SCIENCE & TECHNOLOGY IN SOCIETY

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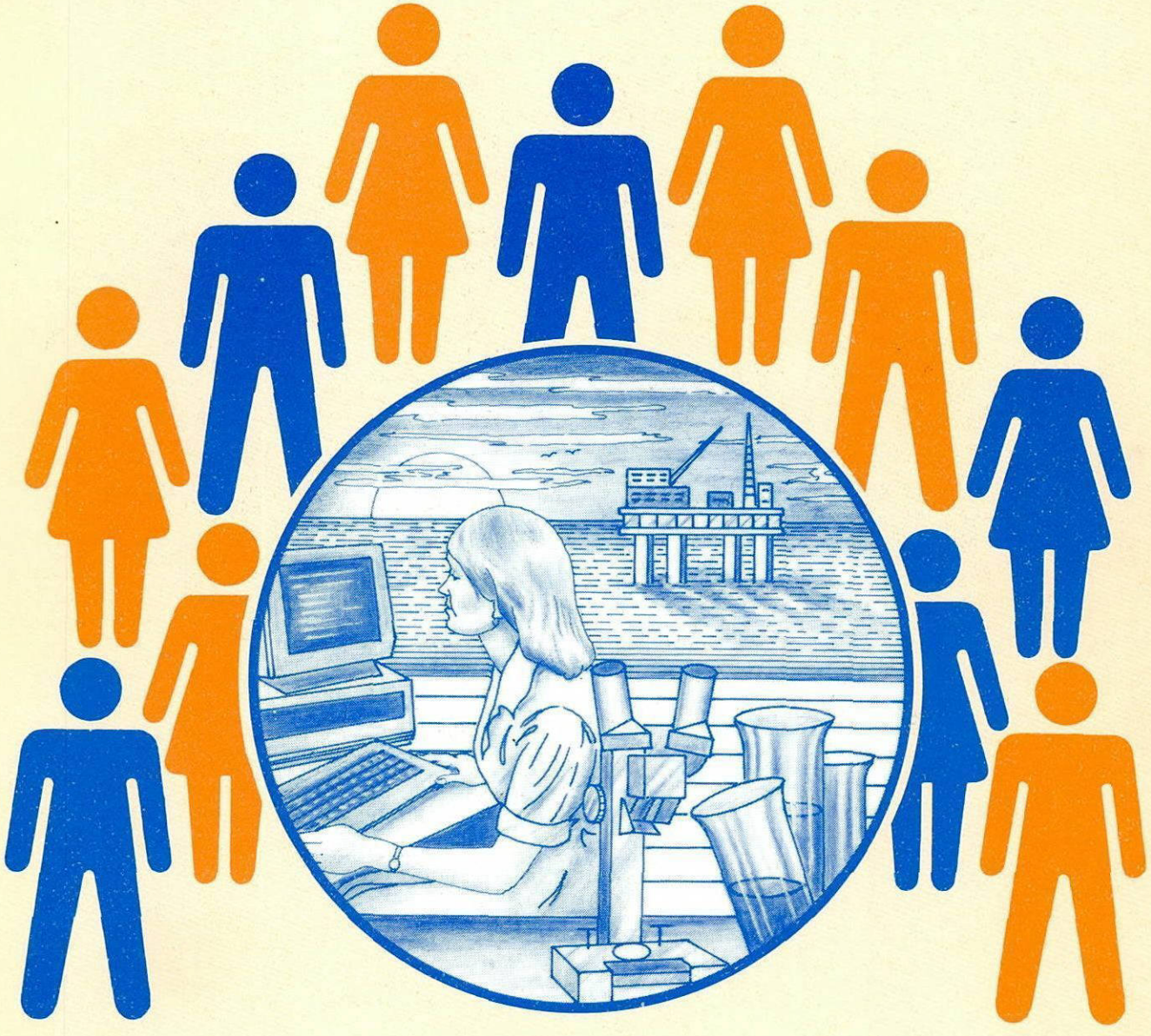

ASE

SATIS

ABOUT SATIS

Science and Technology in Society units are designed to be used in conjunction with conventional science courses, particularly those leading to GCSE examinations. Each unit has links to major science topics as well as exploring important social and technological applications and issues.

The units are self-contained and generally require about 2 periods (around 75 minutes) of classroom time. Each unit comprises Teachers' Notes (blue sheets) and Students' materials (white sheets). Full guidance on use is given in the Teachers' Notes accompanying each unit, which also include background information and suggest further resources.

Each SATIS book contains ten units. The units are numbered in a system giving the number of the book followed by the number of the unit within that book. Thus the first unit in the first SATIS book is numbered 101.

In addition to the SATIS books, a general Teacher's Guide to the project is available, giving guidance on some of the teaching techniques involved as well as ideas for further activities.

Many people from schools, universities, industry and the professions have contributed to the writing, development and trials of the SATIS project. A full list of contributors appears in the Teachers' Guide.

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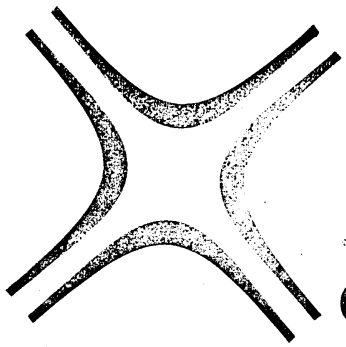
SATIS 5

List of units in this book.



The Association for Science Education
College Lane
Hatfield
Herts AL10 9AA

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Bridges

Contents: A survey of bridges leading to consideration of bridge design, the choice of materials for bridge construction, and optional practical work.

Time: 2 to 8 periods, depending on number of parts done. Homework time could be used.

Intended use: GCSE Physics, Integrated Science or Technology. Links with work on forces, structures and materials.

Aims:

- To complement work on forces, structures and materials
- To develop awareness of the importance of design and materials selection in bridge construction
- To encourage students to look for applications of science and engineering in the world around them
- To provide opportunities to practise a variety of skills, including observation, interpretation, comprehension, problem-solving and design.

Requirements: Students' worksheets No. 501.

- *For Part 1* see notes below
- *For Part 4* if the design task is undertaken, it will be necessary to provide the class with a range of materials. See page 7 for details.

This unit is in four parts. It is not intended that all four parts should necessarily be attempted.

Part 1 Looking at bridges The survey of a range of bridges is a useful initial stimulus for the unit. It can be tackled in a number of ways.

(a) Using slides showing familiar bridges. Up to about twenty-five slides will be needed. It is best if most of these slides are local, and the production of the slide set can be an interesting project for a keen photographer or for members of a photography club. The slides should cover a range of bridge types and show a variety of materials (wood, stone, brick, cast iron, steel, concrete). Just a plank of wood across a ditch can be regarded as a bridge.

(b) Sending students out to look at local bridges. Obviously this procedure is more time-consuming, though homework time can be used and students can be given an extended period to carry out the task. Students could be encouraged to look for bridges on their way to and from school. Alternatively, the teacher might produce a local map showing the location of bridges which students can visit.

The final column of the table headed 'Notes' can be used to give the name of the bridge, state its location, give the date of construction, etc.

Part 2 Why are bridges shaped the way they are? This part looks at some simple principles of bridge design.

Part 3 What are bridges made from? This part takes a brief look at the materials used for bridge construction.

Part 4 Design your own bridge This optional practical work is intended as an open-ended, problem-solving design-and-build task. The paper bridge can be built quite quickly, but more complex bridges made from other materials may need an extended period.

Further questions and activities

If the teacher wishes, and if time permits, further discussion of bridges might be stimulated by the following questions:

1 Which local bridges are made of local building materials? Which local bridges are made from materials brought from elsewhere?

2 What were bridges usually made of three hundred years ago? What materials were used to make the bridges built when the canals were being constructed (1760–1830)? What did the engineers who built the railways use to make their bridges (1830–1890)? What do civil engineers now use to make motorway bridges?

3 Why are suspension bridges made of steel and not concrete? Why are many motorway bridges made of concrete and not steel? Why are large concrete bridges reinforced with steel? Compare the advantages and disadvantages of steel and concrete as bridge building materials.

