

Disposable Nappies

Contents: Survey, decision-making and practical work concerning the science and technology of disposable nappies.

Time: Part 1 can be done at home. Part 2 needs 1 to 2 periods. Part 3 will probably need a minimum of 2 periods.

Intended use: GCSE Chemistry and Science. Links with work on polymers and materials.

Aims:

- To complement and illustrate work on polymers and the uses of materials
- To develop awareness of the involvement of science and technology in the design and manufacture of a familiar consumer product
- To illustrate the way in which the materials for a particular application are selected according to their properties
- To illustrate the way in which scientists and technologists can develop particular materials to suit particular needs
- To provide opportunities to practise a range of skills, including information-gathering, decision-making and experimental design

Requirements: Students' worksheets No.910. It would be useful to have one or two disposable nappies of different brands available, particularly if Part 1 is to be omitted.

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The unit is in three parts

Parts 1 and 3 are optional, though Part 1, which can be done for homework, provides a good lead-in to Part 2. In addition there are optional information sheets (pages 5 and 6). Students should **not** be given the extra information until **after** they have done Part 2.

When they have studied this unit, students may be interested to discuss the wider environmental and resource implications of replacing a renewable, washable product with a non-renewable, disposable one.

Part 1 What's the problem?

Finding out what makes a good nappy. A homework survey. Groups of students might be asked to present a report of their findings before tackling Part 2.

Part 2 Choosing the right materials

A decision-making exercise in which students select suitable materials for a disposable nappy. Superabsorbent polymer can vary in its composition. It is usually a starch-polyacrylate copolymer.

Part 3 Comparing nappies

Practical work in which students are asked to plan and carry out a method for comparing nappies.

Effective testing is the key to successful marketing of a product. The commercial procedure for testing absorbency is as follows:

Stamp out a disc of the absorbent material.

Weigh the dry sample.

Put the sample in a 'tea bag', seal it and drop it into a saline solution for a measured time.

Remove the sample from the solution and allow to drain for 10 minutes.

Re-weigh.

Acknowledgements Figure 1 supplied by Peaudouce; Figure 4 reproduced by permission of MODO Converting Machinery AB.

DISPOSABLE NAPPIES

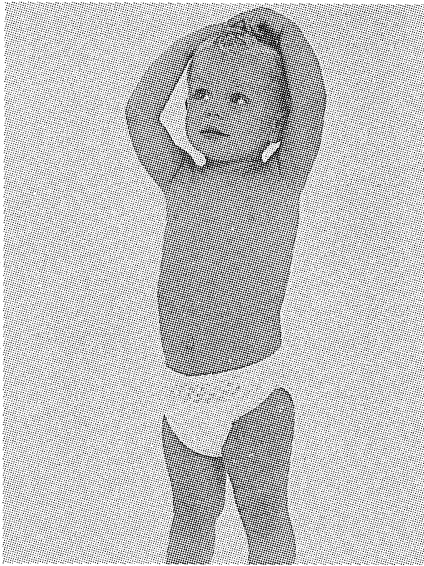


Figure 1

Millions of disposable nappies are used in Britain every day. In this unit you will ask what makes a good disposable nappy. You will look at the materials they are made from, and see that disposable nappies involve a lot of science and technology.

The unit is in three parts :

- Part 1* What's the problem? (Finding out what makes a good nappy)
- Part 2* Choosing the right materials
- Part 3* Comparing nappies.

Part 1 What's the problem?

We all start life wearing nappies but we cannot remember what it felt like. The people who know about nappies are the parents of young children. To find out about nappies you will have to find out what the parents think.

- What are the advantages and disadvantages of washable nappies?
- What are the advantages and disadvantages of disposable nappies?
- What makes a good disposable nappy?

Try to answer these questions by collecting opinions from as many people as possible with recent experience of looking after babies. With the help of other members of your class, interview neighbours, friends and relations who may be able to help you.

While making your survey try to examine as many types of nappy as you can.

Answer question 1 to make sure that you understand some of the key words used in this unit.

Question

- 1 What do these words mean:
- disposable*
 - absorbent*
 - biodegradable*
 - flammable*
 - opaque?*
- (A dictionary will help you)

Part 2 Choosing the right materials

If you have done Part 1, you'll know that a good disposable nappy needs some important properties. It needs to be:

- Absorbent — to soak up lots of liquid
- Leak-proof — so liquid cannot leak out at legs or waistband
- Comfortable — for the baby to wear
- Disposable — the nappy may be disposed of by burning or breakdown by bacteria.

Figure 2 shows a typical disposable nappy.

