Chapter 30 **Nonvertebrate Chordates, Fishes, and Amphibians** **Name _____**

Worksheet Investigating Fish Respiration

Background Information

It is well known that a fish dies from lack of oxygen when taken out of water. However, water contains only 1/30 of the oxygen that is contained in air. In this activity you will investigate the mechanisms that enable fish to remove oxygen from water.

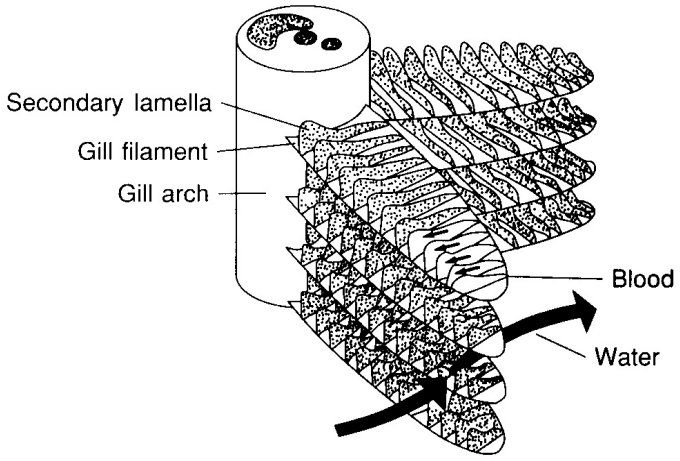
A freshwater fish that has a mass of 100 grams needs the equivalent of 5 cubic centimeters of oxygen ($5cm^3\ O_2$) each hour, when at rest. When active, it needs four times that amount, or 20 cubic centimeters of oxygen each hour ($20cm^3\ O_2$).

Humans can absorb oxygen from air drawn into their lungs. Fish, however, must absorb oxygen that is dissolved in water by passing the water over their gills. Because water is 1000 times denser than air, fish must use a large amount of energy to move enough water over its gills to supply its oxygen needs.

1. Only 2 percent of the oxygen intake in humans is used by respiratory muscles. Do you think the percent of oxygen used by respiratory muscles in a fish is higher or lower than this? Explain.

The rate at which fish remove oxygen from water depends on the flow of blood in the gills and on the amount of water flowing over the gills. Examine Figure 1, which is a diagram of a fish's gill structure. The large arrow indicates the direction of water flow. The small arrows show direction of blood flow.

Figure 1



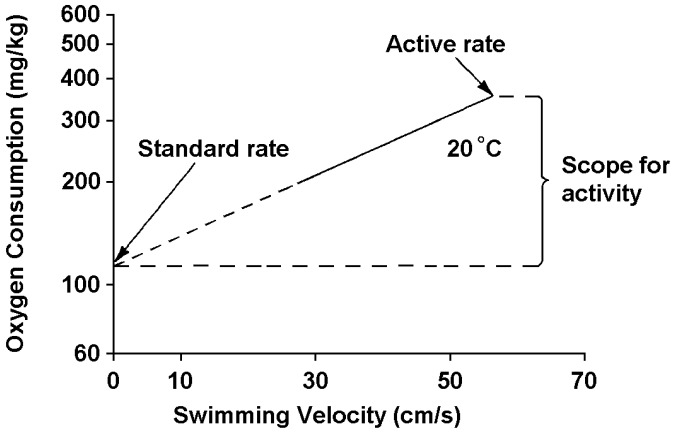
2. Through which structure does the blood flow?

3. What is the direction of blood flow in relation to the direction of water flow over the gills?

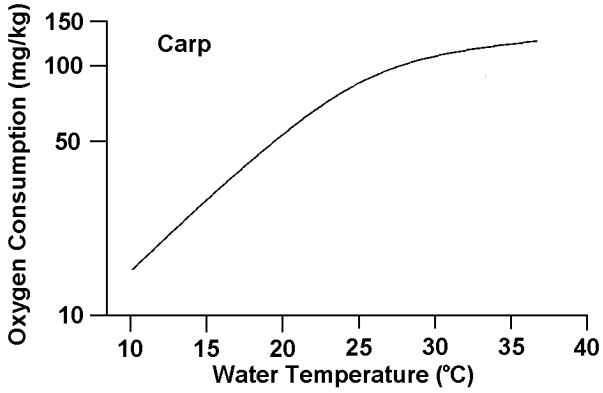
4. The rate of oxygen uptake by gills depends on the surface area, the number, and the thickness of the lamellae across which oxygen must diffuse. What are two ways to increase the rate of oxygen uptake?

The rate at which fish consume oxygen can be affected by a number of factors. Examine graphs A, B, and C and answer the following questions.

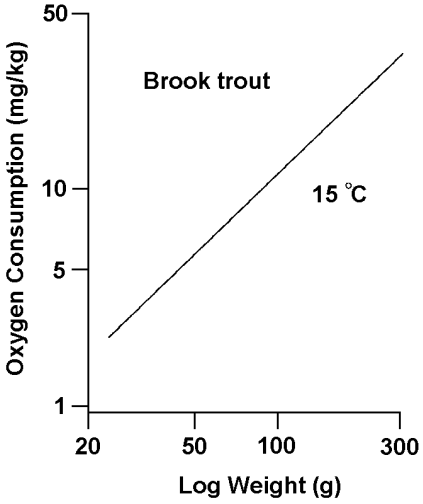
Graph A



Graph B



Graph C



5. Examine Graph A. How does oxygen consumption vary with swimming velocity? Explain this relationship.

6. How does oxygen consumption vary with water temperature in Graph B?

7. Explain why oxygen consumption varies with body weight.