4 'Suspension bridges are really arch bridges upside down'. Explain.

5 Make a study of bridges which move. Why are moving bridges necessary and why do engineers use different types of moving bridges in different situations? Possible examples:

Tower Bridge, which is a bascule bridge
The lift and the transporter bridges over the Tees at Middlesbrough
Pontoon bridges used by armies
The Barton swing aqueduct
Canal swing bridges on the Leeds–Liverpool canal
Canal lift bridges on the Oxford and Llangollen canals
Drawbridges in castles.

6 More advanced work could involve calculations using data for real bridges, to get some idea of the magnitude of the forces involved. Data is available from the organization which manages the bridge.

Further resources

The Federation of Civil Engineering Contractors publish a wallchart and copyright-free set of teachers' notes called *Spanning the Centuries.* They include a plan for ten lessons on bridges as well as ideas for projects, visits and discussions. From the Federation of Civil Engineering Contractors, Cowdray House, 6 Portugal Street, London WC2A 2HH.

The Physics Curriculum Development Project (PLON) from the Netherlands includes an excellent short module on bridges, from which parts of this unit were developed. The module has been translated into English and is available from: PLON, Physics Education Department, State University of Utrecht, PO Box 80-008, 3508 TA Utrecht, The Netherlands.

Acknowledgements Figures 2, 4, 5, 6, 7, 9 and 10 are reproduced by permission of State University of Utrecht, PLON.

BRIDGES

Bridges are everywhere and of all sorts of shapes and sizes. Figure 1 shows some of the main types. In this unit you will be looking at examples of bridges and finding out why bridges are built the way they are.

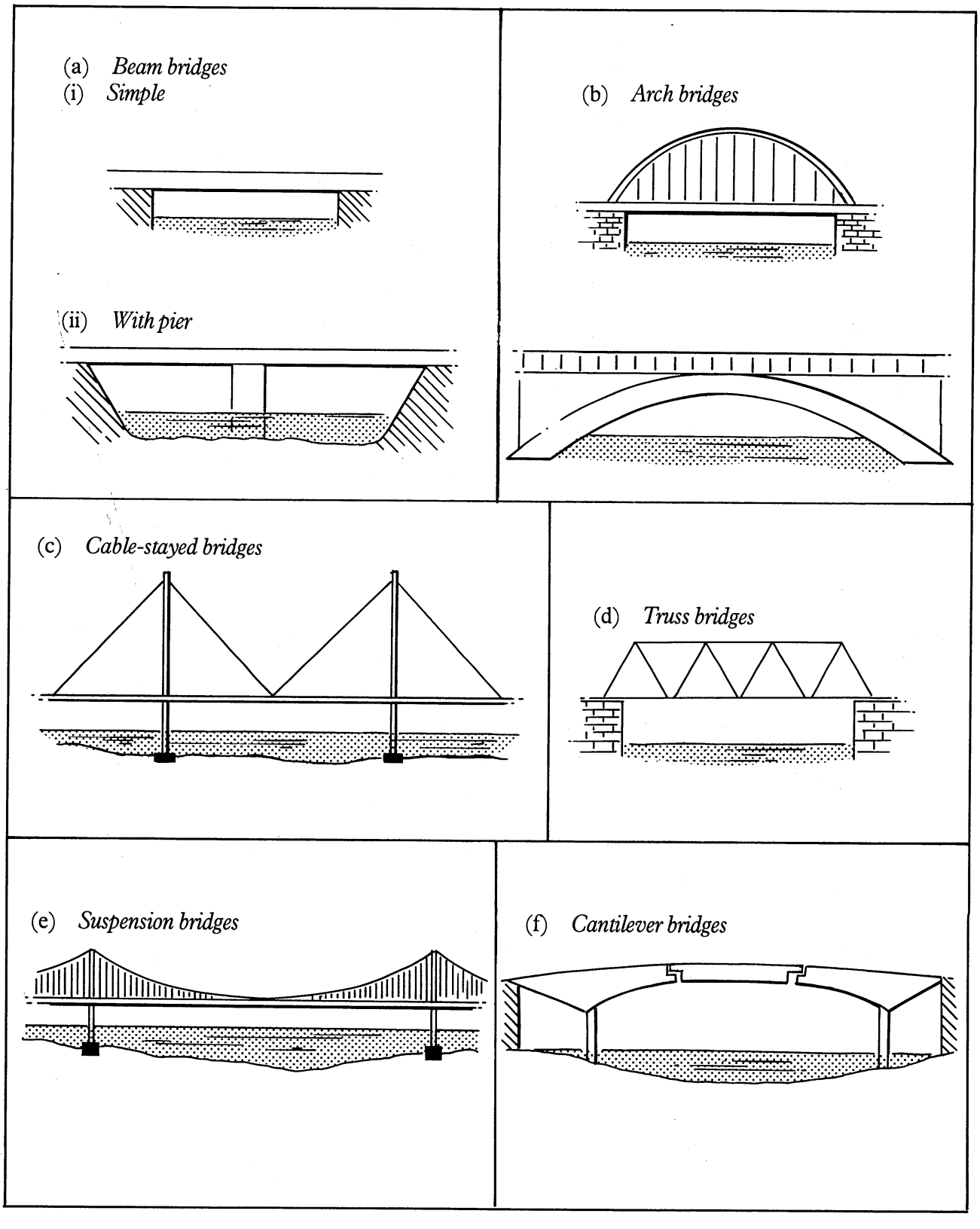


Figure 1 Some of the main types of bridges

Part 1 Looking at bridges

Your teacher may show you some pictures of bridges, or you may make a local survey of bridges.

Draw up a table like the one shown below. As you look at the bridges, fill in the table. The diagrams in Figure 1 should help you decide the type of bridge. If you are not sure of the type, leave the first column blank for the time being.

No.	*What type of bridge is it?*	*What is the bridge made of?*	*What goes over the bridge?*	*What goes under the bridge?*	*Notes*
1					
2					
3					
4					
5					
6					
7					
8					
9					
10					

When you have done your survey, you can go on to Parts 2 and 3. These tell you more about the different types of bridges and the materials they are made from.

Part 2 Why are bridges shaped the way they are?

The main problem with bridges is that they tend to bend, like the simple beam bridge in Figure 2.

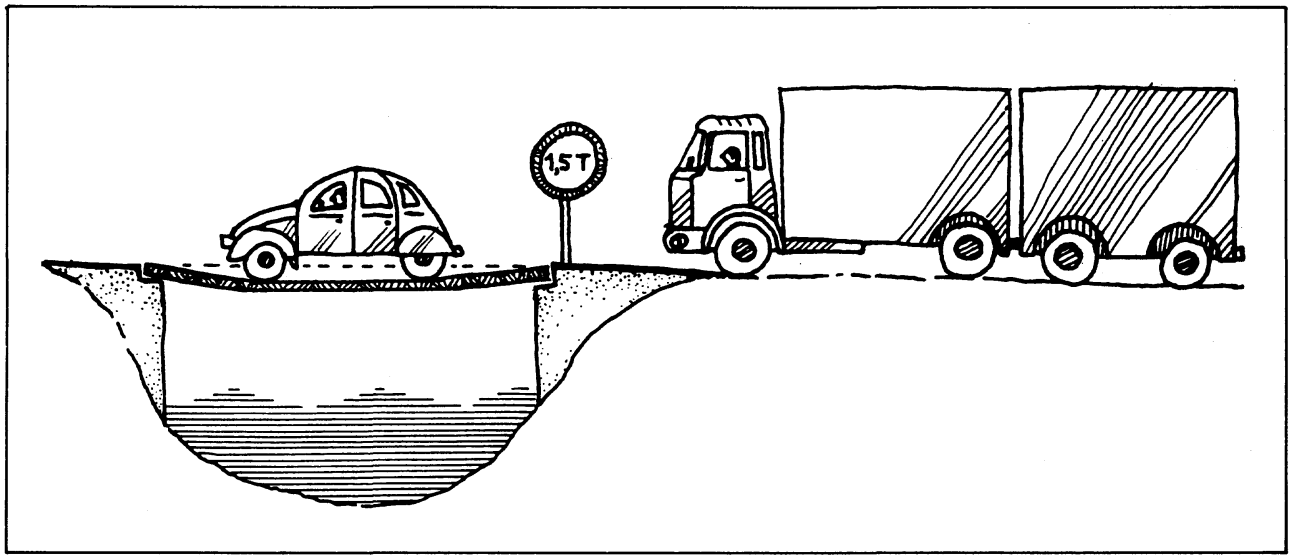


Figure 2 A simple beam bridge bends easily

Bending forces

When something bends, forces are set up in it. Figure 3 shows how the top part has compression forces, which squeeze. The bottom part has tension forces, which stretch.

