

It's Cold Outside: Exploring the Effects of Temperature on GloFish® Activity

Objective

The learner will determine how a low temperature will affect the behavior of a GloFish® fluorescent fish.

The learner will design tables for data collection and prepare a graph of collected data.

National Standards Addressed

Science as Inquiry A—Abilities necessary to do scientific inquiry

Life Science B— regulation and behavior

Introduction

GloFish fluorescent fish are ectothermic organisms. The body temperature of an ectotherm is determined by the environmental temperature. This impacts the range of habitats in which ectotherms can live. GloFish are zebrafish which have been genetically modified, and therefore the environmental temperature range for GloFish should be very similar to that of wild-type zebrafish (also known as zebra danios). Because zebrafish are found in the wild only in tropical climates, scientists have concluded that they are unable to survive in waterways in North America. In this activity, you will measure the impact of temperature on the activity level of GloFish and then compare the results to wild-type zebra danios or another species of freshwater fish.

Special Note: The protocol in this lab has been tested to ensure that it will not harm the fish. It is very important that the protocol be carefully followed.

Materials Needed

Clear plastic cup or clean 250 mL beaker

De-chlorinated (treated) aquarium water (about room temperature $\approx 25^{\circ}\text{C}$)

De-chlorinated (treated) warm water (about 45°C)

Ice

Clock with second hand or stopwatch

Dip net

GloFish®

Zebra danio

Comet or a similar freshwater aquarium fish

Clean thermometer

Graduated cylinder

Permanent marker

Sheet of graph paper

Time Required

55 minutes

Procedures

Part A: Measuring Activity Levels in GloFish®

1. Read through all the procedures.
2. Design a data table under the data section to include temperature and number of crossings. You will also need to include space for the class mean (average) for each trial.
3. Use the marker to draw a vertical line about one centimeter in length on the side of the cup. This will serve as a reference point for observing the behavior of the fish.
4. Place about 150 mL of room temperature aquarium water in into the cup.
5. Carefully remove a GloFish from the aquarium with the dip net and place the fish in the cup.
6. Position a thermometer into the cup so it can be read without disturbing the fish.
7. Wait 30 seconds and record the temperature of the water.
8. As a team member begins the timer, other team members begin to count the number of times the fish crosses the line on the cup as it swims around (or back and forth) for one minute.
9. Record the number of crossings in your data table.
10. Gently place an ice cube in the cup with the fish. Remove the ice when the temperature drops 3°. Record the temperature in the data table and wait 30 seconds.
11. Again count the number of times the fish crosses the mark in one minute.
12. Place another ice cube in the cup with the fish. Remove the ice when the temperature drops another 3°C. Record the temperature in the data table and wait 30 seconds.
13. Again count the number of times the fish crosses the mark in one minute.
14. Repeat this process until the water temperature is around 15°C.
15. Obtain 10 mL de-chlorinated warm water. *Slowly* pour the warm water down the inside wall of the cup. Wait about one minute.

16. Keep adding 10 mL amounts of warm water to the cup until the temperature rises in 3° intervals back to the beginning temperature. Wait one minute in between adding the warm water amounts. Pay close attention to temperature. Sudden changes in water temperature could be fatal to the fish.
17. Pour off excess water in the cup if needed.
18. Post the results of all your trials on the board. Compute the class mean for each trial and record that in your data table.

