

## Camouflage for Life: Measuring the Adaptive Value of Color

### Objective

The learner will determine the evolutionary advantage or disadvantage of GloFish® fluorescent fish colors in a simulated environment.

### Introduction

GloFish are genetically modified golden zebrafish. GloFish have their fluorescent colors because scientists removed fluorescence genes from sea coral and inserted them into golden zebrafish embryos. This gene became part of the developing fish's genetic makeup producing the fluorescent color. The scientists then bred the GloFish with a wild type golden colored zebrafish. The offspring of these fish all have the fluorescent colors.

Most organisms have characteristics that allow them to survive and flourish in their natural environments. Many organisms are camouflaged with specific coloration patterns that allow them to blend into their surroundings. For example, a grasshopper is green to better hide in grass and on trees. This helps them avoid being seen and eaten by predators.

Some people are concerned about the introduction of genetically modified GloFish into U.S. streams or lakes. Since these brightly colored fish do not occur naturally in any tropical fresh water biomes, do they have valid concerns?

### National Standards Addressed

Science as Inquiry A—Abilities necessary to do scientific inquiry

Life Science B—Populations and ecosystems

Life Science B—Diversity and adaptations on organisms

### Materials Per Group

One piece of fabric  
One plastic bag labeled "Lake Population"  
Timer or watch with a second hand  
Ruler  
Colored pencils

### Materials Per Classroom

GloFish® in an aquarium  
Computer with Internet access (or fishing magazines or *National Geographic* magazines)

## Procedures

### Part A: Research Fish Color Patterns

1. Use the Internet or other sources to find at least 5 pictures of freshwater lake and stream fish in their natural habitats.
2. Print these pictures (or cut them out of magazines) and place them in the data section of the lab under the title Freshwater Fish and Their Environments.
3. Use your resources again to find at least 5 pictures of brightly colored marine fish in their natural habitats.
4. Print these pictures (or cut them out of magazines) and place them in the data section of the lab under the title Marine Fish and Their Environments.
5. Look carefully at their surroundings and note the differences where fish make their homes.

### Part B: Simulation

6. Working in groups of 3 spread out the piece of fabric. The fabric represents a model of the lake environment.
7. Choose a person to keep time in your group. This person will be responsible for spreading out the dots from the Lake Population bag on the fabric while the other members are not looking. The other two members will act as predatory fish.
8. The predatory fish will turn their backs while the timer spreads the dots across the fabric. (There should be 15 of each color of the dots in the bag for a total of 60 dots in the Lake Population bag.)
9. When the timer says “go”, the other two students (predatory fish) will turn around and pick up as many dots as they can (one dot at a time) in 5 seconds.
10. The dots that are picked up are laid to the side, not to be used again. These dots represent the fish that were easily seen and eaten.
11. Collect the remaining dots on the fabric and separate them into groups by color.
12. Count the dots in each group and record that number in your data table. These dots represent the fish that survived the feeding.
13. The timer will then spread the counted dots across the fabric while the other two students (predatory fish) turn their backs.
14. Repeat this feeding, counting, and recording dots process one more time.
15. Illustrate the data in the table on a bar graph.

### Data - Part A

Freshwater Fish and Their Environment	Marine Fish and Their Environment

### Data - PART B

In the space below, create a data table that includes the beginning lake population, remaining fish after 1<sup>st</sup> feeding, remaining fish after 2<sup>nd</sup> feeding, and remaining fish after 3<sup>rd</sup> feeding and color groups. Under the table, construct a graph that illustrates your data.

### **Discussion Questions:**

1. Explain why most freshwater fish have dull coloration.
2. Why do you think the ocean fish have bright color patterns?
3. Do GloFish<sup>®</sup> have the usual coloration of a freshwater fish?
4. What happened to the number of colored fish as the larger fish fed?
5. Explain why this occurred.
6. Why did the green fish have an advantage over the GloFish?
7. In the space below, use the colored pencils to draw the environment that would be needed by GloFish if they were to survive and flourish in a freshwater habitat.
8. Do you think GloFish would have a high rate of survival if they were released in natural freshwater habitats? Explain your answer.

### **Elaborations or Extensions**

Students could write research papers on other types of adaptations fish have in order to survive in their environments. Examples – counter shading, unique body shapes, mimicry, etc.

# Camouflage for Life: Measuring the Adaptive Value of Color Answer Sheet

**Intended Grade Level**

6th, 7th, 8th

**Teacher Information**

Buy one or two yards of muted, gold/ green fabric. Purchase paper that closely matches the color of the fabric. If you cannot find paper to match the fabric you may need to color a sheet of paper. Then take a hole punch to punch out the dots of all the colored paper to place in the Lake Population bags.

**Materials Per Group - Part B**

One piece of dull greenish, gold fabric per group (fabric squares cut 60 cm X 60 cm)

Hole punch

Colored paper or card stock – bright red, bright orange, bright green and dull golden green

15 dots of each color – bright red, bright orange, bright green and dull golden green

One plastic bag per group labeled “Lake Population” – each bag should have 15 of each color dots

Timer or watch with a second hand per group

Ruler – one per person

Colored pencils – one box per group

**Data - Part B**

*The data table may look like this:*

	Bright Red	Bright Orange	Bright Green	Golden/Green
Number in Beginning Lake Population	15	15	15	15
Number after 1 <sup>st</sup> Feeding	12	10	11	14
Number after 2 <sup>nd</sup> Feeding	9	8	8	12
Number after 3 <sup>rd</sup> Feeding	6	2	3	11

## Discussion Questions and Possible Answers - Part A

1. Explain why most freshwater fish have dull coloration.

*The water in most freshwater lakes is murky and greenish, brown color so the fish need to blend into that environment so they won't be seen as easily by predators. The bottoms of streams are usually filled with rocks that are a dull brown color. So stream fish would also need to blend in with their surroundings.*

2. Why do you think the marine fish have bright color patterns?

*The marine fish that live around coral reefs must blend in with the brightly colored coral reefs so they won't be seen as easily by predators.*

3. Do GloFish® have the usual coloration of a freshwater fish?

*No, they are much brighter.*

4. What happened to the number of colored fish as the larger fish fed?

*The numbers decreased*

5. Explain why this occurred.

*It is easier to see the brightly colored fish and pick them.*

6. Why did the goldfish, green fish have an advantage over the GloFish?

*It was more difficult to see them; they were camouflaged; they blended into their surroundings*

7. In the space below, use the colored pencils to draw the environment that would be needed by GloFish if they were to survive and flourish in a freshwater habitat.

*Students should draw bright red, bright yellow and bright orange rocky structures for the fish to hide in.*

8. Do you think GloFish would have a high rate of survival if they were released in natural freshwater habitats? Explain your answer.

*No. The GloFish will be more easily seen by predators and therefore more easily eaten.*