Computers and Jobs

Contents: A series of exercises and a design task concerning the impact of computers on jobs.

Time: 1 to 4 periods, depending on how many parts are attempted.

Intended use: GCSE Physics, Integrated Science, Computer Studies and Electronics. Links with work on applications of electronics. It is assumed that students will already have had some experience of computer use and will have some awareness of the potential of computers.

Aims:

- To complement and extend prior work on the uses of computers
- To develop understanding of some of the applications of computers
- To develop awareness of the impact of computers on jobs, and the forces operating to encourage and discourage the introduction of computer technology
- To provide an opportunity to practise skills in communication and problem-solving.

Requirements: Students' worksheets No. 507

This unit is in three parts:

Part 1 Comparing humans and computers
Part 2 Barnes Book Club — a suitable case for computerization?
Part 3 Computers, jobs and society — some points to discuss.

It is not intended that the unit should be used 'cold', but that it should extend prior 'computer application' work.

Part 1

The first exercise should be tackled in pairs. A class list can then be compiled on the backboard or overhead projector. This can stimulate valuable discussion to clarify what we mean by 'human', 'computer' and terms such as 'memory'. Pairs could then answer questions 1 to 3.

Part 2

Part 1 should be completed before this part is attempted, in order to establish the role, strengths and weaknesses of the computer. Tasks 1 to 6 can be tackled by students working in pairs. Following this work, designs for the new system can be compared, perhaps by bringing pairs together in small groups. In appropriate cases, a simple program could actually be written to show how the new system would work.

The teacher may wish the class as a whole to adopt one of the designs and discuss its implications. A role play might be used, with management and worker representatives negotiating about the introduction of the new office system.

Part 3

This part can be used in a variety of ways, including group discussion and written work.

Notes on questions 1 to 3

Qs 1 and 2 Computers can offer efficiency, accuracy, consistency and speed of working on repetitive, high volume jobs. For example, the production of invoices, processing of orders, control of stock and monitoring of routine manufacturing processes all lend themselves well to computerization. There is also a growing trend towards the use of computers to *assist* humans in jobs, as distinct from replacing them — for example, in computer-aided design and computer-assisted learning. With rapid increases in the memory capacity of computers, it will soon be possible to develop 'artificial intelligence' which will further increase the range of jobs that can be done by computers.

Q.3 Jobs relying on human contact lend themselves least to computerization, for example, welfare work and nursing, though even here computers can be used for routine diagnosis. The consistency of the work done by computers can be a disadvantage as well as an advantage, because of the inflexibility that may be involved. Humans can respond far more flexibly and sensitively than computers.

Notes on some of the tasks

Task 1

Customer records would be held on a computer file. Other details such as prices and stock levels would also be held on file. The computer would have a terminal in the Accounts Department and another terminal, with printer, in the Warehouse to print delivery notes.

Working at the computer terminal, the clerk would:
(a) Check whether it was an existing or a new customer
(b) If new, set up a new customer record
(c) Enter the books ordered and money sent.

The computer would:
(a) Update the customer record to show what books had been ordered
(b) Prepare a delivery note and print it at the Warehouse terminal
(c) Keep a track of stock levels of books
(d) Automatically price the order and check against the money sent.

Task 3

Students' answers are likely to vary widely. The following figures are offered for the teacher's guidance.

With the computerized system a clerk might process an order in around 2 minutes. Before computerization it might have taken 20 minutes. Thus the number of clerks could, in theory, be reduced to a tenth of the old number, that is two. In practice four might be more realistic.

Tasks 5 and 6

Points in favour of using computers include a saving of human labour (and therefore wages) and a faster, more efficient customer service. Against using them must be counted the cost of installing and servicing: this will be high, so there will not necessarily be an overall saving of money. There are also the possible problems caused by the loss of human flexibility, and of course the redundancies entailed: in a small firm it would be difficult to absorb the redundant clerks in other departments. Thus it is likely that, broadly speaking, management would favour computerization more than the clerks — though it should be added that the office managers might view it with some initial trepidation, and those clerks remaining after computerization would be likely to find their work more interesting.

