LAB EXERCISE 35

Structure of the Heart

The **heart** is a four-chambered, hollow organ composed primarily of cardiac muscle tissue. It contracts rhythmically, pumping blood into the **arteries.** After passing through tissues, blood returns to the heart by way of the **veins** and is pumped again. This exercise challenges you to explore the anatomy of the heart through the use of models and preserved specimens.

Before you begin

- ❑ Read the appropriate sections of Chapter 18 in your textbook.
- ❑ Set your learning goals. When you finish this exercise, you should be able to
  - ❑ describe the structure of the heart
  - ❑ locate anatomical features of the heart in models and in preserved mammalian specimens
  - ❑ explain the function of major heart structures
- ❑ Prepare your materials:
  - ❑ dissectible models of the human heart
  - ❑ preserved sheep heart
  - ❑ dissection tools and trays
  - ❑ wooden dowels (1 cm diameter × 12 cm), pencils, or dull probes
  - ❑ computer setup with DISSECTIBLE HUMAN or similar human dissection program (optional)
- ❑ Read the directions and safety tips for this exercise **carefully** before starting any procedure.

HINT

Using the DISSECTIBLE HUMAN or similar computerized human dissection program, explore the human body and try to find the structures listed in this activity. Check them off in your Lab Report as you find them.

A. Human heart anatomy

Using dissectible models and the aid given in this exercise, find these features of the heart:

❑ 1 Identify these structures on the external aspect, ventral surface:

❑ **Interventricular sulcus**—This diagonal groove is located between the walls of the two lower heart chambers (**ventricles**). Along this groove lie the **anterior interventricular artery** and the **great cardiac vein.**

❑ **Auricles**—These are the flaplike outpouchings of the left and right **atria** (the upper heart chambers).

❑ **Atrioventricular sulci**—These are grooves between the walls of the atria above and the ventricles below. Locate the **small cardiac vein** and **right coronary artery** on the right and the **great cardiac vein** and **circumflex artery** on the left.

❑ **Aorta**—The largest artery of the body, it forms the **aortic arch** above the heart.

❑ **Pulmonary artery**—Somewhat smaller than the aorta, this vessel leaves the heart as a single **trunk** but soon branches to become the **left** and **right pulmonary arteries.**

❑ **Superior and inferior vena cava**—These two large veins communicate with the right atrium.

❑ **Apex**—The apex is the lower "point" of the heart.

❑ 2 Identify these features of the heart on the external aspect, dorsal surface:

❑ **Atria**—These are the upper left and right chambers. They have relatively thin walls.

❑ **Ventricles**—These are the lower left and right chambers. They have relatively thick walls.

❑ **Interventricular sulcus**—It is similar to that on the ventral surface. Locate the **middle cardiac vein** and the **posterior ventricular artery.**

❑ **Pulmonary veins**—These veins communicate with the atria.

❑ 3 Identify these features visible on the internal aspect:

❑ **Atria**—They are distinguished by their position and thin walls.

❑ **Ventricles**—They are thick-walled lower chambers. Note that one ventricle has thicker walls than the other. What functional adaptation does this represent?

❑ **Interventricular septum**—This heart wall separates the left and right ventricles from each other.

❑ **Cuspid valves**—Also called **atrioventricular (AV) valves,** these valves ensure one-way flow of blood from the atria into the ventricles. The left AV valve, or **mitral (bicuspid)** valve, is composed of two cusps (flaps). The right AV valve, or **tricuspid valve,** has three cusps. Each cusp is attached to the wall of the ventricle below by means of fibrous

chordae tendineae connected to fingerlike projections of the ventricular myocardium called **papillary muscles.**

- ❑ **Semilunar (SL) valves**—The right SL valve, or **pulmonary semilunar valve,** ensures one-way flow from the right ventricle into the pulmonary artery. The left SL valve, or **aortic semilunar valve,** is at the entrance of the aorta. SL valves are each composed of thin-walled bags that hang from the walls of the vessel.
- ❑ **Myocardium**—This is the muscular layer of the heart wall.
- ❑ **Endocardium**—The thin endothelial lining of the heart chambers, it covers the beamlike **trabeculae** on the inner face of the myocardium.

