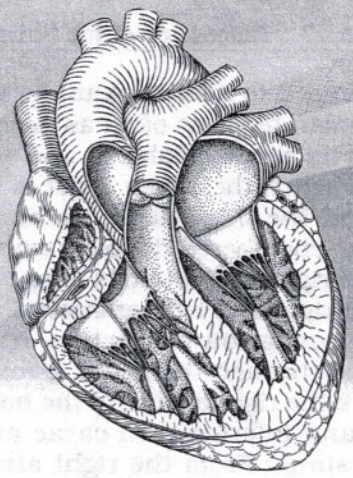
EXERCISE 49

Dissection of the Sheep Heart



PROCEDURAL INQUIRIES

Preparation

1. How can you distinguish the anterior surface of the sheep heart from the posterior surface?
2. What anatomical landmarks will you find as you prepare for bisection?

Dissection

3. What are the layers of the heart?
4. Which blood vessels are associated with each chamber of the heart?
5. What is the ligamentum arteriosum?
6. What are the internal walls of the heart? Where is each located?
7. What are the valves of the heart? Where is each located?
8. What are the internal muscles and tendons of the heart?
9. What is the moderator band?
10. What is the coronary sinus?
11. Where would you find the coronary arteries?
12. What are the nodes of the heart?

Additional Inquiries

13. What is the path of blood through the heart?
14. What is the physical relationship of the atria to the ventricles?

Key Terms

Anterior Interventricular Artery
Anterior Interventricular Sulcus
Aorta
Aortic Arch
Apex
Atrioventricular Node (AV Node)
Atrioventricular Septum
Atrioventricular Sulcus
Base
Bicuspid Valve
Chordae Tendinae
Coronary Artery
Coronary Sinus
Ductus Arteriosus
Foramen Ovale
Fossa Ovalis
Great Cardiac Vein
Interatrial Septum
Interventricular Septum
Ligamentum Arteriosum
Moderator Band
Myocardium
Papillary Muscle
Parietal Pericardium
Pectinate Muscle
Posterior Interventricular Sulcus
Pulmonary Artery
Pulmonary Trunk
Pulmonary Vein
Semilunar Valve
Sinoatrial Node (SA Node)
Trabeculae Carnae
Tricuspid Valve
Vena Cava
Visceral Pericardium

Materials Needed

Sheep Heart (Fresh or Preserved)
(Other mammalian hearts may be substituted)
Dissecting Pan
Blunt Nose Probe
Scalpel
Gloves
Pluck, if available

This exercise is a corollary to Exercise 48. It is assumed that you have already worked through Exercise 48 or that you are working through Exercises 48 and 49 simultaneously. Necessarily, a great deal of overlap exists between Exercises 48 and 49. In dissecting the sheep heart,

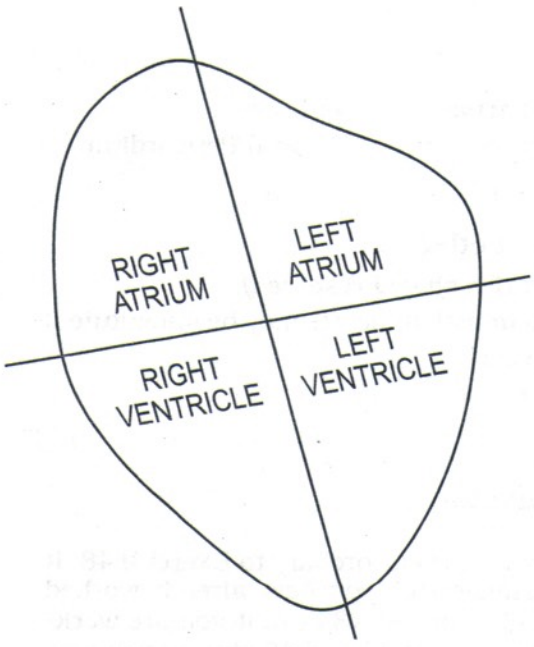
you are encouraged to refer back to the information on the human heart as often as necessary.

