Vocabulary Related to the Cardiovascular System

Terms marked with the ❖ symbol are pronounced on the Student Activity CD-ROM that accompanies this text.

KEY WORD PARTS

- ☐ **angi/o**
- ☐ **aort/o**
- ☐ **arteri/o**
- ☐ **ather/o**
- ☐ **brady-**
- ☐ **cardi/o**
- ☐ **coron/o**
- ☐ **-emia**
- ☐ **erythr/o**
- ☐ **hem/o, hemat/o**
- ☐ **leuk/o**
- ☐ **phleb/o**
- ☐ **tachy-**
- ☐ **thromb/o**
- ☐ **ven/o**

KEY MEDICAL TERMS

- ☐ **aneurysm** (**AN**-you-rizm) ❖
- ☐ **aneurysmectomy** (**an**-you-riz-**MECK**-toh-mee) ❖
- ☐ **aneurysmorrhaphy** (**an**-you-riz-**MOR**-ah-fee) ❖
- ☐ **angiitis** (**an**-je-**EYE**-tis) ❖
- ☐ **angina** (an-**JIGH**-nah *or* **AN**-jih-nuh) ❖
- ☐ **angiocardiography** (**an**-jee-oh-**kar**-dee-**OG**-rah-fee) ❖
- ☐ **angiography** (**an**-jee-**OG**-rah-fee)
- ☐ **angionecrosis** (**an**-jee-oh-neh-**KROH**-sis)
- ☐ **angiostenosis** (**AN**-jee-oh-steh-**NOH**-sis)
- ☐ **antiarrhythmic** (**an**-tih-ah-**RITH**-mick) ❖
- ☐ **anticoagulant** (**an**-tih-koh-**AG**-you-lant) ❖
- ☐ **antihypertensive** (**an**-tih-**high**-per-**TEN**-siv) ❖
- ☐ **aplastic anemia** (ay-**PLAS**-tick ah-**NEE**-mee-ah) ❖
- ☐ **arrhythmia** (ah-**RITH**-mee-ah) ❖
- ☐ **arteriectomy** (**ar**-teh-ree-**ECK**-toh-mee) ❖
- ☐ **arteriosclerosis** (ar-**tee**-ree-oh-skleh-**ROH**-sis) ❖
- ☐ **arteritis** (**ar**-teh-**RYE**-tis)
- ☐ **atherectomy** (**ath**-er-**ECK**-toh-mee)
- ☐ **atheroma** (**ath**-er-**OH**-mah) ❖
- ☐ **atherosclerosis** (**ath**-er-**oh**-skleh-**ROH**-sis) ❖
- ☐ **basophils** (**BAY**-soh-fills)
- ☐ **bradycardia** (**brad**-ee-**KAR**-dee-ah) ❖
- ☐ **cardiac catheterization** (**KAR**-dee-ack **kath**-eh-ter-eye-**ZAY**-shun) ❖
- ☐ **cholesterol** (koh-**LES**-ter-ol) ❖
- ☐ **defibrillation** (dee-**fib**-rih-**LAY**-shun) ❖
- ☐ **diastolic** (dye-ah-**STOL**-ick) ❖
- ☐ **dyscrasia** (dis-**KRAY**-zee-ah) ❖
- ☐ **echocardiography** (**eck**-oh-**kar**-dee-**OG**-rah-fee) ❖
- ☐ **electrocardiogram** (ee-**leck**-troh-**KAR**-dee-oh-**gram**) ❖
- ☐ **embolism** (**EM**-boh-lizm) ❖
- ☐ **embolus** (**EM**-boh-lus) ❖
- ☐ **endarterectomy** (**end**-ar-ter-**ECK**-toh-mee) ❖
- ☐ **endocarditis** (**en**-doh-kar-**DYE**-tis) ❖
- ☐ **eosinophils** (**ee**-oh-**SIN**-oh-fills)
- ☐ **erythrocytes** (eh-**RITH**-roh-sights)
- ☐ **fibrillation** (**fih**-brih-**LAY**-shun) ❖
- ☐ **hemangioma** (hee-**man**-jee-**OH**-mah) ❖
- ☐ **hemochromatosis** (**hee**-moh-**kroh**-mah-**TOH**-sis) ❖
- ☐ **hemoglobin** (**hee**-moh-**GLOH**-bin)
- ☐ **hemolytic anemia** (**hee**-moh-**LIT**-ick ah-**NEE**-mee-ah) ❖
- ☐ **hemostasis** (**hee**-moh-**STAY**-sis) ❖
- ☐ **homocysteine** (**hoh**-moh-**SIS**-teen) ❖
- ☐ **hypoperfusion** (**high**-poh-per-**FYOU**-zhun) ❖
- ☐ **ischemia** (iss-**KEE**-me-ah) ❖
- ☐ **leukemia** (loo-**KEE**-me-ah) ❖
- ☐ **leukocytes** (**LOO**-koh-sites)
- ☐ **leukopenia** (**loo**-koh-**PEE**-nee-ah) ❖
- ☐ **lymphocytes** (**LIM**-foh-sights)
- ☐ **megaloblastic anemia** (**MEG**-ah-loh-**blas**-tick ah-**NEE**-mee-ah) ❖
- ☐ **monocytes** (**MON**-oh-sights)
- ☐ **myocardial infarction** (**my**-oh-**KAR**-dee-al in-**FARK**-shun) ❖
- ☐ **myocarditis** (**my**-oh-kar-**DYE**-tis) ❖
- ☐ **neutrophils** (**NEW**-troh-fills)
- ☐ **palpitation** (**pal**-pih-**TAY**-shun) ❖
- ☐ **pericarditis** (**pehr**-ih-kar-**DYE**-tis) ❖
- ☐ **pernicious anemia** (per-**NISH**-us ah-**NEE**-mee-ah) ❖
- ☐ **phlebitis** (fleh-**BYE**-tis) ❖
- ☐ **phlebography** (fleh-**BOG**-rah-fee) ❖
- ☐ **plaque** (**PLACK**)
- ☐ **polyarteritis** (**pol**-ee-**ar**-teh-**RYE**-tis) ❖
- ☐ **Raynaud's** (ray-**NOHZ**) ❖
- ☐ **septicemia** (**sep**-tih-**SEE**-mee-ah) ❖
- ☐ **systolic** (sis-**TOL**-ick) ❖
- ☐ **tachycardia** (**tack**-ee-**KAR**-dee-ah) ❖
- ☐ **thrombocytes** (**THROM**-boh-sights)
- ☐ **thrombocytopenia** (**throm**-boh-**sigh**-toh-**PEE**-nee-ah) ❖
- ☐ **thrombolytic** (**throm**-boh-**LIT**-ick) ❖
- ☐ **thrombosis** (throm-**BOH**-sis) ❖
- ☐ **thrombus** (**THROM**-bus) ❖
- ☐ **triglycerides** (try-**GLIS**-er-eyeds) ❖
- ☐ **valvoplasty** (**VAL**-voh-**plas**-tee) ❖
- ☐ **valvulitis** (**val**-view-**LYE**-tis) ❖
- ☐ **valvuloplasty** (**VAL**-view-loh-**plas**-tee) ❖
- ☐ **varicose veins** (**VAR**-ih-kohs **VAYNS**) ❖
- ☐ **vasculitis** (**vas**-kyou-**LYE**-tis) ❖

Objectives

Upon completion of this chapter, you should be able to:

1. Describe the heart in terms of chambers, valves, blood flow, heartbeat, blood supply, and heart sounds.
2. Differentiate among the three different types of blood vessels and describe the major function of each.
3. Identify the major components of blood and the major functions of each.
4. State the difference between pulmonary and systemic circulation.
5. Recognize, define, spell, and pronounce the terms related to the pathology, diagnostic, and treatment procedures of the cardiovascular system.

FUNCTIONS OF THE CARDIOVASCULAR SYSTEM

The term **cardiovascular** means pertaining to the heart and the blood vessels (**cardi/o** means heart, **vascul** means blood vessels, and **-ar** means pertaining to). These structures work together as an efficient pumping system to supply all body tissues with oxygen and nutrients and to transport cellular waste products to the appropriate organs for removal from the body.

- In addition, the blood cells play important roles in the immune system (see Chapter 6) and endocrine system (see Chapter 13).

STRUCTURES OF THE CARDIOVASCULAR SYSTEM

The major structures of the cardiovascular system are the heart, blood vessels, and blood.

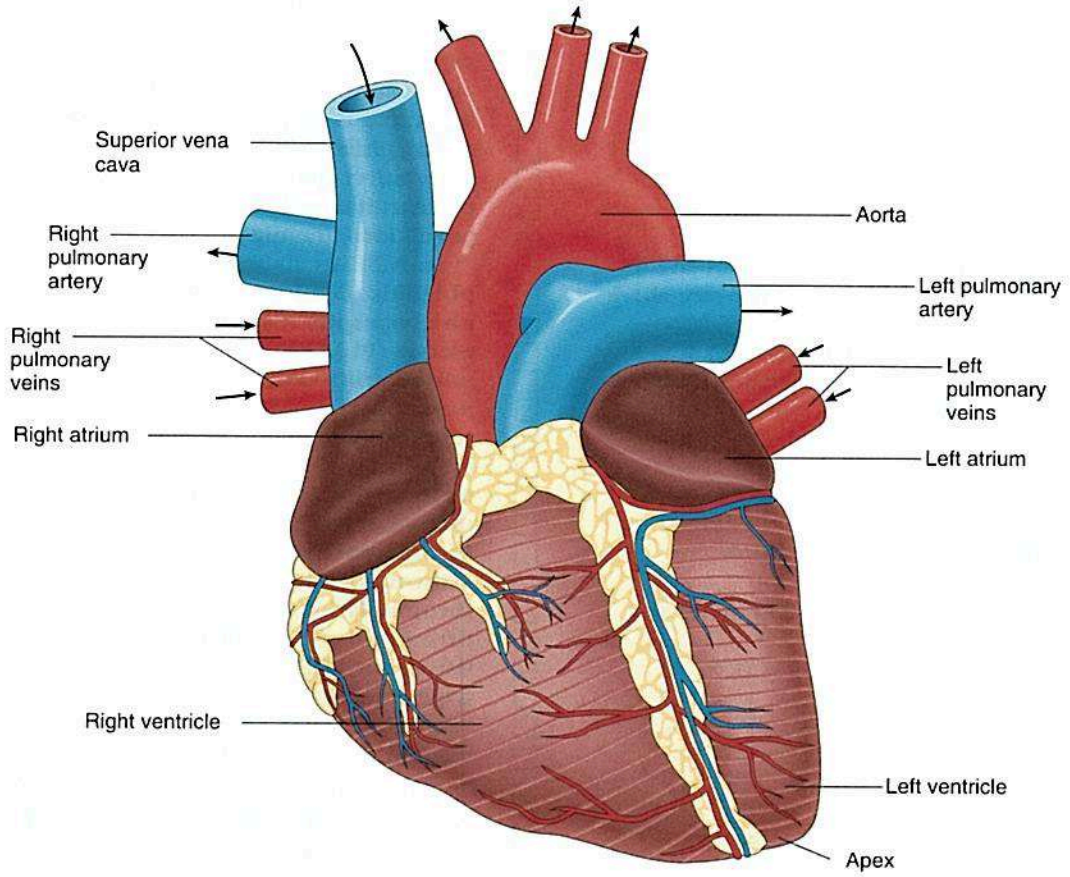

FIGURE 5.1 External view of the heart.

