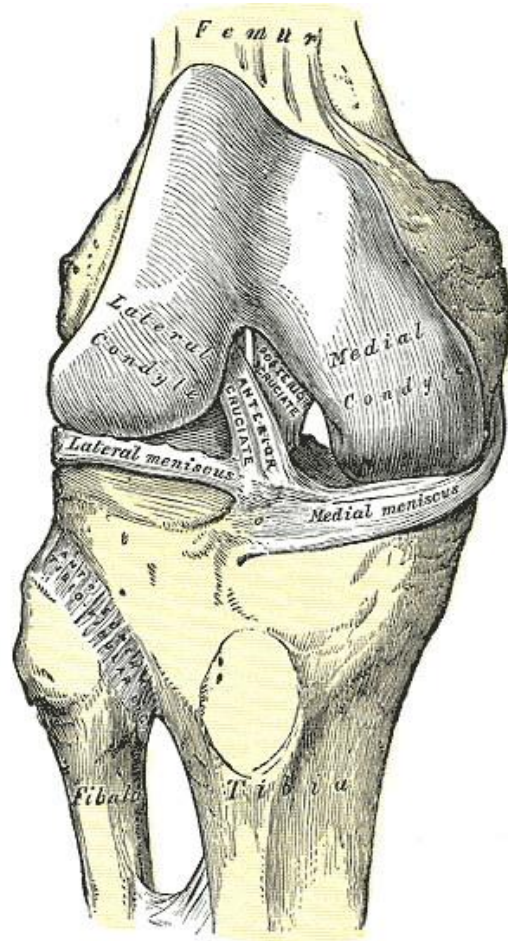
1. glenohumeral ligament
2. coracoacromial ligament
3. coracohumeral ligament

#### HIP JOINT

1. iliofemoral ligament
2. pubofemoral ligament
3. ischiofemoral ligament

#### KNEE JOINT

1. tendon of quadriceps femoris
2. tibial (medial) collateral ligament
3. medial meniscus
4. patella ligament
5. fibular (lateral) collateral ligament
6. lateral meniscus
7. anterior cruciate ligament
8. posterior cruciate ligament



#### Functional Classification of Joints

Type of joint	Description	Examples
Synarthrosis	Immovable joint	Skull sutures
Amphiarthrosis	Slightly movable joint	Pubic symphysis, vertebral column
Diarthrosis	Freely movable joint	Wrist, shoulder, hip

## LAB 6: ARTICULATIONS & KINESIOLOGY

### ACTIVITY: KINESIOLOGY

**Action** is the type of motion that a muscle produces. In medicine, this motion is referred to as *range-of-motion* (ROM) since muscle movement deals with how a particular limb moves at a given joint. Whether you attend a live face-to-face lab or watch a video on ROM, please make notes as the motions are discussed.

Muscle Action	Description
Flexion	Decreasing the angle between two bones; ex arm or leg curls
Extension	Increasing the angle between two bones; ex arm or leg extensions
Abduction	Separating two bones via the midline; ex moving arm or leg away from body
Adduction	Bringing together two bones via the midline; moving arm or leg towards body
Circumduction	Moving the arm or leg in a cone shape
Supination	Moving the arm so the palms are facing anterior/superiorly
Pronation	Moving the arm so the palms are facing posterior/inferiorly
Rotation	Twisting the arm/thigh along its axis
Inversion	Moving the ankles so the soles face medially
Eversion	Moving the ankles so the soles face posteriorly
Protraction	Moving a bone anterior; ex the scapula or mandible
Retraction	Moving a bone posterior; ex the scapula or mandible
Elevation	Moving a bone superior; ex. The scapula or mandible
Depression	Moving a bone inferior; ex. The scapula or mandible
Dorsiflexion	Decreasing angle between foot and leg, ex. Pointing toes upward
Plantarflexion	Increasing angle between foot and leg, ex. Pointing toes downward

## LAB 6: ARTICULATIONS & KINESIOLOGY

### ACTIVITY: KINESIOLOGY

It is critical to name the proper anatomical region when dealing with muscle actions. Avoid confusing the following:

**Arm (shoulder movement) vs. Forearm (elbow movement)**

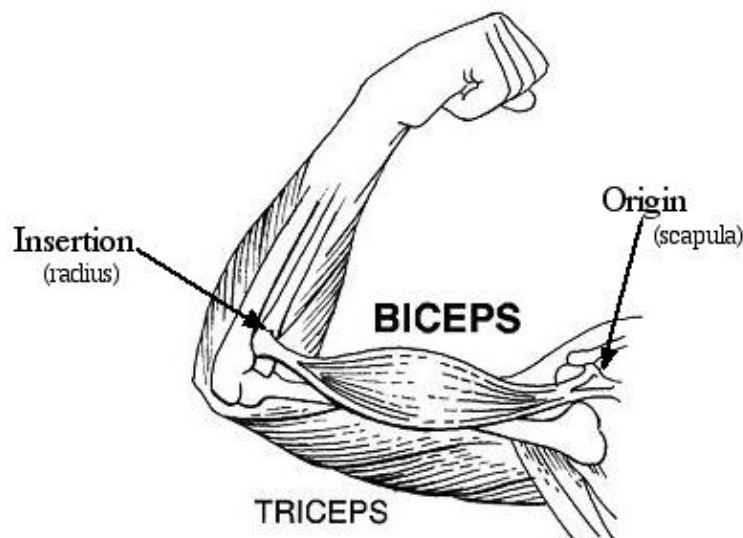
**Thigh (hip movement) vs. Leg (knee movement)**

**Hand (wrist movement) vs. Fingers/Digits movement**

**Example:** the action of the biceps brachii is *forearm flexion*. Alternately, you can also state that the biceps brachii *flexes the forearm*. Either way is correct. However, it is critical to state “*forearm*” and not “*arm*”, which would result in no credit. Do not state “*moves*” as an answer. Students must use correct terminology (flex, extends, abducts, etc.)

