What's in our Food? – a look at food labels

Contents: Survey, analysis and discussion concerning food labelling and food additives.

Time: Homework plus 2 periods of classroom time, depending on extent of discussion.

Intended use: GCSE Biology, Chemistry and Integrated Science. Links with work on food and food preservation.

Aims:
- To complement and revise prior work on food and food preservation.
- To develop awareness of the information available on food labels.
- To develop informed understanding of the function, advantages and disadvantages of food additives.
- To develop awareness of some aspects of food technology.
- To provide opportunities to practise skills in data collection and analysis.

Requirements: Students' worksheets No. 104. If possible, the booklet, *Look at the Label*, (see below). If the food survey is to be done in class rather than at home, a range of packaged foods will be needed.

The use of food additives is controversial. Food manufacturers say they are indispensible for ensuring food is attractive and acceptable and to prevent food spoilage. Environmental and consumer groups often dispute this and claim that additives are used unnecessarily and without sufficient knowledge of their long-term effects. This unit encourages children to find out what is in food and to consider both sides of the controversy.

Part 1 A survey of food

Part 1 is best done at home, though it could be done in class if the teacher brings in suitable foods. It is important to examine a wide variety of foods in a representative 'shopping basket'. The questions on the survey (Q. 1–4) can also be done at home, or as a follow-up in class. The answers to the questions will vary quite widely depending on the home background of individual students.

Part 2 Looking at additives

In this part, attention is focused on the additives in the ingredients lists, and students are asked to classify these according to their purpose. Before doing so, they should have read the Factsheet, which gives more information about additives.

Part 3 Do we need additives?

In this final part of the unit, students discuss the general question of the advantages and disadvantages of additives. This is best done in groups of three or four. The issues are of course very complex, particularly the matter of safety testing, and it is not intended that the students should grasp these complexities – rather that they should consider both the advantages and the disadvantages of the use of food additives.

A useful publication, called *Look at the Label*, is available from the Ministry of Agriculture, Fisheries and Food. It explains the food labelling regulations and gives information on datemarking, additives and so on. It includes a list of government-regulated additives identified by their serial numbers. The booklet is available free from:

Ministry of Agriculture, Fisheries and Food
Publication Unit, Lion House, Willowburn Trading Estate,
Alnwick, Northumberland NE66 2PF

A short film, also called *Look at the Label*, has been produced by MAFF. It is available on free loan or for sale, in video-cassette or 16mm film form, from:

CFL Vision
Chalfont Grove, Gerrards Cross, Bucks SL9 8TN

Acknolwedgement Labels for Figure 1 and Food Labelling Factsheet Figure 1 supplied by J. Sainsbury.

WHAT'S IN OUR FOOD? – A LOOK AT FOOD LABELS

Some of the food we eat is fresh, like apples and lettuce. But most of it has been **processed** in some way, to make it more attractive, to change its flavour or to make it keep longer. Processing food often involves adding chemicals, called **food additives**.

In this activity, you will be looking at some of the chemicals added to food.

Part 1 A survey of food

This survey is best done just after someone in your home has been shopping for food. You need to look at a variety of different food items. Around 15 different items is about right. If you cannot do the survey just after a shopping trip, you could select a range of typical food items from the food cupboard, fridge and freezer.

What you do

A Once you have got the food items together, draw up a table like Table 1.

Table 1

Name of food item	*Datemark*	*Completely fresh*	*Processed, but no ingredients list on packet*	*Processed, with ingredients list on packet*
Vanilla flavour ice-cream	–			✓

B Put the name of the food item in the first column. If the food has a datemark put it in the next column. Put a tick in the third column if you think the food is *completely* fresh and unprocessed.

C If the food item is not completely fresh, look carefully at the packet or label. Does it show a list of ingredients? Put a tick in the appropriate column according to whether it does or does not. An example, 'vanilla flavour ice-cream', has been written in.

D Now draw up a table like Table 2.

Table 2

Name of food item	*Food ingredients, in order of amounts*	*Food additives*
Vanilla flavour ice-cream	Skimmed milk, sugar vegetable fat, Whey solids	Emulsifier E471. Stabilizers E410, E407 Flavouring. Colours E102, E110

E Table 2 will only be used for the foods whose ingredients are listed. The list of ingredients on the label gives the ingredients in order, with the main ingredient first, then the next largest, and so on. Look carefully at the list of ingredients on each food item. Decide which of the ingredients are actually food, and which are additives. You may need some help with this, because it is sometimes difficult to decide what is food and what is additive. Write the information in Table 2 for each food. (An example – 'vanilla flavour ice-cream' again – has already been written in.)

The Factsheet (pages 4 to 6) gives more information about food labelling and additives. Read the Factsheet before you go on to Part 2.

Use the results of your survey to answer these questions.

1 *How many of your food items were*
(a) fresh
(b) processed?

2 *How many of the processed foods did* not *have a list of ingredients? (The Factsheet gives more information about which foods have to have ingredients listed.)*

3 *Look at the datemarks. Which kind of foods keep for the shortest time? (More about datemarks on the Factsheet.)*

4 *What is the difference between chocolate* flavour *yoghurt and chocolate* flavoured *yoghurt? (More about naming foods on the Factsheet.)*

Part 2 Looking at additives

In this part you will be looking more closely at the additives in the food you surveyed.

A Draw up Table 3 as shown below.

Table 3

Name of food item	*Colouring*	*Flavouring*	*Preservatives*	*Antioxidants*	*Texture controllers*	*Others*	*Not sure*
Vanilla flavour ice-cream	E102, E110	✓	–	–	Emulsifier E471 Stabilizers E410, E407	–	–

B For each of the food items in your Table 2, write the name of the item in the first column of Table 3. Then enter the various additives in the appropriate columns. An example (the 'vanilla flavour ice-cream' used before) has already been written in.

If you are uncertain which column any additives go in, put them in the 'Not sure' column. If a type of additive is present, but not identified, just put a tick in the appropriate column (as in the 'flavouring' column for the 'vanilla ice cream' example).

Part 3 Do we need additives?

This part, which involves quite a lot of discussion of ideas, is best done in small groups of three or four.

Points to discuss

- For one or two of the food items in Table 3, try to decide what the food would be like *without* the additives. For example, what would vanilla flavour ice-cream be like without colouring? Without flavouring? Without emulsifiers and stabilizers?
- For the same food items, would you still buy them without the additives? Or would you buy a different food instead?
- Are some types of additives more useful than others? If so, which? Could we manage without *any* additives?
- Should we worry about the possible effect of food additives on our health? (Look at 'Additives and health' on the Factsheet)
- Without food additives the variety of food available in the shops would be much smaller (just imagine – no flavoured potato crisps). Would this matter?
- Some foods do not have to have a list of ingredients. These include fresh fruit and vegetables, cheese, butter and alcoholic drinks. Why do you think this is? Should *all* foods have ingredients lists?

