Icefish Blood Adaptations: Viscosity

hhmi | BioInteractive

Activity
Student Handout

INTRODUCTION

Most animals could not survive in the ocean around Antarctica. The average temperature of the water there is only –1.8°C (28.8°F). At such low temperatures, you would expect the blood of most fish to freeze or be too sluggish to flow throughout the body. However, certain fish called notothenioids thrive in Antarctic waters. How do they do it?

In this hands-on lab activity, you will model the blood of a special notothenioid called the icefish. You will then explore the blood's properties to understand one of the ways in which icefish have adapted to the harsh Antarctic environment.

MATERIALS

- cups of solution A and B
- two 60-mL syringes (without needles)
- felt-tipped marker
- *The Making of the Fittest: The Birth and Death of Genes* video

PROCEDURE

In this lab, you'll test two mystery solutions, A and B. One solution models the blood of a "normal" fish. The other solution models the blood of an icefish.

1. Get cups of solutions A and B from your teacher.
2. Using your marker, label one syringe "A" and the other syringe "B."
3. Fill syringe A with 40 mL of solution A, and syringe B with 40 mL of solution B.
4. Pick up one syringe in each hand. Hold syringe A over the cup for solution A, and syringe B over the cup for solution B.
5. Push both syringes at the same time, with the same force, until they are both empty. Observe how each solution responds to being pushed.
6. Repeat steps 3 through 5 until everybody in your group has had a turn.

QUESTIONS

1. Describe how solutions A and B responded to being pushed. Was it easier or faster to push one solution than the other?

2. Solutions A and B differed in a property called viscosity.
   a. Define "viscosity" in your own words.

   b. Which solution, A or B, had a higher viscosity?

c. Remember that solutions A and B model different types of blood. Would the blood modeled by solution A or B be easier to pump through the body? Support your answer with evidence from your observations.

d. Make a guess about how blood viscosity is related to the ability to survive at very low temperatures.

3. To learn more about icefish blood, watch the BioInteractive short film *The Making of the Fittest: The Birth and Death of Genes*. As you watch, pay attention to any mentions of adaptations involving blood viscosity. Use what you learn from the film to answer the questions below.
   a. How do red blood cells affect the viscosity of blood at cold temperatures?

   b. Which would have a higher viscosity at cold temperatures, icefish blood or “normal” fish blood? Why?

   c. Make a claim about which solution, A or B, modeled blood from an icefish, and which modeled blood from a “normal” fish. Use the properties of the solutions and information from the film to provide evidence and reasoning for your claim.

   d. Explain how an icefish’s blood viscosity is an adaptation to the Antarctic environment.

   e. Do you think this trait would be advantageous in a warmer environment? Justify your answer.

4. “Normal” fish blood contains hemoglobin, but icefish blood does not.
   a. What is hemoglobin, and what is its function in the body?

   b. According to the film, how do icefish survive without hemoglobin?

   c. Icefish have other adaptations that were not mentioned in the film, including a large heart and wide blood vessels. Explain how these adaptations might help an icefish survive without hemoglobin.

   d. Think about the model with solutions A and B that you tested earlier. Propose two modifications to this model to simulate the adaptations from 4c.