

Going to School: Measuring Schooling Behaviors in GloFish®

Objective

The learner will collect data to determine if schooling behaviors are exhibited in GloFish® fluorescent fish.

The learner will design an experiment to determine the effect of body color on schooling behaviors of GloFish.

Introduction

Schooling is a collective behavior observed in a variety of fish species. A school of fish is composed of members of the same species swimming together at a similar speed, direction and pattern. This wide spread behavior is advantageous to fish for several reasons. A primary advantage of fish schooling is to provide protection from predators. Fish swimming among a large population provides security. Predators are more likely to capture a single prey swimming alone than to single out and capture one fish from a crowd of schooling fish. Also, schooling is beneficial to fish because it improves the group's ability to detect predators due to the sheer numbers of watchful eyes and senses. Additional advantages of schooling include reduced friction as the school swims, as well as having several mates readily available to reproduce.

Fish that school exhibit herd-like behavior and seek out other fish rather than spending time alone or isolated. Schooling fish will swim close to members of the same species. They will often swim in the same direction at roughly the same speed. When one fish in the school turns, other members will quickly follow. In this activity, you are going to determine whether GloFish exhibit schooling behaviors by measuring the amount of time the fish spend together in the same area of an aquarium.

National Standards Addressed

Science as Inquiry A—Abilities necessary to do scientific inquiry
Life Science B—Behavior of organisms

Materials Per Group

3 zippered plastic freezer bags (2.5 gallon size)
5 Starfire Red® GloFish®
4 Electric Green® GloFish or Sunburst Orange® GloFish
4 small red/orange fish of a different species
Small fish net
Ruler
Permanent marker

Safety Precautions

Students should be instructed on the proper handling of fish for this activity.

Fish should not be left in the two gallon zippered baggies for more than a single class period.

Students should wash hand thoroughly after handling living organisms.

Procedures

Part A: Observing Schooling Behaviors in GloFish® of the Same Color

1. Obtain a 2.5 gallon zippered bag. On the outside of the bag, use a permanent marker to mark four equal sections on the bag. Label the sections A, B, C, and D. (See Figure 1 below.)

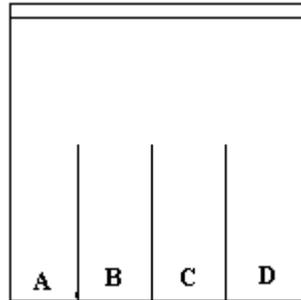


Figure 1

2. Fill the bag with 700 mL of aquarium water.
3. Place a single Starfire Red® GloFish in the bag. Hold the bag upright and observe the fish's movements for one minute; note its location every 15 seconds by placing a tick mark in the corresponding column of Table 19.1
4. Place a second Starfire Red GloFish in the bag. Hold the bag upright and observe the fish for one minute. Note the location of both fish in 15 second intervals by placing tick marks in the corresponding column of Table 19.2.
5. Place two additional Starfire Red GloFish in the bag. Hold the bag upright and observe for one minute. Note the location of all fish in 15 second intervals by placing tick marks in the corresponding column of Table 19.3.
6. Answer discussion questions 1-3.

Part B: Observing Schooling Behaviors in GloFish® of Different Colors

1. Retain the bag of four Starfire Red GloFish from Part A.
2. Prepare a bag of four Electric Green® GloFish. This bag does not need to have sections marked on it.
3. Prepare a third bag containing only one Starfire Red GloFish.

- Place the bags side by side on the lab bench with the bag containing the single Starfire Red® GloFish® in the middle.
- Holding the bags upright slide the two outside bags in opposite directions until only ½ of each outside bag is touching the center bag containing one fish. (See Figure 2 below.)

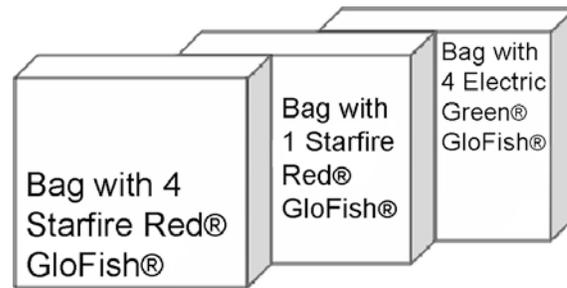


Figure 2

- Observe the Starfire Red GloFish in the center bag for two minutes. Note the location of the fish every 15 seconds by placing a tick in the corresponding column of Table 19.4. Occasionally lightly tap the side of the bag containing the single GloFish to keep it active and moving.

