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.

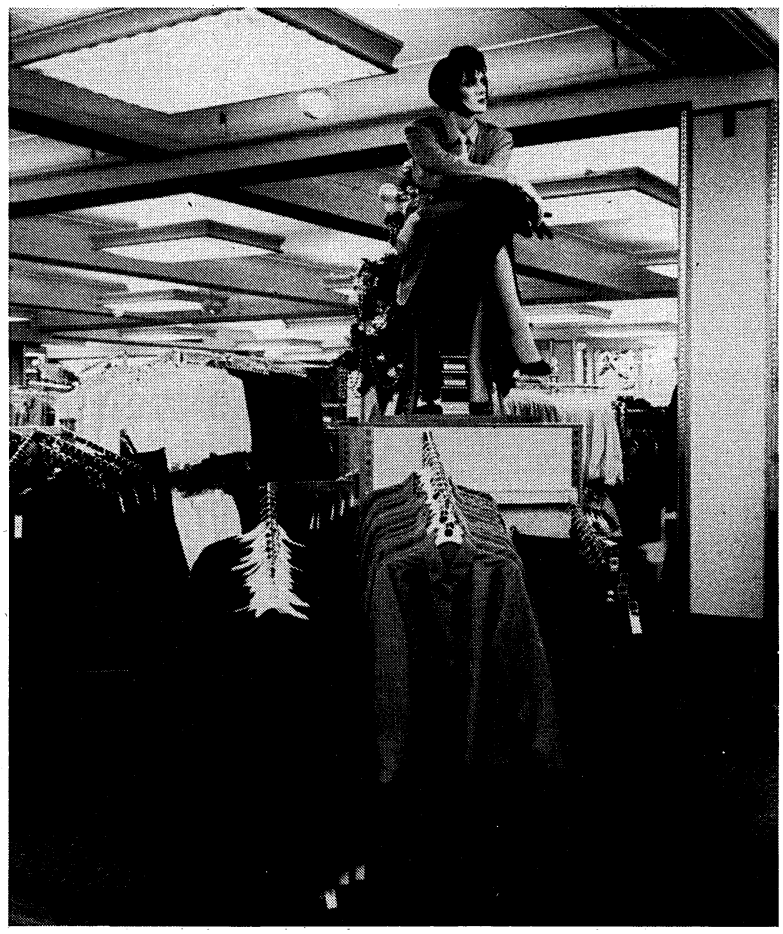


Figure 1 A wide range of fibres is represented in the clothes in a department store like this.

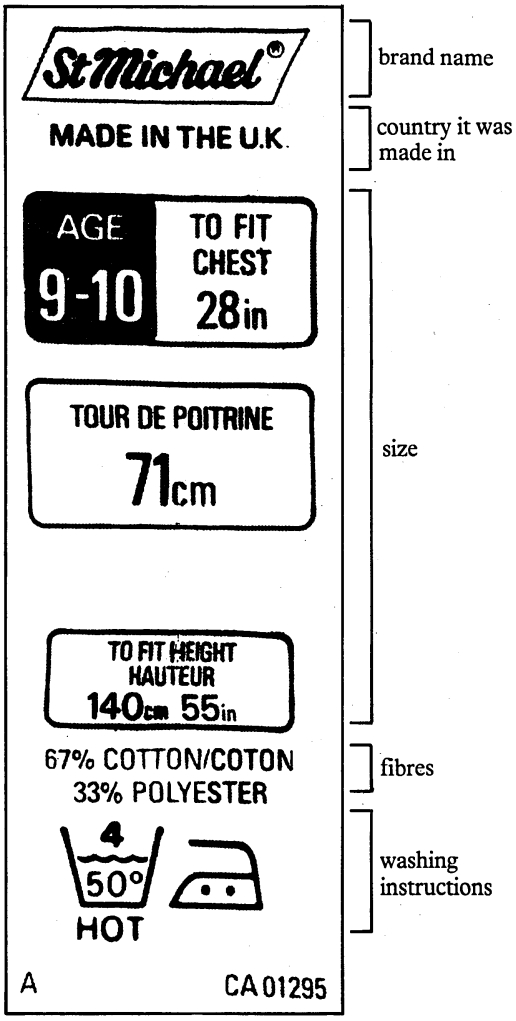


Figure 2 A typical clothing label

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.

