

Hypothermia

Contents: Reading and questions about hypothermia including a case study to show how it can affect young people in severe weather conditions.

Time: 2 periods, or more, depending on the number of parts attempted.

Intended use: GCSE Biology, Human Biology and Science. In Physics courses there are possible links with work on energy transfer by convection, conduction, and radiation as well as with the energy changes which accompany phase changes.

Aims:

- To complement work on the regulation of body temperature and work on heat transfer
- To explain the nature and causes of hypothermia and to show how the condition can affect both old and young people
- To provide opportunities to practise skills in reading and comprehension
- To provide an opportunity to practise the evaluation of evidence.

Requirements: Students' worksheets No.802.

Authors: Julian Cohen and Kris Stutchbury

Suggested use

This unit is in three parts:

Part 1 What is hypothermia?

Part 2 Why are old people more likely to suffer from hypothermia?

Part 3 Danger out of doors

Students should start by studying Part 1 but they can then either study Part 2, or Part 3, or both. Part 3 can be shortened by omitting pages 5 and 6.

The unit concentrates on the dangers of hypothermia, but a sub-normal body temperature can be useful too. Surgeons cool the blood and body before doing heart operations. The heart can be stopped for up to 12 minutes if the body is cooled to 30°C. During one operation at the Westminster Hospital in London a patient's heart was stopped for 50 minutes after cooling the body to 15°C.

Notes on some of the questions

Q.6 Suitable answers might be:

- (a) 29°C
- (b) 1°C
- (c) 26°C
- (d) 43°C
- (e) 60°C
- (f) 200°C
- (g) 10°C

Q.7 Alcohol gives a feeling of warmth and well-being, but this effect does not last and is dangerous for people who are weak, or suffering from exhaustion. Energy loss from the body may increase rapidly after drinking alcohol, because alcohol causes blood vessels in the skin to dilate. Students might be interested to hear about the danger of taking a cold dip to 'sober up' after excessive drinking.

Q.8 Digesting food releases energy and so a nourishing cold meal can help to warm the body in the same way as a hot meal. A cold meal may not feel as satisfying.

Q.9 Activity and regular eating are the best ways of keeping warm. Extra clothing can help but too much produces little extra benefit and may discourage a person from moving around. It can be dangerous for old people to go to bed during the day, even though they might think it will warm them up, because it stops them moving around.

Q.10 There is no real evidence either way, but some medical experts think that there may be a link between the large incidence of bronchitis in Britain and the tradition of having cold bedrooms.

Q.11 Most at risk are: (b), (d) and (e).

Q.13 About twenty people die each year on the hills and moors of Britain. Under normal conditions about one-third of the energy transferred from the body is lost by the evaporation of perspiration. More is lost in this way after strenuous exercise. The danger of wearing damp clothing is that it can allow rapid loss of energy, through loss of air insulation and the cooling effect of evaporation. When there is a wind blowing, wet walkers are no better off than they would be naked at a lower wind speed.

Qs 14 to 16 'Space blankets' are effective because:

- (a) Their shiny inner surface reflects back radiation emitted by the body inside.
- (b) Their outer surface is also partly shiny, and this reduces emission of radiant heat.

A matt black surface is a good absorber and emitter of radiant heat, so a black plastic bag would not be very effective at keeping you warm.

Suggested practical activities

It is possible to simulate various aspects of heat loss using thermometers and water-filled beakers. For example:

1. Show the principle of 'space blankets' by comparing the rate of cooling of two beakers, one wrapped in aluminium foil and the other wrapped in black paper.
2. Demonstrate that huddling together prevents heat loss, by surrounding a beaker of hot water with several other beakers and comparing the rate of cooling with an isolated beaker.

Both these exercises would lend themselves well to problem-solving activities. For example, the first exercise could be presented as 'How can you show that a shiny covering keeps in heat better than a black one?'