❑ 4 Locate these structures of the heart coverings:

- ❑ **Serous pericardium**—The thin, serous membrane that covers the outside of the heart reflects (folds) on itself to form two layers. The inner layer is the **visceral pericardium** and also serves as the outer wall of the heart or **epicardium.** The outer layer is the **parietal pericardium.** Between the two layers of the serous pericardium is the **pericardial space,** which contains lubricating **pericardial fluid.**
- ❑ **Fibrous pericardium**—The tough, fibrous outer covering of the heart and the serous pericardium, it adheres to the outer surface of the parietal pericardium and thus forms a flexible, protective pouch around the heart. The fibrous pericardium rests on the superior surface of the diaphragm.

SAFETY FIRST!

Observe the usual precautions when dissecting your specimen. Heed the safety advice accompanying the preservative and avoid cuts and punctures when using the dissecting tools. Use safety goggles to avoid injury during dissections. As always, dispose of your specimen as instructed.

B. Sheep heart dissection

The sheep heart is very similar in structure to the human heart. It is nearly the same size, so it makes an ideal study specimen.

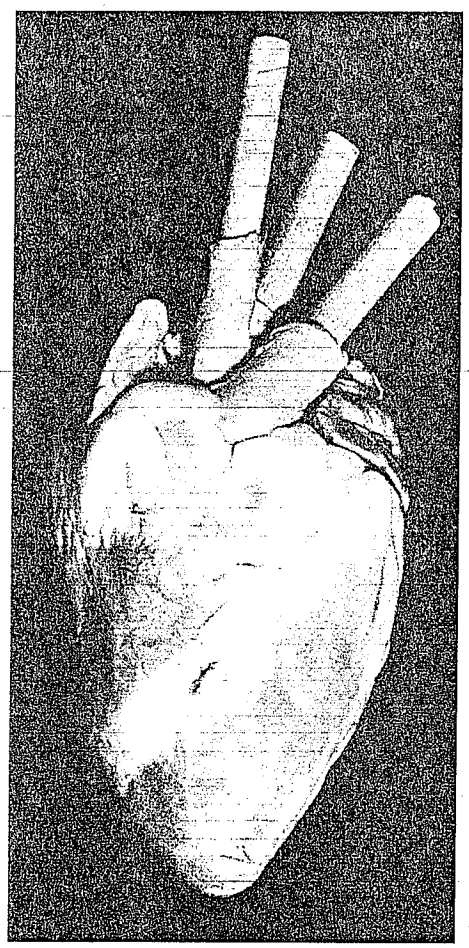
❑ 1 Orient yourself to the specimen. Using the photos as a guide, locate the dorsal and ventral surfaces. The shape of your specimen may have become distorted in shipping, so don't rely on shape as a guide. Recall that directions for the sheep heart are based on the fact that the sheep is a four-legged animal, so its *heart is oriented differently than in the human.*

❑ 2 Identify the structures of the external aspect of the sheep heart as you did for the human heart. Some adipose tissue may have to be removed so that you can see all the structures clearly. You may not be able to locate all of the *coronary vessels* because they are buried under fat. Many of the large heart vessels may have been cut very closely to the heart wall, so they appear as holes or short stubs. Use a wooden dowel or pencil to open the vessels for better viewing (as in the photo; Figure 35-1, *A*). Some identifications of external structures will be tentative until you open the heart and verify your observations.

