WEDDELL SEAL PUPS ARE ON THE ATKINS DIET

As Weddell seal pups nurse from their moms, they develop thick blubber layers because of the high percentage of fat contained in the milk that they drink. We learned in the previous activity just how much fat seal pups take in, and how much we would have to eat to equal that amount. This thick fat layer, which will be 2 ½ inches thick when the pup is full-grown, serves to keep the pup warm, even the coldest and harshest of Antarctic conditions. Interestingly enough, not all marine mammals that live in cold water use blubber to insulate themselves. Sea otters and fur seals, have a dense coat of fur, and they blow air into their 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. So, which kind of insulation works better? Let's find out! For this activity, a water balloon full of hot water will be our marine mammal. How will our different insulators (blubber and fur) stand up to ice water and keep our balloon warm?

Materials needed (and costs of materials. All materials can be purchased at a grocery or drug store):

- Package of balloons ($1.99)
- Meat thermometer ($6.49)
- Binder clips ($1.49)
- Saran wrap ($2.69)
- Container of Crisco ($3.99)
- 1 plastic spoon ($1.19 pk 24)
- 1 plastic tub for ice water ($4.79)
- Bag of ice ($1.50) or make your own
- Water
- 1 pencil with an eraser
- 1 drinking straw
- 1 beanie cap (approximately $5.00)
- 1 plastic cup ($1.50)

Total cost: $30.63

Approximate time for activity: one hour

Instructions:
Make sure you have a data sheet before you start the activity. We'll be taking lots of different temperatures of water, so we'll need a place to write them down. Remember that whenever you record a temperature on your data sheet (which follows the procedures), you should include the units of the measurement. For example, if the temperature of the water is 70 degrees Fahrenheit, you should write "70°F" instead of just "70" (° is the symbol for degrees).

For this activity, it may be helpful to work as a class due to the cost of some of the materials, and rotate through students to set up the various balloon experiments. When

possible, assign jobs to students (such as data recorder, temperature monitor, etc.) so that every student is included in some aspect of data collection.

First, we need to find out how much heat a balloon full of hot water with no insulation will lose when placed in ice water. That way, we can better compare how much heat the balloon loses when insulated with different materials.

Procedure:

1. Fill the plastic tub with ice and cold water. Let it chill for approximately five minutes.
2. Take the temperature of the water with the meat thermometer and record the temperature on your data sheet.
3. Let the tap water run until it is as hot as possible, then fill up the plastic cup (a teacher may be the most appropriate person to handle the hot water).
4. Take the temperature of the water in the cup with the meat thermometer and record it on your data sheet, and then dump out the water.
5. Fill the balloon with the same hot water from the tap (sometimes it's easier to fill the balloons if you blow them up and deflate them first).
6. Twist the top of the balloon and secure it with a binder clip.
7. Immerse the balloon in the ice water for five minutes (it may be helpful to assign someone to time this).
8. After five minutes, remove the balloon from the ice water.
9. CAREFULLY remove the binder clip and empty the water in the balloon back into the plastic cup.
10. Using the meat thermometer, take the temperature of the water in the cup.
11. Record the temperature on your data sheet.

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 we need to fill up the inside balloon with water and the outside balloon with air. The beanie cap serves as the fur insulation. Follow these steps:

1. Using a pencil, insert the ERASER end all the way into the end of a 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.
3. Carefully remove the pencil, making sure that you don't accidentally pull the first balloon out of the second balloon.
4. Fill the plastic cup with hot tap water again and take the temperature of the water with the meat thermometer. Record the temperature on your data sheet and dump out the water.
5. Fill the INSIDE balloon only with the hot tap water.
6. Twist the top of the inside balloon and secure it with a binder clip.
7. Blow up the outside balloon so that the inside water balloon is completely surrounded by air. This can be tricky, and inserting a drinking straw into the outside balloon may help you to inflate it (blow air through the straw, and then trap the air inside by pinching the balloon closed as you remove the straw).

8. Twist the top of the outside balloon and secure it with a binder clip.
9. Place the double-balloon inside a beanie cap. Alternatively, a scarf or an old sweatshirt will work as a fur insulator.
10. Immerse the beanie cap with the double-balloon in it in the ice water for five minutes.
11. After five minutes, remove the beanie cap and double-balloon from the ice water and remove the double-balloon from the beanie cap.
12. Remove the binder clip from the OUTSIDE balloon only and let the air out.
13. CAREFULLY remove the binder clip from the inside balloon and empty the water from the balloon back into the cup.
14. Take the temperature of the water in the cup.
15. Record the temperature on your data sheet.

For the next part of this activity, we need to create a blubber layer for our water balloon. Blubber is a thick fat layer that surrounds a marine mammal's body. We need to create our own fat layer to surround our water balloon, and Crisco makes a good substitute for blubber. Follow these steps:

1. On a desk or table, lay out a sheet of Saran wrap that's big enough to entirely cover a full water balloon.
2. Using the back of a plastic spoon, spread approximately a ¼-inch thick layer of Crisco out on the Saran wrap. Set this aside for now.
3. Fill the plastic cup with hot tap water again and take the temperature of the water with the meat thermometer. Record the temperature on your data sheet and dump out the water.
4. Fill a balloon with the hot tap water.
5. Twist the top of the balloon and secure it with a binder clip.
6. Place the balloon in the center of the Saran wrap and wrap the balloon up in the Crisco. Try to squish the Crisco around until it evenly covers the whole balloon.
7. Immerse the Crisco-covered balloon in the ice water for five minutes.
8. After five minutes, remove the balloon from the ice water.
9. Peel the Saran wrap and Crisco off of the balloon and throw it away. It may be messy and slippery – don't drop the balloon!
10. Carefully remove the binder clip and empty the water back into the plastic cup.
11. Take the temperature of the water in the cup.
12. Record the temperature on your data sheet.

