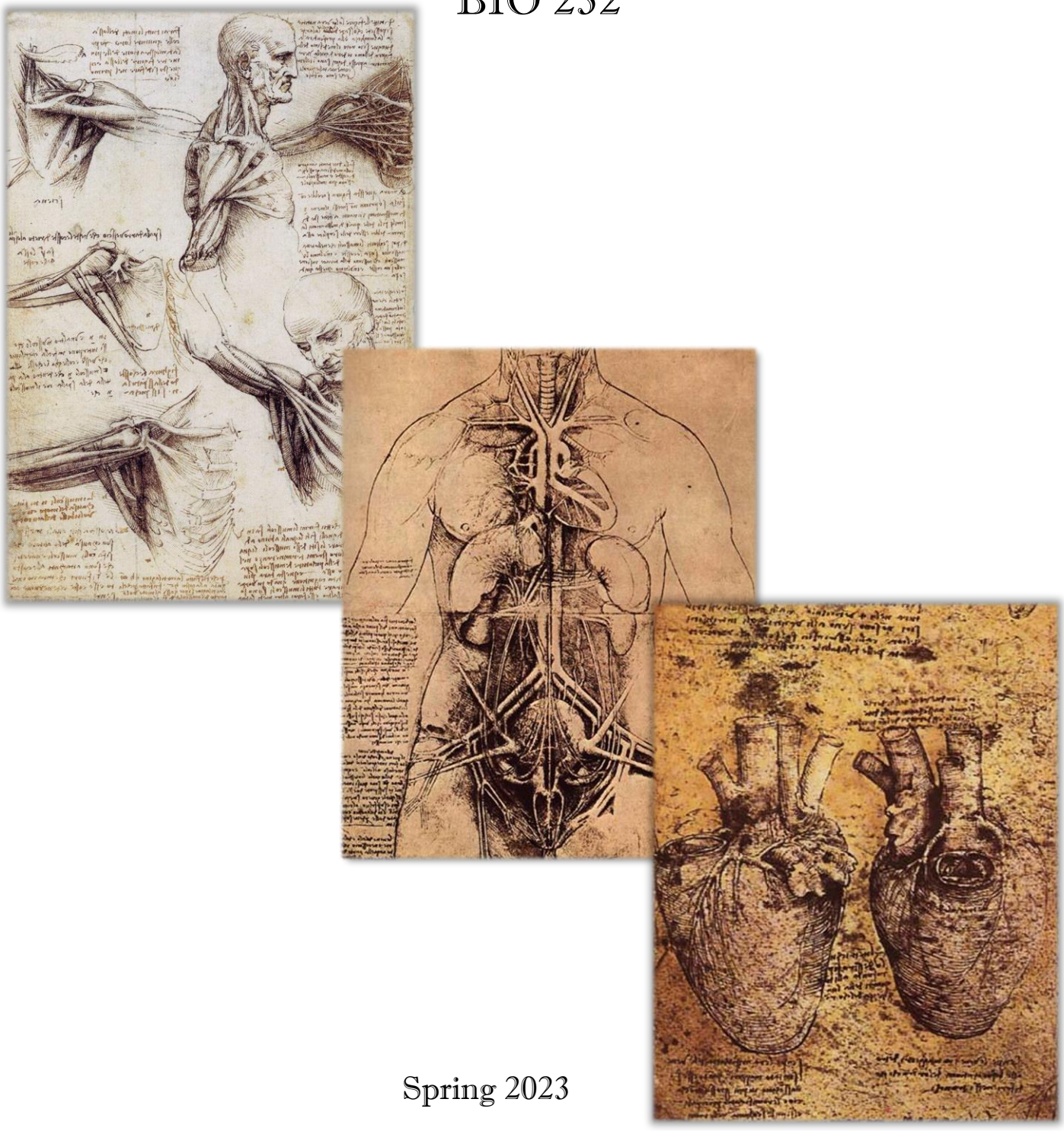
Lab Manual

Human Anatomy and Physiology II

BIO 232



Spring 2023

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Human Anatomy and Physiology 2 Lab Manual

Carolyn Rounds: Own work

Created: January 4, 2023

Welcome to Bio 232!

In this course, the labs will consist of experimentation using animal subjects, virtual scenarios, yourself and your lab partners to test hypotheses about several body systems.

Please let your instructor know if you are unable to participate in any experiment for any reason (sick, injury, etc.). **Participation is always voluntary** – but the more participants, the more data, so join in whenever you can! Non-participants in an experiment will still have responsibilities such as recording data, operating equipment etc.

Information on Dissections

In this course, we will be using a mink as our primary non-human study animal, but we will also be using preserved parts from other animals as well (sheep, pig). The information below is the standard procedure for whenever we are working with preserved specimens.

- The animal specimens are saturated with a preservative that you should not get on you.
    - Tie back long hair/roll up sleeves/remove bracelets & watches before dissecting
    - Let me know immediately if any preservative gets on you
- BEFORE you get your specimen, you **MUST** be wearing:
    - Goggles/Face shield
    - Gloves
    - Plastic Apron

Clean-up Instructions:

- *** KEEP GOGGLES & GLOVES ON DURING CLEANUP!!! ***
- Put specimen back into labeled bag
- Place preserved material that you are discarding into the **yellow** bin
- Wipe down table with **Windex Solution**
- Clean tray with **Windex Solution**, **Rinse** & **Dry**
    - You may also carefully clean your dissection tools with Windex solution and water

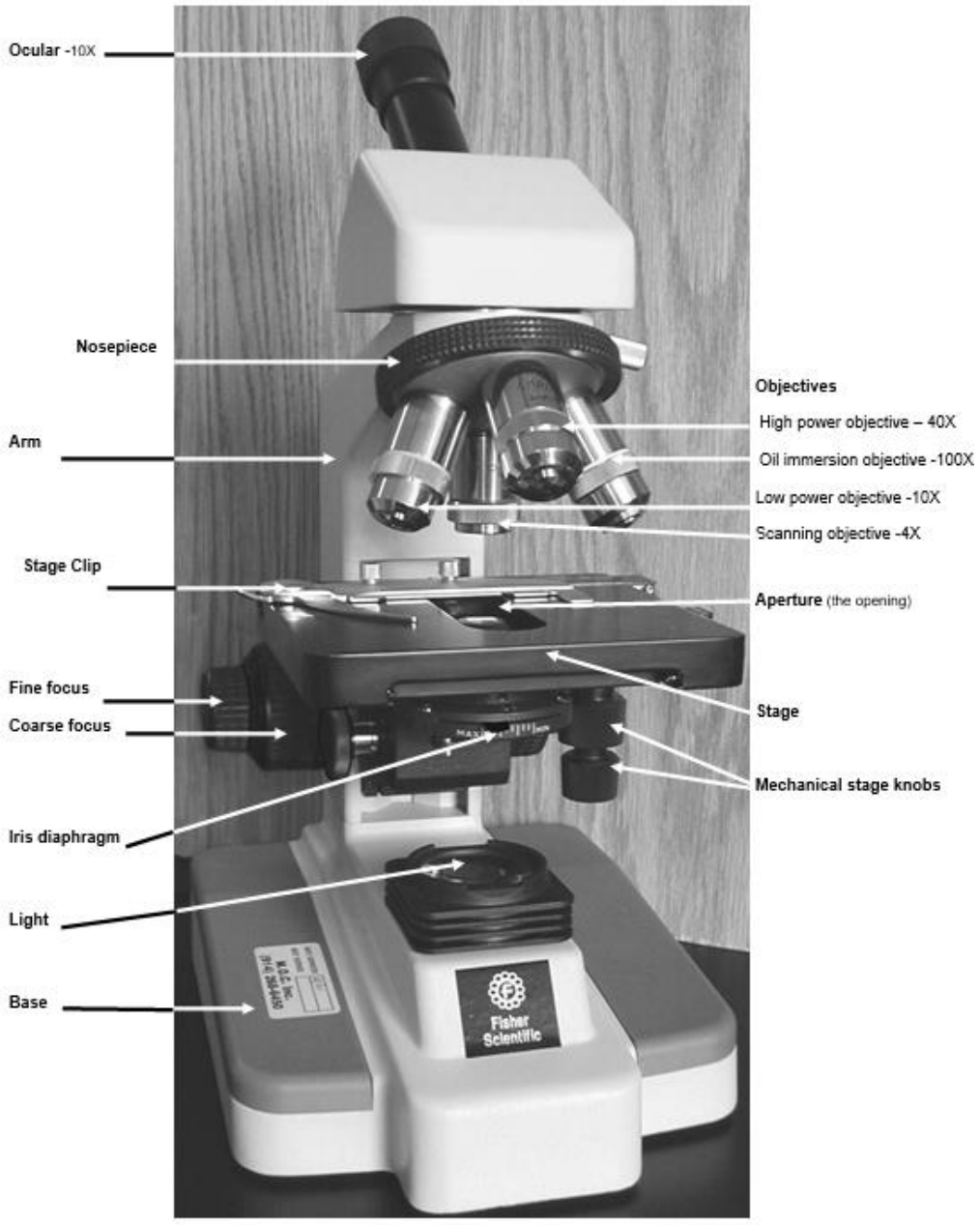
Using the Microscope

Microscopes are in the cabinets labeled “microscopes”.

- Carry the microscope with <u>two hands</u> to your table.
- Be sure the base is at least a thumb length in from the edge of the desk.
- Always clean a microscope before using it. ***<u>Be sure to use lens tissue on the lens.</u>*** The small bottles of lens cleaning solution should be used to wet the lens tissue.

1. Start on the shortest objective (scanning)
2. Turn light down and center slide over light on the stage
3. Use the coarse adjustment knob to raise the stage until it automatically stops
4. Look through the ocular (eye piece) and focus using the course or fine knobs
5. Center specimen and turn to low power
6. Focus using the course or fine knobs, center specimen and turn to high power
7. Use <u>fine</u> focus on high power.
8. When done, return to shortest objective lens (scanning) and remove the slide.

Figure 1



Introduction Attributions

Figures:

1. Microscope
   Carolyn Rounds: Own Work
   Creative Commons Attribution-Share Alike 4.0
   Created: June 16, 2022

Lab 1: Blood Histology and Physiology

Materials: Blood Smear slides, Blood Cell Models, WBC Differential counters, Pulse Oximeters, Blood type samples (4 per table), blood typing trays & toothpicks.
Purpose: The purpose of this lab is to learn to identify structures of the blood under the microscope and on models, including the relative abundance of the different types of leukocytes. Students will perform different activities to explore their effects on the percent oxygen saturation of blood. Additionally, students will learn to determine blood type based on the results of a blood-typing test. This lab addresses SLOs 1, 2, 3.

Part 1: Blood Histology

Procedure:
Be able to identify all the formed elements listed below under the microscope and on a model. Know the general functions & characteristics of Erythrocytes, Leukocytes & Platelets. Sketch the structures on the following page that you view under the microscope.

Formed Element Models

Erythrocyte

Eosinophil

Lymphocyte

Platelets

Basophil

Monocyte

Leukocyte

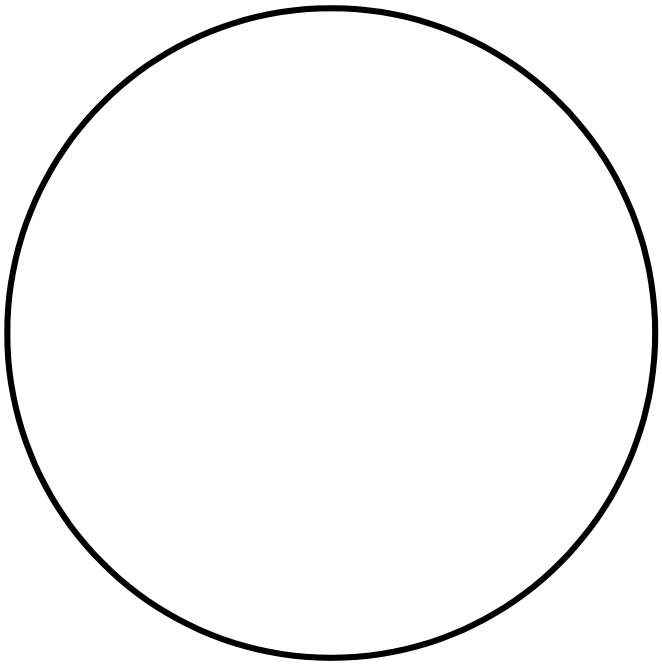
Neutrophil

Blood Smear Slide

Erythrocyte

Leukocyte

Platelet

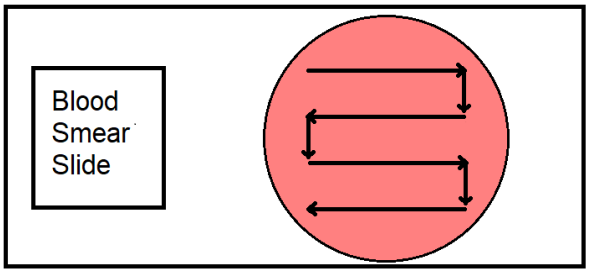


Part 2: Leukocyte Identification

Procedure:

Move your slide in a search pattern as shown in the figure below and identify all of the leukocytes that you see.

Figure 1



Leukocyte count:

	my count	class average count
Neutrophils	_____	_____
Lymphocytes	_____	_____
Monocytes	_____	_____
Eosinophils	_____	_____
Basophils	_____	_____

Part 3: Percent Oxygen Saturation

Background:

Oxygen is an important molecule that is used by cells in your body to make the energy they need in order to function. Muscle cells have especially high demands for oxygen, which they need to make large quantities of ATP during contraction. Oxygen is carried within erythrocytes in molecules called **hemoglobin**. Using a **pulse oximeter**, we can measure the percent of the hemoglobin in the blood that is saturated (filled) with oxygen.

You may have noticed that some activities are easy for you to do, and others require you to use more energy, leaving you tired afterwards. Use the space below to record the kind of activities that you've **observed** caused you to feel each way.

Question: Does the percent oxygen saturation change while performing different activities?

Write a **Hypothesis** that is a possible answer to the question above.

Predict what you expect to see in your results if you're right by ranking the following situations starting with those that you think will have the **smallest change** in percent oxygen saturation to those you think will have the **largest change**. If you think each activity will have the **same change**, or that there will be **no change**, indicate so here.

Activities: Sitting, Standing, Walking down and upstairs, Holding your breath for 40 sec

Procedure:

Percent Saturation of Hemoglobin

1. Two individuals (if possible) should volunteer to be participants.
2. Perform one of the activities in the chart below.
3. Place pulse oximeter on finger immediately after completing the activity and record values for heart rate and % oxygen saturation.
4. Repeat steps 2-3 with the next experimental condition.

	Participant 1		**Participant 2**		**Class Average**	
Experimental Condition	Percent saturation of oxygen	Heart Rate (bpm)	Percent saturation of oxygen	Heart Rate (bpm)	Percent saturation of oxygen	Heart Rate (bpm)
After Sitting for 1 minute						
After Holding your breath for 40 seconds						
After Standing for 1 minute						
After Walking down and up 2 flights of stairs						

Calculate the percent change using the **class average data** for each experimental condition using the following formula:

$$\left(\frac{\text{(Final-Initial)}}{\text{Initial}}\right) \times 100 = \%\ \text{change}$$

For this experiment, the initial value is the sitting value, the final is the experimental activity

Ex: To calculate the % change between sitting and holding breath:

$$\left(\frac{\text{(Holding breath - sitting)}}{\text{sitting}}\right) \times 100 = \%\ \text{change for holding breath}$$

Percent Changes:

	Percent Saturation of Oxygen	Heart rate
Holding Breath:	_____	_____
Standing:	_____	_____
Walking Stairs:	_____	_____

Conclusions:

1. Based on your **results**, rank the activities performed from those that that had the **smallest change** in percent oxygen saturation to those that had the **largest**.

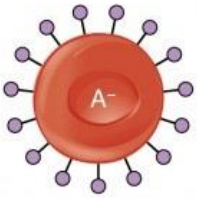
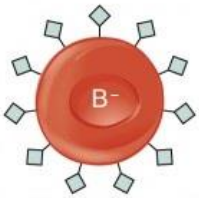
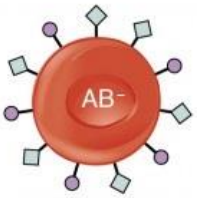
2. How do these **results** compare with your **predictions**? Which ones match? Which do not?

3. Looking at both the **percent oxygen saturation** and **heart rate** results for each activity, which variable changed the **least** from the resting values?

4. Why do you think the variable from question “3” stayed relatively constant?

Part 4: Blood Types

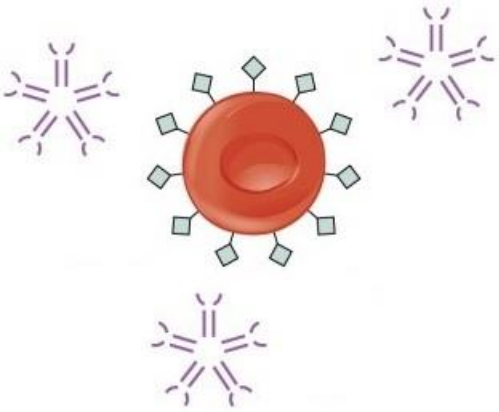
Figure 2

	Blood Type				
	A-	B-	AB-	O-	O+
Red Blood Cell Type					
Antibodies in Plasma	 Anti-B*	 Anti-A*	None*	 Anti-A and Anti-B*	 Anti-A and Anti-B
Antigens on Red blood Cell	A antigen	B antigen	 A and B antigens	None	Rh antigens

* Will produce Rh antibodies after exposure to Rh antigen.

Label the **Antibodies** and **Antigens:**

Figure 3



1. What occurs when the antigens match the antibodies?

2. Do antibodies and antigens normally match in a person's blood?

Fill in the chart below.

Blood Type	Antigen(s)	Antibody(ies)	Can donate blood to:	Can receive blood from:
A				
B				
AB				
O				
Rh+				
Rh-				

People possess different blood types based on their genetics. Since not all blood types are compatible when performing a blood transfusion, determining a person's blood type is essential to ensuring a safe transfusion. For the next experiment, you will be determining the blood types of four different individuals based on their agglutination results. Wherever you see clumping, agglutination has occurred because the antibody matched the antigen in the blood sample. If the blood sample stays clear, no matching has occurred and the sample does not possess that antigen.

<u>Procedure</u>

1. Add 3 drops of "blood" into each well.
2. Place 2 or 3 drops of Antibody A Serum into the "A" well.
3. Place 2 or 3 drops of Antibody B Serum into the "B" well.
4. Place 2 or 3 drops of Rh Antibody Serum into the "Rh" well.
5. Stir the contents of each well with the red toothpicks provided.
   use 3 toothpicks – one for each well to avoid cross-contamination!
6. Record and interpret your results on the following pages.

What is the **name** of the individual you are blood typing? _____

Did the blood in the **"A" well** stay clear or clump? _____

Did the blood in the **"B" well** stay clear or clump? _____

Did the blood in the **"Rh" well** stay clear or clump? _____

What is the **blood type** of this individual? _____

What **type of antibodies** does this individual possess? _____

What type(s) of blood could this person **receive**?

What blood types could this person **donate to**?

What is the **name** of the individual you are blood typing? _____

Did the blood in the **"A" well** stay clear or clump? _____

Did the blood in the **"B" well** stay clear or clump? _____

Did the blood in the **"Rh" well** stay clear or clump? _____

What is the **blood type** of this individual? _____

What **type of antibodies** does this individual possess? _____

What type(s) of blood could this person **receive**?

What blood types could this person **donate to**?

What is the **name** of the individual you are blood typing? _____

Did the blood in the **“A” well** stay clear or clump? _____

Did the blood in the **“B” well** stay clear or clump? _____

Did the blood in the **“Rh” well** stay clear or clump? _____

What is the **blood type** of this individual? _____

What **type of antibodies** does this individual possess? _____

What type(s) of blood could this person **receive**?

What blood types could this person **donate to**?