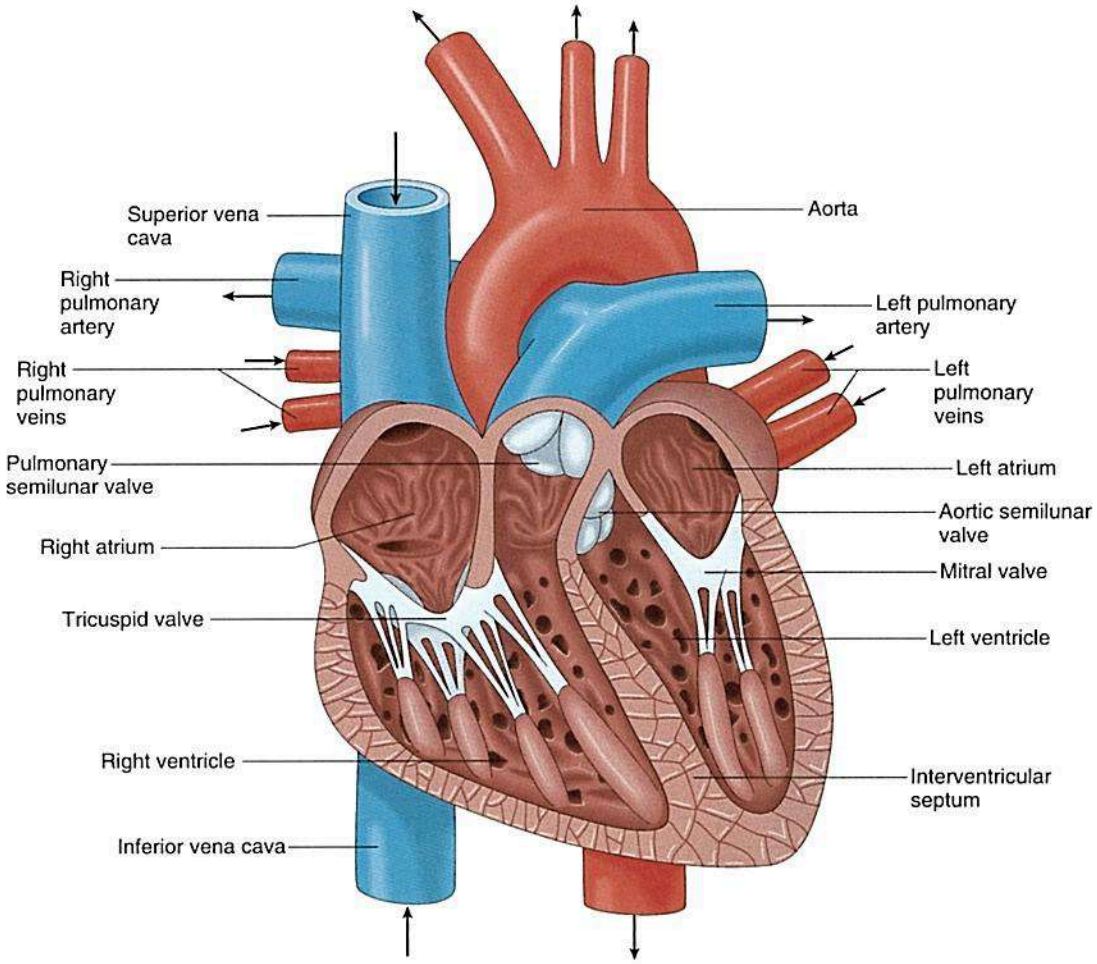

FIGURE 5.2 Cross section of the heart.

THE HEART

The heart, which is a hollow muscular organ located between the lungs and above the diaphragm, is a very effective pump that furnishes the power to maintain blood flow throughout both the pulmonary and systemic circulatory systems (Figures 5.1 and 5.2).

THE PERICARDIUM

- The **pericardium** (pehr-ih-**KAR**-dee-um) is the double-walled membranous sac that encloses the heart.
- **Pericardial fluid** between the layers prevents friction when the heart beats.

THE WALLS OF THE HEART

The walls of the heart are made up of three layers: the epicardium, myocardium, and endocardium (Figure 5.3).

- The **epicardium** (**ep**-ih-**KAR**-dee-um) is the external layer of the heart and also is part of the inner layer of the pericardial sac.
- The **myocardium** (my-oh-**KAR**-dee-um), which is the middle and thickest of the three layers, consists of the cardiac muscle. (See Cardiac Muscle in Chapter 4.)
- The **endocardium** (**en**-doh-**KAR**-dee-um), which is the lining of the heart, forms the inner surface that comes in direct contact with blood being pumped through the heart.

THE BLOOD SUPPLY TO THE MYOCARDIUM

- The myocardium is specialized muscle that beats constantly and *must* have a continuous supply of oxygen and nutrients and prompt removal of waste.
- The **coronary arteries and veins** supply the blood needs of the myocardium. If this blood supply is disrupted, the myocardium in the affected area dies (Figure 5.4).

THE HEART CHAMBERS

The heart is divided into left and right sides. Each side is subdivided, thus forming four chambers (see Figure 5.2).

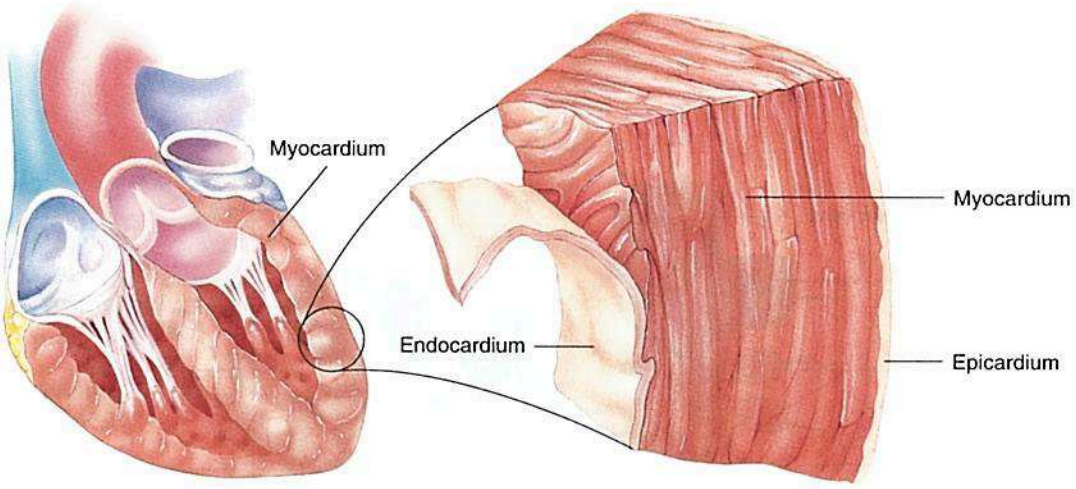

FIGURE 5.3 Schematic of the tissues of the walls of the heart.

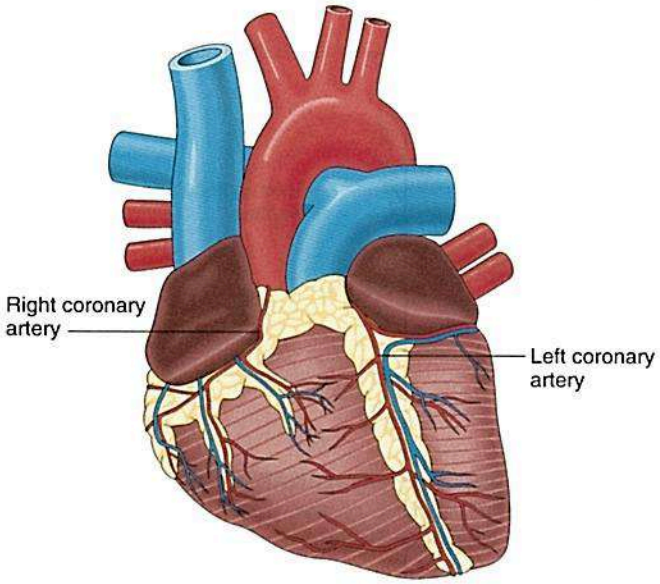

FIGURE 5.4 The coronary arteries supply blood to the myocardium.

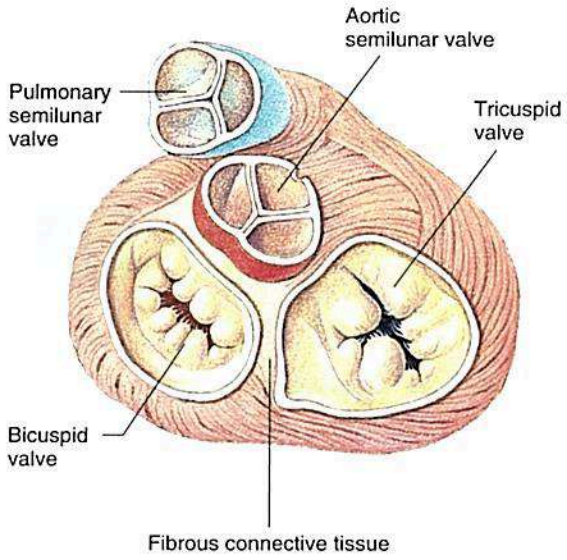

FIGURE 5.5 The valves of the heart. This is a superior view with the atria removed.

- The **atria** (**AY**-tree-ah), the two upper chambers of the heart, are the receiving chambers. All blood vessels coming into the heart enter here (singular, **atrium**).
- The atria are separated by the **interatrial septum.** A **septum** (**SEP**-tum) is a separating wall or partition.
- The two **ventricles** (**VEN**-trih-kuhls) are the lower chambers of the heart. All vessels leaving the heart emerge from the ventricles. (The term *ventricle* refers to the ventricles of both the heart and the brain.)
- The ventricles, separated by the **interventricular septum,** are the pumping chambers. The ventricular walls are thicker than the atrial walls because the ventricles pump blood longer distances.
- The narrow tip of the heart is called the **cardiac apex** (see Figure 5.1).

THE HEART VALVES

The flow of blood through the heart is controlled by the tricuspid, pulmonary semilunar, mitral, and aortic semilunar valves. If any of these valves is not working correctly, blood does not flow properly through the heart and cannot be pumped effectively to all parts of the body (see Figures 5.2 and 5.5).

- The **tricuspid valve** (try-**KUS**-pid) **(TV)** controls the opening between the right atrium and the right ventricle. (Tricuspid means having three points or cusps and this valve is shaped with three points.)

- The **pulmonary semilunar valve** (**sem**-ee-**LOO**-nar) is located between the right ventricle and the pulmonary artery. (Semilunar means half-moon, and this valve is shaped like a half-moon.)
- The **mitral valve** (**MY**-tral), also known as the **MV** or **bicuspid valve,** is located between the left atrium and left ventricle. (Bicuspid means having two points and this valve is shaped with two points.)
- The **aortic semilunar valve** (ay-**OR**-tick **sem**-ee-**LOO**-nar) is located between the left ventricle and the aorta.

SYSTEMIC AND PULMONARY CIRCULATION

The flow of blood through the heart is summarized in Table 5.1. The red arrows indicate **oxygenated** (oxygen-rich) blood and blue arrows indicate **deoxygenated** (oxygen-poor) blood. This flow travels through both the systemic and pulmonary circulation systems. Together these systems allow blood to bring oxygen to the cells and remove waste products (Figure 5.6).

Systemic Circulation

- **Systemic circulation** includes blood flow to all parts of the body *except* the lungs.
- Oxygenated blood flows out of the heart from the left ventricle into arterial circulation.
- Deoxygenated blood returns to the heart through the veins and flows into the right atrium.

Pulmonary Circulation

- **Pulmonary circulation** is the flow of blood between the heart and lungs.
- Blood flows out of the heart from the right ventricle and through the pulmonary arteries to the lungs. This is the only place in the body where arteries carry oxygen-poor blood.
- In the lungs, waste material (carbon dioxide) from the body is exchanged for oxygen from the inhaled air.
- The pulmonary veins carry the oxygen-rich blood into the left atrium of the heart. This is the only place in the body where veins carry oxygen-rich blood.

THE HEARTBEAT

- To pump blood effectively throughout the body, the contraction and relaxation (beating) of the heart must occur in exactly the correct sequence.
- The rate and regularity of the heartbeat is determined by **electrical impulses** from nerves that stimulate the myocardium of the chambers of the heart.
- Also known as the **conduction system,** these electrical impulses are controlled by the sinoatrial (S-A) node, atrioventricular (A-V) node, and bundle of His (Figure 5.7).

Table 5.1

BLOOD FLOW THROUGH THE HEART

↓ The **right atrium (RA)** receives oxygen-poor blood from all tissues, except the lungs, through the **superior** and **inferior venae cavae.** Blood flows out of the RA through the **tricuspid valve** into the right ventricle.

↓ The **right ventricle (RV)** pumps the oxygen-poor blood through the **pulmonary semilunar valve** and into the **pulmonary artery,** which carries it to the lungs.

↓ The **left atrium (LA)** receives oxygen-rich (oxygenated) blood from the lungs through the **four pulmonary veins.** The blood flows out of the LA, through the **mitral valve,** and into the left ventricle.

↓ The **left ventricle (LV)** receives oxygen-rich blood from the left atrium. Blood flows out of the LV through the **aortic semilunar valve** and into the **aorta,** which carries it to all parts of the body, except the lungs.

↓ Oxygen-poor blood is returned by the venae cavae to the right atrium and the cycle continues.

The Sinoatrial Node

- The **sinoatrial node** (**sigh**-noh-**AY**-tree-ahl), also known as the **S-A node,** is located in the posterior wall of the right atrium near the entrance of the superior vena cava.
- Because the S-A node establishes the basic rhythm of the heartbeat, it is called the **natural pacemaker** of the heart.
- Electrical impulses from the S-A node start each wave of muscle contraction in the heart.
- The impulse in the right atrium spreads over the muscles of both atria, causing them to contract simultaneously.
- This contraction forces blood into the ventricles.

The Atrioventricular Node

- The impulses from the S-A node also travel to the **atrioventricular node** (**ay**-tree-oh-ven-**TRICK**-you-lahr).
- Also known as the **A-V node,** it is located on the floor of the right atrium near the interatrial septum.