One key aspect of understanding kinesiology is being able to understand how a particular muscle produces a particular movement. Muscles connect to bones via **tendons**, which cross over at a joint. A muscle connects two or more bones together and the movement occurs at the joint. The bony attachments for the tendons is key for understanding how a muscle works. There are 2 general types of bony attachments:

- a. **Origin:** the non-moveable attachment of a muscle to a bone. While this word makes it sound as though it deals with “where” a muscle originates or begins, it has more to do with the fact that this point of attachment **remains stationary** when the muscle is moving. A key way of identifying an origin is that it is the *medial/proximal/superior* muscular attachment site.
- b. **Insertion:** the **moveable attachment** of a muscle to a bone. Typically, the insertion moves towards the origin. A key way of identifying an insertion is that it is the *lateral/distal/inferior* muscular attachment site.



## LAB 6: ARTICULATIONS & KINESIOLOGY

### ACTIVITY: KINESIOLOGY

Using the criteria of location, students will identify the origin and insertion for the given set of muscles. In the chart below, you'll notice a muscle listed with two points of attachment (shown in alphabetical order). Using a full skeleton, you'll first determine the general location of the muscle, then determine which attachment is the *origin* and which attachment is the *insertion*. Use the relative general location of the two muscle attachments to determine what is the origin and what is the insertion.

Complete all of these exercises **closed book** and **closed notes**. **There is enough information to figure out the answers to these questions.**

### ACTIVITY: DETERMINATION OF ORIGIN AND INSERTION USING SKELETAL MODELS

Muscle	Origin	Insertion
1. Masseter -mandibular ramus -zygomatic arch		
2. Sternocleidomastoid -clavicle and manubrium -mastoid process		
3. Temporalis -coronoid process of mandible -temporal bone		
4. Zygomaticus -lateral sides of mouth -zygomatic bone		
5. Pectoralis major -greater tubercle -ribs, sternum, & clavicle		
6. Deltoid -clavicle and scapula -deltoid tuberosity		
7. Latissimus dorsi -intertubercular groove -vertebral spinous process		
8. Supraspinatus -greater tubercle -supraspinous fossa		
9. Infraspinatus -greater tubercle -infraspinous fossa		
10. Subscapularis -lesser tubercle -subscapular fossa		
11. Biceps brachii -coracoid process -radial tuberosity		

## LAB 6: ARTICULATIONS & KINESIOLOGY

### ACTIVITY: DETERMINATION OF ORIGIN AND INSERTION USING SKELETAL MODELS

Muscle	Origin	Insertion
12. Triceps brachii -olecranon process -scapula and humerus		
13. Brachioradialis -lateral epicondyle of humerus -styloid process of radius		
14. Flexor carpi radialis -medial epicondyle of humerus -metacarpals		
15. Flexor carpi ulnaris -medial epicondyle of humerus -metacarpals		
16. Extensor digitorum -fingers -lateral epicondyle of humerus		
17. Extensor carpi ulnaris -lateral epicondyle of humerus -metacarpal		
18. Extensor carpi radialis longus -lateral distal ridge/surface of humerus -metacarpal		
19. Gluteus maximus -gluteal tuberosity -ilium, sacrum, & coccyx		
20. Adductor group -linea aspera -pubis		
21. Psoas major -lesser trochanter -vertebral transverse process		
22. Semitendinosus -ischial tuberosity -tibial medial surface		
23. Semimembranosus -ischial tuberosity -tibial medial surface		
24. Rectus femoris -iliac spine & acetabulum -tibial tuberosity		
25. Vastus lateralis -greater trochanter -tibial tuberosity		

## LAB 6: ARTICULATIONS & KINESIOLOGY

### ACTIVITY: DETERMINATION OF ORIGIN AND INSERTION USING SKELETAL MODELS

Muscle	Origin	Insertion
26. Vastus medialis -linea aspera -tibial tuberosity		
27. Tibialis anterior -lateral condyle of tibia -metatarsal		
28. Gastrocnemius -calcaneus bone -femoral condyles		
29. Soleus -calcaneus bone -head of fibula & tibial shaft		

### ACTIVITY: DETERMINATION OF MUSCLE ACTION ACCORDING TO THEIR NAME AND SHAPE

Some muscles have 2 or 3 parts to their name.

The **first** part states the action of the muscle

The **second** part states what is moved by the muscle

The **third part**, if the muscle has one, states along which bone the muscle is located.

A second way of determining muscle action is by analyzing their shape. Some muscles are round and become narrower or constricted when they contract. The last 2 muscles on the following muscle chart do just that. Think about their location and “act” out their action to figure out what they do. Please complete this chart closed book/note.