What is the **name** of the individual you are blood typing? _____

Did the blood in the **“A” well** stay clear or clump? _____

Did the blood in the **“B” well** stay clear or clump? _____

Did the blood in the **“Rh” well** stay clear or clump? _____

What is the **blood type** of this individual? _____

What **type of antibodies** does this individual possess? _____

What type(s) of blood could this person **receive**?

What blood types could this person **donate to**?

Attributions for Lab 1

Figures:

1. Blood Smear Scanning
   Carolyn Rounds: Own Work
   Creative Commons Attribution-Share Alike 4.0
   Created: July 29, 2022

2. & 3.
   ABO blood type
   https://commons.wikimedia.org/wiki/File:ABO_blood_type.svg
   InvictaHOG
   Public domain
   Created: August 25, 2006

Lab 2: Heart Anatomy

Materials: Dissection Kit, Preserved Heart, Human Heart Models, Heart with Lungs Model, Human Torso Model, Plasticized Heart.

Purpose**:** The purpose of this lab is to identify the blood vessels and major structures of the heart. Students will also identify the components of an ECG and will relate them to the electrical signaling and contraction events of the cardiac cycle. Sample ECG readings will be analyzed, and ECG paper will be used to determine the R-R Interval time. This lab addresses SLOs 3 and 6.

Part 1: Blood Vessels and Structures of the Heart

Procedure: Identify the following structures on the models and real hearts. Know which blood vessels and which areas of the heart contain oxygenated (HbO_2) and deoxygenated blood (Hb). Identify the structures with an "p" on both the models and the preserved heart. Be able to describe the direction of blood flow through the heart, and the direction of electrical signaling through the heart's conduction system.

Vessels of the Heart Oxygen Poor (Hb)

superior vena cava

inferior vena cava

pulmonary trunk

left and right pulmonary arteries

cardiac veins

coronary sinus

Vessels of the Heart Oxygen Rich (HbO_2)

left and right pulmonary veins

ascending aorta

arch of the aorta

descending thoracic aorta

brachiocephalic artery

left common carotid artery

left subclavian artery

circumflex artery

left and right coronary arteries

Heart Blood Vessels Labeling:

Create a numerical “key” for each blood vessel, and then label on the models with the number for that structure from your list.

1. _____
2. _____
3. _____
4. _____
5. _____
6. _____
7. _____
8. _____
9. _____
10. _____
11. _____
12. _____
13. _____
14. _____
15. _____

Structures of the Heart

apex[p] pericardium[p] epicardium[p]

base[p] myocardium[p] endocardium[p]

Right Atrium[p]

- auricle[p]
- fossa ovalis
- sinoatrial (SA) node
- atrioventricular (AV) node

Left Atrium[p]

- auricle[p]

Right Ventricle[s]

- tricuspid valve[p]
- chordae tendoneae[p]
- papillary muscles[p]
- trabeculae carneae[p]
- pulmonary semilunar valve
- Purkinje fibers

Left Ventricle[s]

- bicuspid or mitral valve[p]
- chordae tendoneae[p]
- papillary muscles[p]
- trabeculae carneae[p]
- aortic semilunar valve
- Purkinje fibers

Interventricular septum[p]

atrioventricular bundle or bundle of His

right & left bundle branches

Heart Structure Labeling:

Create a numerical “key” for each heart structure, and then label on the models with the number for that structure from your list. Duplicate structures only need to be labeled **once**.

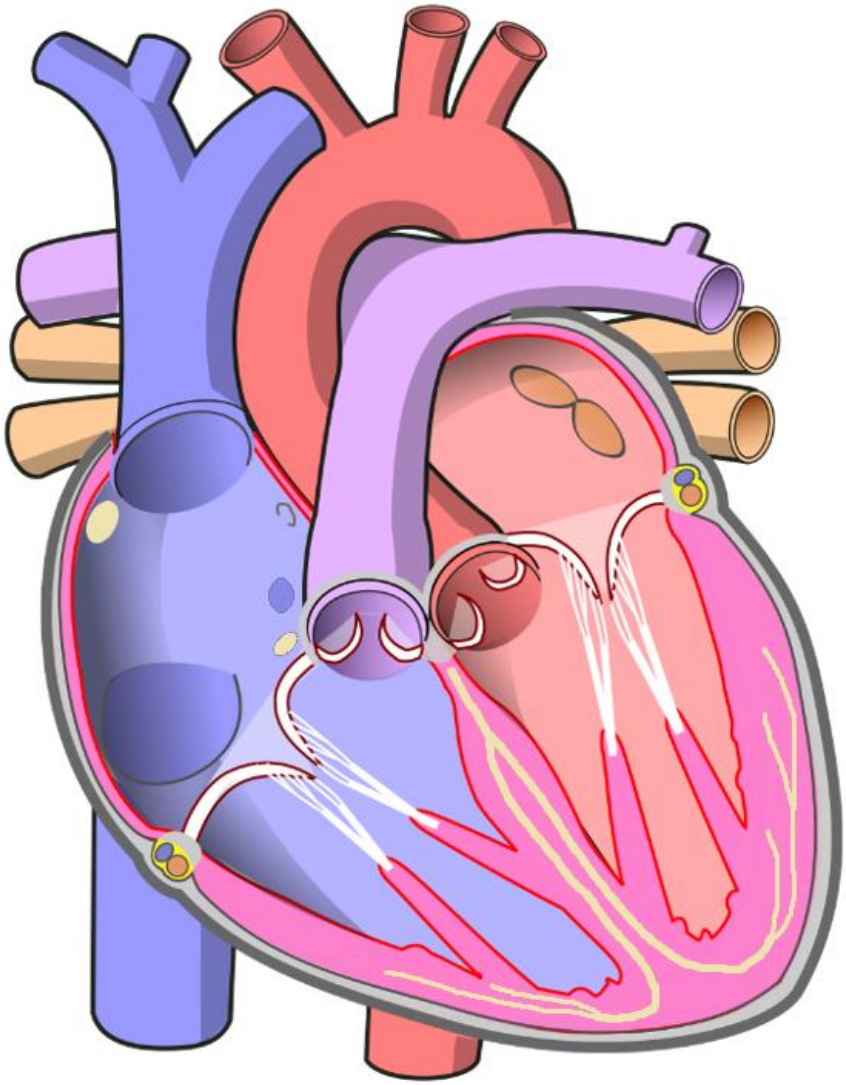
1. _____
2. _____
3. _____
4. _____
5. _____
6. _____
7. _____
8. _____
9. _____
10. _____
11. _____
12. _____
13. _____
14. _____

Diagram the pathway of the flow of blood through the heart using **arrows**.

Label each arrow as having oxygen rich blood with oxyhemoglobin **HbO_2**, or oxygen poor blood with deoxyhemoglobin **Hb**

Practice labeling each structure/vessel the blood flows through.
Include R or L side as needed.

Figure 1

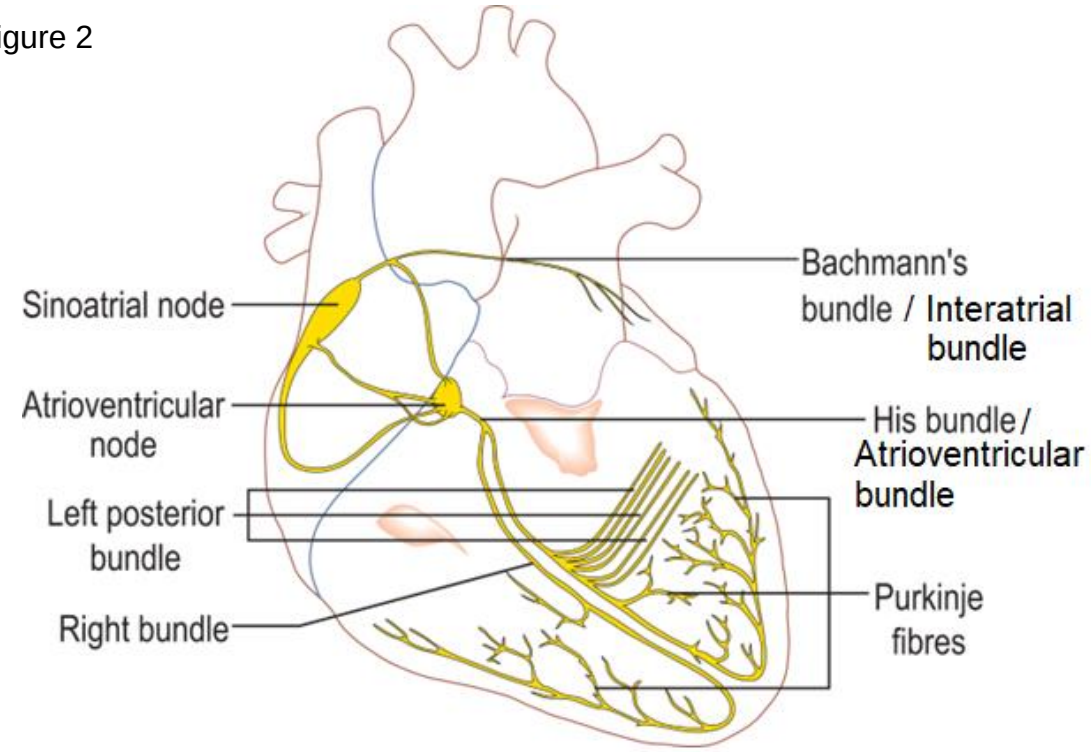


Part 2: Electrical Conduction in the Heart

In this part of the lab, you will be analyzing the ECGs for 2 participants before and after exercising. You will also analyze abnormal ECG readings and identify the parts of each reading that are unusual.

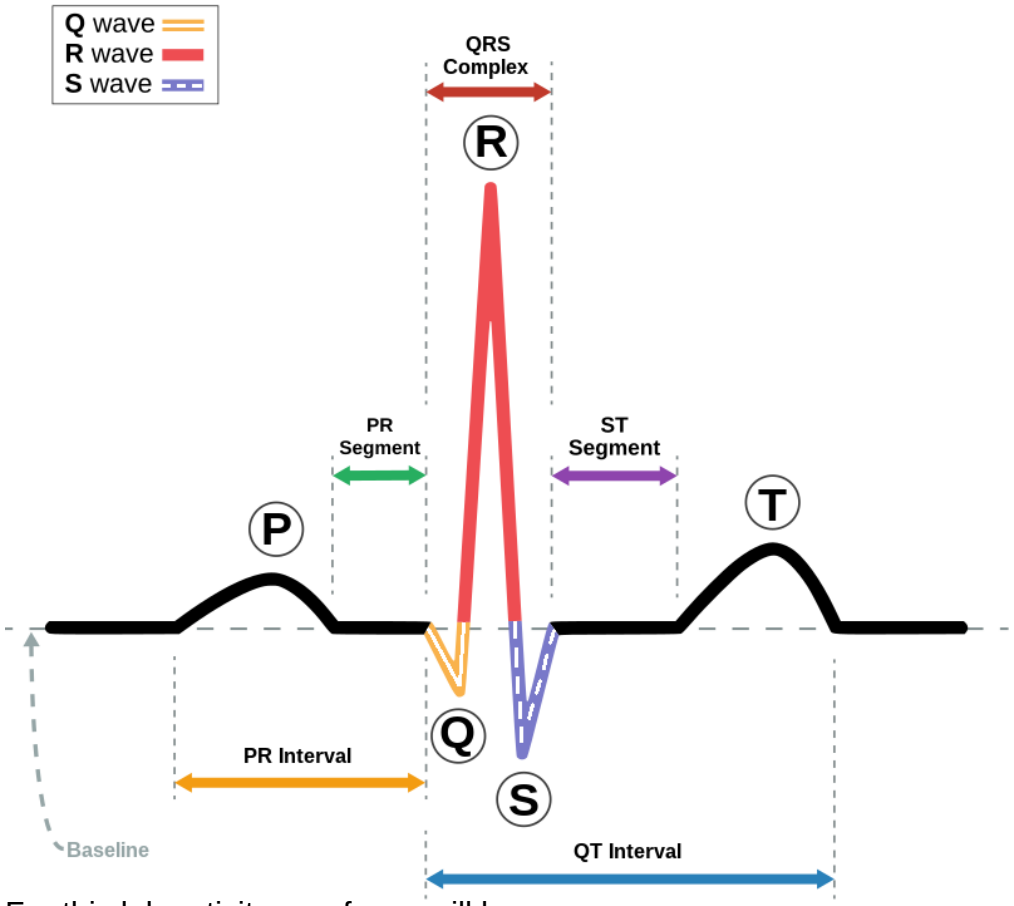
The muscle of the heart contracts not as a single unit, but in an organized sequence to guide blood through the heart's chambers and into their attached vessels. This process requires that action potentials travel along a route not only in the correct direction, but also at the right speed so that the chambers contract and relax in the correct order. The direction that the action potential travels can be recorded graphically as an **ECG** (also called an EKG) or **Electrocardiogram**. This is the same sort of graphical representation as what was recorded in BIO 231 with the EMG while experimenting with skeletal muscle – the only difference is that now we're looking at the contractile signals that are the action potentials propagating through the conduction system and cardiac muscle of the heart as it contracts.

Figure 2



The ECG can be broken into specific peaks or valleys called “waves” that are identified by a particular letter. Segments or intervals between the waves provide information about action potential transmission as well.
P wave - depolarization of the atria
QRS complex - wave of ventricular depolarization, atrial repolarization
T wave - repolarization of the ventricle
P-R interval – depolarization of atria to beginning of depolarization of ventricles
P-R segment - signal goes through AV node and AV bundle
R-R interval – time between two cardiac cycles
S-T segment – ventricular contraction
Q-T interval – depolarization & repolarization of the ventricles

Figure 3



For this lab activity, our focus will be on:

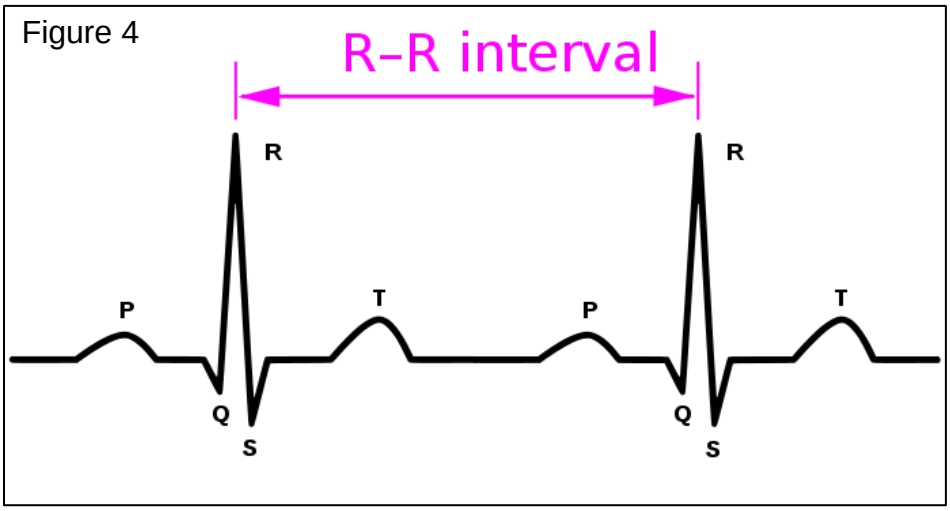
1.) Identifying what a P wave, QRS complex, and T wave look like in a normal ECG.
2.) Recognizing an abnormal ECG, and describing the wave characteristics that are different from a normal ECG.
3.) Calculating the time of the R-R interval for 2 volunteers when they are resting by sitting quietly, and after they have exercised for 5 minutes.
4.) Forming a conclusion about how the R-R interval changes with exercise, and interpreting what that means about how the heart rate has changed.

Procedure:

This activity includes data from two people who have volunteered to be the participants.

1.) After the resting ECG values are taken for Participant 1, use the grid on the ECG reading to calculate the time of one R-R interval.
   a. Do this by counting the number of whole large boxes between any two R waves. Multiply the number of large boxes you counted by 0.2 – since each large box represents 0.2 seconds.
   b. Next, if only part of a large box is between the two R waves, count the number of small boxes that fill in the remaining space.
      Multiply the number of small boxes you counted by 0.05 – since each small box represents 0.05 seconds.
   c. Add the number of seconds that you calculated counting the large boxes to the number that you calculated counting the small boxes to get the time for one R-R interval in seconds.
   d. Don't worry about if the R waves fall in between boxes, just approximate which line the wave is closest to and count the box whole box that the line is part of (don't count ½ or ¼ of a box!)

Figure 4



*** **NOTE** that in this simulation, each large box contains 4 small boxes. As a result, each **small box** will equal **0.05 seconds** (50 ms) of time. Normally, each large box would contain 5 boxes instead of 4 – so do not worry about memorizing the amount of time each box represents, just be able to apply it to the calculations for R-R interval and make sure you understand the process.
Each **large box** still equals **0.2 seconds**.

Figure 5

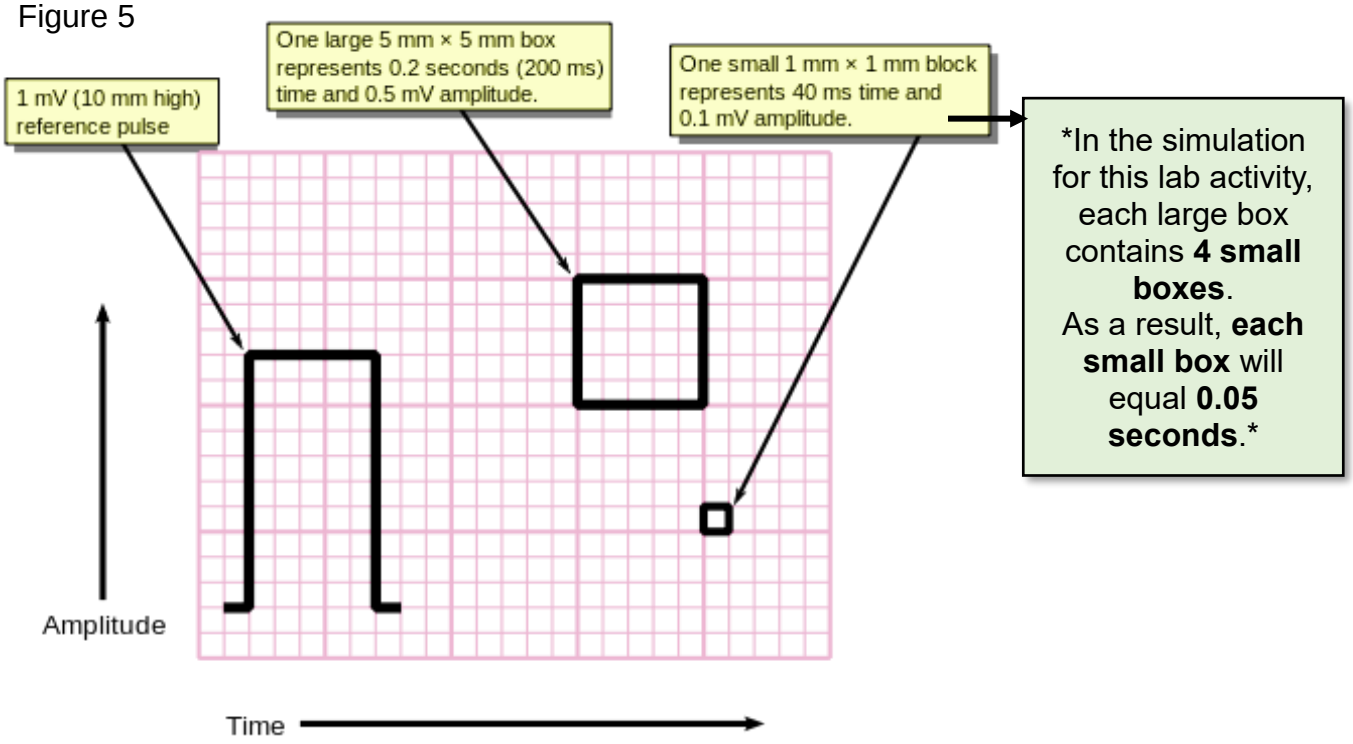


Table 1		
	Time (sec)	
	Participant 1	Participant 2
Resting R-R interval		
Exercise R-R interval		
Percent Change		

1.) **What happened to the R-R interval after the participants exercised based on the percent change value you calculated?**

2.) **What does this tell you about how the heart rate changes with exercise?**

Abnormal ECG Analysis

For each patient, describe any aspects of waves of the ECG that are **missing** or that are **present but abnormally shaped**. Be specific! State what is abnormal about the shape of a wave if that is the issue, or state specific waves that are missing from a reading if needed.

