Fur vs. Blubber: Which is the better insulator for a marine mammal?
Advanced Lesson

For "warm-blooded" animals like mammals, maintaining body temperature is crucial for survival. This is especially challenging in the ocean, because seawater conducts heat 25 times faster than air – that means animals lose heat 25 times faster in water compared to air at the same temperature! Marine mammals use two different kinds of **insulation** to stay warm in the cold ocean: **fur** and **blubber**. Fur is the insulation used by land mammals, and is also used by polar bears, sea otters, and fur seals in the ocean. Other marine mammals, including manatees and dugongs, whales and dolphins, true seals, sea lions and walrus, use a thick blubber layer to insulate their bodies against the cold water.

The way fur works as an insulator is by **trapping air** among the hairs. It is not actually the fur that provides the insulation, but the trapped air layer that creates a barrier between the animal's skin and the surrounding environment. Sea otters and fur seals have a dense coat of fur, and they often blow air into that fur to trap a layer of air between their skin and the water. Their fur is so thick that no water can reach their skin. This way, their skin stays dry and warm.

Blubber is a continuous layer of **fat tissue**, and it is the fat itself that acts as an insulator. Animals like seals and dolphins have very thick layers of blubber to keep them warm in the coldest waters. Their blubber layers can be many inches thick!

So, which kind of insulation works better? Let's find out! For this activity, a water balloon full of hot water will represent the marine mammal.

Background Research: As a polar research scientist your mission is to investigate how polar animals maintain homeostasis of their body temperature. Focus your research on two animals of your choice; they may live in the Arctic or Antarctica. You must choose to research one animal that keeps warm with the aid of blubber and one animal that keeps warm with the aid of fur or feathers. Include in your explanation how the circulatory system works with blubber and fur/ feathers to help maintain homeostasis of body temperature.

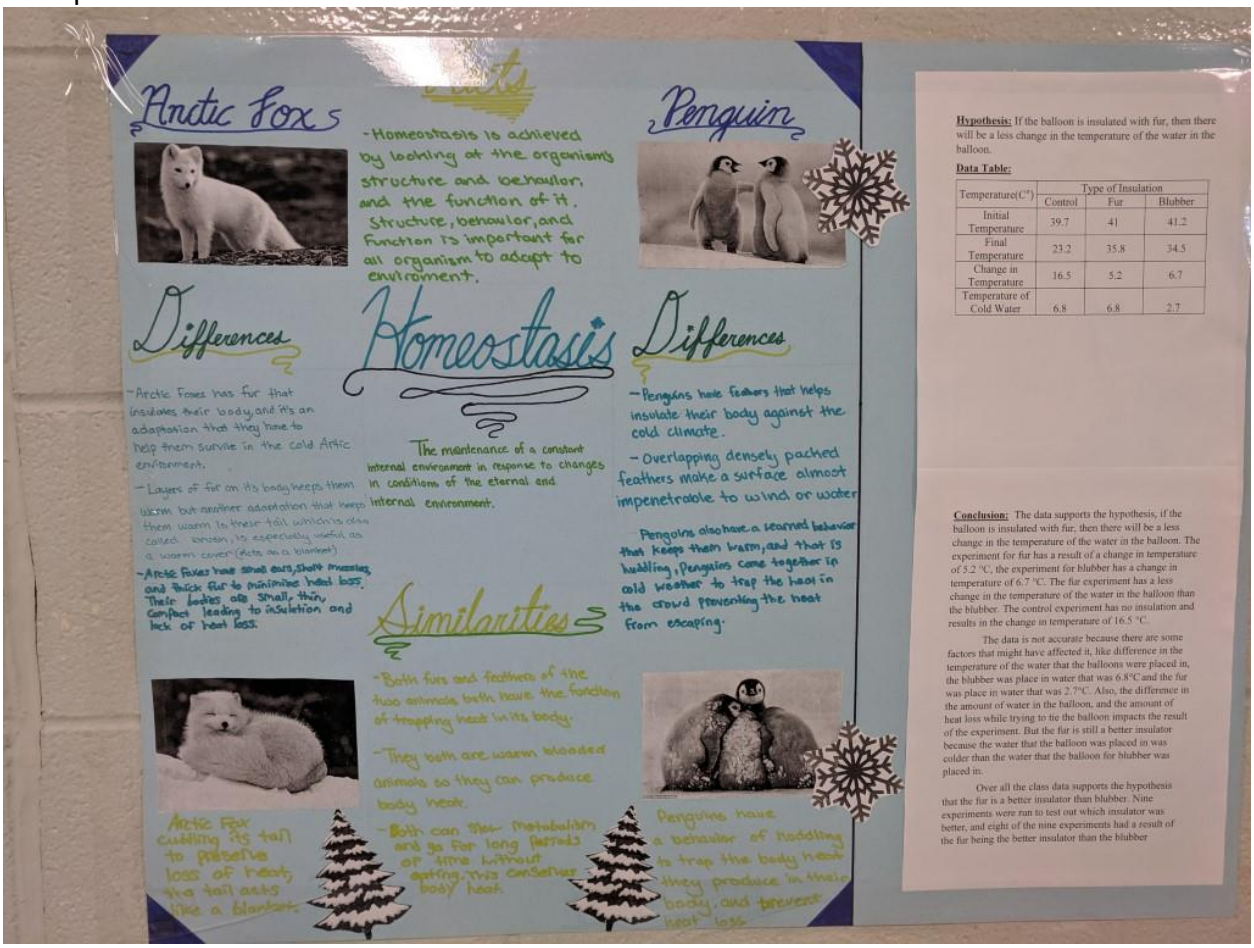
You must include pictures of the animals and basic information about your animals' habitats on your poster.