Food Labelling Factsheet

The Government controls the labelling of foods. Fresh food does not have to be labelled, but most pre-packed food does (although there are exceptions). Figure 1 indicates some of the things the label must show.

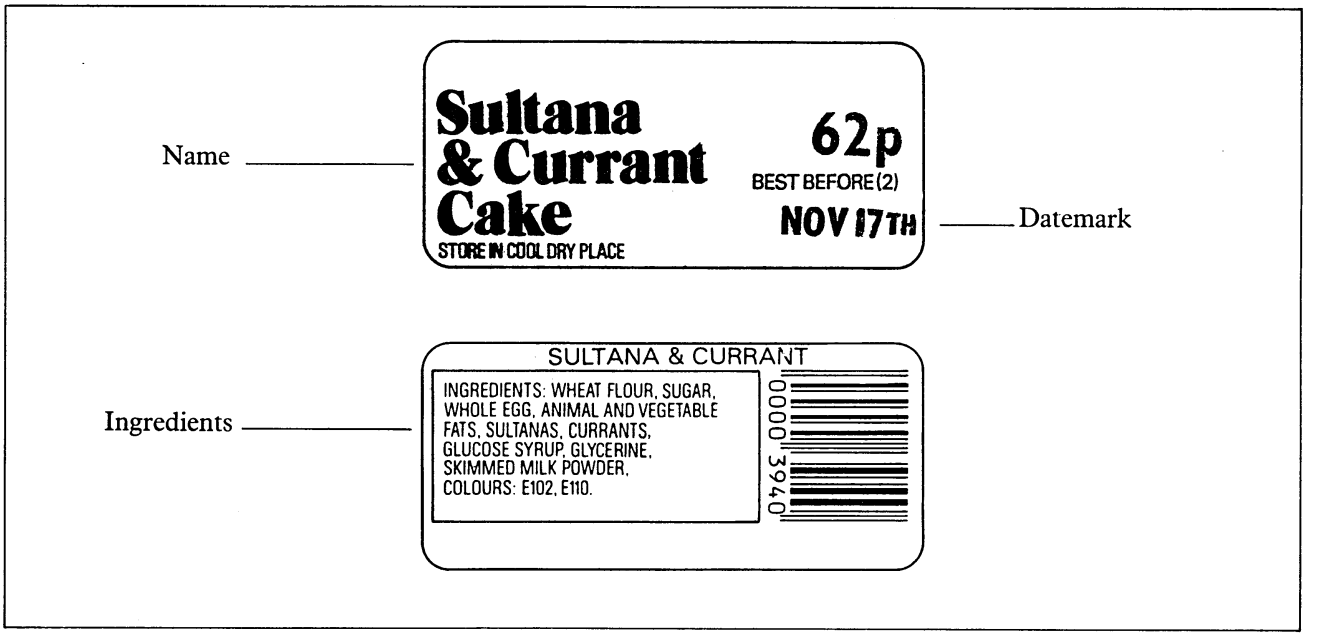


Figure 1

The Datemark

All food goes off eventually, though some foods go off faster than others. The datemark usually gives a 'Best before' date to help consumers and shops make sure it is in good condition. Some foods do not have to carry a datemark. These are mostly long-life foods (foods which last for more than 18 months).

The name

The name of the food should give information about what it really contains. For example, ice-cream can only be called 'Strawberry *flavoured*' if its flavour comes mainly from real strawberries. But if its flavour comes mainly from additives, not fruit, it must be called 'Strawberry *flavour*'.

The ingredients

Most, but not all, prepacked foods have to have a list of ingredients. This shows what went into the food. The ingredients are shown in descending order of weight. If *water* has been added to the food, it need only be shown if it makes up more than 5% of the weight.

Both food and additives are shown on the list of ingredients.

What are food additives?

Food additives are used for a number of different reasons, and these are described below. Most commonly-used additives are regulated by the Government, and most of these have a number. The number tells you what the additive actually is – for example, E330 is citric acid. An E in front of the number means the additive is also regulated by the EEC (European Economic Community).

Types of food additives

Colours

Colouring agents have numbers beginning with 1. They are used, for example, to make sweets and drinks look attractive. They are added to many foods to make up for changes in colour when the natural food is processed.

Flavours

Flavour additives are not regulated and do not have numbers. A flavour such as 'raspberry' or 'bacon' is usually made from a mixture of several different chemicals. The mixture is often a trade secret.

Preservatives

Government-regulated preservatives have numbers beginning with 2. They are used to stop bacteria and fungi growing in the food and making it go off.

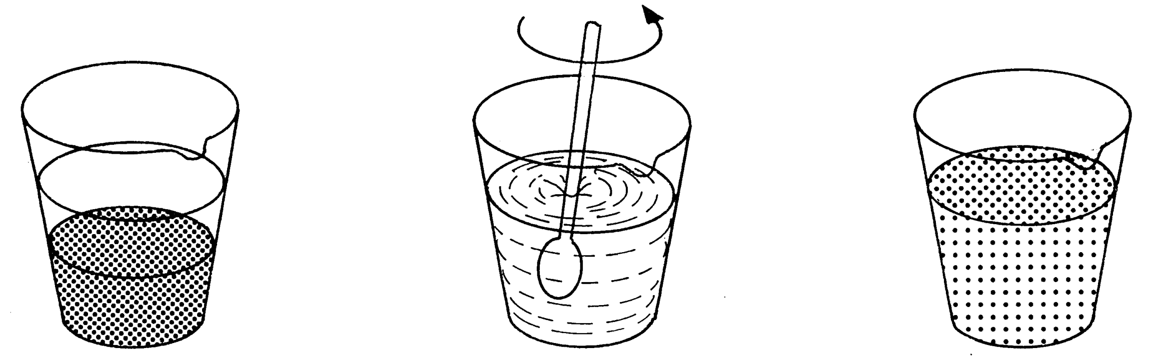
Antioxidants

These have numbers beginning with 3. They help stop fats and oils being oxidized, which would make them taste sharp, rancid and unpleasant.

Additives which control the texture of foods

These have numbers beginning with 4. They include emulsifiers, thickeners, and gelling agents.

Emulsifiers are used to help make oily liquids and watery liquids mix (see Figure 2). For example, mayonnaise contains oil and vinegar. The vinegar will only mix with the oil if an emulsifying agent is added. (In traditional, home-made mayonnaise, the emulsifying agent is egg.) **Stabilizers** are used to stop the emulsion separating again.