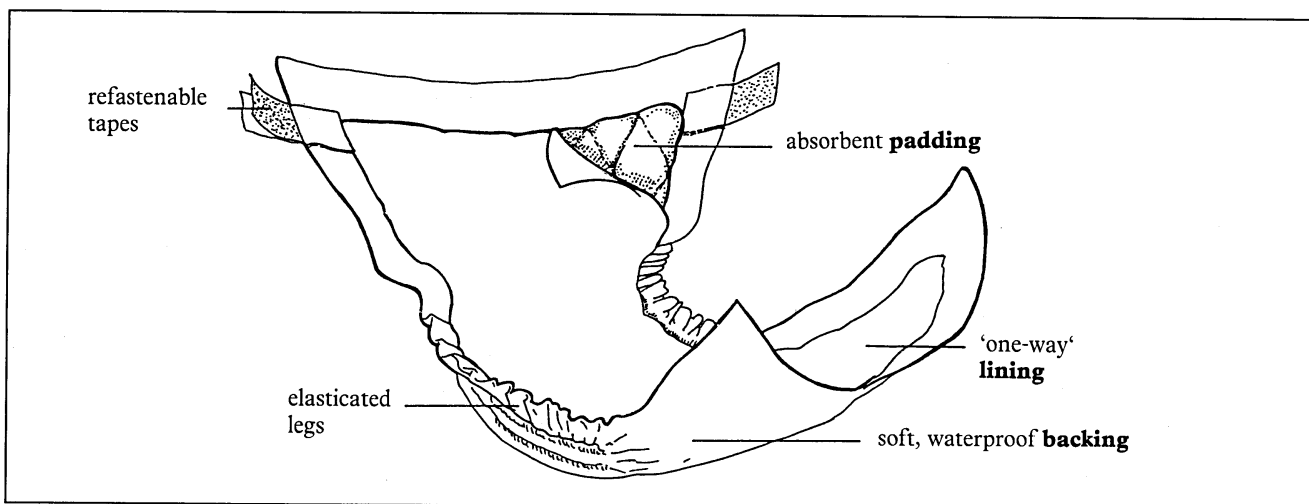


Figure 2 A typical disposable nappy

The **padding** has to be as water-absorbent as possible. The **backing** has to be completely waterproof, but soft. The **lining** has to let water pass through it to the padding. But the lining itself must stay as dry as possible so the baby's skin stays dry.

Table 1 (page 3) shows some materials that might be used in a disposable nappy. You can use the table to answer questions 2 to 7. The information in the 'box' below may help you. It explains why some materials absorb water better than others.

Why do some materials absorb water better than others?

Water contains H_2O molecules.



The O-H group of atoms attracts other O-H groups. This is what holds water together as a liquid.

Other substances also contain O-H groups. Cellulose has long chains of atoms with many OH groups attached to the chain. These O-H groups attract water molecules. That is why cellulose can absorb a lot of water (Figure 3). Cotton and tissue paper consist of cellulose. Rayon is a form of cellulose which has been modified chemically.

'Superabsorbent polymer' was specially developed by scientists to absorb large amounts of water. It forms a kind of jelly which holds the water under pressure. It has lots of O-H groups to attract H_2O molecules, and also has other groups of atoms which attract water. Polythene, on the other hand, has no O-H groups. It has no attraction at all for water — it is waterproof.

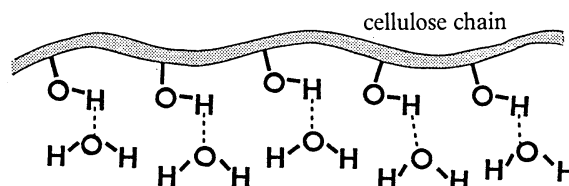


Figure 3

Table 1 Materials that might be used to make disposable nappies

Material	Description	Price	Bio-degradable?	Flammable?	Water-proof?	Water absorbent?	Strength	Softness
Non-woven polypropylene fabric	see box below table	low	no	yes	no	no	strong	soft
Non-woven rayon fabric	see box below table	low	yes	yes	no	yes	strong	soft
Woven cotton cloth	white cloth like sheets	high	yes	yes	no	yes	strong	soft
Aluminium foil	shiny foil	medium	no	no	yes	no	strong	hard
Clear polythene sheeting	clear plastic sheet	low	no	yes	yes	no	strong	soft
Whitened polythene sheeting	opaque, white plastic sheet	low	no	yes	yes	no	strong	soft
Fluffed cellulose pulp (made from wood)	like cotton wool	low	yes	yes	no	yes	weak	soft
Superabsorbent polymer	like cotton wool	high	yes, but slowly	yes	no	very	weak	soft
Tissue paper	creped cellulose	low	yes	yes	no	yes	weak	soft

