How would you Survive? — an exercise in simple technology

Contents: A problem-solving exercise designed to introduce the idea of basic technology.

Time: 2 periods or more, depending on amount of discussion.

Intended use: Could be used with most students of secondary-school age. Relevant to Physics, Chemistry, Integrated Science and Technology courses. Links with work on change of state, fuels and energy changes.

Aims:

- To introduce the idea of basic technology, and to compare it with higher level technology
- To encourage respect for the technological skill of people in less developed countries
- To explore the relation between science and technology and the importance of both to development
- To provide opportunities to practise problem-solving skills.

Requirements: Students' worksheets No. 404. Students will need plenty of paper or card, preferably large sheets, for Tasks 1 and 2, and also coloured pens.

Part 1 Tasks 1 and 2 are best tackled by students working in pairs. It is useful if all the results can be put on a single, large sheet of paper or card. Stress that only *simple* sketches and notes are required, otherwise students may spend too long on presentation of results at the expense of creative thinking.

Pairs could be brought together into larger groups for Task 3. They could be asked to give a brief talk on their solutions.

Part 2 is a discussion activity which is best tackled in small groups.

Further activities

1 As an introductory or follow-up activity, students could be asked to think about how they would prepare for a night spent on open ground somewhere in Britain. They are allowed to use only disposable materials and they can spend no more than, say, a pound on food. Such an exercise has the advantage of being closer to students' own experience.

2 *Experimental work* The following tasks could be set as open-ended problem-solving exercises:

(a) Test methods of starting a fire and keeping it going
(b) Find the best way of melting ice to produce drinking water, keeping evaporation losses to a minimum.

Project work Use library sources to find out about the technology used by Inuit (Eskimo) people.

Acknowledgement Figure 2 supplied by Canada House Film Library.

HOW WOULD YOU SURVIVE? — an exercise in simple technology

Part 1 Shipwrecked in the Arctic

Imagine that you have been shipwrecked on the north coast of Canada inside the Arctic Circle (Figure 1). You are with one other person and the long winter is about to begin. The ground is covered with hard snow to a depth of nearly half a metre. There are no plants or trees. The animals have migrated south for the winter. The average temperature is −30°C and most of the sea is beneath a layer of ice.

Could you survive?

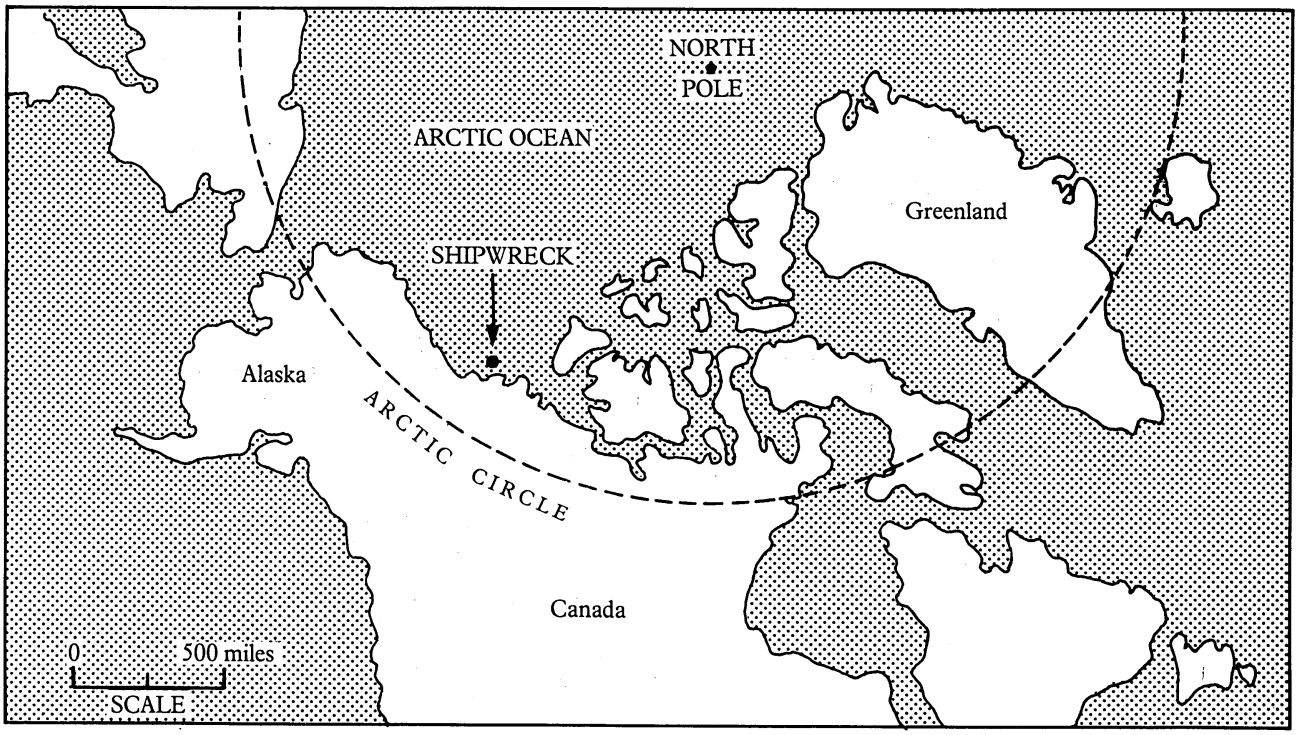


Figure 1 Shipwrecked in the Arctic

The ship went down without your being able to save anything apart from your two dogs. They lead you to the carcass of a caribou deer that died of old age before the winter migration. On the frozen ground beneath the snow are different types of stones. Some are hard but others are easily broken. You also find a few lumps of copper metal. In a frozen river bed you find some driftwood up to eight feet long.

