Anatomy of a Mammalian Heart
An Introduction to Heart Dissection

Name ___________________________________Date: ____ ___________

The human heart is a pump. It pumps blood around the body at different speeds and at different pressures according to the body's needs. It can do this because the wall of the heart is made from **cardiac muscle.** Cardiac muscles are unlike any other muscle. It never gets fatigued like skeletal muscles. On average, cardiac muscle fibres contract and relax about 70 times a minute. In a lifetime, this muscle will contract over two billion times.

The heart has 4 pumping chambers. The 2 upper chambers, the **atria**, pump blood directly from the veins into the lower chambers, the **ventricles**. The right ventricle moves blood to the lungs for oxygenation and the left ventricle pumps blood into the body tissues.

Semilunar valves prevent the backflow of blood into the ventricles. Large valves between the atria and the ventricles prevent the backflow of blood into the atria when the ventricles contract. The **tricuspid and bicuspid valves** prevent blood from being forced back into the atria by ventricular contraction. The opening and closing of these valves produces the "lub-dub" sounds heard through a stethoscope.

Safety:

It is important to remember the following points as you are dissecting the heart.

1.) All safety procedures should be followed.

2.) Safety goggles, non-latex gloves, and lab aprons throughout the dissection.

3.) When making the incisions during the dissection, follow the guidelines that your instructor provides. Do not "saw" through the flesh of the heart with the scalpel but instead make a sharp, continuous stroke. This will help prevent the possibility of accidentally cutting yourself.

Materials Needed:

- heart (fresh or preserved)
- dissection kit
- dissection pan
- non-latex gloves

Procedure- External Anatomy of the Heart

1. Put on safety glasses or goggles and gloves.
2. Obtain a dissecting tray and a set of dissecting instruments.
3. Place the preserved heart on your dissecting tray.
4. Study Figures 1 and 2 and familiarize yourself with mammalian heart structures.
5. Notice the fat that covers the upper part of the heart and blood vessels. Remove as much of this fat as possible, using forceps to either pick or scrape it away. Work carefully and do not damage any of the heart structures as you remove the fat.
6. The fat is light coloured, soft, and without structure. Heart muscle is dark and fibrous. The walls of blood vessels are thin, tough, and usually smooth on the inside. Make an effort to distinguish between these 3 tissue types.
7. Once you remove the fat, locate the structures shown in Figures 1 and 2. In some cases, the blood vessels may be cut so close to the heart that little more than holes remain to show where they once attached.

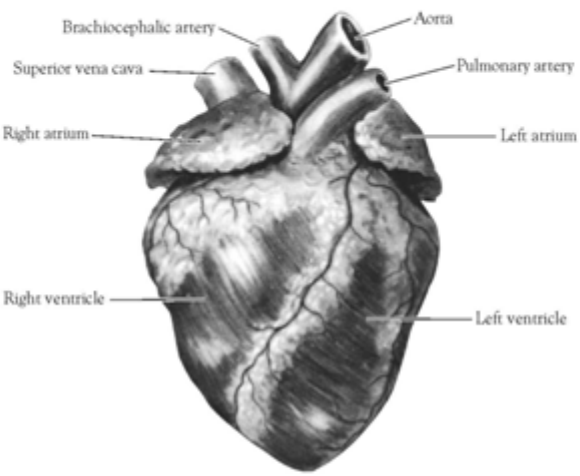


Figure 1. Heart (Anterior View)

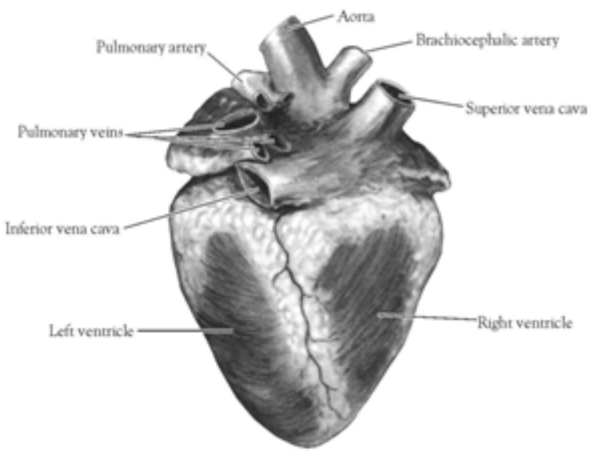
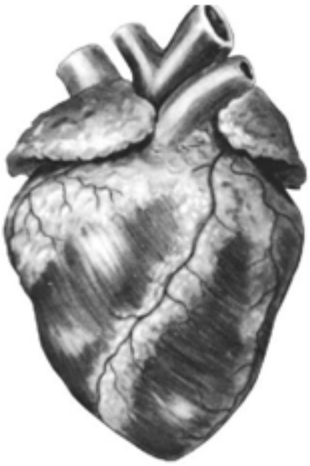


