

How do PINNIPEDS stay warm?

TEACHER



Activity Overview

Pinnipeds and other animals that live in cold regions have adapted to the extreme weather conditions by developing layers of insulation materials. For example, pinnipeds use blubber, birds use feathers, and sheep use wool.

In this activity, students will perform an experiment to explore how different types of insulation materials work. Students will make mitts from plastic bags filled with shortening (simulating blubber), feathers, and wool. Students will also make a mitt filled with air. Students will observe the effects of different insulation materials by placing their hands in the mitts and then putting them into ice water.

After making their initial observations, students will measure and graph the temperature changes in each mitt using a Temperature Sensor connected to a TI CBL 2™ or Vernier LabPro and a TI-73 Explorer™. Students will then compare the measured changes with the differences in temperature they were able to feel with their hands inside the mitt.

Conclusions: Blubber is a type of insulation material that allows pinnipeds to live in cold water. Blubber is a more efficient insulating material than feathers, wool, and air.

Activity at a Glance

Grade: 5-9
Subject: Science
Category: Physical Science, Life Science
Topic: Heat, Physical Properties, Animals, Living Things, Adaptation

Time Required

- One 45-minute period

Level of Complexity

- Medium

Materials*

- TI-73 Explorer™
- TI CBL 2™ or Vernier LabPro
- TI-73 DataMate
- 2 Temperature Sensors
- 4 1-quart Ziploc® bags
- Vegetable Shortening, Wool Yarn and Feathers
- Plastic tub (about 30 cm X 60 cm)
- Ice cubes
- Cold tap water
- Stopwatch



TI-73 Explorer™



Temperature Sensor

* This activity has been written for the TI-73 Explorer™ but you can easily substitute the TI-83 or TI-83 Plus. Also see Appendix A for steps on how to transfer DataMate to your graphing device and how to use DataMate for data collection.



How do PINNIPEDS stay warm?

Concept Background

- A pinniped's body, except for its flippers and head, is enveloped in a thick layer of blubber. For a large male elephant seal, that blubber could be a third of their weight — well over 450 kilograms (1000 pounds)!
- Blubber is less dense than muscle or other body tissue, which helps keep pinnipeds buoyant in the sea. Blubber floats.
- Blubber is a very efficient type of insulation material. It doesn't allow heat to pass through easily.
- Pinnipeds were hunted almost to extinction, in part for their blubber that was turned into oil. Populations have been increasing steadily since the Marine Mammal Protection Act was passed in 1972.
- Feathers and fur trap a layer of air that helps to insulate animals (similar to foam insulation).

Preparation and Classroom Management Tips

- Distribute the shortening, feathers, and wool evenly between the inner and outer bags.
- It is important that students try to eliminate as much air from between the inner and outer bags as possible when making the wool, yarn, and blubber mitts.
- Students may enjoy preparing the mitts themselves.
- Caution students not to puncture the mitts with the temperature probes.
- Caution students to keep the temperature probe in the center of the shortening mitt.
- This activity uses models to simulate how animals use insulation materials to keep warm. Discuss with students how scientists often use models in research where measurements are difficult or dangerous.
- The activity was written so the experiment could be conducted using two temperature probes and either a TI CBL2™ or Vernier LabPro. However, the activity can be done a variety of ways. Using the CBL2, students can collect data using 1 to 3 sensors at a time. Using the LabPro, students can collect data using 1 to 4 sensors at a time.
- This activity works well with students working in groups, or as a demonstration.
- The activities *How Does Blubber Work?*, *Can You Breathe Like a Pinniped?*, and *Pinniped Body Shape – Does It Conserve Warmth?*, explore pinniped adaptations. These activities can be set up as stations in your classroom simultaneously. Have students rotate between stations to complete each activity.
- Encourage students to answer the questions in Data Analysis in their journal.
- Create your own student questions for use on your students' TI graphing devices using the Texas Instruments StudyCard applications.

TEACHER

National Education Standards

Science Standard A: Science As Inquiry

Students should understand scientific inquiry and develop abilities necessary to perform it.

Science Standard C: Life Science

Students should develop an understanding about the structure and function of living systems, reproduction and heredity, regulation and behavior, populations and ecosystems, and the diversity and adaptations of organisms.

Math Standard: Data Analysis & Probability

Students should develop an understanding about how to collect, organize, display, and interpret data.

English Language Arts Standard 3

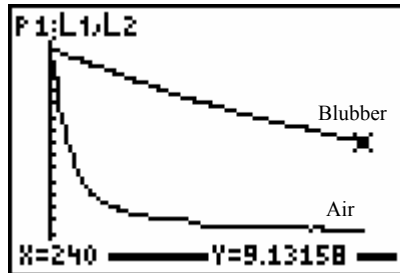
Students should apply strategy to comprehend, interpret, evaluate, and appreciate text.



How do PINNIPEDS stay warm?

Part B. Measuring Temperature in the Blubber and Air Mitts.