Because of its size, availability, and similarity to the human heart, the sheep heart is an ideal organ to dissect. The sheep heart, like the human heart, is a four-chambered double pump (Figure 49–1•) with the right and left **atria** (sing., **atrium**) superior to the right and left **ventricles**.

Before beginning your dissection, review the course of blood through the heart. Deoxygenated blood enters the right atrium of the heart from the superior and inferior vena cavae and from the coronary sinus. From the right atrium the blood travels through the tricuspid valve into the right ventricle. From the right ventricle the blood is pumped through the pulmonary semilunar valve into the pulmonary trunk, which subsequently branches into the right and left pulmonary arteries, which then carry the blood to the lungs.

Following gas exchange in the lungs, the oxygenated blood is returned to the heart via the four pulmonary veins, which empty into the left atrium. From the left atrium the blood passes through the bicuspid (mitral) valve into the left ventricle. From the left ventricle the blood passes through the aortic semilunar valve into the aorta, and from the aorta the oxygenated blood is carried throughout the body. In the body proper the metabolic exchange occurs: oxygen is exchanged for carbon dioxide. Deoxygenated blood is then returned to the heart, and the cycle begins again.

In this exercise we will dissect the sheep heart, although it should be noted that the same instructions would apply to the dissection of any mammalian heart.



● **FIGURE 49–1**
Chambers of the Heart.

❑ Preparation

I. Preliminary Instructions

A. IDENTIFICATION

1➡ As you work through this exercise, identify the structures (in boldface) based on the following descriptions.

2➡ Label Figures 49–2• and 49–3• as you work through your dissection. Refer to Exercise 48 as necessary.

B. PREPARATION OF THE HEART

1➡ Obtain a sheep heart and rinse thoroughly under running water in order to remove as much of the preservative as possible. Run water through the blood vessels if possible to remove fluids that may remain in the cavities.

2➡ Place the heart in a dissecting pan, with the anterior (ventral) surface facing you. The anterior surface is readily discernible because of the large diagonal line of fat that seems to extend from your upper right to your lower left. Beneath the layer of fat is the **anterior interventricular sulcus**.

3➡ If you are able to trim away the fat with your blunt nose probe, you will expose the **anterior interventricular artery** and the **great cardiac vein**. A similar line on the posterior aspect of the heart, known as the **posterior interventricular sulcus**, seems to be vertical. Keep in mind that with the anterior surface facing you, the animal's left side is on your right side.

❑ Dissection

II. External Examination

A. ANTERIOR

1➡ Place the heart so that the anterior position is facing you. The pointed area at the bottom of the heart is the **apex**, while the broad, flattened area at the top of the heart is the **base**.

2➡ Note that extending from the base of the heart are several vessels. These vessels

may be surrounded by excessive amounts of loose, globular fat. Depending on how carefully the heart was removed from the animal, you may find superior to the vessels and fat a piece of cartilagenous material. This is a part of the trachea. (If a pluck is available for demonstration, observe the relation of the trachea to the heart.)

3➡ Around the origins of the large blood vessels, look for traces of the relatively thick fibrous membrane known as the **parietal pericardium.** Much of this membrane is probably missing.

4➡ Depending on the condition of your specimen, you may be able to locate and isolate the **visceral pericardium (epicardium)** from the outer surface of the heart. Beneath this single squamous cell layer is the **myocardium**, the hefty section we generally think of as heart muscle.

5➡ With the anterior surface facing you, gently squeeze various parts of the heart. The animal's left ventricular wall should feel firmer than the right ventricular wall. The thicker left ventricle is required to pump the blood throughout the body. Describe the differences between different parts of the heart.