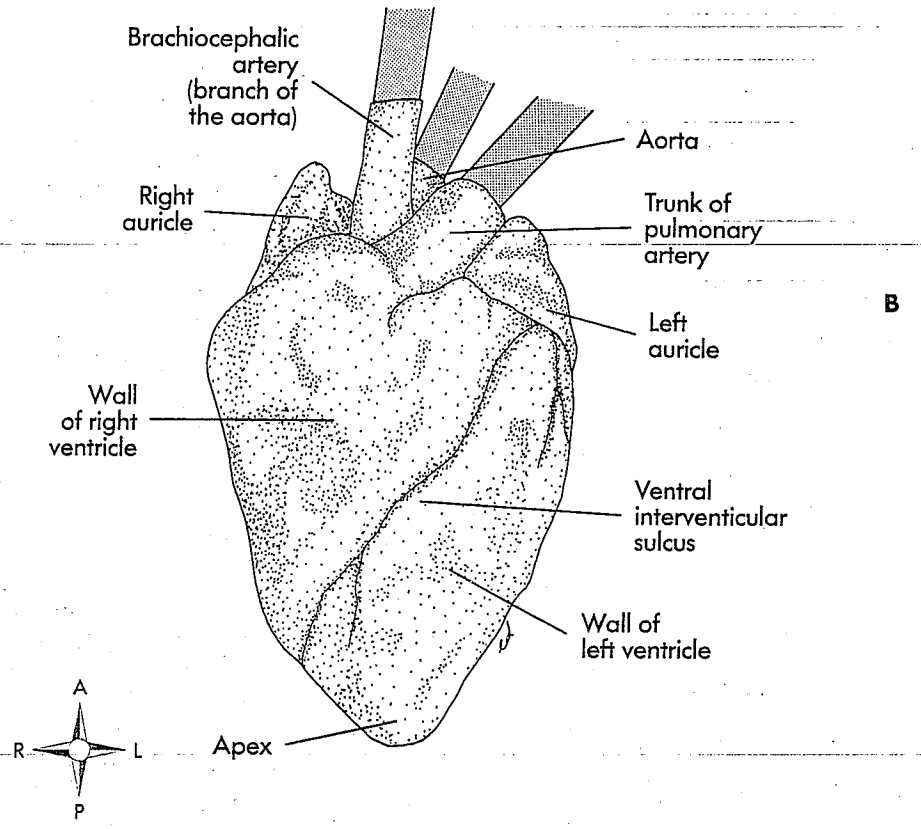
❑ 3 Use a long knife or your scalpel and scissors to cu frontal section in your specimen (as in the photo; Figure 35-2). Try to identify the internal heart features as you did with the human heart model.

HINT

LABORATORY REFERENCE Plates 70 and 71 show color photographs of a preserved sheep heart.

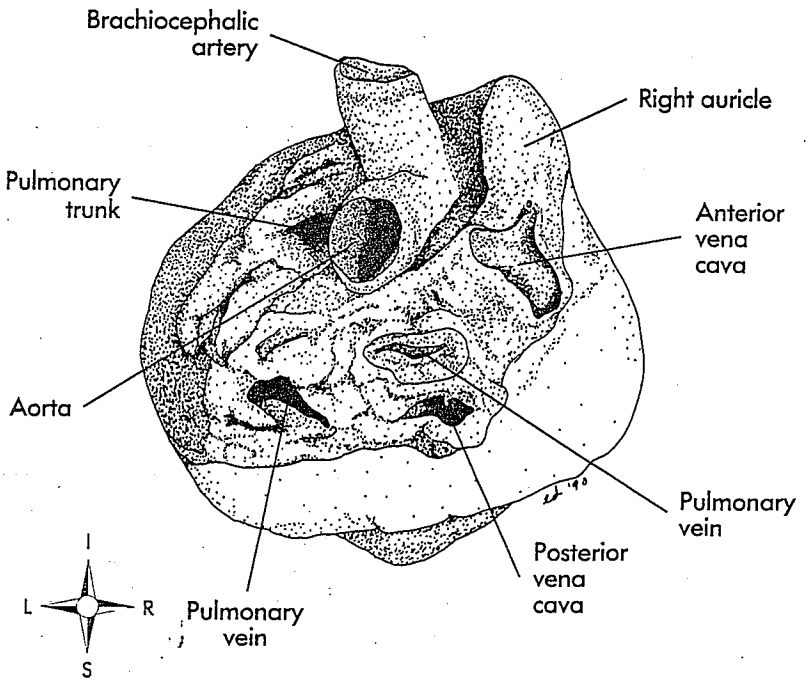


A



B

C



D

Figure 35-1 **A** and **B**, Ventral view of the sheep heart. **C** and **D**, Anterior view of the sheep heart, analogous to a superior view of the human heart.