Acknowledgment Figure 1 supplied by IBM United Kingdom Ltd.

COMPUTERS AND JOBS

In this unit we will be looking at the impact of computers on people's jobs. What jobs do computers take over, and why? Should we encourage more computerization, or should we resist it?

The unit is in three parts:

Part 1 Comparing humans and computers
Part 2 Barnes Book Club — a suitable case for computerization?
Part 3 Computers, jobs and society — some points to discuss

Figure 1 A modern computerized office

Part 1 Comparing humans and computers

Work in pairs.

Think of the differences between a human being and a computer. List as many differences as you can think of. You might make a list like the one started below.

Human	*Computer*
Has emotions and feelings	Can carry out calculations very fast

When your list is complete, compare it with those of other class members. Use your lists and your knowledge of computers to discuss questions 1 to 3.

Questions

1 *For what reasons might computers be used to replace human labour?*

2 *What types of jobs are most likely to be computerized?*

3 *What types of jobs are least likely to be computerized?*

Part 2 Barnes Book Club — a suitable case for computerization?

Barnes Book Club is a mail order company which supplies science fiction books. They advertise widely in newspapers and magazines for people to become members of the book club. Members pay an annual subscription of £5.00. They have to order at least one book every three months. Every three months members receive a catalogue of the books on offer. The books are sold to club members at greatly reduced prices.

The company employs 50 people:

- 10 working in Management, Administration and Marketing
- 5 working as secretaries
- 15 working on packaging and distribution in the Warehouse
- 20 working as clerks in the Accounts Department

Computerization of the Accounts Department

The company management is planning to computerize the Accounts Department. It is your job to advise them on the best way of using computers. Figure 2 shows the layout of part of the Accounts Department.

The job of a clerk in the Accounts Department is outlined in points **A** to **H** on the next page. Read the information, then carry out Tasks 1 to 6.

