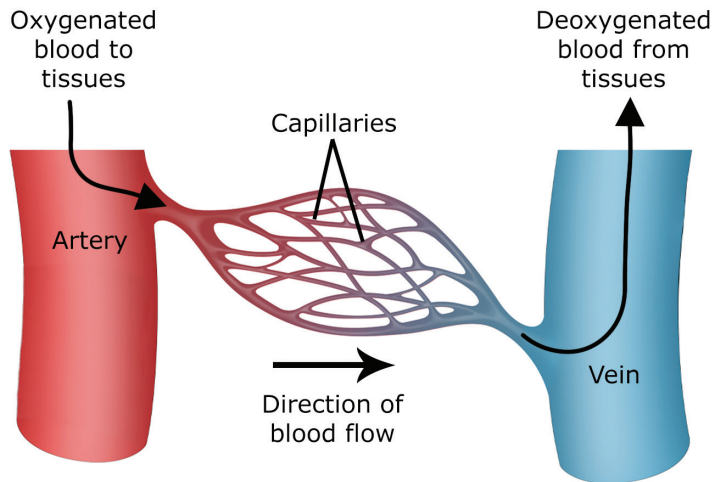


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there are capillary beds in the kidneys to allow waste products in the blood to be removed. Lungs and gills are full of capillaries for gas exchange. Gas and nutrient exchange in tissues occurs in capillaries.



**Figure 15.3.2**

**Capillary beds**

Capillaries are small blood vessels that are the interface between arterial blood—**oxygenated blood**, or blood rich in oxygen and nutrients—and venous blood—**deoxygenated blood**, or blood without oxygen that carries wastes and carbon dioxide. Capillaries are found in dense nets all over the body, called capillary beds. An individual capillary is a tube so small that only one cell can flow through at a time. Also, their walls are so thin they allow oxygen, carbon dioxide, nutrients and wastes to pass through. All gas, nutrient, and cell waste exchanges occur in capillary beds. The blood slows through the capillary bed, which gives time for the gasses, nutrients and wastes to pass through the capillary walls. In circulation diagrams, arteries are usually red to indicate the blood is oxygenated, and the veins are blue to indicate the blood is deoxygenated.

**Gills** are specialized organs that extract oxygen from water and, at the same time, release carbon dioxide into the water. There are capillary beds throughout gills that absorb oxygen dissolved in the water by diffusion into the body. At the same time, carbon dioxide diffuses out of the blood and releases into the water. After passing through the gill capillaries, then, blood is oxygenated. For this process to work correctly, water must always be moving past the gills. Fish constantly swim or open and close their mouths to keep water moving through the gills so proper gas exchange can always occur.

Many amphibians use their skin for gas exchange, and if that's the case, there are lots of capillary beds right underneath the skin. Oxygen diffuses from the air, through the skin and into the blood in the capillary beds, which oxygenates the blood. At the same time, carbon dioxide diffuses out of the blood, through the skin and into the air. The skin must be moist for this to occur, which is one of the reasons amphibian skin is wet and slippery.

**Lungs** are the gas exchange organs in the air-breathing members of Chordata—the reptiles, mammals, birds and humans. Remember that aquatic mammals such as whales, dolphins, and manatees do not have gills; they have lungs. Capillary beds are located throughout lung tissue. The heart pumps deoxygenated blood into the capillary beds in the lungs, where carbon dioxide diffuses out of the blood into the air, and oxygen diffuses into the blood—deoxygenated blood becomes oxygenated in the lungs. For this process to occur properly, there must be continuous movement of air into and out of the lungs. Therefore, we breathe. Breathing allows for constant air movement so proper gas exchange can occur.