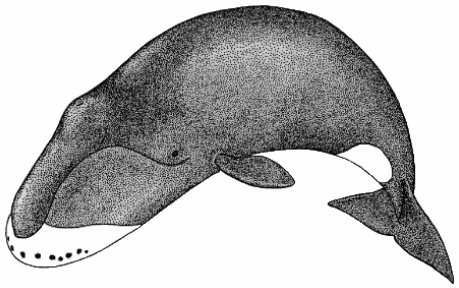


Whales and Sea Ice: Investigating Insulation

Grade levels: 3-6

Unit Objectives:

- Students will learn about the properties of insulation.
- Students will learn to read a thermometer and understand how insulation works in relation to whales.
- Students will gain research skills while learning about whales.
- Students will increase their understanding about the insulating properties of sea ice and what happens to the atmosphere when there are changes in the sea ice.

Important points to understand:

- Did you know that our climate is changing? How will climate change affect the Arctic? Many people want to know and are doing research to find out. Scientists say that climate change will affect the Arctic more than other places in the world!
- In the last 10-15 years, weather patterns have been changing in the Arctic region.
- Animals that live much of their lives around the sea ice, such as the bowhead whale, may be affected by changes in Arctic weather, sea-surface temperatures, or amount of sea ice.
- Arctic cod are an important source of food for seals and whales. Cod gather underneath sea ice and feed on tiny marine animals called zooplankton.
- The zooplankton live off of algae that grow on the underside of the ice.
- Bowhead whales feed on the zooplankton, using sieve-like baleen in their mouths to filter enormous mouthfuls of the tiny crustaceans.
- Without sea ice, the whales will have less zooplankton to eat.
- In the Arctic, sea ice helps to keep the ocean warm and the atmosphere cold.
- Sea ice acts like an insulating blanket during the winter and prevents the loss of heat from the relatively warm ocean to the much colder atmosphere. When sea ice melts, leads and openings occur in the sea ice, and in the Arctic winter, ocean heat flows into the atmosphere.

Day One

A. Introduction

Objectives:

- To provide background information to students for a unit study on whales.
- To increase students critical thinking skills.

Materials:

- Books or internet research on Bowhead whales, including pictures
- White paper and crayons for each student

Procedure:

1. The teacher will read aloud to students some important points about bowhead whales, as well other stories and facts about whales. This website is a good start. http://www.EnchantedLearning.com/subjects/whales/species/Bowheadwhale.shtm
2. Have each student ask at least one question based on the information presented and state one thing they want to learn in this unit.
3. Have students draw their own picture of a bowhead whale based on the information given.

B. Blubber insulation activity

(*Note to teachers- don't tell your students the name of this experiment at first so that they can guess what the lard is representing)*

Objective:

- Students will learn about the insulating properties of blubber.

Background Information

- About 50 million years ago, the ancestors of whales changed from living on land to living in the water.
- Whales had to develop several special features to adapt to life in the water.
- One of these evolutionary adaptations is blubber.
- Blubber is the thick layer of fat that insulates a whale's body in cold water.
- Blubber also helps whales by providing buoyancy and energy when food is scare.
- The bowhead whale has a layer of blubber which is up to 28 inches (70 cm) thick!

Materials for each group (or one group as a whole class, depending on how large the class is):

- 2 pairs of rubber gloves
- 1 bucket (filled with ice water)
- Thermometer
- Vegetable shortening
- Stop watch or watch with a second hand

Procedure:

1. Hold the thermometer in the bucket of ice water for one minute.
2. Record the temperature on the chart provided
3. Choose one student to be the test subject and have the student put a rubber glove on each hand.
4. On the right hand, spread a generous amount of shortening over the glove. Assist the student in putting the second pair of gloves on over the first.
5. Ask the student to put both of his/her hands into the bucket of ice water. Ask the student to remove each hand when the temperature becomes uncomfortable.
6. Choose another student to record the length of time each hand was able to stay in the ice water.
7. Repeat this test with other students. Make sure that the water temperature remains constant (use ice cubes).
8. Find the AVERAGE time in the water for each hand. To do this, add all of the times together and divide that number by the number of students tested.

Temperature: ____ °	**Student 1**		**Student 2**		**Student 3**	
Time in water	Glove	Glove with blubber	Glove	Glove with Blubber	Glove	Glove with Blubber
	___seconds	___seconds	___seconds	___seconds	___seconds	___seconds

Average Time	Glove	Glove with Blubber
	___seconds	___seconds

Blubber insulation questions

1. Which hand was able to stay in the water longer?
2. Based on the experiment, how do you think a whale's layer of blubber protects it from the cold ocean temperatures?
3. Discuss the evolutionary hypothesis that whales' ancestors were once land animals.
4. Ask the students to think of other ways that whales' bodies may have changed to adapt to life in the ocean. (Hints: Look carefully at their body, at the nostrils/blowholes, limbs/flippers and hair loss).
5. If the temperature of the ocean water changed to be much warmer or much colder, how would that affect you if you were a whale?
6. Write a few paragraphs in your science journal from the perspective of a whale in the changing times of today. Think about the class discussion (weather, water temperature, food). Begin, if I were a whale today…
7. Have students proofread their stories for each other.

Day Two

Sea ice insulation activity

Objective:

- Students will learn about the insulating properties of sea ice.
- Students will learn what happens to the atmosphere when the sea ice is gone.