1.) **Is the ECG for Patient #1 normal? If no, what characteristics of the waves are abnormal?**

2.) **Is the ECG for Patient #2 normal? If no, what characteristics of the waves are abnormal?**

* Your instructor may have additional sample ECG readings for you to analyze.

Attributions for Lab 2

Figures:

1. Diagram of the human heart
   https://commons.wikimedia.org/w/index.php?curid=63920599
   Stenemo (derivative work Diagram of the human heart created by Wapcaplet)
   Edited by Carolyn Rounds to add conducting system, fossa ovalis, and opening for cardiac sinus.
   Creative Commons Attribution-Share Alike 4.0
   Created: November 7, 2017

2. Electrical conduction system of the heart
   https://commons.wikimedia.org/wiki/File:Conductionsystemoftheheart.png
   Madhero88
   Creative Commons Attribution 3.0
   Created: April 29, 2010

3. Sinus Rhythm Labels
   https://commons.wikimedia.org/wiki/File:SinusRhythmLabels.svg
   Created by Agateller (Anthony Atkielski), converted to svg by atom.
   Edited by Carolyn Rounds to add dashes and lines within QRS complex.
   Public domain
   Created: January 13, 2007

4. ECG-RR interval
   https://commons.wikimedia.org/wiki/File:ECG-RRinterval.svg
   Created by Agateller (Anthony Atkielski), converted to svg by atom, derivative work: Kychot
   Copyrighted free use
   Created: September 23, 2009

5. Diagram of electrocardiogram paper
   https://commons.wikimedia.org/wiki/File:ECG_Paper_v2.svg
   User:Markus Kuhn modified trace by User:Stannered of original PowerPoint JPEG by User:MoodyGroove
   Public Domain
   Created: May 12, 2007

Lab 3: Cardiovascular Physiology

Materials: Part 1 - ECG Electrode leads, surface electrodes, alcohol wipes.
Part 2 - Well slides, cotton balls, compound microscopes, 5% ethanol solution, ice water bath, 35^{o}C water bath or slide warmer, petri dishes, clicker counters, thermometers, droppers, *Daphnia*.

Purpose: The purpose of this lab is to determine how the ECG of a volunteer changes when someone goes from sitting to standing quickly. Additionally, In this lab you will be recording ECGs for subjects in your group after undergoing different activities. This lab addresses SLOs 1, 4 and 6.

Part 1: Effect on Heart Rate with Standing

Important: Do not attempt this experiment if you suffer from knee pain or dizzy spells. Inform your instructor of any possible health problems that might be exacerbated if you participate in this exercise.

Procedure:

If possible, two people from your lab group should volunteer to be the participants.
Standard Limb Lead ECG

1. Connect the ECG sensor to the computer (this may have been done for you already).
2. Attach three electrode stickers to the arms of each participant, as shown in Figure 1. You will get better readings if the electrodes are attached for a few minutes before you begin recording.
    a. For the participant who is having their ECG tracing done first, attach the **black lead** to the sticker that is just proximal to the right wrist, the **green lead** to the sticker that is just distal to the right elbow, and the **red lead** to the sticker that is just distal to the left elbow.

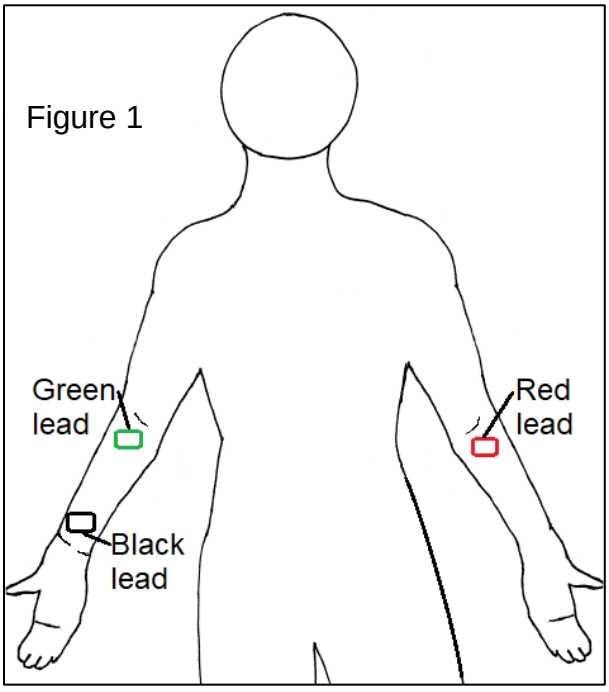


Figure 1

3. Open file 12 “Analyzing Heart EKG” from the “Human Physiology with Vernier” folder.

4. **ANY** electrical signals will produce noise in your reading and you will be unable to interpret your results. Sources of electrical signals include: skeletal muscle contractions, cell phones, electrical outlets, computers.
    - For this reason, the participant should sit at the end of the lab bench, as far from the computer and outlets as possible. All cell phones must be turned OFF, or placed in the cubby with your belongings. Finally, it is essential that the participant move as little as possible during the reading (this includes not talking).
5. The participant should sit in a relaxed position in a chair, with their forearms resting on their legs. The participant should hold the EKG box in their hands, so that it is covered by both hands. This will help to electrically shield the box from outside electrical signals.
6. When the participant is properly positioned, have someone click ▶ Collect to begin data collection.
7. Once data collection is finished, sketch two adjacent ECG tracings in the box on the next page. Label the: P-wave, S-wave, Q-wave, R-wave, and the T-wave.
8. Click and drag to highlight each interval listed in Table 1. Enter the Δ*t* value of each highlighted area to the nearest 0.01 s in Table 1. This value can be found in the lower left corner of the graph. Use Figure 2 and 3 as your guide when determining these intervals.

Figure 2

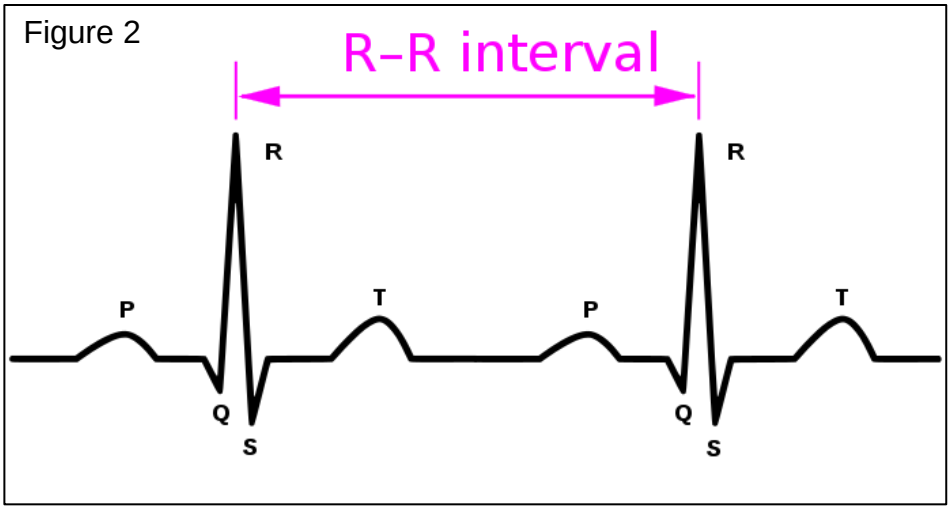
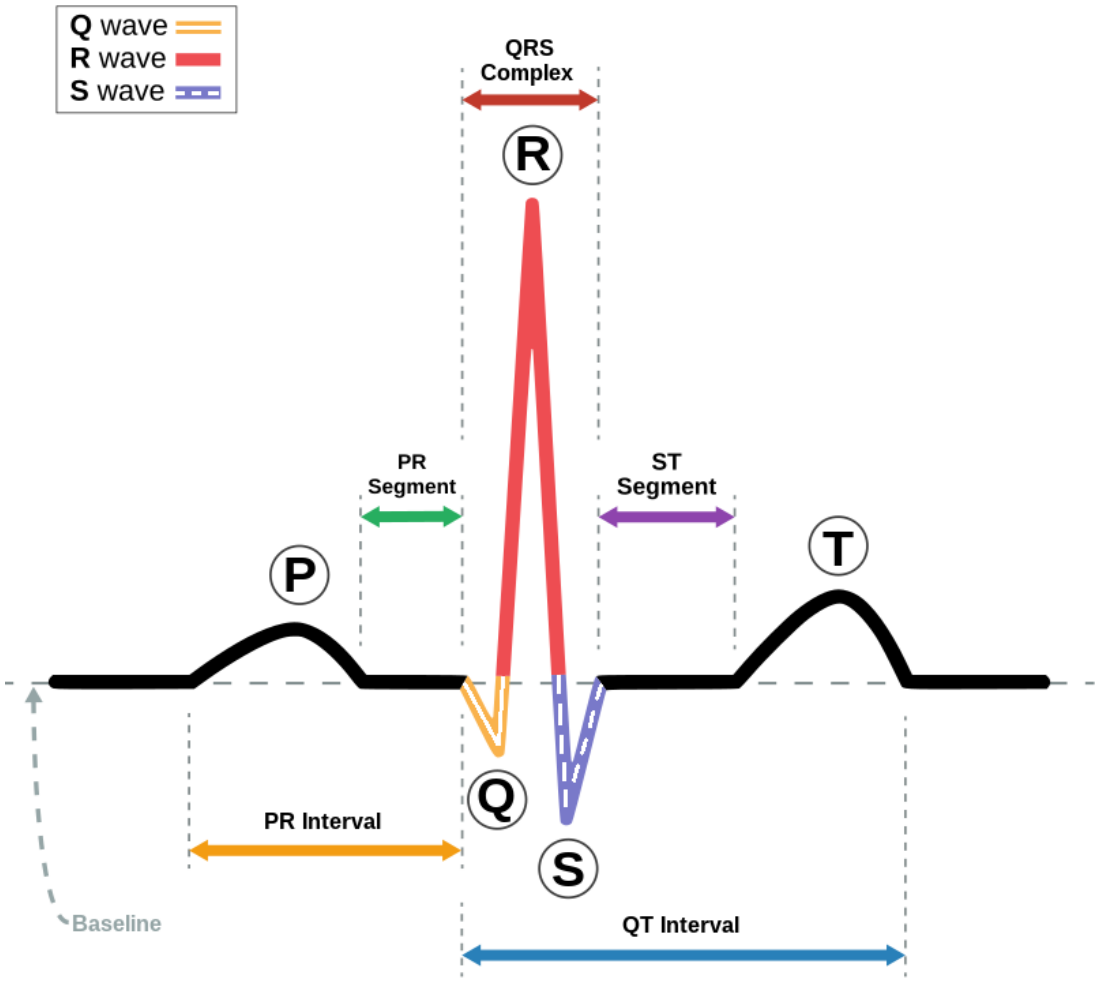


Figure 3



Sketch <u>two</u> of the heart beats you recorded from <u>one</u> participant in the box below.

Table 1: Sitting		
	Time (sec)	
	Participant 1	Participant 2
P – R		
S – T		
Q – T		
R – R		

Part 2: Sudden Standing ECG values

1. Using the same participants from Part 1 (and the same surface electrode pattern) have one subject stand up quickly from a seated position.
2. After the participant is fully standing, **immediately** record the ECG.
3. Once data collection is finished, click and drag to highlight each interval listed in Table 1. Enter the Δ*t* value of each highlighted area to the nearest 0.01 s in Table 2. This value can be found in the lower left corner of the graph. Use Figure 2 as your guide when determining these intervals.

When you are done, create a graph of your Class Average Data and calculate the Percent Change for each value (Initial is Sitting, Final is Standing).

Table 2: Standing		
	Time (sec)	
	Participant 1	Participant 2
P – R		
S – T		
Q – T		
R – R		

Table 3: Class Averages for Sitting & Standing			
	Time (sec)		Percent Change
	Averages for Sitting	Averages for Standing	
P – R			
S – T			
Q – T			
R – R			

DATA ANALYSIS

1. Compare the Percent Changes for the Class Average P-R, S-T, Q-T and R-R intervals. Did you see any significant differences between any of these values? If yes for which? (more than 5% change we'll consider significant)

2. For those values that showed a significant change, what does this mean is happening in the heart as one goes from sitting to standing? (see Figures 2 and 3 for a review of what each interval means)

Part 3: Temperature and Ethanol effects on Heart Rate

Purpose**:** Exposure to hot or cold can have a drastic effect on heart rate, as increased temperature will speed metabolic rates, and decreased temperatures will lead to depressed metabolic rates. This is especially apparent in exothermic organisms (s.a. lizards, amphibians, fish, and invertebrates) which cannot maintain temperature homeostasis by intrinsic mechanisms. We will observe the effects of changes in heart rate on the invertebrate Daphnia. We will also examine the effects of exposure of Daphnia to a 5% ethanol, as ethanol is known to act as a CNS depressant.

Observation: What have you **observed** about how the body responds to prolonged extreme heat? Extreme cold? Exposure to ethanol (the active substance in alcohol)? (These don't have to be experienced observations; you can think about movies you've seen where these scenarios have occurred)

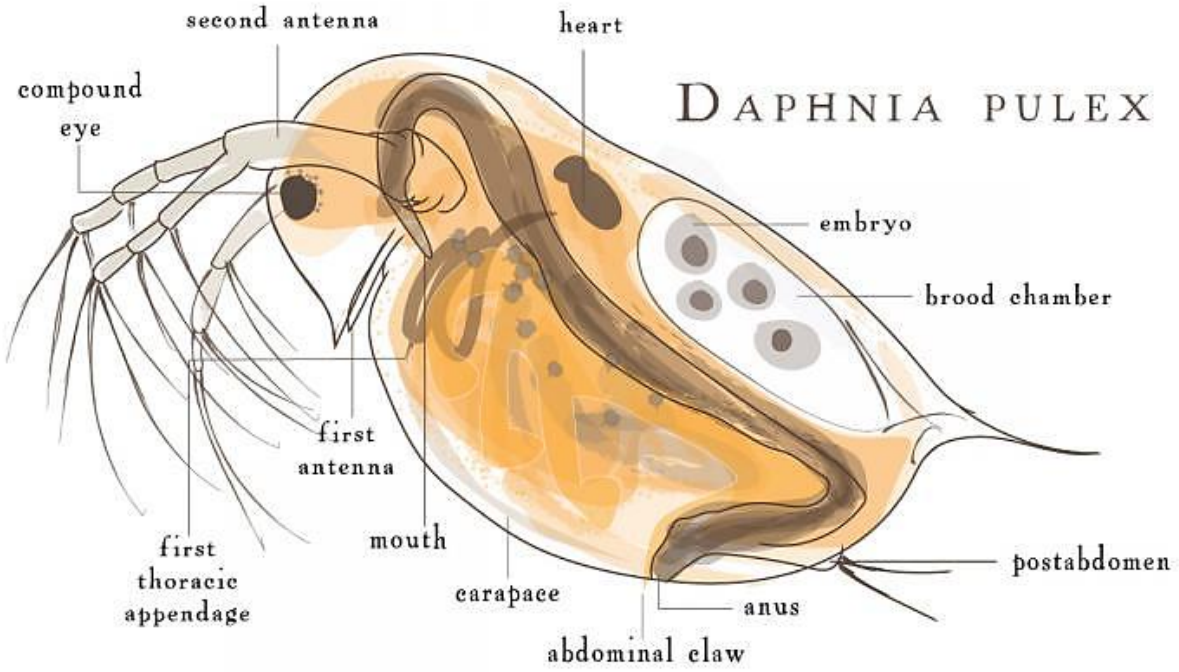
Question: With this observation in mind, we might pose the question:
"How does heart rate change when a living thing becomes extremely cold, when it is extremely hot, and when it is exposed to ethanol?"

Provide **3 Hypotheses** that answer this question. (*When exposed to extreme cold the heart rate will…etc.*)

Make **Predictions** about the results you will get if your Hypotheses are valid. (*Write in terms of **percent change predicted** compared to control value of room temperature*)

***Daphnia* Heart Rate Experiment**
Gloves must be worn when handling ethanol and when touching water from the *Daphnia* tank

Figure 4



1. Record the temperature of the water containing the *Daphnia* in the **Table 1**.
2. Cut off the narrow segments of a plastic dropper (this may have already been done for you) and use it to place one *Daphnia* on a well slide.
3. Tear off a **very** small amount of cotton fibers and place them in the well on the slide with the *Daphnia* to prevent it from moving.
4. Place the slide in a petri dish and use this petri dish to move your slide whenever it is not on the microscope.
5. Remove the slide from the petri dish and put the slide on the stage. Bring the *Daphnia* into focus on the Scanning (4x) objective.
6. Locate the heart as shown in **Figure 4**.
7. Use a clicker counter to count the number of heart beats in the *Daphnia* in room temperature conditions for **15 seconds**. Multiply this number by 4 to calculate the Beats Per Minute (BPM), and record this in **Table 1**.
8. Place the slide with your *Daphnia* in the petri dish. Check to see if your *Daphnia* needs more water. Set the petri dish in the ice water bath (don't let any ice get into the dish) and let sit in the ice for 5 minutes.
9. Record the temperature of the ice water bath in the **Table 2**.
10. After five minutes, retrieve you *Daphnia* from the ice water bath and **quickly** bring it back to your lab bench and put the slide on the microscope.

11. Use a clicker counter to count the number of heart beats in the *Daphnia* for 15 seconds. Multiply this number by 4 to calculate the Beats Per Minute (BPM), and record this in **Table 2**.
12. Place the slide with your *Daphnia* in the petri dish. Check to see if your *Daphnia* needs more water. Put the petri dish in the 35^{o}C water bath (don't let any water get into the dish) or onto the slide warmer.
13. Record the temperature of water bath/slide warmer in **Table 3**.
14. After five minutes, retrieve you *Daphnia* from the water bath/slide warmer and **quickly** bring it back to your lab bench and put the slide on the microscope.
15. Use a clicker counter to count the number of heart beats in the *Daphnia* for 15 seconds. Multiply this number by 4 to calculate the Beats Per Minute (BPM), and record this in **Table 3**.
16. Let your *Daphnia* rest in its petri dish on the lab bench for 5 minutes so that it can return to room temperature. During this time, you should also add a drop or two of room temperature water to the slide.
17. Record the temperature of the ethanol as the temperature shown on the thermometer on the table near the ethanol bottles in **Table 4**.
18. After 5 minutes, use a dropper to remove the fluid that the *Daphnia* is in, and replace it with a few drops of the 5% ethanol solution.
19. Wait 10 minutes and then count the number of beats per minute and record this value in **Table 4**.
20. Standing over a sink, use a dropper rinse the ethanol off of the *Daphnia* with water from the *Daphnia* tank (suck off the ethanol and put it in the sink, then add water from the tank).
21. Return the *Daphnia* to the tank by picking up the cotton it is trapped in and submerging it in the water of the tank. Holding the cotton, move it around until the *Daphnia* is released.

Table 1: *Daphnia* Heart Rate Data Room Temperature

	Temperature (^{o}C)	**Heart Rate (bpm)**
Group Data		
Class Average		

Table 2: *Daphnia* Heart Rate Data Cold Water

	Temperature (^{o}C)	**Heart Rate (bpm)**
Group Data		
Class Average		

Table 3: *Daphnia* Heart Rate Data Warm Water

	Temperature (^{o}C)	**Heart Rate (bpm)**
Group Data		
Class Average		

Table 4: *Daphnia* Heart Rate 5% Ethanol Water

	Temperature (°C)	Heart Rate (bpm)
Group Data		
Class Average		

Clean-up:

- Release *Daphnia* back into fish tank
- Place dirty well-slides in labeled container.
- Throw away used dropper and cotton into garbage.
- Place petri dish on counter by the sink.
- Wipe down table with Windex

Part 4: Neurotransmitter Heart Physiology

We can also observe the behavior of a vertebrate heart while being exposed to different chemical stimulants. Specifically, we can expose the heart to Acetylcholine - a chemical released by Parasympathetic post-ganglionic neurons – and Epinephrine – a chemical released by many Sympathetic post-ganglionic neurons and by the adrenal gland.