The dogs have sniffed out a small hole in the ice on the frozen sea. It is about three centimetres across and could be the breathing hole of a seal. There might also be some fish in the sea below the ice.

Whatever happens you are stuck here until help arrives or the summer comes.

How would you survive?

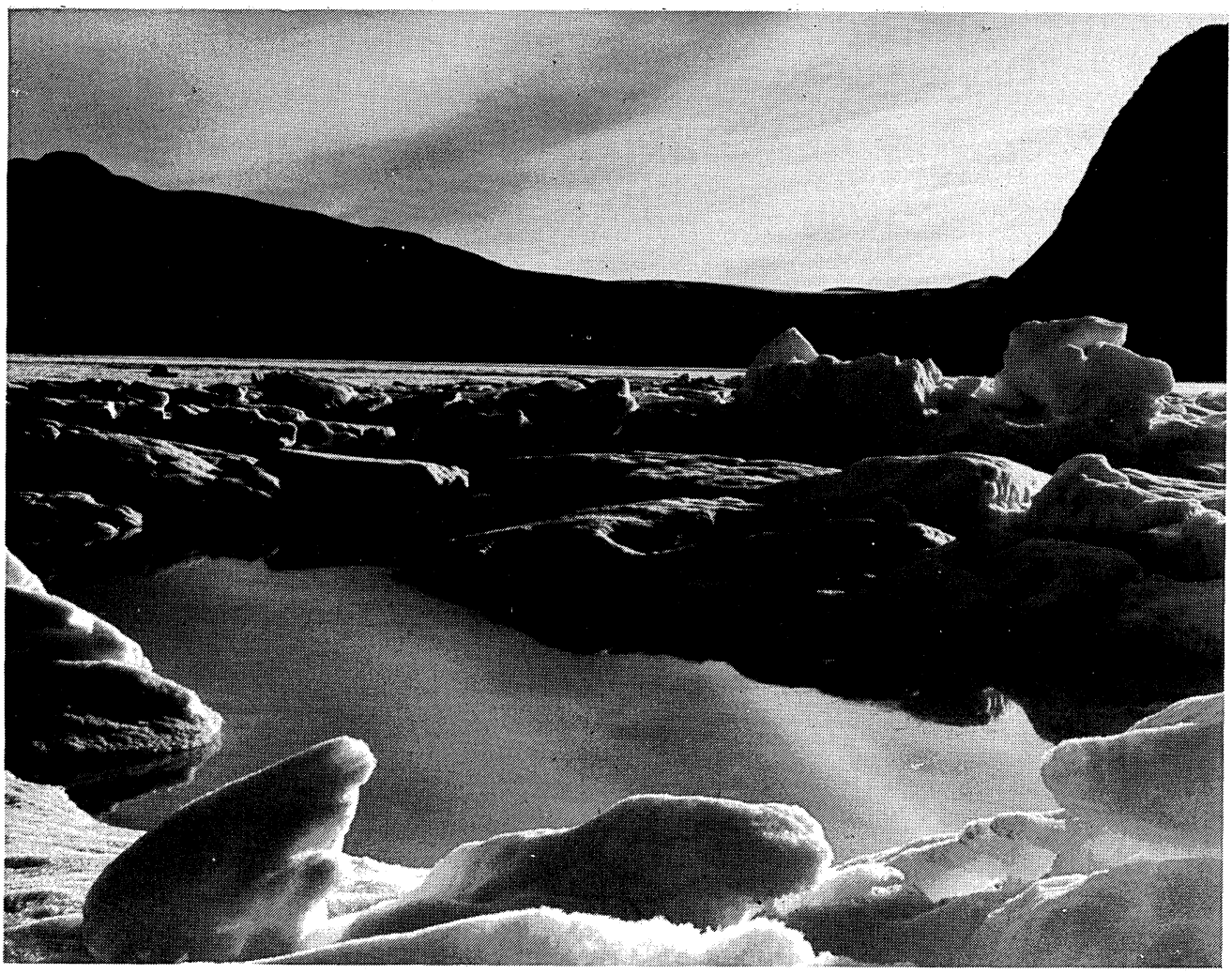


Figure 2 An Arctic landscape

Task Sheet

Work in pairs on these tasks.

Humans use **technology** to provide the things they need for survival and comfort.

Humans are intelligent enough to develop new technologies to cope with the changes in the environment in which they live. Until relatively recently the Inuit (Eskimo) people lived quite successfully in the far north of Canada with a technology that might have been familiar to our ancestors in the Ice Age 20 000 years ago.

Would you be able to use this technology to survive?

Task 1

List all the *resources* available to you.

Task 2

Using these resources, what *technology* would you use to ensure your survival? Illustrate your answers with simple sketches.

- *Food* What would you eat? How would you catch it? If it needs cooking, how would you cook it?
- *Water* How would you obtain enough drinking water? How can you turn ice or snow to water without losing large amounts through evaporation or storage problems? How might you use sea water?
- *Shelter* What kind of shelter would you build, and from what materials? What tools might you have to make to help build it?
- *Clothing* How would you make clothing and bedding?
- *Fire* If you need a fire, how could you start it and how would you keep it going?