Questions

- 2 *Imagine you are a disposable nappy manufacturer. Which material or materials would you choose for the backing? Give reasons for your choice.*
- 3 *Which material or materials would you choose for the padding? Give reasons for your choice.*
- 4 *Which material or materials would you choose for the lining? Give reasons for your choice.*
- 5 *Are there any materials you would like to use but which are not in the table?*
- 6 *Now draw a cross-sectional diagram through the middle of the nappy to show how the different materials would be fitted together. (Your diagram should show the nappy as if it had been cut in half across the middle.)*
- 7 *Having designed your nappy, you now have to market it. Design a poster advertising your nappy. The poster should show clearly what you think are the nappy's strong selling points.*

What are non-woven fabrics?

Traditional fabrics are made by weaving long fibres. Non-woven fabrics are produced by pressing and bonding much shorter fibres.

Non-woven fabrics are now common. They are used to make cloths for wiping up kitchen spills, as well as disposable towels, aprons and nappies.

Toilet paper and kitchen rolls are also examples of non-woven materials made from short fibres.

Part 3 Comparing nappies

Try comparing the effectiveness of different brands of disposable nappy.

- You might test the absorbent padding to see how much water it will soak up.
- Some manufacturers claim that their nappies have 'one-way' linings. You could test the linings to see if the claims are true.
- You could test the sticky tapes used to fasten the nappy. Are the tapes strong enough to hold the nappy on an active baby? Does the adhesive hold fast even when the nappy gets wet?

Plan a method to help you make the comparison before you start. Bear in mind these points:

- Your comparisons must be **fair**. How will you make sure each brand is tested in the same way?
- Your comparisons must be **reliable**. Will you be able to defend your method if a nappy manufacturer says your results are inaccurate?

Further information

Disposable nappies are very big business. In 1987, £200 million was spent on disposable nappies sold in the UK.

The structure of a disposable nappy

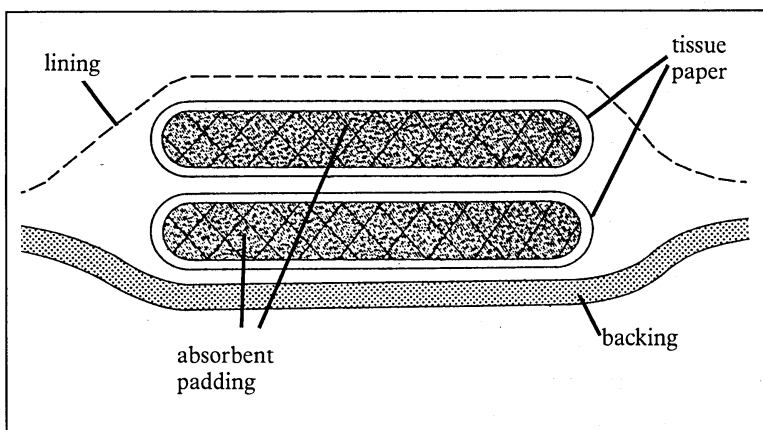


Figure 3 A cross-section showing the construction of a typical disposable nappy

The **backing** is polythene sheeting. The polythene is whitened so that you cannot see through it.

The **absorbent padding** is usually cellulose fluff pulp. It is made from wood pulp and fluffed up to give a high surface area. The fluff pulp is usually wrapped around with tissue paper. The best quality nappies have 'superabsorbent polymer' mixed with the cellulose pulp. 'Superabsorbent polymer' has the advantage of absorbing a large amount of water into a small volume. It forms a gel which traps the water and holds it under pressure.

The **lining** is a non-woven material, usually polypropylene. Polyester or rayon are sometimes used. The advantage of rayon is that it is biodegradable.

Disposal

Disposable nappies cannot be flushed down the toilet whole. One possibility is to tear the padding and lining away from the backing in strips before flushing it away. The backing can then be disposed of separately. As much of the nappy as possible should be biodegradable with this type of disposal.

Another disposal method is to put the whole nappy in the dustbin. There may be hygiene problems if the nappy is very dirty.

Investigation

Try removing some filling from a nappy.

Look at a little of the filling with the help of a hand lens or microscope.

Add some water and leave it for a few seconds. Small lumps of gel can be seen among the cellulose fibres if the filling includes superabsorbent polymer.

Manufacturing nappies

Once the materials for a nappy are decided, the nappies must be manufactured in huge quantities (see question 8). Figure 4 shows a typical machine used to make disposable nappies.