#### Muscle Action Chart

Muscle Name	Muscle Action
Flexor carpi radialis	
Flexor carpi ulnaris	
Extensor digitorum	
Extensor carpi ulnaris	
Extensor carpi radialis longus	
Orbicularis oris	
Orbicularis oculi	

**LAB 6: ARTICULATIONS & KINESIOLOGY**  
**ACTIVITY: FULL SKELETON EXERCISES TO DETERMINE MUSCLE ACTION**

1. For face-to-face labs, please gently pull on the string and note the action provided. For online labs, please watch the ROM labs.
2. Write the answer in the table

Muscle	Action
1. Masseter	
2. Sternocleidomastoid*	
3. Trapezius	
4. Pectoralis major	
5. Deltoid	
6. Latissimus dorsi	
7. Biceps brachii	
8. Triceps brachii	
9. Flexor carpi ulnaris	
10. Extensor carpi ulnaris	
11. Gluteus maximus^	
12. Gluteus medius	
13. Iliacus	
14. Adductor group	
15. Semitendinosus	
16. Rectus femoris	
17. Tibialis anterior**	
18. Gastrocnemius#	

Some of these muscles perform additional actions based upon the portions (heads) of the muscles that are activated along with other muscle groups that may act along with them. For face-to-face labs, please note the following:

\* Pull each string individually

^ Instructor will demonstrate this movement

\*\* Hold leg straight down, then pull string

# Place leg parallel to floor and then pull string

## LAB 6: ARTICULATIONS & KINESIOLOGY

### ACTIVITY: UTILIZING SYNERGISTIC & ANTAGONISTIC MUSCLES TO LEARN ACTIONS

**Synergistic muscles** are a group of muscles that perform the same action. The synergist of a given extensor at a particular joint would be another extensor at a particular joint. Synergistic muscles are typically located on the same side of a particular joint.

On the other hand, **antagonistic muscles** perform opposite actions. Thus the antagonist of a given extensor at a particular joint would be a flexor at the same joint. Antagonistic muscles are typically found on opposite locations on a bone. While one would be anterior, its antagonist would be located posterior on a bone.

By learning which muscles behave as synergists or antagonists, it helps to minimize the memorization of particular muscle actions.

Muscle	Synergist(s)
1. Masseter	Temporalis
2. Biceps brachii	Brachialis and Brachioradialis
3. Flexor carpi ulnaris	Flexor carpi radialis and Palmaris longus
4. Extensor carpi ulnaris	Extensor carpi radialis longus
5. Iliacus	Psoas major
6. Adductor group	Adductor magnus, Adductor longus, and Adductor brevis
7. Semitendinosus	Semimembranosus and Biceps femoris (hamstrings)
8. Rectus femoris	Vastus lateralis and Vastus medialis (quadriceps)
9. Gastrocnemius	Soleus

Look at the actions on previous page and write down muscles that are antagonistic to each other.

Muscle	Antagonist(s)
1. Sternocleidomastoid	
2. Pectoralis major	
3. Biceps brachii	
4. Flexor carpi ulnaris	
5. Gluteus maximus	
6. Gluteus medius	
7. Semitendinosus	
8. Gastrocnemius	

## LAB 6: ARTICULATIONS & KINESIOLOGY

### ACTIVITY: PREDICTING RANGE OF MOTION BASED ON MUSCLE LOCATION

A fairly simple way of predicting ROM is by noting the location of the insertion and to make sure you think about the skeleton in anatomical position. Based upon the prior activities, please fill in the following table.

Location of bone insertion	ROM
Lateral surface	
Medial surface	
Anterior surface of phalanges	
Anterior surface of ulna	
Posterior surface of ulna	
Anterior surface of tibia	
Anterior surface of femur	

### Core (Abdominal Muscles) Actions

Learn the actions of the following 4 muscles

Muscle	Action
1. Rectus abdominis	Flexes vertebral column and compresses abdomen
2. External oblique	Laterally rotates trunk
3. Internal oblique	Laterally rotates trunk
4. Transversus abdominis	Compresses abdomen



## LAB 7: MUSCULAR SYSTEM

### ***LAB OBJECTIVES***

*By the end of the lab, you should be able:*

- Identify selected human muscles using various anatomical models.
- Provide the action, origin, and insertion of the human muscles.

### ***MATERIALS NEEDED***

- Human Muscle Models
- Mini Men
- Medium men
- Sagittal head
- 3B arm and leg models
- Somso arm and leg models

### ***USEFUL HINTS***

- Learning muscles using pictures is different than learning them using actual muscle models.
- Realize a single muscle won't usually\* perform opposite actions; avoid stating that a muscle both flexes and extends the wrist. *\*Muscle movements can be complicated. While most muscles do not produce antagonistic movements, some can do just that. An example is the trapezius which can both elevate and depress the scapula, though not at the same time.*
- Learn the location of the muscles first! Use the location to help you start learning the actions, origins, and insertions. Act out the action and ask yourself "which bone is the origin and which is the insertion?" Since the origin is stationary, imagine the insertion moving towards the origin to help you understand the type of movement that is produced by a particular muscle.
- **Plan on spending additional time studying outside your lab.** Hands-on learning is KEY for mastering muscles. Studying pictures has limited use.
- The Success Center is in the 300 building has muscle models to study (not for check out). Take a study group with you to study!
- The Project RUSH BIO Hub is located in Room 5423. When the Academic Coach or Tutor is present, you may make use of the room and their models.
- The main campus library has limited numbers of muscle models for check out. Distinguish *leg* from *thigh* and *arm* from *forearm* when asked for the actions of selected muscles.