Task 3

Compare your solutions with those of other class members.

- Which solutions would have worked and which not?
- Which were the best solutions?
- What experiments could you do in the laboratory to decide which solutions would work best?
- The exercise is about *technology*, but what *scientific knowledge* was needed to carry it out?
- What has the exercise made you think about the knowledge and skill of the Inuit people, who lived all their lives in these conditions?

Part 2 Thinking about technology

In this exercise you used simple, basic technology. Developed countries such as Britain often use higher-level technology. For example, a camp fire is basic technology, gas-fired central heating is higher-level technology. An abacus or counting frame is basic technology, a computer is high technology.

1 Compare and contrast basic technology and high-level technology. For example, you might discuss these points:

What examples are there of each?

Do they use a lot of resources and materials?

Are local resources used?

What is the impact on the environment?

Is there a pollution risk?

Do they lead to a high or low productivity of labour?

How much skill is needed to make the technology?

How much skill is needed to operate the technology?

How much skill is needed to maintain and service the technology?

How much scientific knowledge is needed to make the technology?

How much scientific knowledge is needed to operate the technology?

How much scientific knowledge is needed to maintain and service the technology?

2 What might happen if high-level technologies are suddenly introduced into a less developed country?

3 Do developed countries *always* need to use high-level technology? Can you think of examples of where basic technology could replace high-level technology in Britain?

4 Is it possible for countries to develop *without* high-level technology?

The Label at the Back — a look at clothing fibres

Contents: A home survey of clothing fibres, accompanied by information and questions on different fibres, natural and artificial.

Time: Homework plus two periods.

Intended use: GCSE Chemistry and Integrated Science. Links with work on fibres, polymers, proteins and cellulose. The information on the Factsheets is only an outline, and it is assumed that students will already have done some work on polymers, probably in conjunction with plastics. Questions 10 to 14 and Factsheet 3 are intended for use only with more able students.

Aims:

- To complement prior work on polymers
- To show the range of different natural and artificial fibres in use in modern garments
- To develop awareness of some of the factors influencing the choice of fibre for a particular application
- To provide opportunities to practise skills in the collection and presentation of data and the retrieval of information.

Requirements: Students' worksheets No. 405. In case some students are unable to carry out the survey at home, it would be useful to have a range of garments available in the lesson.

The unit is in three closely linked parts.

Part 1 Looking at clothing labels
The survey of clothing labels is best done for homework, though it would be possible to bring a range of garments into the class.

Part 2 Which are the most popular fibres?
Some coordination will be necessary when the class results are combined.

Part 3 Questions and activities
Questions 10 to 14 and Factsheet 3 are intended for use only with more able students.

Notes on some of the questions and activities

Q.1 Encourage the students to be imaginative and creative in the presentation of results.

Q.2 If time permits, it would be rewarding to collect and present the combined data on countries of manufacture. Note that a label stating 'Made in the UK' need only mean the garment was sewn in the UK. Both fibre and fabric could have been manufactured elsewhere.

Q.4 Reference might be made to the cool feel and high water absorbency of cotton. Many developing countries have a cotton-based fabric industry which originated from low-cost cotton, but are now experiencing difficulties due to the rising cost of cotton and the fact that it often has to be paid for in US dollars. Such countries are trying to move to other fibres that can be home-produced.

Q.10 From its structure, viscose might be expected to be similar to cotton, though in practice there are considerable differences due to the shorter chain lengths in viscose.

Q.12 The different amino-acid sequences in wool and silk give them different properties.

Q.14 The first regenerated fibres were developed in France and England in the 1880s, from wood pulp and simple chemicals like sodium hydroxide and carbon disulphide. The first fully synthetic fibre, nylon, was not produced until 1935, and synthetic fibre production did not really get under way until the 1950s, when the petrochemical revolution brought down the prices of raw materials.

Note on fabric construction

For simplicity, no mention is made in this unit of the importance of the methods used to convert fibre to yarn, and yarn to fabric. In particular, the type of fabric construction (knitted, woven, stitch-bonded, etc.) is very important in deciding the 'aesthetics' (comfort, handle, etc.) of the garment. Details can be found in Nuffield Home Economics, *Fibres and Fabrics.*

Extension work and other references

A great deal of practical investigation of fibres is possible. For example:

1 Testing the effect of heat on fibres, and comparing their appearance under the microscope (for example, Nuffield 13-16 *Keys and Detection*).

2 Testing the strength, water absorbency, etc., of different fibres (for example, LAMP, Science at Work).

3 Making nylon and rayon (LAMP, Science at Work)

There is an excellent and extensive treatment of fibres and fabrics in the Nuffield Home Economics course, published by Hutchinson. Other useful references:

LAMP Topic Brief No. 14: *Fibres and Fabrics* (ASE)
Science at Work: *Fibres and Fabrics* (Longman)

Acknowledgement Figures 1 and 2 supplied by Marks & Spencer.

THE LABEL AT THE BACK — a look at clothing fibres

Practically all clothes are made from fibres. But many different kinds of fibres are used to make clothes — cotton, polyester, wool and nylon are just a few. In this unit you will be using the labels in clothes to find out the fibres in them. Then you will be answering questions about the different fibres you come across.

