

Name _____ Period _____ Date _____

Take a Deep Breath: Collecting and Graphing Experimental Data

Objective

The learner will determine the rate of gas exchange in a fish using the number of operculum openings.

The learner will collect, organize, and graph experimental data.

Introduction

All animal cells need oxygen to survive. The needed oxygen is brought into the cell from the environment. Aquatic organisms, such as GloFish[®] fluorescent fish, get their oxygen from the surrounding water using gills. Gills are fleshy folds of skin-like material similar in structure to a vacuum cleaners filter. Fish move water through the gills by opening their mouth or swimming with their mouth open. As water passes over the gills the oxygen is absorbed into the fish's bloodstream through the filaments in the gills. Gills also remove carbon dioxide from the fish's bloodstream in the outgoing water. A covering called the operculum protects the delicate gills. The operculum moves in and out as the fish pass water over their gills to get needed oxygen.

In this activity you will observe GloFish as they move their operculum to bring in a fresh supply of water. Using that data, you will calculate average number of times a GloFish opens its operculum during a 10 second time period.

National Standards

Science as Inquiry A—Abilities necessary to do scientific inquiry

Life Science B—Diversity and adaptations on organisms

Life Science C—Structure and function in living systems

Materials Per Group

One GloFish[®] in clear plastic cup of aquarium water

Stop watch

Hand lens

Piece of butcher paper

Meter stick

Markers, map pencils or colors

Safety Precautions

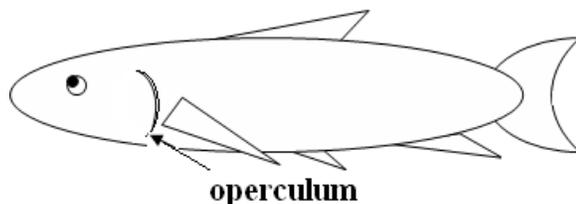
Demonstrate the proper procedure for carrying and handling the cup containing the fish.

Instruct learners to wash their hands thoroughly after handling living organisms.

Procedures

Part A: Counting Operculum Openings

1. Read the introduction section of this exercise to become familiar with gas exchange in fish, such as GloFish®.
2. Obtain a GloFish in a clear plastic cup containing aquarium water.
3. Carefully place the cup containing the fish in the center of your lab table or work area.
4. Use the hand lens to observe the fish. Locate the gill covering called the operculum. Each time the operculum opens, the fish pulls fresh water across the gill surface for gas exchange.



5. Watch the fish for ten seconds and count the number of times the fish opens its operculum. One lab partner should watch the fish and count while the second lab partner uses the stop watch to time ten seconds. This count will be called Trial 1.
6. Record the number of operculum openings from Trial 1 in Data Table 3.1.
7. Repeat steps 4 and 5 two additional times. Record the numbers for these trials in Data Table 3.1.
8. Find the average number of operculum openings for your fish by adding up the numbers from each trial and dividing by 3. Record your average in Data Table 3.1.
9. Share your average with the other groups in the class by writing your average in the table displayed in the classroom.
10. Record the data from 7 other groups in Data Table 3.2.
11. Calculate the class average number of operculum openings. Record your answer in Data Table 3.2.

Part B: Graphing the Data

12. Listen as your teacher describes how to properly prepare a bar graph.
13. On a scratch piece of paper, prepare a rough draft of a graph comparing your group's average operculum openings to the class average operculum openings.
14. Use the meter stick and markers to draw your graph on the butcher paper provided.
15. Color the bars on the graph two different colors. Be sure to label all parts of the graph.
16. Display your graph as instructed by your teacher.
17. Answer the discussion questions.

**Data Table 3.1 - Individual Group
Number of Operculum Openings**

Trial	Number of Operculum Openings/10 seconds
Trial 1	
Trial 2	
Trial 3	
Total number of openings	
Average number of openings/10 seconds	

**Data Table 3.2 - Class Data
Average Operculum Openings**

Trial	Number of Operculum Openings/10 seconds
Group 1	
Group 2	
Group 3	
Group 4	
Group 5	
Group 6	
Group 7	
Group 8	
Class Average number of openings/10 seconds	

Discussion Questions:

1. Calculate the average number of operculum openings for your fish. Show your work in the space provided below.
2. Calculate the class average number of operculum openings. Show your work in the space provided below.
3. Is your group's average higher or lower than the class average?
4. Which average would be considered more accurate, your group data or the class data? Explain your answer.
5. What structures do GloFish® use to obtain oxygen from water?
6. What structures do humans use to obtain oxygen from air?

Elaborations or Extensions

Students prepare models of a lung and gills and use them to compare the structure and functions of a fish respiratory system to that of the human respiratory system.

Instructions for lung model:

- a. Have students carefully cut away the bottom of a water bottle. Be sure to demonstrate how to do this safely.
- b. Have them carefully cut the palm out of a latex glove and place it on the bottom of the bottle so it is tight; secure it with a rubber band.
- c. Place a balloon over the opening of the bottle and poke it down into the bottle, so it will be hanging (balloon is inside out).
- d. Push and pull on the latex glove.
- e. Observe how the balloon expands and contracts.

Instructions for gill model:

- a. Have students cut out several (5-10) large paper towel fish
- b. Put several drops of food coloring into your water bottle (blue works well)
- c. Place your layered fish on a board across a plastic tub
- d. Imagine the coloring in the water is AIR. Pour the colored water over the layers of paper towel fish. Describe the changes in the paper towel.

Take a Deep Breath: Collecting and Graphing Experimental Data Answer Sheet

Intended Grade Level

2nd and 3rd

Teacher Information

Data Table 3.2 may need to be adjusted to accommodate the number of groups you have in your particular class. Expect to see variation in the counts due to student errors. If the range of numbers is extreme you may want to increase the number of trials conducted in Part A to get a more representative set of data.

This activity affords the opportunity to discuss experimental variables and sources of error. In a post lab discussion students could be asked to generate a list of reasons the data vary. Additionally, students should be able to list ways to reduce error in the activity such as having the same person count all trials, keeping still and being quiet during the activity to avoid agitating the fish, etc.

Sample Data

Trial	Number of Operculum Openings/10 seconds
Trial 1	14
Trial 2	22
Trial 3	18
Total number of openings	54
Average number of openings/10 seconds	18

Trial	Number of Operculum Openings/10 seconds
Group 1	18
Group 2	15
Group 3	23
Group 4	20
Group 5	12
Group 6	11
Group 7	19
Group 8	22
Class Average number of openings/10 seconds	17.5

Discussion Questions and Possible Answers

1. Calculate the average number of operculum openings for your fish. Show your work in the space provided below.

$$14 + 22 + 18 = 54$$

$$54/3 = 18 \text{ operculum openings}/10 \text{ seconds}$$

2. Calculate the class average number of operculum openings. Show your work in the space provided below.

$$18 + 15 + 23 + 20 + 12 + 11 + 19 + 22 = 140$$

$$140/8 = 17.5 \text{ operculum openings}/10 \text{ seconds}$$

3. Is your group's average higher or lower than the class average?

Answers will vary.

4. Which average would be considered more accurate, your group data or the class data? Explain your answer.

The class average is more accurate because it includes a larger sample of data.

5. What structures do GloFish® use to obtain oxygen from water?

Gills

6. What structures do humans use to obtain oxygen from air?

Lungs