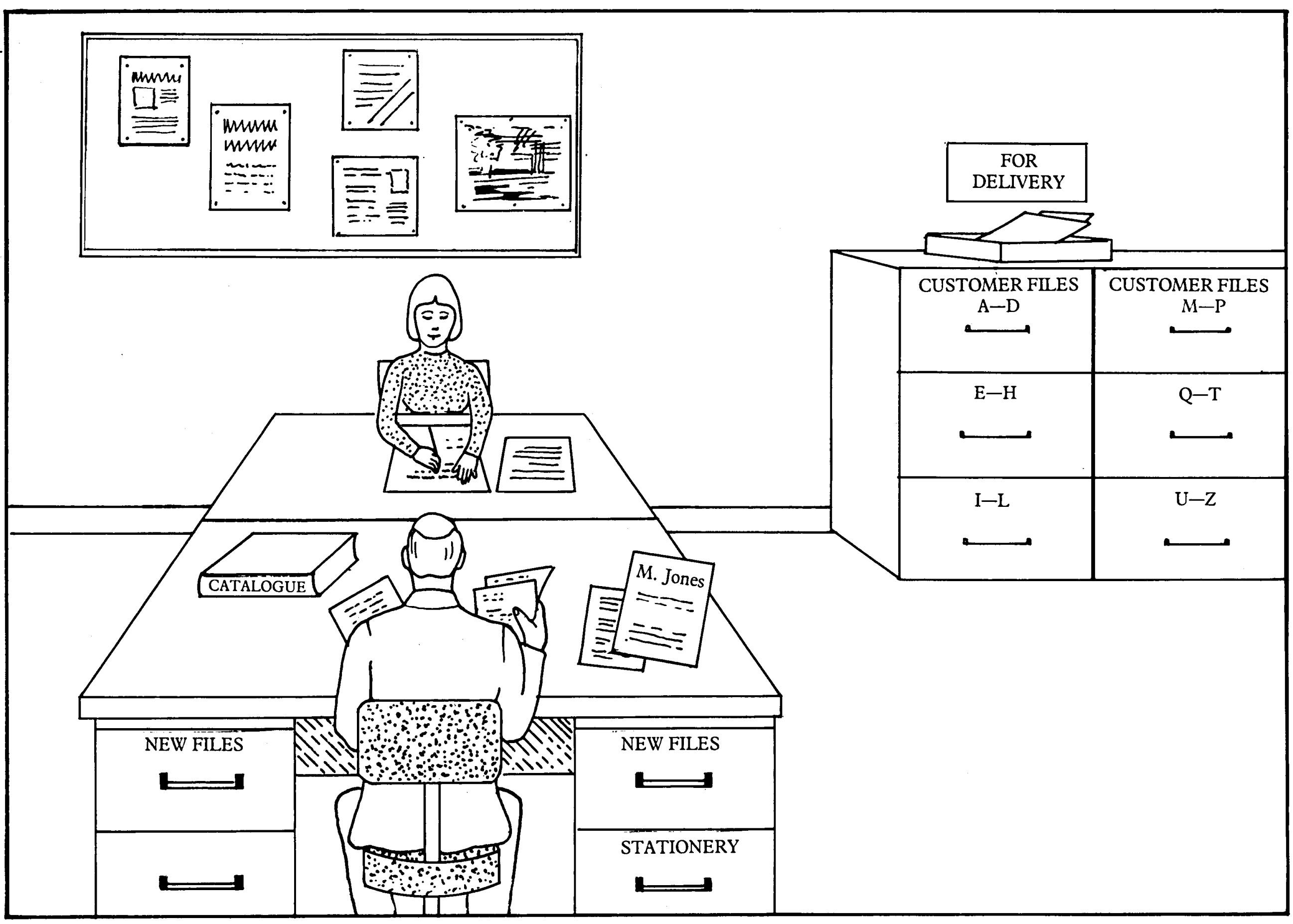

Figure 2 Part of the Accounts Department at Barnes Book Club

A The clerk receives the customer's order by post.

B The clerk looks up the price of the books in the catalogue and checks that the customer has sent in the right amount of money.

C If it is a new customer who is not a book club member, the clerk makes out a new customer file.

D If it is a customer who is already in the book club, the clerk walks over to the filing cabinets and takes out the customer's file.

E The clerk returns to the desk and write the details of the books ordered and price in the customer's file.

F The clerk writes out a delivery note to tell the Warehouse to pack up the books and send them to the customer.

G The clerk gets up and takes the delivery note to a tray from which it will be collected and taken down to the Warehouse.

H The clerk puts a copy of the delivery note in the customer's file and returns the file to the filing cabinets.

Tasks
Work in pairs.

1 Discuss how a computer could be used in the Accounts Department. Which of the jobs **A** to **H** would the computer do?

2 Outline the way the work of the Accounts Department would be carried out following computerization. Make it clear which jobs would be done by the clerk, and which by computer.

3 Twenty clerks were employed in the Accounts Department before computerization. How many do you think would be needed after computerization?

4 Compare the job done by a clerk before and after computerization. How do they compare with regard to
(a) how interesting they are
(b) the amount of skill needed?

5 What reasons can you think of
(a) for
(b) against
the company using computers?

6 How might you feel about computerization if you were
(a) a manager
(b) a clerk
in the company?

You could try acting out a meeting between managers and workers to discuss computerization in the company.

Part 3 Computers, jobs and society — some points to discuss

- What are the forces in society (technological, social, economic and political)
  (a) encouraging the wider use of computers
  (b) holding back the use of computers?
  Which of the two (a or b) is stronger at present? Is the balance likely to shift in the future?
- 'The government of this country should do everything possible to encourage the use of computers in industry'. Do you agree?
- Computer scientists are now working on developing computers with 'artificial intelligence'. What does 'artificial intelligence' mean? What might these computers be able to do that present computers cannot do?
- Will we ever reach a time when *all* jobs are done by computers?
- The year is 2020. Write a short story about what you think life will be like and the role computers will be playing. (If it is good it might even be published by Barnes Book Club!)