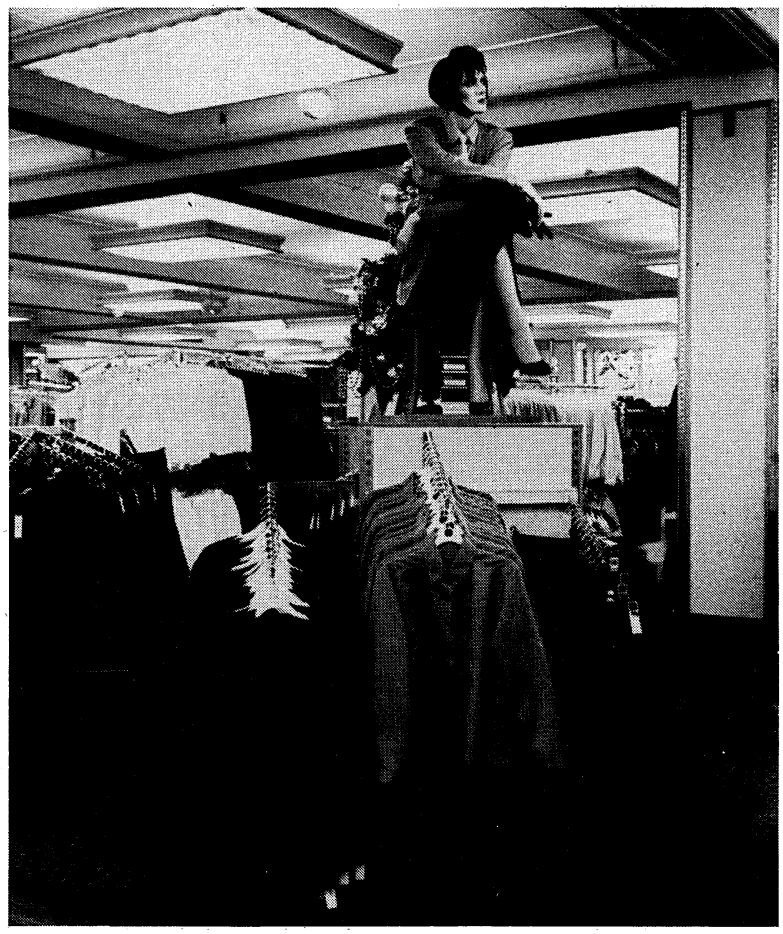


Figure 1 A wide range of fibres is represented in the clothes in a department store like this.

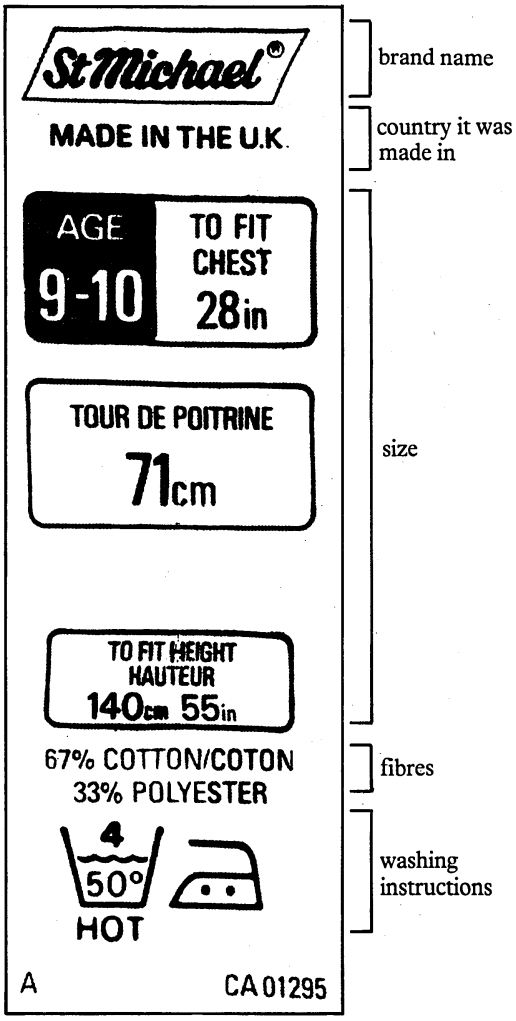


Figure 2 A typical clothing label

Part 1 Looking at clothing labels

This is best done at home. Look at a range of different garments — pullovers, dresses, trousers, shirts, blouses, skirts, night wear, jackets and so on. Each garment you choose must have a label in it showing what it is made from. Figure 2 shows a typical label.

A Draw up a table like Table 1. An example has been filled in to show you what to do.

Table 1

Garment	*Fibres it contains*	*Country it was made in*
Shirt	67% cotton 33% polyester	U.K.

B Enter the details for each garment in the table. You should include at least ten different garments in your survey.

C Many garments have a mixture of different fibres. Give the percentage of each fibre.

Part 2 Which are the most popular fibres?

Factsheet (1) lists the commonest fibres, and gives some of the other names they are known by.

A Draw up a table like Table 2.

B First enter your own results, in the second column. Count up the number of garments in which each fibre is present. It does not matter whether the fibre is part of a mixture or the only one present.

C Now collect the combined results of the whole class, and put them in the third column.