HYPOTHERMIA

This unit is in three parts. The first part tells you about hypothermia. The second part explains why old people may be affected by hypothermia in winter. The third part is a case study showing the danger of bad weather conditions on moors and mountains.

Part 1 What is hypothermia?

The blood inside your body is close to 37°C. As you can see from Figure 1, it is very dangerous if your temperature drops.

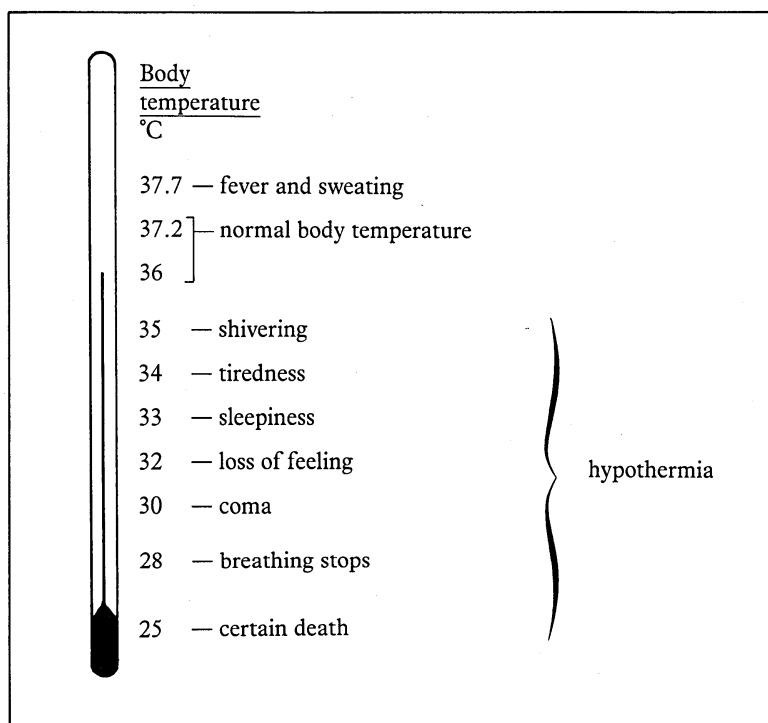


Figure 1

When you begin to get cold you may see goose pimples on your skin, and start to shiver. These are signs that your body is reacting normally to keep your temperature at a safe level.

When you are cold the blood vessels in your skin become narrower so that less blood reaches the surface of your body. This means that less heat is lost. Sometimes this can make your toes and fingers go numb. It may not matter if the blood in your *skin* gets cool as long as the blood circulating *inside* your body through the heart stays close to 37°C.

If you stay cold for a long time and do nothing about it the temperature inside your body may drop to dangerous levels. You begin to suffer the effects of **hypothermia** if your body temperature falls to 35°C, or below. Your heart beats slower and eventually stops if the blood gets too cold.

Now try questions 1 to 5.

Questions

- 1 How does your body reduce the blood supply to your skin when you are cold?
- 2 Why may people look pale when they are cold?
- 3 Why is a thermometer placed under your tongue when your temperature is taken? Why not just hold the thermometer in your hand?
- 4 Why do you think goose pimples appear on your skin when you get cold? Do goose pimples help to keep you warm?
- 5 How do you think shivering helps to stop your body getting too cold?

Here are some of the signs and effects of hypothermia in the order they develop:

- unexpected and unreasonable behaviour
- slow response to questions, lethargy
- blurred vision
- slurred speech
- sudden shivering fits
- sudden outbursts of energy
- falling over
- unconsciousness
- death

Other possible symptoms include: blue lips; pale and puffy face; slow pulse and slow breathing.

How should we treat hypothermia?

If someone is suffering from hypothermia they must be warmed up. This has to be done carefully. If the person is warmed up too quickly from the outside the blood vessels may widen so that there is a rush of blood to the skin. Most of the skin has not warmed up, so that even colder blood is returned to the heart. This can cause sudden death.