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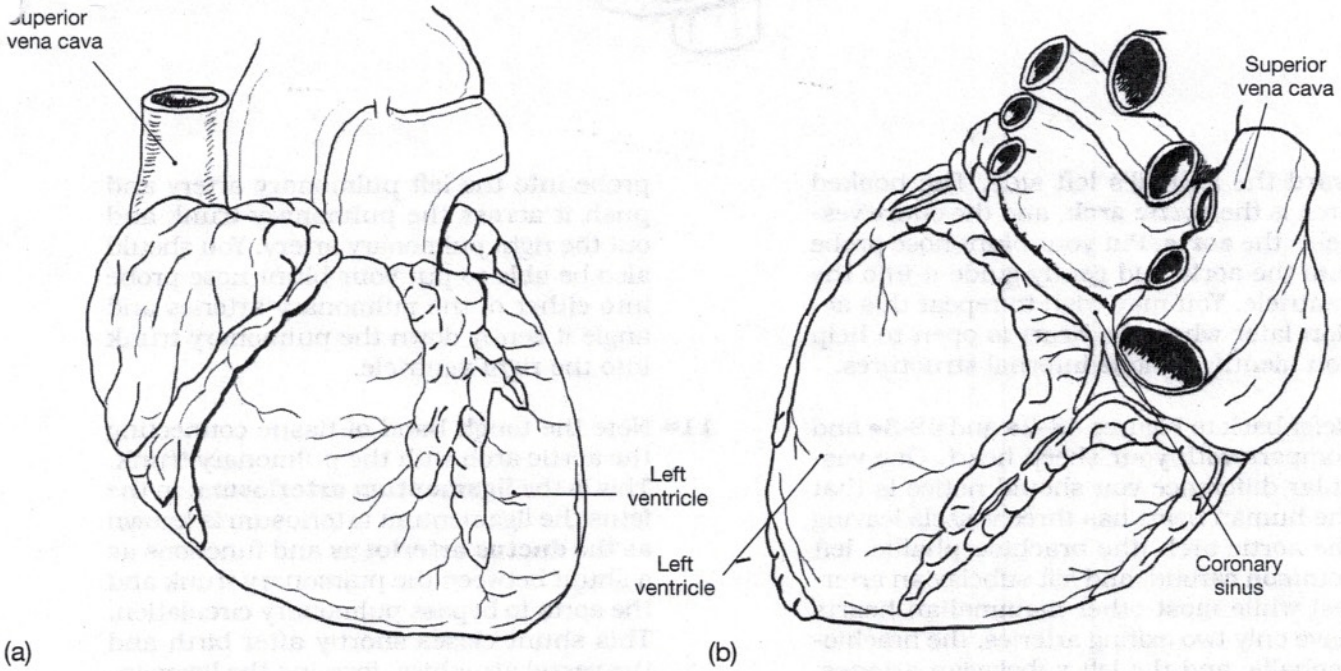
The left and right ventricles will be separated by the interventricular sulci, mentioned in Section I.B.

6➡ With the posterior (dorsal) surface facing you, locate a fat-filled horizontal line. Beneath this fatty tissue is the **atrioventricular sulcus**, which separates the atria from the ventricles.

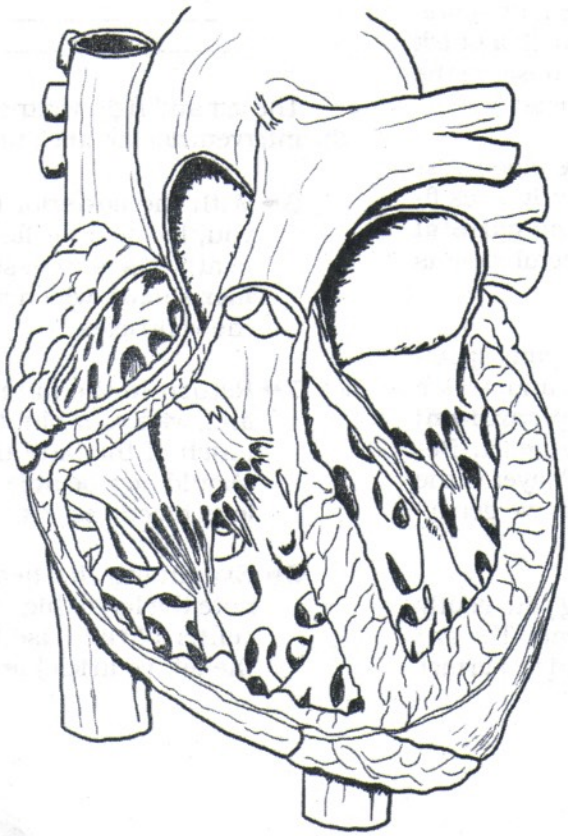
7➡ Return to the anterior base of the heart and, with your blunt nose probe, remove as much of the fatty tissue as possible. You should now be able to distinguish the various blood vessels.