Table 2

Name of fibre	*Number of garments containing the fibre in your survey*	*Number of garments containing the fibre in the whole class combined*
Cotton		
Wool		
Silk		
Viscose		
Acetate		
Triacetate		
Nylon		
Polyester		
Acrylic		
All other fibres		

Part 3: Questions and activities

1 *Present the combined results for the whole class in a way that makes it easy to see which fibres are most popular. For example, you might draw a bar chart or a pie diagram. Try to make your diagram as clear and attractive as you can.*

2 *Apart from the UK (or Britain), which countries manufacture the garments in your survey? (You could collect these results from the whole class, and present them on a bar chart or other diagram.)*

Study Fibres Factsheet (1) before you answer questions 3 to 7.

3 *Why are silk garments uncommon?*

4 *In tropical countries, cotton is the most common fibre. Give one reason why this might be.*

5 *Choose one garment from your survey that needs to be particularly hard-wearing. What fibre is it made from? Why?*

6 *Choose one garment from your survey that needs to be particularly warm. What fibre is it made from? Why?*

7 *Choose two other garments from your survey. What fibres are they made from? In each case, say why you think these particular fibres were chosen.*

Study Fibres Factsheet (2) before you answer questions 8 and 9.

8 *Explain the difference between a synthetic fibre and a regenerated fibre.*

9 *Which was the most popular natural fibre in the class survey? Which was the most popular regenerated fibre? Which was the most popular synthetic fibre?*

Study Fibres Factsheet (3) before you answer questions 10 to 14.

10 Judging from chemical structures, which artificial fibre might you expect to have properties similar to cotton?

11 Suggest one reason why acetate is a low-price fibre.

12 Silk and wool are both protein fibres, yet their properties are very different. What differences between their protein chains might be responsible for their different properties?

13 Some fibres are described as 'cellulosic' fibres. Which fibres on the Factsheet are cellulosic?

14 Regenerated fibres have been used for about a hundred years, but synthetic fibres have only been in use for about fifty years. Suggest a reason for the difference.

Fibres Factsheet (1) Properties of Fibres

Name of fibre	*Other names used*	*Price range*	*Water absorbency* [a]	*Durability* [b]	*Other advantages and disadvantages*
Cotton		medium	high	medium	Feels comfortable, absorbs perspiration
Wool		high	high	high	Feels comfortable and looks attractive. Very warm when knitted
Silk		very high	high	high	Looks and feels attractive
Viscose	Rayon, Sarille, Modal	low	medium	low	
Acetate	Dicel	low	medium	low	
Triacetate	Tricel	medium	medium	low	
Nylon	Bri-nylon, polyamide	medium	low	high	Stretches, dries quickly, strong
Polyester	Terylene	medium	low	high	
Acrylic	Courtelle, Acrilan, Modacrylic, Orlon	medium	low	medium	Warm when knitted

[a] High water absorbency means the fibre attracts water. It can absorb quite a lot of water before it feels wet.

[b] High durability means the fibre is hard-wearing.

Fibres Factsheet (2) — What are Fibres made from?

Some fibres come from natural sources — plants or animals. Other fibres are artificial. Artificial fibres are of two sorts. Some are made by changing and improving natural fibres. These are called **regenerated** fibres. Others are completely artificial, made from non-living materials, usually oil. These are called **synthetic** fibres.

Figure 1 shows the main types of fibres.

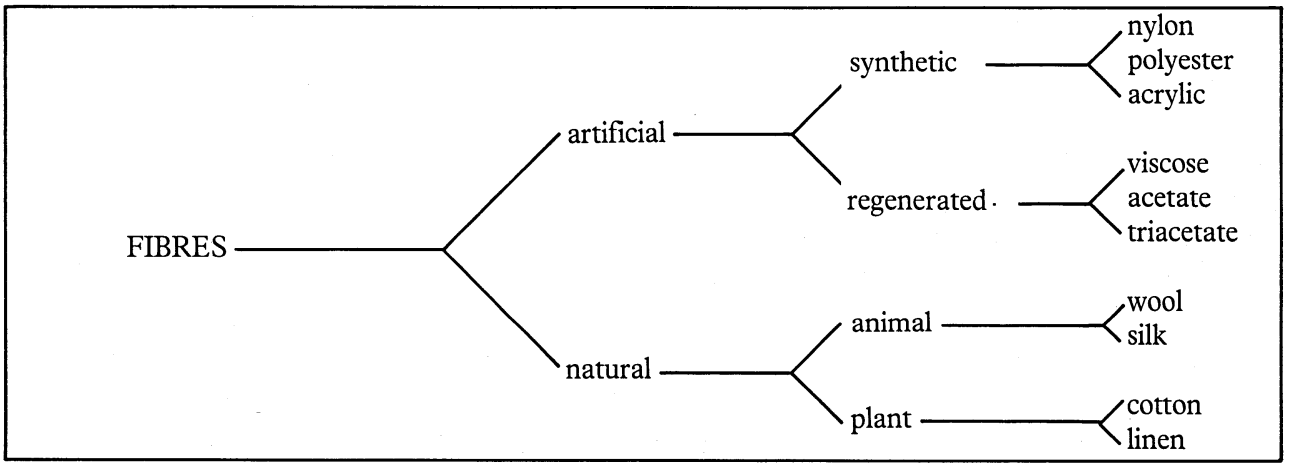


Figure 1 The main types of fibres

All fibres, whether artificial or natural, are **polymers**. That means they contain molecules which are long chains. These long molecular chains are made by joining together hundreds or thousands of smaller units, called **monomers**. For example, cotton is made of cellulose. Cellulose is a natural polymer made by joining together lots of glucose molecules. Glucose is the monomer of cellulose. The structure of cellulose is shown in Factsheet (3).

