



Map of the Arctic –  
Painting in  
Museum Dome  
of SPRI  
Museum

# Keeping Warm –

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# The Science of Polar Clothing

Polar regions are cold. The coldest temperature recorded in Antarctica is  $-89^{\circ}\text{C}$ ! We are warm-blooded animals, and under normal conditions maintain our core body temperature at  $37^{\circ}\text{C}$ . Our bodies have some strategies to prevent heat loss, such as contracting blood vessels near the body surface and at it's

extremities (eg fingers and toes) to prevent warm blood from flowing to areas where heat is lost from the body. However, these cannot deal with the extreme cold faced in polar regions, or with the lengths of time people are exposed to the cold in polar regions. Instead, we rely on special clothing to keep us warm.

## Hypothermia and Frostbite – what happens when we are too cold for too long....

### Hypothermia

When it is very cold, the body loses heat faster than it can produce it. Eventually, the temperature of the body drops below the level required for normal bodily function. This condition is called Hypothermia. People suffering from hypothermia experience physical symptoms, such as skin turning blue and difficulties moving, and also mental effects, such as confusion, memory loss and in later stages irrational behaviour. Eventually biochemical processes within cells begin to shut down. In the worst cases, major organs fail and the victim dies. It is important to avoid hypothermia, particularly when out in the field when medical treatment is often not readily available. Wearing the correct clothing can play a major role in protecting an individual from becoming too cold.

### Frostbite

Frostbite is a condition where damage is caused to the skin and other tissues by extreme cold. When it is getting too cold, the body reduces blood flow to parts of the body a long way from the heart and with a large surface area (eg ears, noses, fingers and toes). In extremely cold temperatures, blood flow to these parts of the body can become dangerously low. The combination of the cold temperatures and poor blood flow can cause tissue damage - frostbite. Symptoms of frostbite include discolouration of the skin, burning/tingling sensations, partial or complete numbness, and possibly intense pain. In extreme cases, nerves and blood vessels can be damaged, which may be followed by gangrene – it is possible that amputation is required in these situations.

Picture of hands affected by frostbite



### Penguin Fact:

*We cannot survive the cold in Antarctica without special clothing, but Emperor Penguins can withstand temperatures of  $-50^{\circ}\text{C}$  or colder as they incubate their eggs in the Antarctic Winter. They use feathers to keep warm, and huddle together to try to stop heat from escaping.*



## The Principals behind Polar Clothing Design...

### 1) To keep the body warm

In such cold temperatures, it is very important to insulate the body. Reducing heat loss reduces the risk of hypothermia, and keeping fingers and toes warm stops them from being damaged by frostbite.

### 2) To allow moisture from sweating to escape

Moisture can cause lots of problems. If you are wet, you lose heat a lot faster than if you are dry – so wet clothes are poor insulators. Also, ice can form within wet clothes.

### 3) To be comfortable and allow free movement

It is no good having clothing to keep you warm if you are unable to move and work in it!

## Native Arctic Clothing...

The clothing worn by Arctic peoples is generally made of animal skins – particularly seal, caribou, polar bear, wolf and fox. Animal skins are warm and lightweight, making them ideal for living and working in such cold environments.



## Clothing of Early Polar Explorers...

The clothing worn by British, French and Dutch Arctic explorers in the 19<sup>th</sup> century were not specially designed, but were clothes they usually wore in the winter months at home, and as such did not have sufficient insulating properties.



The clothing used by Scott and his men in his explorations of Antarctica were made of cotton and wool. Cotton tends to hold moisture, and these clothes must have become very uncomfortable, sapping heat away and freezing.

## Modern Polar Clothing...



Modern polar clothing has used advances in synthetic fabrics to produce clothing that insulates the body well but that is also light weight and allows moisture to escape.

Modern polar clothing is not about one thick layer, but lots of light weight layers which trap air between them – air is a poor conductor of heat. Layers also provide ventilation, helping moisture to escape. The layering system means that clothing meets the demands of a range of conditions that may be met – more layers for colder weather, fewer layers for warmer weather etc.

Thermal underwear and loose-fitting windproof outer layers are particularly important.

Boots and mittens are important to protect the feet and hands, and are specially designed for these extreme conditions. High thermal insulation is important to prevent frostbite. On the hands, if mittens are removed for work, glove liners will protect the hands until the mittens can be replaced.