Risks

Contents: Reading, data analysis and discussion concerning the risks involved in different activities and occupations.

Time: 2 periods.

Intended use: GCSE science courses. Links with work on breathing and lungs (Part 2.1) and nuclear power (Part 2.2). See notes below on suggested use.

Aims:

- To develop awareness of the nature of risk and the possibility of quantifying risks
- To show the difficulty of assessing certain risks
- To show that zero risk is impossible, and to develop the idea of an acceptable risk
- To show some of the factors affecting the way risks are perceived by the public
- To provide opportunities to develop certain skills in communication and data analysis.

Requirements: Students' worksheets No. 508

Suggested use

The unit is in three parts:

Part 1 What are risks?
Part 2 Looking at particular risks
2.1 Risks of being exposed to dangerous substances
2.2 Risks of nuclear power
Part 3 Points to discuss

It is intended that all students should tackle Parts 1 and 3. They should do at least one of sections 2.1 or 2.2 in Part 2, perhaps according to the particular work they are studying in their science courses at the time.

Notes on some of the questions

Q.2 The risk is 1 in 5 480 000. This figure will vary widely from year to year since, unlike road accidents, railway accident statistics are highly dependent on the occurrence of a small number of relatively large accidents.

Q.4 Smokers risk death from heart disease, chronic bronchitis and a number of other causes, as well as lung cancer. On average, a person who smokes 20 cigarettes a day shortens his or her life by 5 years — about 5 minutes for every cigarette smoked.

Qs 6 and 7 The answers to these questions will be highly subjective. If alternative employment is difficult to find, employees may be prepared to accept the risk. They may also take steps, perhaps through their trade union, to get the situation changed. In the case of the asbestos worker, the previous 20 years' exposure is more likely to have already caused the disease than future exposure, given that levels of exposure to asbestos fibres are now legally set at a much lower level than formerly applied.

Qs 8 & 9 At the time of writing (May 1986) the cause and the eventual outcome of the Chernobyl accident are far from clear. The estimate of 1 in 100 000 000 was for an accident of the worst possible kind, and although it is difficult to conceive of an accident much worse than Chernobyl, the reactor was at least not in a semi-urban site. The design and operating procedures of the Chernobyl reactor were very different from those in the West. The reactor was graphite-moderated and water-cooled: no Western reactors have this combination of graphite moderator and water coolant. Furthermore, most, though not all, Western reactors have 'secondary containment' — a strong enclosing structure designed to contain leaks. And the methods of inspection, operating and safety control in Russian reactors are likely to be very different from those employed in the West. It seems likely that the cause of the Chernobyl accident was human error.

Nevertheless, the accident must have considerable significance for nuclear power in Britain, and there is plenty of scope for discussion. It is worth noting that there have been several smaller accidents to Western reactors. In 900 reactor-years of nuclear power in the US, there has been at least one serious accident, at Three Mile Island in 1979. Britain too has had at least one serious accident, the Windscale fire of 1957, in a total of 600 reactor-years. The Chernobyl accident follows 500 reactor-years of Russian experience.

Notes on discussion points

Most of the discussion points are concerned with people's *perception* of risk, which varies widely according to the nature of the risk and the person's standpoint.