Natural fibres like cotton and wool are already in the form of long fibres. Artificial fibres have to be made in bulk as a thick liquid. The liquid is then **extruded** into fibres. This means it is forced through small holes, like toothpaste being forced out of a tube (Figure 2).

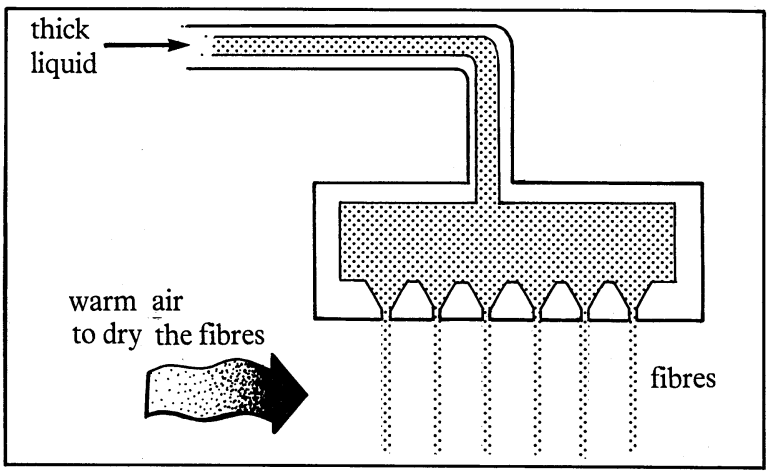
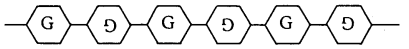
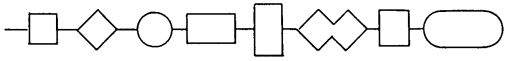
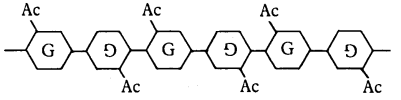
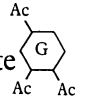
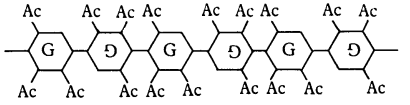
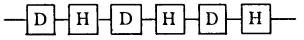
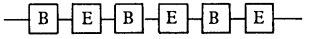
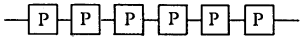


Figure 2 Extruding artificial fibres

Fibres Factsheet (3) gives more details about what the different fibres are made from.

Name of fibre	*How it is made*	*Polymer it contains*	*Monomer*	*Structure of part of the polymer*
Cotton	from the seed-boll of the cotton plant	cellulose	glucose 	
Wool	made by sheep	protein	amino-acids	 (there are 23 different-amino acids, each represented here by a different shape)
Silk	made by silk-worms	protein	amino-acids	as for wool
Viscose	by dissolving wood pulp in chemicals then extruding	cellulose (but shorter chains than cotton)	glucose	as for cotton
Acetate	by reacting wood pulp with acetic acid (Ac) then extruding	cellulose acetate	glucose acetate 	
Triacetate	like acetate but using extra acetic acid (Ac)	cellulose triacetate	glucose triacetate 	
Nylon	by reacting together 1,6-diaminohexane [D], and hexanedioic acid [H] these two chemicals are made from oil	(see structure →)		
Polyester	by reacting together benzene-1,2-dicarboxylic acid [B], and ethane-1-2 -diol [E] — these two chemicals are made from oil	(see structure →)		
Acrylic	by reacting propenenitrile [P] with itself — propenenitrile is made from oil	(see structure →)		

Blindness

Contents: Practical work, reading and questions on the nature, causes and treatment of blindness.

Time: 2 periods.

Intended use: GCSE Biology, Physics and Integrated Science. Links with work on the eye and defects of vision.

Aims:

- To complement and revise prior work on the eye
- To develop awareness of some of the problems faced by blind people
- To develop awareness of some of the causes of and treatments for blindness, particularly in developing countries
- To show some of the medical applications of modern technology
- To provide opportunities to experience some of the problems of blindness, and to practise skills in reading and comprehension.

Requirements: Students' worksheets No. 406. Blindfolds.

This unit is best used after conventional work on the eye and defects of vision.

The exercise in 'What is it like to be blind?' need not take long, but is important in order to give students a feel for the problems encountered by blind people. In school trials it was found to be a very effective way of getting students involved in the topic.

Notes on some of the questions

Qs 1 to 4 An extended version of this exercise, with accompanying information, is to be found in 'What is it like to be blind?', a leaflet produced by the Royal National Institute for the Blind (see 'Further resources' below).

One of the less obvious problems of blindness is the difficulty of conversation without the benefit of eye contact and body language.

Q. 5 As well as the white stick helping sighted people to identify a person who is blind, the stick itself is important for the blind person as a means of locating objects, by touch and by echo detection.

Q. 9 Mention could be made of the greater incidence of blinding tropical disease in the developing world, and of the lower level of medical provision.

Qs 10 and 11 are intended to encourage students to do a little research of their own, perhaps for homework. The notes below may be of help to the teacher.