(1) Oil and water do not mix

(2) Add emulsifying agent. Stir

(3) Oil and water mix

Figure 2 Making an emulsion

Thickeners, as their name suggests, are used to thicken liquids such as soups. **Gelling agents** make liquids set like a jelly. They are used in jams, for example.

Additives and health

Generally, food additives have to be tested for safety before they can be used. These tests are usually done on animals. Nevertheless, some people suspect that certain food additives could have a health risk. Certain people may be allergic to particular additives. It is possible that certain additives could cause cancer if taken in large quantities for many years.

The idea of safety-testing is to find out about health risks such as these, and to ban any additives that are at all doubtful. Government regulations are strict. Even so, it is difficult to find out from tests on animals exactly what an additive will do if regularly eaten by a human for long periods. For this reason, tests on additives leave a wide safety margin.

It is important to bear in mind that without some additives our food could be *less* healthy. Preservatives prevent food going bad, and prevent possible disease-causing microbes from growing in the food.

The Bigger the Better?

Contents: Data analysis and discussion concerning economies of scale, with particular reference to ethene manufacture.

Time: 2 periods or more, depending on how many parts are tackled.

Intended use: GCSE Chemistry and Integrated Science. Links with work on petrochemicals, ethene and cracking.

Aims:

- To complement and revise prior work on the manufacture and uses of ethene.
- To develop awareness of the idea of economies of scale in industry, and how they arise.
- To develop awareness of some of the problems associated with large production units.
- To provide an opportunity to practise data-handling skills.

Requirements: Students' worksheets No. 105.

This unit is in three parts.

Part 1 Are bigger crackers better?
Part 2 Is bigger always better?
Part 3 What about other industries?

Part 3 could be omitted if time is short.

The unit can be tackled on an individual basis, though some of the questions, particularly Q.15 onwards, would be most effectively answered working in small groups.

Less able groups may need some guidance with the calculations in questions 1–12. The calculations for the medium-size cracker have been entered in the table as an example for students to follow. Students should work through the calculations for at least one of the other two sizes of cracker to get a feeling for the way the various costs break down. However, if they are finding the calculations heavy going, it would probably be best to give them the answers rather than let them get bogged down. The answers are given in the table below.

Table 3 – Answers

	large cracker	*medium cracker*	*small cracker*
Q.1	3.5 tonnes	3.5 tonnes	3.5 tonnes
Q.2 Naphtha cost	£595	£595	£595
Q.3 Energy cost	£110	£110	£110
Q.4	£330 million	£230 million	£110 million
Q.5	£ 99 million	£ 69 million	£ 33 million
Q.6	500 000 tonnes	300 000 tonnes	100 000 tonnes
Q.7 Fixed cost	£198	£230	£330
Q.8 Total costs	£903	£935	£1035
Q.9	2.5 tonnes	2.5 tonnes	2.5 tonnes
Q.10 Income	£550	£550	£550
Q.11 Net cost	£353	£385	£485
Q.12 Profit	£ 47	£ 15	– £85

Notes on some of the questions

Qs. 13 and 14 Students will find that the large cracker is the most profitable, with the small one actually making a loss. This is because the larger the cracker, the smaller the fixed costs per tonne of ethene produced.

Qs. 15 to 18 These questions look at the problem of over-capacity, which is considerable in Britain and is likely to become more so as Middle East producers start to manufacture their own higher value petrochemical products.

Qs. 19 and 20 Communication is not a particular problem in large crackers because so few people are involved, but in more labour-intensive industries, communicating in a large plant can be difficult. In a large cracker, telephones and two-way radios are used.

Q. 23 Students may need help here, since they may not be sufficiently familiar with local industries to answer all the questions. It may be profitable to pool the experience of the whole class.

It would be most valuable if the unit could be followed by a visit or visits to local industry.

Acknowledgements Figures 1 and 3 reproduced by permission of ICI.

THE BIGGER THE BETTER?

This unit looks at the economies of scale – the idea that large industrial plants are cheaper to run than small ones. Economies of scale have led to huge factories being built. But why? Why are large plants cheaper – and are they always better? We will use as an example the manufacture of ethene from petroleum.

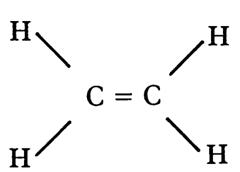
Part 1 Are bigger crackers better?

Why make ethene?

Over a million tonnes of ethene are made in Britain every year. That is 20kg for every man, woman and child.

And why should every man, woman and child *want* 20kg of ethene? Well, it is not much use on its own, but it is very useful for making other things.

The molecule of ethene contains a double bond.



This makes it reactive enough to join up with other molecules, and even with itself. Many different chemical products can be made from ethene.