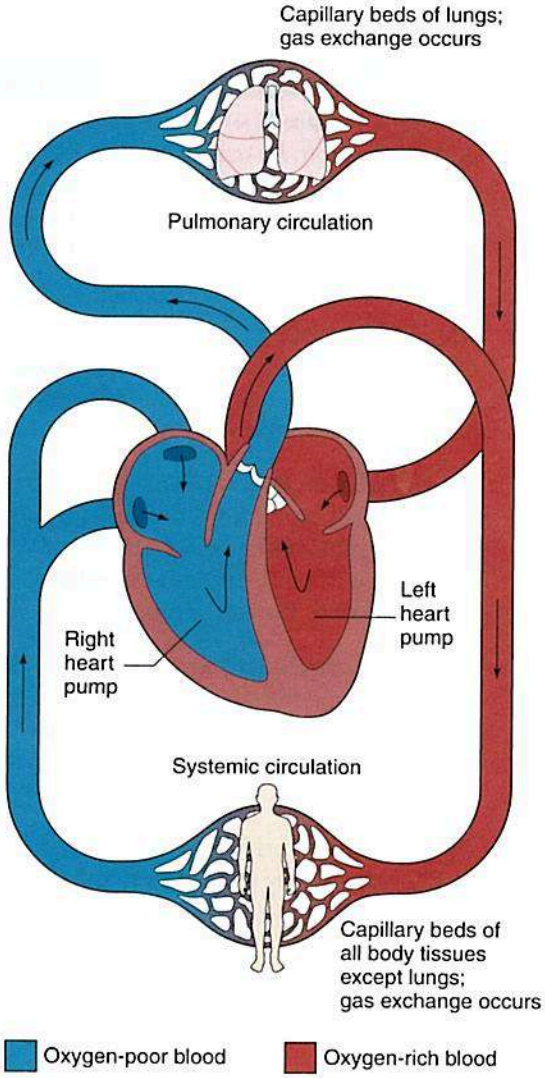

FIGURE 5.6 Systemic and pulmonary circulation.

- The A-V node transmits the electrical impulses on to the bundle of His.

The Bundle of His

- The **bundle of His (HISS),** named for Wilhelm His Jr., a nineteenth-century Swiss physician, is located within the interventricular septum.
- Branches of the bundle of His carry the impulses to the right and left ventricles and the **Purkinje fibers.**
- Stimulation of the **Purkinje fibers,** named for Johannes Purkinje, a nineteenth-century physiologist, causes the ventricles to contract simultaneously forcing blood into the aorta and pulmonary arteries.

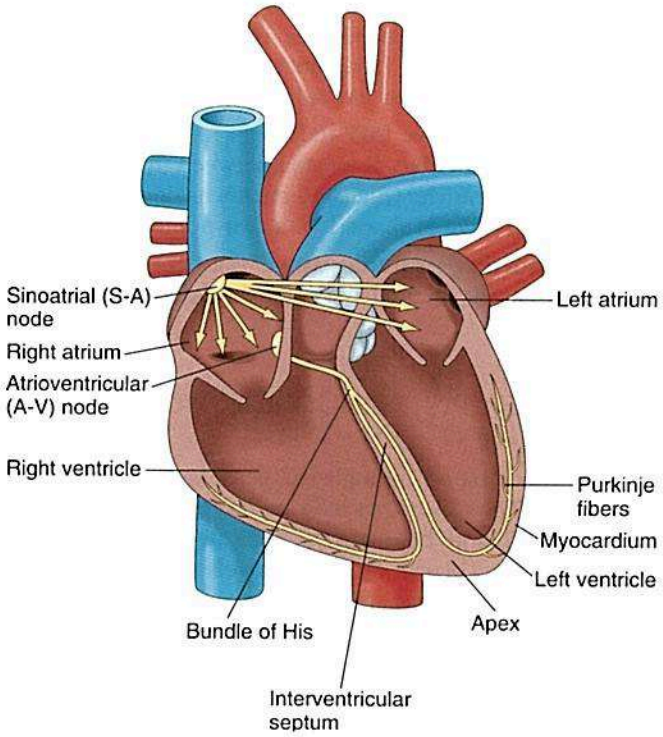

FIGURE 5.7 The electrical conduction system of the heart.

Electrical Waves

The activities of the electrical conduction system of the heart can be visualized as wave movements on a monitor or an electrocardiogram (Figure 5.8).

- The **P wave** is due to the contraction (stimulation) of the atria.
- The **QRS complex** shows the contraction (stimulation) of the ventricles. The atria relax as the ventricles contract.
- The **T wave** is the relaxation (recovery) of the ventricles.

HEART SOUNDS

When a stethoscope is used to listen to the heartbeat, two distinct sounds are heard. They are called the "lubb dupp" sounds.

- Heard first is the **lubb sound.** This is caused by the tricuspid and mitral valves closing between the atria and the ventricles.
- Heard next is the **dupp sound,** which is shorter and higher pitched. It is caused by the closing of the semilunar valves in the aorta and pulmonary arteries as blood is pumped out of the heart.

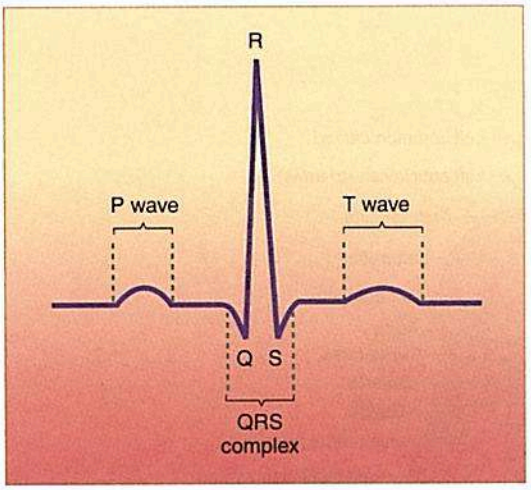

FIGURE 5.8 The waves of contraction and relaxation of the heart can be visualized on a monitor or on an ECG.

THE BLOOD VESSELS

There are three major types of blood vessels in the body: arteries, capillaries, and veins.

- The **lumen** (**LOO**-men) is the opening within these vessels through which the blood flows.

THE ARTERIES

The arteries are the large blood vessels that carry blood away from the heart to all regions of the body. It is the high oxygen content that gives arterial blood its bright red color (Figure 5.9).

- The term **endarterial** (**end**-ar-**TEE**-ree-al) means pertaining to the interior or lining of an artery (**end-** means within, **arteri** means artery, and **-al** means pertaining to).
- The walls of the arteries are composed of three layers. This structure makes them both muscular and elastic so they can expand and contract with the pumping beat of the heart. It is this contraction and expansion that causes blood to spurt out when an artery is cut.
- The **aorta** (ay-**OR**-tah) is the main trunk of the arterial system and begins from the left ventricle of the heart (see Figure 5.1).
- The **coronary artery** (**KOR**-uh-**nerr**-ee) branches from the aorta and supplies blood to the myocardium (see Figure 5.4).
- The **arterioles** (ar-**TEE**-ree-ohlz), which are the smaller thinner branches of arteries, carry blood to the capillaries.

THE CAPILLARIES

- **Capillaries** serve as the anatomic units connecting the arterial and venous circulatory systems. The capillaries, which are only one epithelial cell in thickness, are the smallest vessels in the body.
- Blood flows rapidly along the arteries and veins. However, this flow is much slower through the expanded vascular bed provided by the network of capillaries.
- This slower flow allows time for the exchange of oxygen, nutrients, and waste materials between the tissue fluids and the surrounding cells.

THE VEINS

The veins form a low-pressure collecting system to return the waste-filled blood to the heart (Figures 5.10 and 5.11).

- Veins have thinner walls and are less elastic than the arteries. Contractions of the skeletal muscles cause the blood to flow through the veins toward the heart.
- Veins have valves that enable blood to flow only toward the heart but prevent it from flowing away from the heart.
- **Venules** (**VEN**-youls) are small veins that join to form the larger veins.

The Venae Cavae

- The **venae cavae** (**VEE**-nee **KAY**-vee) are the two large veins that enter the heart (singular, **vena cava**).
- The **superior vena cava** (**VEE**-nah **KAY**-vah) **(SVC)** brings blood from the upper portion of the body (see Figure 5.1).
- The **inferior vena cava (IVC)** brings blood from the lower portion of the body (see Figure 5.2).

THE PULSE AND BLOOD PRESSURE

- The **pulse** is the rhythmic expansion and contraction of an artery produced by the pressure of the blood moving through the artery (see Chapter 15).
- **Blood pressure** is a measurement of the amount of pressure exerted against the walls of the vessels.
- **Systolic pressure** (sis-**TOL**-ick), which occurs when the ventricles contract, is the highest pressure against the walls of the blood vessels.
- **Diastolic pressure** (dye-ah-**STOL**-ick), which occurs when the ventricles are relaxed, is the lowest pressure against the walls of the blood vessels.
- Blood pressure is recorded as systolic over diastolic. A normal blood pressure reading for a seated adult is about 130/84 mm Hg. (*Hg* is the abbreviation for mercury.)

THE BLOOD

Blood is composed of 55 percent liquid plasma and 45 percent formed elements (Figure 5.12). The **formed elements,** also known as **blood corpuscles,** include the red blood cells, white blood cells, and platelets.

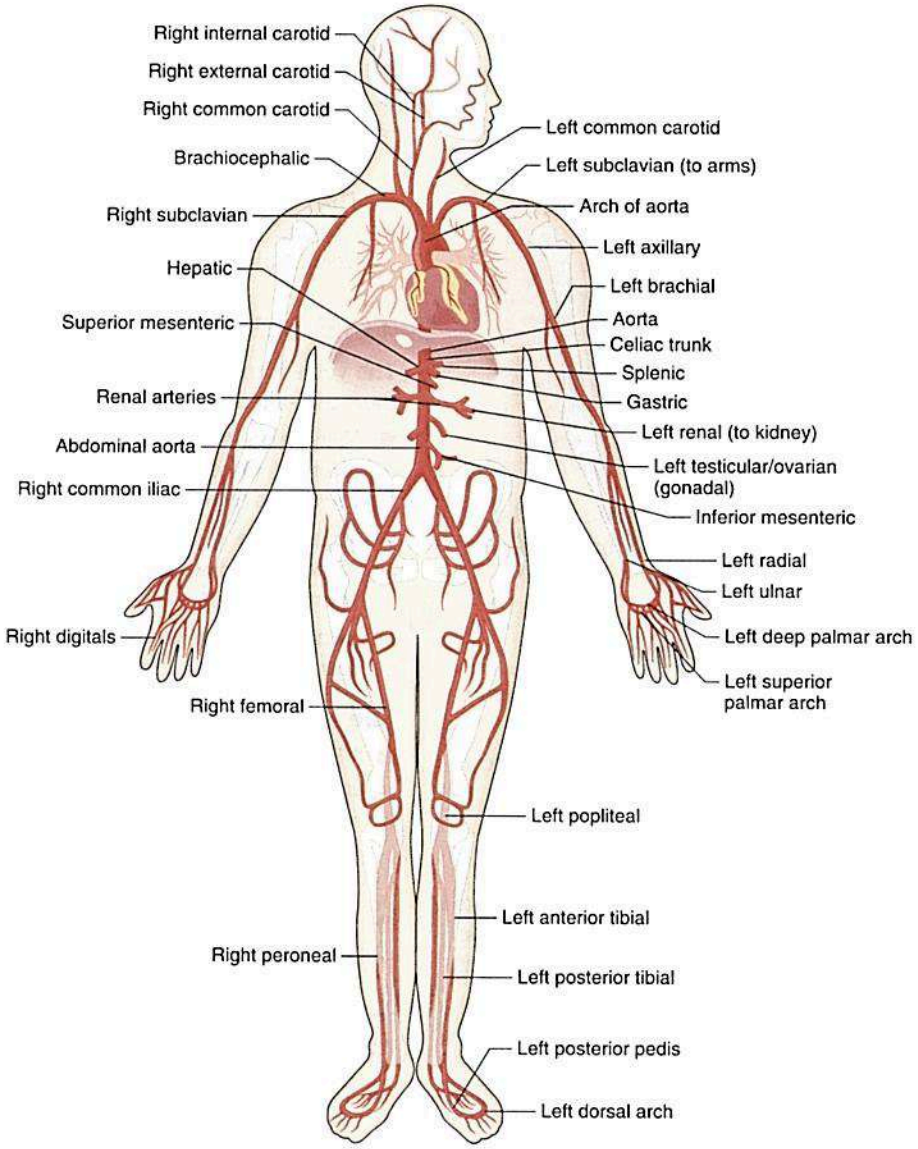

FIGURE 5.9 Arterial circulation.

