

Experiment CM-7: Oxygen Consumption and Aerobic Respiration in Goldfish

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Exercise 1: Measure the Rate of Oxygen Consumption on the Goldfish at Room Temperature - Fed

Aim: To measure changes in dissolved oxygen concentration of water inhabited by fish over time.

Procedure

Note: Each organism is placed in a respirometry chamber (jar or flask) with an appropriate volume of water. Allow the fish several minutes to calm down, and then seal jar with electrode and stopper. Mark your starting point (VB) and allow each experiment to run for 30 minutes. After at least 30 minutes, mark the end measurement VE. This needs to be done for all three fish groups: 4°C, 20°C, and 20°C fed.

1. Half-fill the Erlenmeyer flask or respirometry chamber with fresh, aerated water.
2. Weigh the flask and its contents on the top-loading balance.
3. Catch a fish from the tank that housed them at room temperature - FED and place it in the same flask. Weigh the flask again.
4. Subtract the two weights of the flask. The difference is the weight of the fish.
5. Place a stir bar on the bottom of the flask and place the flask on the magnetic stirrer ([Figure CM-7-L1](#)).

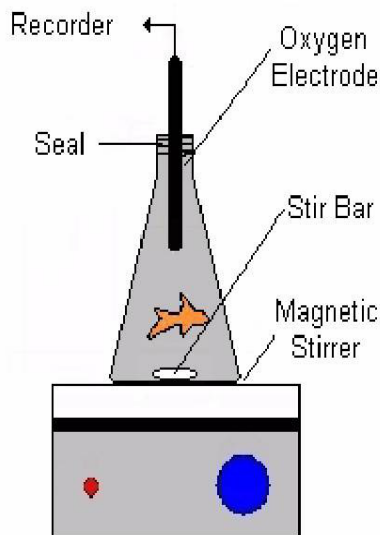


Figure CM-7-L1: Experimental setup for recording changes in the oxygen concentration in water containing a fish.

6. Fill the flask, which is holding the fish, close to the top with fresh, room temperature aerated water. Turn on the stirrer so that the bar rotates very slowly.

Note: The stirrer should be rotating at a speed that does not agitate and stress the fish. Continue to aerate the water in this flask with an aeration stone connected to a aquarium pump.

Warning: In this experiment you will measure the basal metabolic rate. Therefore you must keep the stress level of the fish to a minimum.

7. Cover the sides of the flask with paper towels to minimize disturbance from outside.
8. Let the fish equilibrate to the flask for about 10-15 minutes.
9. Remove the aeration line from the flask at the end of equilibration period.
10. Fill the flask to the brim with aerated water.
11. Tightly seal the top of the flask and around the cable of the oxygen electrode with plastic wrap or parafilm ([Figure CM-7-L1](#)).

Note: It is important that there are no air bubbles on the side of the flask.

12. Type VB (room) in the Mark box to the right of the Mark button.
13. Click Record and press the Enter key on the keyboard to mark the recording. Record the output of the oxygen electrode for 30 minutes, or until the concentration of oxygen falls below 65% of the initial concentration at the beginning of the exercise. Mark the end of the measurement VE (room).

Note: During this time you may elect to set up another fish in a second flask and allow it to equilibrate to its new surroundings.

14. Click Stop to halt the recording.
15. Select Save in the File menu.
16. Open the container. Remove the dissolved oxygen electrode from the flask. Rinse the electrode with deionized water from the squirt bottle. Place the electrode in a beaker of deionized water.
17. Carefully pour all the water from the flask containing the fish into a graduated cylinder. Return the fish to the correct aquarium. Measure the volume of water in the cylinder. Return the water to the stock tank. Record the volume of water in the graduated cylinder.

Note: All data will be collected ahead of time. Data analysis will occur after data is collected for all three (3) fish.

Exercise 2: Measure the Rate of Oxygen Consumption on the Goldfish at Room Temperature - Starved

Aim: To measure changes in dissolved oxygen concentration of water inhabited by fish that have not been fed over time.