The best treatment starts by preventing any more heat being lost. This can be done by wrapping the person up well. (Figure 2)

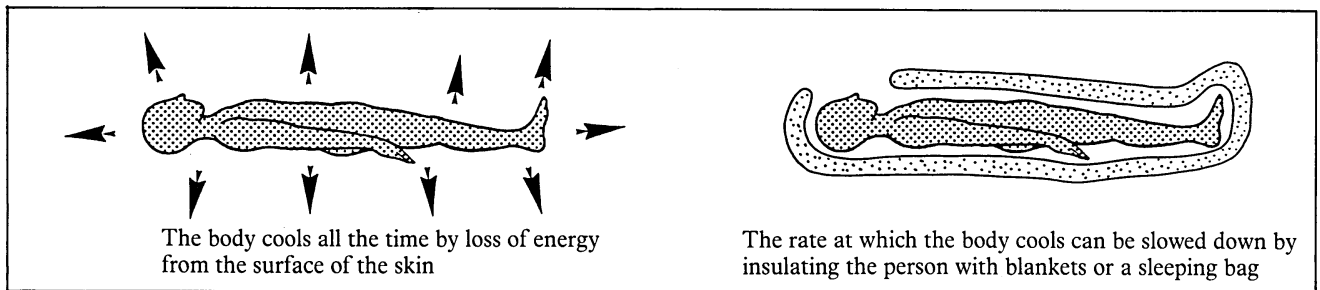


Figure 2

In a case of hypothermia:

DO

- warm up the room
- give a warm drink
- wrap the person up well
- call a doctor

DON'T

- load heavy blankets onto the person
- apply heat directly to the skin
- use hot baths, hot water bottles or electric blankets
- encourage the person to move
- give alcohol

Now try questions 6 to 10.

Questions

- 6 Make an estimate of the temperature in °C of:
- (a) the air on a hot day in summer
 - (b) the air on a cold day in winter
 - (c) the water in an indoor swimming pool
 - (d) the water in a hot bath
 - (e) hot tea when you can just drink it
 - (f) the air in a hot oven
 - (g) milk in a refrigerator
- 7 Do you think a drink of rum, whisky or brandy is a good way to warm up a person who is suffering from extreme cold?
- 8 Does eating cold food, such as a sandwich, make you colder? Is it helpful or harmful to give someone cold food if they are suffering from hypothermia?

Questions

- 9 A person has several layers of clothes on and has the room heating turned up as high as it will go. The person still feels cold. Is it best to:
- (a) put on more clothes
 - (b) go to bed
 - (c) move around and make a hot drink or snack?
- 10 Is it healthier to sleep with the bedroom window open even on cold nights?

Part 2 Why are old people more likely to suffer from hypothermia?

When people move around, their bodies are warmed by heat released from active muscles. Old people are less active, so they are likely to get hypothermia when they sit for long periods in cold rooms.

The natural mechanisms which keep the body warm (see Part 1 of this unit) do not always work as well for the elderly. They may not shiver when they are cold. Also it has been shown that it may take longer for the blood vessels in their skin to narrow. This means that more blood goes on circulating through the colder parts of the body. Old people can sometimes get very cold without realising it.



Figure 3 This man in a wheelchair uses his gas fire sparingly because of the cost. He wraps up with extra clothing and blankets.

Elderly people living on small pensions may be worried about heating bills. They may spend the whole day in cold rooms. This is made worse in bad housing which is damp and draughty.

About 40 000 more old people die in winter than in summer. One recent survey suggests that about 300 — 400 of these extra deaths are directly caused by hypothermia. In most cases the people suffering from hypothermia had got cold because they were ill or suffering from some handicap which stopped them moving around.

Most of the extra deaths in winter are caused by heart attacks, strokes or diseases which affect the lungs.

Now try questions 11 and 12.