- The first discussion point relating to air travel reflects the experiences that: (a) familiar risks are perceived as more acceptable than unfamiliar ones; (b) risks of death involving large but infrequent catastrophes (such as air crashes) are generally perceived as *less* acceptable than risks where people die more frequently but in ones and twos (as in road accidents). The media attention given to large catastrophes also plays a part.
- The fear of a catastrophic explosion may be greater than the fear of the smaller scale (but more probable) road accident. The difficulty of obtaining a reliable figure for the catastrophic risk may also have an influence. Family involvement in the refinery might change perception of the risks: (a) because of greater risk to an employee (making the risk less acceptable); and (b) because the refinery is seen as bringing direct benefit through employment (making the risk more acceptable).
- The Royal Society's report, *Risk Assessment* (reference 1 below), suggests that imposing a continual annual risk of death of 1 in 100 should be considered unacceptable under all normal conditions. On the other hand, it suggests that a risk of one in a million is low enough to disregard, in the sense that few people would commit their own resources to reducing still further a risk already as small as this. Between these extremes the report proposes that *risk management* should consist of comparing risks, detriments, costs and benefits, rather than seeking prohibitions at a higher level and concluding that no special action is needed at the lower level.
- It is generally true that people are prepared to take much higher *voluntary* risks than risks over which they have little or no control.
- Known risks are in general more acceptable to people than unknown risks. It therefore makes sense, quite apart from any moral considerations, for governments and institutions to reveal risks as fully as possible, if only to avoid rumour.

Sources of data

The sources of risk data are as follows:

Table 1 — mainly reference 4 below; Table 2 — mainly reference 2; Tables 3 and 4 — reference 1; risks of nuclear power — reference 3 (figures relate to studies in Norway and USA); risks of a refinery accident — references 5 and 6.

References

1 *Risk Assessment — a Study Group Report*, Royal Society, 1983.
2 *Asbestos: Effects on Health of Exposure to Asbestos*, R. Doll and J. Peto, Health and Safety Commission, 1985.
3 *Comparative Risks of Electricity Production Systems*, A.V. Cohen and D.K. Pritchard, Health and Safety Executive, 1980.
4 *Risks of Energy Provision*, Malcolm C. Scott, in Book F, Science in Society, 1981.
5 *Canvey: an Investigation of Potential Hazards from Operations in the Canvey Island/Thurrock Area*, Health and Safety Executive, 1978.
6 *Canvey: a Second Report*, Health and Safety Executive, 1981.

Acknowledgements Figure 1 supplied by RoSPA; Figure 2 supplied by the Health Education Council; Figure 3 supplied by United Kingdom Atomic Energy Authority.

RISKS

Part 1 What are risks?

Nothing in life is completely safe. We take a risk in everything we do. Even lying in bed, we run a small risk of accidental death — for example, an aeroplane might crash on the house. This risk is very small, and most people accept it without much thought. But some activities — deep sea diving, for example — carry a much higher risk of death. How can we compare risks? Which risks are acceptable, and which are not?

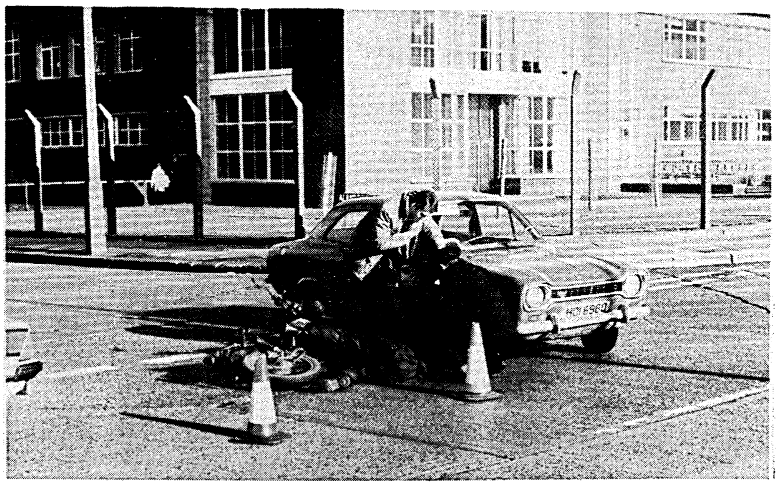

Figure 1 A road acccident. One of the many risks of daily life.