**LAB 7: MUSCULAR SYSTEM**  
**ACTIVITY: LEARN LOCATIONS OF SELECTED MUSCLES**

**HEAD AND NECK MUSCLES**

1. Frontalis
2. Masseter
3. Buccinator
4. Occipitalis
5. Orbicularis oculi
6. Orbicularis oris
7. Sternocleidomastoid
8. Splenius capitus
9. Sternohyoid
10. Omohyoid
11. Temporalis
- 12 A) Zygomaticus major
- B) Zygomaticus minor

**MUSCLES MOVING THE PECTORAL GIRDLE**

13. Pectoralis minor
- 14 A) Rhomboid major
- B) Rhomboid minor
15. Serratus anterior
16. Serratus posterior
17. Trapezius
18. Longissimus thoracis
19. External intercostals
20. Internal intercostals

**MUSCLES MOVING THE UPPER ARM**

21. Pectoralis major
22. Deltoid
23. Latissimus dorsi
24. Supraspinatus\*
25. Infraspinatus\*
- 26 A) Teres major
- B) Teres minor\*
27. Subscapularis\*

\* = muscles of the rotator cuff. Learn by SITS

(supraspinatus, infraspinatus, teres minor, subscapularis)

**MUSCLES MOVING THE HAND**

34. Flexor carpi radialis
35. Palmaris longus
36. Flexor carpi ulnaris
37. Extensor digitorum
38. Extensor carpi ulnaris
39. Extensor carpi radialis longus
40. Extensor carpi radialis brevis

**MUSCLES MOVING THE FOREARM**

28. Biceps brachii
29. Triceps brachii
30. Brachialis
31. Brachioradialis
32. Coracobrachialis
33. Pronator teres

**LAB 7: MUSCULAR SYSTEM**  
**ACTIVITY: LEARN LOCATIONS OF SELECTED MUSCLES**

**MUSCLES MOVING THE ABDOMEN AND TRUNK**

41. Rectus abdominis
42. External oblique
43. Internal oblique
44. Transversus abdominis
45. Diaphragm

**MUSCLES MOVING THE THIGH**

46. Gluteus maximus
47. Gluteus medius
  - Gluteus minimus (no ID)
48. Piriformis
49. Tensor fasciae latae
50. Sartorius
51. Adductor group
  - A) Adductor magnus
  - B) Adductor longus
    - Adductor brevis (no ID)

52. Gracilis
53. Iliopsoas (Iliacus)
54. Iliopsoas (Psoas major)

**MUSCLES MOVING THE LOWER LEG**  
**(HAMSTRING GROUP)**

55. Biceps femoris
56. Semitendinosus
57. Semimembranosus
58. Iliotibial tract/band

**MUSCLES MOVING THE LOWER LEG**  
**(QUADRICEPS GROUP)**

59. Rectus femoris
60. Vastus lateralis
61. Vastus medialis
  - Vastus intermedius (no ID)

**MUSCLES MOVING THE FOOT**

62. Tibialis anterior
63. Gastrocnemius
64. Soleus
65. Fibularis longus

**MUSCLES MOVING THE TOES**

66. Extensor digitorum longus
67. Flexor digitorum longus

**Types of test questions**

1. Given a particular muscle; provide the action.
2. Name a muscle that can cause a particular action.
3. Determine the origin/insertion when given a pair of muscle attachments
4. Movement questions: a description of a motion will be described and the student will determine the muscle that is performing that particular movement

*\*Arm and forearm, thigh and leg, are UNDERLINED to ensure they are used properly and not interchangeably*

## LAB 7: MUSCULAR SYSTEM

### STUDY GUIDE FOR LAB EXAM 4 (covers labs 6 & 7)

*Misspellings count at least a 0.25 point deduction.*

**Questions** are grouped by stations. For each question, you will be asked to identify and name the muscle on a muscle model or a ligament or associated structure on a joint model. You can also be asked to classify a joint in terms of its movement.

**ID Questions:** Make sure you can name the muscle, ligament, and ROM completely!

**Remaining Questions:** are fill-in-the blank and short answers.

1. Provide actions of selected muscles
2. Provide the name of a muscle that does a selected action
3. Determine the origin and insertion of a pair of muscle attachments
4. Determine the action or range of motion given a description of a body movement
  - Example: You pick up your fork to take a bite of food and place your fork back on the table. Describe one motion and one muscle that performs that motion.
  - Answer: Forearm Flexion: Brachialis **or** Forearm Extension: Triceps Brachii
5. Determine the action of a muscle provided the origin and insertion and general location of a muscle
6. Provide synergist and antagonist muscle groups

**To prepare for this lab exam, you should be able to:**

1. Identify, using joint models, all ligaments and associated structures as listed in the appropriate activities.
2. Identify, using human muscle models, all human muscles from the appropriate activities.
3. Identify the action, origin, and insertion of human muscles from the appropriate activities.

### GRADING RUBRIC FOR INSTRUCTORS

**Muscles must be entirely and correctly named.**

*Examples:*

1. Writing *extensor digitorum* for the leg is wrong (zero credit) since that is the muscle that is found on the forearm. The correct answer would be *extensor digitorum longus*, which is found on the leg.
2. Writing *extensor carpi ulnaris* is wrong (zero credit) when the actual muscle is the *flexor carpi ulnaris*.