Poster Layout: Leave a 10" wide space on the right side of the poster board. You will use this space to communicate information from the experiment.

Poster Rubric:

Category	4 Points	3 Points	2 Points	0 Points
Polar Animals	Descriptions of polar animals including basic information, pictures and habitat information.	Descriptions of polar animals including basic information and pictures.	Pictures of polar animals are included.	No pictures or descriptions about polar animals.
Blubber Insulator	In-depth explanation of how blubber aids polar animals to maintain a warm body temperature.	Brief explanation of how blubber aids animals to stay warm.	Little information is provided on how blubber aids animals to stay warm.	No explanation about how blubber aids polar animals to maintain a warm body temperature.
Fur/Feathers Insulator	In-depth explanation of how fur/feathers aid polar animals to maintain a warm body temperature.	Brief explanation of how fur/feathers aid animals to stay warm.	Little information is provided on how fur/feathers aid animals to stay warm.	No explanation about how fur/ feathers aid polar animals to maintain a warm body temperature.
Circulatory System	In-depth explanation of how circulatory system works with blubber and fur/feathers to aid polar animals to maintain a warm body temperature.	Brief explanation of how circulatory system works with blubber and fur/feathers to aid polar animals to maintain a warm body temperature.	Brief explanation of how circulatory system works with either blubber or fur/feathers to aid polar animals to maintain a warm body temperature.	No explanation of how circulatory system works with blubber and fur/feathers to aid polar animals to maintain a warm body temperature.
Attractiveness	Poster is neat, organized, and labeled, with no grammatical errors.	Poster is neat and organized, with no grammatical errors.	Poster is neat and organized.	Poster is messy and unorganized, and contains multiple grammatical errors.

Example:



Temperature(C°)	Type of Insulation		
	Control	Fur	Blubber
Initial Temperature	39.7	41	41.2
Final Temperature	23.2	35.8	34.5
Change in Temperature	16.5	5.2	6.7
Temperature of Cold Water	6.8	6.8	2.7

Experiment: In this experiment we will be testing which adaptation, blubber or fur, is a better insulator for marine mammals. Before conducting the experiment your group must develop a hypothesis about which insulator you think will work better and create a data table. You should read the procedures to better understand the experiment before constructing both a hypothesis and data table.

Helpful Tips:
What is the Independent Variable? Are there multiple conditions for this variable?
What is the Dependent Variable?
What are the units/conditions for your Dependent and Independent Variables?
You must get your table and hypothesis approved before running the Experiment.

Procedure

1. Fill the plastic tub with ice and cold water. Let it chill for approximately five minutes. (Teacher may have this prepared.)
2. Take the temperature of the ice water with the thermometer and record the temperature on your data sheet.

