Cetaceans 4 Grade Curriculum—Lesson 9: How Do Whales Stay Warm?[1]

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Description

Students will investigate the roles that blubber, body shape, and body size play in preventing heat loss in marine mammals.

Objectives

By the conclusion of the activities, students will be able to:

- Explain that blubber helps keep whales warm, even in icy water
- Explain how shape and size affect a whale's ability to stay warm

What You Will Need

For blubber glove:

- Two 1-gallon zipper-seal bags
- One large container of shortening
- Duct tape
- Small bucket or dishpan
- Ice
- Water

For oatmeal labs:

- Three cups of cooked oatmeal per group of four to five students
- Measuring cups (1/2 cup and 1 cup)
- One or two spoons
- Wax paper (four square sheets per group)
- Thermometers (two per group)
- Instruction and data sheets (pages 9-5 to 9-9)—one of each per group
- Pieces of masking tape (about 6 inches long)—four per group
- Paper towels
- Copies of activity page (page 9-10)—one per student
- Stopwatches or timers (one per group)
- Slow cooker
- Rulers

Standards

Florida Sunshine State Standards

Mathematics

- **MA.4.NSO.2.7** Explore the addition and subtraction of multi-digit numbers with decimals to the hundredths.

Science

- **SC.4.L.16.2** Explain that although characteristics of plants and animals are inherited, some characteristics can be affected by the environment.
- **SC.4.P.11.1** Recognize that heat flows from a hot object to a cold object and that heat flow may cause materials to change temperature.

Common Core Standards

Mathematics

- **4.MD.A.2** Use the four operations to solve word problems involving distances, intervals of time, liquid volumes, masses of objects, and money, including problems involving simple fractions or decimals, and problems that require expressing measurements given in a larger unit in terms of a smaller unit.

Note: The blubber glove activity in this lesson is also an optional activity in the 3rd grade manatee curriculum designed by the same authors. If a school is using both curricula, 4th grade students may already be familiar with the blubber glove.

Vocabulary: hypothermia, blubber

Strategy

Ahead of time (can be done days or weeks in advance):

1. Make a blubber glove. To do this, take two 1-gallon plastic bags. Fill one bag until it is about half full with shortening. Try to keep all of the shortening at the bottom of the bag. Put the second gallon bag inside the first bag, so the shortening is sandwiched between

the two bags. Be careful not to push shortening out of the top of the bags! Use duct tape to seal the openings of the two bags together. DO NOT seal the two sides of the inside bag together.

The photo below shows a completed blubber glove. The two plastic bags are attached at the top with duct tape, and the shortening is sealed within.



Figure 1. Completed blubber glove.
Credit: Maia McGuire, UF/IFAS

Immediately before class:

2. Put water into a bucket, dishpan, or similar container. The water should be at least 3 inches deep. Do not fill the container too much or water will spill over during the activity.
3. Cook oatmeal (three cups per group). Keep it warm in a slow cooker set on low. It should be fairly thick.

During class:

4. Ask the students how they stay warm when it is cold. [*Answers might include wearing a jacket, hat, or gloves, staying inside with the heater on, drinking hot chocolate, etc.*] Ask if whales can use any of these same strategies. [*No.*] So how do whales stay warm? [*Some students may know about blubber, which is one correct answer.*] Explain to students that today's lesson will investigate how whales manage to stay warm even if they live in very cold water.
5. Ask the students if any of them have ever felt cold when they were swimming, even on a warm day. Explain that human body temperature is about 98.6°F or 37°C. This is similar to the body temperature of whales and dolphins. If the water temperature is lower than a person's body temperature, the person's body heat will be drawn into the water to try to balance the temperature between the water and the person's body. This heat transfer is about 25 times faster in water than in air, so people will get hypothermia faster in cold water than in cold air. Hypothermia occurs when a person's body temperature falls below 95°F. It makes the body's organs incapable of working properly and can result in death.
6. So, a warm-blooded animal that lives its entire life in water needs to be able to prevent heat loss. Tell the students that they will get to see how blubber helps to keep the whale from losing body heat. Add ice to one of the two containers of water.
7. Place the bottom of the blubber glove into the ice water. Invite a student to put one hand inside the blubber glove. Ask them to put their other hand into the ice water without the blubber glove. Let each student try this. You may need to redistribute the shortening so there is an even layer between the bags. Once every student has tried the blubber glove, ask the class what the blubber glove did. Explain to the class that blubber helps whales to live in cold water.
8. Tell the students that whales' body shape also helps keep them warm.
9. Explain that the class is going to do experiments to look at how body size (Lab #1) and shape (Lab #2) can affect heat loss. These two experiments combined take about 45 minutes of class time. If time is limited, you may have half of the class do the first experiment and the other half do the second experiment. Both groups would then need to pool their data. The activity sheet on page 8 can help keep students busy when they are not actively conducting an experiment.
10. Divide the class into groups of four to five students.
11. Give each group two thermometers, a stopwatch, instruction sheets, two data sheets, and two pieces of wax paper.
12. Assign students roles (two are temperature readers, one is timekeeper, and one or two are data recorders). Ask the students to record the room temperature on the data sheets.
13. Explain that you will be giving each group two portions of oatmeal for Lab #1.
14. Instruct students to use the wax paper to make one oatmeal portion into a ball and the other portion into a half-inch-thick flattened disk. Have them use rulers so they know whether the disk is the right size. Explain that they will need to do this quickly. Show them how to stick the tip of a thermometer into each of the oatmeal shapes and record the temperatures. The thermometer should be inserted into the center of the oatmeal shape. Explain that they will keep the thermometer in place and read the temperature every minute. It will be easiest if the students use masking tape to hold the wax paper and thermometer in place. The timekeeper will call out each minute, the temperature readers will read off the temperature, and the data recorders will record the temperatures on the data sheet.
15. Ask each group to complete the hypothesis on their data sheets (fill in the blank with "round" or "flat").
16. Give each group ½ cup of oatmeal on each of their sheets of wax paper, and tell them to begin. Each group should start as soon as they get their oatmeal.
17. Once both of the lumps of oatmeal have cooled to room temperature (or after 15 minutes, whichever

comes first), have the students remove the thermometers and set them aside. They should throw their wax paper and oatmeal in the trash.

18. When all groups have completed the first oatmeal experiment, discuss the results. Which oatmeal shape cooled the fastest? See if the students can explain why the flatter shape cooled more quickly. Remind them that both shapes cooled because the heat from the oatmeal flowed into the air to try to equal out the temperatures between the air and the oatmeal. The flatter shape cooled faster because the heat had a shorter distance to travel to get from the middle of the oatmeal to the air.
19. Explain Lab #2. In this experiment, the students will get two oatmeal portions of different sizes. They will shape both into balls, using the wax paper as before. They will record the temperatures in the center of the oatmeal over time. Reassign student roles if desired.
20. Ask the students to form a hypothesis for this experiment (the hypothesis should answer this question: which ball, the small one or the large one, will cool the fastest?).
21. Each group of students will need two new pieces of wax paper and two data sheets. Give each group of students a ½-cup portion of oatmeal on one piece of wax paper and a 1-cup portion on the other. Have them begin the experiment. Note that they will record the temperatures every five minutes for this experiment. If possible, have the timekeeper use the countdown feature of the stopwatch as an "alarm" every five minutes.
22. After 30 minutes, have the students remove the thermometers, wipe them with a damp paper towel, and set them aside. They should throw their wax paper and oatmeal in the trash.
23. When all groups have completed the second oatmeal experiment, discuss the results. Which oatmeal shape cooled the fastest? The smaller ball should have cooled the fastest, for the same reason as in the first experiment.
24. Ask the class to identify the best body size and shape for an animal that lives in very cold water (large and round—to reduce heat loss).

Student Instructions

Oatmeal Lab #1

1. Data recorder #1: Read the room temperature off one of the thermometers and record it on both data sheets.
2. Timekeeper: Use the wax paper to gather up one portion of oatmeal into a ball.
3. Data recorder #2: Use the wax paper to shape the other portion of oatmeal into a disk that is about 1/2 inch thick. Check the thickness of the oatmeal disk using a ruler.
4. Temperature reader #1: Place the tip of one thermometer into the middle of the oatmeal ball. Read the temperature. Use a piece of masking tape to gather the wax paper around the thermometer and hold it in place.
5. Data recorder #1: Write the temperature in the correct space on the data sheet.
6. Timekeeper: Start the stopwatch.
7. Temperature reader #2: Place the tip of the second thermometer into the middle of the oatmeal disk. Read the temperature. Use a piece of masking tape to gather the wax paper around the thermometer and hold it in place.
8. Data recorder #2: Write the temperature in the correct space on the data sheet.
9. Timekeeper: Call out each minute. Repeat steps 5, 8, and 9 until you have made observations for 15 minutes.
10. Wipe off the thermometers and set them aside. Throw your oatmeal and wax paper into the trash.