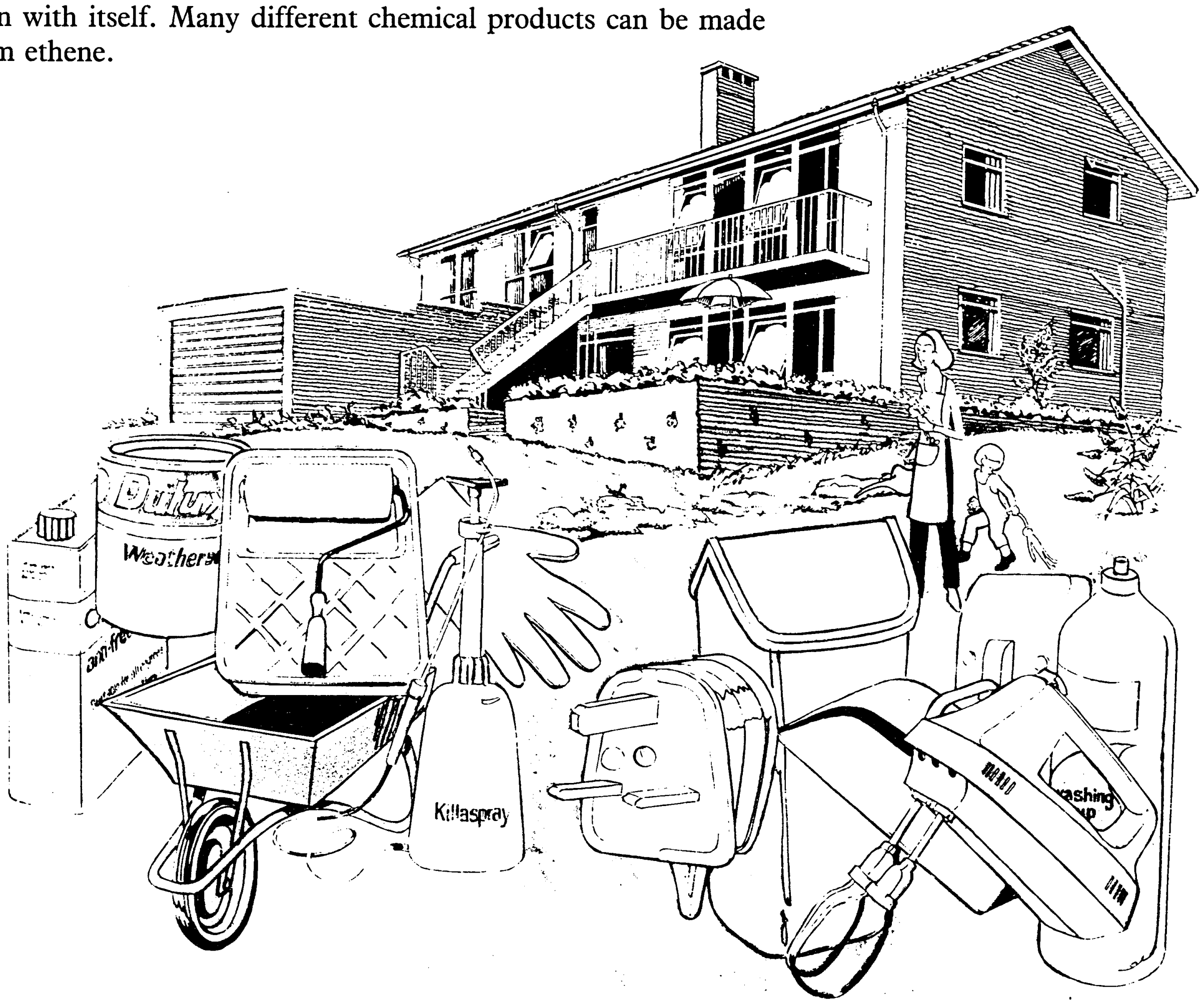


Figure 1 From plastics and paints to detergents and anti-freeze – ethene is used to make many of the things we use every day.

Adding value to oil

Most of the ethene produced in Britain is made from oil, although some is also made from natural gas. By distilling crude oil, a substance called **naphtha** can be produced. Naptha is similar to petrol. However, it is not used as a fuel but as a source of chemicals – **petrochemicals.**

Naphtha is a mixture of many different hydrocarbons. Most of them are alkanes, with between five and nine carbon atoms in their molecules. By heating naphtha vapour under the right conditions, its molecules can be made to break up into smaller molecules. This is called **cracking**. If the right conditions are chosen, a lot of ethene is formed when naphtha is cracked. This ethene can be separated off from other products and used to make many useful things. So, beginning with oil, we have a sequence of changes (Figure 2).

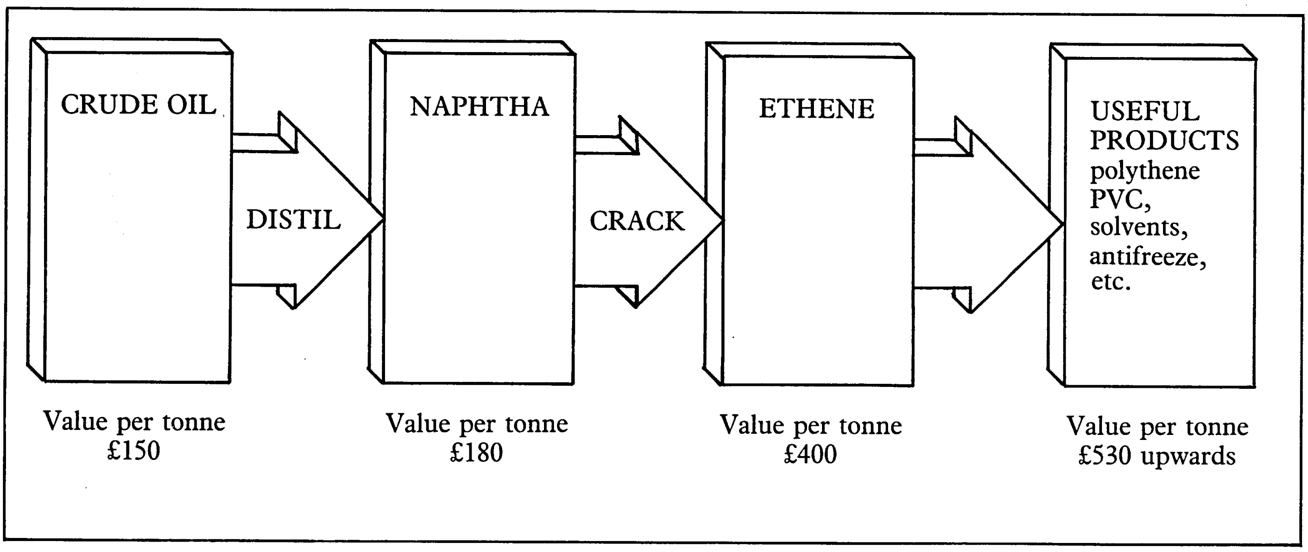


Figure 2 Adding value to crude oil

At each stage in this sequence, *value is added to the starting material.* This added value is needed to pay the wages of employees, run the plant and make enough profit to build new plants.

How big?

We will concentrate on the naphtha → ethene stage. This process is carried out in chemical plants called crackers. Crackers are very complicated, and often huge, as Figure 3 on the next page shows.

What is the best size for a cracker? In this section we will try to find out.

The balance sheet for a cracker

There are many different costs involved in running a cracker. Table 1 on the next page shows the main items.

Table 1 Income and costs of running a cracker

Income	*Costs*
Sale of ethene Ethene sells for £400 per tonne. *Sale of by-products* Cracking produces many by-products as well as ethene. These can be sold as fuel, or, better still, as raw materials for other chemical processes. For each tonne of ethene, 2.5 tonnes of by-products are produced. These can be sold at an average price of £220 per tonne.	*Cost of naphtha* To make a tonne of ethene needs 3.5 tonnes of naphtha. Naphtha costs £170 per tonne. *Energy costs* These are the costs of fuel, steam, electricity, etc., to run the plant. For each tonne of ethene produced, the energy costs are £110. *Fixed costs* These are the costs which are fixed, however much ethene is made in the plant. They include wages, maintenance and the cost of the plant itself. Fixed costs per year can be roughly calculated as 30% of the total cost of building the plant.