PLASMA

- **Plasma** (**PLAZ**-mah) is a straw-colored fluid that contains nutrients, hormones, and waste products. Plasma is 91 percent water. The remaining 9 percent consists mainly of proteins including the clotting proteins.
- **Fibrinogen** (figh-**BRIN**-oh-jen) and **prothrombin** (proh-**THROM**-bin) are clotting proteins found in plasma. They have an important role in clot formation to control bleeding.
- **Serum** (**SEER**-um) is plasma with these clotting proteins removed.

ERYTHROCYTES

- **Erythrocytes** (eh-**RITH**-roh-sights), which are also known as **red blood cells (RBCs)**, are mature red blood cells (**erythr/o** means red and **-cytes** means cells).
- These cells, which are produced by the red bone marrow, are shaped like a doughnut with a thin central portion instead of a hole (see Figure 5.12).
- **Hemoglobin** (**hee**-moh-**GLOH**-bin), which is the iron-containing pigment of the erythrocytes, transports oxygen from the lungs to the tissues of the body.
- A **reticulocyte** (reh-**TICK**-you-loh-**site**) is an immature erythrocyte that is characterized by a meshlike pattern of threads.
- The normal life span of an RBC is about 120 days. After this, **macrophages** in the spleen, liver, and bone marrow destroy erythrocytes that are no longer useful.

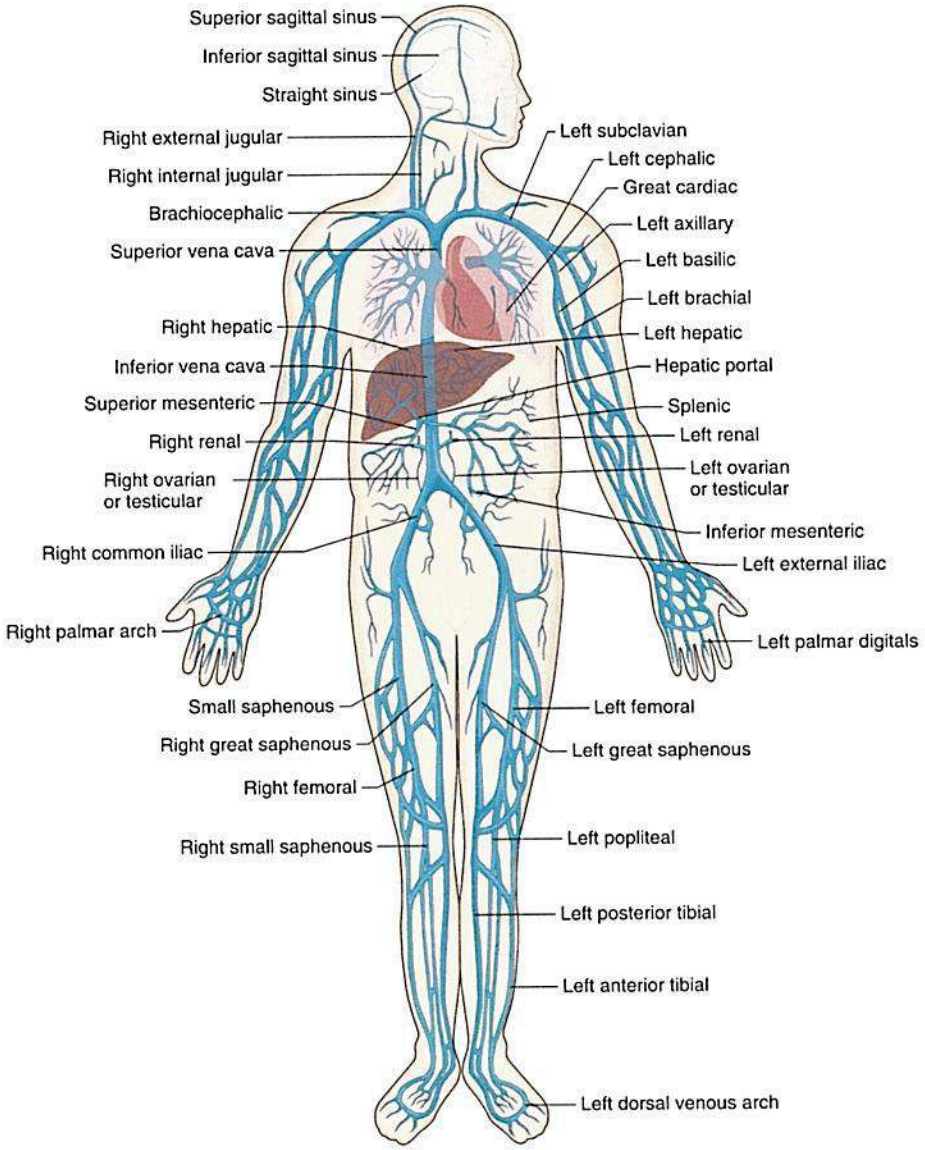

FIGURE 5.10 Venous circulation.

LEUKOCYTES

- **Leukocytes** (**LOO**-koh-sites), also known as **white blood cells (WBCs),** protect the body against harmful invaders such as bacteria (**leuk/o** means white and **-cytes** means cells). The following are the major groups of leukocytes.
- **Neutrophils** (**NEW**-troh-fills), which are formed in red bone marrow, are the most prevalent type of WBC. These cells fight infection by phagocytosis. **Phagocytosis** (**fag**-oh-sigh-**TOH**-sis) is the process of engulfing and swallowing germs (**phag/o** means to eat or swallow, **cyt** means cell, and **-osis** means abnormal condition). An elevated neutrophil count indicates a bacterial infection.
- **Basophils** (**BAY**-soh-fills), which are formed in red bone marrow, promote the inflammatory response.

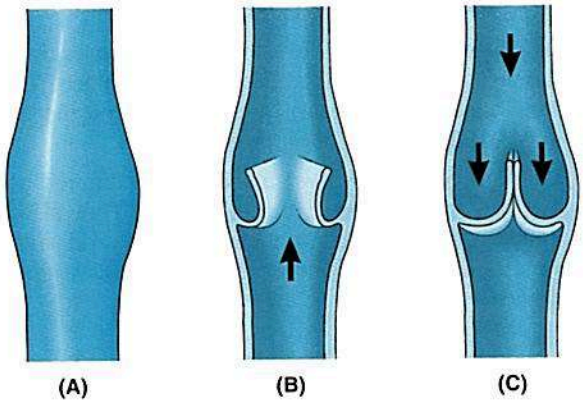

FIGURE 5.11 Veins contain valves to prevent the backward flow of blood. (A) External view of the vein shows wider area of valve. (B) Internal view with the valve open as blood flows through. (C) Internal view with the valve closed.

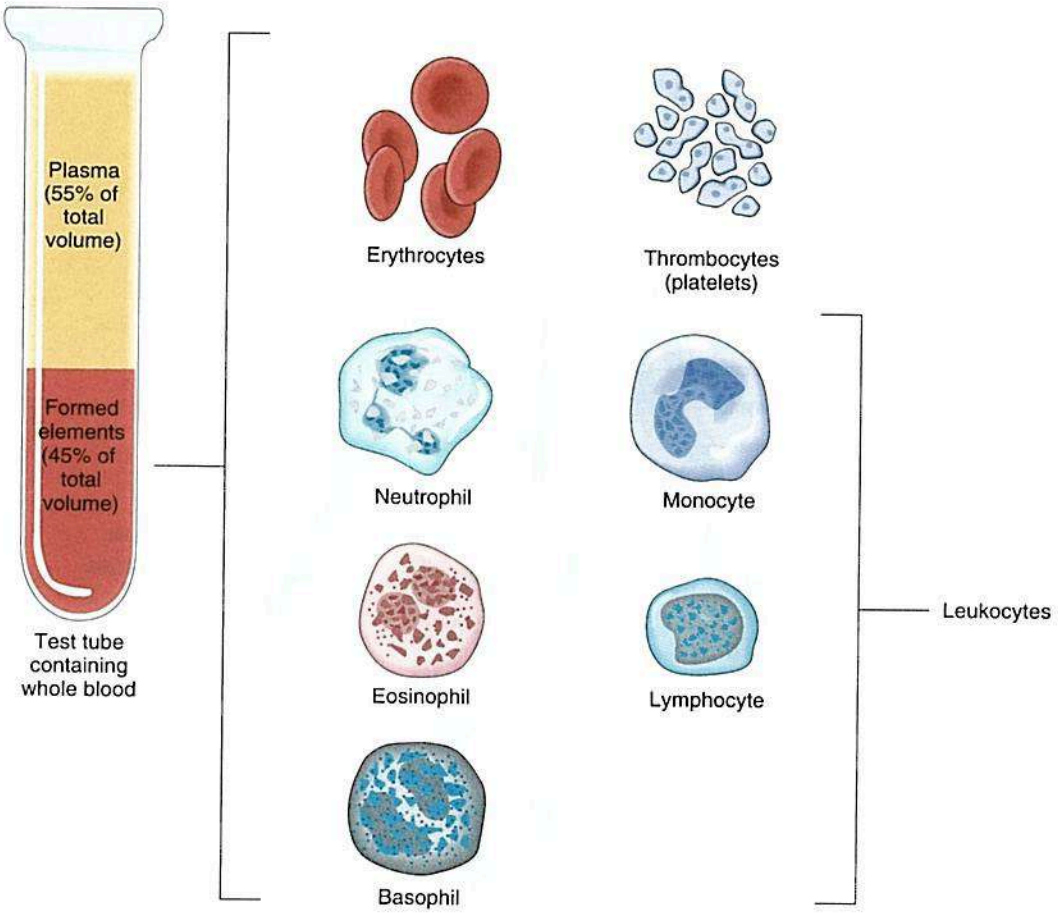

FIGURE 5.12 The major components of blood.

An elevated basophil count may indicate an allergic condition.

- **Eosinophils** (**ee**-oh-**SIN**-oh-fills), which are formed in red bone marrow, increase in response to allergic reactions. An elevated eosinophil count indicates an allergic condition.
- **Lymphocytes** (**LIM**-foh-sights) are formed in red bone marrow, lymph nodes, and the spleen. These cells have an important role in protecting the body against disease (see Chapter 6).
- **Monocytes** (**MON**-oh-sights) are formed in red bone marrow, lymph nodes, and the spleen. They also are important in protecting against disease and an elevated monocyte count usually indicates a chronic infection.

THROMBOCYTES

- **Thrombocytes** (**THROM**-boh-sights), also known as **platelets,** are the smallest formed elements of the blood. They are not cells but are fragments of specialized large bone marrow cells known as megakaryocytes.
- Thrombocytes play an important role in the clotting of blood. When the blood vessel is damaged, platelets are activated. Once activated, the platelets become sticky and clump together to form a clot.

BLOOD TYPES

The four major types of blood are A, AB, B, and O. These groups are based on the presence of the A and/or B antigens on red blood cells. In type O, both antigens are absent. Table 5.2 explains how these types interact in terms of donating and receiving blood.

- The safe administration of blood from donor to recipient requires careful typing and cross-matching to ensure a correct match.
- A patient receiving blood incompatible with his or her own can experience serious and possibly fatal reactions.

THE RH FACTOR

In addition to having antigens A or B, or both, red blood cells also contain the Rh antigen. Because this was first found in Rhesus monkeys, this factor was named for

Table 5.2

Blood Types As Donors and Recipients

Blood Type	Can Donate To	Can Receive From
A	A or AB only	A or O only
B	B or AB only	B or O only
AB (the universal recipient)	AB only	A, B, AB, O
O (the universal donor)	A, B, AB, O	O only

them. Each individual is either positive or negative for the **Rh factor.**

- About 85 percent of Americans are **Rh positive (Rh+).** This means that they *have* the Rh antigen.
- The remaining 15 percent are **Rh negative (Rh-).** This means that they *do not have* the Rh antigen.
- The Rh factor is an important consideration in cross-matching blood for transfusions.
- The Rh factor also causes difficulties when an Rh-positive infant is born to an Rh-negative mother (see Chapter 14).

BLOOD GASES

A **blood gas** is a gas that is dissolved in the liquid part of the blood. The major blood gases are **oxygen** (O_2), **carbon dioxide** (CO_2), and **nitrogen** (N_2).

MEDICAL SPECIALTIES RELATED TO THE CARDIOVASCULAR SYSTEM

- A **cardiologist** (**kar**-dee-**OL**-oh-jist) specializes in diagnosing and treating abnormalities, diseases, and disorders of the heart (**cardi** means heart and **-ologist** means specialist).
- A **hematologist** (**hee**-mah-**TOL**-oh-jist *or* **hem**-ah-**TOL**-oh-jist) specializes in diagnosing and treating diseases and disorders of the blood and blood-forming tissues (**hemat** means blood and **-ologist** means specialist).