Calculating risks

Risks are much easier to compare if we can put a number to them. This is not always easy. But if there are plenty of statistics available it is fairly simple to calculate a **probability**.

For example, suppose we want to work out the risk of dying in a road accident. We can use road accident statistics to do this.

Number of people killed in road accidents
in Great Britain, 1983 = **5445**
Total number of people in Great Britain, 1983 = **54 800 000.**

54 800 000 divided by 5445 equals 10 064. So, if the risk of being killed in a road accident is spread evenly across everyone in Great Britain, during 1983 each person had about a 1 in 10 000 risk. Out of every 10 000 people, on average one person was killed. This risk could also be expressed as a probability of 1/10 000, or 0.0001.

Answer questions 1 and 2.

Questions

1 *Do you think the risk of being killed on the roads is really spread evenly across everyone? If not, which people do you think have the higher risk?*

2 *In 1983, 10 passengers in Great Britain were killed in train accidents. What was a train passenger's average risk of death during that year?*

Table 1 gives some more figures for death risks. Look at the figures, then answer questions 3 to 5.

Table 1 Risk of death from various causes/per year

Cause of death	*Group of people at risk*	*Annual risk of death*
Road accident	All British people	1 in 10 000
Home accident	All British people	1 in 8600
Murder	All British people	1 in 400 000
Murder	Presidents of USA	1 in 50
Electrocution in home	All British people	1 in 1 000 000
Lightning strike	All British people	1 in 10 000 000
Smoking	All British smokers (20 a day or more)	1 in 200
Factory accident	All British factory workers	1 in 40 000
All causes	All British people	1 in 100
All causes	All British people between ages of 1 and 20	1 in 3000

Questions

3 *How many times more likely are you to be electrocuted at home than electrocuted by lightning?*

4 *What extra death risks do smokers have compared with non-smokers?*

5 *Why is the risk of death from 'All causes' lower for people aged 1 to 20 than for the population as a whole?*

Part 2 Looking at particular risks

In this part of the unit, we are looking at the risks involved in particular activities.

2.1 Risks of being exposed to dangerous substances

Whatever we do there are risks (usually small) from substances around us. These substances may be in the food we eat, the air we breathe or the medicines we use. It is impossible to remove all these risks, but we need to try to avoid the most dangerous substances.

For example, practically all medicines have some undesirable side-effects. Before they can be put on the market, medicines have to go through strict safety tests. First they are tested using animals, then they are tested on humans. But some of the side-effects of medicines only show up after many years. This is particularly true of cancers. This makes it very difficult to be sure that a medicine is absolutely safe.

There is the same problem with testing food additives. Government-permitted food additives have to pass strict safety tests, but there is still a risk that some could cause long-term disease. The difficulty is in finding out for sure.

Smoking is a classic example of this problem. For many years people smoked without it being suspected that smoking caused any disease. This was partly because it was such a common habit, and partly because the ill effects take so long to develop. But today, doctors have collected an enormous amount of data on smoking and disease. They can now be sure that smokers have a much higher risk of lung cancer and other dangerous illnesses.