Procedure:

1. Repeat Exercise 1 in its entirety for a fish at room temperature that has not been fed.
2. Catch a fish from the tank that housed them at room temperature - STARVED and place it in the same flask. Weigh the flask again.
3. Mark the recording VB (starved) and VE (starved).
4. Continue with the experiment.

Exercise 3: Measure the Rate of Oxygen Consumption on the Goldfish at Cold Temperature ~ 4°C

Aim: To measure changes in dissolved oxygen concentration of cold water inhabited by fish.

Note: Repeat the Calibration of the Oxygen Electrode again at this point prior to doing this portion of the experiment. Use chilled DI-Water, chilled 0% oxygen solution, and a chilled electrode.

Procedure:

1. Repeat Exercise 1 in its entirety for a fish at cold temperature.
2. Catch a fish from the tank that housed them at cold temperature - 4°C and place it in the same flask. Weigh the flask again.
3. Mark the recording VB (cold) and VE (cold).
4. Continue with the experiment using cold water in the flask/respirometer.

Note: Use the chilled oxygen electrode for this experiment so that there is no temperature change between the water and the oxygen electrode.

Data Analysis

1. Scroll through the data file and locate a section near the beginning of the recording for the fish at room temperature-FED. You should be very near the VB-room mark made during the recording.
2. Click the single cursor icon ([Figure CM-7-L2](#)) and measure and record the Value shown in the right hand margin of the Dissolved O₂ channel for VB-room.

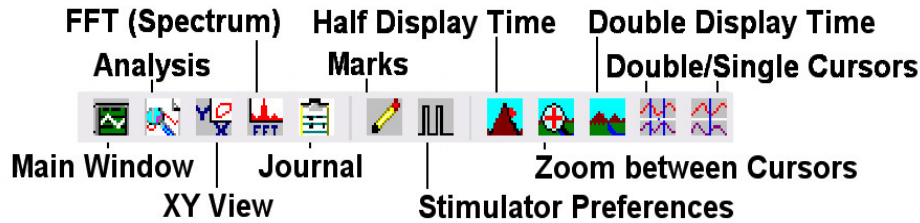


Figure CM-7-L2: The LabScribe toolbar.

3. Click the down arrow to the right of the Mark button and select VE-room. This will adjust your recording to the time at when you made this mark.
4. Click the single cursor icon and measure and record the Value shown in the right hand margin of the Dissolved O₂ channel for the fish at room temperature.
5. Repeat the above data analysis procedures for the fish at room temperature-STARVED and the fish at Cold (4°C) temperatures.
6. Record all your data in [Table CM-7-L1](#).

Calculating a Metabolic Rate

In order to determine the amount of oxygen consumed you need to calculate the following:

1. Total oxygen consumed = VB - VE = O₂ Consumed
2. Individual MO₂ = (O₂ consumed/ time) * volume of water (liters)
3. Mass-specific MO₂ = O₂ consumed/(time * mass)

Note: Assume a time of 30 minutes.

Questions

1. How is the rate of oxygen consumption related to temperature?
2. How is the rate of oxygen consumption related to an organism being fed or not being fed?
3. How is the rate of oxygen consumption per gram of body weight related to the total weight of the animal? When you compare data from the different fish, is there a trend?
4. Explain the physiological parameters that affect metabolism - food consumption, temperature, etc...
5. Did you (or did you not) see any difference in the metabolism of the fish? Explain your answer.

Table CM-7-L1: Rate of Oxygen Consumption and Metabolism of Fish Under Different Conditions.

	Fish - Room Temperature FED	Fish - Room Temperature STARVED	Fish - Cold Temperature
Values			
VA - Air Saturated Value			
VZ - Zero % Value			
VB - Beginning			
VE - End			
MO ₂ /minute			
MO ₂ /minute/gram			

Recipe for 0% oxygen calibration solution.

Concentration (mMolar)	Salt	Grams/Liter DI H ₂ O
15	Sodium Hydrosulfite	2.61