PATHOLOGY OF THE CARDIOVASCULAR SYSTEM

CORONARY ARTERY DISEASE

- **Coronary artery disease (CAD)** is atherosclerosis of the coronary arteries that may cause angina pectoris, myocardial infarction, and sudden death (Figure 5.13).
- **End-stage coronary artery disease,** which is the final phase of CAD, is characterized by unrelenting angina pain and a severely limited lifestyle.
- **Atherosclerosis** (**ath**-er-**oh**-skleh-**ROH**-sis) is hardening and narrowing of the arteries due to a buildup of cholesterol plaques (**ather/o** means plaque or fatty substance and **-sclerosis** means abnormal hardening) (see Figures 5.13 and 5.14).
- An **atheroma** (**ath**-er-**OH**-mah), which is characteristic of atherosclerosis, is a plaque (fatty deposit) within the arterial wall (**ather** means plaque and **-oma** means tumor).
- This type of **plaque** (**PLACK**) is similar to the buildup of rust inside a pipe, and it may protrude outward into the opening of the vessel or move inward into the wall of the vessel. (Compare this with dental plaque, which is discussed in Chapter 8.)
- **Ischemia** (iss-**KEE**-mee-ah) is a deficiency in blood supply due to either the constriction or the obstruction of a blood vessel (**isch** means to hold back and **-emia** means blood).
- **Ischemic heart disease** (iss-**KEE**-mick) **(IHD)** is a group of cardiac disabilities resulting from an insufficient supply of oxygenated blood to the heart that is usually associated with CAD.
- **Angina pectoris** (an-**JIGH**-nah *or* **AN**-jih-nuh **PECK**-toh-riss) is severe episodes of spasmodic choking or suffocating chest pain. This is usually due to interference with, but not complete blockage of, the supply of oxygen to the myocardium.
- A **myocardial infarction** (**my**-oh-**KAR**-dee-al in-**FARK**-shun), also known as a **heart attack** or **MI,** is the occlusion (closing off) of a coronary artery resulting in an infarct of the affected myocardium. Damage to the myocardium impairs the heart's ability to pump blood throughout the body.

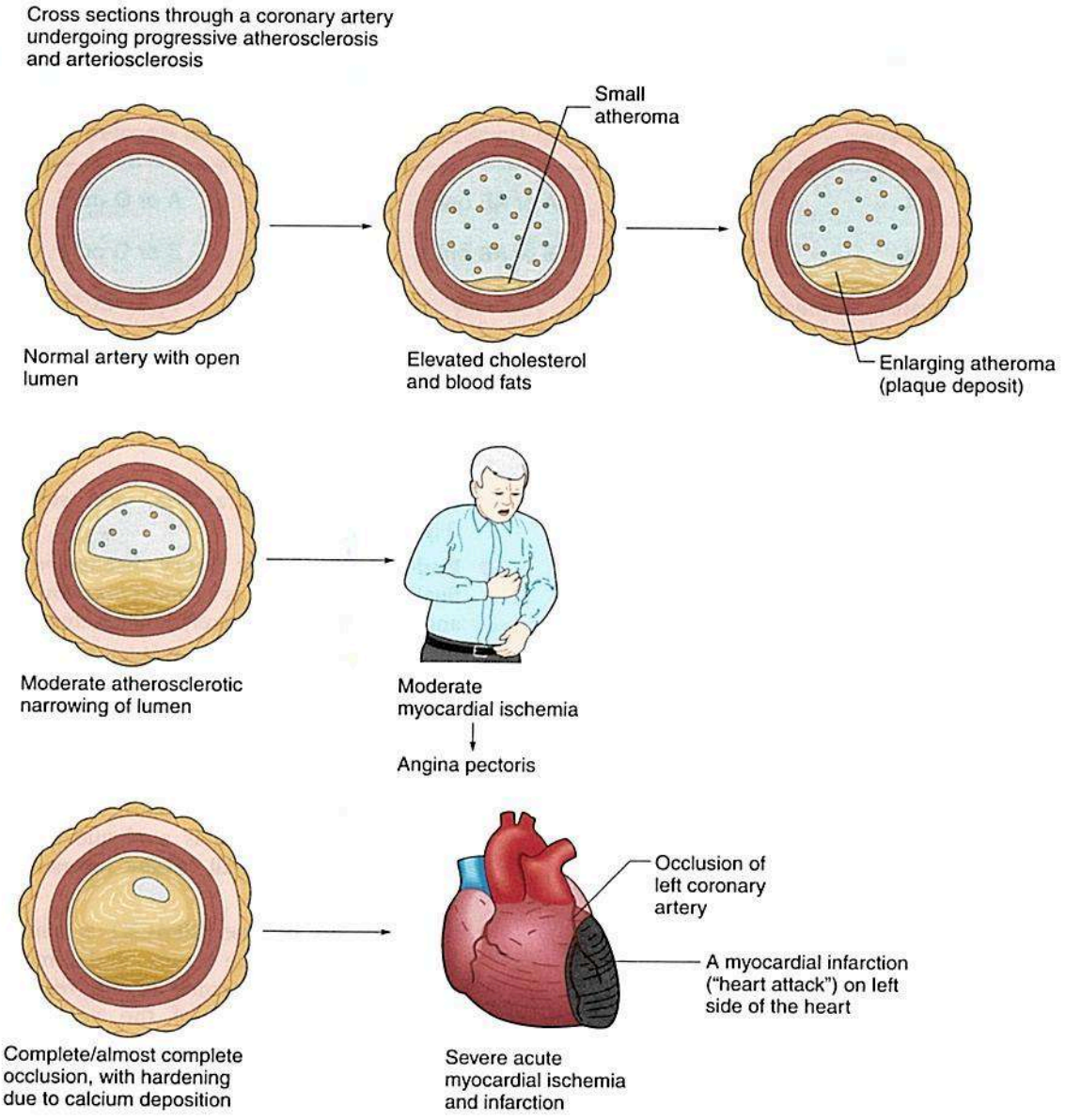

FIGURE 5.13 The progression of coronary heart disease.

- An **infarct** (**IN**-farkt) is a localized area of necrosis (tissue death) caused by an interruption of the blood supply.

CONGESTIVE HEART FAILURE

- **Congestive heart failure (CHF)** is a syndrome in which the heart is unable to pump enough blood to meet the body's needs for oxygen and nutrients. In response to the reduced blood flow, the kidneys retain more fluid within the body and this fluid accumulates in the legs, ankles, and lungs. The term *congestive* refers to this fluid buildup (Figure 5.15).

FORMS OF CARDITIS

- The term **carditis** (kar-**DYE**-tis) means an inflammation of the heart (**card** means heart and **-itis** means inflammation). *Note the spelling of carditis:* **cardi/o** and **card/o** both mean heart. In this term, the word root **card/o** is used to avoid having a double *i* when it is joined with the suffix **-itis**.
- **Endocarditis** (**en**-doh-kar-**DYE**-tis) is an inflammation of the inner layer of the heart (**endo-** means within, **card** means heart, and **-itis** means inflammation).
- **Bacterial endocarditis** is an inflammation of the lining or valves of the heart caused by bacteria.

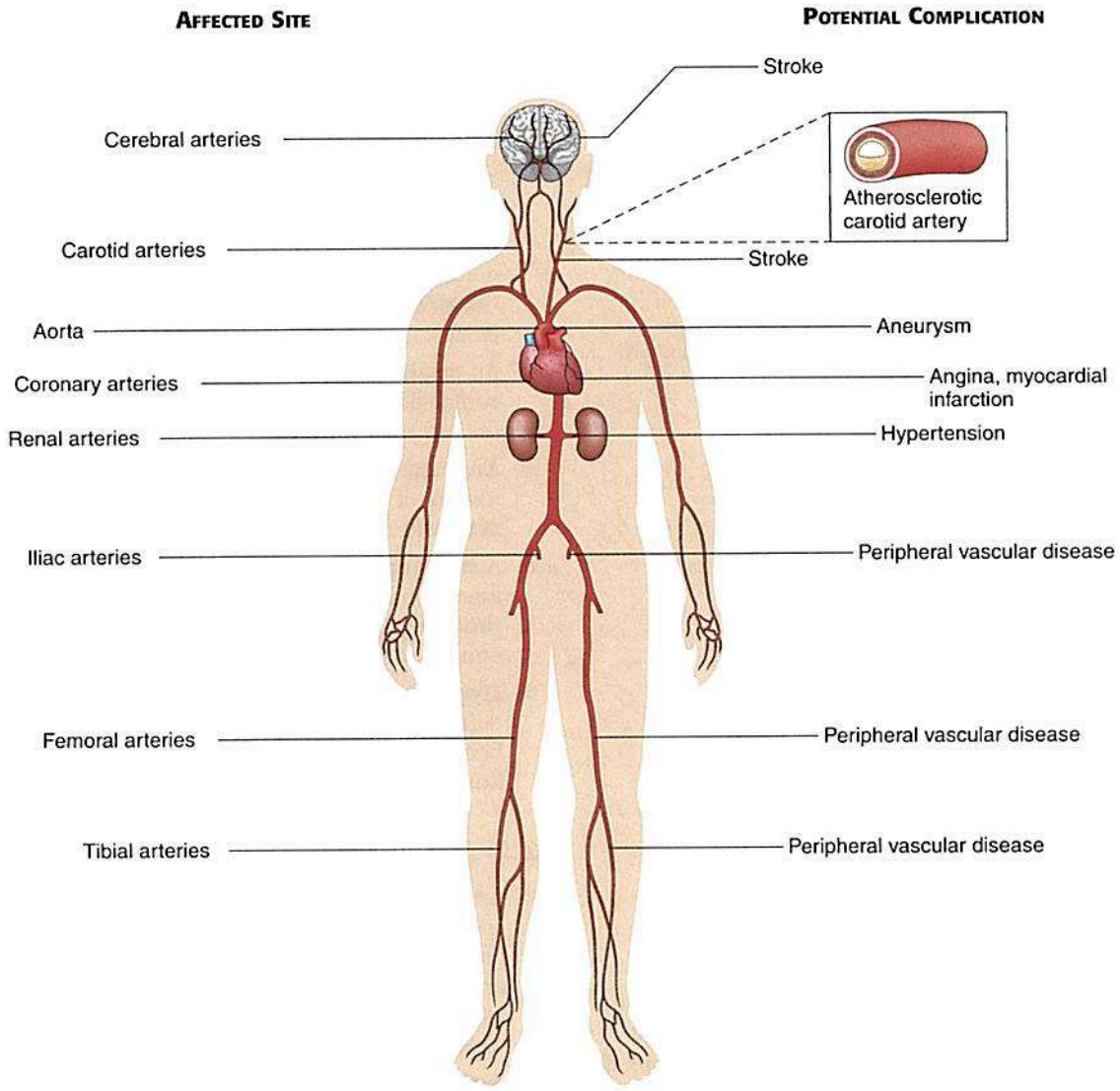

FIGURE 5.14 The risks of atherosclerosis. (Left) Affected sites. (Right) Potential complications.

- **Myocarditis** (**my**-oh-kar-**DYE**-tis) is an inflammation of the myocardium (**my/o** means muscle, **card** means heart, and **-itis** means inflammation).
- **Pericarditis** (**pehr**-ih-kar-**DYE**-tis) is an inflammation of the pericardium (**peri-** means surrounding, **card** means heart, and **-itis** means inflammation).

HEART VALVES

- **Valvulitis** (**val**-view-**LYE**-tis) is an inflammatory condition of a heart valve (**valvul** means valve, and **-itis** means inflammation).
- **Mitral valve prolapse** is an abnormal protrusion of the mitral value that results in the incomplete closure of the valve. (*Prolapse* means falling down.)
- **Mitral stenosis** (steh-**NOH**-sis) is an abnormal narrowing of the opening of the mitral valve. **Tricuspid stenosis** is an abnormal narrowing of the opening of the tricuspid valve.
- A valve that does not function properly may allow blood to flow back into the heart chamber. The sound of this abnormal flow is called a **heart murmur.**

ARRHYTHMIAS

- **Cardiac arrhythmia** (ah-**RITH**-mee-ah), also known as **dysrhythmia** (dis-**RITH**-mee-ah), is an irregularity or the loss of normal rhythm of the heartbeat.
- **Bradycardia** (**brad**-ee-**KAR**-dee-ah) is an abnormally slow heartbeat (**brady-** means slow, **card** means heart, and **-ia** means abnormal condition). This term is usually applied to rates less than 60 beats per minute. (Compare this with tachycardia.)
- A **flutter** is a cardiac arrhythmia in which the atrial contractions are rapid but regular. (Compare this with atrial fibrillation.)