## LAB 8: SPINAL CORD & SPINAL NERVES

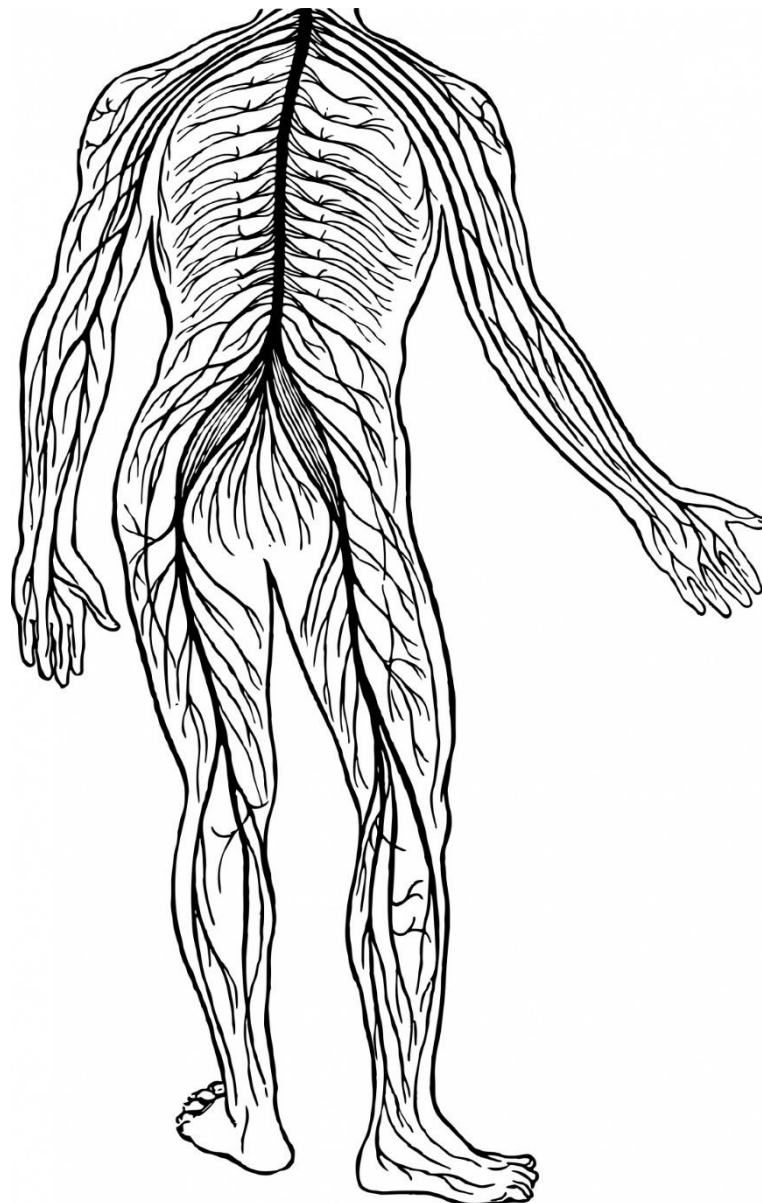
### ***LAB OBJECTIVES***

*By the end of the lab, you should be able:*

- Identify and name the structures of the spinal cord and the spinal nerves.
- Name muscles innervated by selected spinal nerves.

### ***MATERIALS NEEDED***

- Spinal cord models (upright and cross section)
- Flat nervous system models
- Arm and leg muscle models (3b and Somso)



## LAB 8: SPINAL CORD & SPINAL NERVES

### ACTIVITY: SPINAL CORD AND SPINAL NERVES

*Use the various nervous system models to locate the items on this list.*

#### SPINAL CORD (cross section model)

1. columns/white matter (a. lateral, b. anterior, & c. posterior)
2. horns/gray matter (a. lateral, b. anterior, & c. posterior)
3. gray commissure
4. central canal
5. dorsal (sensory) root of spinal nerve {*posterior individual wires*}
6. ventral (motor) root of spinal nerve {*anterior individual wires*}
7. dorsal root ganglion {*where dorsal wires converge*}
8. spinal nerve {*where dorsal and ventral roots merge*}

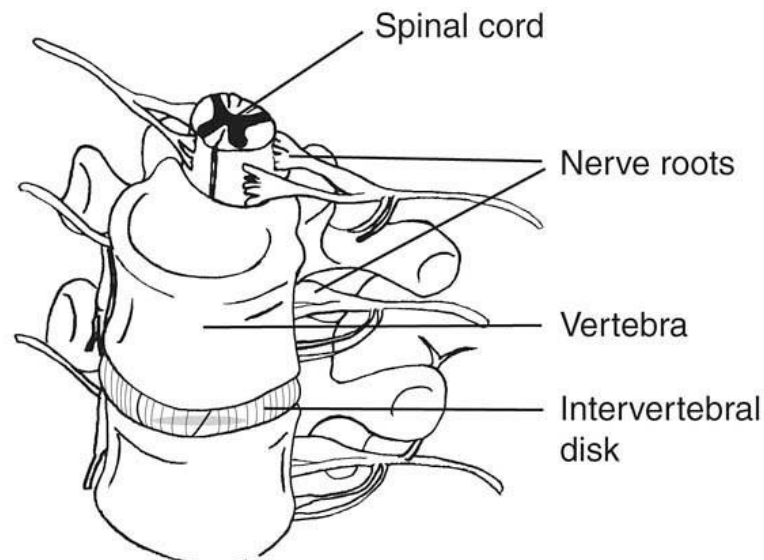
#### SPINAL CORD (standing model)