Part C: Schooling with a Second Species

- Based on the procedures and data gained in Parts A and B of this investigation, do you think GloFish will school with a non-related species of the same color? Formulate a hypothesis and record it in the space provided.
- Work with your group members to design your investigation. Determine what materials will be needed and write the procedures to be followed in the space provided.

3. Perform your experiment, collect and analyze your data.

4. Be ready to present your findings as instructed by your teacher.

Data

Table 19.1 - Location of One Starfire Red® GloFish®

Time	Section A	Section B	Section C	Section D
15 seconds				
30 seconds				
45 seconds				
60 seconds				

Table 19.2 - Location of Two Starfire Red® GloFish®

Time	Section A	Section B	Section C	Section D
15 seconds				
30 seconds				
45 seconds				
60 seconds				

Table 19.3 - Location of Four Starfire Red® GloFish®

Time	Section A	Section B	Section C	Section D
15 seconds				
30 seconds				
45 seconds				
60 seconds				

Table 19.4 - Location of Single Starfire Red® GloFish®

Time	Near Starfire Red® bag	Near Electric Green® bag
15 seconds		
30 seconds		
45 seconds		
60 seconds		
75 seconds		
90 seconds		
105 seconds		
120 seconds		

Part D: Schooling with a Second Species

Problem: Will Starfire Red® GloFish® school with members of another species that are the same size and color?

Hypothesis:

Materials:

Procedure:

Data:

Conclusion:

Discussion Questions:

1. When two Starfire Red® GloFish® are together, were schooling behaviors observed? Use your data to support your answer.
2. Were schooling behaviors observed when four Starfire Red GloFish were placed in the same container? Use your data to support your answer.
3. What are two advantages of schooling in fish?
4. Write a statement summarizing the results obtained in Part B of this activity.
5. Give one possible explanation for the results obtained in Part B of this activity.
6. Predict what behaviors would be exhibited by two Electric Green® GloFish when a mirror is placed just outside the container in which they are swimming. Explain your prediction.
7. Identify two possible sources of error encountered in Part C of this activity.

8. Much of the behaviors exhibited in this activity were based on visual information gained by the fish. Use additional resources to identify two other sources of stimuli information fish use when schooling.

Elaborations and Extensions

Have students research the size of marine schools.

Students can video tape fish swimming in a large aquarium and use the video footage in an experiment to stimulate schooling in a lab activity.

Students can design experiments to determine the effects of mirrors, light, and sound on GloFish® schooling behavior.

Going to School: Measuring Schooling Behaviors in GloFish® Answer Sheet

Intended Grade Level

9th, 10th, and 11th

Teacher Information

In order to expedite the activity have half the groups use red and half the groups use green GloFish® in Part A. This will allow them to share lab set ups in Part B. Fish for Part C should be chosen based on size, color, and economy.

Discussion Questions and Possible Answers

1. When two Starfire Red® GloFish are together were schooling behaviors observed? Use your data to support your answer.

Schooling behaviors are typically seen in groups of fish with more than 4 members. Behaviors that appear to be schooling when only two fish are present could be attributed to chance.

2. Were schooling behaviors observed when four Starfire Red GloFish were placed in the same container? Use your data to support your answer.

Schooling behaviors will likely be observed when 4 GloFish are present in the same container. Schooling behaviors are even more likely to occur when 6 fish are present.

3. What are two advantages of schooling in fish?

Protection from predators, improved predator detection and reduction of friction when swimming are examples of advantages of schooling.

4. Write a statement summarizing the results obtained in Part B of this activity.

Answer will vary; however, there is no tendency in zebrafish to exhibit a color preference when schooling.

5. Give one possible explanation for the results obtained in Part B of this activity.

Answers will vary based on the results obtained, however, there is no tendency in zebrafish to exhibit a color preference when schooling.

6. Predict what behaviors would be exhibited by two Electric Green® GloFish when a mirror is placed just outside the container in which they are swimming. Explain your prediction.

The two Electric Green® GloFish® would likely tend to exhibit schooling behaviors swimming more frequently in the area of the container located nearest the mirror.

7. Identify two possible sources of error encountered in Part C of this activity.

Small sample size, variation in color of second species, markings on the bodies of the second species, timing errors, and movement of lab members during the experiment are examples of sources of error that may be encountered.

8. Much of the behaviors exhibited in this activity were based on visual information gained by the fish. Use additional resources to identify two other factors that may influence schooling behaviors in fish.

Olfaction, chemical stimuli, and presence of predators are examples of factors that will affect schooling behaviors in fish.