No Insulation (Control) –

1. Run tap water until it is hot to the touch. Fill a beaker with 50 ml hot water and take the temperature of the water with the thermometer. Record the initial temperature on your data sheet before you dump out the water.
2. Turn off the faucet, place mouth of balloon over faucet. Turn back on the hot water and fill the balloon with the hot water until the balloon has a height of 12 cm.
   (Sometimes it's easier to fill the balloons if you blow them up and deflate them first.)
3. Tie off the top of the balloon.
4. Immerse the balloon in the ice water for 300 seconds. (Make sure it is completely under water!)
5. After 300 seconds, remove the balloon from the ice water.
6. **CAREFULLY** pop the balloon and empty the water in the balloon into a beaker.
7. Using the thermometer, immediately take the temperature of the water in the beaker.
8. Record the final temperature on your data sheet.

Fur Insulation (Sea Otters and Fur Seals)

Fur works as an insulator for marine mammals only when it traps an air layer between the water and the animal's skin. For this part of the activity, we need to place one balloon inside another balloon, and then **fill up the inside balloon with water and the outside balloon with air**. Follow these steps:

1. Using a pencil, insert the ERASER end all the way into the end of the first balloon.
2. Holding the first balloon tight around the pencil, take another balloon and roll it onto the pencil on top of the other balloon. (The second balloon should be tucked inside the first balloon.)
3. Carefully remove the pencil, making sure that you don't accidentally pull the first balloon out of the second balloon.
4. Run tap water until it is hot to the touch. Fill a beaker with 50 ml hot water and take the temperature of the water with the thermometer. Record the initial temperature on your data sheet before you dump out the water.
5. Turn off the faucet, place mouth of both balloons over faucet. Turn back on the hot water and fill the inner balloon with the hot water until the balloon has a height of 12 cm.
   (Sometimes it's easier to fill the balloons if you blow them up and deflate them first.)
6. Tie the top of the inside balloon.
7. Blow up the outside balloon so that the inside water balloon is surrounded by air, about 4 cm.
9. Tie the top of the outside balloon, trying to tie the top of the water balloon in it as well.
10. Immerse the double-balloon in the ice water for 300 seconds. (Make sure it is completely under water!)
11. After 300 seconds, remove the double-balloon from the ice water.
12. Carefully pop **ONLY THE OUTSIDE** balloon and let the air out.
13. **CAREFULLY** pop the inside balloon and empty the water from the balloon into the beaker.
14. Using the thermometer, immediately take the temperature of the water in the beaker.

15. Record the final temperature on your data sheet.

Blubber Insulation (Seals, Sea Lions, Walrus, Dolphins)

Blubber is a thick fat layer that surrounds a marine mammal's body. You need to create a fat layer to surround your water balloon, and vegetable shortening makes a good substitute for blubber. Follow these steps:

1. Take the temperature of the ice water with the thermometer and record the temperature on your data sheet.
2. On a desk or table, lay out a sheet of plastic wrap that's big enough to entirely cover a full balloon.
3. Using gloves, spread approximately 1 cm thick layer of vegetable shortening out on the plastic wrap. Set this aside for now.
4. Run tap water until it is hot to the touch. Fill a beaker with 50 ml hot water and take the temperature of the water with the thermometer. Record the initial temperature on your data sheet before you dump out the water.
5. Fill a balloon with the hot water until the balloon has a height of 12 cm.
6. Tie the top of the balloon.
7. Place the balloon in the center of the plastic wrap and wrap the balloon up in the vegetable shortening. Try to squish the vegetable shortening around until it evenly covers the whole balloon.
8. Immerse the vegetable shortening-covered balloon in the ice water for 300 seconds. (Make sure it is completely under water!)
9. After 300 seconds, remove the balloon from the ice water.
10. Peel the plastic wrap and the vegetable shortening off the balloon and throw it away. It may be messy and slippery – don't drop the balloon!
11. **CAREFULLY** pop the balloon and empty the water from the balloon into the beaker.
12. Using the thermometer, immediately take the temperature of the water in the beaker.
13. Record the final temperature on your data sheet.

Conclusion: Your conclusion must include if your data supported or did not support the hypothesis. Remember to include the data that you collected as evidence to support your claim. Include any procedure errors that your team made during the experiment and the impact the error may have had on the data. Explain how the results relate to information you learned during your background research.

Communicate the results: Print out your hypothesis, completed data table, and conclusion. Add this information to the right side of your poster, in the 10-inch area that you had left blank.