1. lumbar vertebrae
2. herniated disc (red)
3. intervertebral foramen
4. spinal nerve
5. cauda equina/sacral nerves
6. intervertebral disc

#### SPINAL NERVES (regions) (flat model and see chart)

- a. cervical nerves (C<sub>1</sub>-C<sub>8</sub>)
- b. thoracic nerves (T<sub>1</sub>-T<sub>12</sub>)
- c. lumbar nerves (L<sub>1</sub>-L<sub>5</sub>)
- d. sacral nerves (S<sub>1</sub>-S<sub>5</sub>)

#### ARM and LEG NERVES (*See chart on next page*)



**LAB 8: SPINAL CORD & SPINAL NERVES**  
**ACTIVITY: SPINAL CORD AND SPINAL NERVES**

*Use the flat nervous system, and arm/leg models to locate the nerves on this list.*

*The human muscles are review from a previous lab.*

<b>Brachial Plexus</b>	<b>Muscle Innervated</b>	<b>Action of Muscle(s)</b>
1. Axillary	<ul style="list-style-type: none"> <li>• Deltoid</li> </ul>	Abducts arm
2. Musculocutaneous	<ul style="list-style-type: none"> <li>• Biceps brachii</li> <li>• Brachialis</li> </ul>	Flexes forearm
3. Radial	<ul style="list-style-type: none"> <li>• Triceps brachii</li> <li>• Brachioradialis</li> <li>• Extensor carpi ulnaris</li> <li>• Extensor carpi radialis longus</li> </ul>	-Extends forearm -Flexes the forearm -Extends the wrist
4. Median	<ul style="list-style-type: none"> <li>• Flexor carpi radialis</li> <li>• Palmaris longus</li> </ul>	Flexes the wrist
5. Ulnar	<ul style="list-style-type: none"> <li>• Flexor carpi ulnaris</li> </ul>	Flexes the wrist
<b>Sacral Plexus</b>		
6. Sciatic ( <i>branches are below</i> )	<ul style="list-style-type: none"> <li>• Biceps femoris</li> <li>• Semitendinosus</li> <li>• Semimembranosus</li> </ul>	Flexes the leg
a. Tibial	<ul style="list-style-type: none"> <li>• Gastrocnemius</li> <li>• Soleus</li> </ul>	Plantarflexion
b. Fibular	<ul style="list-style-type: none"> <li>• Tibialis anterior</li> <li>• Fibularis longus</li> <li>• Extensor digitorum longus</li> </ul>	-Dorsiflexion -Plantarflexion -Extends the toes
<b>Lumbar Plexus</b>		
7. Femoral	<ul style="list-style-type: none"> <li>• Sartorius</li> <li>• Iliopsoas (iliacus)</li> <li>• Rectus femoris</li> <li>• Vastus lateralis</li> <li>• Vastus medialis</li> </ul>	-Flexes the thigh and leg -Flexes the thigh -Extends the leg
8. Obturator	<ul style="list-style-type: none"> <li>• Adductor magnus</li> <li>• Adductor longus</li> <li>• Adductor brevis</li> <li>• Gracilis</li> </ul>	Adducts the leg

## LAB 9: BRAIN AND CRANIAL NERVES

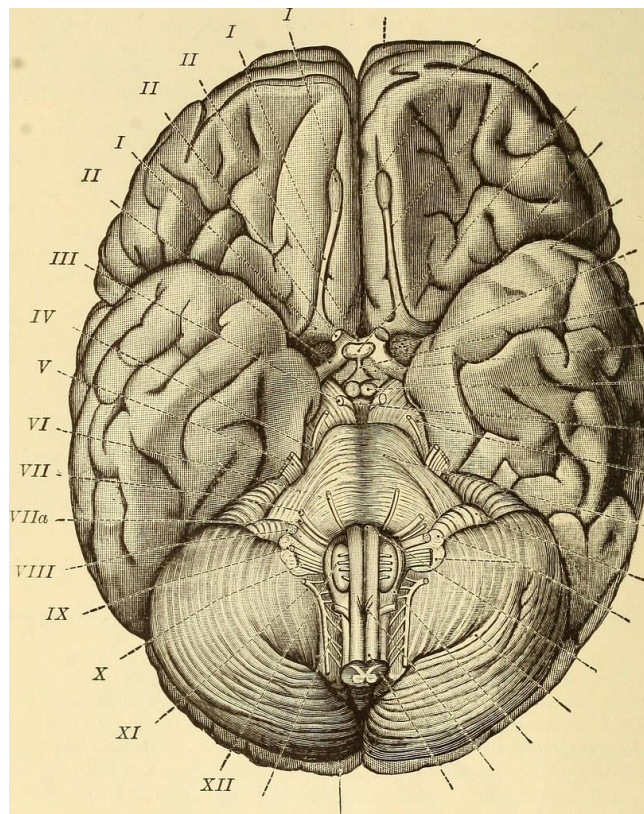
### LAB OBJECTIVES

*By the end of the lab, you should be able:*

- Identify and name the structures of the brain, sheep brain, and the cranial nerves.
- Provide the functions of the parts of the brain and cranial nerves.
- For each cranial nerve, provide the Roman numeral, name, disorders, and clinical testing methods.
- Trace the flow of cerebrospinal fluid (CSF) from the time it is formed until it is absorbed into the venous system.

