How Animals Stay Warm with Blubber

Explore blubber biology with Science Buddies

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Key concepts

Temperature
Heat transfer
Adaptation
Insulation
Fatty tissue

Introduction

Have you ever wondered how whales and other marine mammals survive and keep warm in the cold oceans? Warm-blooded mammals can live in these chilly conditions because their bodies have some cool warmth-saving adaptations, thanks to generations of natural selection.

In other words, to pass on characteristics (via their genes), the predecessors of modern marine mammals had to overcome different challenges to reproduce, and their descendants received the genes that allowed for their survival. This kind of change in organisms over time is what fuels evolution. An important adaptation for marine mammals is blubber, a thick, insulating layer of fat beneath the skin that helps to keep

body warmth in and the cold of the air or water out. Will a layer of fake blubber—in the form of shortening—help you keep from getting cold?

Background

Mammals that have evolved to live in cold waters, such as whales, seals, sea lions and polar bears, commonly have a layer of blubber. Whether they are living in cold waters near the North Pole or around Antarctica or are visiting the deep ocean, these animals' blubber is vital to their survival. During the winter, the air in the Arctic (the northernmost part of the world) is often below –40 degrees Celsius (–40 degrees Fahrenheit). Antarctica, the coldest place in the world, can be below –60 degrees C (–76 degrees F). Depending on the species, whales dive more than 400 or 500 meters (about one fourth of a mile) deep in the ocean, where the water can be colder than 12 degrees C (54 degrees F).

Blubber helps these marine mammals from getting too cold. (Cold-blooded marine animals, such as fish, sharks or crabs, do not need to stay warm and can let their body temperatures get closer to that of the water. Thus, they do not need to have this extra insulation.) Blubber is a thick layer of fat (adipose) tissue. Animals store extra digested food in the form of adipose tissue, which contains molecules called lipids. Adipose tissue has a relatively low thermal conductivity, which means that it does not transfer heat as well as other tissues and materials—such as muscle or skin. That way, it helps to insulate an animal's body.

Materials

- Two bowls
- Cold water

- Warm water
- Ice cubes
- Shortening (such as Crisco)
- Paper towels
- Stopwatch
- Thermometer
- A partner

Preparation

- Put an equal number of ice cubes into each bowl without filling either bowl too full. Add cold water to each bowl.
- Measure the temperature of the water in each bowl with a thermometer. They should be the same temperature. When the temperature levels off (which should happen quickly), the water is ready for the test.

Procedure

- Cover your pointer finger on one hand with a thick layer of shortening, covering the entire area that will be submerged in the water. Leave your other pointer finger clean and bare.
- Have your partner prepare the stopwatch. When he or she is ready, put the pointer finger of each hand into one of the bowls of ice water and have your partner start timing you. As soon as your finger feels too cold to keep it in the water any longer, take it out. *How long did you leave each finger in the bowl?*
- Let your fingers warm up and return to their normal color. If any shortening came off of the covered finger, reapply it.
- Have your partner help you pour the cold water down the sink and refill the two bowls with warm water (make sure it is warm but not hot enough to burn the skin).
- Measure the temperature of the water in each bowl with a thermometer. They should be about the same. *In the warm water, do you think you'll see the same result?*
- Have your partner time how long you can leave each finger in the bowls of warm water. *How long did you leave each finger in the bowl? Was the time difference between the two fingers larger or smaller than when you put your fingers in the ice-*

cold water?

- **Extra:** How consistent are your results? You can repeat this activity two or three times, recording the temperature of the different waters tested and the time each finger was in the water. Then make a graph out of your results. *In which environment did the shortening "adaptation" consistently give an advantage?*

Observations and results

When you dunked your fingers in the ice-cold water, did the finger covered in shortening stay warm longer than the finger that was not covered? Was there not as large a time difference when you put your fingers in the warm water?

Mammals that have adapted to live in cold waters—such as polar bears and whales—can stay warm largely because of their blubber, a thick layer of blubber. The blubber is evenly spread over much of their body, just as the shortening in this activity covered the surface of your finger in a thick layer. Since adipose tissue has a relatively low thermal conductivity, it does not transfer heat well compared to other tissues and materials. Humans have developed some insulating materials for our own daily use. For example, Styrofoam is another material that does not conduct heat relatively well, whereas metals conduct heat very well. This is why hot drinks are often served in Styrofoam, since it keeps the heat inside the cup, thus preventing your hands from being burned. (For the same reason, it can also keep cold drinks cool longer than, for example, a paper cup.) What other materials can you think of that work as insulators?

More to explore

Sink or Swim: Muscle versus Fat from *Scientific American*
Blubber from National Geographic Education
Is Muscle a Better Insulator than Fat in Cold and Heat? from MadSci
What Are You Blubbering About? from Science Buddies

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