Use the clicker to count the number of heartbeats that occur during the video shown by your instructor when the frog heart is exposed to the Acetylcholine (ACh) and to the Epinephrine (E)

Chemical Messenger	Heart Rate (bpm)
ACh	
E	

Attributions for Lab 3

Figures:

1. 3 Lead ECG
   Carolyn Rounds: Own Work
   Creative Commons Attribution-Share Alike 4.0
   Created: December 27, 2022

2. Sinus Rhythm Labels
   https://commons.wikimedia.org/wiki/File:SinusRhythmLabels.svg
   Created by Agateller (Anthony Atkielski), converted to svg by atom.
   Edited by Carolyn Rounds to add dashes and lines within QRS complex.
   Public domain
   Created: January 13, 2007

3. ECG-RR interval
   https://commons.wikimedia.org/wiki/File:ECG-RRinterval.svg
   Created by Agateller (Anthony Atkielski), converted to svg by atom, derivative work: Kychot
   Copyrighted free use
   Created: September 23, 2009

4. Illustration of Daphnia pulex
   https://commons.wikimedia.org/wiki/File:120145_web.jpg
   K.Tapdıqova
   Creative Commons Attribution-Share Alike 4.0
   Created: May 7, 2018

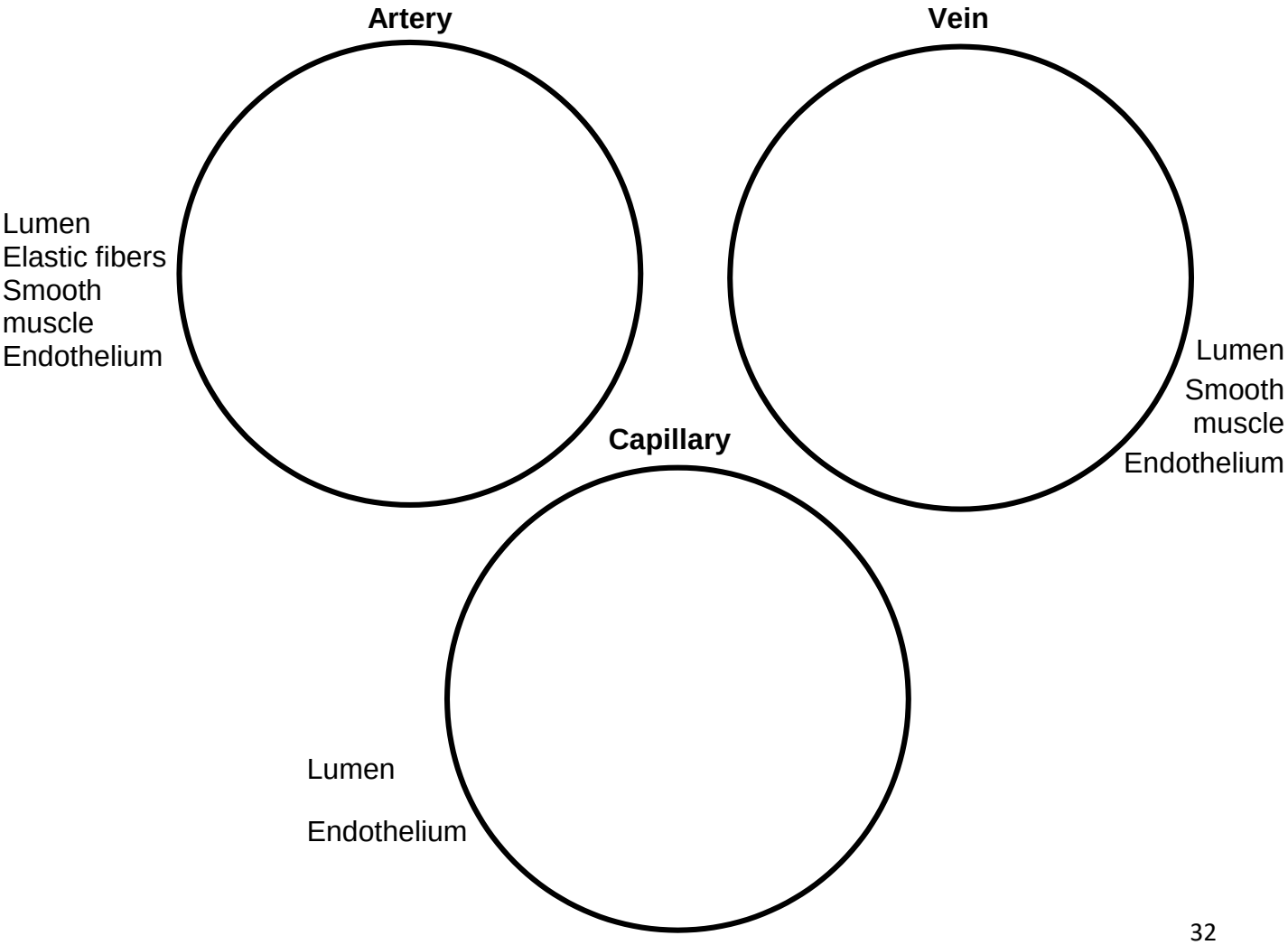
Lab 4: Blood Vessel Anatomy & Histology

Materials: Artery & Vein Model, Artery & Vein slides, Pituitary Gland slides, Human blood vessel model (board), Leg, Arm, & Torso Models.
Purpose: In this lab, students will identify the tissue layers and structures of an artery, vein and capillary. Students will also locate major arteries and veins in the human body and will identify the parts of the body that they supply or drain. Students will practice taking blood pressure while resting and after performing exercise. This lab addresses SLOs 1 and 3.

Part 1: Blood Vessel Histology

Procedure: Be able to identify the structures of arteries & veins on the blood vessel model. Identify and label the structures that are listed next to each circle of an artery, vein and capillary under the microscope.

Artery Model Structures		**Vein Model Structures**	
Tunica Externa	Tunica Intima	Tunica Externa	Tunica Intima
Tunica Media	Connective Tissue	Tunica Media	Connective Tissue
Endothelium	Smooth muscle	Endothelium	Smooth muscle
Elastic Membrane	Lumen	Valve	Lumen



Part 2: Blood Vessels - Arteries

Procedure: Be able to identify and **label all** of these vessels on the human models. Be able to describe the area of the body/organ being **supplied** by these vessels. For paired vessels **ALWAYS** identify if the vessel is right or left.

Blood Vessels: Arteries

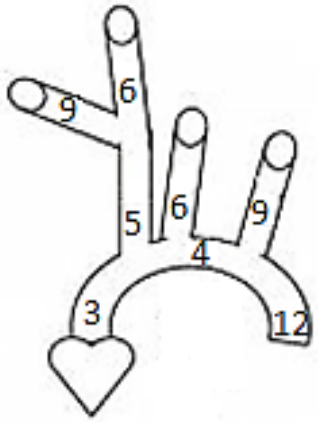
Pulmonary Vessels

1. pulmonary trunk
2. left or right pulmonary artery

Systemic Vessels

3. ascending aorta
4. arch of the aorta
5. brachiocephalic artery
6. left or right common carotid artery
9. left or right subclavian artery
10. left or right axillary artery
11. left or right brachial artery
12. descending thoracic aorta
13. intercostal arteries
14. abdominal aorta
15. celiac artery or trunk
16. hepatic artery
17. gastric artery
18. splenic artery
19. superior mesenteric artery
20. left or right renal artery
21. left or right testicular or ovarian artery
22. inferior mesenteric artery
23. left or right common iliac artery
24. left or right internal iliac artery
25. left or right external iliac artery
26. left or right femoral artery

Figure 1



Part 3: Blood Vessels - Veins

Procedure: Be able to identify and **label all** of these vessels on the human models. Be able to describe the area of the body/organ being **drained** by these vessels. For paired vessels **ALWAYS** identify if the vessel is right or left.

Blood Vessels: Veins

Pulmonary Vessels

27. left or right pulmonary veins

Systemic Vessels

28. superior vena cava
    29. left or right brachiocephalic vein
        30. left or right internal jugular vein
        31. left or right external jugular vein
    30. left or right subclavian vein
        33. left or right axillary vein
            34. left or right brachial vein
                35. left or right median cubital vein
    31. azygous vein
29. inferior vena cava
    38. hepatic portal vein
    39. left or right renal vein
    40. left or right testicular or ovarian vein
    41. left or right common iliac vein
        42. left or right internal iliac vein
        43. left or right external iliac vein
            44. left or right femoral vein

Part 4: Blood Pressure Physiology

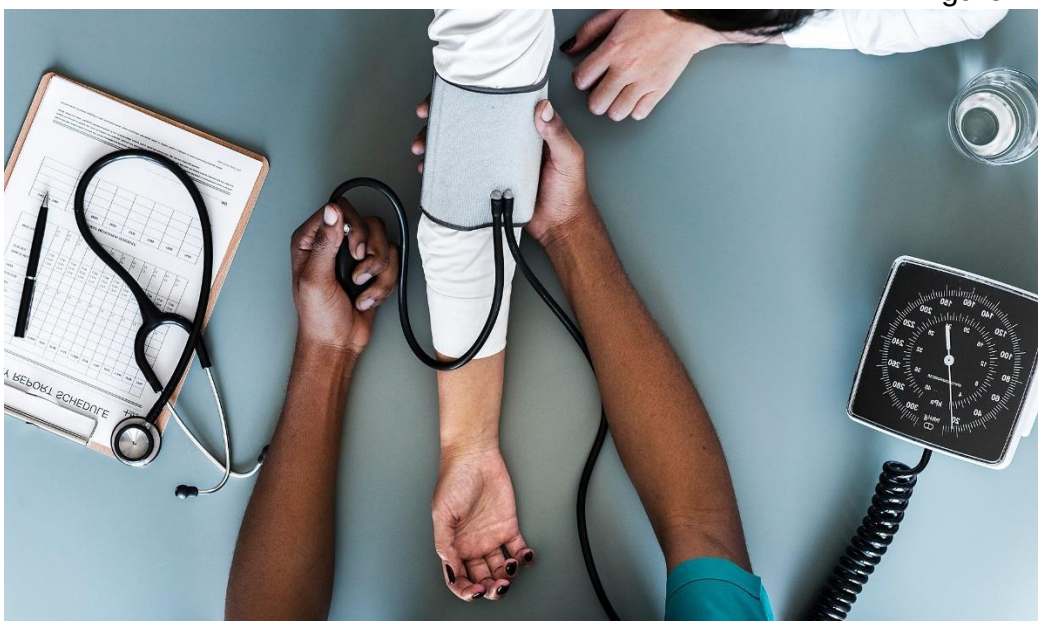
Materials: Electrode leads, surface electrodes, alcohol wipes, Vernier blood pressure cuff, sphygmomanometer, stethoscope.

Blood pressure readings provide us with important information that allows us to calculate the Mean Arterial Pressure (MAP). Since it is difficult to record blood pressure as blood immediately leaves the heart (as the Aorta and other great arteries reside within the thoracic cavity) a close approximation of the MAP can be attained by taking a blood pressure reading from the brachial artery in the brachium of the arm.

Traditionally, blood pressure is measured by preventing blood flow into the brachial artery using a blood pressure cuff with a pump (a **sphygmomanometer**) and then slowly allowing blood to flow back into the artery by releasing the pressure on the cuff and listening for two major Korotkoff sounds. The first sound, usually described as a rushing or tapping, is recorded as the **systolic** pressure – the high pressure value produced by the left ventricle contracting and forcing blood into the brachial artery. The second sound is the lack of noise that is recorded as the **diastolic** blood pressure – the low pressure value that occurs when the heart is in a relaxed state as it passively fills with blood.

Today, you will use the Vernier equipment to get readings which indicate these blood pressure values following periods of activity. When doing so, make sure the subject does not move or talk while data is being recorded by the computer, and also make sure that the blood pressure cuff is correctly positioned so that the sensor sits right at the inside of the elbow.

Figure 2



Observation: Certain scenarios are known to have an impact on blood pressure. Can you think of a few situations that would lead to an increase in blood pressure (think of emotions or activities that might raise blood pressure).

For this activity you will take the blood pressure of a volunteer before and after they exercise.

The goal of this experiment is to answer to **question**:
"What happens to mean arterial pressure (MAP) after exercise?"

Before you begin, **write a Hypothesis** that answers this question.
(Do you think the MAP will go up, go down, or stay the same after exercise?
Do not worry about being right! I don't expect anyone to know the answer right now, so just make an educated guess)

Based on your hypothesis, make a **Prediction** for what **percent change** you would expect to see in the MAP after exercising if your hypothesis is right.
(Do you expect to see a positive percent change, negative percent change, or zero percent change? Remember – a positive percent change indicates an increase from the initial to the final values, a negative percent change indicates a decrease, and a percent change of zero indicates no change.)

Procedure:

Two people from your lab group should volunteer to be participants.

Part I Baseline Blood Pressure

1. Connect the Blood Pressure Sensor to the Vernier computer interface (this may have already been done for you).
2. Open the file "08 Blood Pressure Exercise" from the *Human Physiology with Vernier* folder.
3. Attach the Blood Pressure cuff to the upper arm of the first participant, approximately 2 cm proximal to the elbow. Tighten the cuff so that it fits snug around the arm. The two rubber hoses from the cuff should be positioned over the biceps muscle (brachial artery) right at the crease of the elbow (**Figure 2**).
4. To get a good reading, it is **EXTREMELY** important that the following be done during data collection: **DO NOT** touch or move the blood pressure bulb after pumping it up at the beginning of the reading. **DO NOT** touch the release valve during data collection. The participant must sit quietly and **NOT talk or move** during data collection. If the participant moves or talks, this will disrupt the readings.
5. When you are ready, click Collect to begin data collection.
6. Immediately pump the bulb until the cuff pressure reaches **160 mm Hg**. *Do **NOT** exceed this pressure value.*
7. Stop pumping and do not touch any of the equipment. The participant must sit quietly for the entire data collection time (100 sec). During this time the systolic, diastolic, and mean arterial pressures will be calculated by the software. These values will be displayed on the computer screen.
8. When the blood pressure readings have reached **50 mm Hg** you can release the remaining pressure and allow the program to continue to collect data until the collection period ends. **DO NOT** remove the cuff - the participant must remain sitting still without talking until data collection has completed.
9. Enter the systolic, diastolic, and mean arterial pressures in Table 1.
10. Repeat these steps with the second participant.

Part II Blood Pressure after Activity

1. The same subjects from Part I of the experiment will participate in Part II.
2. Have one of the two participants exercise vigorously by running in place or do jumping jacks for 1 minute.
3. At the end of 1 minute, the participant should sit down, and have their blood pressure recorded as per the instructions in Part I.
4. Enter the systolic, diastolic, and mean arterial pressures in Table 1.
5. Repeat these steps with the second participant.

Table 1		
	Resting	
	Participant 1	Participant 2
Systolic Blood Pressure (mmHg)		
Diastolic Blood Pressure (mmHg)		
MAP (mmHg)		
Class average MAP (mmHg)		
	Physical Activity	
	Participant 1	Participant 2
Systolic Blood Pressure (mmHg)		
Diastolic Blood Pressure (mmHg)		
MAP (mmHg)		
Class Average MAP (mmHg)		

Calculate the **percent change in MAP** using the formula:

$$\left(\frac{[\text{Final-Initial}]}{\text{Initial}}\right) \times 100$$ or for this experiment: $$\left(\frac{[\text{Exercise - Resting}]}{\text{Resting}}\right) \times 100$$

1.) **What is the percent change you calculated for the Class Average values?**

2.) **What does this tell you about how the MAP changes after exercising? Was your original Hypothesis supported?**

Attributions for Lab 4

Figures:

1. Blood flow from Aorta
   Carolyn Rounds: Own Work
   Creative Commons Attribution-Share Alike 4.0
   Created: December 31, 2022

2. Blood Pressure Monitoring
   https://commons.wikimedia.org/wiki/File:Blood_pressure_monitoring.jpg
   rawpixel.com - http://allfreephotos.net/
   Public domain
   Created: June 26, 2019

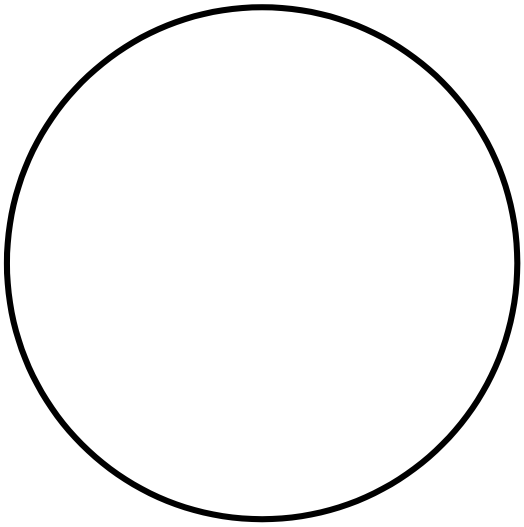
Lab 5: Respiratory System Anatomy & Histology

Materials: Human Torso model, Infant Models, Torso model head in sagittal section, Thorax model, Larynx model, Lung slides, Trachea slide, mink.

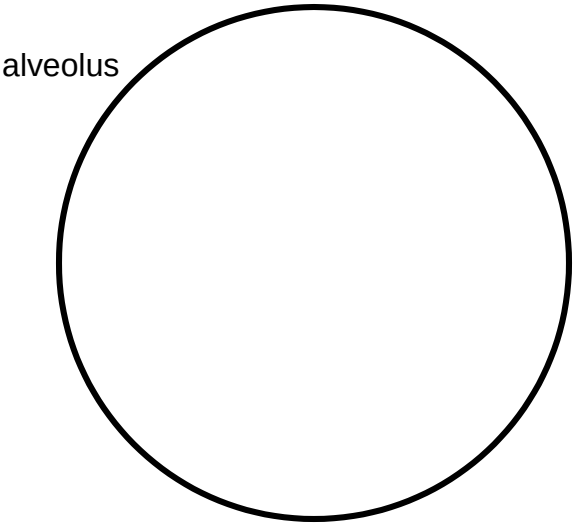
Purpose: In this lab, students will identify respiratory structures under the microscope. Both Respiratory and Lymphatic structures will be identified on the models and in preserved specimens. Students should be able to identify the structures with a * on the mink and structures with a ^{P} on the pig lungs. This lab addresses SLO 3.