Questions

- 11 Which of these old people are likely to be at risk with hypothermia?
- (a) Someone living in an old people's residential home
 - (b) Someone living alone
 - (c) Someone who goes out a lot even when it is cold
 - (d) Someone who lives in a damp and draughty house
 - (e) Someone who is ill and cannot get about easily
- 12 Design a leaflet or poster for a doctor's surgery advising old people of the dangers of hypothermia and telling them how to avoid getting too cold.

Part 3 Danger out of doors

Fit and active people can die from hypothermia too. Mountaineers, divers and fishermen may suffer from hypothermia if they are out in cold wind and rain without proper protection. This is sometimes called **exposure**. The danger is that their bodies will cool faster than they are being heated by the activity of their muscles.

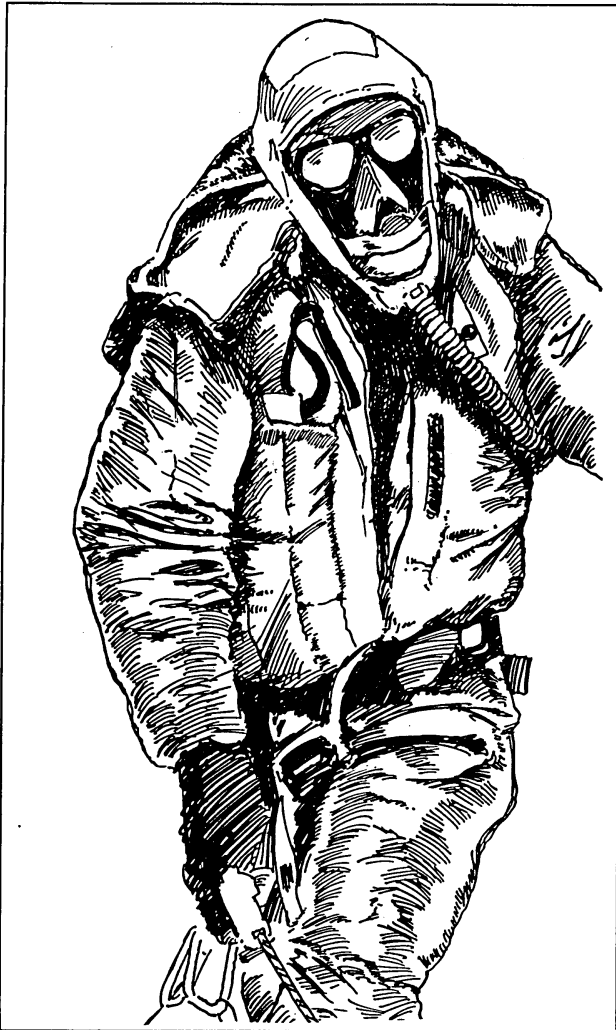


Figure 4 A mountaineer wearing a one-piece suit filled with down to stop his body cooling too quickly.

In emergencies **space blankets** can be used. These are made from thin foil which is shiny on one side. The sufferer is surrounded by the blanket with the shiny surface inside. Space blankets are very effective even though they are thin.

Preventing hypothermia is better than treating it. Hypothermia can set in quickly out of doors in winter when it is windy and wet. Warm and waterproof clothing, warm drinks and high-energy foods can all help to prevent hypothermia.

Now try questions 13 to 17.

Questions

- 13 Why do you get colder more quickly if your clothes are wet and there is a wind blowing?
- 14 Why does a space blanket slow down the loss of heat from the body? (Remember that heat can be transferred by conduction, convection and radiation.)
- 15 Marathon runners are sometimes given a space blanket after they have crossed the finishing line. Why is this a good idea?
- 16 A large black plastic bin liner is less effective than a space blanket. Why?
- 17 Suppose you are in charge of a party of young people setting out for a hike in the hills in winter. What advice would you give and what food, clothing and equipment would you require every member of the party to take with them? What would you say to help them to understand the reasons for your advice?

Exposure on the moors

Here are two accounts of an expedition on Dartmoor. Read them and then try questions 18 to 25.

