

# Arctic adaptations (For the teacher)

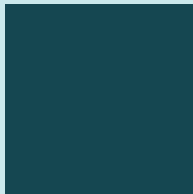


Students will get to experience first-hand which insulation material used by Arctic wildlife is the warmest.

 **Duration:** 75 minutes

## Learning outcomes

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## Materials

- Ziplock bags
- Large plastic (or other waterproof) box
- Cold water and ice cubes
- Insulation materials (down feathers, reindeer hide), bubble wrap (representing air trapped in fur), mayonnaise or other fatty substance to represent marine mammal blubber.
- Tape
- Stopwatch
- A thermometer with waterproof temperature probe
- Data Table (Handout 1)
- Graph (Handout 2)

## GUARDNA cards

### Species Cards

- Bearded seal
- Beluga whale
- Blue whale
- Bowhead whale
- Grey seal
- Harbour porpoise
- Harp seal
- Hooded seal
- Humpback whale
- Killer whale
- Minke whale
- Narwhal
- Pilot whale
- Ringed seal
- Sei whale
- Sperm whale
- Walrus

## Background

In biology, **adaptation** refers to the evolutionary process through which a **species** becomes better suited to its **environment**. In the harsh Arctic conditions, marine mammals rely heavily on their thick **blubber** to endure the extreme cold. This dense layer of fat serves as a highly effective **insulation** against the cold temperatures. Not only that but the **blubber** acts as a vital energy reservoir, sustaining these animals during periods of food scarcity and fasting.

## Preparation

1. Fill up the large box with the cold water and ice cubes.
2. Fill two ziplock bags with each of the different **insulation** materials; that is, two bags of down feathers, two bags of mayonnaise, etc. Leave two bags empty.
3. Close the bags and tape together each matching pair of ziplock bags along three sides, to form sort of an “insulation glove”.
4. Print Handouts 1 and 2.

## Procedure

The experiment will be repeated several times, either by the same group of students or a different one, using different **insulation** materials. Each **insulation** glove represents different **insulation** types, depending on the phase of the experiment. Each experiment has three different roles, and students will rotate through these: technician (**T**), researcher (**R**), and data recorder (**D**).

- Technicians will prepare the activity materials for the researcher and assist.
- Researchers will conduct the actual experiment as a test subject.
- Data recorders will measure and record data from the experiment and assist the technician.

Carefully read the instructions below, so everyone knows their roles.

1. **R** puts their hand in the **insulation** glove, and **T** inserts the thermometer within the glove. The tip of the thermometer should be near the middle knuckle of **R**'s middle finger, or at least at the same spot for each experiment.
2. **D** records the start temperature and write it down in the table (Handout 1).
3. **R** puts their hand within the **insulation** glove in the ice water, as far as possible without getting water inside the glove. **T** starts the stopwatch.
4. Every 10 seconds **T** reads the temperature out loud and **D** records the temperature in the Table (Handout 1), for a total of 90 seconds (see step 5).
5. **R** puts the insulated hand in the ice water for 90 seconds, or until the thermometer reads 15.0 °C. Make sure they remove their hand earlier if it starts to hurt!
6. After **R** removes their hand from the ice water, they should slowly put it into the bucket with lukewarm water. The experiment is now over. Allow **R**'s hand to warm up to within 2 °C of their starting temperature (temperature recorded in step 2).
7. Plot the results in the graph (Handout 2).
8. Repeat step 1-7 for all different insulation options, starting with no **insulation**.

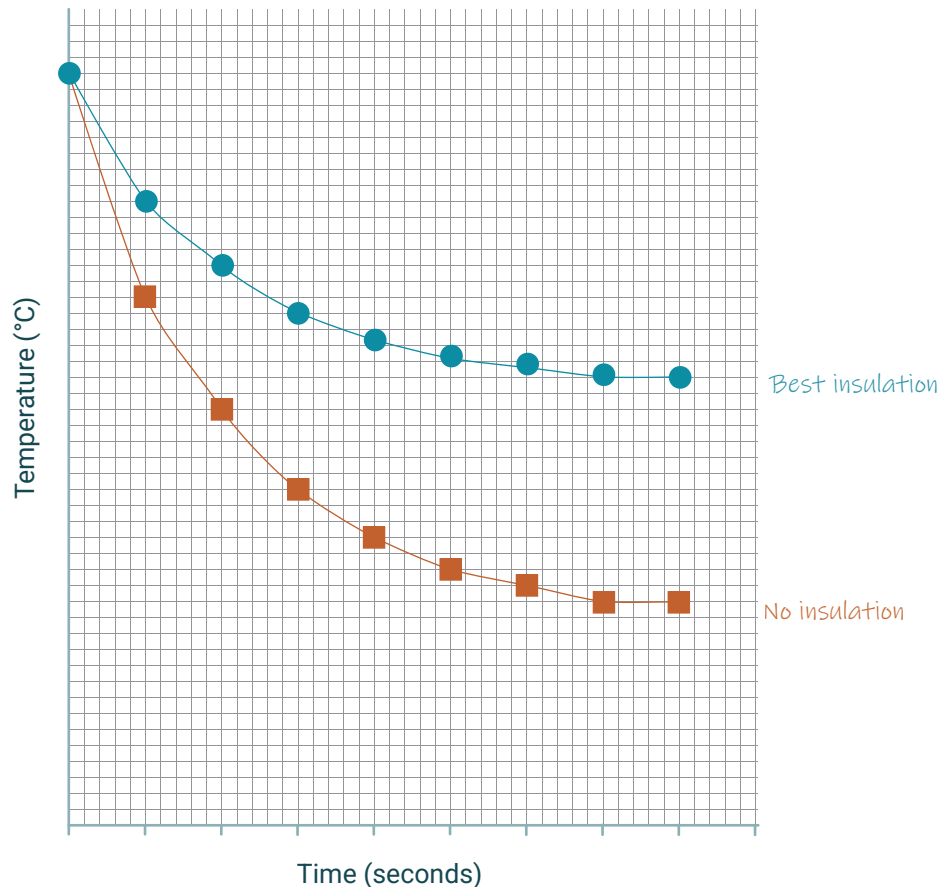
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## Follow-up discussion

- Examine your findings in your table and your plotted line graph. Describe some overall trends you observe. The resulting graph (Handout 2) should resemble the following:



- Which treatment produced the coldest temperature in the shortest period of time?**  
The experiment without **insulation** is expected to show the lowest temperatures, while the experiment using a material that mimics marine mammal **blubber** should exhibit a slower temperature drop.
- Which other adaptations do marine mammals use to endure harsh Arctic conditions?**  
As seen in this activity, one of the most effective **adaptations** marine mammals use to endure the cold Arctic conditions is their thick layer of **blubber**. However, this is not their only survival mechanism. Walrus, for instance, can slow down their heart rate—a process known as **bradycardia**—to reduce blood flow and conserve heat while diving in icy waters. This ability helps them maintain their body temperature in freezing conditions by prioritising blood flow to vital organs and minimising heat loss.  
Additionally, **bradycardia** allows walrus to dive for extended periods while hunting for clams and other **prey** on the seafloor. By lowering their heart rate, they reduce their oxygen demand, enabling them to stay underwater longer without needing to resurface for air.  
Walrus also display changes in skin color due to these blood flow adjustments. When they are warm, increased blood circulation to the skin helps them release excess heat, giving them a pinkish hue. When they are cold, reduced blood flow keeps heat concentrated in their core, resulting in a browner appearance.