Data Sheet Oatmeal Lab 1

Hypothesis: We think that the _ (round or flat) oatmeal will cool the fastest.

The air temperature is _°F (_°C).

1. What was the total change in temperature for
a. The round ball of oatmeal?
b. The flattened disk of oatmeal?
2. Which one cooled the fastest (lost the most heat)—the round ball or the flat disk?

Oatmeal Lab #2

1. See your teacher for more wax paper and new data sheets.
2. Timekeeper: Use the wax paper to gather one portion of oatmeal into a ball.
3. Data recorder #1: Gather the other portion of oatmeal into a ball.
4. Temperature reader #1: Place the tip of one thermometer into the middle of the small oatmeal ball. Read off the temperature. Use a piece of tape to hold the thermometer and wax paper in place.
5. Data recorder #2: Write down the temperature in the correct space on the data sheet.
6. Timekeeper: Start the stopwatch.
7. Temperature reader #2: Place the tip of the second thermometer into the middle of the large oatmeal ball. Read off the temperature. Use a piece of tape to hold the thermometer and wax paper in place.
8. Data recorder #1: Write down the temperature in the correct space on the data sheet.
9. Timekeeper: Call out every five minutes. Repeat steps 5, 8, and 9 for a total of 30 minutes.

10. Wipe off the thermometers with a damp paper towel and set them aside. Throw your oatmeal and wax paper into the trash.

Data Sheet Oatmeal Lab 2

Hypothesis: We think that the _ (small or large) oatmeal will cool the fastest.

The air temperature is _°F (_°C)

1. What was the total change in temperature for
a. The small ball of oatmeal?
b. The large ball of oatmeal?
2. Which one cooled the fastest (lost the most heat)—the small ball or the large ball?

Activity Sheet

Did you know a bowhead whale's blubber can be 17 to 19 inches thick? One inch = 2.5 centimeters. How thick is a bowhead whale's blubber in centimeters?

How many new words can you make from the letters in BOWHEAD WHALE? Try to come up with at least as many words as there are numbered spaces in the table. You can write down more words if you think of any!

Answers for Activity Sheet

A bowhead whale's blubber is 42.5 to 47.5 cm thick.

Suggested words from BOWHEAD WHALE. Note that this is not an exhaustive list of words.

Reference

Experiments modified from "Cool Shapes" activity by SeaWorld—*Arctic Animals 4–8 Teacher's Guide.*

Table 1.

Time	Temperature of Round Ball of Oatmeal	Temperature of Flattened Disk of Oatmeal
Initial reading		
1 minute		
2 minutes		
3 minutes		
4 minutes		
5 minutes		
6 minutes		
7 minutes		
8 minutes		
9 minutes		
10 minutes		
11 minutes		
12 minutes		
13 minutes		
14 minutes		
15 minutes		

Table 1.

Time	Temperature of Round Ball of Oatmeal	Temperature of Flattened Disk of Oatmeal
Initial reading		
1 minute		
2 minutes		
3 minutes		
4 minutes		
5 minutes		
6 minutes		
7 minutes		
8 minutes		
9 minutes		

Time	Temperature of Round Ball of Oatmeal	Temperature of Flattened Disk of Oatmeal
10 minutes		
11 minutes		
12 minutes		
13 minutes		
14 minutes		
15 minutes		

Table 3.

2-letter words	3-letter words	4-letter words	Words with more than 4 letters
1.	1.	1.	1.
2.	2.	2.	2.
3.	3.	3.	
	4.	4.	
	5.	5.	

Table 2.

Time	Temperature of Small Ball of Oatmeal	Temperature of Large Ball of Oatmeal
Initial reading		
5 minutes		
10 minutes		
15 minutes		
20 minutes		
25 minutes		
30 minutes		

Table 4.

2-letter words	3-letter words	4-letter words	Words with more than 4 letters
Ah	Aha	Awed	Abode
Be	Ale	Bawl	Adobe
Do	Awe	Bead	Bowed
He	Awl	Bowl	Bowled
La	Bad	Dale	Hawed
Ow	Bed	Deal	Healed
We	Bee	Hale	Hewed
	Bow	Head	Howled
	Dab	Heal	Wheel
	Dew	Heed	Wowed
	Doe	Heel	
	Eel	Howl	
	Had	Lead	
	Haw	Owed	
	Hew	Wade	
	How	Weed	
	Law	Weld	
	Led		
	Lee		
	Low		
	Ode		
	Owe		
	Owl		
	Web		
	Who		
	Wow		

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