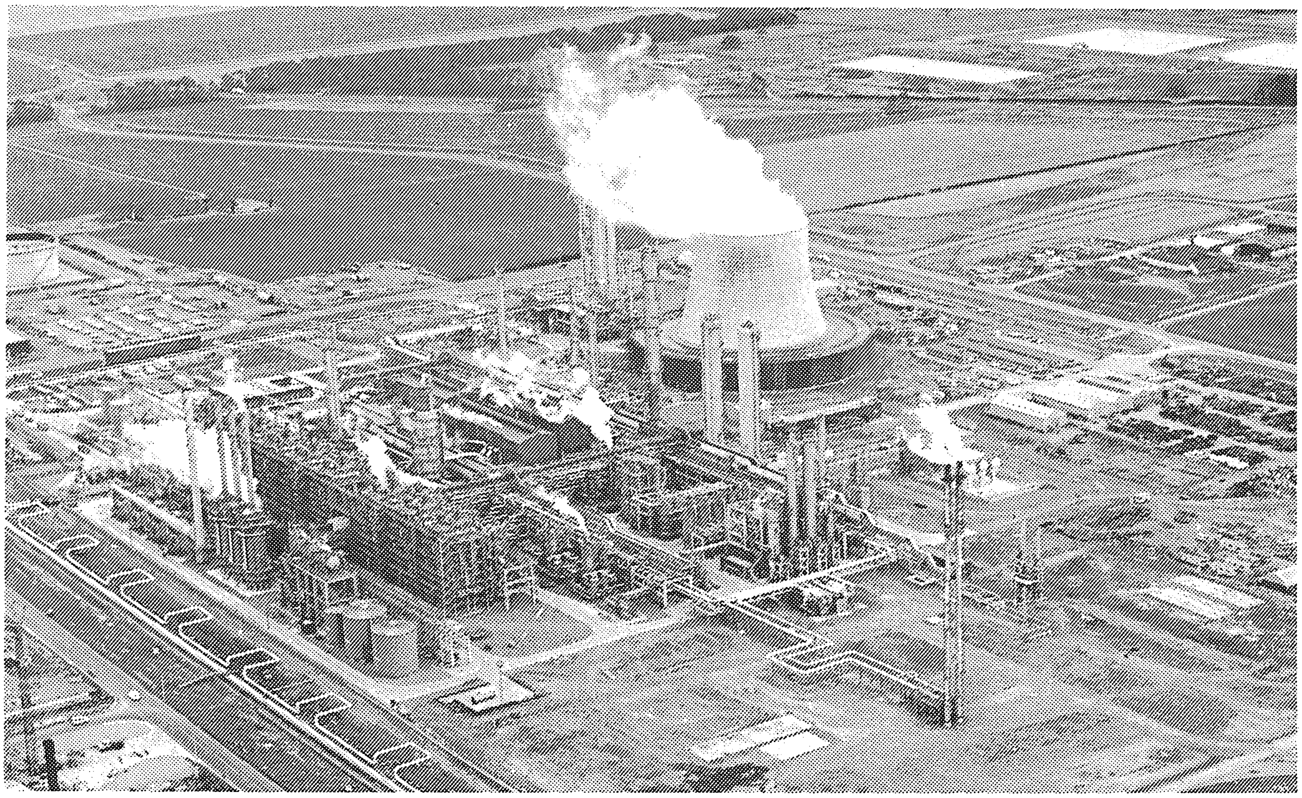


Figure 3 An example of a large cracker

The costs for three different-sized crackers

You are going to do some calculations to compare the costs of three crackers of different sizes. Table 2 gives the details.

Table 2 The costs of three crackers of different sizes

Size of cracker	*Tonnes of ethene made per year*	*Cost of building cracker plant*
Large	500 000	£330 million
Medium	300 000	£230 million
Small	100 000	£110 million

Draw up a table like Table 3. You are going to put the answers to questions 1 to 12 in the table.

Table 3

	large cracker	medium cracker	small cracker
Q.1	tonnes	3.5 tonnes	tonnes
Q.2 Naphtha cost	£	£595	£
Q.3 Energy cost	£	£110	£
Q.4	£ million	£230 million	£ million
Q.5	£ million	£ 69 million	£ million
Q.6	tonnes	300 000 tonnes	tonnes
Q.7 Fixed cost	£	£230	£
Q.8 Total costs	£	£935	£
Q.9	tonnes	2.5 tonnes	tonnes
Q.10 Income	£	£550	£
Q.11 Net cost	£	£385	£
Q.12 Profit	£	£ 15	£

Questions 1 to 12 help you work out the cost of ethene per tonne. Do all twelve questions for the large cracker first, then for the small one. The answers for the medium cracker have been worked out for you already, to help you with your own answers.

Questions

1 *How much naphtha do you need per tonne of ethene made? (see Table 1)*

2 *What is the cost of this naphtha? (see Table 1)*

3 *What are your energy costs per tonne of ethene made? (see Table 1)*

4 *What is the total cost of building your plant? (see Table 2)*

5 *The fixed costs* per year *are roughly 30% of the cost of building the plant. What are your fixed costs* per year?

6 *How many tonnes of ethene will you make per year? (see Table 2)*

7 *From your answers to questions 5 and 6, work out your fixed costs* per tonne of ethene made.

8 *From your answers to questions 2, 3 and 7, work out your* total *costs per tonne of ethene made.*

9 *How many tonnes of by-product will you get per tonne of ethene made? (see Table 1)*

10 *What income will you get from selling these by-products? (see Table 1)*

11 *From your answers to questions 8 and 10, work out your* net *costs per tonne, after allowing for income.*

12 *If you sell the ethene at £400 per tonne, what is your profit per tonne of ethene?*

Compare the profit per tonne from the three crackers – small, medium and large.

13 *Which size cracker is most profitable?*

14 *Look back at your figures. Can you explain why this cracker is the most profitable?*

Part 2 Is Bigger always Better?

Your calculations will have shown you that larger plants are more profitable. But this does not mean they are always the best ones to build. Think about these points.

1. *The plant needs to run at full capacity* Suppose a large cracker only produces 300 000 tonnes of ethene a year, instead of 500 000, because demand for ethene is low.

> *15 What will happen to the cost per tonne of ethene? You can find out by going through the calculations for the large cracker again, using 300 000 tonnes per year instead of 500 000.*

2. *What happens if everyone builds large crackers?* Britain uses just over a million tonnes of ethene a year.

