The Layers of a Blood Vessel Contribute to Vessel Function All blood vessels contain an inner layer of epithelial cells called the endothelium (FIGURE 15.1), which is continuous with the endocardial lining of the heart. Th e endothelium is in direct contact with the blood that fl ows through the lumen (interior opening) of the vessel. Until recently, endothelial cells were regarded as little more than a passive barrier between the blood and the remainder of the vessel wall. It is now known that endothelial cells are active participants in a variety of vessel-related activities, including physically infl uencing blood fl ow, secreting locally acting chemical mediators that infl uence the contractile state of the vessel's overlying smooth muscle, and assisting with capillary permeability. Surrounding the endothelium of a blood vessel is a thin layer of extracellular material called the basement membrane, which provides support to the endothelial cells. With the exception of capillaries, all blood vessels contain layers of smooth muscle and connective tissue that surround the basement membrane, and these layers vary in thickness in diff erent types of blood vessels (FIGURE 15.1). The primary role of the smooth muscle of a blood vessel is to regulate the diameter of the lumen. Sympathetic fibers of the autonomic nervous system innervate vascular smooth muscle. An increase in sympathetic stimulation typically causes the smooth muscle to contract, squeezing the vessel wall and narrowing the lumen. Such a decrease in the diameter of the lumen of a blood vessel is called vasoconstriction. By contrast, when sympathetic stimulation decreases, or in the presence of certain chemicals (such as nitric oxide and H+ ions), smooth muscle fibers relax. The resulting increase in lumen diameter is called vasodilation. The smooth muscle of most blood vessels is at least partially contracted at all times. The ability of a blood vessel's smooth muscle to maintain a state of partial contraction is referred to as vascular tone. As you will learn in more detail shortly, the rate of blood flow through different parts of the body is regulated by the extent of smooth muscle contraction in the walls of particular vessels. Furthermore, the extent of smooth muscle contraction in particular vessel types is crucial to the regulation of blood pressure. Two types of connective tissue may be present in the walls of blood vessels: elastic connective tissue and fibrous connective tissue. Elastic connective tissue contains elastic fibers, which allow blood vessels to stretch in response to incoming blood and then to return to their original shape after being stretched. Fibrous connective tissue contains collagen fibers, which provide blood vessels with significant tensile strength that can sustain the pressure that blood exerts against the vessel walls. Blood vessels vary with respect to the amounts of elastic and fibrous connective tissues that they contain. Arteries Carry Blood Away from the Heart Arteries are blood vessels that carry blood away from the heart. Large-diameter arteries have thick walls composed of several layers of tissue: an endothelium, basement membrane, smooth muscle, fi brous connective tissue, and a high proportion of elastic connective tissue. Because these arteries contain a large amount of elastic tissue in their walls, they are referred to as elastic arteries (FIGURE 15.1). Examples include the two major trunks that exit the heart (the aorta and the pulmonary trunk) and the major branches of the aorta. Th e aorta and pulmonary trunk are the largest elastic arteries, with diameters of about 2.5 cm each; the other elastic arteries have diameters of about 1 cm. Elastic arteries perform an important function: Th ey serve as pressure reservoirs that maintain the driving force for blood fl ow while the ventricles are relaxing. As blood is ejected from the heart into elastic arteries during systole, their highly elastic walls stretch due to the increased blood volume. As the walls stretch, they momentarily store some of the pressure generated by the contraction of the ventricles (FIGURE 15.2a). Th en, while the ventricles are relaxing during diastole, the walls of the elastic arteries recoil as the stored pressure is released. Th is elastic recoil propels blood onward, ensuring that blood continues to move through the remaining arteries of the circulation even though the ventricles are relaxing and not ejecting blood (FIGURE 15.2b).