Part 1: Respiratory Histology

Normal Lung

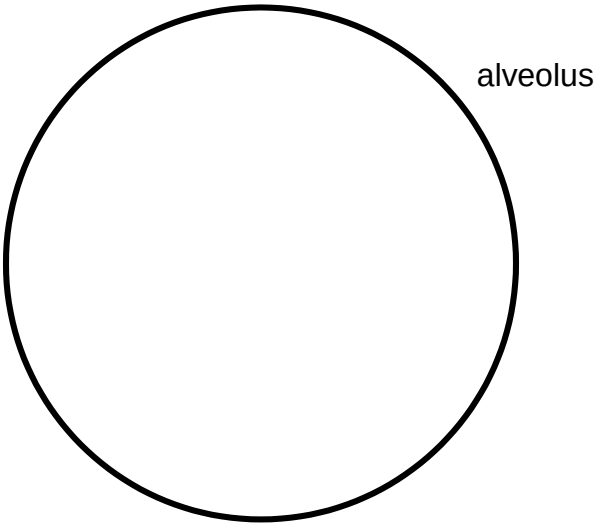


Emphysema Lung

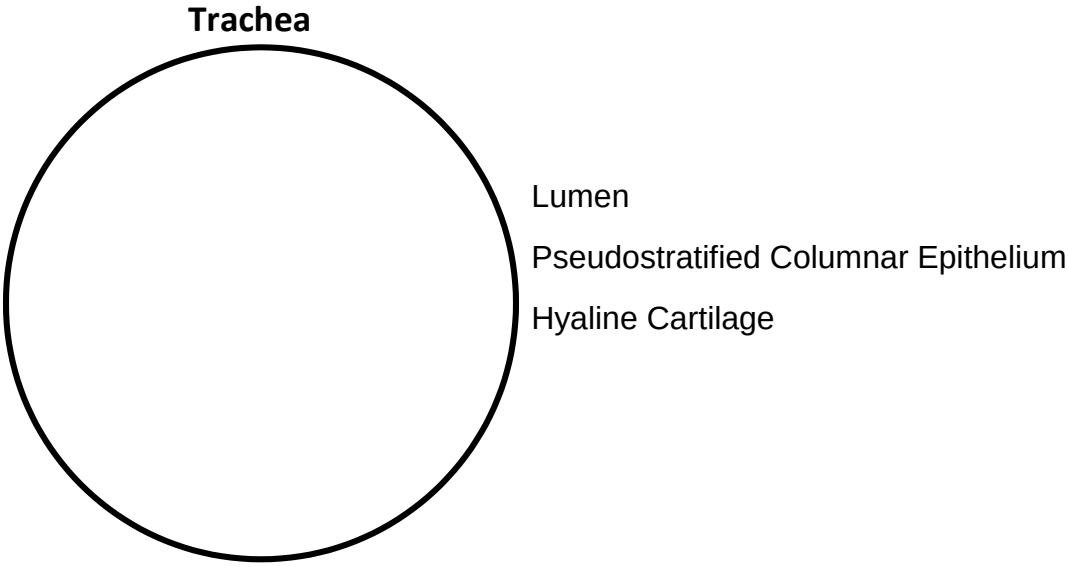


compare structure of tissue to normal

TB (tuberculosis) Lung



compare structure of tissue to normal



Part 2: Lymphatic System Structures

Pharyngeal tonsil

Palatine tonsil

Lingual tonsil

Thymus*

Spleen*

Lymph nodes

Lymph vessels

Part 3: Respiratory System Structures

external nares *

nasal cavity

- nasal conchae

nasopharynx

- eustachian tube

hard palate

soft palate

- uvula

oral cavity

oropharynx

- palatine tonsils

laryngopharynx

hyoid bone

larynx *

- epiglottis
- glottis
- vocal cords
- vestibular fold
- thyroid cartilage
- cricoid cartilage
- arytenoid cartilages

trachea *

- tracheal cartilages *

Bronchial tree

- primary bronchi [p]
- secondary bronchi
- tertiary bronchi
- terminal bronchus
- alveolar sac
- alveolus

diaphragm *

left and right lungs *[p]

Respiratory System Labeling:

Create a numerical “key” for each structure, and then label on the models with the number for that structure from your list.

1. _____
2. _____
3. _____
4. _____
5. _____
6. _____
7. _____
8. _____
9. _____
10. _____
11. _____
12. _____
13. _____
14. _____
15. _____
16. _____
17. _____
18. _____
19. _____
20. _____
21. _____
22. _____
23. _____
24. _____
25. _____

26. _____
27. _____
28. _____
29. _____
30. _____
31. _____
32. _____

Lab 6: Respiratory Physiology

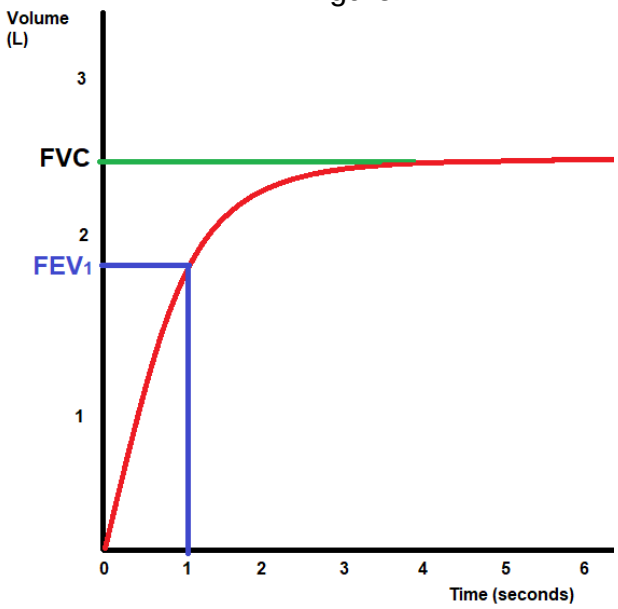
Materials: Vernier Spirometers, bacterial filters, nose clips, Virtual Spirometer Lab.

Purpose: In this lab, students will measure and compare the **FEV_1/FVC** of different individuals and will make comparisons about their lung capacities and respiratory health. This lab will also allow students to measure the amount of air exchanged while breathing at resting levels, as well as following physical activity to explore changes in lung volume and breathing rate. This lab addresses SLOs 1 and 4.

FVC is the **forced vital capacity** – the maximum volume of air that can be expelled from the lungs following a deep inhale.

FEV_1 is the **forced expiratory volume in 1 second** – the volume of air that is expelled after 1 second during the scenario described above.

Figure 1



FEV_1/FVC when multiplied by 100 tells us what percentage of all the air exhaled was expelled during the first second of exhaling. In a healthy person, this should be around 80%. Someone with an obstructive lung disorder would have an **FEV_1/FVC** of 70% or less – indicating that airflow out of their lungs is being blocked or impeded.

These values provide valuable information about how air is being conducted through the lungs, and can be used to indicate both obstructive and restrictive lung diseases, as well as natural variations that exist between people based on their age, height and assigned sex.

In this lab activity we will explore what differences (if any) exist between smokers and non-smokers, young and old individuals, short and tall individuals, and those whose gender assigned at birth is female or male.

Procedure:

To begin **watch the short video** on how the experiment works in the tab that says "Introduction" by following the link in "Materials" on page 1.

When you are ready, click the tab at the top that says "Spirometer"

Enter the criteria for the individual listed: you choose different ages/heights by dragging the button in each area. Then click "Start". After that, save your data by clicking "Record Data".

*****It is essential that you click "Record Data" after each recording, you cannot record past data if you have moved on to a new participant*****

When you are done recording all your data, copy that data into the space provided in this procedure.

Answer the questions posed to analyze your data.

Gather data on the following participants:

1.) Male age 70, height 160 cm, non-smoker
2.) Male age 20, height 160 cm, non-smoker
3.) Male age 20, height 170 cm, non-smoker
4.) Female age 45, height 170 cm, smoker
5.) Female age 45, height 170cm, non-smoker
6.) Male age 45, height 170cm, non-smoker

Age	Height	F/M	Smoke	FVC	FEV_1/FVC (%)
			FEV_1		

Part 2: Ventilation Experiment

When you are breathing quietly, such as when you sit quietly in class, you only use a small portion of the volume of your lungs for gas exchange. The remainder of this volume is used for exchanging larger amounts of air during periods of activity.

Tidal Volume (TV): The volume of air breathed in and out without conscious effort

Inspiratory Reserve Volume (IRV): The additional volume of air that can be inhaled with maximum effort after a normal inspiration

Expiratory Reserve Volume (ERV): The additional volume of air that can be forcibly exhaled after normal exhalation

Vital Capacity (VC): The total volume of air that can be exhaled after a maximum inhalation:

VC = TV + IRV + ERV

Residual Volume (RV): The volume of air remaining in the lungs after maximum exhalation (the lungs can never be completely emptied)

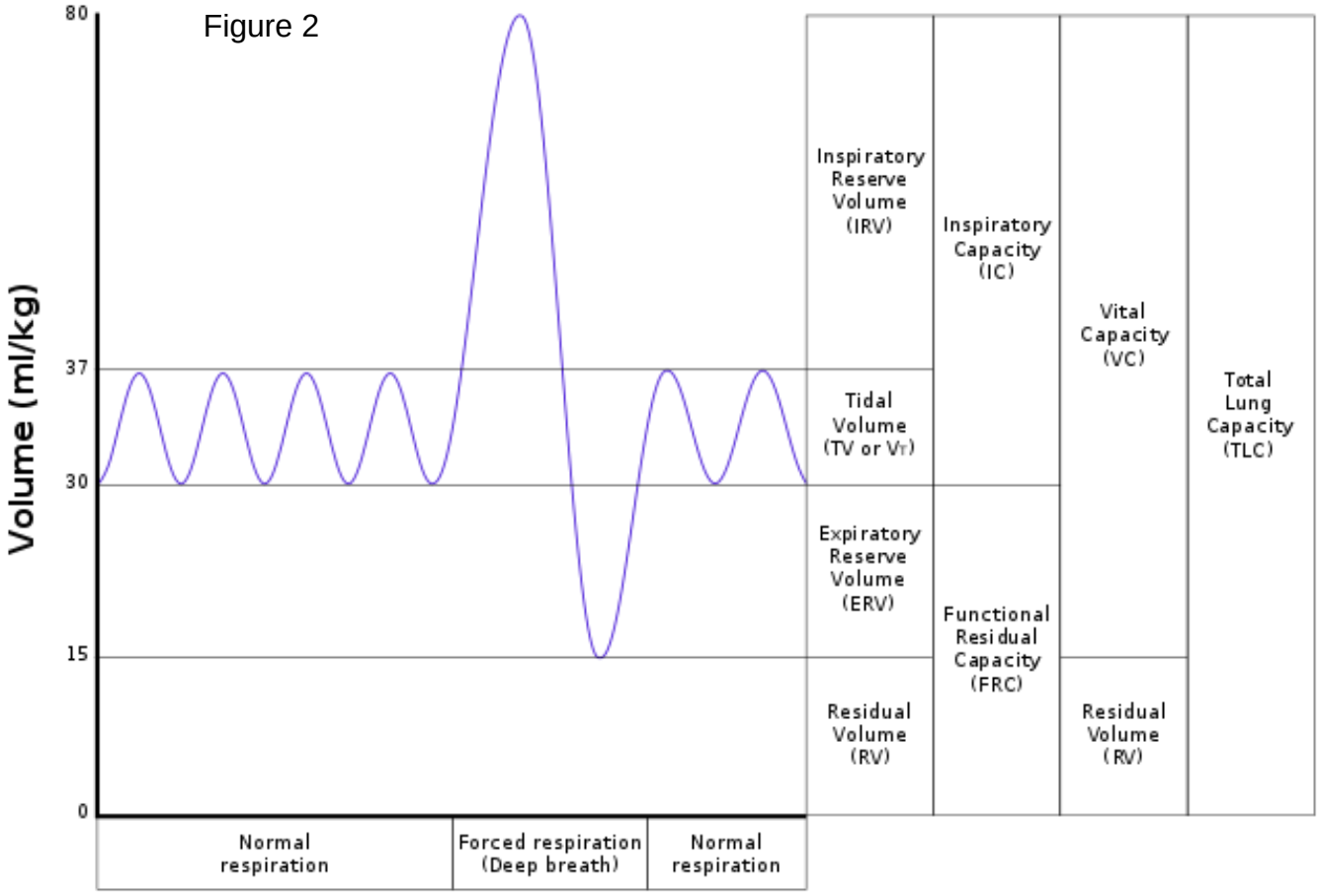
Total Lung Capacity (TLC):

TLC = VC + RV

Minute Ventilation: The volume of air breathed in 1 minute:

MV = (TV)*(breaths/minute)

Figure 2



Procedure:

What have you **observed** about your breathing when you are sitting quietly compared to when you are physically active? Is the rate / speed of breathes the same?

We can then ask a **question** concerning breathing recovery following a few different scenarios:

"How does the minute ventilation change after holding your breath and after exercise?"

What are your **Hypotheses** that answer this question? (hint: you will have 2. Do you think the MV increases, decreases, or stays the same?)

What are your **Predictions** for what you would see in your data if these Hypotheses are valid? (What **percent change** would you expect to see in your data if you're right for each scenario? Should it be positive, negative, or zero?)

Procedure:

***Important* Do not** attempt this experiment if you are currently suffering from a respiratory ailment such as the cold or flu.

Part I: Total Lung Capacity

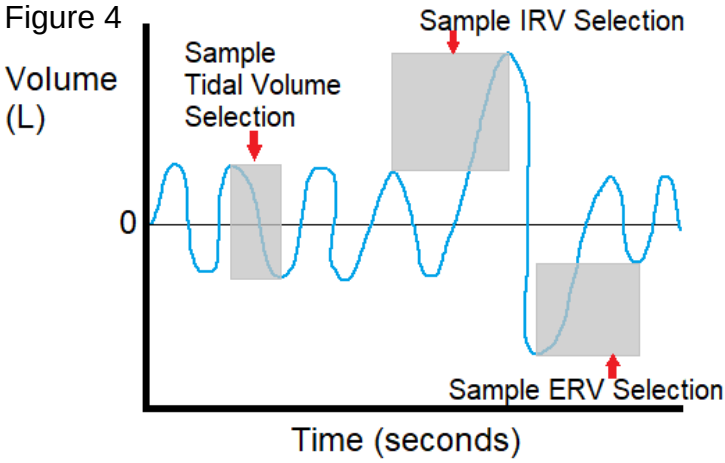
One participant will participate in this part.

Connect the Spirometer to the Vernier computer interface. Open the file "19 Lung Volumes" from the *Human Physiology with Vernier* folder.

Figure 3

1. Attach the larger diameter side of a bacterial filter to the "Inlet" side of the Spirometer. (see Figure 3).
2. Hold the Spirometer in one or both hands. Brace your arm(s) against a solid surface, such as a table, and click "zero" to zero the sensor.
   **** Note: The Spirometer must be held straight up and down, as in Figure 3, and not moved during data collection.****
3. Put on the nose plug and Click "collect" to begin data collection.
4. Taking normal breaths, begin data collection with an inhalation and continue to breathe in and out. After **4 cycles** of normal inspirations and expirations fill your lungs as deeply as possible (maximum inspiration) and exhale as fully as possible (maximum expiration**). *It is essential that maximum effort be expended when performing tests of lung volumes.***
5. Follow this with at least one additional recovery breath.
6. Click "stop" to end data collection.
7. Click the "Next Page" button to see the lung volume data. If the baseline on your graph has drifted, use the Baseline Adjustment feature to bring the baseline volumes closer to zero, as in Figure 4.

Figure 4



8. Select a representative peak and valley in the Tidal Volume portion of your graph. Place the cursor on the peak and click and drag down to the valley that follows it.
   **Make sure that you drag the cursor on a diagonal path from the peak to the valley, so that the highlighted area forms a grey square/rectangle. **
9. Enter the Δ*y* value displayed in the lower left corner of the graph to the nearest 0.1 L as Tidal Volume in Table 1.

10. Move the cursor to the peak that represents your maximum inspiration. Click and drag down the side of the peak until you reach the level of the peaks graphed during normal breathing.
11. Enter the Δ*y* value displayed in the lower left corner of the graph to the nearest 0.1 L as Inspiratory Reserve Volume in Table 1.
12. Move the cursor to the valley that represents your maximum expiration. Click and drag up the side of the peak until you reach the level of the valleys graphed during normal breathing.
13. Enter the Δ*y* value displayed in the lower left corner of the graph to the nearest 0.1 L as Expiratory Reserve Volume in Table 1.
14. Calculate the Vital Capacity and enter the total to the nearest 0.1 L in Table 1.
15. Calculate the Total Lung Capacity and enter the total to the nearest 0.1 L in Table 1. (Use the value of 1.5 L for the RV.)
16. Repeat steps 3-16 with a second subject – making sure that the second subject uses a fresh bacterial filter.
17. Share your data with your instructor and complete the Class Average columns in Table 1.

	Participant Results	**Class Average Participants with EPC Organs**	**Class Average Participants with SPC Organs**
Lung Volume (L)			
Tidal Volume (TV)			
Inspiratory Reserve (IRV)			
Expiratory Reserve (ERV)			
Vital Capacity (VC)			
Residual Volume (RV)	1.5 L	1.5 L	1.5 L
Total Lung Capacity (TLC)			

**EPC = egg producing and conducting
**SPC = sperm producing and conducting

Did you notice any differences between the VC and TLC of the Participants with EPC organs compared to those with SPC organs? What were they?

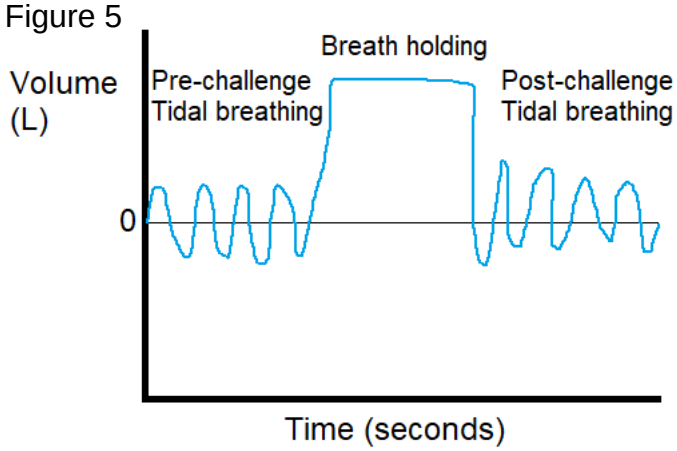
What is an anatomical reason why this difference would occur?

Part II: Tidal Breathing Response to Holding Breath

*Different subjects can participate than in Part I – **BUT** the same two subjects must participate in parts II & III*

1. Click on the Data Collection Icon and change the collection time to 120 seconds.
2. Click on the experiments tab and extend the collection time until it is at least 120 seconds.
3. Hold the Spirometer in one or both hands. Brace your arm(s) against a solid surface, such as a table.
4. Put on the nose clip and Click "collect" to begin data collection.
5. Taking normal breaths, begin data collection with an inhalation and continue to breathe in and out.
6. After 4 cycles of normal inspirations and expirations fill your lungs as deeply as possible (maximum inspiration) and hold your breath for at least 30 seconds.
7. After at least 30 sec of breath holding, resume normal breathing and collect data for 120 seconds.
   ****Do not force your breathing to be normal after the breath holding – just breathe however feels natural****
8. Click the Next Page button, , to see the volume data. If the baseline on your volume graph has drifted, use the Baseline Adjustment feature to bring the baseline volumes closer to zero, as in Figure 5.
9. Select a representative peak and valley in the portion of your graph prior to the onset of breath holding. Place the cursor on the peak and click and drag down to the valley that follows it.
10. Enter the Δ*y* value displayed in the lower left corner of the graph to the nearest 0.1 L as the Before Challenge Tidal Volume in Table 2.

Figure 5



11. Select two adjacent peaks in the portion of your graph prior to the onset of breath holding. Click and drag the cursor from one peak to the next. Use the Δt value displayed in the lower left corner of the graph to calculate the respiratory rate in breaths/minute by using the formula 60sec/ Δt = respiration rate (bpm).
12. Enter this value to the nearest 0.1 breaths/min as the Before Challenge Respiratory Rate in Table 2.
13. Repeat Steps 6 and 7, selecting regions in the portion of your graph after normal breathing had been resumed (between 60–80 s). Enter the values in the After Challenge section in Table 1.
14. Calculate the Minute Ventilation values for before and after the challenge and enter the results to the nearest 0.1 L in Table 2.
15. Repeat steps 1-12 with participant 2, making sure that they use their own bacterial filter.

Part III: Tidal Breathing Response to Exercise

1. Clear the data from Part III by choosing Clear All Data from the Data menu.
2. Hold the Spirometer in one or both hands. Brace your arm(s) against a solid surface, such as a table.
3. Put on the nose plug and click “collect” to begin data collection.
4. Taking normal breaths, begin data collection with an inhalation and continue to breathe in and out.
5. After 4 cycles of normal inspirations and expirations, stop breathing into the Spirometer and begin running in place for 40 seconds. ****Continue data collection while the subject runs****
6. After 40 sec of running in place, stand quietly and breathe into the Spirometer. Collect data for 120 seconds.
   ****Do not force your breathing to be normal after running – just breathe however feels natural****
7. Click the Next Page button,  , to see the volume data. If the baseline on your graph has drifted, use the Baseline Adjustment feature to bring the baseline volumes closer to zero.
8. Select a representative peak and valley in the portion of your graph prior to the onset of rapid breathing. Place the cursor on the peak and click and drag down to the valley that follows it.
9. Enter the Δ*y* value displayed in the lower left corner of the graph to the nearest 0.1 L as Before Challenge Tidal Volume in Table 2.
10. Select two adjacent peaks in the portion of your graph prior to the onset of rapid breathing. Click and drag the cursor from one peak to the next. Use the Δt value displayed in the lower left corner of the graph to calculate the respiratory rate in breaths/minute.
11. Enter this value to the nearest 0.1 breaths/min as Before Challenge Respiratory Rate in Table 2 by using the formula 60sec/ Δt = respiration rate (bpm).
12. Repeat Steps 8 - 11, selecting regions in the potion of your graph after normal breathing had been resumed (between 60–80 s). Enter the values in the After Challenge section in Table 2.
13. Calculate the Minute Ventilation values for before and after the challenge and enter the results to the nearest 0.1 L in Table 2.
14. Repeat steps 1-13 with participant 2, making sure that they use their own bacterial filter.