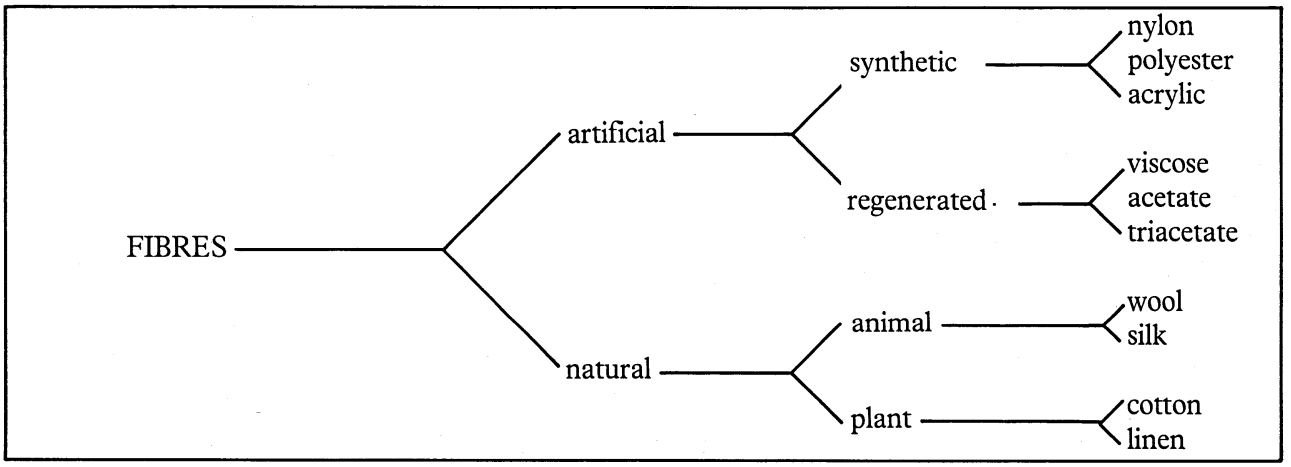


Figure 1 The main types of fibres

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).

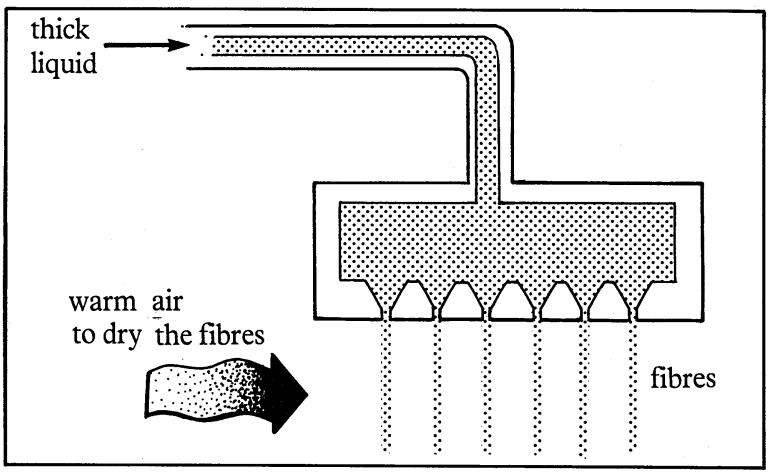
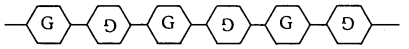
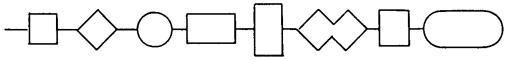
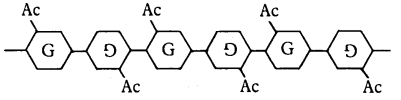
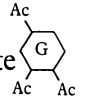
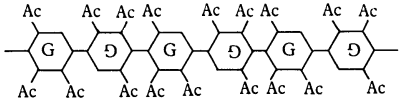
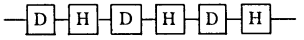
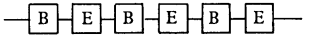


Figure 2 Extruding artificial fibres

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 →)