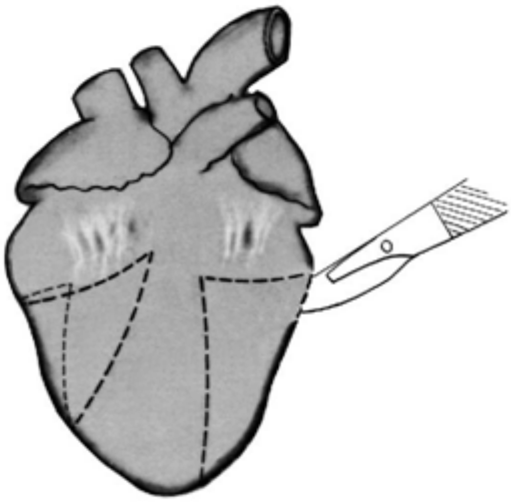
Figure 2. Heart (Posterior View)

Procedure- External Anatomy of the Heart
The Superior and Inferior Vena Cava

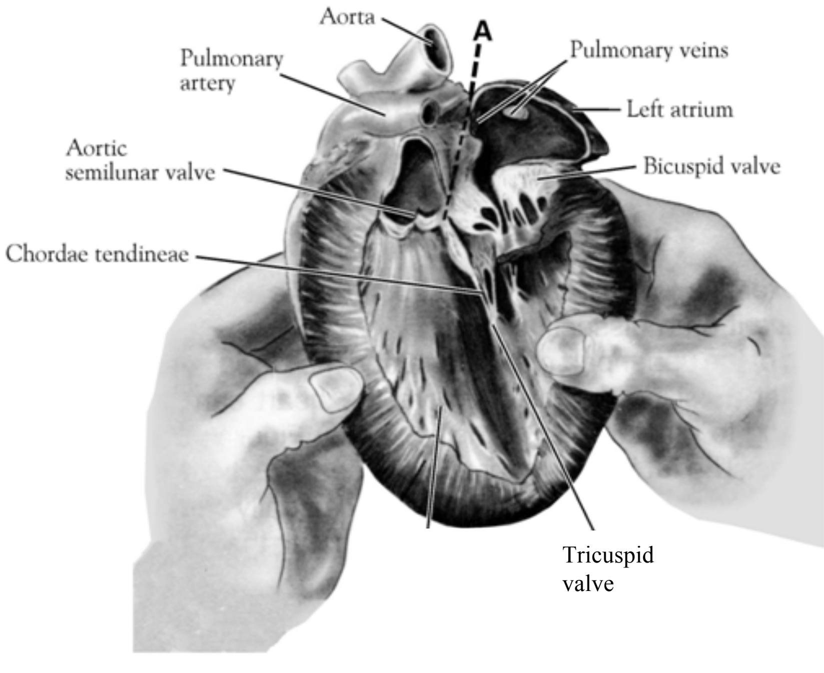
1. Position the heart as shown in Figure 3 (anterior side up). Cut open the left atrium and locate the bicuspid valve between the left atrium and ventricle.

2. Beginning at a point below the middle of the left ventricle, make an incision through the left ventricle wall as shown in Figure 4. Remove the lower-front portion of the wall.