Background information

- Sea ice covers a vast area in the Arctic Ocean, about 7.5 to 15.0 million kilometers.
- Sea ice helps to insulate the cold Arctic atmosphere from the relatively warm ocean water and prevents warming of the atmosphere.
- Since the early 1970's satellites have observed a steady decline in the Arctic sea ice cover. The sea ice has been disappearing at a rate of 3% each decade.
- Changes in the climate around the world seem to be why there is less sea ice.
- As the sea ice disappears, this leaves openings in the Arctic Ocean. In the summer, any loss of ice cover means there is a greater absorption of sunlight, or solar radiation, at the ocean surface. This increases the air and ocean temperatures, which will then further reduce sea ice cover.
- This is known as the ***sea ice albedo-temperature positive feedback***. Small changes in sea ice can cause big changes in the polar climate, which affects the global climate!

Materials for each group:

- 2 Thermometers (digital work well)
- 2 Styrofoam cups
- Lid for one cup
- Boiling water

1. Take your two thermal cups and fill them ¾ full with boiling or almost boiling water (Teachers should handle the water so students don't hurt themselves). The water in these cups represents the ocean in the Arctic.
2. Place a thermometer in each of the cups and make a lid for one of the cups that can fit around the thermometer. (Make sure you make a lid out of material that provides insulation, such as Styrofoam.) The lid on the cup represents sea ice over the ocean.
3. Measure the temperature in each of your cups every 15 minutes for one hour.

Example data sheet:

Time:	9:00am	9:15am	9:30am	9:45am	10:00am	10:15am
Ocean with sea ice (cup w/ lid)	(temperature)					
Ocean with no sea ice (no lid)						

4. Create a graph with this data showing how the temperatures change over time. This is a great way to practice graphing and comparing numbers visually! See our lesson on "Learn How to Graph" at http://www.arm.gov/docs/education/lessons/gettingstarted/learn2graph.pdf.

5. Learn and memorize the meanings for at least four of the following words pertaining to sea ice in Inupiaq.

Iñupiaq Language Sea Ice Vocabulary:

Aluksraq: young ice punched by seals forming a seal blowhole.
Ataiq: to become loose, detached (used when pack ice breaks off from shore ice).
Atitu: for there to be a wide open lead in the ice
Aupkaq: to melt through leaving a hole (of ice in spring).
Imaiq: when the ice closes up so that there is no water, no leads.
Kisitchat: anchor fast ice; fast ice touching the ocean floor.
Maniit: to be rough, uneven, especially ice when there are ice piles.
Sarri: good, thick ice from the north (pack ice), floating pack ice (across from land locked ice).
Sikuaq: thin ice dangerous to walk on.
Sikuliaq: young ice formed around edge of old solid ice on open lead.

Sea ice insulation questions:

1. What did you observe happen to the temperature in each of your cups? Why did this happen?
2. Why did you put hot water into your two cups?
3. When the heat from the water or "ocean" shifted, where did it go? Did it go to the same place for both "oceans"?
4. How does sea ice keep the water warmer than the air throughout the winter?
5. What are three Inupiaq words for types of sea ice? Write down their meaning. Pick one of the three words and use it in a sentence.

Days Three – Five

Research and Writing activity

Objectives

- To introduce students to the process of conducting research
- To

Procedures:

1. Have each student use the Internet and library to find five interesting facts about a whales, such as what they eat, their weight, etc… These website are a great start!
http://www.EnchantedLearning.com/subjects/whales/allabout/
http://www.EnchantedLearning.com/subjects/whales/species/Bowheadwhale.shtm
2. Have students type their information on the computer.

3. Have students use the pictures they drew on day one as covers for their reports. The reports will include the information from previous days (charts, stories, etc…and the five new facts.
4. Students will present their reports to their own class and the grade level below them. Encourage the students to take their report home and show it to their family as well!

Other Related Classroom Activities:

Classes in communities on the North Slope of Alaska along the coast can invite a local elder to speak to the classroom about sea ice and whales. For example, elders can relate stories of traveling over the sea ice, speak of the marine mammals that live on the sea ice, tell about the different types of sea ice and traditional stories about whales. If this unit is done in October, it can be correlated with the fall whale hunt. Take a class trip out to see a whale brought in. Discuss whaling practices and whale biology and see it firsthand.

Performance Standards:

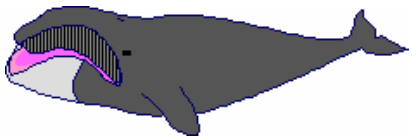
Grade 3

Language Arts: 1b, 2a, 2d, 3e, 4a, 5b, 5c, 5f, 5g
Math: 1a, 2b, 2c, 2d, 2e, 10, 11
Science: 1a, 1b, 1c, 2b, 2e, 4a, 4d, 4e, 4f, 4g

Grade 4

Language Arts: 1a, 1b, 1c, 1d, 2a, 2b, 2c, 2d, 3g, 4a, 5a, 5d, 5e, 5g, 7a, 7c
Math: 1a, 1b, 1c, 1d, 2a, 2b, 2c, 2d, 2e
Science: 1a, 1b, 1c, 1d, 2b, 2c, 2e, 3b, 3d, 3e, 5a, 6f

Grade 5
Grade 6



WORD HUNT

How many 2-, 3-, and 4-letter words can you make using the letters from the following word?

BOWHEAD WHALE

1.	11.
2.	12.
3.	13.
4.	14.
5.	15.
6.	16.
7.	17.
8.	18.
9.	19.
10.	20.