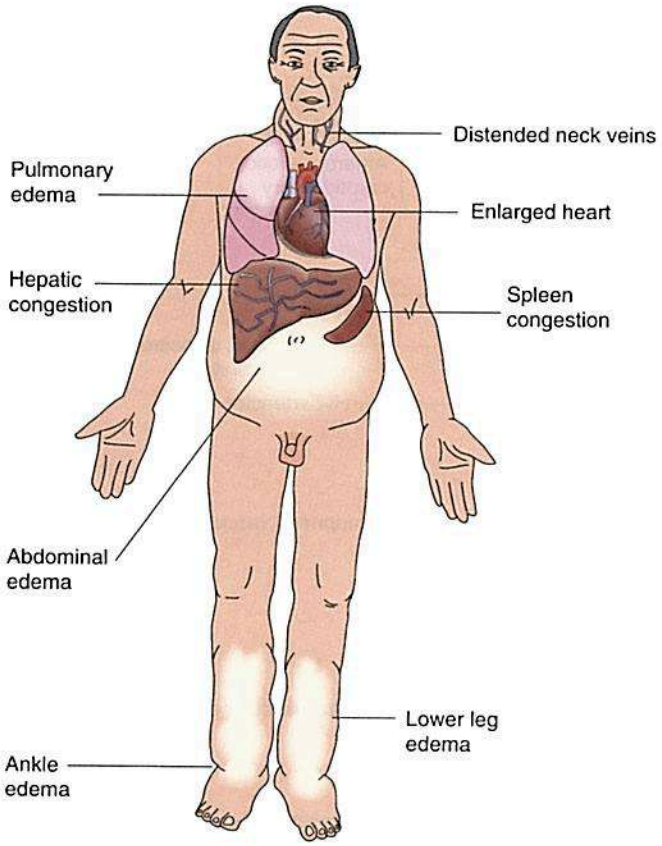

FIGURE 5.15 Signs of congestive heart failure.

- **Palpitation** (**pal**-pih-**TAY**-shun) is a pounding or racing heart with or without irregularity in rhythm. This is associated with certain heart disorders, or it may be a response accompanying a panic attack (see Chapter 10).
- **Tachycardia** (**tack**-ee-**KAR**-dee-ah) is an abnormally fast heartbeat (**tachy-** means rapid, **card** means heart, and **-ia** means abnormal condition). This term is usually applied to rates greater than 100 beats per minute. (Compare this with bradycardia.)
- **Paroxysmal tachycardia** is a fast heartbeat of sudden onset. *Paroxysm* (**PAR**-ock-sizm) means a sudden convulsion, seizure, or spasm.

FIBRILLATION

- **Fibrillation** (**fih**-brih-**LAY**-shun) is rapid, random, and ineffective contractions of the heart.
- In **atrial fibrillation (AF),** also known as **A fib,** the atria beat faster than the ventricles. This condition produces an irregular quivering action of the atria and a very rapid ventricular heartbeat.
- **Ventricular fibrillation,** also known as **V fib,** is the result of irregular contractions of the ventricles and is fatal unless reversed by electric defibrillation.

BLOOD VESSELS

- **Angiitis** (**an**-je-**EYE**-tis), also known as **vasculitis** (**vas**-kyou-**LYE**-tis), is the inflammation of a blood or lymph vessel (**angi** means vessel and **-itis** means inflammation). *Note:* This term is spelled with a double **i**.
- **Angionecrosis** (**an**-jee-oh-neh-**KROH**-sis) is the necrosis (death) of the walls of the blood vessels (**angi/o** means vessel and **-necrosis** means tissue death).
- An **angiospasm** (**AN**-jee-oh-**spazm**) is a spasmodic contraction of the blood vessels (**angi/o** means vessel and **-spasm** means tightening or cramping).
- **Angiostenosis** (**AN**-jee-oh-steh-**NOH**-sis) is the narrowing of a blood vessel (**angi/o** means vessel and **stenosis** means abnormal narrowing).
- A **hemangioma** (hee-**man**-jee-**OH**-mah) is a benign tumor made up of newly formed blood vessels (**hemangi** means blood vessel and **-oma** means tumor). (See also Chapter 12.)
- **Hypoperfusion** (**high**-poh-per-**FYOU**-zhun) is a deficiency of blood passing through an organ or body part. *Perfusion* (per-**FYOU**-zuhn) means the flow of blood through the vessels of an organ.

ARTERIES

- An **aneurysm** (**AN**-you-rizm) is a localized weak spot or balloon-like enlargement of the wall of an artery. Most aneurysms occur in large blood vessels and are named for the involved blood vessels such as an aortic aneurysm. If an aneurysm ruptures, it is often fatal because of the rapid loss of blood.
- **Arteritis** (**ar**-teh-**RYE**-tis) is inflammation of an artery (**arter** means artery and **-itis** means inflammation).
- **Polyarteritis** (**pol**-ee-**ar**-teh-**RYE**-tis) is an inflammation involving several arteries (**poly-** means many, **arter** means artery, and **-itis** means inflammation).
- **Arteriosclerosis** (ar-**tee**-ree-oh-skleh-**ROH**-sis) is the hardening of the arteries, which reduces the flow of blood through these vessels (**arteri/o** means artery and **-sclerosis** means abnormal hardening).
- **Raynaud's phenomenon** (ray-**NOHZ**) consists of intermittent attacks of pallor (paleness), cyanosis (blue color), and redness of the fingers and toes. These symptoms are due to arterial and arteriolar contraction and are usually caused by cold or emotion.

VEINS

- **Phlebitis** (fleh-**BYE**-tis) is the inflammation of a vein (**phleb** means vein and **-itis** means inflammation).
- **Varicose veins** (**VAR**-ih-kohs **VAYNS**) are abnormally swollen veins usually occurring in the legs (Figure 5.16). A *varicosity* (**var**-ih-**KOS**-ih-tee) is one area of swelling (plural, *varices*).

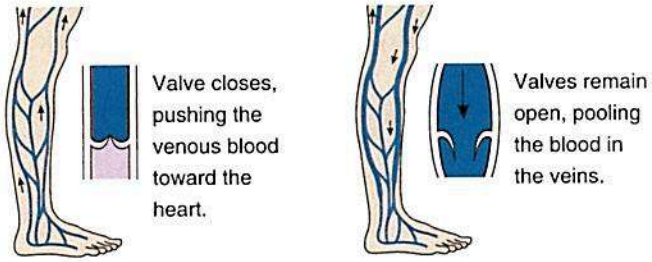

FIGURE 5.16 Normal veins and varicose veins compared.

THROMBOSES AND EMBOLISMS

- A **thrombosis** (throm-**BOH**-sis) is an abnormal condition in which a thrombus develops within a blood vessel (**thromb** means clot and **-osis** means abnormal condition) (plural, **thromboses**).
- A **thrombus** (**THROM**-bus) is a blood clot attached to the interior wall of a vein or artery (**thromb** means clot and **-us** is a singular noun ending).
- A **thrombotic occlusion** (throm-**BOT**-ick ah-**KLOO**-zhun) is the blocking of an artery by a clot (**thromb/o** means clot and **-tic** means pertaining to). As used here, *occlusion* means a blockage in a canal, vessel, or passageway in the body.
- A **coronary thrombosis** (**KOR**-uh-**nerr**-ee throm-**BOH**-sis) is damage to the heart caused by a thrombus blocking a coronary artery.
- An **embolus** (**EM**-boh-lus) is a foreign object, such as a blood clot, quantity of air or gas, or a bit of tissue or tumor that is circulating in the blood (**embol** means something inserted and **-us** is a singular noun ending) (plural, **emboli**).
- An **embolism** (**EM**-boh-lizm) is the blockage of a vessel by an embolus. An embolism occurs when the embolus is larger than the blood vessel and blocks the flow of blood (**embol** means something inserted and **-ism** means condition).

BLOOD DISORDERS

- **Dyscrasia** (dis-**KRAY**-zee-ah) is any abnormal or pathologic condition of the blood (**dys** means bad, and **-crasia** means a mixture or blending).
- **Hemochromatosis** (**hee**-moh-**kroh**-mah-**TOH**-sis) is also known as **iron overload disease** (**hem/o** means blood, **chromat** means color, and **-osis** means abnormal condition). This is a genetic disorder in which the intestines absorb too much iron. The excess iron enters the bloodstream and accumulates in organs where it causes damage.
- **Septicemia** (**sep**-tih-**SEE**-mee-ah), also known as **blood poisoning,** is the presence of pathogenic microorganisms or their toxins in the blood.

Cholesterol

- **Cholesterol** (koh-**LES**-ter-ol) consists of lipids (fatty substances) that travel in the blood in packages called **lipoproteins.** The presence of cholesterol at certain levels is normal and essential for good health. A pathologic condition is present when these fats are present in excessive amounts. Table 5.3 shows the desirable levels of each substance for people without heart disease. These are expressed as milligrams per deciliter (mg/dl).
- **Low-density lipoprotein cholesterol** is also known as **LDL** or **bad cholesterol** because excess quantities contribute to plaque buildup in the arteries.
- **High-density lipoprotein cholesterol** is also known as **HDL** or **good cholesterol** because it carries unneeded cholesterol back to the liver for processing and does not contribute to plaque buildup.
- **Triglycerides** (try-**GLIS**-er-eyeds) are combinations of fatty acids attached to glycerol that are also found normally in the blood in limited quantities.

Table 5.3

BLOOD LIPOPROTEIN LEVELS

Test	Desirable (mg/dl)	Borderline (mg/dl)	Undesirable (mg/dl)
Total cholesterol	Below 200	200–239	Above 240
LDL cholesterol	Below 130	130–159	Above 160
HDL cholesterol	Above 45	35–45	Below 35
Triglycerides	Below 150	150–199	Above 200–499

- **Homocysteine** (**hoh**-moh-**SIS**-teen) is an amino acid normally found in the blood and used by the body to build and maintain tissues. However when present in elevated levels of more than 12 micromoles per liter, homocysteine can damage arterial walls and increase the risk of coronary artery disease. Such increases may be caused by a diet severely lacking in several B vitamins.
- **Hyperlipidemia** (**high**-per-**lip**-ih-**DEE**-mee-ah), also known as **hyperlipemia** (**high**-per-lye-**PEE**-mee-ah), is a general term for elevated plasma concentrations of cholesterol, triglycerides, and lipoproteins. The levels of each of these substances can be measured by a blood test.

BLOOD CELLS

- **Erythrocytosis** (eh-**rith**-roh-sigh-**TOH**-sis) is an abnormal increase in the number of circulating red blood cells (**erythr/o** means red, **cyt** means cell, and **-osis** means abnormal condition).
- **Thrombocytopenia** (**throm**-boh-**sigh**-toh-**PEE**-nee-ah), also known as **thrombopenia,** is an abnormal decrease in the number of platelets (**thromb/o** means clot, **cyt/o** means cell, and **-penia** means a deficiency of).
- **Leukopenia** (**loo**-koh-**PEE**-nee-ah) is an abnormal decrease in the number of white blood cells. It may affect one or all kinds of white blood cells (**leuk/o** means white and **-penia** means a deficiency of).
- **Leukemia** (loo-**KEE**-mee-ah) is a malignancy characterized by a progressive increase of abnormal leukocytes (**leuk** means white and **-emia** means blood condition).

ANEMIAS

- **Anemia** (ah-**NEE**-mee-ah) is a disorder characterized by lower than normal levels of red blood cells in the blood (**an-** means without or less than and **-emia** means blood condition).
- **Aplastic anemia** (ay-**PLAS**-tick ah-**NEE**-mee-ah) is marked by an absence of *all* formed blood elements (**a-** means without, **plast** means growth, and **-ic** means pertaining to). This is caused by the failure of blood cell production in the bone marrow.
- In **hemolytic anemia** (**hee**-moh-**LIT**-ick ah-**NEE**-mee-ah), red blood cells are destroyed faster than the bone marrow can replace them (**hem/o** means relating to blood and **-lytic** means to destroy).
- **Iron-deficiency anemia** develops if not enough iron is available to bone marrow to make hemoglobin. It may be caused by inadequate iron intake, malabsorption of iron, pregnancy and lactation, or chronic blood loss.
- In **megaloblastic anemia** (**MEG**-ah-loh-**blas**-tick ah-**NEE**-mee-ah), the bone marrow produces megaloblasts. These are large abnormal red blood cells with a reduced capacity to carry oxygen. This type of anemia is almost always caused by a vitamin deficiency.
- **Pernicious anemia** (per-**NISH**-us ah-**NEE**-mee-ah) is an autoimmune disorder in which the red blood cells are abnormally formed, due to an inability to absorb vitamin B_{12}. (*Pernicious* means destructive, fatal, or harmful.)
- **Sickle cell anemia** is a genetic disorder that causes abnormal hemoglobin, resulting in the red blood cells assuming an abnormal sickle shape. This abnormal shape interferes with normal blood flow, resulting in damage to most of the body systems.
- **Thalassemia** (thal-ah-**SEE**-mee-ah), also known as **Cooley's anemia,** is a group of genetic disorders characterized by short-lived red blood cells that lack the normal ability to produce hemoglobin.

HYPERTENSION

- **Essential hypertension,** also known as **primary hypertension** or **idiopathic hypertension,** is consistently elevated blood pressure of unknown origin. (*Idiopathic* means of unknown cause.) The classifications of blood pressure for adults are summarized in Table 5.4.
- **Secondary hypertension** is caused by a different medical problem such as a kidney disorder or a tumor on the adrenal glands. When the other problem is cured, the secondary hypertension should be resolved.
- **Malignant hypertension** is characterized by the sudden onset of severely elevated blood pressure. It can be life-threatening and commonly damages small vessels in the brain, retina, heart, and kidneys.