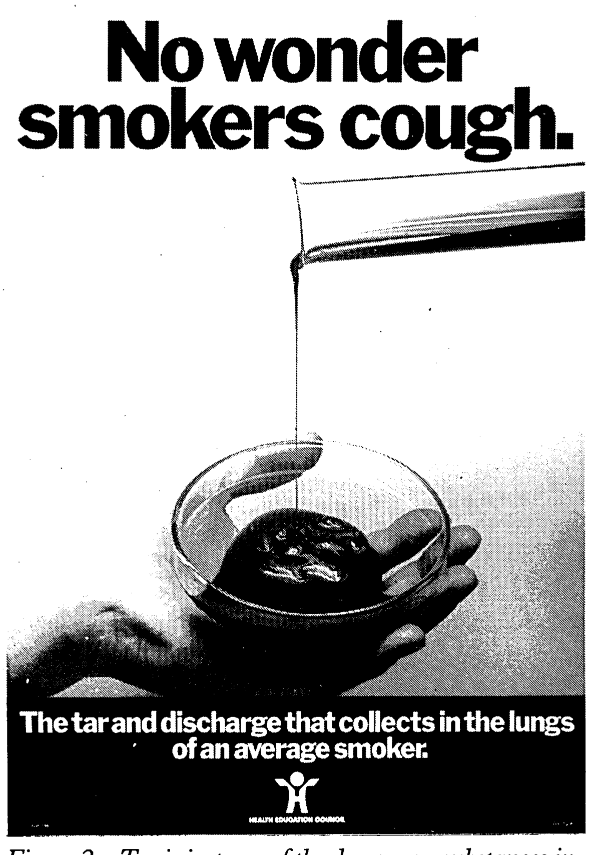

Figure 2 Tar is just one of the dangerous substances in cigarette smoke

People at work sometimes run risks from substances they work with. Asbestos is an example. Asbestos is useful for many applications, from brake linings to fire blankets. But doctors now believe asbestos can cause a number of serious diseases. These include lung cancer and a lung disease called asbestosis. But these diseases take many years to develop, so for many years people have worked with asbestos without being aware of the risk. Today, the amount of asbestos allowed in the atmosphere of a factory is limited by the Government. Scientists are working to find ways of replacing asbestos altogether.

Table 2 gives some of the risks associated with smoking and with asbestos.

Look at Table 2, then answer questions 6 and 7.

Questions

6 *Suppose you worked in an asbestos textile factory for 20 years before you discovered its risk. Would you be prepared to go on working there and accept the risk? Or would you look for a new job?*

7 *You are a non-smoker who works in an office with two other people, both smokers. Would you be prepared to go on working there and accept the risk of passive smoking?*

Table 2 Risks of death over whole lifetime from smoking and asbestos hazards

Cause of death	*Group of people at risk*	*Lifetime risk of death from this cause*
Smoking	Smokers (20 a day or more)	1 in 4
Passive smoking	People who breathe smoke from other people's cigarettes for at least 7 hours a week	1 in 1000
Asbestos	People working for 25 years in an asbestos textile factory under present safety limits	1 in 200
Asbestos	People who have worked for 20 years in a building in which asbestos has been used as a building material	1 in 100 000

Part 2 Looking at particular risks

In this part of the unit, we are looking at the risks involved in particular activities.

2.2 Risks of nuclear power

Three of the most important risks of nuclear power are:

- Risks to uranium miners who mine uranium fuel for the nuclear reactors
- Risks from processing used fuel and storing radioactive waste products
- Risk of a major catastrophe at the reactor, releasing radioactive materials into the environment.

The last of these is the risk that concerns people most.

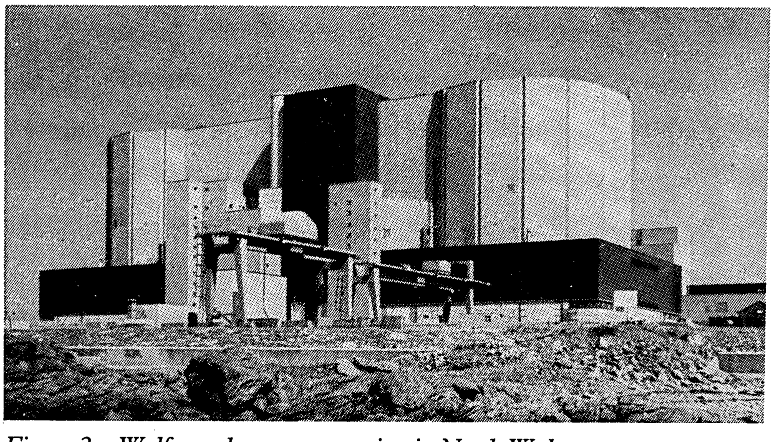

Figure 3 Wylfa nuclear power station in North Wales

What is the risk of a nuclear catastrophe?