> *16 How many 500 000 tonne per year crackers does Britain need?*
>
> *17 ICI, BP, Shell and Esso all run petrochemical plants. What would happen if they* all *built 500 000 tonne per year plants?*
>
> *18 Oil producing countries like Saudia Arabia are beginning to build their own large crackers so they can produce ethene instead of just crude oil and gas. They can then convert ethene to useful products like polythene for export. What is the advantage to these countries of doing this? What effect might it have on British petrochemical companies?*

3. *Communications and industrial relations* Most of the processes that go on in a cracker are automatic. Gases and liquids are moved around in pipes, often controlled by computer. Not many people are needed to run the plant, but the workers do need to be very skilful.

The area of a large plant is about 15 hectares, which is about the the same as 36 football or hockey pitches.

> *19 What communication problems might there be within a large cracker plant?*
>
> *20 Which do you think would be better for good industrial relations – a large plant or a smaller one? Why?*

4. *Distribution* Once ethene has been made, it must be distributed to the factories which use it to make other materials. Sometimes these factories are nearby, but sometimes they are a long distance away.

> *21 What distribution problems may arise if a small number of very large crackers are built?*

5. *Environmental problems*

> *22 Which do you think would cause fewer environmental problems – a large cracker, or several small ones? Why?*

Part 3 What about other industries?

In the case of ethene, economies of scale have led to larger and larger plants being built. But even with ethene, bigger is not necessarily always better, as large plants bring their own problems.

In other industries the economies of scale may not be so important as for ethene. It all depends on the type of industry.

Take furniture, for example. Making furniture is **labour-intensive**. This means it needs large numbers of people to make the products – far more than in an ethene cracker. Building an enormous furniture factory would lead to many problems – for example, with industrial relations, communications and quality control. It is difficult to take a pride in your work in an enormous factory where you feel no more than a cog in a huge machine.

23 *It is best to work in small groups on this question.*

(a) *Think of as many examples as you can of* small *industries in your local area or in a nearby town. In each case, say what the industry makes. As far as possible, try to decide why the factory is that size, and whether it could usefully be made bigger.*

(b) *Repeat part (a), but this time for any* large *industries in the locality. Once again, try to decide why the factory is large, and whether it could usefully be broken down into smaller units.*

If you get a chance to visit local industries, try to talk to people working there about what they think is the best size for their factory.

The Design Game

Contents: Exercise in designing an energy-efficient home.

Time: 1 to 2 double periods.

Intended use: GCSE Physics and Integrated Science. Links with work on heat transfer and energy saving.

Aims

- To complement and revise prior work on heat transfer and energy conservation.
- To develop understanding of the use of insulation and passive solar heating to conserve energy.
- To develop awareness of the need to design and insulate a house carefully in order to conserve energy, and awareness of some of the factors that need to be considered.
- To develop awareness of some of the techniques used by an architect in designing a house.
- To provide an opportunity to practise design and problem-solving skills.

Requirements: Students' worksheets No. 106. Scissors and paste.

This unit is in three parts:

Part 1 Introduction
Part 2 Designing the bungalow
Part 3 Insulating the bungalow

In parts 2 and 3, it is important that students read all the points of information before marking the plan.

Teachers might like to increase the economic component of the task by imposing financial constraints – for example, by telling students they can only afford to double-glaze half their windows, or by giving them some representative costs and a fixed sum within which to work.

The final follow-up questions should be tackled if possible: it is particularly useful for students to compare their designs with one another.

Further resources

A pack of useful Design and Planning Games is available from:

Resources for Learning Development Unit
Bishop Road
Bishopston
Bristol BS7 8LS.

Acknowledgements This unit is based on a Design Task developed for the Open University T101 course. The drawings of household furniture are reproduced by permission of the Open University.

THE DESIGN GAME

Part 1 Introduction – Keeping your home warm

In a house, bungalow or flat heat escapes through the walls, roof, floor, windows and doors. By **insulating** a house and keeping the heat in for longer, we can *halve* the energy needed to heat it – and *halve* the fuel bills. Figure 1 shows how much heat escapes from different parts of a normal house.

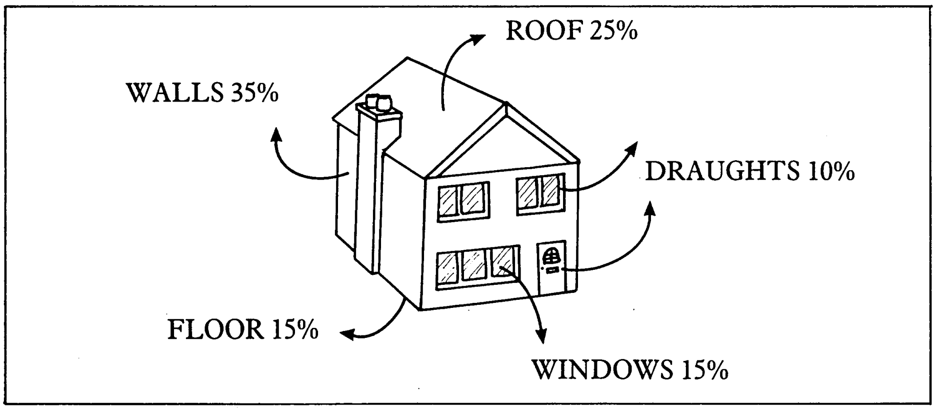


Figure 1 How a house loses heat

If we get the design of the house right, we can also use the Sun's energy to heat it.

The pictures in Figures 2 and 3 show a house in Milton Keynes, Buckinghamshire. The house is specially designed so it needs very little energy to heat. It has a lot of insulation in the loft and walls as well as double glazing. This insulation helps to keep heat in.

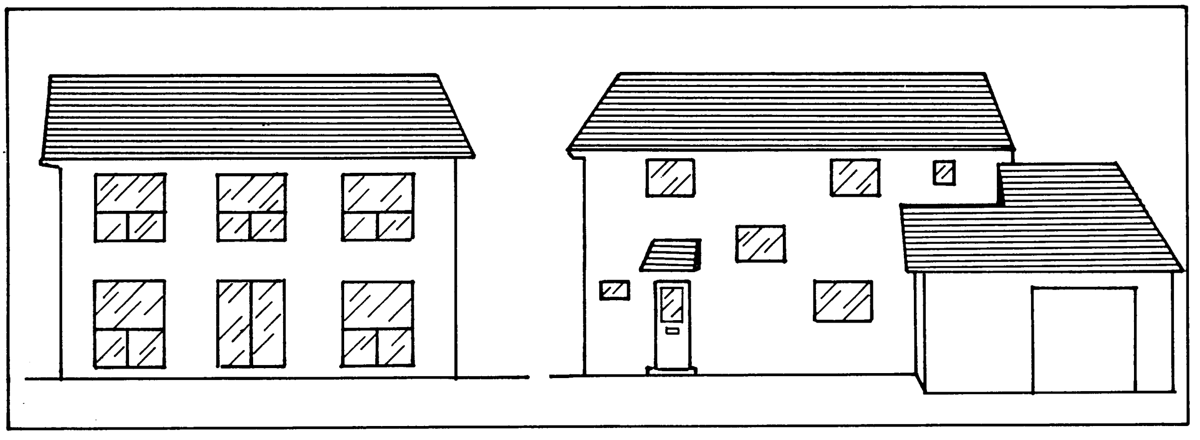


Figure 2 South facing – large windows *Figure 3 North facing – small windows*

The house also uses the Sun's heat to keep it warm. The house designers have built the house facing North–South, with large windows on the South side and small windows on the North side. This is called **passive solar heating**. These houses have much smaller heating bills than normal houses.