8➡ Examining the heart from the anterior, note the large thick vessel arising from the center of the base (actually arising from the left ventricle) and hooking sharply to-



● **FIGURE 49–2**
Sheep Heart — Exterior View.
(a) Anterior **(b)** Posterior.

● **FIGURE 49–3**
Sheep Heart — Anterior View.



ward the animal's left side. The hooked area is the **aortic arch**, and the entire vessel is the **aorta**. Put your blunt nose probe into the aorta and gently guide it into the ventricle. You may wish to repeat this action later when the heart is open to help you identify various internal structures.

9➡ Refer back to Figures 48–2● and 48-3● and compare with your sheep heart. One vascular difference you should notice is that the human heart has three vessels leaving the aortic arch (the brachiocephallic, left common carotid, and left subclavian arteries) while most other mammalian hearts have only two exiting arteries, the brachiocephallic and the left subclavian arteries. Identify these vessels on your sheep heart.

10➡ Anterior to the aorta is the **pulmonary trunk**. The pulmonary trunk divides into the **right and left pulmonary arteries**. If the vessel on your heart is of sufficient length, you can trace this division. You should be able to put your blunt nose probe into the left pulmonary artery and push it across the pulmonary trunk and out the right pulmonary artery. You should also be able to put your blunt nose probe into either of the pulmonary arteries and angle it gently down the pulmonary trunk into the right ventricle.

11➡ Note the tough band of tissue connecting the aortic arch with the pulmonary trunk. This is the **ligamentum arteriosum**. In the fetus the ligamentum arteriosum is known as the **ductus arteriosus** and functions as a shunt between the pulmonary trunk and the aorta to bypass pulmonary circulation. This shunt closes shortly after birth and the vessel atrophies, forming the ligamentum arteriosum.

B. Posterior

1➡ Now examine the posterior aspect of the heart. On the animal's right you should see a large thin-walled vessel that seems to be opening straight up from the base of the

heart. This is the **superior vena cava.** Also on the right, just superior to the atrioventricular sulcus, is another large thin-walled vessel. This is the **inferior vena cava.**

2➡ If you are having difficulty locating the inferior vena cava, place your blunt nose probe into the superior vena cava and gently follow the posterior wall of the vessel. Your probe will pass though the right atrium and exit via the inferior vena cava.

3➡ Just superior to the inferior vena cava you should see two thin-walled vessels. Directly across the heart (on the animal's left) you should see two more thin-walled vessels. These four vessels are the **pulmonary veins**, and they enter the left atrium. You can run your blunt nose probe through these veins also, although this is sometimes more difficult because these veins are much smaller than the other vessels mentioned thus far. If the cut of the heart makes finding these vessels difficult, come back to them when you examine the interior aspects of the left atrium. You may then be able to find these vessels by running your probe around the left atrial wall.

II. Internal Examination

Refer to Exercise 48 as often as necessary.

A. Directions for Dissection

1➡ Although several methods of dissecting the heart exist, we will do an anterior/posterior bisection, beginning at the apex.

2➡ Before beginning your bisection, carefully plan the location of your incision. On each side of the heart project an imaginary lateral line from the apex to the approximate area of the atrioventricular sulcus. With your scalpel begin at the apex and carefully cut the myocardium bisecting each ventricle. (If you use scissors instead of the scalpel, keep the blunt end of the scissors on the inside of the heart.) Now cut the **interventricular septum**, the wall between the two ventricles.

B. Ventricular Structures

1➡ Lift the anterior section of the heart and observe the interior of the ventricles. The myocardium of the left ventricle is thicker than the myocardium of the right ventricle. Refer to Figure 48–4●. The left ventricle will appear to be considerably larger than the right ventricle, though the lumina of the ventricles are actually the same size.