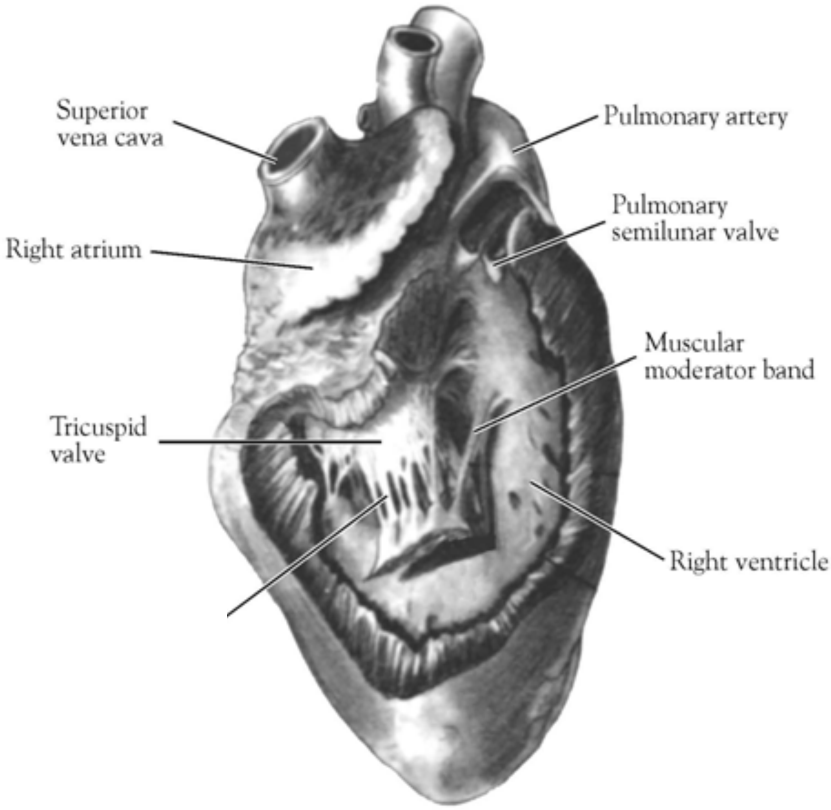




3. Look through the hole you have produced and locate the tricuspid and bicuspid valve as shown in Figure 5.
4. Trim away the front and side of the left ventricular wall, leaving part of the papillary muscles and all of the bicuspid valve in place. Make an incision to the side of the bicuspid valve as shown at A in Figure 5.
5. Spread the left side of the heart and identify the structures labelled in Figure 5



6. The right side is dissected similarly; begin by opening the top of the right atrium and locating the tricuspid valve between the right atrium and ventricle.
7. Remove the lower-front portion of the ventricular wall just as you removed that of the left ventricle.
8. Cut high across the front of the heart to locate the pulmonary semilunar valves.
9. Identify the structures labelled in Figure 6.



The Right Atrium

Now observe the vena cava and the right atrium.

The superior vena cava returns unoxygenated blood from the head, neck and upper extremities. The inferior vena cava returns unoxygenated blood from the lower body. The blood enters into the heart into the right atrium.

Observe the heart and locate the right atrium. Now probe down through the right atrium into the right ventricle. Your probe will push through a valve called a **atrialventricular valve** or AV valve. When you create a window to the right ventricle you will notice that this valve has three flaps and thus it is also called the tricuspid valve. Measure the thickness of the superior vena cava which is a vein that returns unoxygenated blood to the heart. Now measure the thickness of the wall of the right atrium. Record both measurements in millimetre into a data table. The walls of the vena cava as well as the right atrium are relatively thin compared to the arteries which emerge from the heart and the ventricles of the heart as the blood pressure in the vena cava and right atrium is rather low since blood is returning to the heart in these areas.

The Right Ventricle and Pulmonary Artery

Now you will examine the right ventricle.

Observe the right ventricle and measure the thickness of the wall of right ventricle in millimetre.

Use your probe to find the AV valve from the prospective of the right ventricle. Notice that it has three leaflets and is therefore often referred to as the tricuspid valve. Unoxygenated blood flows into the right atrium and then moves into the right ventricle through the AV valve. When the right ventricle contracts, the AV valve is closed such that blood cannot backflow into the atrium and the blood can only move forward through the pulmonary valve into the pulmonary artery. As the right ventricle contracts, the right atrium fills with blood. Then as the right ventricle relaxes, the right atrium pushes blood through the AV valve into the ventricle.

When blood is pumped from the right ventricle to the pulmonary artery out to the lungs, the AV valve closes as its leaflets come together. A sound is created in this process- the "lub" of the "lub dub" sound of the heart. Using your probe again, find the pulmonary artery which leads out of the right ventricle. Notice the pulmonary valve which separates the right ventricle from the pulmonary artery. When the right ventricle contracts, this valve is open. When the right ventricle relaxes and re-fills with blood from the right atrium, the pulmonary valve closes, preventing blood from backflowing from the pulmonary artery. The closing of the pulmonary valve causes a "dub" sound of the "lub dub". Note that all of the blood at this point in time is unoxygenated blood. Thus the "lub dub" sounds of the heart as heard through the stethoscope are created by the AV valve and the pulmonary valve as they prevent blood from back flowing in the heart and only moving forward- towards the lungs.

The Lungs

Once unoxygenated blood enters the lungs, it travels through many miles of capillaries in each of the lungs. In the smallest of capillaries, the red blood cells exchange carbon dioxide (a product of cellular respiration, CO_2) with oxygen (O_2) in small air sacs called the alveoli. Once the red blood cells contain oxygen, they begin their journey back to the heart through many miles of veins and eventually into the pulmonary veins which lead from each of the lungs.