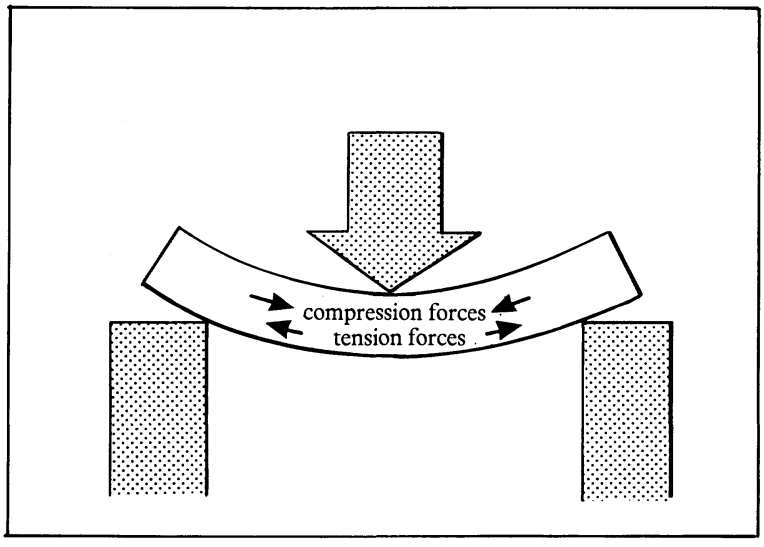


Figure 3 Compression and tension forces in a bending beam

By transferring these forces somewhere else, we can stop the bridge bending too much.

Beam bridges with piers

The easiest way to stop a simple beam bridge bending is to put a pillar (pier) underneath (Figure 4). The pier is easily able to stand the compression forces which are transferred to it.

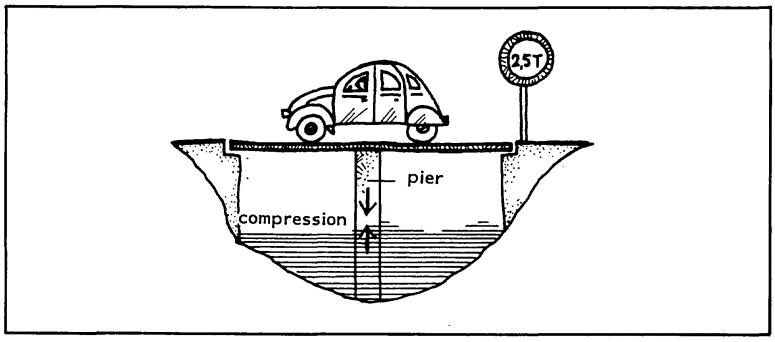


Figure 4

Cable-stayed bridges

Another way to stop a beam bridge bending is to use cables called stays (Figure 5). Tension forces are transferred to the cables, which are strong enough to stand these forces without stretching much.

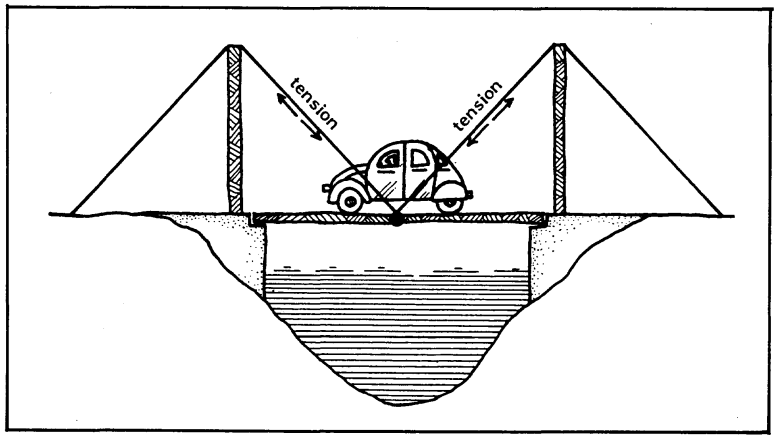


Figure 5

Truss bridges

Truss bridges are designed to transfer compression and tension forces to cross-members. Figure 6 shows the simplest possible truss bridge — most have far more cross-members than this.

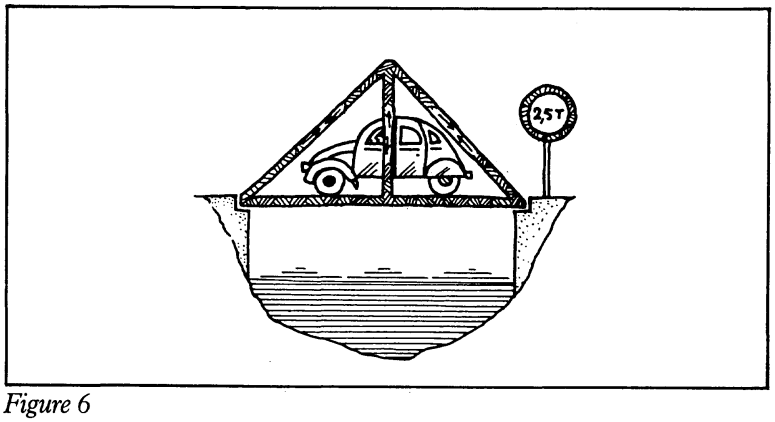
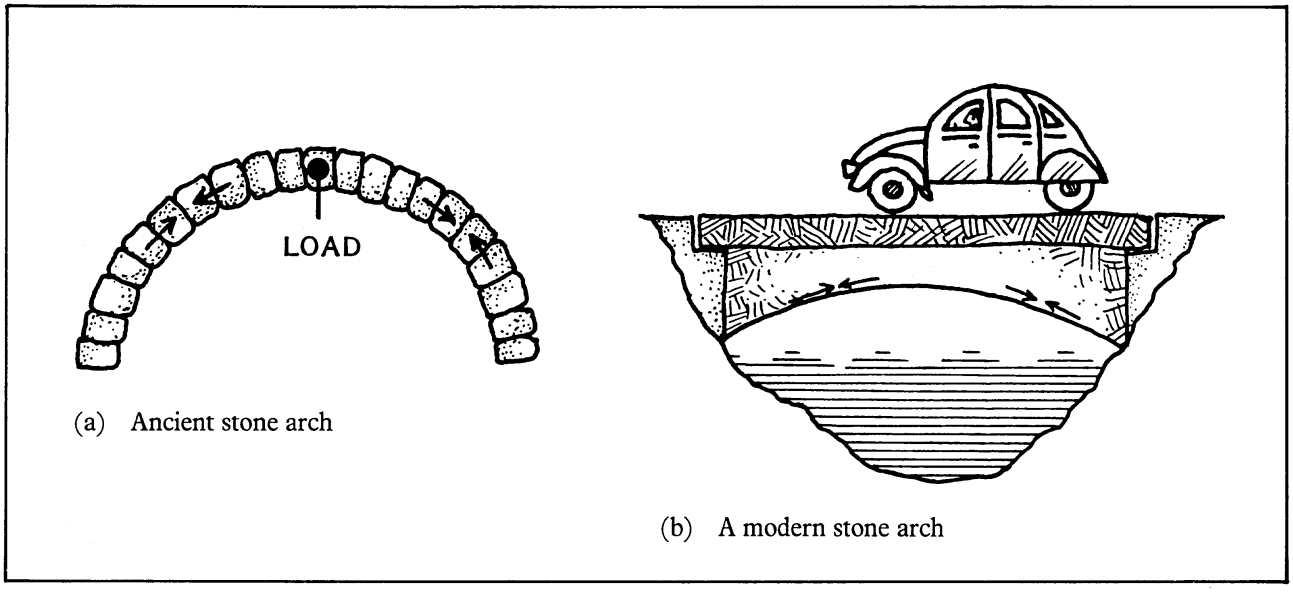


Figure 6

Arch bridges

Some of the oldest bridges are arch bridges. The arch may be above or below the bridge deck, but the general principle is the same in each case. Compression forces are transferred to the arch. The arch in turn transfers these forces to the ground on each side of the bridge (Figure 7).



