recoil inwards as the pressure drops. Therefore, as blood at high pressure enters an artery, the artery becomes wider, reducing the pressure a little. As blood at lower pressure enters an artery, the artery wall recoils inwards, giving the blood a small 'push' and raising the pressure a little. The overall effect is to 'even out' the flow of blood. However, the arteries are not entirely effective in achieving this: if you feel your pulse in your wrist, you can feel the artery, even at this distance from your heart, being stretched outwards with each surge of blood from the heart.

As arteries reach the tissue to which they are transporting blood, they branch into smaller and smaller vessels, called **arterioles**. The walls of arterioles are similar to those of arteries, but they have a greater proportion of smooth muscle. This muscle can contract, narrowing the diameter of the arteriole and so reducing blood flow. This helps to control the volume of blood flowing into a tissue at different times. For example, during exercise, arterioles that supply blood to muscles in your legs would be wide (dilated) as their walls relax, while those carrying blood to the gut wall would be narrow (constricted).

Capillaries

The arterioles themselves continue to branch, eventually forming the tiniest of all blood vessels, **capillaries**. The function of capillaries is **to take blood as close as possible to all cells, allowing rapid transfer of substances between cells and blood**. Capillaries form a network throughout every tissue in the body except the cornea and cartilage. Such networks are sometimes called **capillary beds**.

The small size of capillaries is obviously of great importance in allowing them to bring blood as close as possible to each group of cells in the body. A human capillary is approximately 7 μm in diameter, about the same size as a red blood cell (Figure **8.6**). Moreover, the walls of capillaries are extremely thin, made up of a single layer of endothelial cells. As red blood cells carrying oxygen squeeze through a capillary, they are brought to within as little as 1 μm of the cells outside the capillary which need the oxygen.

In most capillaries, there are tiny gaps between the individual cells that form the endothelium. As we shall see

8.5 Photomicrograph of an artery (left) and a vein (right) (× 110).

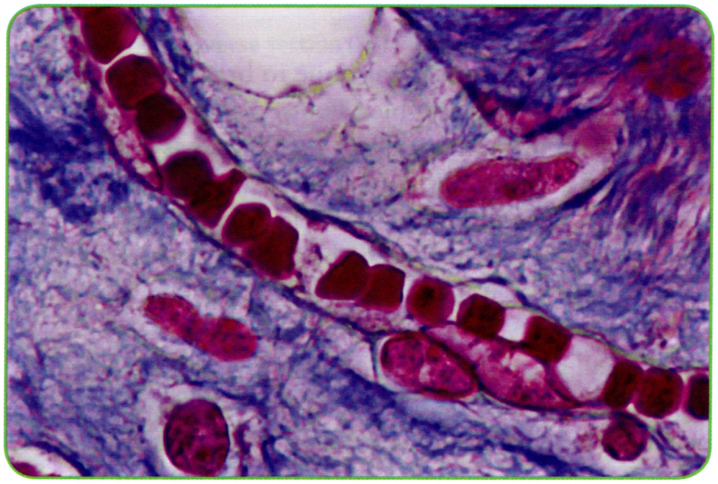

Figure 8.6 Photomicrograph of a blood capillary containing red blood cells, which are stained pink (× 900). The cells with dark purple nuclei are the endothelium of the capillary wall.

SAQ 8.3

Suggest why there are no blood capillaries in the cornea of the eye. How might the cornea be supplied with its requirements?

later in this chapter, these gaps are important in allowing some components of the blood to seep through into the spaces between the cells in all the tissues of the body. These components form tissue fluid.

By the time blood reaches the capillaries, it has already lost a great deal of the pressure originally supplied to it by the contraction of the ventricles. As blood enters a capillary from an arteriole, it may have a pressure of around 35 mm Hg or 4.7 kPa; by the time it reaches the far end of the capillary, the pressure will have dropped to around 10 mm Hg or 1.3 kPa.

Veins

As blood leaves a capillary bed, the capillaries gradually join with one another, forming larger vessels called **venules.** These join to form **veins.** The function of veins is **to return blood to the heart.**

By the time blood enters a vein, its press… to a very low value. In humans, a typical … blood pressure is about 5 mm Hg or less. This … pressure means that there is no need for veins … walls. They have the same three layers as arteries … tunica media is much thinner and has far fewer … and muscle fibres.

The low blood pressure in veins creates a problem … can this blood be returned to the heart? The problem … perhaps most obvious if you consider how blood … from your legs. Unaided, the blood in your leg veins … sink and accumulate in your feet. However, many … veins run within, or very close to, several leg muscles … Whenever you tense these muscles, they squeeze … on the veins in your legs, temporarily raising the … within them.

This squeezing in itself, would not help to push … back towards the heart; blood would just squidge … down as you walked. To keep the blood flowing in … direction, veins contain half-moon valves, or semilunar **valves**, formed from their endothelium (Figure 8.7 … valves allow blood to move towards the heart, but … from it. Thus, when you contract your leg muscles … blood in the veins is squeezed **up** through these … cannot pass **down** through them.

Figure **8.8** shows how blood pressure changes as … blood travels on one complete journey from the heart … through the systemic circulatory system, back to the … and then through the pulmonary circulatory system.

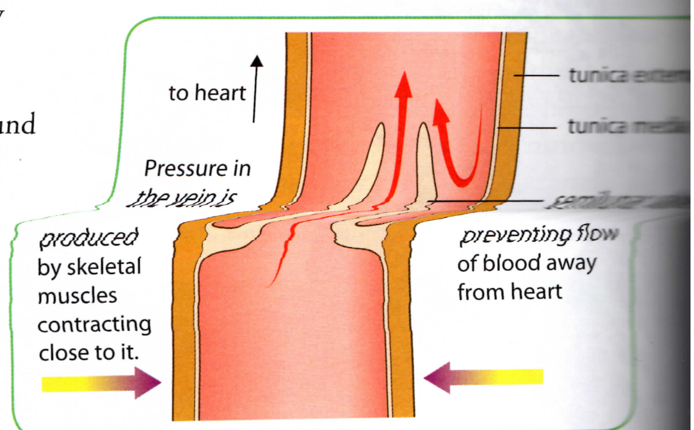

Figure 8.7 Longitudinal section through a small vein and a valve.