Trachoma

Trachoma is a disease in which the conjunctiva and cornea are affected by a virus, leading to blindness. The disease is very common in Africa and the East. Up to one-sixth of the world's population may be affected.

Glaucoma

This disease is derived from abnormal pressures building up in the eyeball. As a result blood fails to reach the eye and loss of vision results. If it is discovered early enough progression can be halted.

Keratomalacia

Keratomalacia is caused by a deficiency of vitamin A in the diet. This disease leads to softening and eventual perforation of the retina.

Xerophthalmia

Xerophthalmia is common among the poor of many developing countries and is due to a deficiency of vitamin A. Its most serious consequence is defective vision, starting with night blindness and ending with total blindness.

Onchocerciasis (River Blindness)

Onchocerciasis is caused by the filarial worm, *Onchocerca volvulus*, which is transmitted by the black fly, *Simulium*. The larvae of the filarial worm are introduced into the skin by the bite of the fly. The worms migrate through the tissues, causing inflammation of the skin, enlargement of the lymphatic glands and inflammation of the eye, leading to blindness.

Rubella (German Measles)

Pregnant women infected with rubella virus may transmit this virus to the unborn child in the uterus. The risk of infection is highest during the first few weeks of pregnancy, when 50 per cent of infants will be affected. The risk falls to 4 per cent by the fourth month. The affected babies show one or more of the features of the congenital rubella syndrome. The commonest features are cataracts, deafness and heart defects. Girls are now immunised against rubella in their early teens.

Further resources

The Royal Commonwealth Society for the Blind have useful resources, including films, concerning the problem of blindness in developing countries. Royal Commonwealth Society for the Blind, Commonwealth House, Heath Road, Haywards Heath, West Sussex RH16 3AZ.

The Royal National Institute for the Blind (RNIB) will supply information concerning blindness, including samples of braille sheets and a key to the braille alphabet. The Royal National Institute for the Blind, Education Department, 224-228 Great Portland Street, London W1N 6AA.

Acknowledgements Figure 1 supplied by RNIB; Figure 2 is reproduced by permission from *Science* by Graham Hill and John Holman (Nelson); Figure 3 reproduced by permission of Royal Commonwealth Society for the Blind.

BLINDNESS

For those of us who are able to see, it is difficult to imagine what it would be like to be blind. *But more than 27 million people in the world are blind.* That is at least one in every 175 people.

Activity: What is it like to be blind?

It is difficult to imagine the problems we would meet if we were to become blind. In this experiment you are going to find out a little about the difficulties.

While you are doing the experiment, think about questions 1 to 4.

What you do

With your partner, decide who will be 'blind' first. The 'blind' person should put on the blindfold. Fasten it so that you cannot see anything, but do not make it too tight.

Once you are blindfolded you must not remove the blindfold at all until your turn has finished. The other person will act as the guide. You will be going for a walk around the school. It is up to the guide to make sure that the 'blind' person does not come into any danger.

Ask your teacher how long you may go out for. At 'half-time' change places.

When you return write your answers to questions 1 to 4.

Figure 1 This visually handicapped girl uses her sense of touch to find out about the donkey.

Questions

1 *What thing do you find most difficult about being 'blind'?*

2 *How would you find your way around the school on your own if you were blind?*

3 *What advice would you give to someone acting as a guide to a blind person?*

4 *In what ways is* conversation *difficult when you cannot see?*

What causes blindness?

Blindness has many causes. Accidents, disease, poor diet and old age can all lead to partial or total blindness. The following sections tell you about the causes of blindness, and some of the ways it can be cured. After reading, answer questions 5 to 11.

You may need to refer to Figure 2, which shows the main parts of the eye.

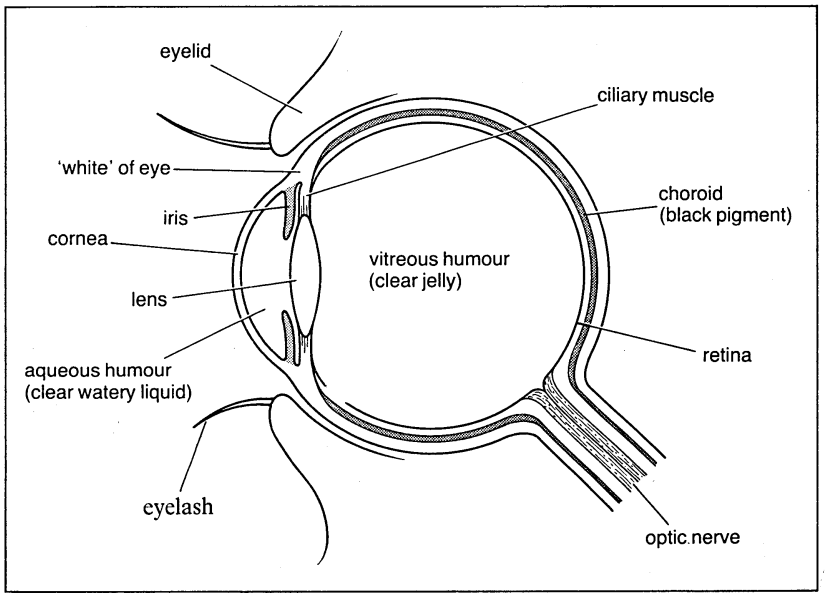


Figure 2 The main parts of the eye

Blindness in Britain

In Britain only a very small proportion of the population are blind, though this still amounts to 130 000 people. Blindness is most common among old people. The biggest cause of blindness is diabetes, which affects about 600 000 people.