DIAGNOSTIC PROCEDURES OF THE CARDIOVASCULAR SYSTEM

- **Blood tests** are discussed in Chapter 15.
- A **pulse oximeter** is an external monitor that is placed on the patient's finger to measure the amount of oxygenated blood in the circulatory system. In a normal reading, 96 percent to 100 percent of the blood is saturated by oxygen. The levels of other blood gases are measured with a blood test.
- **Angiography** (**an**-jee-**OG**-rah-fee) is a radiographic (x-ray) study of the blood vessels after the injection of a contrast medium (**angi/o** means blood vessel and **-graphy** means the process of recording). The resulting film is an **angiogram** (Figure 5.17). This procedure is frequently performed in conjunction with cardiac catheterization.

Table 5.4

Blood Pressure Classifications for Adults

Category	Systolic (mm Hg)	Diastolic (mm Hg)
Optimal	less than 120	less than 80
Normal	less than 130	less than 85
High-normal	130–139	85–89
Hypertension	higher than 140	higher than 90

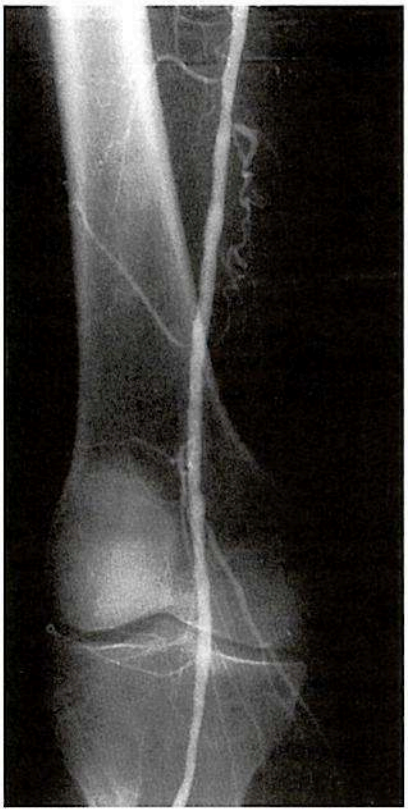

FIGURE 5.17 An angiogram showing the femoral arteries. The use of a contrast medium makes the arteries visible.

- **Angiocardiography** (**an**-jee-oh-**kar**-dee-**OG**-rah-fee) uses a contrast medium and chest x-rays to visualize the dimensions of the heart and large blood vessels (**angi/o** means blood vessel, **cardi/o** means heart and **-graphy** means the process of recording). The contrast medium, which appears white on the film, is used to make these soft tissue structures visible on the resulting **angiocardiogram.**
- **Cardiac catheterization** (**KAR**-dee-ack **kath**-eh-ter-eye-**ZAY**-shun) **(CC)** is a procedure in which a catheter is passed into a vein or artery and is guided into the heart. When the catheter is in place, a contrast medium is introduced to produce an angiogram to determine how well the heart is working. This procedure is also used for treatment purposes (see Clearing Blocked Arteries).
- **Phlebography** (fleh-**BOG**-rah-fee) is the technique of preparing an x-ray image of veins injected with a contrast medium (**phleb/o** means vein and **-graphy** means the process of recording). The resulting film is a **phlebogram.**

ELECTROCARDIOGRAPHY

- An **electrocardiogram** (ee-**leck**-troh-**KAR**-dee-oh-**gram**), also known as **ECG** or **EKG,** is a record of the electrical activity of the myocardium (see Figure 5.8). **Electrocardiography** (ee-**leck**-troh-kar-dee-**OG**-rah-fee) is the process of recording this activity (**electr/o** means electric, **cardi/o** means heart, and **-graphy** means the process of recording).
- A **Holter monitor** is a portable ECG that is worn by an ambulatory patient to continuously monitor the heart rates and rhythms over a 24-hour period.
- **Stress tests** are ECGs used to assess cardiovascular health and function during and after the application of stress such as exercise on a treadmill.
- In a **thallium stress test** (**THAL**-ee-um), the flow of blood through the heart during activity is assessed through the use of thallium (a radiopharmaceutical) during a stress test. Radiopharmaceuticals are discussed further in Chapter 15.

ULTRASONIC DIAGNOSTIC PROCEDURES

- **Echocardiography** (**eck**-oh-**kar**-dee-**OG**-rah-fee) **(ECHO)** is an ultrasonic diagnostic procedure used to

evaluate the structures and motion of the heart (**ech/o** means sound, **cardi/o** means heart, and **-graphy** means the process of recording). The resulting record is an **echocardiogram.**

- **Transesophageal echocardiography** (**trans**-eh-**sof**-ah-**JEE**-al **eck**-oh-**kar**-dee-**OG**-rah-fee) **(TEE)** is an ultrasonic procedure that images the heart from inside the esophagus. Because the esophagus is so close to the heart, this technique produces clearer images than those obtained with echocardiography.

TREATMENT PROCEDURES OF THE CARDIOVASCULAR SYSTEM

Antihypertensive Medications

An **antihypertensive** (**an**-tih-**high**-per-**TEN**-siv) is administered to lower blood pressure. The following are medications used for this purpose:

- **ACE inhibitors** (angiotensin-converting-enzyme inhibitors), which are used to treat hypertension and congestive heart failure (CHF), interfere with the action of the kidney hormone renin that causes the heart muscles to squeeze.
- **Beta-blockers** slow the heartbeat.
- **Calcium channel blockers** reduce the contraction of the muscles that squeeze blood vessels tight. These medications are used to treat hypertension, angina, and arrhythmia.
- **Diuretics** (**dye**-you-**RET**-icks), which increase urine secretion to rid the body of excess sodium and water, are administered to treat hypertension and CHF.

Additional Medications

- **Statins,** a type of **cholesterol lowering drug,** are used to reduce LDL (bad) cholesterol and triglycerides or to raise HDL (good) cholesterol.
- **Digoxin** (dih-**JOCK**-sin) also known as **digitalis** (**dij**-ih-**TAL**-is), slows and strengthens the heart muscle contractions and is used in the treatment of atrial fibrillation and CHF.
- **Nitroglycerin,** a vasodilator, is used to relieve the pain of angina. It may be administered sublingually (under the tongue), through the skin (by a patch), or orally as a spray.
- An **anticoagulant** (**an**-tih-koh-**AG**-you-lant), also known as a **thrombolytic** (**throm**-boh-**LIT**-ick) agent, slows blood clotting (coagulation) and prevents new clots from forming.
- An **antiarrhythmic** (**an**-tih-ah-**RITH**-mick) is administered to control irregularities of the heartbeat.
- **Tissue plasminogen activator** (**TISH**-you plaz-**MIN**-oh-jen **ACK**-tih-**vay**-tor) **(TPA)** is a clot-dissolving enzyme used for the immediate treatment of heart attack victims.
- A **vasoconstrictor** (**vas**-oh-kon-**STRICK**-tor) constricts (narrows) the blood vessels.
- A **vasodilator** (**vas**-oh-dye-**LAYT**-or) dilates (expands) the blood vessels.

CLEARING BLOCKED ARTERIES

- **Percutaneous transluminal coronary angioplasty** (**AN**-jee-oh-**plas**-tee) is also called **PTCA** or **balloon angioplasty** (Figure 5.18). In this procedure, a small balloon on the end of a catheter is used to open a partially blocked coronary artery by flattening the plaque deposit and stretching the lumen. After the plaque has been flattened, the balloon is deflated and the catheter and balloon are removed.
- **Percutaneous** (**per**-kyou-**TAY**-nee-us) means through the skin (**per-** means through, **cutane** means skin, and **-ous** means pertaining to). *Transluminal* means within the lumen of an artery.
- In a similar technique, a **stent** is implanted in a coronary artery to provide support to the arterial wall to prevent restenosis (Figure 5.19). **Restenosis** describes the condition when an artery that has been opened by angioplasty closes again (**re-** means again and **-stenosis** means narrowing).
- An **atherectomy** (**ath**-er-**ECK**-toh-mee) is the surgical removal of plaque from the interior lining of an artery (**ather** means plaque and **-ectomy** means surgical removal). After the catheter and balloon are in place, the balloon is inflated and a cutting tool is used to shave off pieces of the plaque buildup (Figure 5.20).
- An **endarterectomy** (**end**-ar-ter-**ECK**-toh-mee) is the surgical removal of the lining of an artery that is clogged with plaque (**end-** means within, **arter** means artery, and **-ectomy** means surgical removal).
- A **carotid endarterectomy** is the surgical removal of the lining of a portion of a clogged carotid artery leading to the brain. The artery may be reinforced with a piece of vein taken from the leg. This procedure is performed to reduce the risk of stroke by ensuring the blood flow to the brain.

CORONARY ARTERY BYPASS GRAFT

- **Coronary artery bypass graft (CABG)** is also known as **bypass surgery** (Figure 5.21). In this surgery, which requires opening the chest, a piece of vein from the leg is implanted on the heart to bypass a blockage in the coronary artery and to improve the flow of blood to the heart.
- A **minimally invasive direct coronary artery bypass (MIDCAB),** also known as a **keyhole** or **buttonhole bypass,** is an alternative technique for some bypass cases. This procedure is performed with the aid of a fiberoptic camera through small openings between the ribs.

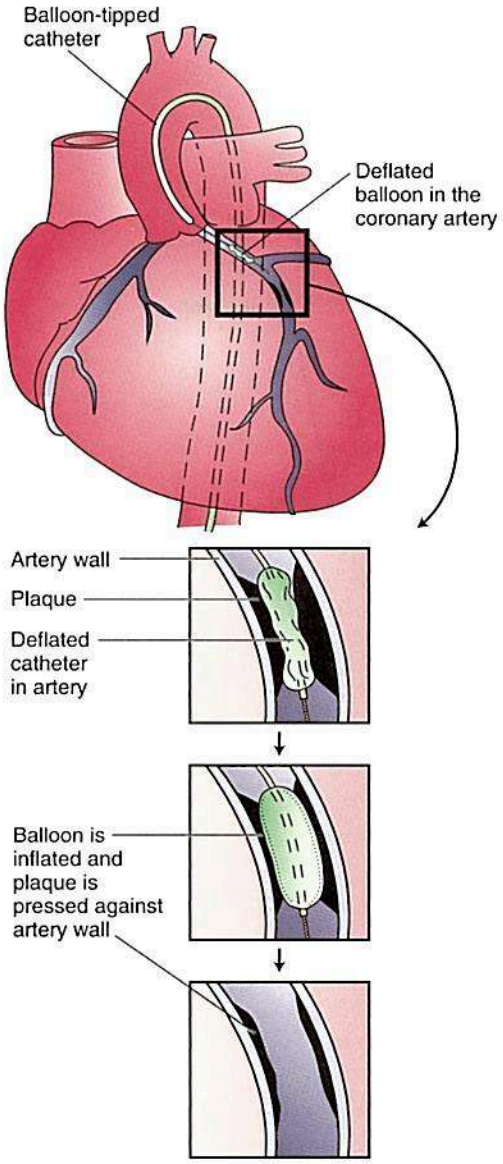

FIGURE 5.18 Balloon angioplasty is used to reopen a blocked coronary artery.

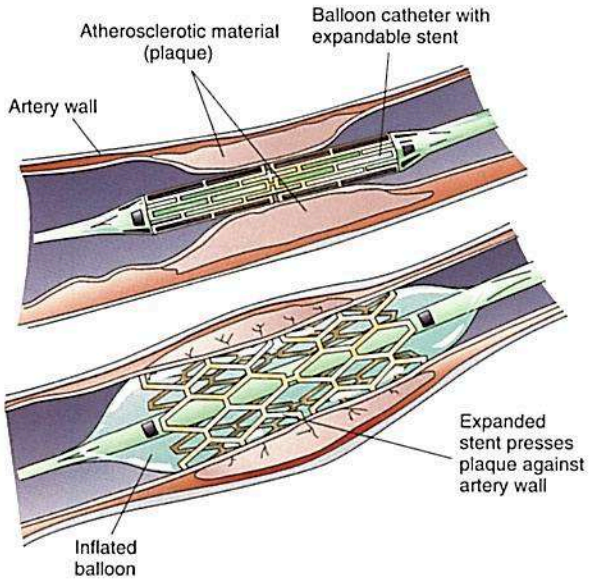

FIGURE 5.19 A stent is placed to prevent restenosis of the treated artery.

