OBJECTIVES:

- Identify human blood cell types
- Examine the circulatory structures of various animals.
- Identify internal and external anatomy of a mammalian heart.
- Compare circulatory systems among organisms.

INTRODUCTION

In this Lab exercise, we will examine the anatomy and physiology of animal circulation. You by now have read and heard about animal circulation, and the lab activities here will help add to your knowledge. As we link the circulatory and respiratory function together, we focus on the role of the circulatory system in distributing oxygen (among other things) to the cells of the multicellular animal, and carrying the carbon dioxide (among other things) away from the cells of a multicellular animal. We will exam a diversity of circulatory structures in the animal kingdom.

The basics of a circulatory system in general include a "pump" (typically a "heart") that drives oxygen carrying fluid and cells around the body (in either a cavity for open circulation or vessels for closed circulation). This fluid carries oxygen to cells (used for aerobic respiration), and carries carbon dioxide (metabolic by-product) away from the cells. We will look at the anatomy and physiology of these structures (hearts, vessels, and blood cells).

STUDENT PREPARATION AND GENERAL LAB PROCEDURES

- Students will work in groups of 2-4 as instructed.
- Prepare for this laboratory by reading pages 898-903, and reviewing figure 42.17 in your Campbell text. Familiarizing yourself in advance with the information and procedures covered in this laboratory will give you a better understanding of the material and improve your efficiency.
- For each slide you view under the scope, draw and label the specimen in your lab notebook. When you label the drawings, be sure to include the structures that you can identify on the specimen and the total magnification you used.
- Sketch and label each of your dissection specimens and the demo dissected specimens.
- Information from your textbook, lab handouts, lab manual and lectures will assist you as you identify the various structures.

Part A: Animal Dissections

Use the .pdf files from the website (you should have the rat .pdf already) for instructions on proper dissection techniques for both mammalian, rat and sheep, hearts. You will be responsible for identifying and knowing functions for the structures listed below for each organism.

Rat

Structures to identify:
Heart & arteries: right and left (R&L) atria, R&L ventricles, aortic arch, R&L common carotid,
subclavian, brachiocephalic, abdominal (dorsal) aorta, renal arteries, R & L common iliac
Veins: posterior & anterior vena cava, renal vein, external jugular veins (pulmonary veins are generally not identifiable)

Mammalian Heart: Use .pdf provided on website for this dissection!
Structures to identify (external): pericardium, R&L atria, R&L ventricles, aorta, pulmonary artery, vena cava, pulmonary veins, coronary artery
Structures to identify (internal): R&L atria, R&L ventricles, pulmonic semilunar valve, aortic semilunar valve, right atrioventricular valve (also called the tricuspid valve), chordae tendinae, left atrioventricular valve (also called the bicuspid or mitral valve)

Part B: Human Blood Cells

Background: Human blood is a connective tissue. The cells that make up the tissue include erythrocytes (red blood cells or “RBC’s”), leukocytes (white blood cells), and thrombocytes (platelets). In this lab, we are focusing on the role of the red blood cells as carriers of oxygen. We will briefly discuss, however, the role of the white blood cells, immune response, platelets, and clotting, in lecture. For this activity, you will get the opportunity to see these cells in relation to each other. Identify the cell types that you see (including the different types of white blood cells). The link below is an excellent resource for learning the different types of human blood cells identifiable with Wright stain.
http://www.siumed.edu/~dking2/intro/bldcells.htm#b

Materials Needed:
Microscope Slides: Human Blood-Wright Stain (identify blood cell types) Human Blood-disease slides (What abnormalities do you notice?)

Procedures
1. Scan the slides at low power to see the relative abundance of blood cell types.
2. Increase magnification (to the 40 or 100 objective) and draw and identify the various blood cell types.

Part C: Additional Slides & Demonstrations

Structures and cells to look for and identify:
Microscope Slides: Human Artery-Vein (compare the walls of the artery and vein)
  Cardiac muscle tissue
  Smooth muscle
  Striated muscle

Dissection Demos: Pigeon: right atrium, right ventricle, left atrium, left ventricle, aortic arch, right & left subclavian arteries, dorsal aorta, common carotid arteries, jugular veins
Dogfish (shark): Atrium, ventricle, conus arteriosus, aorta, afferent arteries, sinus venosus
Earthworm: hearts (pulmonary arches), dorsal blood vessel

Models:
  Plasticized squid : branchial (gill) hearts, branchial (gill) veins, systemic heart
  Plasticized clam: (heart)
  Insect and Earthworm plastic models
  Human circulatory system model
  Plasticized hearts of various organisms

Lab: Circulation
PRELAB is on a SEPARATE SHEET at the end of this lab and is due at START of Monday 14 May

POST-LAB: Use your observations from today to answer the following questions. These questions should be completed on a separate piece of paper and turned into your instructor no later than the date he/she indicates.

1. What is the most abundant blood cell type in the human blood cell Wright stain slide?

2. What visual differences did you notice between the erythrocytes, and leukocytes?

3. How did the walls of the artery compare to the walls of the vein in the artery-vein slide?

4. Most mollusks have open circulatory systems. How does the closed circulatory system of the squid suit its mode of life?

5. The bird has a 4-chambered heart, compared to the 3-chambered heart found in other reptiles (see book, Figure 42.5, for diagram). Why might a 4-chambered heart have been more strongly selected for in birds than in other reptilian species?

6. Which of the organisms you viewed in lab had open circulation? Single circulation? Double circulation? Which is most efficient at getting oxygenated blood to the body?

Lab Quiz Preparation: For the lab quiz, be able to identify the structures in the rat and mammalian heart, as well as those in the demo organisms and slides. Be able to compare and contrast the circulatory systems of the various organisms viewed in lab. Though you are not required to hand in the questions posed in the mammalian heart dissection handout, you will be responsible for them on lab quiz!

Lab Notebook Check: Your lab notebook entry this week should contain a title and objective for this lab, along with lab partner names. You may cut and past specific procedures from your lab handouts. You do not need to tape the mammalian heart dissection guide into your lab notebook! You will want to know the material for lab practicums, however. Include sketches of the various slides (labeled as always!) along with sketches of your dissections (both rat and sheep heart) and the demonstration dissected organisms (shark, pigeon, squid, any others your instructor may have available), with circulatory system parts labeled. Other models – plastic models of earthworm, insect, etc. do not need to be sketched in your notebook, though they may be included in lab practicums. As always, include your own notes that may help you recall both procedures and what you are viewing!
Prelab
Animal Circulation

Prelabs are due at the beginning of the lab period. No credit will be given for late prelabs. Use information from your textbook (Ch. 42 Circulation & Gas Exchange) to answer the questions below.

Question:
1. a) Draw a diagram of the human heart and its immediate vessels and label it with the following terms:
right & left atria, right & left ventricles, aorta, pulmonary artery, superior and inferior vena cava, pulmonary vein, semilunar valves, atrioventricular valves.

b) Using arrows, indicate where blood enters the heart, from where it came, which valves it passes through, where blood exits the heart, and where the blood is going. Note, for each chamber of the heart, whether or not blood has high oxygen content. Note, for each main vessel entering or leaving the heart, whether the blood is under high or low pressure and whether or not it has high oxygen content.