In this unit you are going to imagine that you are an architect – a person who designs buildings. You are going to *design an energy-saving bungalow*. To do this you will need to make use of insulation and the Sun's heat as in the Milton Keynes houses. You are going to design a bungalow for a young couple who have no children.

Part 2 Designing the bungalow

A Look at the piece of paper which is marked out in squares (page 4). Each square has a side of 2cm. This represents 1 metre in a real bungalow on this site. You will use this paper to draw a plan of the bungalow and its rooms. Read B, C, D, and E, and answer questions 1 to 6, before you draw the plan.

B You will need to mark out the rooms on the paper. You will need:

a bedroom
a living room
a kitchen
a bathroom
hallways (if you want them)

C Before you start marking out the rooms there are a lot of things to think of. Answer questions 1 to 3.

D You can use the Sun's heat to help keep the bungalow warm. Look at Figure 4, then answer questions 4 to 6.

Questions

1 *Which rooms will the couple spend most of the time in and which least?*

2 *Which rooms should be biggest and which smallest?*

3 *Which rooms will need to be kept especially warm?*

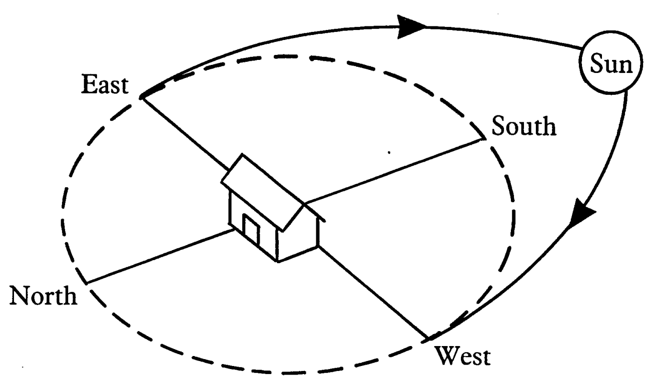


Figure 4 Movement of the Sun during the day

E When you decide where to put the rooms you must follow building regulations. Some of these are:

- The bathroom entrance should not be next to the kitchen entrance.
- Each room must have a window.
- The bungalow should be easy to live in. For example, you would not want to have to go through the bedroom to get to the kitchen.
- Do not put windows at the corner of the house or it might fall down.

To help you judge the size of rooms, look at the sheet which has drawings of household furniture on it (page 5). You can cut out the ones you want. You do not have to use them all. Move them around the site and stick them on once you have decided where they will go. Remember to leave space for the doors to open.

Remember: the larger the bungalow the more expensive it will be to heat.

Now mark in your design for the bungalow on the site in pencil:

1 Mark and name the rooms
2 Mark doors in green (including front and back door)
3 Mark windows in blue

Questions

4 *Where does the Sun:*
(a) rise
(b) set
(c) shine from for most of the day?

It is important to decide on which side of the house you put each room (North is marked on the site). If you are going to spend a lot of time in the living room you might build it facing South with large windows. This means you will get a lot of sunlight in the living room.

5 *Which side might you put the rooms you use* least?

6 *Would you put big windows or small windows in these rooms? Why?*

Part 3 Insulating the bungalow

Now you have designed your bungalow you are going to decide how best to insulate it. Insulation will help to stop heat escaping from the bungalow. Read F, G and H below.

F *Cost* It costs money to insulate a house. Double glazing and cavity wall insulation can be expensive. If you do insulate a house it will save money on fuel bills – but is it worth it? For example, suppose insulating a house costs £2000 in materials and labour and saves £200 a year on fuel bills. It will take 10 years to get your money back. This is called the **payback period**. If you are not going to stay long in a house it might not be worth insulating it completely, although an insulated house might sell for more.

G *The loft* and outside walls are already insulated.

H *The windows* could be double glazed.

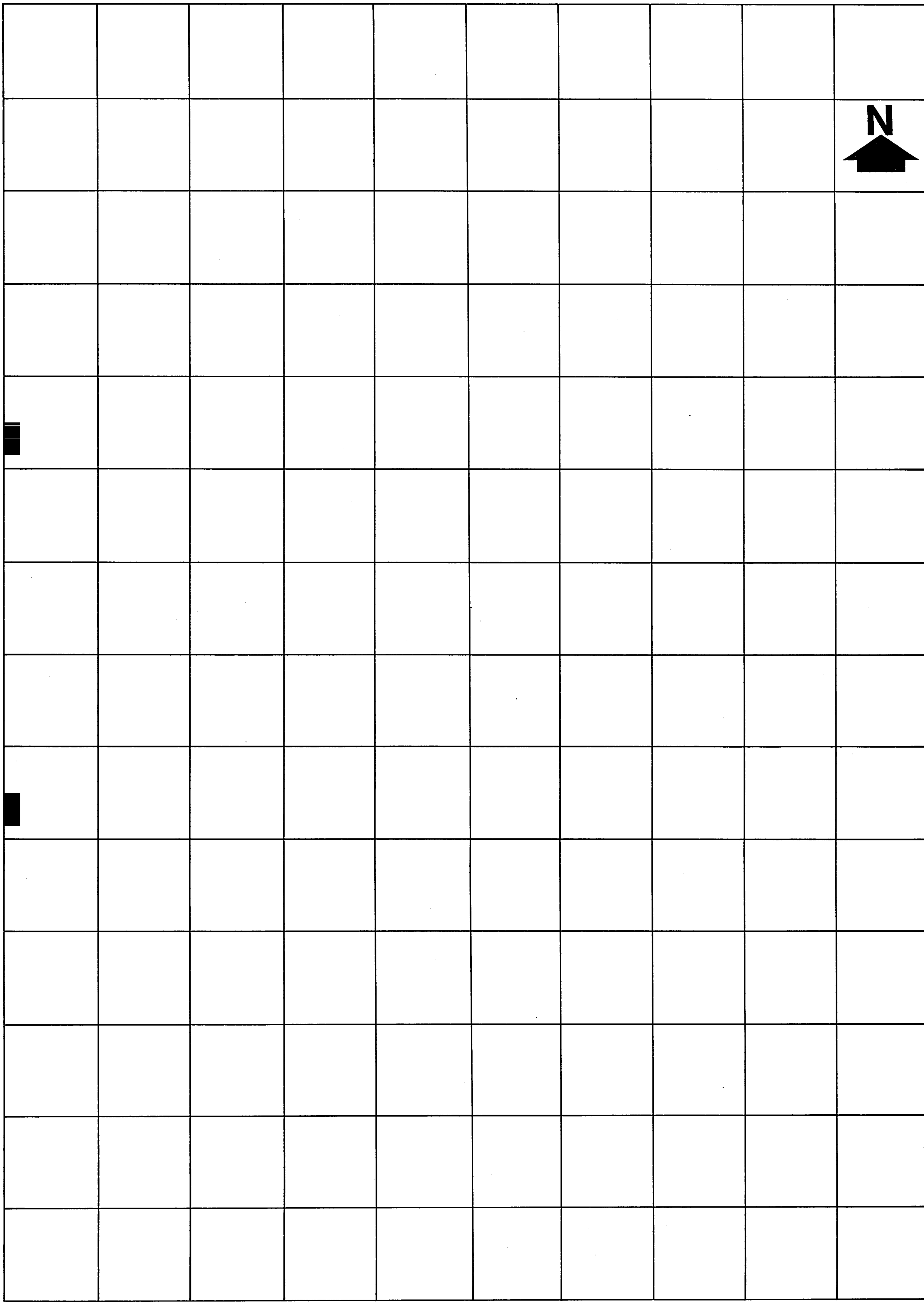
Decide which windows you will double glaze and mark them with crosses. (A double glazed window will now be blue with crosses.)