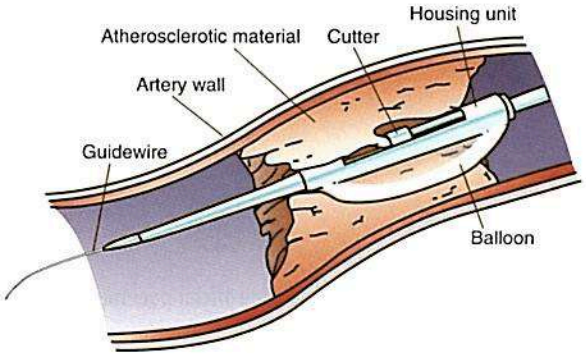

FIGURE 5.20 A cutting instrument is used to remove plaque from the artery wall.

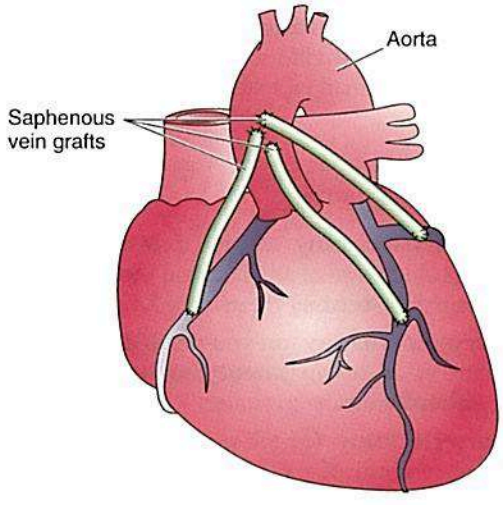

FIGURE 5.21 Coronary artery bypass surgery.

HEART

- **Defibrillation** (dee-**fib**-rih-**LAY**-shun), also known as **cardioversion** (**kar**-dee-oh-**VER**-zhun), is the use of electrical shock to restore the heart's normal rhythm. This can be performed externally as an emergency procedure or a device may be implanted to control severe arrhythmias.
- **Valvoplasty** (**VAL**-voh-**plas**-tee), also known as **valvuloplasty** (**VAL**-view-loh-**plas**-tee), is the surgical repair of a heart valve (**valv/o** means valve and **-plasty** means surgical repair). This term also describes the surgical replacement of a heart valve.
- A **pacemaker** is an electronic device that may be attached externally or implanted under the skin, with

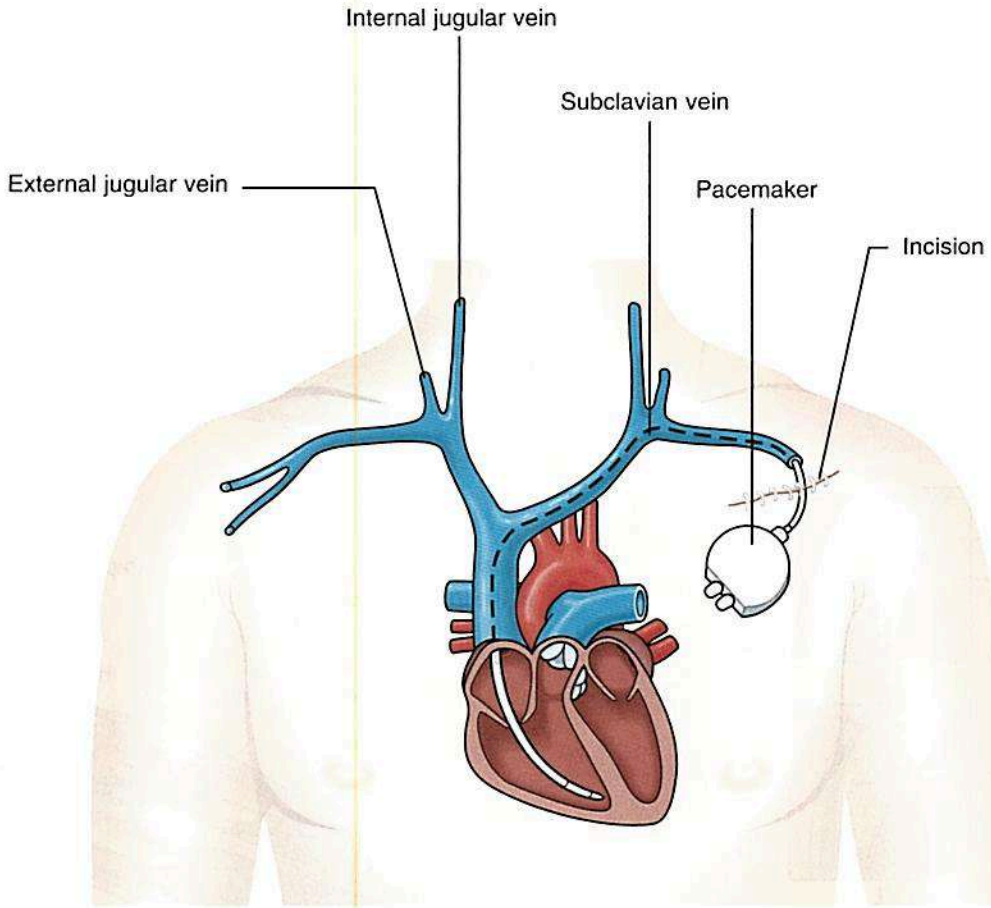

FIGURE 5.22 This type of artificial pacemaker is implanted under the skin.

connections leading into the heart to regulate the heartbeat (Figure 5.22). Pacemakers are used primarily as treatment for bradycardia or atrial fibrillation.

- **Cardiopulmonary resuscitation (CPR),** is an emergency procedure for life support consisting of artificial respiration and manual external cardiac compression.

BLOOD VESSELS, BLOOD, AND BLEEDING

- An **aneurysmectomy** (**an**-you-riz-**MECK**-toh-mee) is the surgical removal of an aneurysm (**aneurysm** means aneurysm and **-ectomy** means surgical removal).
- **Aneurysmorrhaphy** (**an**-you-riz-**MOR**-ah-fee) means to suture an aneurysm (**aneurysm/o** means aneurysm and **-rrhaphy** means to suture).
- An **arteriectomy** (**ar**-teh-ree-**ECK**-toh-mee) is the surgical removal of part of an artery (**arteri** means artery and **-ectomy** means surgical removal).
- **Hemostasis** (**hee**-moh-**STAY**-sis) means to control bleeding (**hem/o** means blood and **-stasis** means stopping or controlling).
- **Plasmapheresis** (**plaz**-mah-feh-**REE**-sis) is a procedure in which the plasma is removed from donated blood, and the remaining components, mostly RBCs, are returned to the donor. This is performed to reduce or eliminate harmful substances present in the plasma.
- A **transfusion** is the introduction of whole blood or blood components into the bloodstream of the recipient. Unless the blood for transfusion has been carefully typed and cross-matched, the patient may suffer a severe transfusion reaction. Donated blood is also tested to prevent the transmission of bloodborne diseases such as the human immunodeficiency virus (HIV) and hepatitis.

Career Opportunities

In addition to the medical specialties already discussed, some of the health occupations involving the treatment of the cardiovascular system include

- **Phlebotomist,** or **venipuncture technician:** takes patient blood samples and prepares them for testing
- **Perfusionist:** operates a heart-lung machine during coronary bypass surgery
- **Cardiovascular technologist:** assists with cardiac catheterization procedures and angioplasty, monitors patients during open-heart surgery and the implantation of pacemakers, and performs tests to check circulation
- **Electrocardiograph (ECG** or **EKG) technician:** a cardiovascular technologist who operates electrocardiograph machines and Holter monitors and performs other specialized cardiac tests

STUDY BREAK

Have you ever taken a big bite of a Popsicle or a mouthful of an ice-cold drink and felt a sudden pain in your head? The not-very-scientific term *ice cream headache* is sometimes used to describe this phenomenon as are the alarming (and inaccurate) terms *brain freeze* and *frozen brain syndrome.* An ice cream headache occurs when a really cold food or beverage comes into contact with the roof of the mouth; it usually lasts only about 30 seconds.

The cause of the pain is the dilation of blood vessels in the head. This dilation is probably caused by a reaction in the nerve center located above the roof of your mouth. When this nerve center gets cold, it seems to overreact and tries to heat your brain with warm blood. The *carotid arteries,* which carry blood to the brain, send a sudden surge of blood to all the blood vessels in the forehead and face, causing a temporary but painful buildup of pressure.

About one out of every three people experience ice cream headaches from time to time. The best way to avoid them is to keep icy cold foods and beverages away from the roof of the mouth or to cool the mouth down gradually by taking small bites or sips if you are really hot.

Health Occupation Profile: Cardiac Sonographer

Michael C. Foster, 34, is a cardiac sonographer. "I take pictures (still and moving) of people's hearts using ultrasound. As a runner, I've always been fascinated by the heart and how it works, how it acquires disease, and how it is repaired. I completed the two-year cardiovascular technology program at our local community college and now have a great job at Duke University Medical Center. It's my job to make a 'movie' that will inform the doctor about the patient's heart function. I do this by using a handheld probe placed on the patient's chest. The study usually takes about 30 minutes, and I see 8 to 10 patients a day. Since my skills center on diagnosis, I'm often the first person to have an idea of what might be wrong with a patient's heart. I work closely with doctors to identify the cardiac problem. My work helps the medical team plan the patient's care. I like my job because my specialized skills help solve important medical problems and often make people's quality of life significantly better."

Review Time

Write the answers to the following questions on a separate piece of paper or in your notebook. In addition, be prepared to take part in the classroom discussion.

1. **Written assignment:** Identify the arteries that carry only **deoxygenated** (oxygen-poor) blood and the veins that carry only **oxygenated** (oxygen-rich) blood.

   Discussion assignment: Which heart chambers pump deoxygenated blood to the lungs and which chambers receive oxygenated blood from the lungs?

2. **Written assignment:** Explain the meaning of the abbreviation **CHF.** Include with your explanation some of the symptoms that the patient with this condition experiences.

   Discussion assignment: How would you explain this condition in terms that a patient's family might understand?

3. Mike Muldoon's **blood pressure** is 160/90. **Written assignment:** Describe what each number indicates.

   Discussion assignment: How could you explain to Mr. Muldoon the risks of not controlling his blood pressure?

4. James has been diagnosed with **high cholesterol,** and he is confused about the difference between LDL and HDL.

   Written assignment: Describe the differences between LDL and HDL.

   Discussion assignment: How would you explain to James why one is considered good and the other is considered bad?

5. Mrs. Warren requires an **artificial pacemaker.**

   Written assignment: Identify which structure is known as the natural pacemaker and list two conditions that might make this surgery necessary.

   Discussion assignment: How would you explain to Mrs. Warren how the artifical pacemaker will work in her body?

Optional Internet Activity

The goal of this activity is to help you learn more about medical terminology while improving your Internet skills. Select ***one*** *of these two options and follow the instructions.*

1. **Internet Search:** Search for information about **blood cancers** such as leukemia and lymphoma. Write a brief (one- or two-paragraph) report on something new you learned here and include the address of the web site where you found this information.

2. **Web Site:** To learn more about **heart attack symptoms** go to this web address: **http://www.heartinfo.org/**. Write a brief (one- or two-paragraph) report on something new you learned here.

The Human Touch: Critical Thinking Exercise

The following story and questions are designed to stimulate critical thinking through class discussion or as a brief essay response. There are no right or wrong answers to these questions.

Randi Marchant, a 42-year-old waitress, was vacuuming the family room when she felt that painful squeezing in her chest again. Third time today, but this one really hurt. She sat down to catch her breath and stubbed out the cigarette smoldering in the half-filled ashtray by the couch. Her husband, Jimmy, and stepdaughter Melonie had pestered her until she finally had taken time off work to see her doctor. Dr. Harris found that her blood pressure was 168/98—probably owing to the noon rush stress at work, she rationalized. At least her cholesterol test was only 30 points above average this time. It had been slowly coming down, even though she cheated on her diet.

Another wave of pain tightened its icy fingers around her heart, and the pain moved up into both sides of her jaw. Randi remembered the doctor's words: "Probably just a little heartburn. Women have less risk for heart attack than men." This didn't feel like heartburn, but the pain didn't radiate down her left arm so it couldn't be her heart, could it?

"Don't think about the pain," she told herself. "Think of something else. . . . Melonie's prom dress . . . needs altering . . . " Randi fell to the floor, clutching her chest, just as Melonie walked in. She saw her stepmother slumped on the floor and screamed, "Oh my God! Help, somebody help!"

Suggested Discussion Topics

1. What information in the story indicates that Randi might be a candidate for heart disease?
2. Discuss why you think Dr. Harris didn't consider Randi a candidate for heart attack.
3. What can Melonie do immediately to save Randi's life?
4. Discuss why it is important that Randi receive appropriate treatment immediately.
5. What steps should someone at risk for heart disease take to help prevent the problem from becoming more serious?

Student Workbook and Student Activity CD-ROM

1. Go to your **Student Workbook** and complete the Learning Exercises for this chapter.
2. Go to the **Student Activity CD-ROM** and have fun with the exercises and games for this chapter.