Data Analysis



Sample graph

- 1 Q. Draw a sketch of the graph created by your graphing device. Label *Blubber* the curve that represents the temperature for the blubber mitt. Label *Air* the curve that represents the temperature for the air mitt. . (Note: *P1* represents the sensor connected to CH1 and *P2* represents the sensor connected to CH2).
 - A. *Answers will vary. The students should sketch a graph similar to the sample graph above.*
- 2 Q. By observing your graph how does the temperature in the blubber mitt change during the four-minute period?
 - A. *The temperature in the blubber mitt decreases slightly. It decreases slower than the temperature in the air mitt.*
- 3 Q. By observing your graph how does the temperature in the air mitt change during the four-minute period?
 - A. *The temperature in the air mitt decreases significantly. The decrease in temperature in the air mitt is greater than the decrease in temperature in the Blubber mitt.*
- 4 Q. Copy Table 1 into your journal.
- 5 Q. Record the temperature of the blubber and air mitt at the beginning of the experiment in Column A of the table (x = 0 seconds).
 - A. *Answers will vary.*
- 6 Q. Record the temperature of the blubber and air mitt at the end of the experiment in Column B of the table(x = 240 seconds).
 - A. *Answers will vary.*
- 7 Q. How does your data compare to which hand felt colder when you first made observations with the mitts in your hands?
 - A. *The air mitt felt colder during the initial observations with hands. The data shows the air mitt cooling to a lower temperature.*

TEACHER

Vocabulary

Adaptation A physical feature or ability, developed over many generations, that helps a species survive in its environment.

Carnivore A flesh-eating animal.

Double migration Two annual round trips made by the northern elephant seal between its feeding grounds in the north Pacific and the Channel Islands.

Insulation material Materials which don't let heat pass through easily.

Molt To shed the skin, fur, or feathers periodically. Northern elephant seals are said to do "radical molting" because their skin comes off in sheets.

Otariid Any of approximately 14 species of pinnipeds, including the California sea lion, that have outer ear flaps and hind flippers that can be rotated underneath the body.

Phocid Any of approximately 19 species of pinnipeds known as "true seals," including the northern elephant seal. Phocids do not have extended earflaps. They do not use their flippers for moving on land. Instead they wriggle from side to side or hunch their bodies like caterpillars.

Pinniped A walrus, sea lion, or seal.

Taxonomy The science of classification and categorization of living things. Linnean taxonomy categorizes all plants and animals into the following seven subgroupings, each more specific than the one before: kingdom, phylum, class, order, family, genus, species.

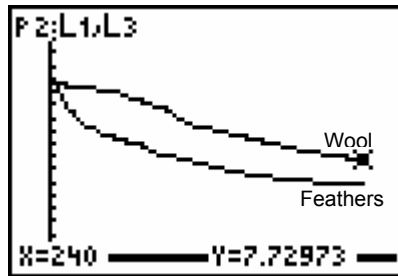


How do PINNIPEDS stay warm?

TEACHER

Part C. Measuring Temperature in the Feather and Wool Mitts.

Data Analysis



Sample graph

- 1** Q. Draw a sketch of the graph created by your graphing device. Label *Feather* the curve that represents the temperature for the feather mitt. Label *Wool* the curve that represents the temperature for the wool mitt. . (Note: *P1* represents the sensor connected to CH1 and *P2* represents the sensor connected to CH2).
A. *Answers will vary. The students should sketch a graph similar to the sample graph above.*
- 2** Q. By observing your graph how does the temperature in the feather mitt change during the four-minute period?
A. *The temperature in the feather mitt decreases slightly.*
- 3** Q. By observing your graph how does the temperature in the wool mitt change during the four-minute period?
A. *The temperature in the wool mitt decreases slightly.*
- 4** Q. Record the temperature of the feather and wool mitt at the beginning of the experiment in Column A of Table 1(x = 0 seconds).
A. *Answers will vary.*
- 5** Q. Record the temperature of the feather and wool mitt at the end of the experiment in Column B of Table 1(x = 240 seconds).
A. *Answers will vary.*
- 6** Q. Find the change in temperature by subtracting Column B from Column A (A-B). Record the change in temperature fore each mitt (blubber, skin, feather, and wool) in Table 1.
A. *Answers will vary.*
- 7** Q. Using Table 1, which mitt had the greatest change in temperature?
A. *The air mitt.*
- 8** Q. Using Table 1, which mitt had the smallest change in temperature?
A. *The blubber mitt.*



How do PINNIPEDS stay warm?

TEACHER

- 9** Q. Based on your data, which insulating material worked the best? Explain.
- A. *The temperature in the blubber mitt changed the least. This means that shortening is a poor conductor of heat, which makes it a good insulator.*
- Although air is a good insulator, too, it does not work as well as shortening, feathers, or wool.*
- 10** Q. Based on your data, and on information from the Research Article, describe how pinnipeds are adapted to living in cold water.
- A. *A pinniped's body is enveloped in a thick layer of blubber. Like shortening, blubber is a poor conductor of heat, which makes it a good insulator. Blubber keeps a pinniped's body heat from escaping.*