Final questions

7 *Are there any other ways you could insulate your bungalow? If so how? Mark in any other ways on your site plan.*

8 *Why have you designed your bungalow as you have? How does it compare with those of other members of the class?*

9 *Could your design be improved in any way? If so how?*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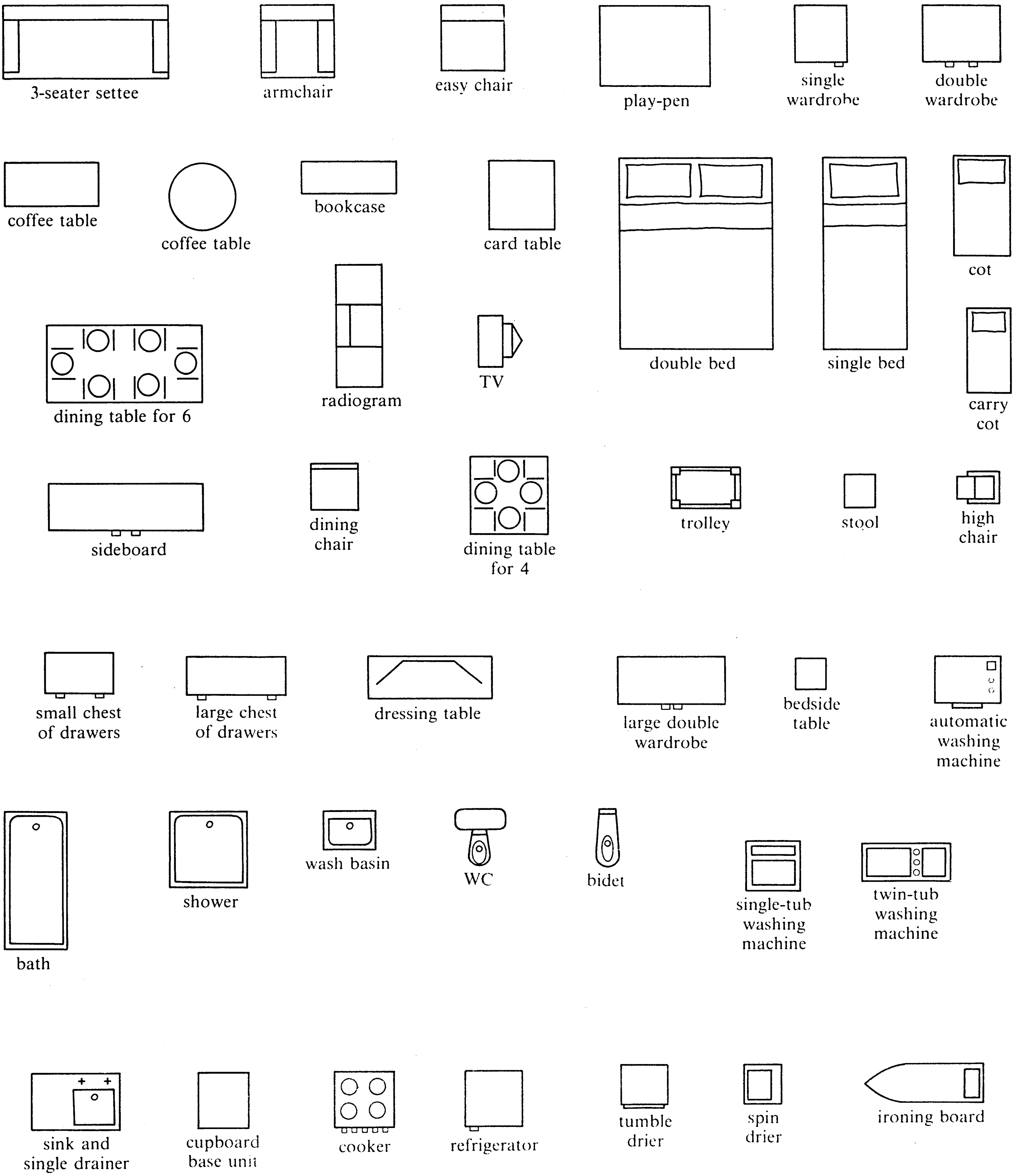
3-seater settee
armchair
easy chair
play-pen
single wardrobe
double wardrobe
coffee table
coffee table
bookcase
card table
double bed
single bed
cot
dining table for 6
radiogram
TV
carry cot
sideboard
dining chair
dining table for 4
trolley
stool
high chair
small chest of drawers
large chest of drawers
dressing table
large double wardrobe
bedside table
automatic washing machine
bath
shower
wash basin
WC
bidet
single-tub washing machine
twin-tub washing machine
sink and single drainer
cupboard base unit
cooker
refrigerator
tumble drier
spin drier
ironing board