(a) Ancient stone arch

(b) A modern stone arch

Figure 7 Arch bridges

Suspension bridges

The longest bridges are often suspension bridges.

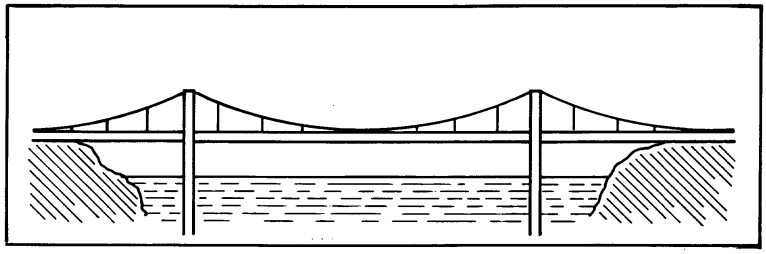


Figure 8

Question

1 *Make a copy of the suspension bridge shown in Figure 8. Draw arrows to show the forces acting in (a) the cables; (b) the towers; (c) the deck.*

Other types of bridges

There are many other types of bridges, with different shapes and designs. But the general principle of bridge design is always the same — trying to stop it bending.

Question

2 *Do you know any other types of bridge, not described here? If so, try to explain how the design stops the bridge bending. Diagrams will help you to do this.*

Part 3 What are bridges made from?

Bridges are made from a variety of materials. Which materials are chosen depends on several things, including:

- Cost and availability
- Resistance to fire and corrosion
- Strength.

The most common materials are:

Stone — Cheap and resistant. Strong under compression, but weaker under tension.

Steel — Fairly cheap. Strong under compression and tension. Resistant, but needs maintenance to stop it rusting.

Concrete — Cheap and resistant. Strong under compression, but weak under tension. Can be strengthened by reinforcing with steel rods.

Figure 9 shows a reinforced concrete beam bridge. The reinforcing rod is in the *lower* part of the bridge. This is where the tension forces are. The upper part of the bridge has compression forces, which the concrete can stand.

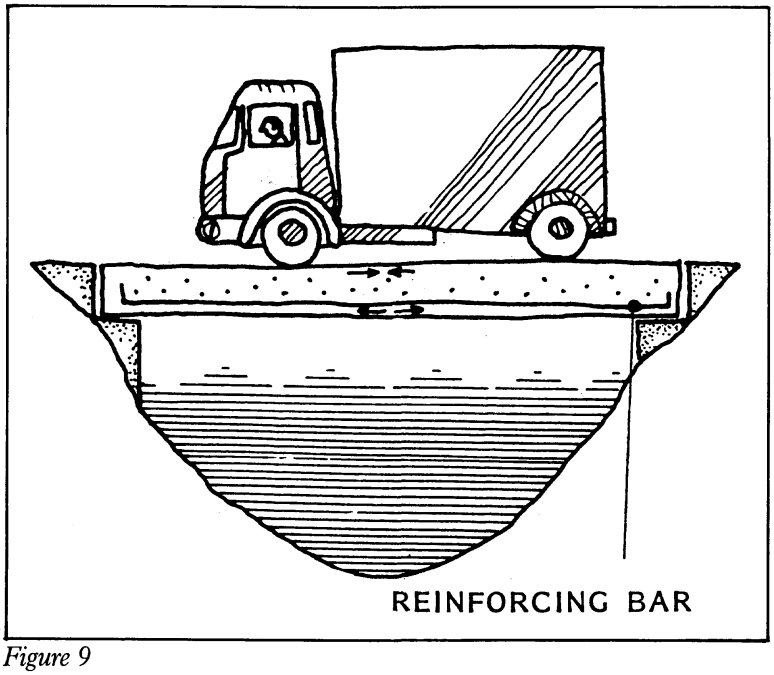


Figure 9

Questions

3 *Look at the pictures in Figure 10 below. The reinforcing rod is at the top of the balcony beam, but at the bottom of the floor beam. Explain why.*

4 *For three bridges you know, try to decide why the bridges were made out of that particular material.*

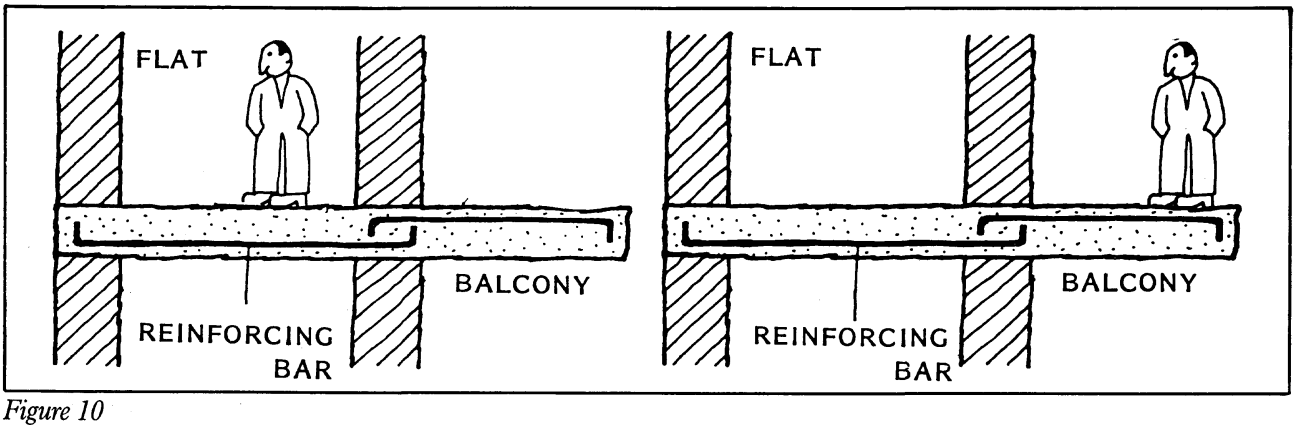


Figure 10

Part 4 Design your own bridge

1 A simple paper bridge

Target:

The intention is to design and build a bridge to carry model cars across a gap at least 25cm wide. The roadway must be wide enough and strong enough to carry two model cars side by side in the middle.

Your bridge should be carefully made and be designed to look good as well as being functional.

Materials:

1 or 2 sheets of A4 paper from which you will make the bridge. Small pieces of sticky tape, or glue, can be used to hold the paper in place, but you must not use them to fix the ends of the bridge to the edges of the gap.

2 A more sophisticated bridge

Target:

The intention is to design and build a bridge which will cross a gap of not less than 50cm. The total mass of the bridge must not exceed 30g. The bridges built by different groups in the class can be tested by hanging loads from the middle of the bridge.

Materials:

Any materials may be used, such as balsa wood, card, paper, string, wire, glue, sticky tape, etc., so long as the total mass of the bridge is not more than 30g. It must be possible to lift the bridge into position and the ends of the bridge must not be fastened to the edges of the gap.

The Coal Mine Project

Contents: Role-play simulation concerning the case for and against opening a coal mine.

Time: A minimum of 2 periods plus homework if Part 1 is omitted. The project could be extended to 4 periods if Part 1 is used.

Intended use: GCSE Chemistry and Integrated Science. Links with work on coal and carbon compounds.