Concept Check 1 Why would you expect these differences in the myocardial walls? Why would you expect the actual lumen size to be the same?

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2➡ Note the **chordae tendinae**, the string-like attachments running from the **cusps** of the valves to the muscles on the ventricle walls. Three cusps — the **anterior, medial, and posterior** — form the **tricuspid valve** between the right atrium and right ventricle, and two cusps — **anterior and posterior** — form the **bicuspid valve** between the left atrium and left ventricle. (The bicuspid valve was formerly known as the mitral valve.) The muscles of the ventricular walls are the **papillary muscles**. The chordae tendinae anchor into these papillary muscles. The papillary muscles in both ventricles can be subdivided into anterior and posterior papillary muscles. The folds and grooves on the internal surface of the ventricle are the **trabeculae carnae.**

3➡ At about the middle of the right ventricle, locate a tough diagonal cord running between the interventricular septum and the ventricular wall. This **moderator band** functions both as myocardial reinforcement and as a part of the cardiac conduction system.

C. Atrial Structures

1➡ Continue your lateral incisions up into the atria. Carefully cut the **atrioventricular septa,** the walls between the atria and the ventricles, but leave the **interatrial septum** intact.

2➡ Using your thumb and index finger reach up and bring your fingers together on either side of the interatrial septum. As you feel this area, you will note an oval depression. This is the **fossa ovalis**. In the fetus this fossa ovalis was the **foramen ovale,** an opening between the right and left atria, a shunt to bypass pulmonary circulation. This foramen closes at birth. See Exercise 54 for a discussion on the analogous human structures.

3➡ Note the interior walls of the atrium. The ridge-like surface is called the **pectinate muscle** (from *pecten*, "comb"). On the posterior wall of the right atrium you should

be able to locate both the superior and inferior vena cavae. You may have to run your blunt nose probe through the vena cavae from the outside in order to be certain.

4➡ Slightly medial from the entrance of the inferior vena cava into the right atrium you should notice a "hole" on the posterior wall. Put your blunt nose probe into this opening. Your probe, which you should be able to feel on the exterior surface of the heart, will follow the posterior atrioventricular sulcus. The opening is the opening to the **coronary sinus,** the vein that drains the cardiac muscle.

5➡ In the left atrium you should be able to locate the points where the pulmonary veins enter the heart. You may need your probe to verify that you have found these small openings.

D. Structures of the Aorta

1➡ Locate the **aortic semilunar valve** by tracing the aorta back into the left ventricle.

2➡ In the walls of the aorta just superior to the aortic semilunar valve, you should be able to find two openings to the **coronary arteries.** Examine these openings with your blunt nose probe. Were you able to find the coronary arteries? _____ What is the physical relationship between the semilunar valve and the coronary arteries?

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Concept Check **2** What is the functional relationship between the semilunar valve and the coronary arteries?

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E. Pulmonary Semilunar Valves

1➡ Locate the **pulmonary** (or pulmonic) **semilunar valve** by tracing the pulmonary trunk back into the right ventricle. You should be able to see the three cusps of this valve.

F. Nodal Tissue

1➡ Depending on the condition of your heart, you may possibly be able to locate the **sinoatrial (SA) node**, the pacemaker of the heart, which is located in the right atrium near the opening of the superior vena cava. The **atrioventricular (AV) node** is located on the inferior portion of the interatrial septum. If you are able to find either of these nodes, the tissue will feel like a hard nodule.

❑ Additional Activities

1. Compare the sheep heart with other mammalian hearts. What similarities and differences do you see?
2. Use the dissecting microscope to examine parts and sections of the sheep heart. Try to get a close-up of the valves and vessels. What similarities and differences do you notice between the atrioventricular valves and the semilunar valves?

NOTES

Answers to Selected Concept Check Questions

1. The ventricles pump the same amount of blood so the lumen volumes should be the same. The walls of the left ventricle are thicker because more contractile force is necessary to pump the blood throughout the body.
2. This relationship prevents backflow and excessive pressure in the coronary arteries while assuring continuous blood flow to the heart muscle.