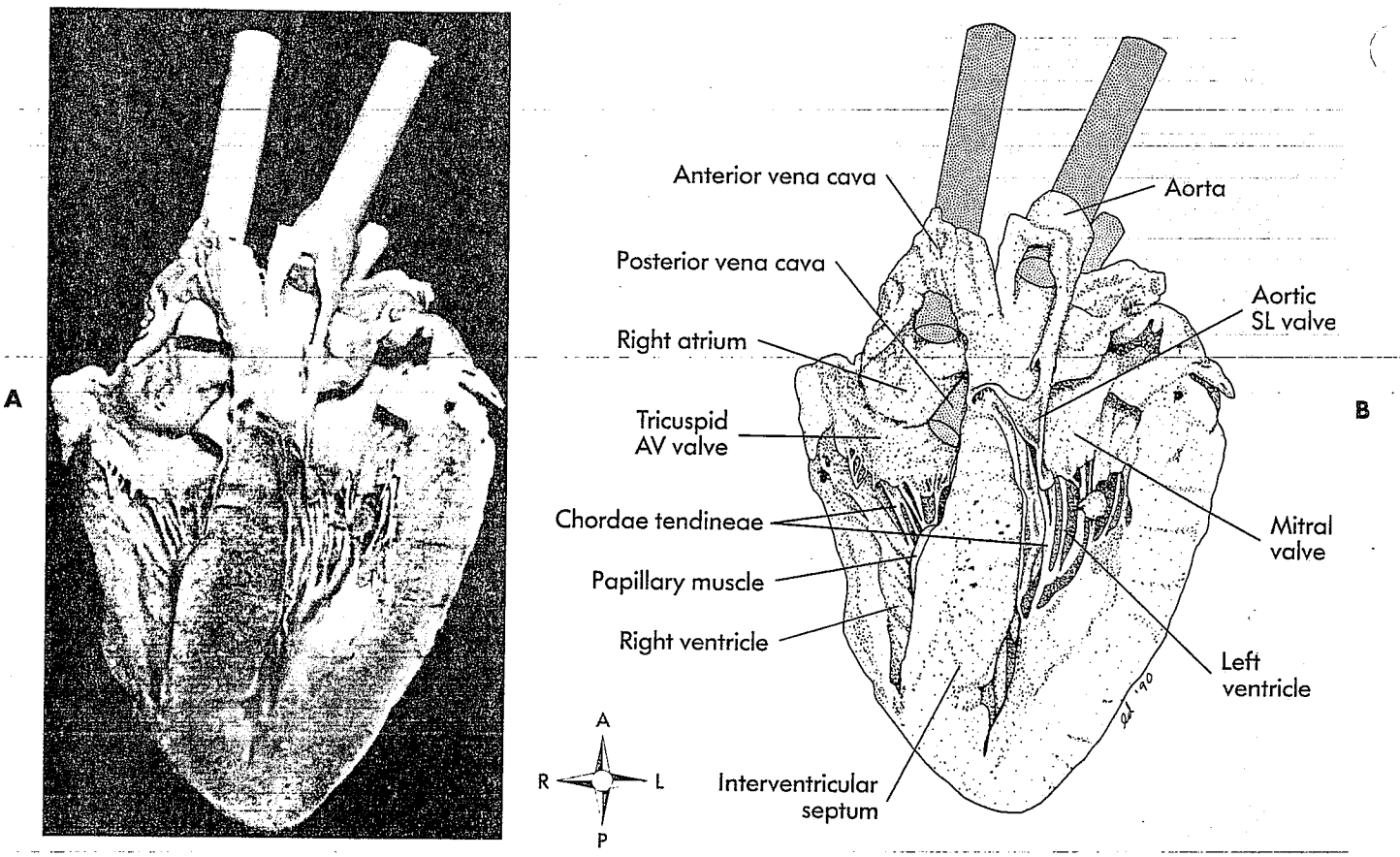