Aims:

- To complement work on coal and carbon compounds
- To show some of the economic and other advantages of developing a coal mine
- To show some of the environmental and other problems involved in developing a coal mine
- To provide opportunities to practise skills in the preparation, presentation and criticism of an argument.

Requirements: Students' worksheets No. 502.

For Part 1 (optional): Copies of a map of the school district, or the local area that has been chosen for the site of the mine.

For Part 2

- General Briefing (one for each student in the class).
- Role Cards (one for each member of Groups A and B). The role notes are printed on A4 size masters, with three roles per sheet. These masters can be reproduced on paper or card, which can then be cut up into individual role cards.
- Opinion Grid (one for each member of group C).
- Chairperson's Briefing sheet (one only, for the Chairperson).

This unit is intended to introduce students to the many competing factors associated with the opening of a coal mine. The details of the mine on the General Briefing sheet are based partly on plans for the development of the major coalfield in the Vale of Belvoir.

For the purpose of this simulation it is assumed that the National Coal Board, after sinking bore-holes, have confirmed the existence of a commercial coal field in the locality of the school.

The unit is in two parts.
Part 1 (optional) Development of the site.
Part 2 The public meeting.

Location of the mine

It would be best if an imaginary location for the mine could be invented in the vicinity of the school. However, for schools in urban areas this may be impractical, since in reality a mine could not be developed on an urban site, and in any case several of the arguments in the role-play hinge around the impact of the mine on a rural or partly rural environment. For these reasons, teachers in urban schools may prefer to select a more rural site, but preferably one nearby and known to the students. Teachers in areas where coal-mining is already established may also wish to adapt the approach.

Once the site has been selected, it can be developed in Part 1. If Part 1 is to be omitted, students can simply be told the site in Part 2.

Part 1 (optional): Development of the site

The teacher will need to provide a map of the local district.

The class should be split into small groups of 4 or 5 and, using the General Briefing sheet, each group has to produce the best possible ideas about how the site should be developed.

Access roads will be needed for the construction and later a railway line will be needed to transport most of the coal to the nearest coal-fired power station (the teacher may need to say where this is!).

After a short discussion about each group's proposals, the class could quickly decide on the best arrangements for developing the site.

Part 2: The public meeting

Procedure

1 The class should be divided into three groups:

Group A The members of this group are in favour of the development. There are six main speakers, corresponding to the six Group A Role Cards. Each will be able to speak for up to two minutes at the meeting.

Group B The members of this group are against the development. There are six main speakers corresponding to the six Group B Role Cards. Each will be able to speak for up to two minutes at the meeting.

Group C This group (the remainder of the class) are undecided about the development, and have come along to hear the arguments and to ask questions about the issues, which may affect them personally.

Some roles could be omitted if inappropriate to local conditions. In this case, to maintain balance a Group A *and* a Group B role should be omitted.

A Chairperson should also be chosen to run the public meeting. Obviously the student chosen for this role needs to have appropriate qualities.

2 Students should prepare for the meeting by studying the General Briefing and, where appropriate, their Role Card. This could conveniently be done in homework time prior to the lesson in which the meeting is to be held. If Part 1 of the unit has been omitted, the teacher would need to give details of the local site being developed.

Members of Groups A and B should be encouraged to prepare their speeches carefully and to work on their roles. Suitable 'props' could be used.

Group C should think of questions to ask at the meeting.

3 For the public meeting, the groups should be suitably arranged in three blocks, with Groups A and B either side of the Chairperson, who should introduce the meeting by outlining the procedure indicated on the Chairperson's Briefing.

The Chairperson should be left in charge of organizing the meeting, and his or her overall authority should be emphasized.

4 A follow-up discussion is valuable. Did students feel the debate was fair? Did it favour one side or the other? Did they 'believe' in the case they were arguing? Did the vote go the way they expected beforehand? This procedure for making the decision is time-consuming; is it all worthwhile? (The Vale of Belvoir Inquiry cost over £2 million and the main opposition parties had to raise £130 000 to fight their case. The meeting simulated here is only one component in an extensive process of consultation leading to a Public Inquiry and finally to a decision by the Secretary of State for the Environment.)

Further resources

Films and further information on the coal-mining industry are available from: Schools Service, National Coal Board, Hobart House, Grosvenor Place, London SW1X 7AE.

A useful film about coal and its future potential is *Coal — the Bridge,* produced by BP. It lasts 25 minutes and is available on free loan from: BP Film Library, 15 Beaconsfield Road, London NW10 2LE.

Fuller details on how a coal mine might be located can be found in the *Schools Council Geography 16—19 Project* (Longman).

Acknowledgement Figure 1 supplied by the National Coal Board.

THE COAL MINE PROJECT

General Briefing

Imagine a new coal mine is to be opened in your district. The project could cause quite a lot of argument. Some people would be in favour, because of employment and local development. Others might be against it, perhaps for environmental reasons.

In this unit you will be taking part in an exercise which simulates this kind of situation. First, read the information below.

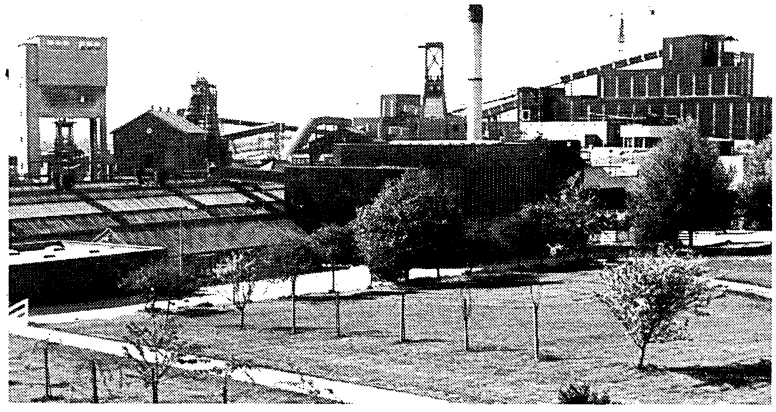


Figure 1 The surface buildings at a coal mine

Details of the proposed mine

1 *Site* At the start of the project, one mine shaft would be sunk. You will be told where the site of the shaft is. Later, another two or three shafts may be sunk elsewhere in the area.

2 *Site area* About a tenth of a square mile of land would be needed for the mine buildings, the rail yard and the coal storage area. A further square mile would be needed for spoil tips. The shaft towers are likely to be 50m high.

3 *Production of coal* 3 million tonnes of coal are to be mined each year.

4 *Spoil (waste rock, etc.)* 1.5 million tonnes of spoil will need to be disposed of on tips every year. The tips would be gently sloped and would be gradually restored for agricultural use. The total land required for tipping would be about a square mile, but only a fraction of this would be used at any one time. If there are suitable holes nearby, these could be filled with spoil.

5 *Workforce* About 1000 mineworkers will eventually be employed, together with 100 managerial and clerical staff.

6 *Subsidence (collapse of land above mines)* Subsidence will be less than in other coalfields because the coal is very deep. The ground is likely to subside by about a metre. The coal will not be extracted from below large towns or large factories, and probably not below railways. The Coal Board will make good any damage caused by subsidence.

7 *Transport* Coal would have to be transported to nearby power stations. This would require a rail link so that the large amounts of coal could be transported by train.

Group A role card

Local Job Centre Manager

In your speech you should explain that you are worried about unemployed people in the area, especially young people leaving school. You cannot find even short-term work at the moment for people who are desperate to get a job.

Some people have asked you if they should move away from this area in order to find a job. You are also worried about other local industries cutting back on their workforce. Explain how many jobs will be created by this coal mine and what a big difference it will make to the employment situation.

Think about some of the problems that face unemployed people. Do people objecting to this scheme have any idea what it is like to be unemployed?

Group A role card

Secretary, Society for a Nuclear Free Future

In your speech you should first state why you are so strongly against nuclear energy, listing some of its dangers. You think that it is far safer to have coal-fired power stations in Britain. You therefore believe that we must be prepared to use our massive reserves of coal. As well as being economical it will also provide plenty of employment. If areas like this won't allow their coal to be mined, then the government may go ahead and build more nuclear power stations. You believe that alternative sources of energy will unfortunately not be practical for a long time to come.

