

# Internal Investigations

## Objective

Students will use print and electronic resources to collect information to compare the circulatory and respiratory systems of humans and whales.

## Materials

- ☐ internet access and other reference materials

## Background

The circulatory and respiratory systems of humans and whales are similar in structure, but whales have special physiological adaptations for life in the ocean. Whales often dive in search for food. When diving, the heart rate slows and blood is shunted from tissues tolerant of low oxygen levels. The blood then moves towards the heart, lungs, and brain, where oxygen is needed. The muscles of whales have a high content of the oxygen-binding proteins hemoglobin and myoglobin. Myoglobin stores oxygen and helps prevent muscle oxygen deficiency. Compared to land mammals, baleen whales have up to nine times the concentration of myoglobin.

The circulatory system of whales can also adjust to conserve or dissipate body heat and maintain body temperature. Some arteries of the flippers, flukes, and dorsal fin are surrounded by veins. Thus, some heat from the blood traveling through the arteries is transferred to venous blood rather than the environment. This countercurrent heat exchange aids whales in conserving body heat. To dissipate heat, circulation increases in veins near the surface of the flippers, flukes, and dorsal fin, and decreases in veins returning the blood to the body core. Excess heat is shed to the environment.

Whales breathe through a single blowhole (toothed whales) or two blowholes (baleen whales) on the top of the head. A whale holds its breath while under water, then opens the muscular flap(s) of the blowhole to exhale at the surface. During each respiration, a whale exchanges 80% or more of its lung air, which is much more efficient than humans. Humans exchange about 17% to 20% of their lung air with each breath.

## Action

Have students write a report comparing and contrasting the circulatory and respiratory systems of humans and whales. How do the adaptations of each system benefit humans and whales in their own environments?