Table 2				
	Holding Breath		Exercise	
	P1	P2	P1	P2
Before Challenge				
Tidal Volume (L)				
Respiratory Rate (bpm)				
Minute Ventilation (L/min)				
Class Average Minute Ventilation (L/min) **before** challenge				
After Challenge				
Tidal Volume (L)				
Respiratory Rate (bpm)				
Minute Ventilation (L/min)				
Class Average Minute Ventilation (L/min) **after** challenge				

Conclusions:

Calculate the percent change for the class average MV for each challenge.

Holding Breath Percent Change: _____

Exercising percent Change: _____

Based on the data in your class average results, were your predictions matched? Which?

Were either of your hypotheses supported? Which?

Attributions for Lab 6

Figures:

1. Forced Vital Capacity
   Carolyn Rounds: Own Work
   Creative Commons Attribution-Share Alike 4.0
   Created: January 3, 2023

2. Lung Volumes
   https://commons.wikimedia.org/wiki/File:Lungvolumes.svg
   Original uploader was Vihsadas at English Wikipedia.
   Derivative work: rscottweekly
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   Created: May 4, 2011

3. Handheld spirometer
   https://commons.wikimedia.org/wiki/File:Handheld_spirometer.jpg
   Handheld spirometer by COSMED (http://www.cosmed.com/spiropalm)
   Modified by Carolyn Rounds: cropped, rotated, increased contrast.
   Creative Commons Attribution-Share Alike 3.0
   Created: November 12, 2009

4. Sample Ventilation Volumes
   Carolyn Rounds: Own Work
   Creative Commons Attribution-Share Alike 4.0
   Created: January 3, 2023

5. Sample Challenge Volumes
   Carolyn Rounds: Own Work
   Creative Commons Attribution-Share Alike 4.0
   Created: January 3, 2023

Lab 7: Urinary Anatomy

Materials: Preserved Kidney, Human Torso model, Kidney model, Nephron model, Pelvis models, Kidney Slide, Microscopes.
Purpose: In this lab, students will identify the microscopic structures of the kidney, and will located structures on a preserved kidney. In addition, models will be used to identify the structures of the urinary system. Simulated urinalysis data will be used to diagnose several patients by analyzing their test results. This lab addresses SLOs 3 and 9.

Part 1: Microscopic Kidney Structures

Procedure: Identify the structures next to each circle under the microscope.

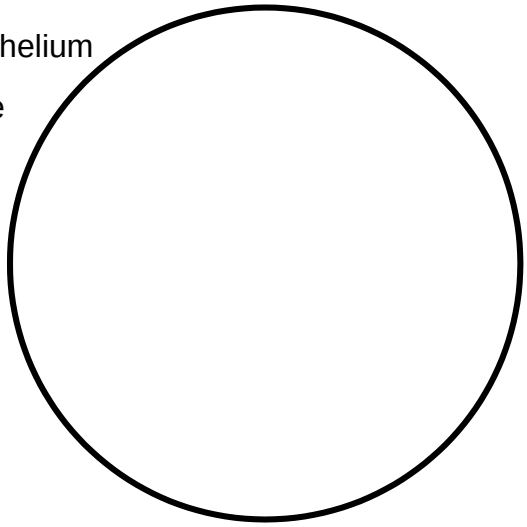
Kidney Slide

Simple squamous epithelium

of Glomerular Capsule

Lumen

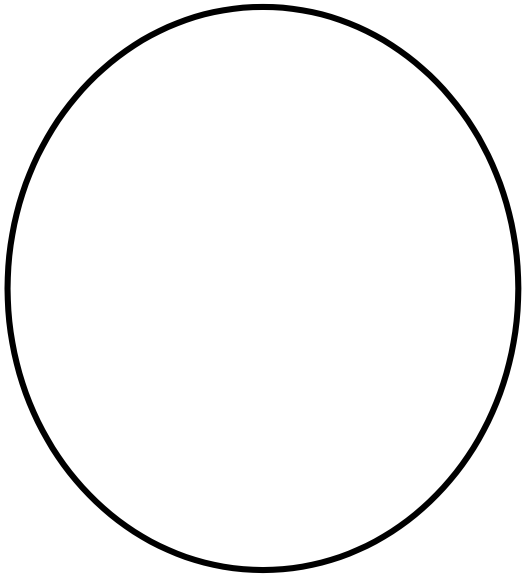
Glomerulus



Simple cuboidal epithelium

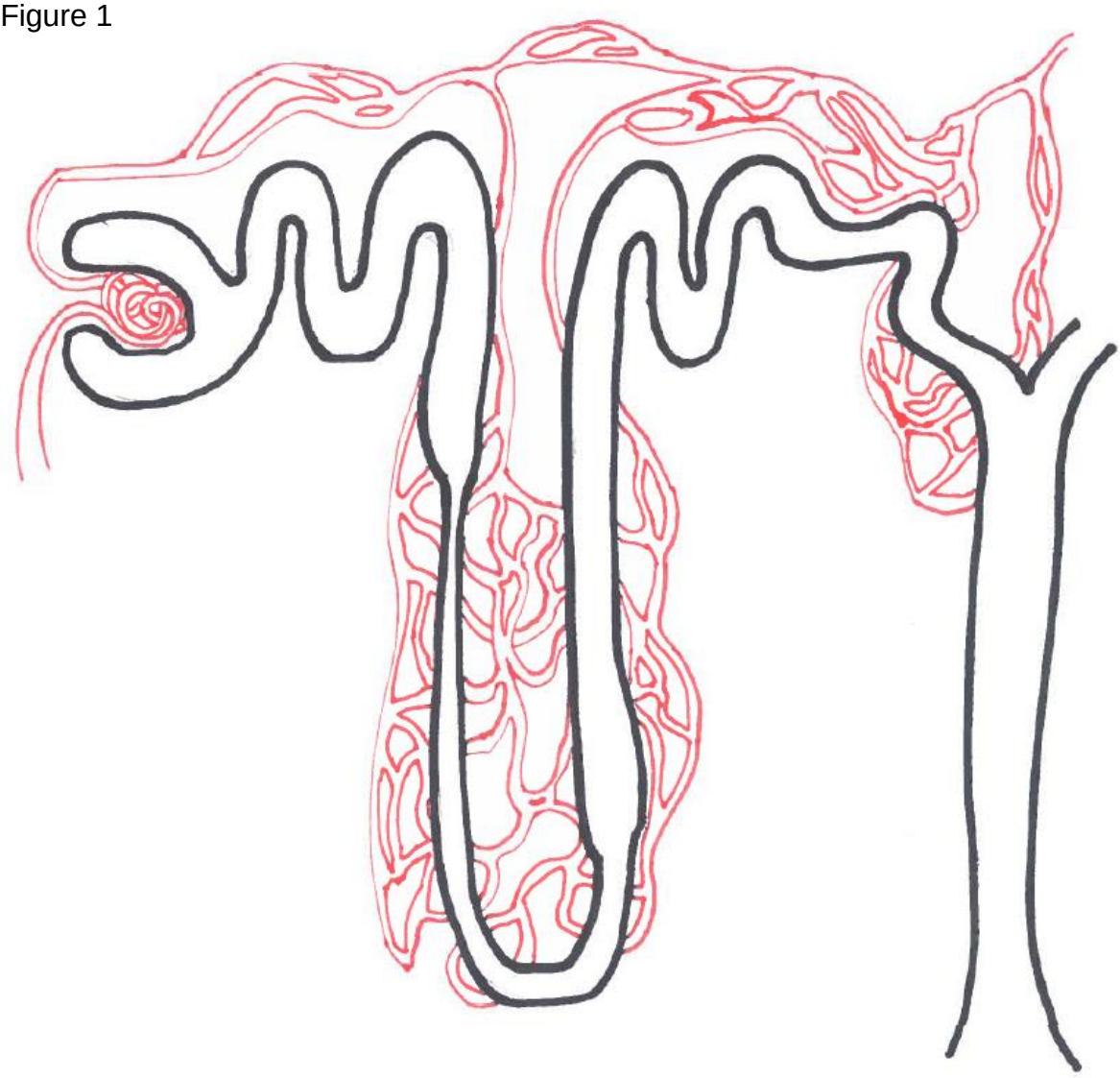
of Nephron Tubule

Lumen



Label the structures of the nephron. In addition, indicate the location and direction of **Filtration**, **Secretion**, and **Reabsorption** – as well as the **substances** that move during each of these activities.

Figure 1



Part 2: Gross Urinary System Anatomy

Procedure: Identify all of the following structures on a model. Identify the structures with an [p] on the preserved kidney.

Blood Supply of Kidney

renal artery

segmental artery

interlobar artery

arcuate artery

cortical radiate artery

Vessels around Nephron

cortical radiate vein

arcuate vein

interlobar vein

renal vein

Kidneys

hilum [p]

renal capsule [p]

renal cortex [p]

renal column [p]

renal medulla [p]

renal pyramid

renal papilla

calyx [p]

renal sinus

renal pelvis [p]

Ureters [p]

Urinary bladder

Rugae

Urethra

Internal urethral sphincter

External urethral sphincter

Nephron

Glomerular capsule or Bowman's capsule

Podocytes

Simple squamous epithelium

Proximal convoluted tubule

Descending Nephron Loop or loop of Henle

Ascending Nephron Loop or loop of Henle

Distal convoluted tubule

Collecting duct

Blood Vessels of Nephron

Near Glomerular capsule:

Afferent Arteriole

Glomerulus

Efferent Arteriole

Near PCT, DCT, CD:

Peritubular Capillaries

Near Nephron Loop or Loop of Henle:

Vasa Recta

Collecting duct

Gross Urinary System and Blood Vessel Labeling:

1. _____
2. _____
3. _____
4. _____
5. _____
6. _____
7. _____
8. _____
9. _____
10. _____
11. _____
12. _____
13. _____
14. _____
15. _____
16. _____
17. _____
18. _____
19. _____
20. _____
21. _____
22. _____
23. _____
24. _____
25. _____
26. _____

Nephron Model Labeling:

1. _____
2. _____
3. _____
4. _____
5. _____
6. _____
7. _____
8. _____
9. _____
10. _____
11. _____
12. _____
13. _____
14. _____

Part 3: Urinalysis

Procedure: To use the results of the Urinalysis simulation on Brightspace to diagnose each patient.

Because the kidneys are organs that filter the body's blood, a urinalysis can provide important information about an individual's health. Use the following chart to review some common aspects of urine tested for on a urinalysis test strip.

Test parameter	**Presence indicates…**	**Example Diseases/Disorders**
BLO = blood	Bleeding in part of the urinary tract. Presence in urine is abnormal.	Injury, kidney stones, infection
BIL = bilirubin	Usually broken down and utilized by the liver to make bile. Presence in urine is abnormal.	Liver disease, blockage or bile duct
URO = urobilinogen	Usually broken down by the liver. Presence in urine is abnormal.	Liver disease.
KET = ketone	Ketones are a metabolic biproduct produced when fats are being used by the body for energy. High levels in urine are abnormal.	Starvation. Untreated diabetes mellitus.
GLU = glucose	Normally completely reabsorbed from filtrate. Presence in urine is abnormal.	Untreated diabetes mellitus.
PRO = protein	Normally cannot enter the filtrate of the nephron. Presence in urine is abnormal.	Hypertension, renal disease
NIT = nitrites	Nitrites are produced by some bacteria. Presence in urine is abnormal.	Infection
LEU = leukocytes	Present in response to an infection. Presence in urine is abnormal.	Infection
pH	A pH of 6 is normal, but can become acidic down to 4 and alkaline up to 8.	pH varies with diet, so pH alone is not diagnostic. It can confirm if something that causes increased acidity or alkalinity is suspected. High pH can indicate a bacterial infection.
SG = specific gravity	How dilute or concentrated the urine is. 1.0 is the specific gravity of pure water: urine can range from 1.001 for very dilute to 1.035 for very concentrated.	Very high specific gravity indicates dehydration. Very low specific gravity indicates an excess of water in urine, which can indicate untreated diabetes mellitus

Experiment:

*Note that urine samples can also be checked for clarity, odor, and color. For this lab we will focus on only the results shown on the test strip.

Record the data from the Urinalysis Simulation in the table below. Indicate if the parameter is negative (or within normal levels) with a "-", if it is positive (or outside normal levels) with a "+". For pH, indicate the **pH number**, and for **specific gravity** indicate the **number** present.

	BLO	BIL	URO	KET	GLU	PRO	NIT	LEU	pH	SG
Patient #1										
Patient #2										
Patient #3										
Patient #4										

For each patient, make as best a diagnosis as you can based on the test results.

Patient #1 Diagnosis:

Patient #2 Diagnosis:

Patient #3 Diagnosis:

Patient #4 Diagnosis:

Attributions for Lab 7

Figures:

1. Nephron Diagram
   Carolyn Rounds: Own Work
   Creative Commons Attribution-Share Alike 4.0
   Created: January 3, 2023

Lab 8: Digestive System Anatomy & Histology

Materials: Esophagus slide, Intestine slide, Mink, Human Torso model, Intestine Model, Mandible models, tooth models

Purpose: In this lab, students will identify histological and gross anatomical structures of the digestive system under the microscope, on models, and in preserved specimens. This lab addresses SLO 3.

Procedure: Identify the following structures under the microscope.

Small Intestine

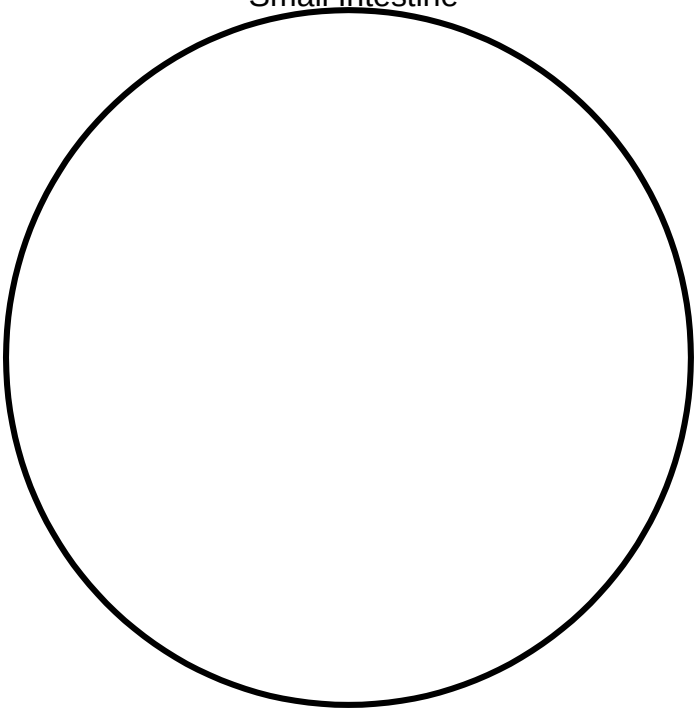
mucosa

goblet cell

submucosa

muscularis

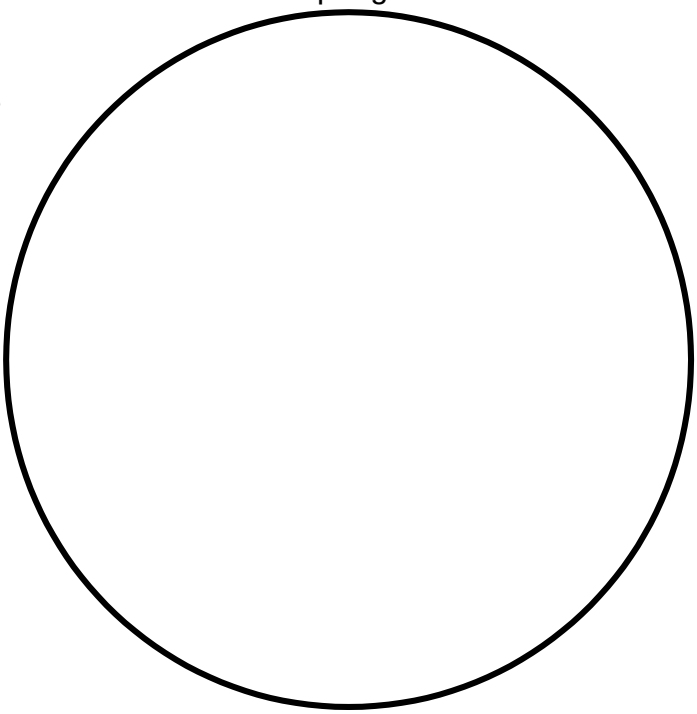
serosa



Esophagus

Stratified squamous epithelium

Smooth muscle



Procedure**:** Identify all of the following structures on models. Be able to identify the structures with a * on the mink.

Small Intestine Model

villi
mucosa
- simple columnar epithelium
- lamina propria
  - capillaries
- lacteals

submucosa
- blood vessels
- irregular connective tissue
- lymph nodes

Peyer's patches
muscularis
serosa

Digestive System Model Structures

Teeth
- incisors
- canines
- premolars
- molars

salivary glands
- parotid
- submandibular
- sublingual

oral cavity
- hard palate
- soft palate
- uvula
- tongue

oropharynx
laryngopharynx
esophagus *
stomach *
- greater curvature
  - greater omentum
- lesser curvature
- cardia
- fundus

- body
- rugae
- pylorus
    - pyloric sphincter
- small intestine
    - duodenum *
    - jejunum *
    - ileum *
        - iliac sphincter
- mesentery *
- large intestine
    - haustra
    - taenia coli
    - cecum *
    - ascending colon *
    - descending colon *
    - sigmoid colon
    - rectum*
- anus
- liver *
- gallbladder
- pancreas *

Digestive System Labeling:

Create a numerical “key” for each structure, and then label on the models with the number for that structure from your list.

1. _____
2. _____
3. _____
4. _____
5. _____
6. _____
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33. _____
34. _____
35. _____
36. _____
37. _____
38. _____
39. _____
40. _____
41. _____
42. _____

Lab 9: Digestive Physiology

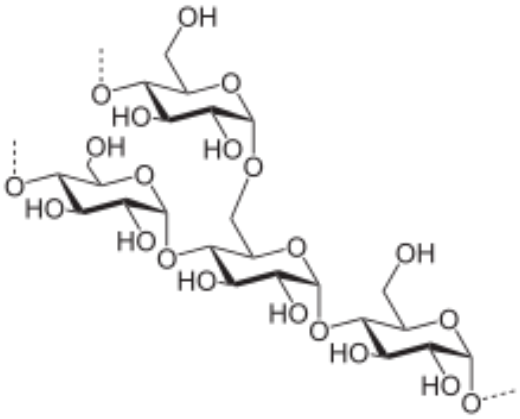
Materials: Amylase, boiled starch, benedict's solution, pH 7 buffer, 0.1M HCl, spot trays, graduated cylinders, droppers, pH paper, 37^{o}C water bath, 100^{o}C water bath or test tube heater. Lipase, bile, litmus cream with triglycerides, graduated cylinders, small beakers, medium beakers, droppers, 37^{o}C water bath.

Purpose: The purpose of this lab is to discover the type of environments in which starch and triglycerides are best digested into the molecules that form them. For starch, students will specifically explore under what conditions the starch is digested the best by the enzyme amylase when environments are varied with regard to pH. For triglycerides, environments will be varied with regard the chemicals present (lipase, bile, or both), and will be tested over a period of time for the presence of fatty acids. This lab addresses SLOs 1, 4, and 7.