Think of some other reasons why you prefer coal to be used to make electricity instead of nuclear power.

Group A role card

Representative of the National Union of Mineworkers

If the mining industry is to survive, then the country must be prepared to dig up its coal. In your speech you should explain that people in this area must be more realistic and less sentimental in their thinking. Explain that you feel the rest of the country will suffer if the mine is not opened. Work would be provided for skilled mineworkers from pits that have closed. If Britain does not develop its coal industry, which country will supply the coal instead? What are the dangers of becoming dependent on another country for our sources of energy?

Try to think of the advantages of burning coal in the home and in power stations. Explain that modern mines are safe places to work.

Group A role card

Director, chemical manufacturing firm

In your speech you should explain the industrial importance of coal. It can be used as a source of chemicals, and to make coke for steelmaking. It is also used as a fuel in industry.

At the moment industry depends on oil even more than coal. But in future, oil supplies will run out. Coal can be turned to liquid fuel to replace oil. At present your firm makes most of its chemicals from oil. But in the future you will need to use coal instead.

It is very important to make sure there will be plenty of coal to make these chemicals and fuels in the future.

Group A role card

Owner of a large local building firm

In your speech you should explain how this development is desperately needed by local building firms. It will create many more jobs and prosperity for the community. Try to think of all the areas where new jobs would be created while the mine was being built. This will include the construction of the mine buildings, and also new roads and houses. There will be new jobs in quarries and brickworks, and many manufacturing industries which provide supplies.

Explain that the proposed mine buildings would be well laid out so that they would blend with the surroundings, and that there would be a tree-planting scheme.

Group A role card

Area Planning Manager, National Coal Board

In your speech you should explain to the audience how concerned they should be about Britain's energy supplies. Oil reserves are limited. Many people think oil is too precious to burn as a heating fuel, because it is a valuable source of chemicals. Coal is at present used to meet about one-third of our energy requirements. We are lucky enough in Britain to have 300 years of coal supplies left.

It is very important that workable coalfields are developed now. Modern mines need to be opened in plenty of time so that the older mines can be slowly closed down as their coal becomes too difficult to get out. This site is in an ideal situation, providing high quality coal.

Think of other reasons why this coal should be dug up and not left under the ground.

Group B role card

President, local Conservation Society

You are keen on local conservation. In your speech you must explain the different ways this development will affect the environment and the local wild life. You must mention why this particular area is worth conserving. Say why you believe the impact of the mine on wild life and the environment would be disastrous.

Think of the effect on beauty spots and rare species of plants and animals. You are particularly concerned about waste tips.

Group B role card

Senior teacher at the local school

This development is likely seriously to affect the school. You are concerned that the dirt and dust from the mine will be a nuisance. It may also be a health hazard to the school's students. The increase in traffic in the area is likely to be a disturbance and a danger to the children.

Try to include in your speech all the effects you think the development will have on the school.

Group B role card

Local farmer

You are likely to lose land through this development. Land for the mine would be taken from you by compulsory purchase. Your buildings are likely to suffer from subsidence. Dust will be blown onto your pasture, making the grass less suitable for grazing. The waste tips are likely to take up valuable agricultural land in the area.

You should also mention in your speech that you are very worried about the effects of subsidence on drainage in the area. A drop in the land level would mean that the area was more liable to flooding. It might become waterlogged.

Group B role card

Chairperson, local Residents' Association

This development will make this a less attractive place to live. It will lower house prices in the area. Subsidence may also affect the houses, particularly large, old houses. The Coal Board has guaranteed to pay for any repairs that are needed, but residents are still very worried about undetected effects on the foundations of their homes.

You might mention the housing problems caused by workers moving into the area. Noise, dust and traffic will be a nuisance. The pit head and waste tips are likely to be visible from a number of houses. The roads are already heavily congested and local communities will suffer from heavy lorry traffic.

Group B role card

Member of the Area Health Authority

In your speech you should outline how concerned you are about the effect of coal mining on the health of the local community.

Try to include:

- The health of the miners digging the coal
- The effect of dust on others living in the area
- Increased stress caused to residents by noise, traffic, etc.

You are worried about the community health bill that will result if this project goes ahead.

Group B role card

Secretary, local branch of Friends of the Earth

You are worried about the effect of air pollution caused by burning coal. Sulphur in the coal may cause acid rain when the coal is burnt. Digging more coal out of the earth is wasting Britain's natural resources. Instead we should be cutting down our energy demands and developing new types of alternative energy. With careful energy saving we would not need the extra coal.

Your speech should try to explain why this type of development is unnecessary. You could also mention the effect of the increase in traffic on the environment.

Group C Opinion grid

This grid is designed to help you follow the debate and reach your decision. Copy out the grid and put a tick in one of the boxes after each of the speeches.

	strongly against	*against*	*neutral*	*in favour*	*strongly in favour*
Before the debate					
After speaker 1					
After speaker 2					
After speaker 3					
After speaker 4					
After speaker 5					
After speaker 6					
After speaker 7					
After speaker 8					
After speaker 9					
After speaker 10					
After speaker 11					
After speaker 12					
After summing up					
FINAL DECISION					

Try to ask the different speakers searching questions after they have spoken. Use the General Briefing sheet to help you with the facts. Be ready to ask your question when the speaker has finished.

Chairperson's Briefing

You are in charge of organizing the debate and keeping order. Much of the success of this exercise depends on you! During the speeches no one should be allowed to interrupt. Each speech should not last longer than two minutes.

Speakers

Group A, in favour of the development:

1 Area Planning Manager, National Coal Board

2 Secretary, Society for a Nuclear Free Future

3 Owner of a large local building firm

4 Representative of the National Union of Mineworkers

5 Director, chemical manufacturing firm

6 Local Job Centre Manager

Group B, against the development:

1 President, local Conservation Society

2 Chairperson, local Residents' Association

3 Secretary, local branch of Friends of the Earth

4 Senior teacher at the local school

5 Local farmer

6 Member of the Area Health Authority

The best way of organizing the debate is to start with a speaker from Group A, and then follow with a speaker from Group B. Continue with speakers from Group A and Group B alternately.

After each speech you should invite questions from the floor. Do not allow anyone to talk too much.

If time allows, a more general discussion could take place towards the end, but you would need to chair this part of the meeting carefully. Before the vote, allow a speaker from each Group to sum up their case in not more than two minutes.

Finally allow Group C, the 'public' who have attended this public meeting to vote. Remind them that they should have considered all the arguments they have heard. They should vote 'For' or 'Against' the proposal to open a mine.

Paying for National Health

Contents: Decision-making simulation concerning the cost of medical treatment under the National Health Service.

Time: Homework plus 2 periods.

Intended use: GCSE Biology, Human Biology and Integrated Science. Links with work on prevention and cure of certain medical problems; covers health education, heart disease, kidney disease, drug abuse, hip failure, AIDS and care of the new-born and the elderly. Several areas of human biology are covered, and the unit would be useful during revision.

Aims:

- To develop awareness of the cost of the National Health Service, and the way it is financed
- To develop awareness of the most important items in Health Service costs, and the difference between capital costs and running costs
- To show the need for compromise and negotiation between several equally deserving cases when limited resources are allocated
- To provide opportunities to practise skills in communication, in particular the presentation and negotiation of a case.

Requirements:

- For each student: copy of General Briefing
- For each group: copies of the appropriate Briefing sheets (one per group member).

The National Health Service is organized into fourteen Regions, and each Region is organized into Districts. The information in the Briefing sheets is based on data provided by the Salford District Health Authority, which is itself part of the North Western Regional Authority.

Suggested use

There are several ways the unit can be used. One possibility is as follows:

1 Give each student a copy of the General Briefing to study. This could be done for homework the preceding evening.

2 Select five 'interest groups' from the eight available. Allocate each student to one of the groups, and issue the appropriate Briefing sheets. The preparation tasks for the different 'interest groups' vary in complexity. Some are very simple, while others require a certain amount of mathematical competence. Teachers may wish to bear this in mind when allocating students to groups.