### MATERIALS NEEDED

- Brain models
- Midsagittal head models
- Neurovascular skull models
- Ventricle models
- Sheep brains
- Dissection trays
- Dissection tools
- Aprons, Gloves, Goggles
- Encased brain specimens



## LAB 9: BRAIN AND CRANIAL NERVES

### ACTIVITY: IDENTIFICATION OF BRAIN AND CRANIAL NERVES

#### BRAIN and Selected Structures

##### 1. Cerebrum

- a. left cerebral hemisphere
- b. right cerebral hemisphere
- c. frontal lobe
- d. parietal lobe
- e. occipital lobe
- f. temporal lobe
- g. insula lobe
- h. longitudinal fissure
- i. transverse fissure
- j. sulcus (*plural* = sulci)
- k. gyrus (*plural* = gyri)
- l. corpus callosum
- m. cerebral cortex
- n. superior longitudinal sinus

##### 2. Cerebellum

- a. cerebellar hemisphere
- b. vermis

##### 3. Diencephalon

- a. thalamus
- b. hypothalamus
- c. epithalamus (pineal gland or pineal body)

##### 4. Brain stem

- a. midbrain (mesencephalon)
- b. pons
- c. medulla oblongata

##### 5. Olfactory tracts

##### 6. Olfactory bulbs

##### 7. Optic

- a. nerve
- b. chiasma
- c. tract

##### 8. Pituitary gland

##### 9. Ventricles

- a. lateral ventricles
- b. third ventricle (*has "hole" in center*)
- c. fourth ventricle
- d. cerebral aqueduct
- e. interventricular foramen
- f. septum pellucidum

##### 10. Choroid plexus

##### 11. Spinal cord

##### 12. Temporal nerve

##### 13. Zygomatic nerve

##### 14. Buccal nerve

##### 15. Mandibular nerve

##### 16. Trigeminal nerve

\* You need to be able to identify cranial nerves I-VI on models.

However, learn all of the cranial nerves in terms of name, number, function, test, and disorder.

## LAB 9: BRAIN AND CRANIAL NERVES

### ACTIVITY: NAME AND FUNCTIONS OF CRANIAL NERVES

For each of cranial nerves listed on the next page:

- Be able to provide the nerve numbers in Roman numerals.
  - *For example:* Optic is cranial nerve II
- Provide the name of the nerve.
  - *For example:* Cranial nerve II is the optic nerve
- Provide the exact function.
  - *For example,* Optic = sensory: vision
- Suggest methods for clinical testing.
- List disorders.

#### Cranial Nerves Helpful Hints

Cranial Nerves	Mnemonic #1	Mnemonic #2
<i>Olfactory</i>	<b>On</b>	<b>Oh</b>
<i>Optic</i>	<b>O</b> ccasion	<b>Oh</b>
<i>Oculomotor</i>	<b>O</b> ur	<b>Oh</b>
<i>Trochlear</i>	<b>T</b> rusty	<b>To</b>
<i>Trigeminal</i>	<b>T</b> ruck	<b>T</b> ake
<i>Abducens</i>	<b>A</b> cts	<b>A</b>
<i>Facial</i>	<b>F</b> unny	<b>F</b> amily
<i>Vestibulocochlear</i>	<b>V</b> ery	<b>V</b> acation
<i>Glossopharyngeal</i>	<b>G</b> ood	<b>G</b> o
<i>Vagus</i>	<b>V</b> ehicle	<b>V</b> egas
<i>Accessory</i>	<b>A</b> ny	<b>A</b> fter
<i>Hypoglossal</i>	<b>H</b> ow	<b>H</b> ours

\* S = Sensory, M = Motor, B = Both Sensory and Motor

- You have **1** nose, **2** eyes, and **3, 4, 6** makes my eyes do tricks!  
{I = olfactory, II = optic, III, IV, VI = control eye movement}

## LAB 9: BRAIN AND CRANIAL NERVES

### CRANIAL NERVE CHART

*Use the brain models to locate Cranial Nerves I – VI.*

CN	Name	Function	Test	Disorder
I	Olfactory	<b>Sensory:</b> smell	Identify aromas	Loss of smell
II	Optic	<b>Sensory:</b> vision	1. Eye chart 2. Identify when object enters visual field	Blindness
III	Oculomotor	<b>Motor:</b> focusing on images eye movement	1. Penlight → iris constricts 2. Eye follows moving objects	Double vision
IV	Trochlear	<b>Motor:</b> eye movement	<i>See CN III for testing</i>	Double vision
V	Trigeminal	<b>Sensory</b> branches for pain, touch, temperature to your face <b>Motor:</b> closing the jaw ( <i>masseter &amp; temporalis</i> )	1. Corneal reflex → blink 2. Sense pain, touch, temperature 3. Open/close mouth	Tic douloureux: trigeminal inflamed. Any facial touch is very painful
VI	Abducens	<b>Motor:</b> moves eye laterally	<i>See CN III for testing</i>	Can't move eye laterally
VII	Facial	<b>Sensory:</b> taste <b>Motor:</b> salivation, tears, control of <i>facial muscles</i>	1. Identify tastes 2. Test tearing; test facial symmetry	Bell's palsy: facial paralysis
VIII	Vestibulocochlear	<b>Sensory:</b> equilibrium and hearing	Test ear with tuning fork	1. Deafness 2. Loss of balance
IX	Glossopharyngeal	<b>Sensory:</b> taste <b>Motor:</b> swallowing, salivation	Gag/swallow reflex	1. Can't swallow 2. Can't taste
X	Vagus	<b>Sensory:</b> receives information from visceral organs <b>Motor:</b> parasympathetic stimulation to visceral organs	<i>See CN IX for testing</i>	Visceral organ disorders; death
XI	Accessory	<b>Motor</b> control of <i>trapezius</i> , and <i>sternocleidomastoid</i>	1. Rotate shoulders 2. Shrug shoulders	Neck or shoulder paralysis
XII	Hypoglossal	<b>Motor:</b> tongue control	Protrude/retract tongue	Speech/swallow impairment