Now that we've collected our data, we need to analyze it. Follow the instructions on your data sheet and answer the questions.

DATA SHEET FOR INSULATION ACTIVITY

Temperature of ice water: _____

Balloon with no insulation

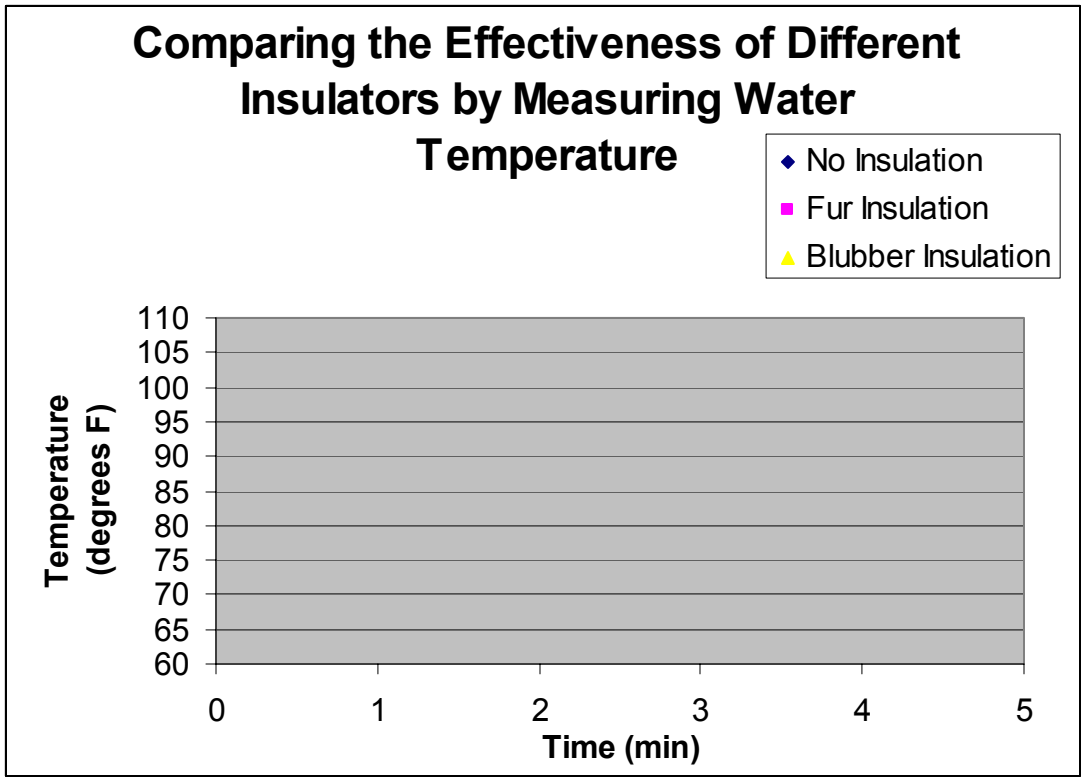
Starting temperature inside balloon (call this number X)	Ending temperature of water inside balloon after five minutes in ice water (call this number Y)	How much heat the water in the balloon lost (equal to X - Y)

Balloon with fur insulation

Starting temperature inside balloon (call this number X)	Ending temperature of water inside balloon after five minutes in ice water (call this number Y)	How much heat the water in the balloon lost (equal to X - Y)

Balloon with blubber insulation

Starting temperature inside balloon (call this number X)	Ending temperature of water inside balloon after five minutes in ice water (call this number Y)	How much heat the water in the balloon lost (equal to X - Y)



Scientists often make graphs with the data they collect. A graph is a way to put numbers into a picture in order to see what the data means. To better understand this, let's make a graph with our temperature data.

Graphs have two axes: an X axis, which runs horizontal (left to right), and a Y axis, which runs vertical (up and down). On this graph, time measured in minutes is on the X axis, and temperature measured in degrees Fahrenheit is on the Y axis. Entering data onto a graph is similar to finding a product on a multiplication table. On the X axis of this graph, "0" indicates the time when the temperature of the water in the balloon was the highest: the moment we put the balloon in the ice water. "5" on the X axis means five minutes, and that indicates the time when the water in the balloon was the coldest: right when we took the balloon out of the ice water after five minutes. In order to put the data on the graph, follow these steps:

- Find the "0" on the X axis with your finger, and then follow the Y axis up until you find the temperature on the graph that matches the temperature of the water in the balloon right before it was put into the ice water.
- Make a mark on the graph right at that point (make marks the shape of the same shape in the legend on the graph: diamonds for no insulation, squares for fur insulation, and circles for blubber insulation).
- Find the "5" on the X axis with your finger, then follow the Y axis straight up until you find the temperature on the graph that matches the temperature of the water in the balloon right after it was taken out of the ice water.
- Make the same mark at that point.
- Connect those two dots with a line.

- Do this with all three sets of data that you collected (balloon with no insulation, balloon with fur insulation, and balloon with blubber insulation) in order to see which balloon lost its heat the fastest.

Questions: Analyze Your Data

1. Which balloon lost the most heat?

2. What was the best insulator (was air and fur, or blubber the best at keeping the water inside the balloon warm?

3. What do you think would happen if you used a bigger water balloon? Would the temperature inside the balloon drop faster or slower in the ice water?

4. Based on your answer for number three, do you think it is common for small marine mammals to live in icy Antarctic water? Why or why not?

5. What do you think would happen to the water balloon inside the air balloon if the air balloon had more air in it? What would happen if the fur layer was thicker than just a beanie?

6. What do you think would happen if you made a thicker blubber layer around the third balloon? How about a thinner blubber layer?