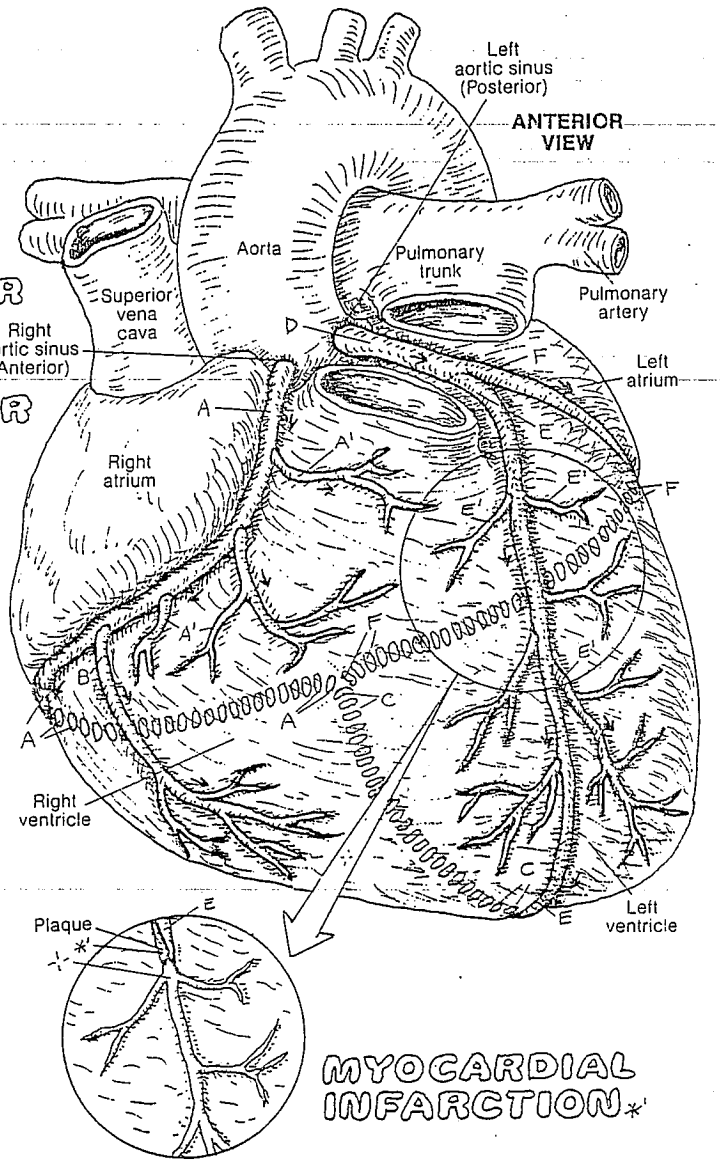