3 Allow the groups up to 20 minutes working together to prepare their cases. (Guidelines for doing this are given on the Briefing sheets.)

4 Bring the groups together. Allow each group no more than 2 minutes to present their case. The presentation could be by a single spokesperson, or could be a joint effort. During the presentations it would be helpful to draw up a summary table on the blackboard or overhead projector. The table on the next page gives the correct values.

Interest group	*Capital cost of scheme*	*Running cost per year*	*Number of patients benefiting*
1 Heart disease treatment			
(a) Heart Attack Response Team	£20 000	£40 000	100
(b) Heart transplants	—	£150 000	10
2 Health Education Service	£15 000 (if 5 Health Education Officers appointed)	£75 000 (if 5 Health Education Officers appointed)	up to 250 000
3 Kidney disease treatment			
(a) Hospital machines	£173 000	£292 000	24
(b) Home treatment	£232 800	£168 000	24
4 Drug Dependence Unit	£65 000	£100 000	50
5 Intensive care facilities for new-born babies	£400 000	£200 000	100
6 Geriatric care			
(a) Community care	—	£75 000	
(b) Extra geriatric beds	£100 000	£25×28×365 = £255 500	245
7 Hip replacements	£84 000	£55×4×365 = £80 300	100
8 AIDS service	£87 000	£48 500	100

5 By means of a chaired discussion, decide how the money should be allocated. This could be initiated by the Chairperson making a statement such as 'We cannot provide *all* these services because we only have £1 million to spend this year. What are we going to do?' Negotiation and compromise will be necessary, with 'interest groups' having to reduce their proposed schemes.

During these negotiations it will be necessary to have at least one neutral party present. This could of course be the teacher, but an effective procedure would be to bring in an outside 'expert', such as a local Health Education Officer, a representative of the local Health Authority or a doctor.

Other possible approaches

(a) With a suitable class, the final negotiations could be chaired by a student, with perhaps a panel of students representing the District Health Authority.

(b) Instead of making an oral presentation, each group could prepare a press release making out the case for their particular scheme. The press releases could then be assessed by the teacher or outside expert. Discussion should follow naturally.

(c) It would be valuable to use the unit in conjunction with a visit to a local hospital.

Acknowledgement Figure 1 supplied by Salford Health Authority.

PAYING FOR NATIONAL HEALTH

General Briefing

The National Health Service cost £16 billion (£16 000 000 000) a year to run in 1985. This is about £50 per second. Most of the money for the Health Service comes from the taxes and the National Insurance Contributions we pay. The money is limited and there is not enough to pay for all the health services we would like. Often there are difficult choices to make about where to spend money.

In this unit you will be looking at the choices that might have to be made in the imaginary Health District of Norton.

The Norton Health District

Norton is an industrial city of 250 000 people. It is part of the large urban area of Greater Norchester, which has a population of 2.5 million (see Figure 2). Many of Norton's traditional industries are declining and unemployment is high.

In this exercise we will imagine the Norton Health Authority has an extra £1 million (£1 000 000) to spend this year.

In addition there will be an extra £0.75 million (£750 000) to be spent in each following year. The Health Authority can therefore afford to improve some of their services.

Figure 1 Waiting to see the doctor

How the money could be spent

There are several different 'interest groups', each wanting to spend money in different ways. The interest groups are concerned with:

Heart disease treatment
Health Education Service
Kidney disease treatment
Drug Dependence Unit
Intensive care facilities for new-born babies
Geriatric care (care of the elderly)
Hip replacements
AIDS service.

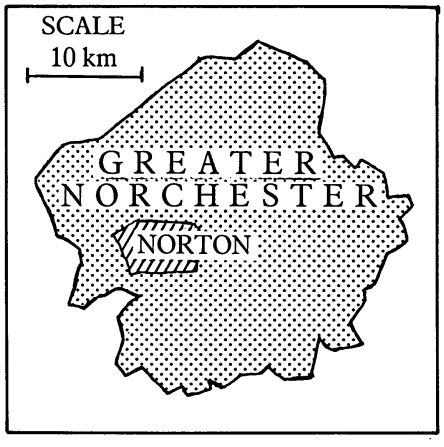


Figure 2 Norton and Greater Norchester

What you will be doing

You will be in one of the 'interest groups'. Your group's job will be to study your Briefing sheet and prepare your case. Later the various interest groups will come together. Your group will have to present their case and try to persuade the others why you should be allocated money. You will then all work together to decide how the money should be divided up.

Remember — there is
£1 000 000 to spend this year
£750 000 to spend each following year

Briefing sheet 1

Heart disease treatment

Norton has one of the worst records of heart disease in the country. Heart disease is approximately 30 per cent higher than the national average. In 1984, nearly a thousand residents died from heart attacks. This was almost half the total deaths in Norton from all causes. 75-80 per cent of these deaths from heart attacks were in the over-65 age group.

There are two ways the situation could be improved if money was available.

(a) Heath Attack Response Team

To provide a 'flying squad' able to respond quickly to heart attack cases. The team would give emergency treatment in people's homes before taking them to hospital. This would need a doctor, two nurses and a driver. They would be on standby duty 24 hours a day. These staff would do other duties when not answering calls.

The total running costs, including salaries, drugs, travel, etc., would be **£40 000 per year**. A specially converted and equipped ambulance would also be needed at a capital cost of **£20 000**. This ambulance would last 5 years.

Estimated number of patients benefiting from this additional service: **100 per year**

(b) Heart transplants

Heart transplants need highly specialized equipment and staff. They are only done in one or two centres in England. There are never enough hearts donated to meet the demand. In any case, not every patient is suitable for this type of treatment.

The approximate cost to send a patient from Norton to an existing Heart Transplant Centre is estimated at **£15 000 per patient**.

Estimated number of patients it would be possible to treat: **10 per year**.

What you should do

1. Prepare your case so you can argue the benefits of spending money on treating heart disease. You may want to elect a speaker to present your case, or you may want to share the job.
2. Make sure you know the total *capital cost* (that is, 'setting-up' cost) of your scheme.
3. Make sure you know the total *running cost* of your scheme per year.
4. You may not be allowed enough money to provide the whole scheme. Decide how you would be prepared to reduce it if necessary.

Briefing sheet 2

Health Education Service

Doctors believe that diseases such as heart disease and cancer are linked with habits such as smoking and diet. If people could be persuaded to stop smoking and improve their diet, heart disease and cancer could be cut down.

One Health Education Officer's salary and supporting costs would amount to **£15 000 per year**. If people were persuaded to be more health conscious, for example, by giving up smoking, less health care would be needed. This would save the Health District money.

If enough Health Education Officers were appointed, efforts could be made in other areas. For example, health education can help reduce drug abuse. It can encourage parents to use ante-natal care, and help to avoid unnecessary deaths of new-born babies.

Costs per Health Education Officer = **£15 000 per year** (including salary, publications and secretarial assistance).

If more than two officers are appointed, there will be capital costs of **£5 000** for each extra officer. This will be needed to provide an office base.

It is generally recommended that there should be one Health Education Officer per 50 000 people. However, many Health Districts have less than this. The population of Norton is 250 000.

Estimated numbers of patients who would benefit: up to **250 000**, depending on number of officers appointed.

What you should do

1 Prepare your case so you can argue the benefits of spending money on a Health Education Service. You may want to elect a speaker to present your case, or you may want to share the job.

2 Make sure you know the total *capital cost* (that is, 'setting-up' cost) of your scheme.

3 Make sure you know the total *running cost* of your scheme per year.

4 You may not be allowed enough money to provide the whole scheme. Decide how you would be prepared to reduce it if necessary.

Briefing sheet 3

Kidney disease treatment

In the past, diseases of the kidneys often proved fatal. They can now be treated successfully by two methods: transplants and kidney machines. Transplants are carried out on patients in a neighbouring District. However, there are not enough kidneys donated to meet the demand. In any case, not all patients are suitable for this type of treatment. Kidney machines for 'renal dialysis' are therefore needed. The patient has to be connected to the kidney machine for ten hours or so, two or three times each week.