Part 1: Starch (Carbohydrate) Digestion

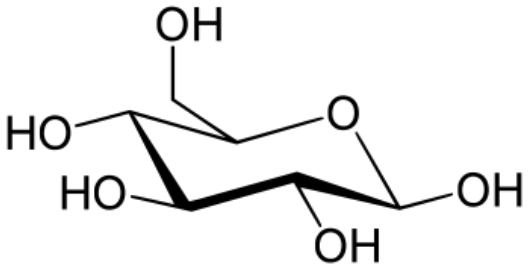
Starch is a type of carbohydrate polymer (a polysaccharide) which humans and other animals can consume to generate energy in the form of ATP. This is possible because starch is made up of many smaller subunits of the carbohydrate monomer glucose (a monosaccharide). In the digestive system, the enzyme amylase breaks starch down into smaller fragments, which are eventually broken into glucose subunits or which can then be used directly for ATP synthesis or stored in the body as glycogen (another glucose-based polysaccharide) for energy production later. Like other enzymes, amylase has and ideal pH at which it is best able to break starch apart into glucose. For this experiment, the amylase used is most similar to the Pancreatic Amylase produced by our body.

Figure 1



Starch

Figure 2



Glucose (a reducing sugar)

HOW TO USE THE REAGENTS! READ FIRST!

Benedict's Solution test for Reducing Sugar (Glucose)

At the end of your tests for starch, you will take the solution that remains in each test tube and test for the presence of glucose/short glucose chains using Benedict's Solution. Benedict's Solution is a reagent that indicates the presence of reducing sugars (carbohydrates with a free aldehyde or ketone group) which all monosaccharides, some disaccharides, and few polysaccharides. Starch is not a reducing sugar, but it is made up of reducing sugars in the form of glucose and the short glucose chains it can be digested into by the enzyme amylase. The more glucose that is present in your solution, the more red the Benedict's Solution will become. Orange indicates a moderate amount of glucose, green & yellow shows traces of glucose, while blue (the regular color of Benedict's Solution) indicates no glucose. Since there are degrees of glucose presence in the solutions you are testing, you will rank glucose presence as 3 indicating the most glucose, 2 indicating a moderate amount of glucose, 1 showing a little glucose, and 0 for no glucose.

Glucose test Procedure:

1. Transfer 10 drops of the experimental solution to a test-tube.
2. Add 10 drops of Benedict's Solution to the test tube.
3. Place the test tube in the 100^{o}C water bath or test tube heater for 3 minutes.
4. **Carefully** remove the **HOT** test tube using a **test tube holder** and place in your test tube rack.
5. Record the amount of reducing sugar detected using the image in the lab atlas.

Observation: Reflect on what you have previously learned about proteins. Do proteins function normally under all possible environmental conditions (all temperatures, all pHs)? What happens to the white of an egg if you heat it up?

Question: This leads us to ask the question:

"What is the ideal pH for amylase to break down starch into smaller sugars?"

Provide a **Hypothesis** that answer this question with regard to pH.

(Your options are pH 1 or pH 7)

Example: A pH of 9 will be the best pH to digest starch into smaller sugars.

Make a **Prediction** about what you should see in the rate of color change from blue to red if you're correct.

Example: The amylase/starch solution will turn red fastest in the pH of 9.

Procedure:

Goggles and gloves must be worn at all times during this lab.

1. Add 2 ml of **amylase** to 2 small beakers.
    a. Label one beaker “pH 1” and label the other beaker “pH 7”
2. For the “**pH 1**” beaker, add **3ml of water**.
    a. Then, slowly add HCl a drop or two at a time to make a pH of 1 in the test tube.
    b. After you add a drop or two of HCl, test the pH of your solution on a piece of pH paper until it indicates a pH of 1.
3. For the “**pH 7**” beaker, add **3ml** of a **pH 7 buffer** to make a pH of 7 in beaker.
4. Create 7 test tubes that you will use to test the solution from **EACH** beaker (you will have 14 test tubes total)
    a. Label 7 test tubes with the **pH number 1 AND** the **time** you will be testing it (0, 5, 10, etc.)
        i. Add 10 drops of Benedict’s Solution to each test tube.
    b. Label 7 test tubes with the **pH number 7 AND** the **time** you will be testing it (0, 5, 10, etc.)
        i. Add 10 drops of Benedict’s Solution to each test tube.
5. When you are ready to begin testing, add **5 ml of boiled starch** to each beaker.
    a. Mix the contents of each beaker with its own dropper. Leave the dropper in the beaker to avoid cross-contamination.
    b. After mixing, **immediately** transfer **10 drops** of the amylase/starch solution from each beaker into the test tube for time zero.
        i. Test for reducing sugars using the procedure on the previous page.
        ii. Record your results in Table 1 below.
6. Place your beaker in a 37C water bath for 5 minutes.
7. Repeat the test for reducing sugar every 5 minutes.

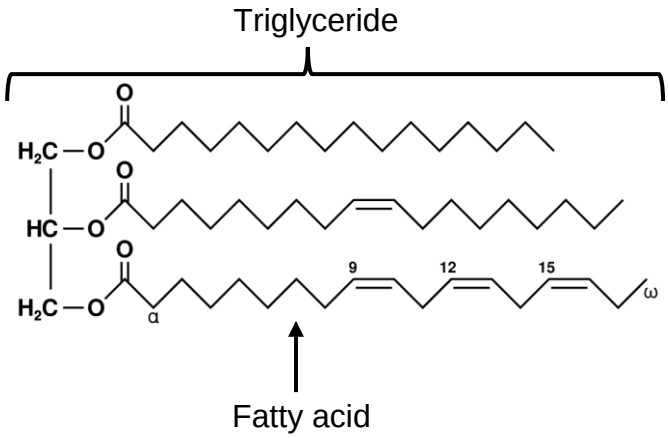
Table 1

	Reducing Sugar Test Results						
Time / Tubes	0 min	5 min	10 min	15 min	20 min	25 min	30 min
pH 1							
pH 7							

Part 2: Lipid Digestion

Lipid digestion is challenging for the body, due to the hydrophobic nature of the major lipid nutrient that we consume: triglycerides. The gallbladder produces bile, an important material that increases the surface area of fat droplets. Lipases are found throughout the digestive system, beginning with the saliva, and continuing into the small intestine.

Figure 3



HOW TO USE THE REAGENT! READ FIRST!

Litmus test for Lipids

To test for the presence of lipids (in this case triglycerides), you will use a litmus cream solution. You will use litmus as a pH indicator to show when the solution has gone from a neutral to an acidic state. As more and more triglycerides are being digested, more fatty acids are present in the solution, so a lower pH will cause the litmus to turn more pink/red. If no triglycerides are being digested, the litmus will remain a slightly bluish purple color. Since there will be varying amounts of triglycerides present in the samples that you test, you will rate the amount of triglycerides detected based on the image in the lab atlas.

Observation: If you put oil into water, what have you noticed about it? Did the oil easily break apart and dissolve in the water?

Question: "What chemicals must be present for the best triglyceride digestion into fatty acids?"

Write a **Hypothesis** that answers this question by choosing **one** of these three chemical environments: Lipase only, Bile only, Lipase and Bile.

What do you **Predict** your results will show with regard to the **color of the litmus** (purple, pink, or red-pink**)** and the **speed with which it turns this color** (faster or slower) if your hypotheses are correct?

Procedure:

1. Setting up your test tubes
    a. Get **6 test tubes** and label them 1-3 A, 1-3 B and with your group's initials.
    b. Transfer **10ml of bile** into a small beaker (it's ok if you go a little over).
    c. Gently swirl the lipase solution, then transfer **10ml of lipase** solution into a second small beaker (it's ok if you go a little over).
    d. Transfer **10ml of litmus solution** into a third small beaker (it's ok if you go a little over).
    e. Transfer **3ml of bile** into test tubes **1A** and **3A**.
    f. Transfer **3ml of lipase** into test tubes **2A** and **3A**.
    g. Add **3ml of water** to test tubes **1A** and **2A**.
    h. Transfer **3ml of litmus cream** into test tubes **1, 2, & 3 B**
        i. If the litmus solution is pinkish, add one drop of 0.1M NaOH and mix with a dropper to make the solution a bluish purple color.
        ii. The solutions in test tubes 1, 2 & 3B should all be the same color to start (the bile solution may be slightly brownish).
2. Add test tubes A to B for test tubes of the same number.
    a. Cover each B test tube with parafilm and shake vigorously for 30 seconds.
    b. Record the number associated with the color change of each solution in time zero column of Table 2.
    c. Place all B test tubes in the 37^{o}C water bath for 5 minutes.
3. Retrieve your test tubes and bring them back to your table.
4. Record the color of each solution in Table 2, then return the test tubes to the water bath and record the color of the test tubes every 5 minutes for 30 minutes.

Table 2							
	Fatty Acid Test						
Time / Tubes	0 min	5 min	10 min	15 min	20 min	25 min	30 min
1B bile color							
2B lipase color							
3B lipase & bile color							

Attributions for Lab 9

Figures:

1. Structure of Amylopectin
   https://commons.wikimedia.org/wiki/File:Amylopektin_Sessel.svg
   NEUROtiker
   Public domain
   Created: April 29, 2008

2. Beta-D-Glucose
   https://commons.wikimedia.org/wiki/File:Beta-D-Glucose.svg
   Yikrazuul
   Public domain
   Created: October 5, 2009

3. Fat triglyceride shorthand formula
   https://commons.wikimedia.org/wiki/File:Fat_triglyceride_shorthand_formula.PNG
   Wolfgang Schaefer
   Public domain
   Created: April 21, 2005

Lab 10: Reproductive Histology

Materials: Sperm slide, ovary slide, testis & epididymis slide, ovary model.
Purpose: The purpose of this lab is to identify the structures of the testes and uterus on models and under the microscope. This lab addresses SLO 3.

Part 1: Ovary histology

Ovary slide (structures with * also on Ovary model)
Primordial follicle*
    Primary oocyte*
Primary follicle
    Primary oocyte
Secondary follicle*
    Primary oocyte*
Mature or Tertiary follicle*

primary oocyte* zona pellucida

corona radiata antrum*

ovulation of oocyte**

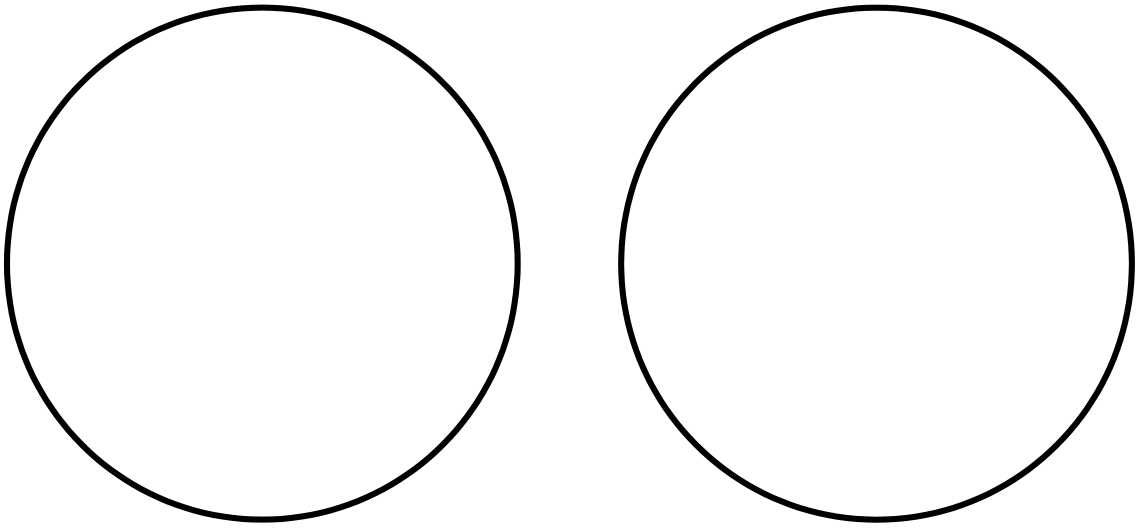
Corpus Luteum **

Corpus Albicans **

**only on model

Ovary slide

Mature follicle



Part 2: Testis and Epididymis Histology

Testis and Epididymis Slide

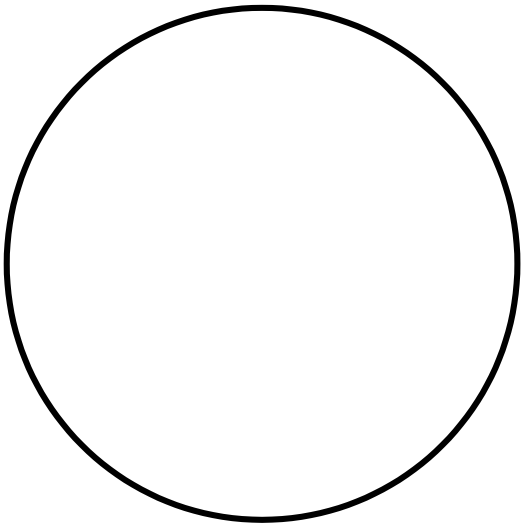
Testis
interstitial cells
seminiferous tubules
- spermatogonia
- primary spermatocytes
- secondary spermatocytes
- spermatids

Epididymis
- spermatozoa

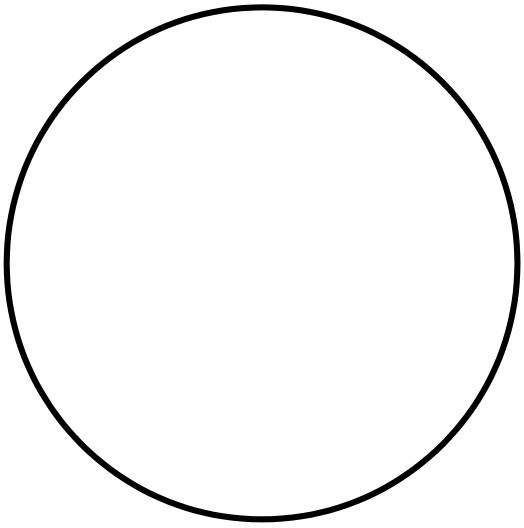
Sperm slide

sperm
- head
- flagellum

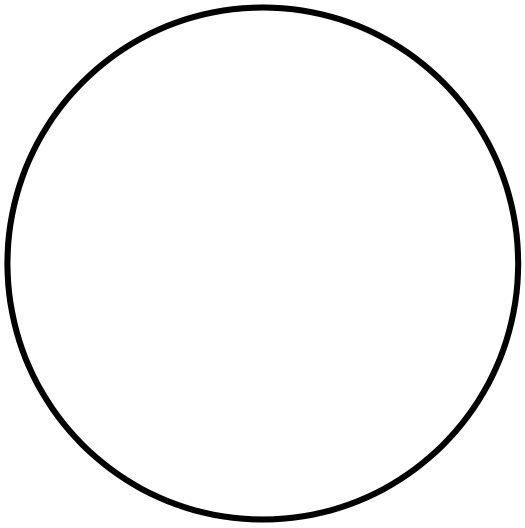
Sperm



Testis



Epididymis



Lab 11: Reproductive Anatomy

Materials: Pelvis models, Torso models
Purpose: In this lab, students will identify reproductive organs and structures on human models. This lab addresses SLOs 3 and 14.

Part 1: Reproductive System Anatomy

Egg Producing & Conducting Organs

- External Structures
  - mons pubis
  - clitoris
  - labia minora
  - labia majora
- Vestibular gland
- Vagina
  - rugae
- Cervix
- Uterus
  - myometrium
  - endometrium
- Oviducts
  - infundibulum
    - fimbria
  - ampulla
  - isthmus
- Ovaries

Sperm Producing & Conducting Organs

- Scrotum
- Testes
  - Seminiferous tubules
- Epididymis
- Spermatic cord
  - Ductus deferens or vas deferens
- Inguinal canal
- Seminal vesicles
- Ejaculatory duct
- Prostate gland
- Bulbourethral gland
- Urethra
  - prostatic urethra
  - membranous urethra
  - spongy urethra
- Penis
  - shaft
    - corpus cavernosum
    - corpus spongiosum
  - prepuce
  - glans

EPC Organ Labeling:

Create a numerical “key” for each structure, and then label on the models with the number for that structure from your list.

1. _____
2. _____
3. _____
4. _____
5. _____
6. _____
7. _____
8. _____
9. _____
10. _____
11. _____
12. _____
13. _____
14. _____
15. _____
16. _____
17. _____

SPC Organ Labeling:

Create a numerical “key” for each structure, and then label on the models with the number for that structure from your list.

1. _____
2. _____
3. _____
4. _____
5. _____
6. _____
7. _____
8. _____
9. _____
10. _____
11. _____
12. _____
13. _____
14. _____
15. _____
16. _____
17. _____
18. _____
19. _____
20. _____

Lab 12: Development & Reproductive Physiology

Materials: Lab atlas, development models.
Purpose: The purpose of this lab is to identify the structures of the spermatozoa and ovum, as well as the different stages of development on the models. Students will also determine the unknown hormone that has been injected into a rat subject. This will be achieved by comparing autopsy results of organ weights for a control rat with those of the experimental rats that have been injected with unknown hormones. This lab addresses SLOs 1, 2, 3, and 4.

Part 1: Development Structures

- Spermatozoa
  - acrosome
  - nucleus
  - midpiece
  - flagella
- Secondary Oocyte
- Morula
- Blastocyst
- Gastrula
  - embryonic disc
    - primitive streak
    - ectoderm
    - mesoderm
    - endoderm
- Umbilical cord
  - umbilical arteries
  - umbilical vein
- Chorion
  - Chorionic Villi
- Placenta
- Yolk Sac
- Amnion
- Uterus
- Cervix
  - Mucus Plug
- Vagina

Development Structure Labeling:

1. _____
2. _____
3. _____
4. _____
5. _____
6. _____
7. _____
8. _____
9. _____
10. _____
11. _____
12. _____
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23. _____
24. _____
25. _____
26. _____

Part 2: Hormone Control in SPC organs

Background:

The data for this laboratory were compiled from 3 male laboratory rats; one was the control group and the remaining two were experimental groups.

The two experimental group rats were injected with a hormone on a daily basis for 2 weeks.

Autopsies were performed on the animals after that time.

The group of students performing this exercise were very disorganized and rushed through the work, and forgot which rat was injected with which hormone after they had performed the autopsies (oh no!). However – their work was not for nothing! We can figure out which rat got which hormone based on the relationships we know exist between hormones and the organs they stimulate in the male reproductive system!

Using the following organs and rats that were autopsied, match the experimental rat with the hormone it was injected with.

The bottles on the refrigerator shelf were **LH,** and **testosterone**. So to begin, we will outline how these hormones act with the male reproductive system, and then will make some predictions about how body and organ weights should change based on these hormones being present in the two experimental rats. We will use the control group rat to compare the experimental group rats to, in order to see where the organ or body weights underwent a change.

Activity 1:

Fill in the blanks to complete the feedback system for LH & Testosterone in the space below (you can use your lecture notes to help find the answers).

Hypothalamus

Gonadotropin Releasing Hormone (GnRH)

(+)

Anterior Pituitary

Luteinizing Hormone (LH)

(+)

Target Organ

(+)

Target Cells

Hormone Secreted

Measurable changes produced in Rat:

- Increased muscle mass

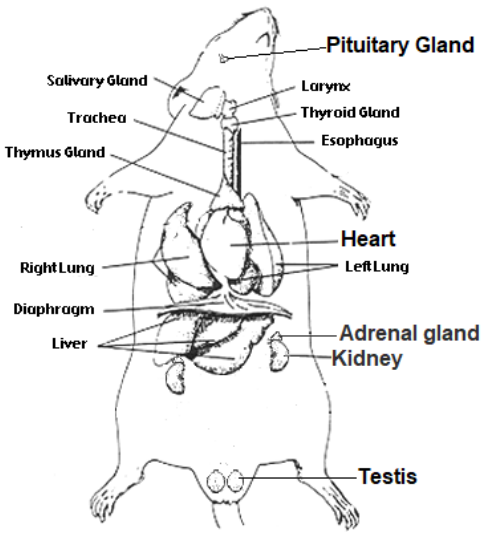
(-) Negative feedback when higher than homeostatic set-point prevents activity of this gland

(-) Negative feedback when higher than homeostatic set-point prevents activity of this gland

(-)

(-)

Figure 1



Activity 2: Hypertrophy & Atrophy

For each of the following hormones that have been injected at higher than normal levels into the rats, predict what organs would hypertrophy (become larger), and which would atrophy (become smaller) for LH or Testosterone.