Part B: Measuring Activity Levels in Zebra Danios and Comet

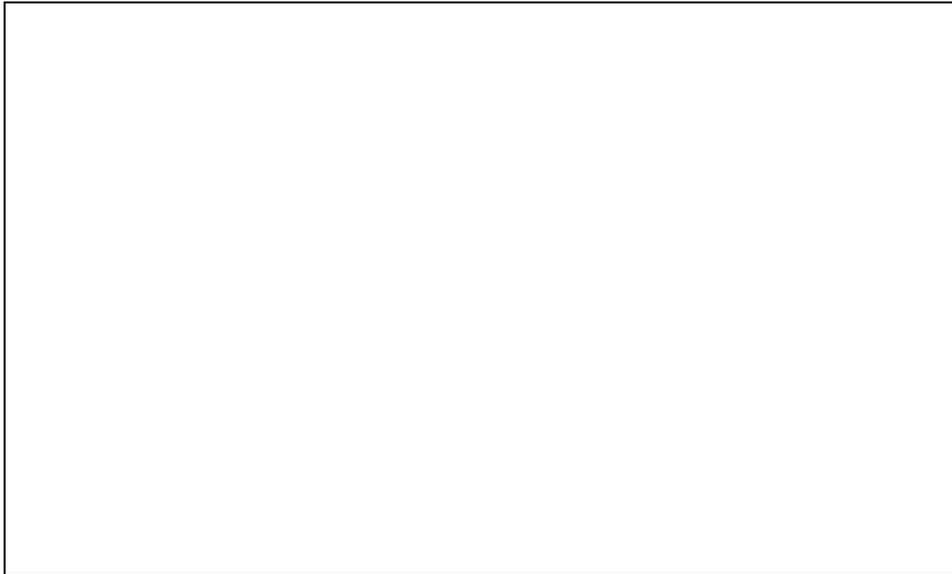
1. In this part of the activity, you will be collecting data on the activity levels of zebra danios and Comets. Work with your lab to design a data table that could be used to collect this type of data. Remember to label the rows and columns. Include an appropriate title for your data table. Draw your table in the space provided for Table 7.2.
2. Repeat steps 3 through 18 of Part A as you collect data on the zebra danio.
3. Repeat steps 3 through 18 of Part A as you collect data on the Comet.
4. Obtain a sheet of graph paper. Prepare a labeled graph of the class data for all three types of fish.

Data

Table 7.1



Table 7.2



Discussion Questions:

1. Describe how the colder temperature affected the activity level of the fish.
2. At which temperature did the fish show the greatest amount of activity?
3. Name another affect a low temperature would have on the body functions of a fish.
4. If tropical lakes in Central America have an average temperature of 27°C and lakes in North America have an average temperature of 15°C, in which lake would the fish most likely thrive?
5. Would GloFish or wild-type zebrafish be able to inhabit in the lakes and streams of North America? Explain your answer.
6. Describe how the activity level of the GloFish compares the activity levels of the zebra danio and Comet. Use data from your investigation in your description.

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Intended Grade Level

6th, 7th and 8th

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Safety Precautions

The protocol in this lab has been tested to ensure that it will not harm the fish. Students should receive clear, emphatic instructions regarding the importance of following the protocol that is provided.

The teacher should heat the water in one central location. Have only one student from each group obtain the warm water.

Students should thoroughly wash their hands after lab activities involving living organisms.

Teacher Information

Make sure you prepare extra de-chlorinated water at least a day in advance of this lab. Clear, plastic cocktail cups can be used in place of beakers. If using beakers, make sure they are very clean and the students can place a small piece of tape on the side of the beaker to mark on instead of marking on the beaker with a permanent marker.

To save time you may want to have some groups collect data on GloFish, while other groups collect data on zebra danios and others collect on Comets.

Elaborations or Extensions

Students may want to refer to online resources to find out more about the research that has been done on GloFish.

Students could design investigations to determine the impact of temperature on other ectothermic organisms such as brine shrimp, pill bugs, meal worms, etc.

Students could research adaptations that allow some ectothermic fish to survive in much colder environments.

Possible Answers to Discussion Questions

1. Describe how the colder temperature affected the activity level of the fish.
The amount of times the fish swam around the mark in the cup was lower, therefore, the activity level of the fish declined.

2. At which temperature did the fish show the greatest amount of activity?
The higher temperature
3. Name another effect a low temperature would have on the body functions of a fish.
Lower respiration rate, lower metabolism rate, etc.
4. If tropical lakes in Central America have an average temperature of 27°C and lakes in North America have an average temperature of 15°C, in which lake would the fish most likely thrive?
Central America
5. Would GloFish or wild-type zebrafish be able to inhabit in the lakes and streams of North America? Explain your answer.
No, lake and stream temperatures in North America would be too cold for them to be able to survive. This is the reason that zebrafish do not populate waterways in North America.
6. Describe how the activity level of the GloFish compares the activity levels of the zebra danio and Comet. Use data from your investigation in your description.
Zebra danio and GloFish data will be notably similar. The data collected on the third type of fish will vary with species. Comets are typically more cold tolerant than danios and GloFish.