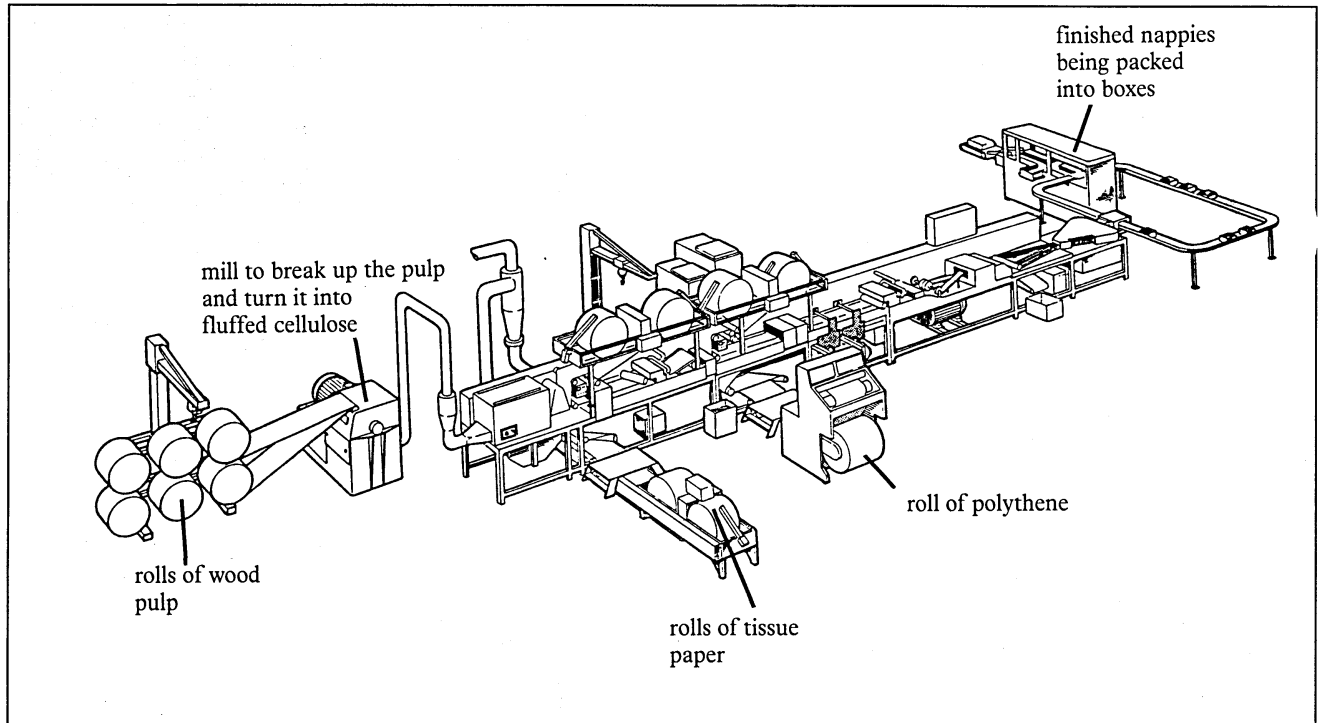


Figure 4

The machine shown in Figure 4 can produce up to 500 disposable nappies each minute. One operator, two packers and a part-time supervisor are the only people needed to run the machine.

Now answer question 8.

Question

- 8 There are about 2 million babies in Britain. About half of them wear disposable nappies. Suppose a baby uses an average of 5 nappies a day. How many nappies must be manufactured each day to meet Britain's needs?

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SATIS 9

List of units in this book

901 THE CHINESE CANCER DETECTIVES

Reading, questions, role-play and practical work related to the story of the identification of the cause of oesophageal cancer in Lin Xian, China.

902 ACID RAIN

A structured discussion about the problems of acid rain.

903 WHAT ARE THE SOUNDS OF MUSIC?

Reading and questions about sound and music, together with suggested teacher demonstrations and class investigations.

904 WHICH BLEACH?

Survey, practical work and questions about the consumer testing of bleaches.

905 THE IMPACT OF INFORMATION TECHNOLOGY

Reading, questions and discussion activities about the impact of information technology on our lives.

906 IT IN GREENHOUSES

Reading and questions about the use of information technology to control the environment in greenhouses.

907 YOUR STARS — REVELATION OR REASSURANCE?

A practical investigation of the validity of astrology.

908 WHY NOT COMBINED HEAT AND POWER?

Reading, questions and data analysis concerning the use of hot water and steam from power stations to run industrial processes and to heat homes.

909 AIDS

Activities and factsheets concerning AIDS, its causes, transmission and prevention.

910 DISPOSABLE NAPPIES

Survey, decision-making and practical work concerning the science and technology of disposable nappies.

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