It is impossible for a nuclear reactor to explode like a nuclear bomb. But if a reactor gets out of control, the uranium fuel in its core can get very, very hot. This could cause the steel or concrete container around the core to break open. Highly radioactive materials would be released. Depending on the weather, these materials would spread over a wide area.

The worst possible accident would be for a large release of radioactive materials from a reactor in a semi-urban area. This would probably cause several thousand deaths from radiation sickness. In addition, tens of thousands of people would develop cancers over the next thirty or forty years.

Until 1986, a major nuclear accident had never happened anywhere in the world. It was very difficult to estimate the risk of such an accident happening. All that nuclear engineers could do was estimate the probability of several safety devices going wrong together. In the 1970's, nuclear engineers studied the risk of the worst possible kind of nuclear accident. They made an estimate based on studies of reactors in Western Europe and the USA. They estimated the risk of the worst possible accident to be around one in one hundred million (1 in 100 000 000) per reactor per year.

In April 1986, a major nuclear accident *did* happen, at Chernobyl in Russia. Large quantities of radioactivity were released when the reactor overheated and caught fire. Radioactive fallout caused severe contamination in the surrounding countryside. Contamination spread to several other countries in Europe. It will not be possible to tell for several years how many deaths were caused by this accident, but the number will be probably be large.

Answer questions 8, 9 and 10.

Questions

8 Why will it not be possible to tell for several years how many deaths the Chernobyl accident caused?

9 The Chernobyl reactor had only been running about ten years when this accident happened. The estimate made in the 1970's suggested that a major accident would only happen to a reactor in the USA or Western Europe once in one hundred million years.

a. Does this mean the estimate was wrong?

b. If so, why do you think the engineers got the estimate wrong?

10 What does the Russian disaster mean for British nuclear reactors?

Some people say it means British reactors should be closed down for good.

Others say that an accident to a Russian reactor does not necessarily mean we need to worry about British reactors.

Give one argument that might be used on each side.

Part 3 Points to discuss

These points are best discussed in small groups of three, four or five.

- Table 3 gives the number of people killed per billion kilometres travelled for different types of transport.

Table 3 Deaths per billion kilometres (1 000 000 000 km) travelled

Method of travel	*Number of people killed*
Train	0.45
Aeroplane	1.4
Road	
bus	1.2
car	15
bicycle	85
motor cycle	524

You can see that air travel is about 10 times safer than car travel over the same distance. Yet people are usually a lot more nervous about a plane journey than a car journey. Why do you think this is?

- Imagine you live near a big oil refinery. There are several risks from the refinery. Two of the more important ones are:

  (a) The risk of a large explosion and fire due to an accident in the refinery. This would be a major disaster and would probably cause tens of deaths in the neighbouring district. Engineers have estimated that the risk of such an accident is 1 in 10 000 per year.

  (b) The risk of increased road accidents due to the big lorries which serve the refinery. These lorries have caused 2 deaths in the 10 years since the refinery was opened.

  Which risk would concern you most? Why? Would your feelings about the risks be any different if someone in your family worked in the refinery?

- All jobs and occupations have some risk. Table 4 gives the risk of accidental death per year from several different types of work.

Table 4 Risk of accidental death at work

Type of work	*Annual risk of death*
Deep sea fishing	1 in 300
Coal mining	1 in 5000
Farming	1 in 9000
Working in a car factory	1 in 70 000

How large do you believe a risk should be before it is considered unacceptable for any worker?

How small do you think a risk should be before it is considered not worth worrying about?

- Suppose you were a coal-miner who was also a keen rock-climber. The risk of death during rock-climbing is about 100 times greater than the risk of death during coal mining. Which risk would you be more prepared to accept?

- Should the public be told about all the risks they run? Or are there some risks that are better kept secret?