Diabetes may cause the blood vessels in the eye to grow abnormally. The vessels may weaken and spill blood on the retina. This may disturb vision or even cause blindness. The vessels can be sealed by welding them with a fine laser beam.

Not all blind people are *totally* blind. In Britain people are **registered blind** if they are unable to read the top letter in an eyesight test from three metres or less. People with only a tiny bit of vision left can learn to use it very effectively.

Cataracts are another serious cause of blindness in Britain (see below).

Blindness in tropical countries

In the tropical countries of the world the problem of blindness is often far greater than in Britain. Blindness is usually caused by tropical diseases which are often not treated until too late.

For example, in parts of tropical Africa and Central America one of the major causes of blindness is a small black fly. The fly passes on a small parasite worm when it bites the skin of the victim. The worm travels through the body and causes inflammation of the eye. If it is not treated, the disease causes blindness. Because the fly breeds in rivers the disease is called **River Blindness**.

River Blindness is increasing as the number of dams and irrigation schemes in developing countries grow. These areas provide suitable habitats for the black fly. Up to 80 per cent infection occurs in some areas. In some villages all the adults are blind. People will often move away from land where there is running water to less fertile land to avoid infection.

The fly can be controlled by removing the vegetation from near the water or by using insecticides like DDT. River blindness was wiped out in Kenya by the use of DDT, but this has side effects on other animal life.

Cataracts

Sometimes the eye lens becomes clouded. This causes blurred vision, and eventually blindness. This disease is called **cataract**. The problem usually occurs in old age and is particularly common in developing countries.

The blindness can be cured by removing the lens. 3000 years ago surgeons would push the lens down into the eye 'out of the way'. The operation was sometimes successful.

In India 5.5 million people are unable to see because they have cataracts. The cure is simple — remove the clouded lens and fit the patient with glasses. However, there are few eye hospitals in India and most patients cannot afford treatment. The solution to this problem is 'Eye Camps'.

Eye Camps

Before the arrival of the Eye Camp, advance notices are posted on trees or taken round by a man on a bicycle. Nurses and equipment arrive, and the clinic is set up. Sometimes it is in a local building, but often tents are used.

A temporary operating theatre is set up and patients are examined and treated. Surgeons may operate on up to 200 patients in a day, removing a diseased lens in five minutes. Ten days later the bandages are removed and the patient is fitted with glasses — their sight restored.

The first Eye Camps were organized in India. They were so successful that the idea has spread to Pakistan, Bangladesh and Sri Lanka.

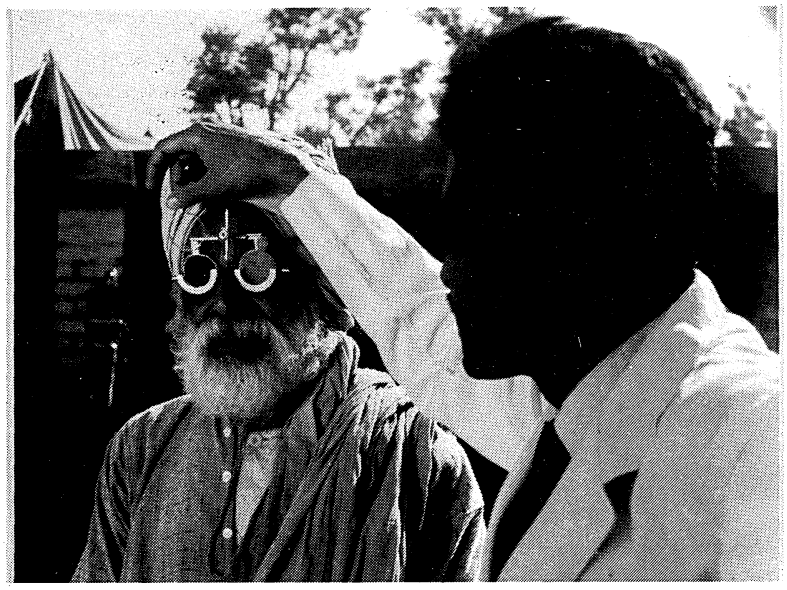


Figure 3 A patient having his eyes tested after a successful operation in an Indian Eye Camp.

A more sophisticated cataract operation uses ultrasonic vibrations. The tip of an ultrasonic vibrator is inserted through a small cut in the cornea. Very high frequency vibrations cause the lens to break up. The inside of the eye is then flushed with water and the pieces of lens are washed away. The patient is then given glasses or a contact lens.

Questions to answer and discuss

5 *Why do blind people carry white sticks?*

6 *Education is difficult for blind children. In Britain, blind children often go to special boarding schools. But more and more blind children are being educated in normal schools.*
What problems are there with each type of education? Which do you think you would prefer if you were blind?

7 *What is your attitude to blind people? How do you feel when you meet or see a blind person?*

8 *In what ways has modern technology helped improve the treatment of blindness?*

9 *Why are there relatively fewer blind people in Britain than in the developing world?*

10 *Occasionally babies are born blind. How would this affect the way they develop in the first few months of life? Try to find out what causes babies to be blind.*

11 *Glaucoma and trachoma are diseases which frequently cause blindness. Find out more about these and other blinding diseases.*