## LAB 9: BRAIN AND CRANIAL NERVES

### ACTIVITY: SHEEP BRAIN DISSECTION

#### Materials:

- Sheep brains
- Dissection trays
- Dissection tools (probes)

**Procedure:** Obtain a small dissection tray, probe, and a sheep's brain. View the various structures listed below, then return the sheep's brain to the container. Clean up your area and return the cleaned tools.

#### Locate the following structures on the sheep brain:

1. Dura mater
2. Right cerebral hemisphere
3. Left cerebral hemisphere
4. Longitudinal fissure
5. Transverse fissure
6. Right cerebellar hemisphere
7. Left cerebellar hemisphere
8. Vermis (of cerebellum)
9. Cerebral gyrus
10. Cerebral sulcus
11. Cerebral cortex (gray matter)
12. Cerebral white matter
13. Lateral ventricle (*observe cross section*)
14. Midbrain
15. Olfactory bulbs
16. Olfactory tracts
17. Optic nerves
18. Optic tracts
19. Optic chiasma
20. Spinal cord
21. Medulla oblongata
22. Pons
23. Corpus callosum
24. Septum pellucidum
25. Thalamus
26. Hypothalamus



## LAB 10: SPECIAL SENSES

### LAB OBJECTIVES

*By the end of the lab, you should be able:*

- Identify and name the structures of the human eye and ear.

### ***MATERIALS NEEDED***

- Eye models
- Ear models
- 

### **ACTIVITY: GROSS ANATOMY OF THE EYE**

*Use the eye models to locate the items on this list.*

#### **FIBROUS TUNIC (OUTER LAYER)**

1. Sclera
2. Cornea

#### **VASCULAR TUNIC (UVEA or MIDDLE LAYER)**

3. Choroid
4. Ciliary body
5. Iris
6. Pupil {*hole in iris*}

#### **NEURAL TUNIC (INNER LAYER)**

7. Retina
8. Macula lutea
  - a. Fovea centralis

#### **OTHER PARTS (INTERNAL & EXTERNAL)**

- |                    |                           |
|--------------------|---------------------------|
| 9. Lens            | 12. Extrinsic eye muscles |
| 10. Lacrimal Gland | a. Inferior rectus        |
| 11. Optic Nerve    | b. Superior rectus        |
|                    | c. Medial rectus          |
|                    | d. Lateral rectus         |

**LAB 10: SPECIAL SENSES**  
**ACTIVITY: GROSS ANATOMY OF THE EAR**

*Locate these items on the ear model.*

**OUTER EAR**

1. Auricle (pinna)
2. External auditory canal
3. Tympanic membrane

**MIDDLE EAR**

4. Malleus (hammer)
5. Incus (anvil)
6. Stapes (stirrup)
7. Auditory (Eustachian or pharyngotympanic) tube

**INNER EAR**

8. Cochlea
9. Semicircular canals (anterior, lateral, and posterior)
10. Vestibulocochlear nerve (CN VIII)
11. Round window
12. Vestibule

## LAB 10: SPECIAL SENSES

### STUDY GUIDE FOR LAB EXAM 5 (covers Labs 8-10)

*Misspellings count at least a 0.25 point deduction.*

**Identification Questions.** You'll be asked to provide the name of a nerve, organ, structure, etc. The following can be tagged for identification purposes on models/specimens viewed during lab instruction.

1. Identify **all** structures as found on the human brain models.
2. Identify **all** structures as found on the sheep brain.
3. Identify and name the structures of the spinal cord and the spinal nerves.
4. Identify and name the structures of the eye and ear.

**Short Answer Questions.** To be successful on this part of the exam, make sure you can:

1. State which muscles(s) is/are innervated by a particular spinal or cranial nerve.
2. State which range of motion (ROM) (action of each muscle) is impacted if a particular nerve is damaged.
3. State which spinal nerve is damaged if given a limited ROM.
4. For each of the 12 cranial nerves, provide the Roman numeral, name, disorders, and clinical testing methods.
5. Trace the flow of cerebrospinal fluid (CSF) from the time it is formed until it is absorbed into the venous system. (10 point question).

### GRADING RUBRIC FOR INSTRUCTORS

1. **Structures must be correctly and fully named.**
2. Each item named in the CSF is worth 1 point. **Points will be deducted for placing steps in the wrong order or for missing steps.**
3. **Credit will not be rewarded for just stating *sensory* or *motor* in terms of cranial nerve functions.**

Specific functions from the Cranial Nerve Table must be mastered.

*Example:*   **Question:** Provide the function of cranial nerve VI

**Incorrect answer:** motor

**Correct answer:** moves eye laterally