Glands or organs that are being stimulated a lot by the injected hormone will hypertrophy (and weigh more than the control), while under-stimulated glands or organs will atrophy (and weigh less than the control).

The parts of the rat that have been weighed are the **testes**, **anterior pituitary**, and the **whole rat** (to determine **body weight**)

For your predictions, **fill in the blanks to complete the sentences provided**: Your options to fill in these blanks are **testes**, **pituitary gland**, or **none**. For **body weight**, predict if it will **increase, decrease, or be the same as the control**.

If you are confused about how to proceed – **STOP**! I've posted a Wendy Video in the Lab folder that reviews the feedback systems and predictions. Watch this before you go any further if you'd like more explanation

Question: Was each experimental rat injected with LH or Testosterone?

Hypothesis #1: Experimental rat #1 was injected with Testosterone.

Prediction #1: If this hypothesis is correct, then:

_____ will **weigh more**,

_____ will **weigh less**,

_____ will **weigh the same as the control**,

and **body weight** will _____
(select: increase/decrease/be the same as the control).

Hypothesis #2: Experimental rat #2 was injected with Luteinizing Hormone.

Prediction #2: If this hypothesis is correct, then:

_____ will **weigh more**,

_____ will **weigh less**,

_____ will **weigh the same as the control**,

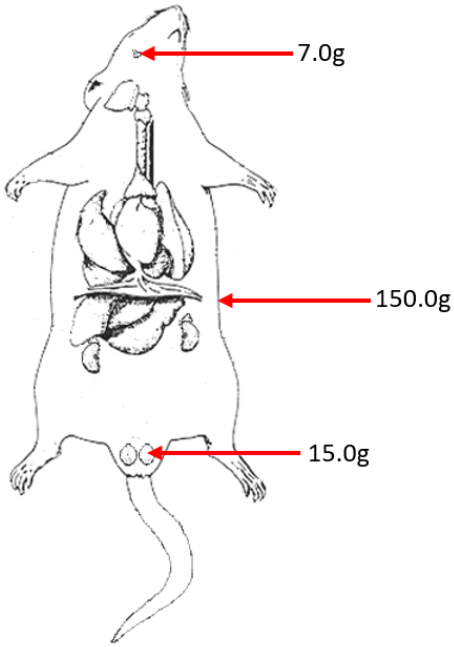
and **body weight** will _____
(select: increase/decrease/be the same as the control).

Activity 3: Collect data!

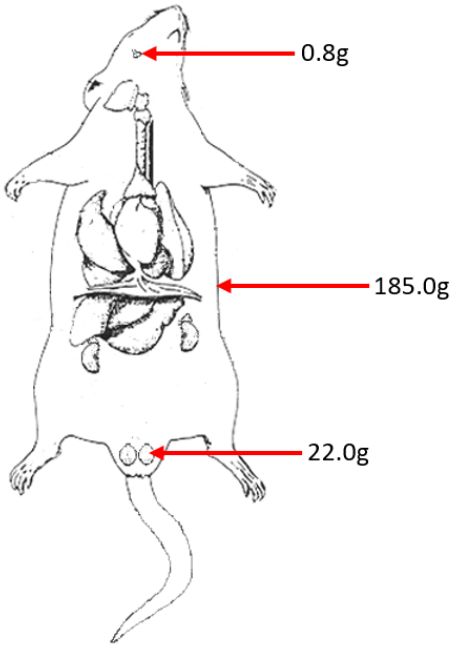
Record the weights of each rat into the table below. Once all the weights have been included, indicate if the weight for the experiment rat increased, decreased, or stayed the same as the control rat. ***IMPORTANT!*** If the weight only differed from the control by +/- 10%, record this as the same as the control – since some variability in each rat will produce small differences in organ size that are not due to the hormone being injected.

Figure 2

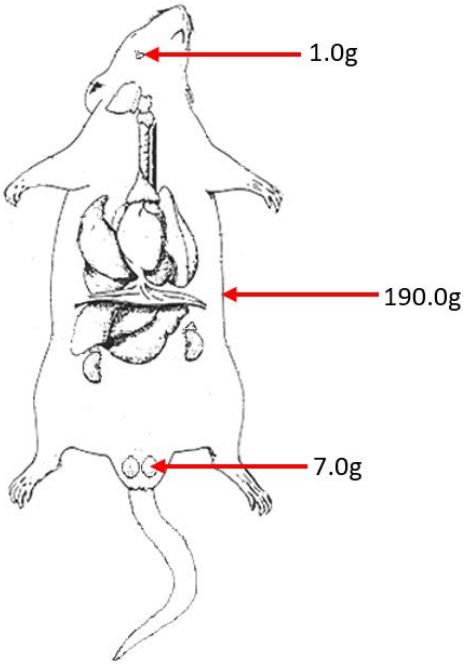
Control Rat



Experimental Rat #1



Experimental Rat #2



Results:

Fill in **Table #1** with your recorded weights in grams.

Table 1: Rat Weights

	Control	Experimental Rat #1	Experimental Rat #2
Pituitary gland			
Testes			
Body weight			

Calculate the percent change in weight for experimental rats #1 & #2, and fill them into **Table #2.** Make sure that next to each percent change you include a **"+"** to indicate that the weight increased compared to the control, a **"-"** to indicate that the weight decreased compared to the control, or "**NC"** to indicate there was no change in the weight compared to the control. ***DON'T FORGET! If the weight only differed from the control by +/- 10%, record this as NC***

Table 2: Percent changes in Experimental Rats compared to Control.

	Exp. Rat #1	Exp. Rat #2
Pituitary gland		
Testes		
Body weight		

After filling in the experimental data, also include your PREDICTED changes in this **Table 3** for each rat (refer back to **page 86** and record in this table what you predicted). Use "+" , "-" , or NC in the table to indicated your predictions.

Table 3: Predicted changes in Experimental Rats compared to Control

	Predicted Exp. Rat #1	Predicted Exp. Rat #2
Pituitary gland		
Testes		
Body weight		

Conclusions:

Based on your comparison of your results compared to your predictions…

1.) Were either of your hypotheses supported? Which?

2.) What hormone was Experimental Rat #1 injected with? Experimental Rat #2?

Attributions Lab 12

Figures:

1. Rat Dissection
   https://www.biologycorner.com/resources/rat_dissection.gif
   https://www.biologycorner.com/worksheets/rat_thoracic.html
   Modified by Carolyn Rounds: August 2020
   Added pituitary gland, adrenal gland, kidney, and testes. Removed intestines, stomach and spleen.
   Creative Commons Attribution-Share Alike 4.0

This Lab is an adaptation of:

LABORATORY EXERCISE USING ‘‘VIRTUAL RATS’’ TO TEACH ENDOCRINE PHYSIOLOGY Cynthia M. Odenweller, Christopher T. Hsu, Eilynn Sipe, J. Paul Layshock, Sandhia Varyani, Rebecca L. Rosian, and Stephen E. DiCarlo Department of Physiology, Northeastern Ohio Universities College of Medicine, Rootstown, Ohio 44272 Published in: THE AMERICAN PHYSIOLOGICAL SOCIETY, VOLUME 18 : NUMBER 1 – ADVANCES IN PHYSIOLOGY EDUCATION – DECEMBER 1997
https://journals.physiology.org/doi/pdf/10.1152/advances.1997.273.6.S24

AHBS Lecture and Laboratory Policies and Procedures

Keep for future reference

1. You are expected to read, know and follow the Code of Conduct as described in the Student Handbook at all times. You may obtain your copy from the Office of Student Personnel Services in the Student Services Building. It is expected that all people will be treated with respect and honor.
2. Honesty and integrity in all aspects of student life are expected. Any behavior contrary to the Code of Conduct will be dealt with according to the Student Handbook. Academic dishonesty is a very serious offense and will be treated according to the published guidelines and college policies. Penalties for academic dishonesty will result in a minimum of no credit for the academic work in question and may result in failure in the course.
3. All cell phones and other electronic devices must be turned off in the laboratory and classrooms. It is not proper to leave the class to answer a phone call as this disturbs you, the instructor and other students. In case of "expected emergencies" ask the instructor for the proper procedure.
4. Your attendance is expected at all classes – both lecture and laboratory. It is your responsibility to "make-up" the work missed in lecture. In addition, please make every effort to be on time for class, for your benefit and to minimize distraction for others. This is especially important in laboratory since important protocol and safety information is given at the beginning of each lab.
5. Please do not wear hospital attire (scrubs or uniforms) to school. Work clothes should be replaced with street clothes that have not been in the hospital environment. Shoes should cover your feet for your protection.
6. Make-up lecture exams or labs are a privilege, not a right. Please remember that make-ups are only offered with advance notice for legitimate emergencies that can be verified. It is up to you to notify the instructor in advance and provide the instructor with valid proof for having missed the exam or lab. Make-up exams are scheduled at the instructor's convenience and usually are a different format and time than the regularly scheduled exams. Laboratory exams may not be made up.
7. If you miss a lab and do not make it up, the penalty will be a deduction of 10% from the lab grade for each of the first 2 missed labs. If 3 labs are missed and not made up, you will receive a grade of F for the course. If a lab report is due for the missed lab, you may not get credit for the lab report unless the lab is made up in another section of the same course or similar lab in a different course. The Lab Makeup Form must be signed by the instructor (of the makeup lab class) and submitted with the lab report. It is your responsibility to inform the lab instructor in advance when the makeup work will be done.
8. It is the responsibility of the student to determine the times when the lab can be made up, and request permission from the instructor (of the makeup lab), in advance to attend a lab for which you are not registered. If no lab section in the same course is available, your lab instructor may approve attendance at some other lab in some other biology course as an acceptable makeup for the missed lab. However, if the lab report is associated with the missed lab, you will not receive credit for the lab report.

   A Laboratory Makeup Form is to be signed by the instructor (of the makeup lab) to verify that you have attended a makeup lab. This form must be submitted to your regular lab instructor **within a week** of the time that the lab was made up.

AHBS Lecture and Laboratory Policies and Procedures

9. In compliance with SUNY and OSHA requirements, no food or drink is allowed in the labs at any time. This will be strictly enforced. Personal property not required for the lab should be stowed in the cubicles provided for this purpose. The floor is not a proper place for backpacks etc., where they are a tripping hazard in the lab.
10. Cleaning solutions are in all of the laboratories. Lab tables should be wiped down before and after each laboratory.
11. All laboratory equipment and supplies are the property of Dutchess Community College. Please treat them better than you would if they were yours. We do not want you to have to replace any broken or wasted material.
12. Protective gear must be worn for appropriate laboratories. Any wet lab requires the use of eye protection. If you do not have your own, you must use the goggles we provide. <u>You will be expelled from the lab for noncompliance.</u>
13. Any bodily fluids, or materials contaminated with bodily fluids must be "red bagged" for proper disposal. Do not lay contaminated material on the lab surfaces. If you suspect any contamination, glove and immediately wipe all surfaces with the disinfectant provided in the laboratory.
14. Do not touch broken glass with your skin. Glass should be swept up and placed in the broken glass containers in each room. Never reach into a broken glass container.
15. All accidents must be reported to college personnel.
16. Many students share our equipment and materials. Please be considerate of others. Scheduled classes have first priority on all equipment and materials.
17. Study times and rooms are subject to change. Check with college personnel before you count on study availability. The weeks that lab exams are being given will have greatly restricted access to time, rooms and materials.
18. Learning is fun! Enjoy the laboratories safely please.

Tear on dotted line and return to instructor please

I have read the above information, and any questions regarding these policies and procedures have been answered to my satisfaction.

I understand and agree to follow these policies and procedures for the duration of my enrollment in this laboratory course.

_____	_____	_____	_____
print name	signature	date	course & section

Laboratory Make-up Form

Policy:

- → Have you checked your syllabus to determine your instructor's policy on missed labs?
- → Labs should be made up within 1 week of missed lab.
- → If you miss a lab and do not make it up, the penalty will be deduction of 10% from the lab grade for each of the first 2 missed labs.
- → If 3 labs are missed and not made up, you will receive a grade of F for the course.
- → It is your responsibility to determine the times when the lab can be made up, and request permission from the instructor of the make-up lab in advance.
- → Some instructors may be giving a lab exam during the time you want to make up your lab, if this is the case, you cannot make up the lab time with them.
- → Open lab is NOT suitable for make-up purposes.
- → Laboratory support staff do not make up labs with students.

Student Name_____

Course Name & Section of Missed Lab_____

(Example: BIO 105-012 Osmosis)

Date of missed lab_____

Upon completion of Lab:

The student has successfully completed the_____ lab.

Name of Make-up Instructor:_____

Signature of Make-up Instructor:_____

Date

Optional Extra Credit*

Use the labeling sheets on the following pages to practice labeling models OUTSIDE OF LAB. This can be done in the **Biology Open Lab** (see Brightspace for schedule), or in the **Math and Science Center** in Washington 324.

Extra credit labeling is an **individual assignment** – NOT a group assignment. While you may work with others on your labeling, each extra credit submission must be done using YOUR labels, not the group ones.

Make sure you **sign in** to Open Lab or the Math and Science Center, since if you are not signed in on the list for the date shown on your extra credit labeling, you will not earn any points.

To earn extra credit ALL labels must be correct, and ALL the vocabulary on the labeling sheet spelled correctly.

* Your instructor will let you know if they are offering this extra credit option. See your course syllabus for details.

EXTRA CREDIT

Name: _____

Date: _____ Open Lab / MSC

Heart Blood Vessels Labeling:

1. _____
2. _____
3. _____
4. _____
5. _____
6. _____
7. _____
8. _____
9. _____
10. _____
11. _____
12. _____
13. _____
14. _____
15. _____

EXTRA CREDIT

Name: _____

Date: _____ Open Lab / MSC

Heart Structure Labeling:

1. _____
2. _____
3. _____
4. _____
5. _____
6. _____
7. _____
8. _____
9. _____
10. _____
11. _____
12. _____
13. _____
14. _____

EXTRA CREDIT

Name: _____

Date: _____ Open Lab / MSC

Respiratory System Labeling:

1. _____
2. _____
3. _____
4. _____
5. _____
6. _____
7. _____
8. _____
9. _____
10. _____
11. _____
12. _____
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EXTRA CREDIT

Name: _____

Date: _____ Open Lab / MSC

27. _____

28. _____

29. _____

30. _____

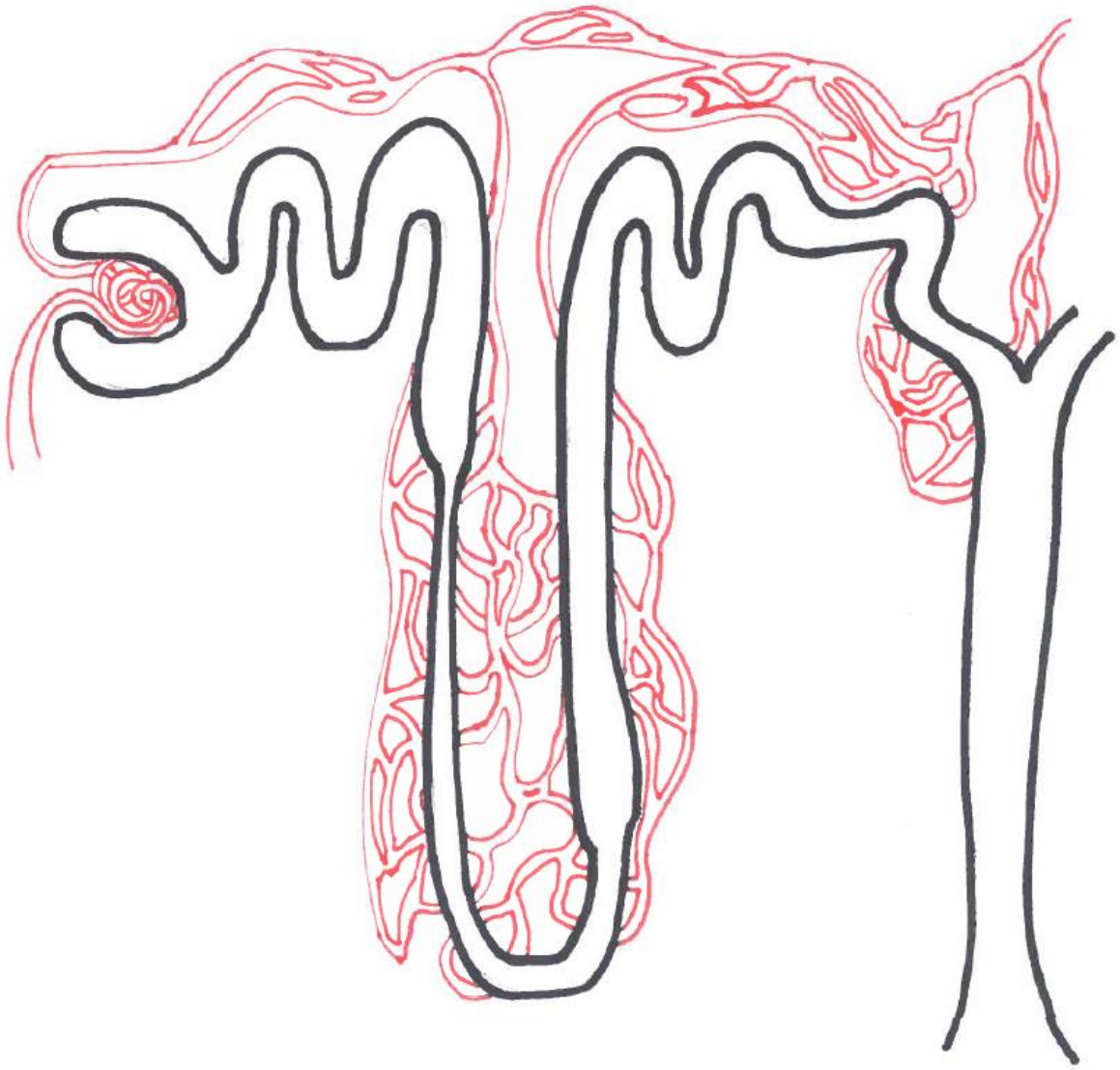
31. _____

32. _____

EXTRA CREDIT

Name: _____

Date: _____ Open Lab / MSC



EXTRA CREDIT

Name: _____

Date: _____ Open Lab / MSC

Gross Urinary System and Blood Vessel Labeling:

1. _____
2. _____
3. _____
4. _____
5. _____
6. _____
7. _____
8. _____
9. _____
10. _____
11. _____
12. _____
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25. _____
26. _____

EXTRA CREDIT

Name: _____

Date: _____ Open Lab / MSC

Nephron Model Labeling:

1. _____
2. _____
3. _____
4. _____
5. _____
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9. _____
10. _____
11. _____
12. _____
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14. _____

EXTRA CREDIT

Name: _____

Date: _____ Open Lab / MSC

Digestive System Labeling:

Create a numerical “key” for each structure, and then label on the models with the number for that structure from your list.

1. _____
2. _____
3. _____
4. _____
5. _____
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8. _____
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12. _____
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25. _____

EXTRA CREDIT

Name: _____

Date: _____ Open Lab / MSC

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42. _____

EXTRA CREDIT

Name: _____

Date: _____ Open Lab / MSC

EPC Organ Labeling:

Create a numerical “key” for each structure, and then label on the models with the number for that structure from your list.

1. _____
2. _____
3. _____
4. _____
5. _____
6. _____
7. _____
8. _____
9. _____
10. _____
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12. _____
13. _____
14. _____
15. _____
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17. _____

EXTRA CREDIT

Name: _____

Date: _____ Open Lab / MSC

SPC Organ Labeling:

Create a numerical “key” for each structure, and then label on the models with the number for that structure from your list.

1. _____
2. _____
3. _____
4. _____
5. _____
6. _____
7. _____
8. _____
9. _____
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EXTRA CREDIT

Name: _____

Date: _____ Open Lab / MSC

Development Structure Labeling:

1. _____
2. _____
3. _____
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