The Pulmonary Veins and the Left Atrium

Using your probe, locate a number of pulmonary veins and probe into them. Your probe should emerge in the left atrium as you look through the "window" of muscle tissue. Measure the thickness of the walls of the right atrium. Now find the mitral valve or bicuspid valve which separates the left atrium and left ventricle.

The Left Ventricle and Aorta

Now locate the left ventricle. Measure the thickness of the wall of the left ventricle. Blood enters the left side of the heart through the pulmonary veins from each of the lungs where it has been oxygenated. As it fills the left atrium, the left ventricle contracts and pushes blood into the aorta. When the left ventricle contracts, the mitral valve closes, thereby preventing blood from backflowing into the left atrium. Once blood enters the atrium, the left ventricle relaxes, and the aortic valve closes. Find the aortic valve by locating the aorta and pushing your probe down through it into the left ventricle. The valve you push the probe through is the aortic valve.

Once oxygenated blood enters the aorta it travels through many miles of arteries and capillaries until it reaches the smallest capillaries where oxygen diffuses out of the red blood cells through the walls of the capillaries into the surrounding cells where carbon dioxide is exchanged with it. Once the red blood cells have obtained the carbon dioxide they begin their journey back to the heart via many miles of veins. Eventually the blood reaches the superior or inferior vena cava and the journey begins again!

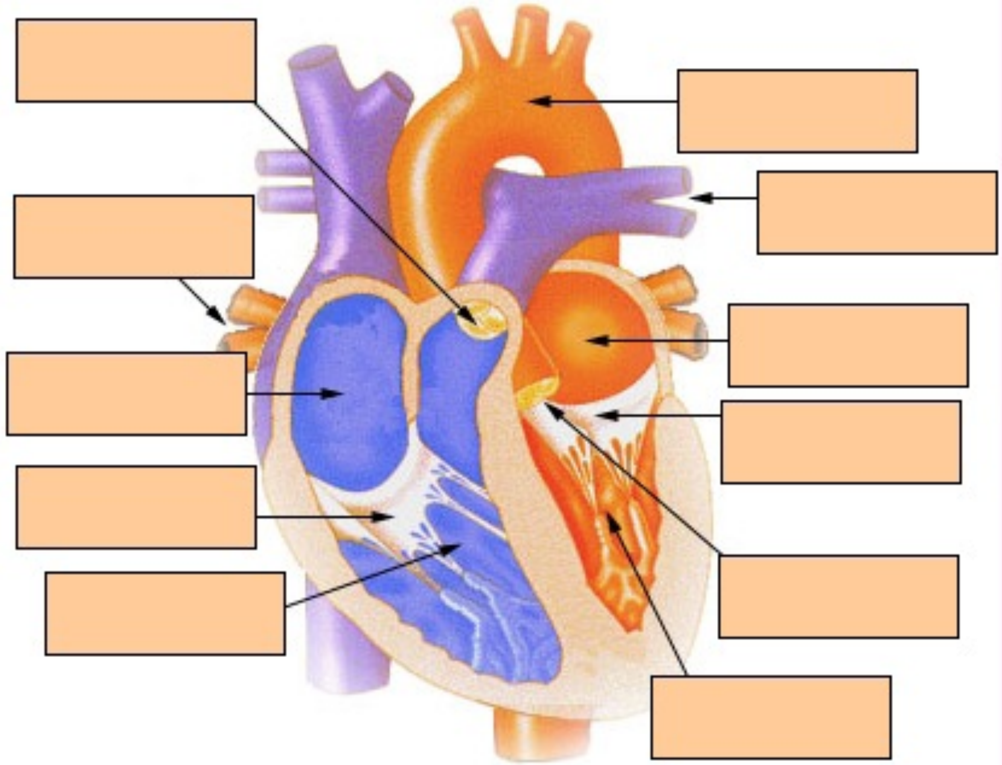
Questions:

1. What can you deduce (figure out) from the data you observed from the thickness of the walls of the veins, arteries, atria, and ventricles? Write a short, analytical paragraph regarding your findings.

2. Pretend you are a red blood cell. Explain in words your way through the cardiovascular system starting at the superior vena cava, delivering oxygen to the brain, and then returning to the vena cava. Make sure to list the important veins, arteries, atria, ventricles, valves, etc. that you will come into contact with as you make your journey. Write a paragraph describing this journey

3. Label the structure of the heart.

Structure of the Heart



Aorta (arch)

Right ventricle

Left ventricle

Right atrium

Left atrium

Pulmonary valve

Tricuspid valve

Mitral valve

Aortic valve

Pulmonary arteries

Pulmonary veins