Newtown High School magazine

Outdoor pursuits group — spring activities

by Sam Jump

Highlight of this term was a weekend snow and ice survival course at Alenmore Lodge in Scotland. Thirty-two members attended. Weather conditions in Scotland were superb, with two days of bright sun but plenty of good firm snow. We were able to practise step-cutting and survival techniques.

The techniques learnt in Scotland stood us in good stead later as Susan Wiseman showed during a training weekend on Dartmoor in April. Susan Wiseman, Peter Furly, Jenny Long and Simon West set out to walk 10 miles across the moor.

They woke up late and missed breakfast which was probably a mistake. They led off in bright sunshine but ran into blizzard conditions at about midday.

Simon, the youngest in the group, began to show signs of exhaustion. Susan organised the others to make a shelter in some rocks. They put all the spare clothing on him, and gave him hot drinks and glucose tablets.

Susan and Peter set off to get help. Simon and Susan had a couple of days in hospital, but all's well that ends well and it just goes to show the value of good training.

In closing I'd like to thank Kris Checkland for all her help in looking after the gear and Mike Thomas for driving the minibus. We'd also like to thank the members of the Police and the Dartmoor mountain rescue team who brought Simon down.

Extract from a local newspaper, April 3rd:

POLICE CHIEF SLAMS CARELESS HIKERS

Chief Inspector Stern of the Devon Constabulary yesterday condemned badly prepared and equipped groups who treat Dartmoor as a playground, without realising that weather conditions can change very quickly.

A party of walkers from Newtown High School in Cheshire left Princetown in bright sunshine on Saturday morning on a training walk for the Duke of Edinburgh Gold Award. Weather conditions deteriorated rapidly and by noon it was snowing heavily. One of the party collapsed, and was suffering from hypothermia. Failure to report at the third checkpoint alerted leaders that all was not well.

A search was quickly mounted, led by the

Dartmoor rescue team and helped by police and local residents. During the afternoon, conditions became so bad that Police Constable Paul Rogers, 29-year-old father of two, collapsed and had to be assisted from the moor by the rescue team.

As dusk fell, conditions improved slightly and the rescue team were able to reach the stranded party, led to the spot by plucky 17-year-old Susan Wiseman, who had left her companions to seek help after organising shelter for the exhausted boy and getting him into a sleeping bag.

Today, Susan and 16-year-old Simon West are recovering from their ordeal in an Exeter hospital. A hospital spokesman said that Simon had been suffering from

hypothermia, which can occur very quickly in such extreme conditions. Lack of effective waterproof over-trousers had caused Simon's trousers to become soaked and the resultant heat loss had contributed to his collapse.

Alison Rogers, wife of the Police Constable who collapsed, said, 'I blame the school. I don't think these school parties ought to be out on the Moor at this time of year. It's always those of us who live here that have to help when they run into trouble.'

Chief Inspector Stern underlined her statement, reminding all parties venturing on to the Moor at Easter that: 'Full winter gear, emergency rations, and survival kit are essential'.

Questions

- 18 *How do you think that Susan and the others were able to tell that Simon was beginning to suffer from hypothermia?*
- 19 *In what ways were the group well prepared for the expedition?*
- 20 *What two mistakes did Simon make which made it more likely that he would suffer from hypothermia in the cold snowy weather?*
- 21 *What other equipment might the group have carried to help them to cope with the emergency?*
- 22 *Do you think that the leaders of the exercise had done everything possible to prevent accidents of this sort? Explain.*
- 23 *What differences are there between the two accounts of the emergency? Why do you think that the two versions are different? Which story do you think is likely to be more accurate?*
- 24 *How do you think that Inspector Stern would react if shown Sam Jump's account of the expedition?*
- 25 *Imagine that you are the headteacher of Newtown High School.*
 - (a) *How do you react to the newspaper story? Are you going to take any action about it?*
 - (b) *Will you allow the Outdoor Pursuits Group to organise another expedition to Dartmoor next year? What reasons will you give if you are asked to justify your decision?*