Figure 35-2 A and B, Ventral view of the frontal section of a sheep heart.

VI. CARDIOVASCULAR SYSTEM

CORONARY ARTERIES & CARDIAC VEINS

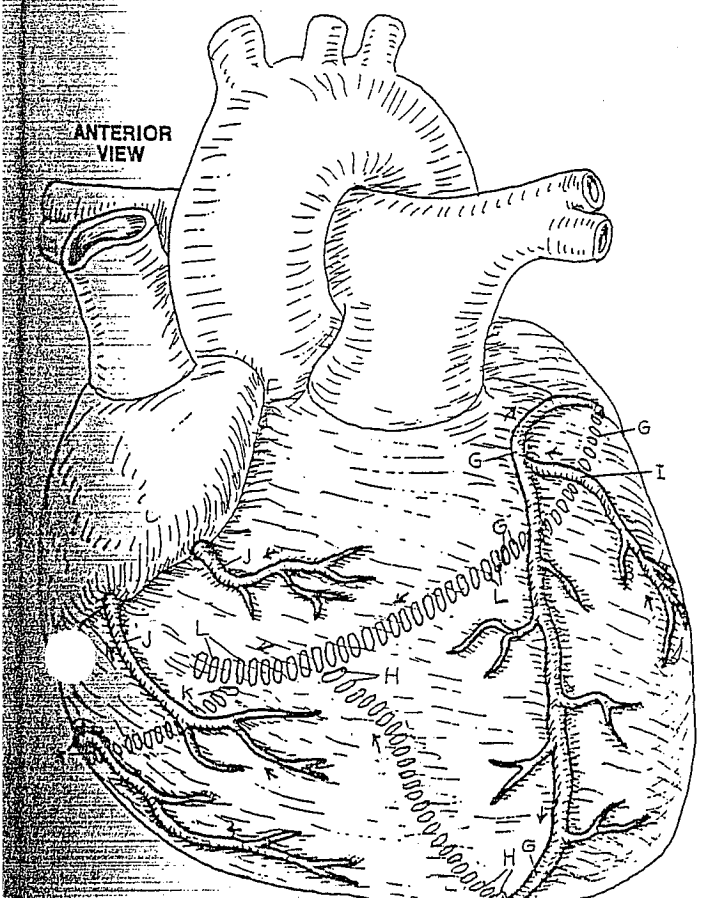
Use your brightest colors for A, D, and L. (1) When coloring the arteries, include the broken lines which represent vessels on the posterior surface of the heart. (2) Do the same with the veins. (3) Color the artery in front of the plaque in the circled view; color the vessel after the plaque a lighter shade of the same color or do not color it at all.



CORONARY ARTERIES:*

- RIGHT CORONARY ARTERY A
  - MUSCULAR BRANCH A'
  - MARGINAL BRANCH B
  - POSTERIOR INTERVENTRICULAR (DESCENDING) BRANCH C
- LEFT CORONARY ARTERY D
  - ANTERIOR INTERVENTRICULAR (DESCENDING) BRANCH E
    - MUSCULAR BRANCH E'
  - CIRCUMFLEX BRANCH F

The *coronary arteries* form an upside down crown (*L. corona*) about or just deep to the surface of the heart. The arteries lie in grooves or sulci, often covered over by the epicardium and sometimes the myocardium as well. Both left and right arteries arise from small openings (aortic sinuses) just above the two aortic semilunar valve cusps. Generally, the left coronary artery is somewhat larger than the right; the flow rate through the left is greater in most people than that through the right during the cardiac cycle. There may be considerable variation in the anastomotic pattern of the left and right arterial branches. These branches terminate in multitudes of arterioles supplying the vast capillary network among the muscle fibers. The apparent multiple communications among the left and right coronary arteries notwithstanding, varying degrees of vascular insufficiency occur when there is significant obstruction of one or both coronary arteries. There is some extra-coronary arterial supply to the heart from the epicardial vessels (branches of internal thoracic arteries) and aortic vasa vasorum.



MYOCARDIAL INFARCTION*'

Insufficient oxygenation (hypoxia) of the myocardium occurs with significantly reduced blood flow to the muscle (ischemia), often inducing sharp, crushing chest pain (angina pectoris). About 75% or more obstruction by atherosclerotic plaque (thrombi) can cause myocardial damage (myocardial infarction). Significant plaque in the artery to the sinoatrial node (not shown) can cause arrhythmias in the cardiac conduction system, often necessitating the installation of an artificial pacemaker in the chest.

CARDIAC VEINS:*

- GREAT CARDIAC V. G
- MIDDLE CARDIAC V. H
- MARGINAL V. I
- ANTERIOR CARDIAC V. J
- SMALL CARDIAC V. K

CORONARY SINUS L

The *cardiac veins* travel with the coronary arteries, but incompletely. Vast anastomoses of veins occur throughout the myocardium; most drain into the right atrium by way of the *coronary sinus*. The *anterior cardiac veins* conduct blood directly into the right atrium. Other small veins may drain directly into the right atrium as well. Some deep (arteriosinusoidal) veins drain directly into the atria and ventricles. Extracardiac venous drainage can also occur through the vasa vasorum of the vena cavae.