These machines could either be in hospitals or in patients' homes.

(a) Hospital machines

Existing hospital accommodation could be converted to provide up to 6 beds and machines.

Cost of 6-bed Renal Dialysis Unit

Capital costs:	
6 machines at £8000 each	**£ 48 000**
Conversion of hospital accommodation	**£125 000**
Running costs.	
Doctors, nurses and technical staff	**£250 000 per year**
Running costs of machines — 6 at £7000 each	**£ 42 000 per year**
Estimated number of patients benefiting	**24**

(b) Home treatment

A further **24** patients could be treated by having kidney machines installed in their own homes. These patients would use the hospital unit only to train to use their machines. The estimated training time is three months per patient.

Costs of home treatment

No additional costs for doctors and nurses if the hospital unit has already been built.

Capital costs:	
24 machines at £8000 each	**£192 000**
Home alterations — 24 at £1700 each	**£ 40 800**
Running costs:	
24 home machines at £7000 each	**£168 000**
Number of patients benefiting	**24**

What you should do

1. Prepare your case so you can argue the benefits of spending money on treating kidney disease. You may want to elect a speaker to present your case, or you may want to share the job.
2. Make sure you know the total *capital cost* (that is, 'setting-up' cost) of your scheme.
3. Make sure you know the total *running cost* of your scheme per year.
4. You may not be allowed enough money to provide the whole scheme. Decide how you would be prepared to reduce it if necessary.

Briefing sheet 4

Drug Dependence Unit

Drug abuse and glue sniffing have increased alarmingly in the Greater Norchester region, particularly among young people. It is estimated that there are over a thousand drug addicts in the Greater Norchester region. A Drug Dependence Unit is urgently needed to help these people break their addiction. Without this help there will be further unnecessary deaths of young people.

To convert existing hospital accommodation to provide a Drug Dependence Unit would cost £325 000. The unit would cost £500 000 a year to run.

However, the unit would not just benefit Norton. It would also provide a specialized service to the rest of Greater Norchester. The unit would therefore get extra funds from the Greater Norchester Regional Health Authority. Norton would only pay one-fifth of the total costs.

The net cost to Norton would therefore be:

Capital costs	**£ 65 000**
Running costs	**£100 000 per year**
Estimated number of patients treated in Norton	**50**

What you should do

1. Prepare your case so you can argue the benefits of spending money on a Drug Dependence Unit. You may want to elect a speaker to present your case, or you may want to share the job.
2. Make sure you know the total *capital cost* (that is, 'setting-up' cost) of your scheme.
3. Make sure you know the total *running cost* of your scheme per year.
4. You may not be allowed enough money to provide the whole scheme. Decide how you would be prepared to reduce it if necessary.

Briefing sheet 5

Intensive care facilities for new-born babies

The death rate among new-born babies has always been high in Norton. Out of 3200 births in 1979, 70 babies died. This is almost twice the national average. It is one of the worst new-born death rates in the country. Additional intensive care facilities for new-born babies would mean many of these young lives could be saved.

Costs for four intensive care cots in a special unit

Capital costs:

Conversion of part of existing Maternity Unit	**£300 000**
Equipment	**£100 000**

Running costs:

Doctors, nurses and other running costs	**£200 000 per year**
Estimated number of babies benefiting per year	**100**

What you should do

1. Prepare your case so you can argue the benefits of spending money on intensive care facilities for young babies. You may want to elect a speaker to present your case, or you may want to share the job.
2. Make sure you know the total *capital cost* (that is, 'setting-up' cost) of your scheme.
3. Make sure you know the total *running cost* of your scheme per year.
4. You may not be allowed enough money to provide the whole scheme. Decide how you would be prepared to reduce it if necessary.

Briefing sheet 6

Geriatric care (care of the elderly)

The number of people in Norton over the age of 75 is expected to increase dramatically over the next ten years. It is expected to rise from about 14 000 to around 16 000. This age group needs a considerable amount of hospital treatment. To meet national standards for geriatric care, it is estimated that Norton needs an extra 35 geriatric beds.

However, this number of beds could be reduced if more people were looked after in the community. By looking after people in their own home, the number of extra geriatric beds needed could be reduced.

(a) Costs of a Community Care Team

A Community Care Team would consist of community nurses and health visitors. By increasing the support given to old people in their own homes, many hospital admissions could be prevented. Even when people did need to go into hospital, the length of stay could be reduced in many cases. The number of extra geriatric beds required could be reduced by about 7, to 28 in total, while still treating the same number of patients.

Running costs of Community Team:

4 community nurses, 3 health visitors	**£70 000 per year**
Travelling expenses	**£ 5 000 per year**

(b) Costs of extra geriatric beds

Capital costs:

A ward of up to 28 beds could be converted from existing accommodation at a cost of **£100 000**

Running costs:

Each of the 28 geriatric beds costs a total of **£25 per day** for medical, nursing and other staff. This includes general services such as laundry and catering.

Estimated number of patients benefiting per year: **245**

What you should do

1. Prepare your case so you can argue the benefits of spending money on geriatric care. You may want to elect a speaker to present your case, or you may want to share the job.
2. Make sure you know the total *capital cost* (that is, 'setting-up' cost) of your scheme.
3. Make sure you know the total *running cost* of your scheme per year.
4. You may not be allowed enough money to provide the whole scheme. Decide how you would be prepared to reduce it if necessary.

Briefing sheet 7

Hip replacements

Hip replacements are of enormous benefit to elderly people. They help keep them mobile, so they can continue to get out and about and enjoy life. However, the average waiting time for a hip replacement in Norton is one year.

If a small extension to the existing wards was built, four extra beds could be provided for hip replacement operations. It would not be necessary to build a new operating theatre. Within the existing operating theatres it would be possible to carry out 100 hip replacements each year. This would go a long way to meeting the total need.

Capital costs:
To build and equip the four-bed extension **£21 000 per bed**

Running costs:
The daily running cost for each bed is **£55** for medical, nursing and other staff. This includes general services such as laundry and catering.

Estimated number of patients treated per year **100**

What you should do

1 Prepare your case so you can argue the benefits of spending money on hip replacements. You may want to elect a speaker to present your case, or you may want to share the job.

2 Make sure you know the total *capital cost* (that is, 'setting-up' cost) of your scheme.

3 Make sure you know the total *running cost* of your scheme per year.

4 You may not be allowed enough money to provide the whole scheme. Decide how you would be prepared to reduce it if necessary.

Briefing sheet 8

AIDS service

Much publicity has been given to the alarming new disease AIDS (Acquired Immune Deficiency Syndrome). AIDS is making more and more demands on the Health Service. Help is needed both for those who actually have the disease and those who fear they may have been in contact with it.

The Norton Immunology Laboratory tests blood samples for suspected AIDS. Demand for these tests has risen dramatically over the last three years. In 1982, there was no AIDS work. In 1985, AIDS testing exceeded all other forms of blood testing. This takes up time which in the past was used for other purposes. Extra resources are needed to help the laboratory cope.

There is also a need for specialists to advise suspected AIDS carriers. Two clinic sessions per week would be needed.

Costs of AIDS service

Capital costs:

Extra laboratory space within Immunology Department	**£50 000**
Computer system to analyse test results	**£37 000**

Running costs:

Laboratory technician to carry out tests	**£10 000 per year**
Laboratory equipment, chemicals and computer running costs	**£26 000 per year**
Specialist advice clinic	**£12 500 per year**
Estimated number of patients receiving tests and advice per year	**100**

What you should do

1. Prepare your case so you can argue the benefits of spending money on an AIDS service. You may want to elect a speaker to present your case, or you may want to share the job.
2. Make sure you know the total *capital cost* (that is, 'setting-up' cost) of your scheme.
3. Make sure you know the total *running cost* of your scheme per year.
4. You may not be allowed enough money to provide the whole scheme. Decide how you would be prepared to reduce it if necessary.