BIOLOGY IN ENGLISH

Gills are an efficient gas-exchange surface in water

Animals with gills use various means of ventilation. Among molluscs, such as a clam or a squid, water is drawn into the mantle cavity, where it passes through the gills. In crustaceans, such as crabs and shrimps, which are arthropods, the gills are located in thoracic chambers covered by the exoskeleton. The action of specialized appendages located near the mouth keeps the water moving. In fish, ventilation is brought about by the combined action of the mouth and gill covers, or *opercula* (singular, *operculum*). When the mouth is open, the opercula are closed and water is drawn in. Then the mouth closes, and the opercula open, drawing the water from the pharynx through the gill slits located between the gill arches.

The gills of bony fishes are outward extensions of the pharynx (**figure 1**). On the outside of the gill arches, the gills are composed of filaments that are folded into platelike lamellae. Fish use **countercurrent exchange** to transfer oxygen from the surrounding water into their blood. Concurrent flow means that the two fluids flow in opposite directions: O_2-rich water passing over the gills would flow in the same direction as O_2-poor blood in the blood vessels. This arrangement would result in an equilibrium point, at which only half the oxygen in the water would be captured. With countercurrent flow, as blood gains oxygen, it always encounters water having an even higher oxygen content. A countercurrent mechanism prevents an equilibrium point from being reached, and about 80-90% of the initial dissolved oxygen in water is extracted.

ANSWER
How does the countercurrent exchange work?

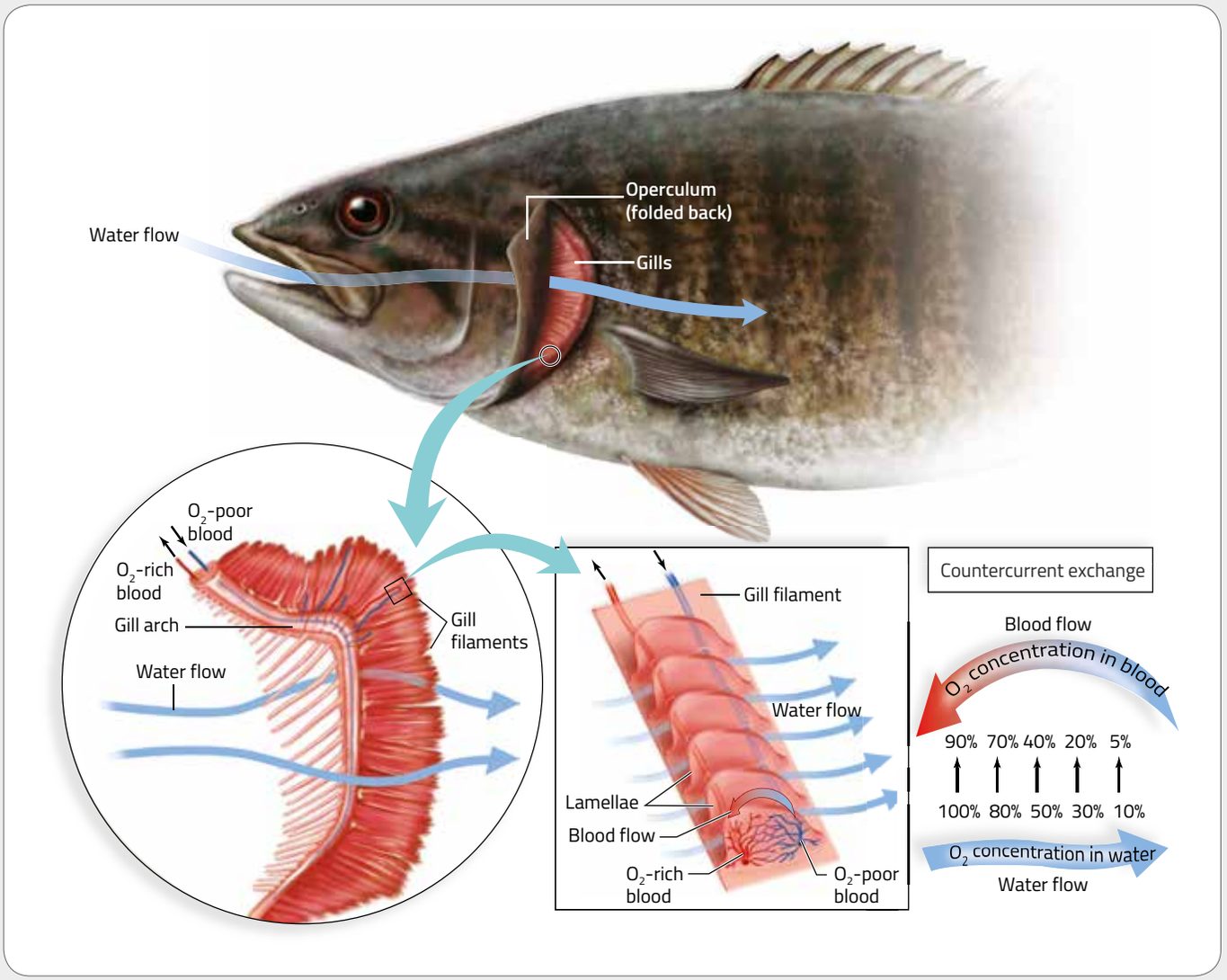

Figure 1 Gills in bony fishes help carry out countercurrent exchange.